Oxford International Primary

Grade 4

Science

Teaching Guide

Pakistan Edition

OXFORD UNIVERSITY PRESS

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Published in Pakistan by
Oxford University Press
No.38, Sector 15, Korangi Industrial Area,
PO Box 8214, Karachi-74900, Pakistan

First published in 2014
Second Edition (SNC) published in 2024

Oxford International Primary Science (Second Edition) Teacher's Guide 1, *Oxford International Primary Science (Second Edition) Teacher's Guide 2*, *Oxford International Primary Science (Second Edition) Teacher's Guide 3*, *Oxford International Primary Science (Second Edition) Teacher's Guide 4*, *Oxford International Primary Science (Second Edition) Teacher's Guide 5*, and *Oxford International Primary Science (Second Edition) Teacher's Guide 6* were originally published in English in 2021 by Oxford University Press, Great Clarendon Street, Oxford, OX2 6DP, United Kingdom with the ISBNs 9781382017329, 9781382017336, 9781382017343, 9781382017350, 9781382017367, and 9781382017374. This adaptation is published by arrangement. Oxford University Press Pakistan (SMC-Private) Limited is solely responsible for this adaptation from the original work

ISBN 9789697341290

Acknowledgements
The publisher and authors would like to thank the following for permission to use photographs and other copyright material:

Cover: Artwork by Blindsalida

Photos: Page xii: Rawpixel.com/Shutterstock; page xvii(tl): Evgeny Karandaev/Shutterstock

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Contents

Contents

Introduction

The joy of learning science

We are living in an ever-changing world, where the way we work, live, learn, communicate and relate to one another is constantly shifting. In this climate, we need to instill in our learners the skills to equip them for every eventuality so they are able to overcome challenges, adapt to change and have the best chance of success. To do this, we need to evolve beyond traditional teaching approaches and foster an environment where students can start to build lifelong learning skills for success. Students need to learn how to learn, how to problem solve, be agile and work flexibly. Going hand-in-hand with this is the development of self-awareness and mindfulness through the promotion of wellbeing to ensure students learn the socio-emotional skills to succeed.

Teaching and learning with *Oxford International Primary Science*

This series is based on National Curriculum of Pakistan and also incorporates elements from the English National Curriculum Programme of Study for Primary Science. The books for each year (or stage) follow the scheme and meet all the learning objectives – including working scientifically. Each lesson includes the learning objectives from the curriculum and summary of the key teaching points.

The teaching units in the series are flexible: they can be adapted as you see fit to meet the needs of your students. Each unit stands alone and can be taught in any order.

The books are designed for students aged 5 to 11. Underpinning the rationale for the series is the strong belief that science provides a way of thinking and working. It helps us to make sense of the world we live in and provides intellectual skills that help us in all curriculum areas and in life.

This introduction shows how to use the resources to develop your students' scientific knowledge, skills and understanding.

This series has seven main aims:

1 To deliver scientific knowledge and facts

2 To deliver scientific understanding

3 To deliver scientific methods of enquiry

4 To deliver scientific thinking and reasoning

5 To help students understand the development of science and its uses in context in the world around them

6 To support the wellbeing of students

7 To give students a global outlook

1 Scientific knowledge and facts

The Student Book introduces concepts in a logical sequence and ensure that new ideas are introduced sensitively. Key scientific concepts and ideas are explained. Students are then asked to discuss and apply their new knowledge.

2 Scientific understanding

Knowledge without understanding is only useful for recall. Understanding moves to a deeper intellectual level and enables students to think and apply that knowledge. Effective learning requires students to develop appropriate attitudes, skills and enthusiasm, and this can be encouraged by good teaching and exciting resources. This means students can gain an understanding of the principles and practice of science.

The knowledge, or content, in this series is based on the English National Curriculum. Each book has five units.

Though this is not a theoretical book, it is important to consider underpinning ideas that have informed good practice in the classroom:

- Teaching approach
- Cognitive style
- Active learning

Teaching approach

The kind of teaching strategies used are key to achieving understanding. Telling and giving students information is important but usually only improves students' short-term memory of scientific facts. This is often called 'passive learning' as students are not intellectually engaged in the process themselves.

Teaching and learning can either be teacher-centred (didactic) or student-centred (heuristic). Good teaching is a combination of these.

Didactic	Heuristic
Advantages • Clear learning objectives • Teacher can demonstrate a professional approach, e.g. presentations • Teacher is seen as 'expert' • Fewer problems with classroom management and behaviour	*Advantages* • Can be motivating and powerful • Develops a range of skills • Learning is relevant • Encourages creativity and problem solving • Student has a say in the learning
Disadvantages • May build on inaccurate knowledge • May not be motivating • Does not develop skills • Does not give students responsibility • Limited by the teacher	*Disadvantages* • May not deal with underlying principles – too pragmatic • If only existing skills are learned, this approach may not encourage questioning of existing approaches • Lack of structure may confuse • Classroom management may be problematic

Advantages and disadvantages of teacher-centred and student-centred approaches (Cotton, J., 1995, *The theory of learning: an introduction,* Kogan Page, London) © Kogan Page 1995. Reproduced with permission of the Licensor through PLSclear.

Cognitive style

Cognitive style is a student's personal and preferred way of organising and representing information. The cognitive style, or way of thinking, impacts on how our students see and make sense of the world.

Cognitive styles can be split into four types:

1 Wholists like to see the whole picture when learning – the big picture.

2 Analysts prefer to get down to the detail and look at only one or two details.

3 Verbalisers welcome chances to talk through problems.

4 Imagers see mental pictures when dealing with information.

Most people are a combination of all of these but have a preference for one or two. These cognitive styles may have a major impact on the processing of information.

We need to be aware of the possible cognitive styles of our learners and ensure that our approach balances all four styles.

Lev Vygotsky stressed the importance of social relationships between the teacher and learners, and amongst learners. He stressed that language and discussion are key to development.

Benjamin Bloom proposed an 'educational taxonomy' identifying different learning 'domains':

- Cognitive (knowledge)
- Affective (attitudes)
- Psychomotor (skills)

The domain can be seen as a ladder that starts with remembering and proceeds to more complex tasks such as analysing. The 'rungs' of the ladder are:

1 Recall data

2 Understand

3 Apply (use)

4 Analyse

5 Synthesise

6 Evaluate

This ladder helps teachers to devise tasks, sequences of tasks and questions appropriate to the level of thinking of their students. Considering this will help develop your students' ability to think and reason.

Active learning

Active learning approaches encourage students to engage with tasks and to develop skills that they may not develop during teacher-led, didactic lessons. Active learning combines a number of models of teaching growing out of 'discovery learning' ideas.

Whole-class instruction can be as effective as individual instruction, especially in terms of the time students spend on tasks. The key to effective teaching is the appropriate selection of approaches at any particular time and with any particular group. The table opposite summarises common teaching approaches. It does not indicate poor teaching on the left (teacher-centred) and good teaching on the right (student-centred).

Possible active learning strategies

- Group discussion (talking and listening)
- Active reading
- Active writing
- Presentation
- Role-play and drama
- Information technology
- Visits, visitors and field trips
- Data handling
- Problem solving
- Video and audio tape recording
- Games and simulations

Questioning and group work are very important. These will be dealt with in more detail on pages ix–xi.

The Student Books present ideas in a range of ways – written, diagrams, charts, tables and photographs. The lessons contain a rich variety of learning and teaching approaches, such as individual reading and writing, paired and small group discussion work, whole-class discussion and activity, problem solving, investigations, research activities, presentations, surveys and review and reflection. In addition, suggestions for other activities, such as field trips and educational visits, are included in the Teacher's Guide.

3 Scientific methods of enquiry and working scientifically

This series promotes scientific enquiry and closely follows the working scientifically objectives in the English National Curriculum. Students are encouraged to use and reflect on the different ways that scientists work and think, which have produced the knowledge, theories and laws of science over the last 1000 years. It is based on 'empiricism'; arriving at knowledge and understanding through observation and experiment.

Scientists progress by observation and questioning what they see and already know. From this they develop hypotheses which they test by experiments and develop new knowledge. This will be further explored in the section 'How to be a Scientist'.

Science teaches students to think in a structured way that is good for analysing and solving problems. However, students should understand that science is also a creative human endeavour. Imagination is vital to scientific progress.

The books in this series allow students to develop their skills to work scientifically by addressing each of the appropriate scientific enquiry processes at each stage. Students are encouraged to plan and carry out full-scale investigations in the later stages and, as such, apply the skills learned earlier.

4 Scientific thinking and reasoning

It is essential to encourage students to think and reason for themselves. Thinking and reasoning are important life skills. The abilities to think, reason and research make students independent learners who can interpret and understand new ideas more quickly. Unfortunately, this aspect of education is often neglected.

In this series, the ability to think and reason will be encouraged, nurtured, practised and assessed at each level. Scientists use deductive logical thinking to make sound inferences which take them from the known to discover the unknown. They use reason and argument based on fact and evidence to prove their case. Allowing students to experience these processes promotes their curiosity and enthusiasm. 'Discovery learning' approaches allow students to experience the thrill of finding out.

Resist the temptation to provide answers, solutions and too much support for your students. We hope that the learning activities within the books, and the support provided in the Teacher's Guide, will help you to create a learning environment where at times students can plan, find out and learn new ideas themselves – with you as a guide and facilitator. Allow them time to think and discuss ideas before gently guiding those who need support.

Teacher-centred learning	**Student-centred learning**
Teacher exposition	Group work
Accent on competition	Accent on cooperation
Whole-class teaching	Resource-based learning
Teacher responsible for learning	Student more responsible for learning
Teacher providing knowledge	Teacher as guide/facilitator
Students seen as empty vessels which need filling	Students have ownership of ideas and work
Subject knowledge valued	Process skills are valued
Teacher-imposed discipline	Self-discipline
Teacher and student roles emphasised	Students seen as source of knowledge and ideas
Teacher decides the curriculum	Students involved in curriculum planning
Passive student roles	Students actively involved in learning
Limited range of learning styles and activities	Wide range of learning styles employed

Select a variety of approaches to promote active learning

5 Science in context

It is vital to link what students learn in the classroom to the real world. This makes their learning relevant and helps them to relate new ideas to their own experiences:

- Stress that science involves an ongoing process of change and improvement in ideas. Explain that our ideas about science are built on earlier ideas. Point out that people in the past could only use what they knew at the time to make sense of the world. Sometimes this meant they put forward ideas that scientists now know are not correct. For example, many people thought that the world was flat, and the Sun orbited the Earth.
- Emphasise that some early thinkers created ideas that are still remarkably similar to our modern ideas. For example, over 2200 years ago Aristarchus suggested the Earth orbits the Sun. Democritus stated that matter is made of smaller particles more than 2300 years ago. Even our understanding of forces, based on Isaac Newton's laws of motion, were proposed by Philoponus over 1500 years ago.
- Explain that science theories develop when a person or a team puts forward new ideas. If other scientists test these ideas and agree then the idea becomes a part of science theory. It might be changed later with new evidence. This is how ideas develop.
- Explain that developing new technologies and materials also helps form new science ideas. For example, until the invention of the microscope 500 years ago, scientists could not see microorganisms and did not know they existed. Improvements in telescopes have resulted in changing ideas about the stars and even our nearest planets. Modern materials have allowed spacecraft and computers to be made.

The activities in each lesson provide you with many opportunities to relate the science content and processes to the real world. Whenever possible, take students out to see examples of science being used in the real world – such as on farms, in factories or even at an airport. You can invite people in to talk about their jobs and how they use science – for example, doctors, vets, farmers, gardeners and builders.

6 Wellbeing

The Student Book provides opportunities for teachers to consider the vital importance of wellbeing and to weave this into their teaching. The enquiry-based approach encourages curiosity and helps students to think about the world around them.

Wellbeing does not mean feeling happy all of the time. Making mistakes, feeling challenged and even being confused at times can help to develop resilience.

The resources support wellbeing directly by:

- **Providing questions and science facts** to challenge and engage students. They can reflect on prior learning and apply new skills.

For example, students are asked to think back to their work on components of an electrical circuit in earlier lessons and list those they have used to build a circuit.

- **Encouraging active science.** This means an active brain and also an active body. Students learn better and make better progress when they are physically active in lessons.

For example, students play the role of particles by arranging themselves into a close packed pattern to represent solids, move slightly to represent liquids and then move around the room to model the particles in gases.

- **Promoting group work.** Collaborative work is used throughout the resources so that students have opportunities to develop their collaborative skills. This growth through practice develops confidence and happiness.

There are opportunities for group work and collaboration in every lesson. For example, students work together to decide on key questions to ask a visiting health professional and work in groups regularly to plan and carry out investigations and surveys.

- **Presenting 'stretch zone' challenges** to encourage students to develop thinking skills and welcome challenge. They will become more familiar with moving away from a 'comfort' zone into the 'stretch zone' without worrying.

For example, students are asked to apply their understanding of habitats and survey techniques to hypothesise why some animals are found in certain locations but not others.

- **Offering mindful moments.** These provide opportunities for students to pause and re-focus their attention.

For example, the end-of-unit questions in the Student Book offer ideal opportunities for students to think about their learning.

Teachers are encouraged to develop the following approaches:

- Providing praise with a growth mindset. Teachers should work to praise the process rather than the intelligence or marks. Giving positive feedback on how something is being done is highly effective. This includes praising effort, perseverance, resilience, teamwork, strategies, etc.
- Discussing and evaluating mistakes. Learning always involves making mistakes. Students should not fear or worry about mistakes. They should see them as opportunities to learn.

7 A global outlook

The *Oxford International Primary Science* resources are designed to address the idea that academic lifelong success is the result of both academic performance and

emotional wellbeing. As educators we want to prepare our students for a workplace that is unknown to us. Ideas and activities identify areas where students can develop skills while feeling safe and confident enough to apply themselves to the content of the lessons. Skills are separated into distinct categories designed to provide the opportunities to develop key lifelong skills. Students are inspired by images and information that result in curiosity and wonder. Students become confident problem solvers by taking risks that also develop creative skills. Real-world skills are encouraged through carefully designed projects and activities. Students are introduced to project management and aspects of literacy, for example financial and functional literacy. There is an emphasis on carrying out research and careful analysis of the information that they find in addition to their own findings and data. Students have opportunities to develop interpersonal skills through communication and relationship building. They are encouraged to voice their ideas through discussion activities. The projects particularly allow students to take part in leadership roles and the responsibility that comes with this. The resources address the students' self-development skills through critical thinking, ethics and motivation. There are a number of sections throughout the scheme where students are introduced to ethical and sensitive issues.

Wellbeing is an area that is emphasised in the resources with a desire to address mental health issues, supporting learners in and out of school. Students are encouraged to care for their own minds by promoting mindfulness and to manage stress more effectively. Students should become more optimistic about their lives and the world around them. They are encouraged to care for their bodies with an emphasis on being active and eating healthily. Students are encouraged through a number of activities to build and maintain relationships and friendships with family and others. They learn how to communicate confidently with a range of people and connect through kindness and thoughtful behaviours. Students are more conscious about the world beyond their immediate environment but know they have a valued role and place, resulting in becoming better and more responsible lifelong citizens from an early age.

Teaching techniques for this series

Science learning is made up of:

- Remembering science facts
- Gaining scientific knowledge
- Developing science skills
- Developing science understanding

Facts are important but being told facts does not ensure knowledge and understanding. Working out science problems and engaging with scientific processes is much more likely to help students develop understanding. This is why applying scientific skills – doing science rather than remembering it – is vital.

Think about the question below:

Question: Who was the scientist who discovered the force of gravity?

Answer: Isaac Newton.

Knowing the answer to this question takes the learner no further. It demands no higher order thinking skills and does not help with solving any other problems. However, if a student understands Newton's theory of gravity and motion, they can start to explain and predict how things move, float and fly. Understanding enables a student to apply knowledge and solve problems and furthers their learning.

This series aims to provide science facts and knowledge but also science understanding. Certain strategies are better at teaching understanding than others.

Effective questioning is the key

Students can learn to understand by listening and reading. This is only possible if they have acquired advanced learning techniques and have sufficient background knowledge and understanding in which to fit any new ideas. That is why you can enhance your understanding, for example about your teaching, through these approaches, but this is not true for young learners. For inexperienced and less skilled students, the teacher enables them to progress from memory recall to deeper understanding. This series focuses on teaching and learning approaches that promote understanding. Science facts and knowledge are covered, of course, otherwise there would be a lack of context and content but the activities are also designed to develop thinking and learning skills.

Research tells us that teachers ask up to 400 questions per day. That can be 30 per cent of teaching time. It is clear then that time spent improving our questioning techniques will have an important impact on learning.

To give you some idea about the complexity of questioning you may wish to think about your own practice:

- Why you are asking a question
- What type of questions you are going to ask
- When you are going to ask questions
- How you are going to ask questions
- Who you are going to ask questions to
- How you expect the questions to be answered
- How you will respond if the person does not understand the question
- How you will react to an inappropriate or wrong answer
- How you will react to an appropriate answer
- How long you will wait for an answer

As teachers we ask questions for a number of reasons:

- To get attention

- To check students are paying attention
- To check understanding
- To reinforce or revise a topic
- To increase understanding
- To encourage thinking
- To develop a discussion

Bloom describes six levels of thought process:

- Knowledge
- Comprehension
- Application
- Analysis
- Synthesis
- Evaluation

We need to ask questions that encourage deeper thinking. If we only ask questions at the knowledge end of the spectrum, we will not encourage students to analyse or synthesise new ideas.

We also need to think about the nature and style of our questions. Two major categories are closed and open.

Closed questions

These tend to have only one or a limited range of correct answers. They require factual recall. They are useful for whole-group question and answer sessions, to quickly check learning or refresh memory or as a link to new work. Examples include:

Question: What is the boiling point of water at sea level?

Answer: 100°C.

Question: What are the three stages of the water cycle?

Answer: Water; clouds; rain.

These are very good for knowledge recall but are generally non-productive regarding anything else.

Open questions

These may have several possible answers and it may be difficult to decide which are correct. They are used to develop understanding and encourage students to think about issues and ideas. They encourage students to think and manipulate information and are much more complex. We are not looking for a single right answer; we are looking for what the student thinks may be the right answer. Once the teacher gets the student thinking, then the teacher can use this information to move the learning on towards the right answer, while promoting understanding at the same time.

Examples include:

Question: Where do you think the water in rain clouds comes from?

Answer: Any answer will have a little 'rightness' in it that the teacher can use. The student may answer 'From the sea.'

The teacher then can follow several further lines of enquiry to extend the learning. For example, the teacher could ask, 'Do you know of any other places the water might have come from?' Or 'How do you think that the water got into the clouds?'

These follow up 'how' and 'why' questions encourage students to think more deeply about the science and their understanding of the key ideas and principles.

Open questions require students to make links between ideas and apply knowledge – they often require students to be logical and imaginative. They require a longer time to think and answer than closed questions, and may lead on to wider discussion and debate.

Question series

Closed and open questions can be linked together to form a series. A series must be well planned but can lead to much improved understanding. Start with a few relatively easy factual closed questions and move towards more open questions. This is known as 'agenda building'. At the same time, you can move from individual to paired and then to small group discussion as the questions become more open and demand higher-level thinking.

In this series we promote an 'enquiring classroom' where closed questions are used, but also open questions which promote enquiring minds.

Question and answer techniques – some tips

1 The 'don't lead students down dark tunnels' technique

Students need to know where they are going before they start their learning journey, so tell them. For example:

'Today we are going to learn how magnets react to each other.'

This gives students the big idea on which they can hang the information that follows and make sense of it.

2 The 'ask students what they think' technique

Students usually lack the confidence to answer questions like:

'How did the water from the sea get into the clouds?'

Unless they are confident they know the correct answer, they will probably be reluctant to answer because they are afraid of failure. However, rephrase the question and say:

'How do you think that the water might have got from the sea up into the clouds?'

Then you are giving them permission to try even if they are not sure they are correct. In this way you do not always get the same students volunteering answers and you can give other students confidence.

3 The 'praise all answers' technique

To encourage students to share their thinking and

suggestions, we have to value and thank them for their efforts. We may say, 'Good try but not quite there yet. Let me see if I can help you – do you think it could have something to do with the heat of the Sun?'

There is usually an element of correctness in most students' attempts which we can praise.

4 The 'teach from students' answers' technique

In one Student Book there is a question which asks:

'Why does a watermelon contain 600 seeds?'

As a student, I do not know the answer and I am afraid of failure.

If the teacher asks students what they think and values their answers, then this productive line of enquiry will help take a student and the rest of the class to the correct answer as well as an understanding.

Select the element of correctness from the student and then expand and explain to help all the rest of the students understand. For example:

Student: I think it is because they want to grow lots of new watermelons!

Teacher: Good answer. It is all about germination and new life. However, do you think that when one watermelon sheds its seeds, there will be 600 new watermelons springing up beside it?

Student: No, not all 600!

Teacher: Good, that's important. You have told me that not all of them survive. How many do you think survive?

The teacher leads and expands and informs the student's answers to arrive at the understanding of 'producing many, so that a few can survive to carry on the species'. Because students have been actively involved in this journey they will not only remember; they will understand.

5 The 'do not let students struggle' technique

If you find that you are asking questions and the answers are nowhere near what you are looking for, then give students the answer or suggest a choice of answers. Without this, the progress of the lesson is halted and students and teacher get frustrated; move the lesson on. Tell them and expand and explain your answer.

6 The 'right answer' technique

If you get the right answer, then all is good, or is it? Only the person who has given the answer understands why it is correct so you need to expand and explain, so that the rest of the class can share in that student's understanding.

Teacher: Good answer, what made you think of that?

Teacher: I see what you mean; you made the connection between the boiling kettle and steam and thought the Sun's heat did the same with the sea only it is invisible. Well done!

Whole-class or group work

Whole-class question and answer methods work very well and highly structured whole-class activities can help to keep students on task. However, maximum contributions and participation are usually encouraged in small groups.

Group work can help students to learn more effectively. They can learn science better and cooperative learning can help social cohesion, motivation and improvements in self-esteem. The student who is shy is more likely to contribute to a discussion with another person or one or two other people than volunteer ideas in front of the whole class. In addition, by sharing work, students can cover more ground more quickly. The small group is also a good forum for generating creativity.

Another advantage is that small group work frees the teacher from having to be at the front and leading the whole class. The teacher can move around the room and direct attention and support when and where it is most needed. Individual needs can be better met in this way.

Some specific examples of group work are described below.

1 Short, informal discussions

These are sometimes called 'Buzz groups'. They are very useful as they do not need any structure and can be used at any time. Simply ask pairs or small groups to look at a picture or think about an issue and then give them a few minutes to share their ideas. There are numerous examples of these in the resources, linked to questions for the buzz groups to consider.

2 Think-pair-share

Students think about something individually for a few minutes and then work with a partner to compare their ideas. Finally, the pair present their ideas to the class.

3 Circle of voices

This works with larger groups of students (four, five or six). Students take it in turns to speak about their ideas on a topic or question. No one else is allowed to speak so this helps to develop social and listening skills.

4 1-2-4

Students think about an issue or carry out a task individually – for example, make a list of animals and plants they have seen – and then work with a partner to compare lists and discuss a slightly more complicated question – for example, which animals eat other animals? Finally, pairs join to form fours. They share ideas and then work together on a final task – for example, make some food chains.

5 Jigsaw

Students work alone to become experts on an aspect – for example, different habitats – then join back together to share their expertise and answer a larger question – for example, how are animals adapted to habitats?

Differentiation

Differentiation is closely linked to inclusion: ensuring all students have access to the curriculum. This means that learning and teaching approaches must consider individual needs. Not all learners will learn at the same pace or in the same ways.

Approaches supported by the resources are:

1 **Modifying content.** At times we can adjust the content for some learners to provide sufficient support or adequate challenge. Examples are stretch zone tasks in the Student Book. This is often called differentiation by task.

2 **Differentiating expected outcomes.** This allows all students to tackle the same tasks but outcomes are differentiated – usually in terms of 'All students should … ', 'Most students will … ' and 'Some students may … '. These differentiated outcomes are given in each lesson section of this Teacher's Guide. This is often called differentiation by outcome.

3 **Differentiating the process.** This means providing more or less support as students are carrying out a task. Advice on this is in each Teacher's Guide lesson section and also there are additional support activities that can be given to some students. For example, investigation support pages.

4 **Questioning.** This is a very effective way of differentiating work. Use questions to check progress and decide when extra support or challenge is needed. Questions in the resources are designed to progress from low on Bloom's taxonomy (remember and understand) towards higher levels (analyse and evaluate).

5 **Varied approaches to assessment**. The resources include a wide range of assessment methods. These include verbal, written and drawn responses and individual and collaborative assessments. There are also differentiated questions ranging from easier introductory questions to more challenging ones.

Assessment

Assessment is an essential part of learning. Without being able to check progress, teachers and students will not be able to identify areas of strength and areas in need of development.

Assessment can be classified as either formative or summative.

Formative assessment takes place during learning and is used to address issues as they arise. This means learning and teaching can be modified during lessons to better meet the needs of learners. Feedback to students is ongoing.

Each activity within the Student Book provides opportunities for formative assessment and feedback. This can be through teachers listening to discussions or presentations, observing the outputs of investigations and through assessing outcomes such as posters, reports and leaflets. Individual questions in discussion tasks can be used to monitor understanding and identify misconceptions. These can be addressed as they are noted. Some of these are noted in the Review and reflect sections in the lesson guidance in this Teacher's Guide.

Summative assessment is used to measure or evaluate student progress at the end of a process – for example, when a unit is completed or at the end of a year. Summative assessment compares students' attainment against a standard or benchmark.

The 'What have I learned?' features at the end of each unit can be used for summative assessment. Teachers can record which questions each student is answering correctly and use this to measure individual attainment. It can also indicate how well the class is progressing though the work. In this way, the assessment can inform individual interventions (extra support for a student) or whole-class interventions (reviewing work that is not well understood).

Each activity – group and individual – can be assessed through observation and questioning and progress notes. Written or drawn responses for each activity, can be assessed/marked using the school's marking policy and unit, end-of-term and end-of-year judgements made about individual and class progress.

Feedback is a crucial aspect of assessment. This should be as positive and encouraging as possible (see the wellbeing section) and identify clear targets. Involve students in assessment and target setting. Assessment is done with learners not done to learners.

How to Support Non-English Speakers

Teaching Primary Maths and Science through English: identifying the challenges and providing the support

The challenges

Ministries of Education at both local and national level are increasingly adopting the policy of English Medium Instruction (EMI), as improving the levels of achievement in English is usually an important factor.

In international schools it is likely that students do not share a mother tongue with each other or perhaps the teacher. English is, therefore, chosen as the medium for instruction to level the playing field and to provide the opportunity to develop proficiency in an international language.

This does not mean that the maths or science teacher is now being asked to replace the English teacher, or to have the same skills or knowledge of English (though in many primary schools one teacher may indeed teach both). It does mean that the science or maths teacher needs to become more language aware.

This raises significant challenges, including:

- the teacher's knowledge of English
- students' level of English (which may vary considerably in international schools)
- resources which provide appropriate language support
- assessment tools which ensure that it is the content and not the language which is being tested
- differentiation which acknowledges different levels of proficiency in both language and content.

Meeting the challenges positively

Perhaps lack of confidence in their own English proficiency is one of the most common concerns among teachers. However, while it is a factor, success in EMI is not necessarily linked to the teachers' proficiency in the second language. Teachers who have English as their mother tongue may well lack the sensitivity to, or awareness of, the language that a non-native speaker has acquired through learning and studying the second language. Developing this awareness and demonstrating it in both materials and method is the key to effective EMI.

Classroom language/Teacher Talk

Often non-native-speaker teachers are more concerned about their ability to run and manage the whole class in English than they are about the actual teaching of the maths or science concepts. The resources or textbook should help them with the latter. However, this use of English in the class is very important as it provides exposure to the second language, which plays a valuable role in language acquisition. The Teacher Talk for purposes such as checking attendance and collecting homework does not have to be totally accurate or accessible to students.

When teaching the science concepts, however, it is essential that the Teacher Talk is comprehensible. Some basic strategies to ensure this include:

- simplify your language
- use short simple sentences and project your voice
- paraphrase as necessary
- use visuals, the board, gestures and body language to clarify meaning
- repeat as necessary
- plan before the lesson
- prepare clear simple instructions and check understanding.

Creating a language-rich environment

Primary teachers often excel at providing a colourful and engaging physical environment for students. In the EMI classroom this becomes even more important. Posters, Word walls, lists of key structures, students' work and English signs and notices all provide a backdrop which provides the opportunity for exposure and language acquisition.

Planning

When planning the teacher needs to identify what the Language Demands are. This means thinking about what language students will need to understand or produce, and deciding how best to scaffold the learning to ensure that language does not become an obstacle to understanding the concept. This involves providing Language Support and goes beyond the familiar strategy of identifying key vocabulary.

Support for listening and reading

Listening and reading are receptive skills, requiring understanding rather than production of language.

Here are some suggestions for approaching such tasks.

If you are asking your students to listen to or read texts in English, ask yourself the following questions when you are planning the unit:

1 Do I need to teach any vocabulary before they listen/read?

2 How can I prepare them for the content of the text so that they are not listening 'cold'?

3 Can I provide visual support to help them understand the key content?

4 How many times should I ask them to read/listen?

5 What simple question can I set before they listen/read for the first time to focus their attention?

6 How can I check more detailed understanding of the text? Can I use a graphic organiser (e.g. tables, charts and diagrams) or gap-fill task to reduce the Language Demands?

7 Do I need to differentiate the task for those students who find reading/listening difficult?

8 Could I make the tasks interactive (e.g. jigsaw reading i.e. when students access different information before coming together, and information share)?

9 How am I going to check their answers and give feedback?

Support for speaking and writing

Speaking and writing are productive skills and may need more language input from the teacher, who has to decide what language students will need to complete the task and how best to provide this. When you plan to use a task which requires students to produce English (speak or write), you need to think about how to help them do this.

This means that you have to think in detail about what language the task requires (Language Demands) and what strategies you will use to help them use English to perform the task (Language Support).

You need to ask yourself the following questions:

1 What vocabulary does the task require? (LD)

2 Do I need to teach this before they start? How? (LS)

3 What phrases/sentences will they need? Think about the language for learning maths/science: e.g. predicting and comparing. What structures do they need for these language functions? (LD)

4 While I am monitoring this task, is there any way I can provide further support for their use of English (especially for the weaker students)? (LS)

5 What language will students need to use at the feedback stage (e.g. when they present their task)? Do I need to scaffold this? (LD, LS)

Teaching vocabulary and structures

Vocabulary

Learning the key maths and science vocabulary is central to EMI and 'learning' means more than simply understanding the meaning. Knowing a word also involves being able to pronounce it accurately and use it appropriately. Below is a list of strategies which could be useful:

- Avoid writing the list of vocabulary on the board at the start of the unit and 'explaining' it. The vocabulary should be introduced as and when it arises in the unit. This helps students associate the word or phrase with the concept and context.
- Record the vocabulary clearly on the board and check that you are confident with the pronunciation and spelling.
- Give students a chance to say the word once they have understood it. The most efficient way to do this is through repetition drilling.
- Use visuals whenever possible to reinforce students' understanding of the word.
- Ensure students are recording the vocabulary systematically in their glossaries and, if possible, use a Word wall which lists the vocabulary under unit/topic headings.
- Remember to recycle and revise the vocabulary.

Structures

In order for students to talk or write about their maths/science they will need to go beyond vocabulary: they will also need to use those phrases and sentence frames which a particular task requires. For example, they may need the following expressions in maths and science:

X is the same as Y.

The sides are the same length.

The next number in the sequence.

I predict that X will happen.

If X happens, then Y happens.

The next step is …

The teacher needs to build up these banks of common maths/science phrases and encourage students to record them. This is an important part of identifying the Language Demands and providing the necessary support. The teacher does not have to focus on grammar here as the language can be taught as 'chunks' rather than specific grammatical structures.

How to use the language support in the classroom

The study of science involves becoming familiar with an extensive and specific vocabulary. This is sometimes referred to as the language of science. Add to this the fact that for many students the language of instruction – English – is not their first language, and it is clear that we need to be sensitive to the use of language and language support.

The Student Book supports language development by clearly identifying key words in the Word clouds on the WOW pages and making bold the key content and enquiry words for each lesson. An interactive glossary is also of vital importance in helping students understand the language. The Student Book topic pages also combine words with pictures as this is most effective in helping students understand the meanings of words. The linking of image to word is an essential factor in language development.

Repetition is also very important and the Student Book introduces and reinforces words by showing the words and asking students to use them in their discussions and answers.

Each section of the teaching notes linked to a particular activity or lesson also provides specific language support. Detailed and specific advice is provided for each key word and other words vital for scientific literacy. A range of strategies are suggested, including card sorts and card games, Word walls, team games to define or explain words, use of similar words to explain meaning and exploration of the origins of words.

Key principles underpinning language support in this series are:

- Words should be introduced and explained carefully.
- The word should be explained in context.
- Repetition is vital.
- Words should be linked to pictures or actions.
- Students should develop their own glossaries.
- The learning of vocabulary should be fun.
- Language should not be a barrier to learning.

Not all students will understand ideas and concepts at the same rate and there is likely to be variation in language skills. The Student Book pages are set out to be easy to follow and use, but there are also suggestions for further work and activities within each unit of this Teacher's Guide. These will help you to differentiate the learning and provide alternative learning opportunities. You should find the advice about pair and group work particularly valuable in helping you to meet individual needs.

Component Overview

The Student Books

The Student Books are textbooks for students to read and use. The Student Books include everything you need to deliver the course to your students, guide their activities and assess their progress.

Student Book	Typical student age range
Student Book 1	Age 5–6
Student Book 2	Age 6–7
Student Book 3	Age 7–8
Student Book 4	Age 8–9
Student Book 5	Age 9–10
Student Book 6	Age 10–11

The Teacher's Guides

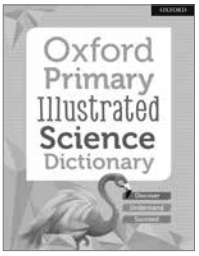
Each Teacher's Guide includes:

- An introduction with advice about delivering science and using the Student.
- A brief lesson plan for every lesson in each Student Book.
- Model answers to the activities and investigations; and answers to the assessment activities.

There are six Teacher's Guides:

Oxford Primary Illustrated Science Dictionary

The *Oxford Primary Illustrated Science Dictionary* gives comprehensive coverage of the key science terminology students use in the course. Each entry is in alphabetical order and, along with a clear and straightforward definition, has a fun and informative colour illustration or diagram to help explain the meaning. The dictionary is suitable for students with English as an additional language.



The curriculum

The *Oxford International Curriculum* offers a new approach to teaching and learning focused on wellbeing, which places joy at the heart of the curriculum and develops the global skills students need for their future academic, personal and career success.

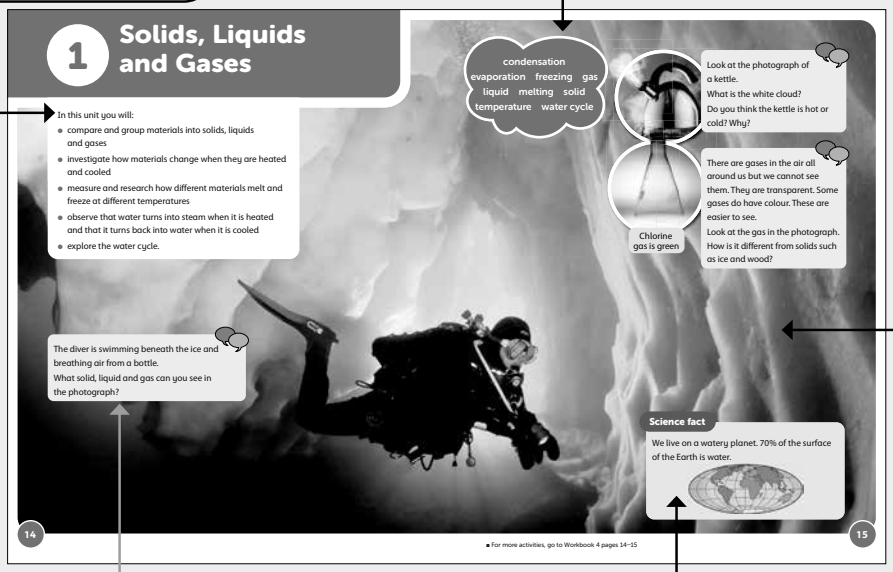
Through six subjects; English, maths, science, computing, wellbeing and global skills projects, the *Oxford International Curriculum* offers a coherent and holistic approach to ensure continuity and progression across every student's educational journey, equipping them with the skills to shape their own future. Through this approach, we can help your students discover the joy of learning and develop the global skills they need to thrive in a changing world.

Tour of a typical unit

Unit starter

Learning goals are stated clearly in every unit.

The Word cloud presents key words introduced in the unit.



The introductory spread is bright and colourful to spark interest in young students.

Discussion activities allow students to develop communication skills.

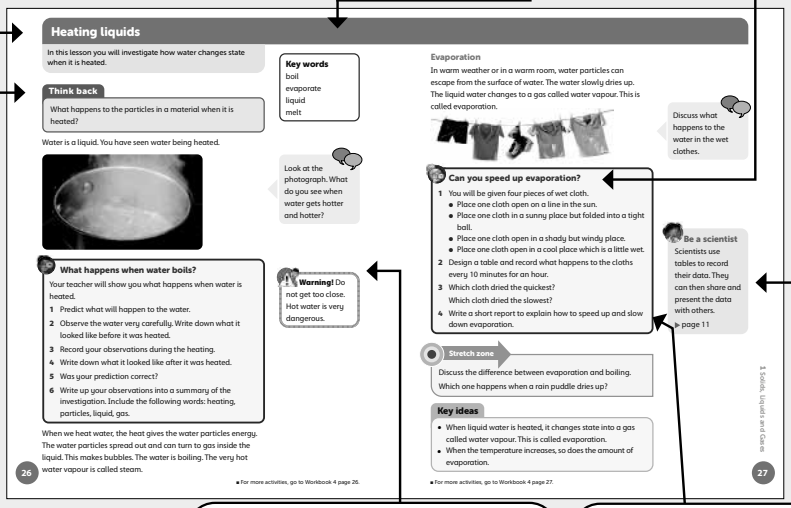
Science fact boxes engage students to think about how science has developed or is used in everyday life.

Lesson pages

Key word boxes show the main science vocabulary for the lesson.

Learning objectives for the lesson are clearly set out at the start and summarised in the Key idea box at the end.

Investigations engage students to work scientifically.



Be a scientist boxes help students to develop their skills to work scientifically.

Think back boxes remind students of prior learning.

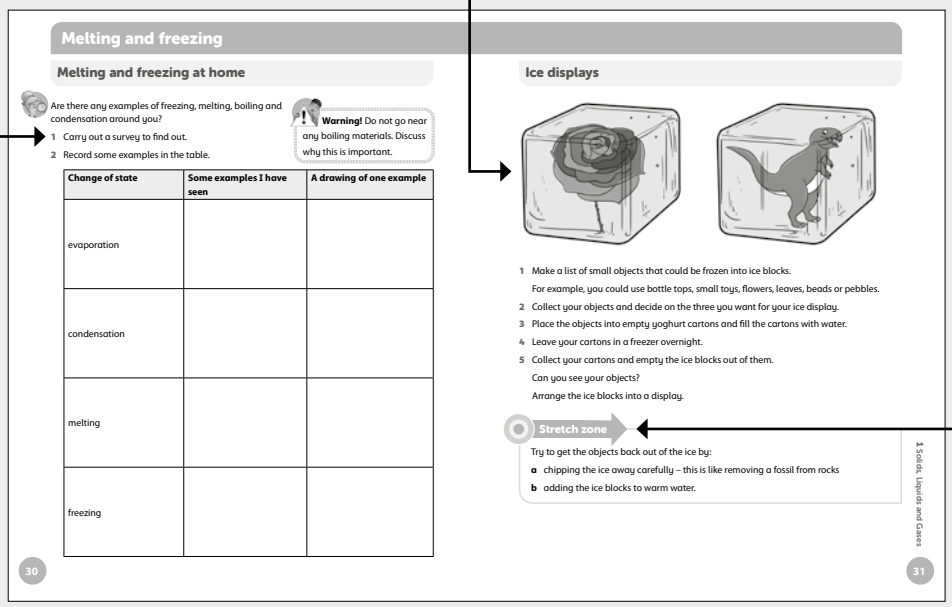
Warning boxes prompt students to identify risks and to learn how to keep themselves and others safe during practical work.

The student-friendly text is accessible for English language learners. Step-by-step instructions guide students through the activities they will undertake.

Carefully scaffolded activities promote deep learning.

Illustrations engage and support students to learn English.

Stretch zone activities challenge the most confident students.



Melting and freezing

Melting and freezing at home

Are there any examples of freezing, melting, boiling and condensation around you?

1 Carry out a survey to find out.
2 Record some examples in the table.

Warning! Do not go near any boiling materials. Discuss why this is important.

Change of state	Some examples I have seen	A drawing of one example
evaporation		
condensation		
melting		
freezing		

Ice displays

1 Make a list of small objects that could be frozen into ice blocks.
For example, you could use bottle tops, small toys, flowers, leaves, beads or pebbles.
2 Collect your objects and decide on the three you want for your ice display.
3 Place the objects into empty yoghurt cartons and fill the cartons with water.
4 Leave your cartons in a freezer overnight.
5 Collect your cartons and empty the ice blocks out of them.
Can you see your objects?
Arrange the ice blocks into a display.

Stretch zone

Try to get the objects back out of the ice by:
a chipping the ice away carefully – this is like removing a fossil from rocks
b adding the ice blocks to warm water.

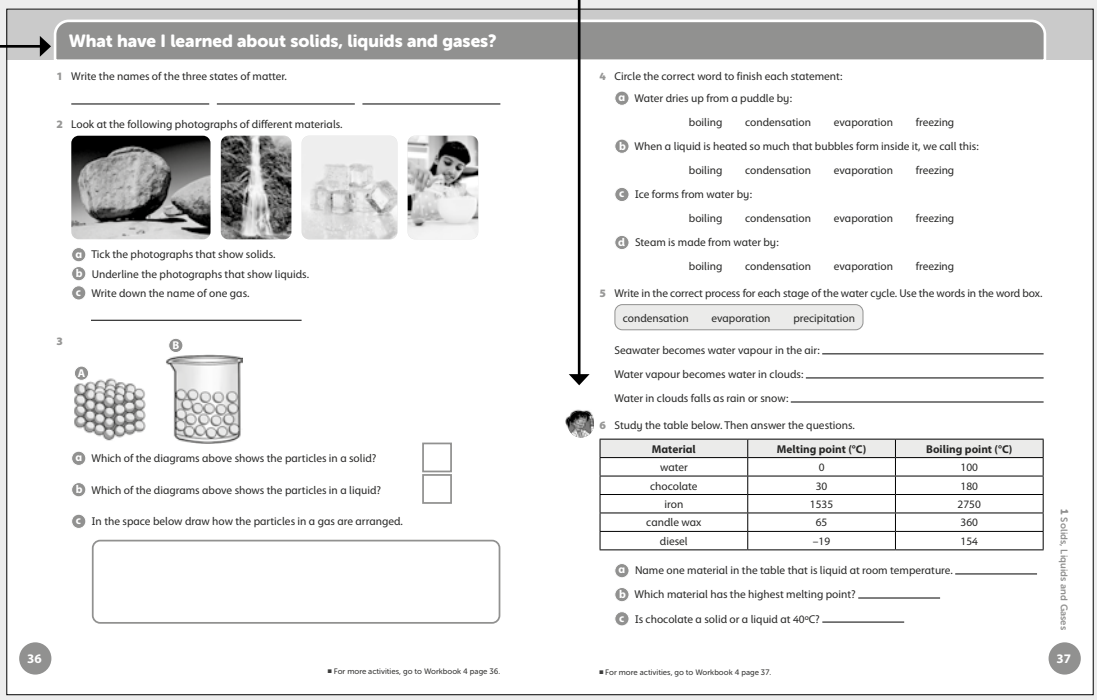
1 Solids, Liquids and Gases

30 31

What have I learned? pages

Students' progress is assessed through the questions and tasks at the end of each unit.

Be a scientist questions encourage application of science knowledge and skills.



What have I learned about solids, liquids and gases?

1 Write the names of the three states of matter.

_____ _____ _____

2 Look at the following photographs of different materials.

a Tick the photographs that show solids.
b Underline the photographs that show liquids.
c Write down the name of one gas.

_____

3

a Which of the diagrams above shows the particles in a solid? ☐
b Which of the diagrams above shows the particles in a liquid? ☐
c In the space below draw how the particles in a gas are arranged.

4 Circle the correct word to finish each statement:
a Water dries up from a puddle by:
boiling condensation evaporation freezing
b When a liquid is heated so much that bubbles form inside it, we call this:
boiling condensation evaporation freezing
c Ice forms from water by:
boiling condensation evaporation freezing
d Steam is made from water by:
boiling condensation evaporation freezing

5 Write in the correct process for each stage of the water cycle. Use the words in the word box.

condensation evaporation precipitation

Seawater becomes water vapour in the air: _____
Water vapour becomes water in clouds: _____
Water in clouds falls as rain or snow: _____

6 Study the table below. Then answer the questions.

Material	Melting point (°C)	Boiling point (°C)
water	0	100
chocolate	30	180
iron	1535	2750
candle wax	65	360
diesel	–19	154

a Name one material in the table that is liquid at room temperature. _____
b Which material has the highest melting point? _____
c Is chocolate a solid or a liquid at 40°C? _____

1 Solids, Liquids and Gases

36 37

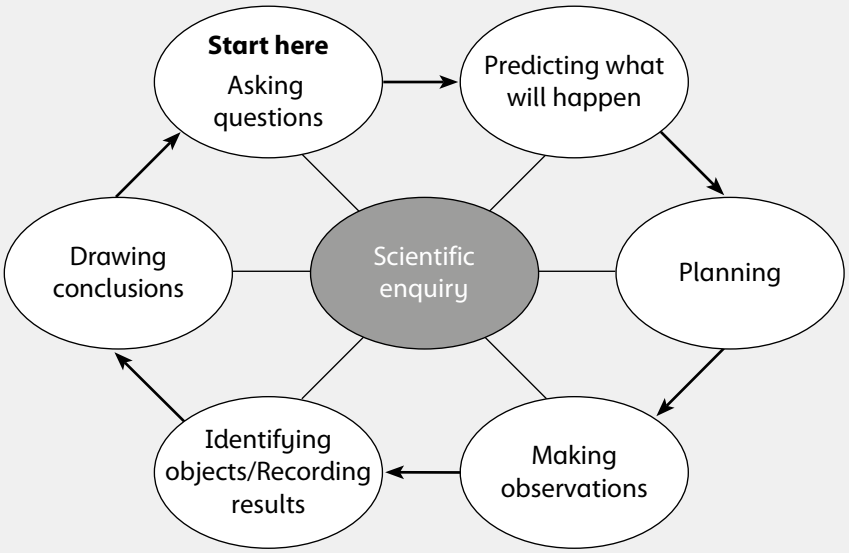
■ For more activities, go to Workbook 4 page 36.
■ For more activities, go to Workbook 4 page 37.

Teaching Notes

How to be a Scientist: Scientific Enquiry

These pages are designed to support you in teaching your students how to tackle scientific enquiry, i.e. investigative approaches within science lessons. The structure of the pages closely follows the layout of the student pages in the Student Book so that you can guide them stage by stage through the process.

The diagram shows the important ideas about scientific enquiry presented to students.



Scientific enquiry teaching techniques

The questioning techniques on pages ix-xi are the same strategies as used in scientific enquiry to guide students. However, in scientific enquiry there is a layer of methodology to add where these scientific skills have to be learned: observation; comparison; prediction; identifying factors; controlling variables; fair testing; recording and interpreting.

Your technique should now extend to questions about the planning, processes and risk assessment as well as questions about the content. For example:

- What equipment do you need?
- How will you make sure everyone is safe?
- What do you think will happen?
- Why are you being asked to add exactly 200 cm^3 of water? Why not add more?
- What can you see? Have you seen anything similar before?
- How would you test to see which one was lighter?
- Do you need to repeat the test? Why?
- Is this a fair test?
- How can I make improvements?

The Student Books include numerous examples of such questions, but you will be able to follow them up and make them a normal way to encourage students to think about science. When you are demonstrating a phenomenon or discussing an idea, ask students enquiry-based questions. Also include questions about safety and about everyday uses of the science. An enquiry-based approach encourages students to think about why and how, not just what.

Students have been doing practical work in science lessons for many years. Often students either observe a demonstration or carry out the experiment themselves following detailed verbal or written instructions. Though this can be a useful approach, it does not allow students to develop other key scientific enquiry skills.

The approach to scientific enquiry adopted in this scheme is to encourage students to be more responsible for identifying what should be investigated and how. Students are encouraged to reflect on the outcomes and explain what their results tell them. This can be summarised as:

WHAT am I going to investigate?

HOW am I going to investigate this?

WHAT do my results tell me?

Students do not have to carry out full investigations all of the time. You can concentrate on one or two phases of the scientific enquiry process. For example, present students with results from secondary sources and ask them to make sense of them. Or plan an investigation and discuss this but do not actually carry out the investigation. This is a good way to develop scientific enquiry skills. However, it is also important to allow students to put these together and carry out full investigations. This is when they are being scientists.

Investigations are best done within the context of the science ideas being studied at the time. They should never be a bolt-on, additional activity. Students need sufficient background knowledge to make sense of the investigation. The scientific enquiry ideas within the scheme start with a suitable stimulus. It is important to set the context within which students can ask questions. They need enough

information to understand the basic scientific ideas and formulate questions to be asked, but not too much so that all curiosity and discovery is removed.

Having set the scene, you may wish to work through the planning grid with students. Each student can then use this as they work through the rest of the scientific enquiry phases.

In summary: Context background knowledge stimulus scientific enquiry

Asking questions

The key to effective scientific enquiry is to encourage students to ask questions. Students are asked to start questions with words such as 'how', 'which', 'what', 'do' and 'does'. They are given some questions that would fit in with the example investigation, for example:

- Does the substance have a fixed volume?
- Does it have a fixed shape?

Help students to ask questions from a very early stage. This is the enquiry part of scientific enquiry.

Even when not focusing on investigative work you can develop questioning skills by modelling good practice. When undertaking any sort of scientific work keep asking students 'What would happen if …' or 'Why does this …' types of questions.

Predicting what will happen

In this phase you encourage students to discuss their ideas about what they think will happen in an investigation. They are given an example:

Question: What would you observe if you warmed a cube of ice on a windowsill?

with some questions to consider to help with a prediction:

- Do you think the ice would change?
- What did you think about to help you decide?

Remind students that scientists use their previous knowledge and experience, and sometimes secondary sources and models to help with their predictions.

Include practice in predicting at the start of any practical work in science.

Planning

This is known as 'planning an investigation' in later stages. It is possible to allow students to design their own plans for simple investigations. The two key questions are:

What will you keep the same?

What will you change?

Also talk to students about the equipment they will need. It is a good idea to discuss and share plans before starting. This will allow students to see good examples and also you can check the viability of the plans. You can also re-group students so that those with similar plans work together.

It is never too early to ask students whether what they designed was a fair test.

Students should now also be developing the skill of identifying risks and working safely. Ask them to think about potential risks, such as the substances and equipment they are handling and where they are carrying out the work.

Making observations

This phase relies on observation skills and often the accurate use of measurement. In the investigation used in the Student Book pages students are asked to discuss which senses they use to make observations and why they have to be careful about using them.

Now is the time to talk to students about making errors and the importance of repeat measurements. At this stage, they also need to think about what equipment they need to take measurements and the use of standard units.

Identifying objects/Recording results

Make sure that students understand that there are many different ways to record their results. The most common at this stage is to complete a results table and graphs. Example results tables and graphs are shown in the Student Book but give students practice in drawing them. Encourage students to report back on their findings in different ways. This can be as drawings, models, words or by speaking. Encourage computing skills by allowing students to record their results by taking photographs or by filming their investigations.

Drawing conclusions

Encourage students to look at their results carefully. In the Student Book they are asked to do three things after their investigation:

1 Think about how accurate their results are

2 Report the findings to others

3 Think about any new questions their investigation has raised

Ask students if they can think of any improvements. This is an important aspect of scientific enquiry.

How to be a Scientist: Investigation Master Sheet

Scientific enquiry planning grid

Asking questions

What am I trying to investigate? What is my question?

Predicting what will happen

My reason is that …

Planning

I will need …

What am I going to change?

What am I going to keep the same?

What I am going to measure is …

What I am going to do is …

I will be careful of …

My drawing of what I will set up:

Making observations

How can I make my observations accurate?

Which measuring devices can I use?

Identifying objects/Recording results

How will I keep my results neat and tidy?

Will I use a table, a chart, a graph, a drawing, a model, a photograph or a video?

My table/chart/graph/drawing/model will look like this (you may need a separate page):

Drawing conclusions

Can I see any patterns?

Are any results unusual?

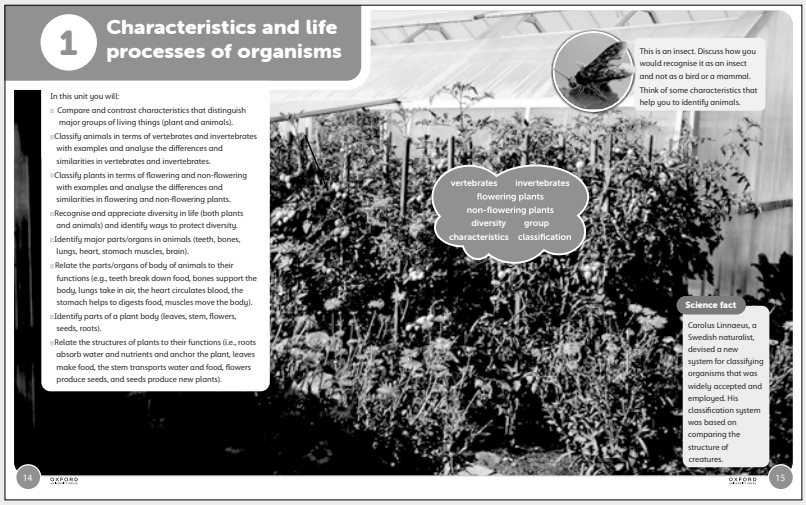
Do the results support my prediction?

How could I make my investigation more accurate?

1 Characteristics and life processes of organisms

In this unit students will:

- Compare and contrast characteristics that distinguish major groups of living things (plant and animals).
- Classify animals in terms of vertebrates and invertebrates with examples and analyse the differences and similarities in vertebrates and invertebrates.
- Classify plants in terms of flowering and non-flowering with examples and analyse the differences and similarities in flowering and non-flowering plants.
- Recognise and appreciate diversity in life (both plantsand animals) and identify ways to protect diversity.
- Identify major parts/organs in animals (teeth, bones,lungs, heart, stomach muscles, brain).
- Relate the parts/organs of body of animals to their functions (e.g., teeth break down food, bones support the body, lungs take in air, the heart circulates blood, the stomach helps to digests food, muscles move the body).
- Identify parts of a plant body (leaves, stem, flowers,seeds, roots).
- Relate the structures of plants to their functions (i.e., roots absorb water and nutrients and anchor the plant, leaves make food, the stem transports water and food, flowers produce seeds, and seeds produce new plants).



Getting started

This unit explores in detail the ways in which different animals and humans grow and develop. Students review their prior knowledge of life processes studied in Year 2. They investigate insects in their local environment and consider the differences between living and non-living things. Students also compare how animals and plants interact with their environment and demonstrate the processes of life. The vital need for animals to reproduce to make new copies of themselves is discussed and students then study in detail the life cycles of butterflies, frogs, chickens, horses and humans to illustrate the changes that take place throughout these cycles.

Check your classroom science library if you have set one up. Add some books and magazines about wildlife. You may be able to add information leaflets from a local zoological garden or wildlife centre. Remember that you can also download specific information. This will allow you to make small information booklets to support each lesson and especially Stretch zone activities.

Science in context

Use the lessons in this unit to encourage students to learn more about the animals that live in their local area, while also developing a global aspect by showing that the life cycles covered are found throughout the world. Allow students to survey and investigate animals in habitats in their local area. If possible, take them out to see habitats in the wild and in parks and on farms. Remember to find out where they have visited in previous years to add to this experience rather than duplicating it. Encourage students to find out about how some people, as part of their work, study animals and their life cycles. You could invite farmers and zoologists to talk to your class. If there is a local zoological garden, take students there to see a wide range of animals.

Scientific enquiry skills

An Investigation master sheet is given in this Teacher's Guide on to help students plan their scientific enquiries. Scientific enquiry skills for this unit focus on observation to aid the collection and presentation of data. In addition, you should stress the need to look after animals carefully and return them to the wild. These ethical considerations are vital. Students will also develop the skills of using the internet, books and other sources to find out secondary sources of information. They will also analyse and present data in the form of tables, charts and posters and communicate their ideas in a variety of ways such as computer presentations, posters, information leaflets and displays.

Resources

Student Book: animal identification key or book; caterpillars and leaves from the plant they were found on; tall glass containers with air holes in the lids; paper plates; paper fasteners; cameras (optional); scissors; sprouting potatoes; resources to make computer presentations; rulers; string; strips of paper; materials to make posters and leaflets; cardboard boxes with lids; cardboard; sticky tape; access to an outdoor area to observe an animal; access to the internet; books on animal and plant life in hot, dry habitats; books and magazines about extinct animals; books about insect life cycles.

Key words for the unit

The below words are in the Word cloud in the Student Book.

vertebrates invertebrates flowering plants non-flowering plants diversity group characteristics classification

Scientific enquiry key words

Plan and/or carry out enquiries to answer questions

Make observations

Take measurements, using equipment accurately

Record data and results using diagrams and labels, tables, keys and graphs

Report and present findings in a variety of ways

Draw conclusions and give explanations

Use scientific evidence to support or refute ideas

Language support

It is always useful to start a new unit by reading out the words in the Word cloud. As you read out each word ask students to discuss it. They should list the words they are not familiar with. Add all of the words to a Word wall for the unit so students see the key words they will be using; this will help them to learn the words. Ask them to create a glossary and start adding any definitions they are confident with. This could be a regular end-of-lesson task or starter for following lessons to encourage recall.

Unit at a glance

The key teaching points for students in this unit are:

- to introduce the unit objectives
- to introduce the learning outcomes
- to engage students with the content of the unit
- to review and build on prior learning and understanding of the topics.

In the next lesson students will review their understanding of the processes of life.

The purpose of this introductory lesson is for students to start thinking about different animals and what they need to stay alive. They will also reflect on how animals are different, how they are the same and how they develop throughout their lives. The introductory pages show photographs of a range of different living things and the images are used to prompt discussions. They are designed to be engaging and to enthuse students to learn more.

This is an insect. Discuss how you would recognise it as an insect and not as a bird or a mammal.

Think of some characteristics that help you to identify animals.

Allow students to talk about each animal and then ask them to decide how the animals are the same and how they are different. Ask students questions to check their understanding, for example: How do the similarly or differently do insects and animals move? How do they sense their environment? Are they all the same size and colour? What do they have to do to stay alive?

Possible response: *Students should realise that the animals have many things in common (eyes, limbs, noses, ears, mouths, fur or hair) but there are differences such as size, shape of limbs and colour. Despite these differences all of the animals need to move to catch and eat food, they all need to sense their environment, and they all need to drink water.*

Science fact: Carolus Linnaeus, a Swedish naturalist, devised a new system for classifying organisms that was widely accepted and employed. His classification system was based on comparing the structure of creatures.

Read out the Science fact or ask a volunteer to read it out. Ask students to suggest reasons why Linnaeus's system was widely adopted. Students can think back to their work on identification keys and to expand their thinking you can also point out that in their work scientists may specialise in one type of animal. For example, they may only study some types of beetles or birds or only study whales and not other things that live in the oceans.

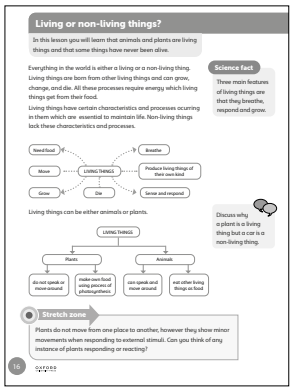
Computing link: Ask students to search the internet to find out more about Carolus Linnaeus and his work.

Extra activities

1 Students make their own classroom Word wall. You could buy or make wallpaper backing that looks like bricks and ask students to write some word cards – give each group two or three to make – and fix these to the Word wall. They can also download and print off pictures of a range of animals to make an eye-catching display for the Word wall.

2 **Computing link:** Ask students to work in groups of three or four. Give each group the name of one living organism and ask them to use the internet and other sources to research the animal. They should find out about the habitats the animals live in and what they eat. Students could make an information sheet to keep in the class library.

Living or non-living


Living or non-living things?

In this lesson you will learn that animals and plants are living things and that some things have never been alive.

Everything in the world is either a living or a non-living thing. Living things are born from other living things and can grow, change, and die. All these processes require energy which living things get from their food.

Living things have certain characteristics and processes occurring in them which are essential to maintain life. Non-living things lack these characteristics and processes.

Science fact

Three main features of living things are that they breathe, respond and grow.

Need food
Move
Grow
LIVING THINGS
Breathe
Produce living things of their own kind
Die
Sense and respond

Living things can be either animals or plants.

Discuss why a plant is a living thing but a car is a non-living thing.

LIVING THINGS
Plants
Animals
do not speak or move around
make own food using process of photosynthesis
can speak and move around
eat other living things as food

Stretch zone

Plants do not move from one place to another, however they show minor movements when responding to external stimuli. Can you think of any instance of plants responding or reacting?

16

Getting started

In this lesson students look at the life processes carried out by living things. They carry out a survey in their area to observe how different animals move and students present their findings as a poster or presentation. They also study examples of animals using other life processes.

Language support

To help develop language skills you could use flashcards with the words of the life processes (breathing, feeding, growth, movement, reproduction and senses) written on them. Hold up each card in turn and ask students to take it in turns to tell their partner why this life process is so important to animals.

Resources

Student Book: access to a local outdoor area to observe living things resources to make a poster or presentation.

Scientific enquiry key words

Make observations

Record data and results using diagrams and labels, tables, keys and graphs

Report and present findings in a variety of ways

Draw conclusions and give explanations

Lesson at a glance

The key teaching points for students in this lesson are:

- living things are either plants or animals.
- Living things need to carry out certain life processes to allow them to stay alive.

In the lesson students will explore the differences between living and non-living things.

Think back: List two life processes you have used today. What would happen if animals were not able to carry out the life processes?

Ask students to think back to their work in earlier years about life processes. Working with a partner, they can share examples of life processes they have used. Ask volunteers to share their examples with the class.

> ***Possible response:*** *Students should suggest they have used breathing, feeding, movement, senses and they will have grown slightly. Students may suggest that animals that were not able to carry out the life processes would not survive.*

Discuss why a plant is a living thing but a car is a non-living thing.

Arrange students into pairs or groups of three or four for discussion Allow students to talk and discuss the question. Ask for volunteers to share their answers with the class.

> ***Possible response:*** *Students should suggest that the a car does not display the three main features of life. It does not breathe or grow and though it appears to "respond", it only does so when there is a person or electrical component directing its response. In contrast, plants display all these features.*

Ask for volunteers to read out the life processes on the page. Next, ask students to suggest the name of the life process being described.

Investigation: Observing animal movement

Allow students to work in groups of three or four. Explain that they are going to observe and identifya living thing in their local area and record how it moves. Take them out to an area near the school – an area of woodland or near a pond. You could also take them to a zoological garden if there is one near the school.

Ask students to stand or sit quietly and observe the living thing for 15–30 minutes. They should record the name and type of the living thing and then note their observations about how it moves in a table and then present their findings to the class using a poster or presentation. Students can then compare their results and decide on the most common type of movement.

> ***Possible response:*** *Students should observe and record a wide range of living things – such as plants, shrubs, trees, insects, birds, amphibians, reptiles, birds and mammals. They should see a variety of modes of movement with flying and walking possibly the most common.*

Be a scientist: Scientists often set time limits on observations and surveys. They also compare what happens in day time with night-time.

During the investigation explain to the students that scientists cannot look at everything all of the time. They have to select a fair way of getting an idea of what lives in an area. For example, they might observe an animal every day for a week for two hours during the day, then observe it for two hours every night for a week and compare the results. Ask students to think about why just observing for a short time on just one day might not be the best way to do a survey.

Discuss what would happen to the living things if they were not able to move.

Allow students to work in their investigation groups to discuss the question. They can think about the animal they have observed as well as other animals they know about. Ask some volunteer groups to share their ideas with the class.

> ***Possible response:*** *Students should suggest that if animals were not able to move predators could catch them or they would not be able to catch their food. They could also not move away from dangers such as fires and floods and if food runs out they could not move to a new area.*

Science fact: Three main features of living things are that they breathe, respond and grow.

Read out the Science fact or ask a volunteer to read it out. Ask students to suggest why they think these are the three main characteristics used to determine life. You can suggest that these features are the ones found on all living things, no matter how big or small, or even microscopic!

Stretch zone: Plants do not move from one place to another, however they show minor movements when responding to external stimuli. Can you think of any instance of plants responding or reacting?

Ask students to work with a partner or in a small group to brainstorm the answer. Allow them to write out their oughts and present them to the class or another group.

> ***Possible response:*** *Students should suggest that plants are capable of detecting and responding to various stimuli in their environment. For example, they use mechanisms to change how they grow, depending on factors such as light, gravity, water, temperature, herbivores and infections. You can also guide them to discover that some plant responses called tropisms, are directional movements towards or away from a stimulus.*

Review and reflect

Ask students to make word cards by writing one life process on each card. They test a partner by lifting up a word card and asking them to read it out and say why it is important to animals. You can allow some quiet time for students to reflect on what they have done well in the lesson and to think of one thing they would do better.

Conclude the lesson by asking students to attempt questions 5 in the 'What have I learned about characteristics and life processes of organisms? in the Student Book.

Extra activities

1 **Computing link:** Hand out the name of a different living things to groups of students. Ask them to use the internet to research and find out how it moves, feeds, breathes and senses the environment. They can download pictures and make an information sheet to add to the class library. This is a chance to use living things not from your area to give a global outlook.

2 **Maths link:** Ask students to carry out a survey of flying, walking and slithering animals they see near the school. They count how many of each they observe over a 15-minute period, record them in a table and then produce a bar chart to help them to analyse their findings.

Differentiation

Supporting: Ask students to act out the life processes of growth, movement, breathing and feeding as you say the words out loud.

Consolidating: Display large versions of the life process' sticky notes so students can easily refer to them throughout the lesson and unit.

Extending: Ask students to design a table to show the life processes and the importance of each one to living things.

Differentiated outcomes	
All students	should be able to list the life processes for living things
Most students	will be able to describe some examples using life processes to stay alive
Some students	may be able to explain the function of each life process in keeping living things alive

Investigation: Survey of living and non-living things

Allow students to work in groups of three or four. Explain that they are going to plan a survey of the local area. Ask them to move carefully around the area you have selected for them and to find ten examples of living things and ten examples of non-living things. They should also record five things that were once living. Suitable areas include the school grounds, a local park, a beach or a botanical garden.

Encourage students to take photographs or draw the examples they find and to present their findings as a large poster. Explain that one half should be labelled 'living' and the other half 'non-living'. Explain that they should place examples of once-living things at the bottom of the 'living' part of the poster. Help them to make a class display or exhibition of all of the posters.

Possible response: *Students should find many living things (different plants, insects, birds, amphibians, reptiles, mammals and possibly fish) and non-living things such as soil, sand, rocks, structures (e.g. concrete buildings and roads), road signs, vehicles, toys, ornaments and statues). Once-living things could include wooden structures such as fences and houses, fallen leaves, dead branches and flowers, dead insects, pine cones and bark.*

Investigation: Do plants move?

Students work in groups of three or four. You can use the same groups as in the first investigation of this lesson or mix the groups up so that students learn to work with other people. Explain that they are going to investigate movement in plants. Ask if they think that plants move and write their ideas on the board. Ask them to set up a potato maze. They place a sprouting potato at the far end of the maze. To make sure the potato is in the dark they put a lid on the box, seal the box to make it lightproof other than the hole and place it in a sunny place. Light can enter through the hole in the box but the maze stops it shining directly onto the potato. Ask students to write a prediction of what they will see over the next few days. They should observe their maze every two days for about two weeks. At every check they take the lid off to see what is happening but they must place it back quickly to limit the light entering.

Maths link: Each time they open the maze students measure how long the potato plant is. Discuss how this will be measured but suggest that they measure from the top of the potato and to the end of the longest shoot. They could use string to follow the shape of the shoot and then measure the string against a ruler. Encourage them to record the measurements in a table and then use the data to draw a graph or chart. They should then write up a report that includes labelled drawings or photographs, the result table, a chart or graph and their conclusions.

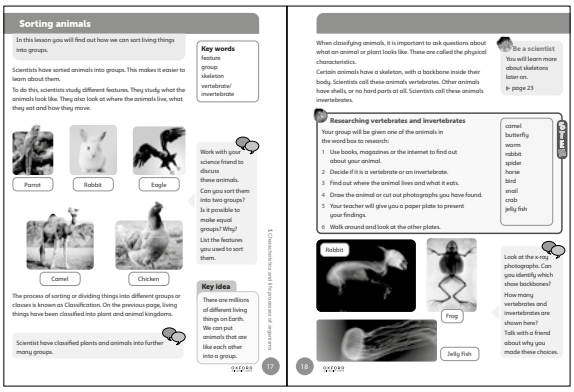
Possible response: *Students should find that the potato sends out shoots that grow towards the light. The potato may also have produced roots and these push the potato towards the light so it can look as if the potato has moved along the maze.*

Was your prediction correct? Do plants move?

Ask students to look back at their observations and results and then talk about their prediction and whether they think the potato actually moved. Ask some volunteer students to share their ideas with the class. Explain that the potato may seem to have moved along the maze but you can point out that this is because the roots will have been growing and pushing the potato, and the shoots will grow towards the light.

Possible response: *Students should be able to check their prediction. If they predicted the potato would not grow towards the light ask them why they believed this. They should realise that plants do grow towards the light (and roots grow downwards due to gravity) but this isn't the same as movement in animals.*

Sorting animals



Getting started

In this lesson students observe some living things and use observable characteristics to sort them into groups.

Language support

Read out the key words in the word box at the top of the page. Ask students to talk to each other about each word in turn. Ask them which words they have heard of before. List any new words on the board or pin word cards onto a wall. The E-book has a section that highlights these words and students can hear them being pronounced. Try to introduce the words by putting them into a sentence. You could also play a game by asking students to put their hand up every time they hear the words in the lesson.

Resources

Student Book: books; magazines; paper plates.

Key words

feature group skeleton vertebrate/invertebrate

Other words in the lesson

x-ray

Scientific enquiry key words

observe compare notice patterns record group/classify

Lesson at a glance

The key teaching point for students in this lesson is living things can be sorted into groups.

Read out the text at the top of page 17 to introduce this section. Point out that the features of a living thing are what it looks like and what it does. Students can use these features to group similar animals.

Discussion

Work with your science partner to discuss these animals. Can you sort them into two groups? Is it possible to make equal groups? Why? List the features you used to sort them.

Ask students which animals they recognise:

1 Ask students to look at each animal.

2 Point out the features they will see on the rabbit. For example, the shape of ears, number of eyes and type of body covering.

3 Ask students to predict how the rabbit will move.

4 Students can then look at the other animals to identify features they have in common and how they are different.

5 Ask students to group the animals into two groups so that each group has a lot in common.

Point out that by working together students can share ideas and use the strengths that each person brings to the task. This will make it more fun and they will achieve more.

Then read out the discussion task and tell students that this is a chance for them to use their scientific observation skills to look at the features of each animal. Once they have completed this, ask them to put the animals into two groups. You can then ask them to share their groupings and the list of features they used to help them to make their decision.

Possible response: *Students could place the parrot, chicken and eagle into one group based on presence of wings and beaks as features. The camel and rabbit could be placed into the second group based on them having four legs, hair or fur, and visible ears. Other groupings are possible – for example they may include the chicken with the rabbit and camel as they look soft. Discuss each grouping. At this stage, any groupings are acceptable as long as they are linked to features.*

Discussion

Look at the x-ray photographs. Which show vertebrates? Which show invertebrates? Talk with a partner about why you made these choices.

Remind students that vertebrates will have a skeleton, with a backbone, inside their body. Encourage them to start by checking each x-ray to see if such a skeleton is shown. Students will have to look carefully as the invertebrate jelly fish does have markings on the x-ray but these are not as dark or pronounced as would be seen if it had bones. Ask students to use any prior knowledge they have about the animals to help in their discussions. Emphasise that this is what scientists do to help them to make decisions.

Answer: *Students should observe that the rabbit and frog have a clearly shown internal skeleton and so are vertebrates. The jelly fish does not have an internal skeleton and so is an invertebrate.*

Investigation: Researching vertebrates and invertebrates

Write down the names of the animals on separate pieces of paper and fold the paper over. Ask each student group to take a piece of paper to find out which animal they are researching. You can then hand out tablets, laptops or books to support students in carrying out their research. If students cannot have access to the internet you could download information pages about each animal and make a series of booklets simply stapled or clipped together.

Stress that they need to find out if the animals are vertebrates or invertebrates and where they live and what they eat. Once students have researched their animal, ask them to download or draw pictures of their selected animal and stick these to a paper plate. They should write whether the animal is a vertebrate or an invertebrate. You can display the plates on a wall and ask students to walk round so they can learn about all the other animals.

Answer: *Students should find out that the camel, rabbit, bird and horse are vertebrates and that the butterfly, worm, jelly fish, snail, crab and spider are invertebrates.*

Key idea

We can put animals that are like each other into a group.

Summarise the lesson by asking students what they have learned.

Let them share their ideas, read out and discuss the Key idea. This will remind students that we can put animals that are very similar into the same group.

Review and reflect

Encourage students to reflect on their learning throughout the lesson. Use the discussion tasks and the research investigation activity encourage students to think about what they understand and what they are finding less straightforward. Discuss the outcomes of each task with students. Encourage them to identify aspects they have not completed correctly and help them to identify improvements. This will help students to develop a positive approach to learning by understanding that learning is a process that will improve with practice and reflection.

Remember to praise the process of learning as much as, if not more than, the outcomes. Encourage students to ask questions and to look back through prior work to review and revise. Use every opportunity to allow students to work together to check understanding and share ideas. After the research investigation ask students to reflect on how they found out about the animals – and to discuss and list which skills they used.

Conclude the lesson by asking students to try question 4 on page 34 of the Student Book.

Extra activities

1 Ask students to create a glossary for the unit. They can add any words used in the lesson.

2 **Computing link:** Allow students to choose one animal to research. Encourage them to list or draw the features associated with the animal. Ask them to decide if the animal is a vertebrate or an invertebrate. They could make a poster to share information about their animal.

3 **Maths link:** Ask students to look out of the window or watch a wildlife film for 10 minutes. They can count the different animals they see. Ask them to record how many of each animal they observe. They can present this as a tally chart or simple graph. If students are unlikely to see many animals through the window you could ask them to survey birds, or show them a short wildlife film from the internet.

Differentiation

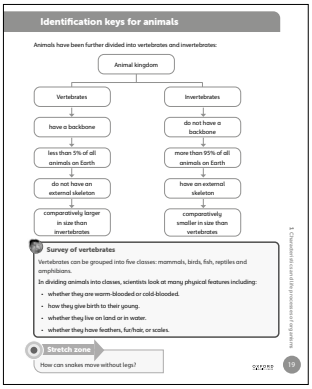
Supporting: You may need to give some very specific examples of features for some students. Make these obvious, such as long ears, wings or arms and legs.

Consolidating: Some students may need support in linking the terms vertebrate and invertebrate with an internal skeleton and backbone. Ask them to feel their ribs and backbone and then ask them to think about feeling a worm or a jelly fish.

Extending: Ask some students to research invertebrates that have a strong skeleton but outside the body.

Differentiated outcomes	
All students	should be able to use some features to group animals.
Most students	will be able to explain why some animals are vertebrates and others are invertebrates.
Some students	may be able to classify less common animals into smaller groups.

Identification keys for animals



Getting started

This lesson covers the idea of using identification keys to name animals within habitats. Remind students that no one can learn and remember the names of every living thing on Earth, so keys are used to help us. Point out that the examples in the book are simplified and only cover a few animals to show how keys work. You could start by showing pictures of lots of different animals and asking students to tell you what sort of characteristics they could use to group and identify them. For example – show them a snake, a fish and a goat.

Language support

Ask students to suggest one feature they can see that could be used to group the animals into smaller groups. Write this down, for example, 'has fur' or 'has wings'. Explain that when we group animals into smaller and smaller groups we are classifying them. You could point out that students are grouped this way in schools – into different classes. Write the phrase 'physical characteristic' on the board. Explain that a physical characteristic is the way an object or an animal or plant looks. You could play a game where students describe the physical properties of an object and their partner has to guess the object.

Resources

Student Book: access to outdoor areas to study animals; clipboards; paper.

Other words in the lesson

amphibian bird characteristics fish mammal reptile

Scientific enquiry key words

ask questions use equipment observe

compare notice patterns record
group/classify use secondary sources
communicate findings

Lesson at a glance

The key teaching points in this lesson are:

- identification keys can be used to group, identify and name animals
- keys can be used to identify animals we have never seen before.

Explain to the students that it is based on asking questions that have two possible answers. This lets us move through the key along a path until we get to the name of the animal we are trying to identify. At each question and answer we move to the next level and so on.

Explain to students that identification keys can get quite complicated and can help us to identify creatures that we do not know the names of. Tell them that as there are so many different types of animals and plants (nearly nine million known) one key cannot cover all living things. Keys are made just for specific groups (such as monkeys, coral reef fish or snakes). You could point out that it is estimated that there are up to 400 000 types of beetles so many keys are needed just for this group.

Investigation: Survey of vertebrates

The purpose of this investigation is to encourage students to apply their understanding of the use of a key to animals they survey in the local area. Remind students of their prior learning that vertebrates can be grouped into five classes: mammals, birds, fish, reptiles and amphibians.

Allow students to read through and discuss the key and then take them outside to survey some vertebrates. It is best if they work with a partner or in a small group of three or four. They could use a worksheet to record their findings. Tell them to use the key to help them decide which class of vertebrate each animal belongs to. If you want them to see a wide range of vertebrates, you could take them to a bird feeding station, a wooded area, a garden, a river or lake and a beach area if possible. Another alternative is to arrange a visit to a local zoological gardens or even a natural history museum.

Ask students to record their observations in a table and use this to determine the most common type of vertebrate observed.

Maths link: Students can then present their findings as a bar chart and compare it with others in the class.

Stretch zone: How can snakes move without legs? Explain that snakes are vertebrates as they have an internal skeleton and a backbone but they do not look like many other vertebrates, as they do not have legs.

Allow students to talk about when they have seen snakes moving, possibly on television programmes and in films.

Answer: *Students should recall that snakes move by slithering or wriggling their bodies.*

Computing link: Make the point that the vertebrate key was very general – it helped students to place the vertebrates into five smaller groups or classes but didn't help with naming individual types of fish, amphibians, reptiles, birds or mammals. Allow them to search for bird keys – ideally birds found in your region. These might be of different designs to the yes/no (dichotomous) keys shown so far, but they will follow the same principle of asking questions about what the birds look like and then narrowing it down until each one is identified.

Review and reflect

Remember to praise the process of learning as much as, if not more than, the outcomes. Encourage students to ask questions and to look back through prior work to review and revise. Use every opportunity to allow students to work together to check understanding and share ideas. After the survey investigation ask students to reflect on how they felt about using keys – and to discuss and list which skills they used.

Conclude the lesson by asking students to present the results of their survey in a bar chart. You may wish to remind them that each animal has its own bar along the horizontal (x) axis and the numbers are written up the vertical (y) axis.

Extra activities

1 **Computing link:** You could allow students to work in small teams to download pictures of animals from the internet and then make an electronic key showing the different identifying features of the animals. You can then ask students to pass their identification keys to other teams to test and evaluate.

2 Ask students to make an identification key with animals of their choosing, such as pets or favourite animals from around the world. They can make this into a large poster for display around the room.

3 **Maths link:** Ask students to research how many types (species) of fish, amphibians, reptiles, birds and mammals are estimated to live in the world. They can then present this data as a table and as a bar chart.

Differentiation

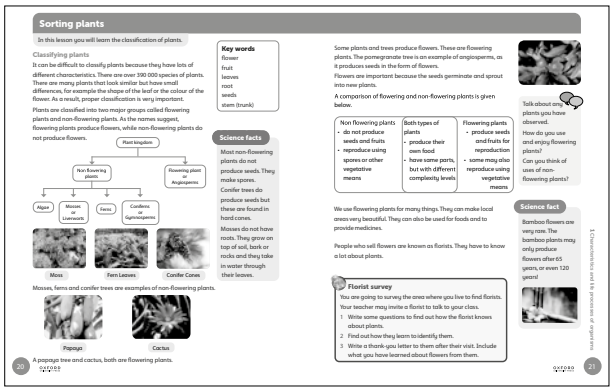
Supporting: Provide templates for keys (boxes and arrows only) or even half-completed keys to help students in their designs.

Consolidating: Display examples of keys around the room. These can be downloaded from the internet. Have identification books as part of a small class library.

Extending: Encourage students to find and use different formats of keys so they develop from using the simple dichotomous variety.

Differentiated outcomes	
All students	should be able to state that identification keys can be used to group and identify animals
Most students	will be able to use keys to identify animals from pictures and group animals observed during surveys
Some students	may be able to use a variety of different types of keys to identify different types of animals

Sorting plants


Sorting plants

In this lesson you will learn the classification of plants.

Classifying plants

It can be difficult to classify plants because they have lots of different characteristics. There are over 390 000 species of plants. There are many plants that look similar but have small differences, for example the shape of the leaf or the colour of the flower. As a result, proper classification is very important.

Plants are classified into two major groups called flowering plants and non-flowering plants. As the names suggest, flowering plants produce flowers, while non-flowering plants do not produce flowers.

Plant kingdom
Non-flowering plants
Flowering plant or Angiosperms
Algae
Mosses Liverworts
Ferns
Conifers or Gymnosperms

Moss
Fern Leaves
Conifer Cones

Mosses, ferns and conifer trees are examples of non-flowering plants.

Papaya
Cactus

A papaya tree and cactus, both are flowering plants.

20

Key words
flower
fruit
leaves
root
seeds
stem (trunk)

Science facts
Most non-flowering plants do not produce seeds. They make spores.
Conifer trees do produce seeds but these are found in hard cones.
Mosses do not have roots. They grow on top of soil, bark or rocks and they take in water through their leaves.

Some plants and trees produce flowers. These are flowering plants. The pomegranate tree is an example of angiosperms, as it produces seeds in the form of flowers.
Flowers are important because the seeds germinate and sprout into new plants.
A comparison of flowering and non-flowering plants is given below.

Non flowering plants	Both types of plants	Flowering plants
• do not produce seeds and fruits • reproduce using spores or other vegetative means	• produce their own food • have same parts, but with different complexity levels	• produce seeds and fruits for reproduction • some may also reproduce using vegetative means

We use flowering plants for many things. They can make local areas very beautiful. They can also be used for foods and to provide medicines.

People who sell flowers are known as florists. They have to know a lot about plants.

Florist survey
You are going to survey the area where you live to find florists. Your teacher may invite a florist to talk to your class.
1 Write some questions to find out how the florist knows about plants.
2 Find out how they learn to identify them.
3 Write a thank-you letter to them after their visit. Include what you have learned about flowers from them.

Talk about any plants you have observed.
How do you use and enjoy flowering plants?
Can you think of uses of non-flowering plants?

Science fact
Bamboo flowers are very rare. The bamboo plants may only produce flowers after 65 years, or even 120 years!

© Characteristics and life processes of organisms

21

Getting started

In this lesson about identification keys students look at how we can use keys to name plants within habitats. Point out that the principle for using a key to identify plants is exactly the same as when using them for identifying animals. Remind students that there will be yes/no questions and they will have to draw on their observation skills to make decisions about characteristics.

Language support

You could create a wall display with the help of your students to display the key words. This could be visually attractive. For example, you could download and display pictures of cacti, flowering plants and non-flowering plants near the appropriate words.

Key words

flower fruit leaves root seeds stem (trunk)

Other words in the lesson

florist flower leaf shrub species tree

Scientific enquiry key words

ask questions use equipment observe
compare notice patterns record
group/classify use secondary sources

Lesson at a glance

The key teaching points in this lesson are:

- no one can know all of the different types of plants in the world
- identification keys can be used to identify different types of plants in the same way they are used to identify animals.

Think back: Why do scientists use identification keys?

Ask students to reflect on their experiences of using keys in the last lesson. Allow them to talk to each other about how useful the keys were and if they had any problems with them. You can ask for volunteers to share their ideas with the class.

> ***Possible response:*** *Students should appreciate that keys are a simple way to identify living things without attempting the impossible task of memorising millions of different types and names.*

Talk about any plants you have observed. How do you use and enjoy flowering plants? Can you think of uses of nonflowering plants?

Start the lesson by asking students to identify the plants in the photographs in the spread. Reinforce the idea that we are familiar with many different kinds of plants and may even know the names of some.

> ***Possible response:*** *Some uses of flowering plants, include decorating our homes, gifting, cooking, and even aromatherapy. Uses and enjoyment of nonflowering plants, include use as Food, medicine, landscaping, air purification.*

Read through the text at the top of page or ask a student to read it out. This highlights the huge number of species of plants that exist (390 000) and that it is impossible for anyone to know them all so identification keys are very important. Stress that there are many plants that look similar but have small differences, for example the shape of the leaf or the colour of the flower.

Show students the key at the bottom of page. Explain that this looks at two different types of plants: flowering and non-flowering. Reinforce the idea that we follow the yes/no arrows to the next identifying feature down the levels of the identification key.

Investigation: Florist survey

The purpose of this investigation is to set the science students are learning into a realistic and relevant context. Explain that they are going to survey the area where they live to find florists. They may be able to do this from memory, by using the internet or from local advertising information and leaflets. If possible, invite a florist into school to talk to your class. If you cannot manage to do this, then a person who looks after the school grounds or a local gardener or park keeper would make a suitable substitute.

Ask students to work with a partner or in a small team to write some questions to find out how the florist or other visitor knows about plants. Encourage students to design questions that help them to find out how the visitor learned to identify plants. They can try to find out if the visitor uses keys and how many non-flowering and flowering plants they use.

A relevant and interesting way to allow students to reflect on their learning is to ask them to work together to produce a thank-you letter for the visitor after the visit. Remind them to include what they have learned about flowers from them. This keeps the activity within context and is also an example of courtesy and good manners.

Summarise the lesson by asking students what they have learned. Ask them to write down one thing they have learned about identification keys or about plants. Remind students that identification keys are important as they can help us to identify plants we have not seen before.

Review and reflect

Encourage students to reflect on their own learning by pausing for a few moments and thinking about which parts of the work they found tricky. Talk about how they managed this and suggest that next time they stop for a short while and take a few deep breaths. Also remind them that when they are doing tricky work they are training their brain and this will help their future learning.

Extra activities

1 You could ask students to create an identification key for some of the plants in your area as a way of consolidating their ideas about plant characteristics and identification keys. Suggest they concentrate on only four or five of the most common plants. For example, they could research information about trees or common pot plants.

2 **Computing link:** Download keys of regional plants and allow students to plan a survey to identify and count examples from the area around the school. They could produce a computer presentation or download photographs to make an information sheet about the plants.

3 Students could make a 3D model of one the plants shown in the Student Book. They can then leave this on their desk and move around the room and use the key to identify all of the models produced by the class.

Differentiation

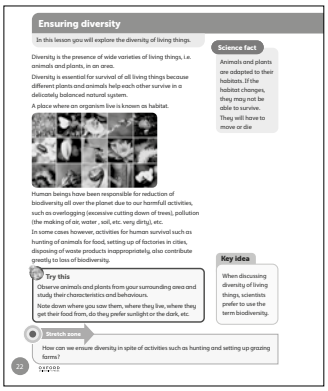
Supporting: Work through the keys a step at a time with students rather than leaving the activities as totally student-centred until they are confident with using plant keys.

Consolidating: Display a range of potted plants and occasionally ask students to move them into groups so each group contains similar plants.

Extending: Ask students to research one type of cactus (for example Barrel cacti) in more detail to show how keys can either be very general or made more specific.

Differentiated outcomes	
All students	should be able to use a simple plant identification key to name some plants from photographs
Most students	will be able to apply their knowledge of keys to identify some common plants in the area near their school
Some students	may be able to research keys to find out how groups of plants can be further classified into smaller groups

Ensuring diversity


Ensuring diversity

In this lesson you will explore the diversity of living things.

Diversity is the presence of wide varieties of living things, i.e. animals and plants, in an area.
Diversity is essential for survival of all living things because different plants and animals help each other survive in a delicately balanced natural system.
A place where an organism live is known as habitat.

Science fact

Animals and plants are adapted to their habitats. If the habitat changes, they may not be able to survive. They will have to move or die

Human beings have been responsible for reduction of biodiversity all over the planet due to our harmfull activities, such as overlogging (excessive cutting down of trees), pollution (the making of air, water , soil, etc. very dirty), etc.
In some cases however, activities for human survival such as hunting of animals for food, setting up of factories in cities, disposing of waste products inappropriately, also contribute greatly to loss of biodiversity.

Try this

Observe animals and plants from your surrounding area and study their characteristics and behaviours.
Note down where you saw them, where they live, where they get their food from, do they prefer sunlight or the dark, etc.

Key idea

When discussing diversity of living things, scientists prefer to use the term biodiversity.

Stretch zone

How can we ensure diversity in spite of activities such as hunting and setting up grazing farms?

22

Getting started

In this lesson students will discover an appreciation for the diversity and benefit of wide variety in living things. They will gain an appreciation of how different plants and animals help each other survive.

Language support

You could create a wall display with the help of your students. This could be visually attractive. For example, you could download and display pictures of insects, animals and flowering plants and non-flowering plants.

Scientific enquiry key words

ask questions use equipment observe
compare notice patterns record
group/classify use secondary sources

Lesson at a glance

The key teaching points in this lesson are:

- no one knows all of the different types of plants and animals in the world.
- diversity is the key to ensuring survival of living things. The term Biodiversity is used when discussing diversity of living things.

Think back: Whyis it essential to have different types pf plants and animals in an area?

Ask students to reflect on their experiences and observations of areas with wild life in urban, urban planned and rural settings. If they do not have such experience, you can plan short, guided trips where they can observe and record the number of living things in an area.

Possible response: *Students should appreciate that keys are a simple way to identify living things are present different times of environment but thrive in areas where all their needs are met.*

Start the lesson by asking students to identify the living things in the photograph. Reinforce the idea that we routinely observe many different kinds of plants and animals, and may even know the names of some.

> ***Possible response:*** *Students should notice insects they have seen before – even if they cannot name them. Most obviously they will observe the varieties of plants that common in urban planned park areas. Point out the variety of shapes seen in the different species. Students should know that they could find and use a key to help them to identify them.*

Read through the text at the top of page or ask a student to read it out. This highlights the importance of diversity and its role in survival of life. Stress that there are many living things may look similar but have small differences, resulting in slight advantage or disadvantage in a given habitat.

Reinforce the idea of habitat and discuss how a habitat can be big or small depending on which living thing is under discussion.

Observe animals and plants from your surrounding area and study their characteristics and behaviours.

Note down where you saw them, where they live, where they get their food from, do they prefer sunlight or the dark, etc.

Encourage students to think back to their earlier work on plants and animals and ask them to talk about the differences between 2 types of a same things, for example, two plants, two insects, two flowers, two shrubs, two birds, two mammals, etc.

> ***Possible response:*** *Students should recall that trees usually have a central woody stem called a trunk and shrubs have more than one woody stem and these are usually thinner than tree trunks.*

Investigation: Florist survey

The purpose of this investigation is to set the science students are learning into a realistic and relevant context. Explain that they are going to survey the area where they live to find florists. They may be able to do this from memory, by using the internet or from local advertising information and leaflets. If possible, invite a florist into school to talk to your class. If you cannot manage to do this, then a person who looks after the school grounds or a local gardener or park keeper would make a suitable substitute.

Ask students to work with a partner or in a small team to write some questions to find out how the florist or other visitor knows about plants. Encourage students to design questions that help them to find out how the visitor learned to identify plants. They can try to find out if the visitor uses keys and how many non-flowering and flowering plants they use.

A relevant and interesting way to allow students to reflect on their learning is to ask them to work together to produce a thank-you letter for the visitor after the visit. Remind them to include what they have learned about flowers from them. This keeps the activity within context and is also an example of courtesy and good manners.

The next activity develops the idea of the usefulness of identification keys when trying to identify one particular variety of a certain type of plant. Students are asked to use an identification key for a specific type of plant: cactus. Ask students to work in pairs for this activity. Read out the scenario: Imagine your friend wants to buy a cactus with pink flowers. She thinks it is called a Saguaro. Use the key below to see if she is correct. If not, which cactus should she buy?

Ask students to use the identification key to help you find the right cactus for their imaginary friend.

> ***Answer:*** *Students should identify that the cactus with the pink flowers is Opuntia aciculata.*

Key idea

Identification keys can be used to help to identify plants.

Summarise the lesson by asking students what they have learned. Ask them to write down one thing they have learned about identification keys or about plants. Ask a volunteer to read out the key idea. This will remind students that identification keys are important as they can help us to identify plants we have not seen before.

Review and reflect

Encourage students to reflect on their own learning by pausing for a few moments and thinking about which parts of the work they found tricky. Talk about how they managed this and suggest that next time they stop for a short while and take a few deep breaths. Also remind them that when they are doing tricky work they are training their brain and this will help their future learning

Conclude the lesson by asking students to complete question 2 in the 'What have I learned about habitats?' activity on page 62 of the Student Book.

Extra activities

1 You could ask students to create an identification key for some of the plants in your area as a way of consolidating their ideas about plant characteristics and identification keys. Suggest they concentrate on only four or five of the most common plants. For example, they could research information about trees or common pot plants.

2 **Computing link:** Download keys of regional plants and allow students to plan a survey to identify and count examples from the area around the school. They

could produce a computer presentation or download photographs to make an information sheet about the plants.

3 Students could make a 3D model of one the cacti shown in the Student Book. They can then leave this on their desk and move around the room and use the key to identify all of the models produced by the class.

Differentiation

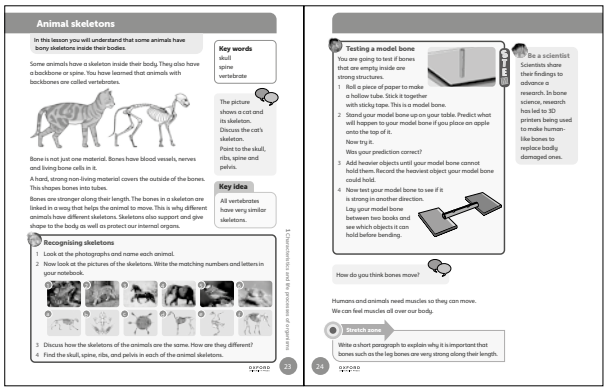
Supporting: Work through the keys a step at a time with students rather than leaving the activities as totally student-centred until they are confident with using plant keys.

Consolidating: Display a range of potted plants and occasionally ask students to move them into groups so each group contains similar plants.

Extending: Ask students to research one type of cactus (for example Barrel cacti) in more detail to show how keys can either be very general or made more specific.

Differentiated outcomes	
All students	should be able to use a simple plant identification key to name some plants from photographs
Most students	will be able to apply their knowledge of keys to identify some common plants in the area near their school
Some students	may be able to research keys to find out how groups of plants can be further classified into smaller groups

Animal skeletons



Getting started

In this lesson students study animals that have a bony skeleton. They test the strength of a model bone to explore how the structure of bone helps it to be light but also strong.

Language support

Most of the key words for this lesson are the names of bones students studied last lesson so the game of saying the names of bones quickly and having students point to that part of their body will be a useful strategy and introduction to the lesson. Review students' understanding of the word 'vertebrate'. They should be familiar with this word from earlier work but spell it out on the board and explain that a vertebrate is an animal with a backbone or spine.

Resources

Student Book: paper and sticky tape; books.

Key words

skull spine vertebrate

Other words in the lesson

strong structures

Scientific enquiry key words

observe record data carry out tests

Lesson at a glance

The key teaching points in this lesson are:

- animals with backbones and internal skeletons are called vertebrates
- bones are light and strong because they are not solid but grow as tubes.

Think back Point to these parts of your skeleton: skull, ribs, spine and vertebra.

Ask students to reflect on the bones they have learned about earlier. Ask them to point to different bones in their body. Ask them to check to see if their partner points to the same places in their body. They can discuss any differences.

> ***Possible response:*** *Students should point to their head, chest, back and hips.*

Discussion

The picture shows a cat and its skeleton. Discuss the cat's skeleton. Point to the skull, ribs, spine and pelvis.

Point out the pictures of the cat and the cat skeleton. Ask students to look at both carefully. Hint that they should compare the cat's skeleton to the picture of the human skeleton. Ask students if they see any other similarities between the cat's skeleton and the human skeleton.

> ***Possible response:*** *Students should be able to identify the skull, ribs, spine and pelvis of the cat as they are almost identical to these bones in the human skeleton.*

Read through the text beneath the cat pictures or ask a student to read it out. Write the word 'vertebrate' on the board and explain that some animals have a skeleton inside their body, with a backbone or spine. Remind students that these animals are called vertebrates.

Investigation: Recognising skeletons

The purpose of this investigation is to allow students to learn more about vertebrates by matching photographs of animals to their skeletons.

Ask students to look at the photographs and name each animal. They should then look at the pictures of the skeletons. Explain that they should write the matching numbers and letters in their notebook to record their ideas.

> ***Answer:*** *Students should match the following: 1 = b; 2 = a; 3 = d; 4 = f; 5 = e; 6 = c.*

Ask students to discuss how the skeletons of the animals are the same. They should also think about how the skeletons are different. Students should try to find the skull, spine, ribs and pelvis in each of the animal skeletons.

> ***Possible response:*** *Students should suggest that the skeletons are very similar and have the same types of bones in similar locations. They vary in size and shape to match the body shape of the animal.*

Investigation: Testing a model bone

The purpose of this investigation is to test how bones can be light yet strong by using a paper tube as a model bone. Explain to students that they are going to test if bones that are empty inside are strong structures.

Ask students to roll a piece of paper to make a hollow tube. They can stick it together with sticky tape. Explain that this is their model bone. Point out that scientists often use models of things for scientific tests. For example, they make model cars and aircraft to test in wind tunnels. Ask them to think about why they are not using real human bones in their investigation.

Next, ask students to stand their model bone up on the table and predict what will happen to the model bone if they place an apple onto the top of it. They should then test their prediction. You can use small weights of any kind if you prefer not to use an apple. Ask students to check to see if their prediction was correct. Students then add heavier objects until their model bone cannot hold them. They should record the heaviest object the model bone could hold. They can design a results table for this.

Ask students to then test their model bone to see if it is strong in another direction. Explain that they should lay their model bone between two books and see which objects it can hold before bending. Point out the diagram in the investigation box, as this will help them to visualise the test. Students should compare how much weight the model bones could hold in both of the directions.

Point out that the bones in a skeleton and how they connect to muscles are linked to the way the animal moves. This is why animals have different skeletons.

Be a scientist Scientists share their findings to advance research. In bone science, this has led to 3D printers being used to make human-made bones to replace badly damaged ones.

Read out the Be a scientist information to students. Explain that scientists and doctors are always trying to use new technology to help heal people. Ask them if they have heard of 3D printers. Tell them that astronauts in space have been able to make tools, such as spanners, using 3D printers. The computer sends the details and the printer makes objects out of materials such as plastics or metals. Now doctors can print out replacement bones and joints.

Stretch zone: Write a short paragraph to explain why it is important that bones such as the leg bones are very strong along their length.

Ask students to reflect on the findings of the investigation using a model bone. They found it was stronger along its length than across it. Students should then think about where the leg bones are and what they do. Ask them to stand up. Ask, 'Where is the weight on your leg bones? Is it across the bones? Is it along the length?' Students can then write their paragraph.

Key idea

All vertebrates have very similar skeletons.

Summarise the lesson by asking students what they have learned. Let them share their ideas, read out and discuss the key idea. This will remind students that vertebrates have internal skeletons, including a backbone. They will also learn that vertebrate skeletons all have very similar structures but have some important differences in shape and size. Ask students to tell you how the skeleton of a frog, a fish and a bird are the same and how they are different.

Extra activities

1 **Computing link:** Students could use the internet to research the skeletons of some other vertebrates. You could allocate a different class of vertebrates to each group, so you have covered the skeletons of fish, amphibians, reptiles, birds and mammals across the class. Students can download pictures or design and construct a digital information page about their class of animals. These can be combined as an online resource or printed out to form a booklet.

2 **Maths link:** Students could research more about the composition of bone. They could find out about bone marrow and the minerals that are found in bones. You can link this with the need to consume enough minerals such as calcium in the diet to relate this back to earlier work on balanced diets.

Differentiation

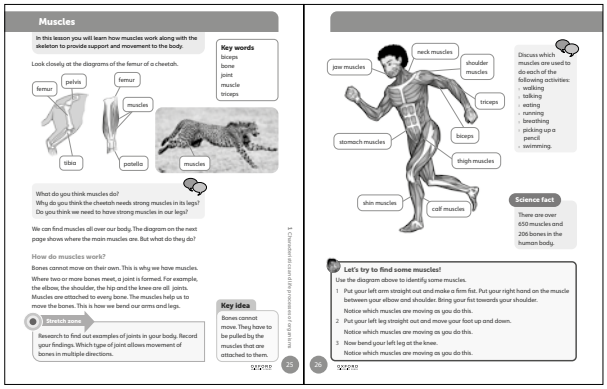
Supporting: Explain that a skeleton must be similar in shape to the animal, as it has to support every part of the body. Draw the outline of a made-up skeleton and ask students to predict what shape the animal will be.

Consolidating: Make a large version of the photographs and matching skeletons shown in the Student Book so students can remind themselves of the similarities and differences between the skeletons of different animals.

Extending: Challenge students to look at structures such as bridges and buildings to link the supporting structures to the role of bones in the body.

Differentiated outcomes	
All students	should be able to link a picture of a vertebrate to its skeleton.
Most students	will be able to describe the similarities between the skeletons of all vertebrates.
Some students	may be able to explain why there are significant variations in the skeletons of some vertebrates, such as forelimbs adapted for flight in birds.

Muscles



Getting started

In this lesson students will learn that bones cannot move without being moved by muscles. Students will identify some of the muscles in their body and explore which bones they move.

Language support

Read through the key words for the lesson and spell the word 'muscle' on the board. Underline the 'sc' letters in the middle and point out that it makes an 's' sound – similar to 'buses' and 'passes'. You could point out the difference in spelling to the mussels that are animals living in water. The words 'muscle' and 'mussel' are pronounced the same – they are homophones (words that sound the same but have a different meaning).

Resources

Student Book: books about joints or access to the internet.

Key words

biceps bone joint muscle triceps

Other words in the lesson

attached femur patella pelvis tibia

Scientific enquiry key words

observe notice patterns

Lesson at a glance

The key teaching points in this lesson are:

- bones cannot move on their own
- muscles are attached to bones and move them by pulling on them
- where bones meet there are joints.

Discussion

What do you think muscles do? Why do you think the cheetah needs strong muscles in its legs? Do you think we need to have strong muscles in our legs?

Point out the diagrams at the top of page. Ask students to look at them carefully and identify the bones. They can point to these bones in their body. Make sure that students notice where the muscles are attached to the bones and that there are joints shown in the diagrams. Ask students to discuss the questions and make notes of their answers. You can then ask for volunteers to share their ideas with the class.

Possible response: *Students should suggest that muscles help bones to move. They should state that the cheetah needs strong muscles in its legs because it has to run quickly. They may suggest that we need strong muscles in our legs to walk and play sports.*

Investigation: Let's try to find some muscles!

The purpose of this investigation is to allow students to identify some of the major muscles in their body and explore the body movements that these muscles can cause. Ask students to study the diagram to help them to identify some muscles.

Students can read though the investigation and carry out the tasks as an independent activity or you can take them through it step by step. Either way, students should place their left arm straight out and make a firm fist. They then put their right hand on the muscle between their elbow and shoulder. Ask them to bring their fist towards their shoulder. You can demonstrate this if students are not sure of the movement – it is just a bending of the arm. Students should notice which muscles are moving as they do this and record the names of the muscles they can identify. You can ask them to do the same movement but with their hand on the back of the arm to feel any muscles. This antagonistic movement (muscles working in pairs) is covered in the next lesson but it is an opportunity for students to feel this action here.

Students should then put their left leg straight out and then move their foot up and down. They should identify any muscles that are moving as they do this and record their names. Next, students should bend their left leg at the knee and identify which muscles are moving as they do this. Ask them to write down the names of the muscles.

As a plenary to the investigation you can do the movements in front of the class and ask them to tell you the names of the muscles helping you to move.

Answer: *Students should identify that as they bend their arm they can feel the biceps move. If they hold the back of the upper arm they will feel the triceps move. When they move their foot up and down they are using the shin and calf muscles and when they bend and straighten their leg they should feel the thigh muscles.*

Discussion

Discuss which muscles are used to do each of the following activities: walking; talking; eating; running; breathing; picking up a pencil; swimming.

Ask students to apply their knowledge of the muscles of the body to talk about the seven activities listed. Point out that they can keep looking at the diagram of the muscles to help them.

Students may find it useful to model the activities by pretending to do them. For example, they can feel the muscles when they move their mouth as if eating, when they are running on the spot, or when they move their arms and legs as if they were swimming. This movement will help to keep students alert and attentive and also help them to remember the activity and the muscles.

Answer: *Students should identify the following muscles to do each activity: walking = the muscles in the legs (thigh, shin and calf); talking = jaw muscles; eating = jaw muscles; running = leg muscles (thigh, shin and calf); breathing = stomach muscles (and some students may suggest chest muscles); picking up a pencil = arm (biceps and triceps) and students may volunteer back muscles; and swimming = arm (biceps and triceps), leg (thigh, shin and calf) and stomach muscles.*

Science fact There are over 650 muscles in the human body.

Read out the Science fact and ask students to look back at the diagram of the person and the muscles. Explain that some muscles are large, such as the biceps and triceps, but there are lots of very small muscles that movethe face, fingers and toes and some inside the body that carry out jobs such as beating the heart and squeezing and mixing food.

Ask students to feel where the biceps meets the elbow and ask them if they can feel where the end of the muscle meets the bone. This is where the muscle fixes or attaches.

Stretch zone: Research to find out examples of hinge joints and ball and socket joints in your body. Record your findings.

Computing link: Allow students to have access to the internet if this is possible. If not, you can make a small library of biology books that should contain information about joints. Ask students to find out about the two types of joints. They can download pictures and make a poster to present their ideas.

Key idea

Bones cannot move. They have to be pulled by the muscles that are attached to them.

Summarise the lesson by asking students what they have learned. Let them share their ideas, read out and

discuss the key idea. This will remind students that bones need help to make them move. It is the muscles that pull the bones. Ask students to move their body by using the muscles you say out loud: biceps; thigh muscle; calf muscle.

Review and reflect

You can set up this activity at the end of the lesson, either as an open book or a closed book task. You could also hand out a piece of paper. Then ask them to list the names of as many muscles as they can and the jobs the muscles perform. Students can then self-check the answers to all of the review activities by turning back to the Student Book.

Extra activities

1 Ask students to make a poster-sized picture of a person and the main muscles. Explain that they should miss off the labels but make a label card for each muscle they have learned about. Display the posters and then ask students to move to a poster from another group and fix the label cards in the correct places.

2 Ask students to try to walk across the room three times. The first time they should try it without using any arm muscles, the second time without using any calf muscles and the third time without using thigh muscles. Ask them to discuss what it felt like and what it taught them about the importance of muscles.

Differentiation

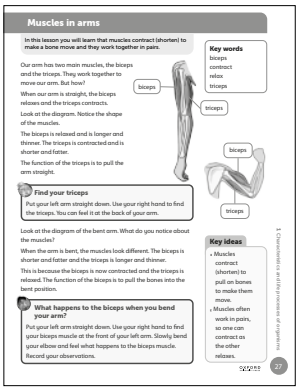
Supporting: Allow students to keep their Student Book open during all of the labelling and naming activities so they can have a constant reminder of the muscles.

Consolidating: Display the names of the main muscles – either as a Word wall or as a large picture.

Extending: Ask students to research how muscles are attached to bones and to find out the difference between tendons and ligaments.

Differentiated outcomes	
All students	should be able to state that muscles need help to move.
Most students	will be able to state that muscles move bones by pulling on them and give some examples.
Some students	may be able to explain that muscles are attached to bones by tendons and muscles move bones by contracting.

Muscles in arms


Muscles in arms

In this lesson you will learn that muscles contract (shorten) to make a bone move and they work together in pairs.

Our arm has two main muscles, the biceps and the triceps. They work together to move our arm. But how?

When our arm is straight, the biceps relaxes and the triceps contracts.

Look at the diagram. Notice the shape of the muscles.

The biceps is relaxed and is longer and thinner. The triceps is contracted and is shorter and fatter.

The function of the triceps is to pull the arm straight.

Key words
biceps
contract
relax
triceps

biceps
triceps
biceps
triceps

Find your triceps
Put your left arm straight down. Use your right hand to find the triceps. You can feel it at the back of your arm.

Look at the diagram of the bent arm. What do you notice about the muscles?

When the arm is bent, the muscles look different. The biceps is shorter and fatter and the triceps is longer and thinner.

This is because the biceps is now contracted and the triceps is relaxed. The function of the biceps is to pull the bones into the bent position.

What happens to the biceps when you bend your arm?
Put your left arm straight down. Use your right hand to find your biceps muscle at the front of your left arm. Slowly bend your elbow and feel what happens to the biceps muscle. Record your observations.

Key ideas
- Muscles contract (shorten) to pull on bones to make them move.
- Muscles often work in pairs, so one can contract as the other relaxes.

1 Characteristics and life processes of organisms

27

Getting started

In this lesson students study how muscles move bones in more detail. They repeat the limb movement investigations but this time students explore the ways that muscles work in pairs to move bones. They learn that muscles cannot push bones; they can only pull by contracting. This is why muscles get bigger as they work.

Language support

The new words for this lesson are 'relax' and 'contract'. Explain that 'contract' means 'to get smaller'. Students can model this, and the word 'relax'. Ask them to stand up and when you say 'contract' they fold up into a ball. When you say 'relax' they can stand up again and go back to as they were before. Do this three or four times. You can also ask them to clench their hands into a fist and when you say 'relax' they can unclench their fists.

Resources

Key words

biceps contract relax triceps

Other words in the lesson

fatter longer shorter thinner

Scientific enquiry key words

use equipment observe communicate findings

Lesson at a glance

The key teaching points in this lesson are:

- muscles contract to pull on bones. As they contract they become shorter and fatter
- muscles cannot push, they can only pull
- muscles often work in pairs so as one contracts the other relaxes.

Think back Why are muscles needed in your body?

Ask students to sit absolutely still for 30 seconds. Tell them that although they are not moving some muscles are working to keep them alive. Remind them that their heart is a muscle, for example. Now ask them to move their arms and legs and tell them to imagine life with no muscles. Students can then discuss the Think back task and share their ideas with the class.

Point out the diagrams in the previous spread. Tell students that they are going to look at muscles again, but this time in much more detail.

Take this opportunity to explain to students that learning in science often means finding out about something and then later looking at a more complicated version of it. This is linked to personal development as they become better able to understand complex ideas. Remind them that the storybook they read when they were five now looks very easy and they have moved on to more complicated stories and language. The same happens in science.

Discussion

Discuss which muscles we use when we bend our arm at the elbow.

Explain to students that this is a similar discussion to the last one, but this time using the arm instead of the leg. Remind students to use the diagram to help them and they can move their arms as they work out which muscles are involved.

Possible response: *Students should suggest that the biceps help to bend the arm at the elbow.*

Show students the diagram of the muscles of the arm and point out that the biceps and triceps are on opposite sides of the upper arm bone – the humerus. Read out the text next to the arm diagram or ask volunteer students to read out a sentence at a time. After each sentence you can ask a student to explain what it means in his or her own words. You can help by asking the following questions during the reading: What are the two muscles in the upper arm? Which muscle is at the front of the arm? Which muscle relaxes as the arm straightens? Which muscle contracts? How does this change the shape of the muscles? Are relaxed muscles long and thin or are they short and fat? Which muscle bends the arm? Which muscle straightens the arm?

Investigation: Find your triceps

The purpose of this investigation is to allow students to investigate the way that the biceps and triceps work together. Ask students to put their left arm straight down. They should then use their right hand to find the triceps. Remind them that they did a similar activity last lesson but they were feeling the biceps. Tell them that they can feel the triceps at the back of the arm. Ask students what they feel as they move their arm straight down.

Possible response: *Students should feel the triceps muscle get bigger and shorter as they straighten their arm.*

Point out the diagram of the bent arm. Ask students to look closely at the muscles and tell you what they notice about them.

Read out the text opposite the diagram and explain that when the arm is bent, the muscles look different. The biceps is shorter and fatter and the triceps is longer and thinner. Tell students that this is because the biceps is now contracted and the triceps is relaxed. Summarise by telling students that the function of the biceps is to pull the bones into the bent position and the triceps pull the bones into a straight position.

Tell students that they are going to detect these movements in the next investigation.

Investigation: What happens to the biceps when you bend your arm?

The purpose of this investigation is to allow students to feel the opposite actions of the biceps and triceps to apply their theoretical knowledge of muscle contraction and relaxation. Ask students to stand up and then put their left arm straight down. They use their right hand to find their biceps muscle at the front of their left arm as they have done before. Students should then slowly bend their arm at the elbow and feel what happens to the biceps muscle. Ask them to record their observations. They can then repeat this but feeling the triceps muscle and record their observations.

Possible response: *Students should feel the biceps contract and get shorter and fatter as the arm bends and the triceps relax and become longer and thinner. As the arm straightens the biceps relax and become longer and thinner and the triceps contract and become shorter and fatter.*

Science fact Muscles cannot push. They only pull by contracting. This is why they work in pairs.

The information in the Science fact is a crucial concept for students to understand. You can illustrate it by handing out a toy car or any object on wheels and asking students to tie some string to the car and pull it along. Then ask them to push on the string to see if the car moves. They will find the string, like muscles, can only be used to pull and not to push.

Discussion

Can you think of another example where muscles work together in pairs?

Ask students to think back to examples of them moving their body, in the lessons and also when doing sports and other activities. They can then suggest an example of another limb that bends and needs two sets of muscles working together.

Possible response: *Students should suggest either the leg with the muscles at the front and back of the thigh (femur) or the foot with muscles at the front and back of the shin.*

Key ideas

Muscles contract (shorten) to pull on bones to make them move.

Muscles often work in pairs, so one can contract as the other relaxes.

Summarise the lesson by asking students what they have learned. Let them share their ideas, read out and discuss the key ideas. This will remind students that muscles pull by contracting. This shortens them and so they pull on a bone. Remind students that muscles cannot push. Ask them to think why this fact means that muscles have to work in pairs. You can allow students a few minutes to think about the problems they would have if they could bend their leg but never straighten it again.

Review and reflect

You can encourage students to reflect on their learning. Ask them to keep a count of how many times they had to look back at the diagram to help them to draw their version of it.

Students can also create and demonstrate model arms to other students and think of one way to improve their model to make it more realistic. Tell them this goal-setting is a very important part of learning.

Extra activities

1 Students can make a model arm. They can demonstrate their model and then display it with information labels explaining the names of the muscles and how they work together to bend and straighten the aram.

2 **Computing link:** Students can research some examples of muscles that do not work like the biceps and triceps but still have a vital role to play in the body. They could select the heart, the muscles of the digestive system, the muscles to open and close the eyes or the muscles between the ribs to help with breathing. They could find diagrams and design a computer presentation.

3 **Computing link:** Ask students to find out about diseases that affect the muscles and describe the problems this causes for people. Examples include multiple sclerosis and muscular dystrophy. They can look up charity sites and health information leaflets and find information on the internet. They can then produce their own information leaflets to share their ideas.

Differentiation

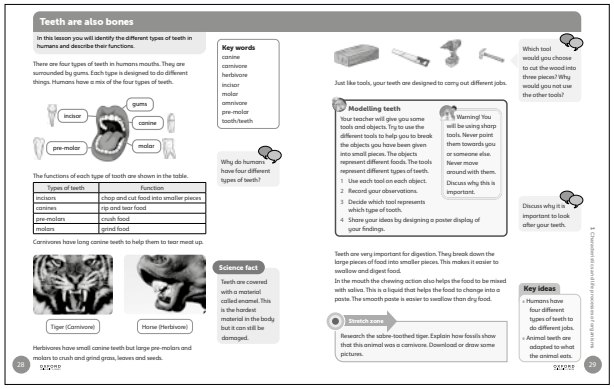
Supporting: Allow students to keep their Student Book open throughout so they can easily refer to them.

Consolidating: Make your own large model of the model arm and demonstrate this regularly to students, naming the muscles every time.

Extending: Introduce the term 'antagonistic pair' to describe the way muscles work in pairs.

Differentiated outcomes	
All students	should be able to state that some muscles work in pairs.
Most students	will be able to describe that when muscles contract they become shorter and fatter and when they relax they become longer and thinner.
Some students	may be able to explain how antagonistic pairs work together because muscles cannot push bone.

Teeth are also bones


Teeth are also bones

In this lesson you will identify the different types of teeth in humans and describe their functions.

There are four types of teeth in humans mouths. They are surrounded by gums. Each type is designed to do different things. Humans have a mix of the four types of teeth.

incisor
gums
canine
pre-molar
molar

The functions of each type of tooth are shown in the table.

Types of teeth	Function
incisors	chop and cut food into smaller pieces
canines	rip and tear food
pre-molars	crush food
molars	grind food

Carnivores have long canine teeth to help them to tear meat up.

Tiger (Carnivore)

Horse (Herbivore)

Herbivores have small canine teeth but large pre-molars and molars to crush and grind grass, leaves and seeds.

Key words
canine
carnivore
herbivore
incisor
molar
omnivore
pre-molar
tooth/teeth

Why do humans have four different types of teeth?

Science fact
Teeth are covered with a material called enamel. This is the hardest material in the body but it can still be damaged.

Which tool would you choose to cut the wood into three pieces? Why would you not use the other tools?

Just like tools, your teeth are designed to carry out different jobs.

Modelling teeth
Your teacher will give you some tools and objects. Try to use the different tools to help you to break the objects you have been given into small pieces. The objects represent different foods. The tools represent different types of teeth.
1 Use each tool on each object.
2 Record your observations.
3 Decide which tool represents which type of tooth.
4 Share your ideas by designing a poster display of your findings.

Warning! You will be using sharp tools. Never point them towards you or someone else. Never move around with them. Discuss why this is important.

Discuss why it is important to look after your teeth.

Teeth are very important for digestion. They break down the large pieces of food into smaller pieces. This makes it easier to swallow and digest food.

In the mouth the chewing action also helps the food to be mixed with saliva. This is a liquid that helps the food to change into a paste. The smooth paste is easier to swallow than dry food.

Stretch zone
Research the sabre-toothed tiger. Explain how fossils show that this animal was a carnivore. Download or draw some pictures.

Key ideas
- Humans have four different types of teeth to do different jobs.
- Animal teeth are adapted to what the animal eats.

Getting started

In this lesson students will study the shape and function of teeth in humans. They will learn how the different teeth are designed to cut, tear or grind food. They will learn the names of the four different types of teeth and also consider how animal teeth are adapted to what the animal eats.

Language support

Possible new words for students in this lesson are canine, incisor, pre-molar and molar. Write these words on the board or on word cards.

Resources

Student Book: tools such as hammers, drills, saws, and various objects to test with these tools (students need to experience varying degrees of difficulty in cutting, crushing and breaking the objects); materials to make posters.

Key words

canine carnivore herbivore incisor molar omnivore pre-molar tooth/teeth

Other words in the lesson

crush grind gums rip tear

Scientific enquiry key words

ask questions use equipment observe compare notice patterns record carry out tests group/classify communicate findings

Lesson at a glance

The key teaching points in this lesson are:

- humans have four different types of teeth and these have different functions
- animal teeth are adapted to what the animal eats.

Think back: What happens to food in your mouth as you are eating it?

Ask students to sit quietly for a few moments and think about the last meal or snack they had. Ask them what they did while they were eating the food and why it was important to chew it carefully and slowly. You could ask them why it is dangerous to try to swallow large pieces of food.

Possible response: *Students should remember that food is chewed and bitten into smaller pieces in the mouth. Some may also recall that saliva is added. You could point out that saliva has two functions: it contains enzymes to break down food; and it lubricates the food so it is easier to swallow.*

Read out the text at the top of page. This explains the four types of teeth. Point out the diagram of the mouth and teeth and read through the labels slowly. Ask students to study the table describing each tooth and its function. Ask them to try to link the function with the shape of the teeth in the diagram.

Point out the photographs of the two animals at the bottom of page. Ask students to read the text about carnivores and herbivores and ensure that they link the eating of meat with long canine teeth and the eating of plants with pre-molars and molars. You could also point out that the incisors of herbivores are large so they can snip plant material.

Why does a human have all four types of teeth?

Ask students to work with a partner or in a small group. Explain that they are now able to apply new knowledge to their observations. Students should then discuss why humans have all four types of teeth. Point out that humans do not have very large canine teeth or molars.

Possible response: *Students should appreciate that humans have all four types of teeth because humans are omnivores and eat a variety of different foods.*

Science fact Teeth are covered with a material called enamel. This is the hardest material in the body but it can still be damaged.

Ask students to gently open and close their mouths so their teeth make a clicking noise when they touch. Next ask them to tap their thumb against their first finger and then do both at the same time. Explain that the skin of their fingers is soft but the enamel of their teeth is hard

and so makes a noise. Ask students to think about how teeth can be damaged and explain that they will be looking at ways to look after teeth in a later lesson.

Which tool would you choose to cut the wood into three pieces? Why would you not use the other tools?

Point out the pictures of the tools at the top of page 29. Explain that the pictures show a block of wood, a saw, a drill and a hammer. Point out that tools are designed to do different jobs and so are our teeth. Ask students to discuss which tool would be best suited to cut the wood. They should also think about why the other tools, useful though they are, are not suitable for cutting wood.

Possible response: *Students should be aware that the saw is designed for cutting or sawing wood. The drill would only put holes in the wood and the hammer is too blunt to cut it.*

Investigation: Modelling teeth

Warning! You will be using sharp tools. Never point them towards you or someone else. Never move around with them. Discuss why this is important.

Read through the warning information and ask students to talk about the advice linked to using sharp tools. They can discuss when they have used sharp tools and what could happen if they did not follow the rules. Explain that when they think about the safety rules to be followed in an investigation or activity they are doing a risk analysis. Stress that students will be using sharp tools. They must be very careful. Insist they never move around with them.

Explain to students that they should try to use the different tools to help them break the objects they have been given into small pieces. Explain that the objects represent different foods and the tools represent different types of teeth. Ask students to use each tool on each object and record their observations. Ask students to decide which tool represents each type of tooth. Ask them to share their ideas by designing a poster display of their findings.

Possible response: *Students should link hammers to molars or pre-molars as they can be used to crush objects; drills and sharp tools to canines or incisors. If they use scissors, these are acting as incisors.*

Discuss why it is important to look after your teeth.

Ask students to talk to a partner about how they look after their teeth. You can ask them to imagine what problems they would have if they did not have any teeth. To illustrate this you could hold up an apple or a similar fruit and ask them how they would take a bite.

Possible response: *Students should realise that without the range of teeth in their mouth they would not be able to bite, chew or crush food.*

Read through the text beneath the investigation box or ask for volunteers to read a sentence or paragraph each. The text reinforces the ideas that the teeth break down food into smaller pieces and the chewing action helps food to be mixed with saliva.

Point out to students that digestion of some carbohydrates (starchy foods) starts in the mouth, because saliva contains an enzyme called amylase. This breaks down starch into a sugar called maltose. You could set a differentiated task to challenge some students to look up the action of amylase.

Stretch zone: Research the sabre-toothed tiger. Explain how fossils show that this animal was a carnivore. Download or draw some pictures.

Computing link: Allow students to use the internet to find out about the sabre-toothed tiger. Encourage them to research pictures of skulls and artists' impressions of what this extinct animal looked like. Ask students to pay particular attention to the teeth. They can download or draw pictures and produce an information sheet or computer presentation.

Possible response: *Students should discover that the sabre-toothed tiger is so named due to its very large sword-like canine teeth. Point out that the sabre is a type of sword used in Olympic fencing. This tiger was clearly a carnivore.*

Key ideas

- *Humans have four different types of teeth to do different jobs.*
- *Animal teeth are adapted to what the animal eats.*

Ask volunteers to read out the key ideas. Ask students to write down the names of the four different teeth found in humans onto four separate pieces of paper. You can then read out the functions from the table on page and students should hold up the appropriate type of tooth to match the function. This will help to consolidate understanding of how teeth are adapted to carry out specific functions.

Review and reflect

Encourage students to reflect on their own learning by pausing for a few moments and thinking about which parts of the work they found tricky. Talk about how they managed this and suggest that next time they stop for a short while and take a few deep breaths. Also remind them that when they are doing tricky work they are training their brain and this will help their future learning.

Extra activities

1 Ask students to produce modelling clay models of each type of human tooth. They can then make models of the teeth of lions and cows to make a comparison. The models can be displayed with labels.

2 **Computing link:** Ask students to research and download drawings of the structure of a tooth showing the inner layers and outer layers and the nerves and blood supply. This will also be useful for a later lesson on caring for the teeth.

Differentiation

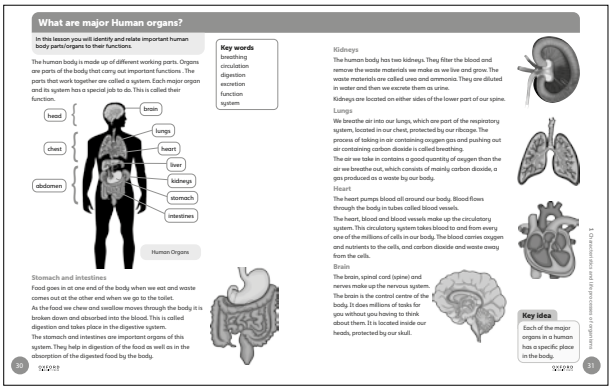
Supporting: Lay tools out next to pictures of the different teeth to link the idea of shape and function: screwdriver = canine; pestle and mortar = molar; hammer = pre-molar; scissors or ruler = incisors.

Consolidating: Display pictures of the four types of teeth and key words to help students to learn the shape and name of each.

Extending: Allow students to research a wide range of animal skulls and use teeth shapes to predict whether they are herbivores, carnivores or omnivores.

Differentiated outcomes	
All students	should be able to state that humans have four different types of teeth
Most students	will be able to name the types of teeth in humans and link their shape to their function
Some students	may be able to predict whether animals are herbivores, carnivores or omnivores depending on teeth (dentition)

What are major animal organs?



Getting started

In this lesson students look at the major organs which are responsible for breathing, taking in food and water, circulating the blood and removing dangerous waste products. The brain controls all of these. They investigate one function of the nervous system – reaction time.

Language support

Write the key words on the board but replace some letters with dashes. Ask students to work out what the words are and then they can write them down. Explain that breathing is a process for getting air into and out of the lungs and the others are systems where organs work together to carry out important functions.

Resources

Student Book: writing materials; large sheets of paper.

Key words

breathing circulation digestion excretion function system

Other words in the lesson

absorbed ammonia blood vessels carbon dioxide circulatory system digestive system excretory system filter nervous system oxygen reaction respiratory system urea

Scientific enquiry key words

Make observations

Record data and results

Report and present findings

Lesson at a glance

The key teaching points for students in this lesson are:

- the human body contains many different organs
- each organ has its own location and function
- organs work together in organ systems.

Think back: How are the brain, heart and lungs protected?

Ask students to work with a partner to think about the question. *Answer: The skull protects the brain and the ribs protect the heart and lungs. Some students may know that the plate at the front of the ribs (sternum) also protects the heart and lungs.*

Next, ask students to read the text and study the diagram on page 30. They can take it in turns to read out each of the labels with a partner.

Elicit that it is the organs that keep us alive. You may need to prompt to establish that the brain is an organ. Use questions to check understanding. You could ask, 'Do we need the heart to stay alive? What would happen if we did not have a stomach or intestines? Why are the lungs important?' Ask students to stand up and as you say out the parts of the body or names of organs, they have to point to it on their body.

Look at the intestines in the diagram. Discuss why they have to be so long. Share your ideas with the class.

Students can continue to work with a partner.

Answer: *The intestines need to be long because the digestive process takes time. Foods are broken down slowly, step by step, and there has to be time for the nutrients to be taken into the body.*

Lungs

Students can read the text about the lungs and study the diagram showing lung structure. Point out that the lungs work 24 hours a day throughout a person's lifetime. To check understanding you can ask, 'What do the lungs breathe in? What do the lungs breathe out?' Elicit that the lungs work to keep us alive.

Discuss how the lungs allow gases to enter and leave the body. Why is this important?

Possible response: *The lungs are open to the air and they have many branches inside that have a good blood supply. This helps gases to move from the lungs to the blood and from the blood to the lungs. This is important because the gas oxygen is needed for life and carbon dioxide is a waste product that has to be removed from the body.*

Heart

Students can then read the text about the heart and look carefully at the heart diagram. Point out the different chambers and the vessels leaving the heart. You can ask students some questions about the text such as, 'What does the heart pump around the body? What is the circulatory system? What is taken to and away from cells in the body?'

Brain

Ask a volunteer to read out the text about the brain and point out the diagram of the brain. Ask students to think about why the brain is so important for the body and ask them to name five things they do that are controlled by the brain. They can work in groups to list the activities, which should include heart beating, breathing, moving, seeing, hearing, feeling, smelling, tasting, thinking, eating, talking, etc. Share activities with the class. Lead students to realise that every single part in their body is under the control of the brain. Use the analogy of a giant master computer that fits into a tiny skul.

Stomach and intestines

Students can next read the text about the stomach and intestines silently. Remind them that they studied the digestive system in Year 4. Elicit that the digestive system absorbs food, which contains energy that keeps us alive. This is an opportunity to reinforce energy as the fuel of life. A good analogy is petrol or diesel in cars.

Kidneys

Students can then read the text about the kidneys and look carefully at the diagram of part of the excretory system. This is also called the urinary system. The excretory system also includes waste leaving the large intestine, materials leaving the skin and gases leaving the lungs. Remind students of earlier work in Year 3 when they filtered muddy water to clean it. If possible, demonstrate this.

Investigation: Where do the organs fit?

Students can work in their pairs or join together to form a small group. Explain that they are going to create a life-sized drawing of the position of human organs. They can follow the instructions to end up with a largesheet of paper on the floor with a body outline drawn Unit 1 Characteristics and life processes of organisms 31on it. Two ways of doing this are explained. The casting a shadow method can be used if it is important to avoid any contact between students.

Ask students to draw the organs onto the body outline. Point out that the organs need to be the correct size. Each organ must have a label. Arrange an exhibition to display the body outlines in your classroom and allow students to walk around so they can compare theirs with other groups. Ask them to evaluate their own poster.

Science fact Many scientists think of the skin as an organ. It is made of layers and contains blood vessels, nerves, hairs and oil glands.

Share out the above given Science fact in class. Ask students if they think their body outline should have the skin labelled as an organ. Point out that debates like this are common and useful in science. Explain that, at the moment, they are not going to think of skin as an organ, but this may change over the years as they progress through school. This is partly what makes science so interesting. It is always being reviewed and updated.

Key idea

Each of the major organs in a human has a specific place in the body.

Ask students to read the key idea and then close all of their books. They can work with a partner to review their learning from this lesson. On a blank piece of paper they should take it in turns to write down the name of an organ they have learned about in the lesson, so they end up with a list. Remind them that they will need seven organs on their list.

Review and reflect

Encourage students to reflect on their learning throughout the lesson. Use the discussion tasks and the poster investigation activities to encourage students to think about what they understand and what they are finding less straightforward.

Discuss the outcomes of each task with students. Encourage them to think about any questions they have not completed correctly and help them to identify improved answers. When they walk around, they could leave notes containing two comments about what they liked about each display and one suggestion for improvement. They can then go back to their own display and review and reflect on the comments.

Point out that learning is a process and not a one-off event and explain to students that they will learn better if they think about what they have done well and what they need to do to improve. Emphasise that practice and reflection are vital.

Extra activities

1 You could obtain plastic models of the body. Show students these and allow them to take them apart and put them back together again. The advantage of models is that they give a 3D view of the organs and how closely packed together they need to be.

2 Ask students to make their own 3D models of the organs of the body. They could use card or modelling clay. Encourage them to make each organ model the correct shape and relative size and, once the body model is assembled, ask them to include label cards.

3 Investigation: Where do the organs fit?

Students can work in their pairs or join together to form a small group. Explain that they are going to create a life-sized drawing of the position of human organs. They can follow the instructions to end up with a largesheet of paper on the floor with a body outline drawn Unit 1 Characteristics and life processes of organisms 31on it. Two ways of doing this are explained. The casting a shadow method can be used if it is important to avoid any contact between students.

Ask students to draw the organs onto the body outline.Point out that the organs need to be the correct size. Each organ must have a label. Arrange an exhibition to display the body outlines in your classroom and allow students to walk around so they can compare theirs with other groups. Ask them to evaluate their own poster.

Differentiation

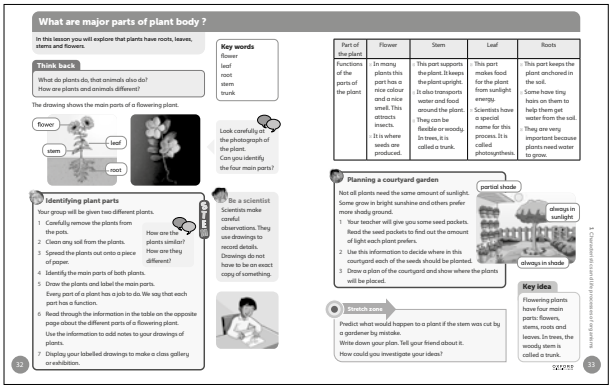
Supporting: Allow students to refer back to the diagram in the Student Book when drawing and labelling the organs.

Consolidating: At regular intervals across a few days, say the name of an organ and ask volunteers to point to where it is in the body and describe its functions.

Extending: Ask students to think about how the structure of each organ allows it to carry out its functions.

Differentiated outcomes	
All students	should be able to state the functions of the heart, lungs and brain
Most students	will be able to describe the functions of the major organs
Some students	may be able to link the structure of an organ to its ability to carry out its function

What are major parts of plant body?



Getting started

In this lesson students will review their knowledge of the parts of a flowering plant. They will examine a plant and draw it as a scientific drawing. Students will also link each part to its function.

Language support

To help develop language skills you could use flash cards with pictures of the four plant parts and ask students to name them. You could extend this to include the functions of the four main plant parts by having two sets of cards, one set with the plant part names and one set with the functions. Ask students to match the cards.

Resources

Student Book: flowering plants in pots, with the soil loose enough for easy extraction of the plants; labels.

Key words

flower leaf root stem trunk

Other words in the lesson

hairs seeds soil woody

Scientific enquiry key words

use equipment observe notice patterns
record data use secondary sources
communicate findings

Lesson at a glance

The key teaching points in this lesson are:

- flowering plants all have the same main parts: roots, leaves, stems and flowers
- each part of a flowering plant has vital and specific functions.

Think back What do plants do, that animals also do? How are plants and animals different?

Ask students to talk about the questions and agree on some answers to share with the class.

Possible response: *Students should realise that animal and plants grow and take in water. They may say that both breathe in or take in gases. They could also say that both reproduce. Students should recall that plants make their own food but animals need to eat plants or other animals. Elicit that animals usually move more than plants – though address the misconception that plants do not move (flowers follow the Sun, for example) but stress that plants do not move from place to place like many animals.*

Discussion

Look carefully at the photograph of the plant. Can you identify the four main parts?

Ask students whether they can remember the names of the four main parts of a plant. Revise root, flower, leaf and stem. Ask students to look at the scientific drawing and photograph of the flowering plant to see where each part is located. This activity is important as it makes a link between a clearly labelled scientific drawing and a photograph of the real plant. Explain that each part is very important to keep the flowering plant healthy.

Answer: *Students should be able to identify the flower, stem, leaves and roots.*

Investigation: Identifying plant parts

The purpose of this investigation is to allow students to identify the parts of a flowering plant using real examples. Give each group two different plants. Explain that they should carefully remove the plants from the pots. Remind them to clean any soil from the plants and spread the plants out onto a piece of paper. Ask them to look carefully at each plant and decide how the plants are similar and how they are different. They should identify the main parts of both plants and then draw the plants and label the main parts. Finally, they can add to the information on their drawing by using the information in the table on.

Investigation: Planning a courtyard garden

The purpose of this investigation is to allow students to apply their knowledge of plant growth and light. Students can work in small groups of three or four for this activity. Ask them to read through the instructions. This explains that not all plants need the same amount of sunlight. Point out that some grow in bright sunshine and others prefer more shady ground.

Give each group some seed packets. Ask students to read the seed packets to find out the amount of light each plant prefers. They should then use this information to

decide where in a courtyard each of the seeds should be planted. You can use the example in the picture on page or use an actual courtyard if one is available. Ask students to draw a plan of the courtyard and show where the plants will be placed. You can display the plans in your room and allow students to walk around to compare their ideas with others.

Stretch zone: Predict what would happen to a plant if the stem was cut by a gardener by mistake.

Write down your plan. Tell your friend about it.

How could you investigate your ideas?

Read through the Stretch zone activity with students and remind them that when they are challenged by a task their brain is working harder and they will learn more. Ask them to think about the link between the function and location of stem.

> ***Possible response:*** *Possible response: Depending on the severity of the cut, the plant may suffer due to loss of water and minerals or even die. Encourage students to use the planning an investigation sheet and methodology.*

Review and reflect

Ask students to sit down for a few minutes and think about what they have learned from the lesson. They can then think of one idea from the lesson that they would like to investigate and find out more about. Ask them to make a plan about how they would do this. This planning time will allow students to think up some imaginative and original things to do and you could let them carry out these projects which will be highly motivating and will reinforce learning.

Extra activities

1 Ask students to create a poster of a flowering plant with blank label boxes. They then make four label cards: stem; leaf; roots; flower. They can hand the label cards to other students and ask them to pin the labels in the correct place on the poster.

2 **Computing link:** Students can research some examples of flowers from around the world. For example, they could find out which countries produce flowers to sell to other countries. They could also research if any flowers in their country have been introduced by people and were not there naturally.

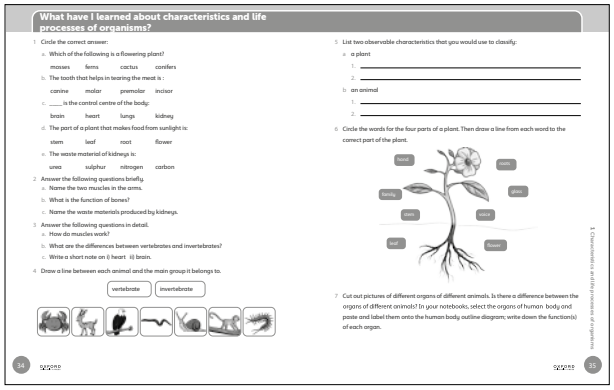
Differentiation

Consolidating: Use the posters and labelled models produced by students as long-term displays to consolidate knowledge about the parts of a flowering plant and their functions.

Extending: Encourage students to identify the main parts of a flowering plant from a wide range of pictures and example plants even though the parts may vary considerably in appearance.

Differentiated outcomes	
All students	should be able to identify the roots, stem, leaves and flowers in pictures of flowering plants.
Most students	will be able to identify the roots, stem, leaves and flowers in samples of living flowering plants and describe their functions.
Some students	may be able to explain what would happen to a flowering plant if any of the main parts are missing or damaged.

What have I learned about characteristics and life processes of organisms?


What have I learned about characteristics and life processes of organisms?

1 Circle the correct answer:
a. Which of the following is a flowering plant?
mosses ferns cactus conifers
b. The tooth that helps in tearing the meat is :
canine molar premolar incisor
c. ____ is the control centre of the body:
brain heart lungs kidney
d. The part of a plant that makes food from sunlight is:
stem leaf root flower
e. The waste material of kidneys is:
urea sulphur nitrogen carbon
2 Answer the following questions briefly.
a. Name the two muscles in the arms.
b. What is the function of bones?
c. Name the waste materials produced by kidneys.
3 Answer the following questions in detail.
a. How do muscles work?
b. What are the differences between vertebrates and invertebrates?
c. Write a short note on i) heart ii) brain.
4 Draw a line between each animal and the main group it belongs to.
vertebrate invertebrate
5 List two observable characteristics that you would use to classify:
a. a plant
1. _____
2. _____
b. an animal
1. _____
2. _____
6 Circle the words for the four parts of a plant. Then draw a line from each word to the correct part of the plant.
leaves roots stem flower
7 Cut out pictures of different organs of different animals. Is there a difference between the organs of different animals? In your notebooks, select the organs of human body and paste and label them onto the human body outline diagram; write down the function(s) of each organ.
34 SCIENCE SCIENCE 35

Getting started

The aim of this section is to encourage students to review their learning after each lesson in the unit and also to undertake some end-of-unit review and reflection. Here are questions linked to concepts and topics covered in the unit. These will assess students' knowledge and understanding of the topic. You may have been using questions after each lesson where provided;. However, it is also worth allowing students to answer all of the questions at the end of the unit. This will test longer-term understanding and recall. You can do this as an informal individual or pair activity and allow students to look information up as they work through the questions or you can set it as an individual 'closed-book' activity.

It is important that students report areas that they are not confident with. This information is useful for them in that they can think about what they need to review or ask advice about. It is also vital for you as it provides information about any topics you may wish to revisit.

What have I learned about characteristics and life processes of organisms? answers

1 Circle the correct answer.

Make sure students understand that they have four options but they should only circle one choice – A, B, C, or D.

Answer: *a. cactus b. canine c. brain d. leaf e. urea*

2 Answer the following questions briefly.

a. Name the two muscles in the arms.

b. What is the function of bones?

c. Name the waste materials produced by kidneys.

Answer: *a. biceps and triceps.*
b. they help the animals to move, and they also support and give shape to the body as well as protect the internal organs.
c. Urea and Ammonia.

3 Answer the following questions in detail.

a. How do muscles work?

b. What are the differences between vertebrates and invertebrates?

c. Write a short note on i) heart ii) brain.

Point out that there are two questions within question 3. They should think about each one separately.

Answer: *ncourage students to research and extract answers from the Student book spreads as well as from the class discussions.*

4 Draw a line between each animal and the main group it belongs to.

Answer: *Students should identify the worm, snail and centipede as invertebrates and the rest as vertebrates.*

5 List two observable characteristics that you would use to classify:

a. a plant

b. an animal

Answer: *Students should be encouraged to do this question themselves. The earlier class discussion will be of use for this question as well.*

6 Circle the words for the four parts of a plant. Then draw a line from each word to the correct part of the plant.

Answer: *roots, stem, leaves, flowe.*

7. Cut out pictures of different organs of different animals. Is there a difference between the organs of different animals? In your notebooks, select the organs of human body and paste and label them onto the human body outline diagram; write down the function(s) of each organ.

This activity is suggested to be done as either differentiation, extra-credit, or research group work. The aim is for students to broaden their horizon and understand that similarities and differences between and within animal groups.

Summative assessment

You can read out the answers to the this section in the Student Book for students to self-assess or you can take in the pages and mark them to award an overall score. You could allocate marks as follows: question 1 = 5; question 2 = 3 (1 mark each); question 3a = 1, question 3b = 1; 3c = 2 (1 mark each part); question 4 = 7; question 5 = 4 (1 mark each); question 6 = 2. This makes a total of 25 marks.

If necessary, ask students to revisit topics and questions to help them to learn more about any they did not score well on. In this way the questions are both summative and formative. All assessments should be linked to enhancing learning and in this way the 'What have I learned about?' pages will support this as well as providing data to report back to students, parents and/or other significant adults.

This feedback can then be used to form support strategies to help students improve. Keep the recording and analysis of students' self-evaluations simple. A general impression of the self-evaluation of the class is all that is required, for example: 50% of the class were not confident about … .

Investigate like a scientist

The below activity is designed to encourage students to apply their investigative and creative skills and review key aspects of the content of the unit.

Building a wildlife pond

Resources: string or hose pipe; spade; pond liner; spirit level; plank; sand; large stones; water (rain water is best); pond plants; materials to make a poster.

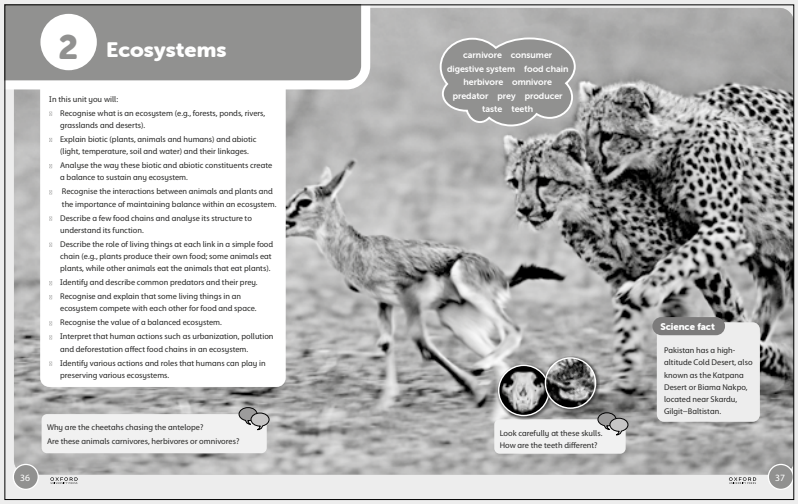
Explain that students are going to build a wildlife pond. The size will depend on many factors, such as space available, resources available and the time you wish to allocate to this project. Whatever the size, the process is the same. Work through the instructions with students and make sure you use a sunny place outside. You can help them to allocate roles. Some can mark out the pond with string or a hosepipe and others can help to dig out the pond. Make sure the pond has some deep areas so animals and plants can obtain the correct temperature and level of sunlight. It will also need to have some shallow areas near the edges so animals such as frogs can get out of the water. Help students to use a plank and spirit level to make sure the sides and bottom are flat. They must remove any sharp stones and then cover the bottom with a 5 cm layer of sand. They will need to work together to spread out the liner into the hole and get rid of any creases. They can hold the liner down at the edges with large stones.

Students then add sand to the bottom of the liner and carefully fill the pond with water. They should let the water settle for a week and then they can add the pond plants. Suggest they add soil and plants around the edge of the pond as well as in the middle. They can observe the pond regularly and record any insects or amphibians they see there. Ask them to identify any eggs, young or adult animals. They can use the pond for many investigations, for example to find out which animal life cycles they see in the pond. Students can review what they have learned in the unit by making a poster showing one of the life cycles they have observed in or near the pond.

Note: if standing water is likely to attract insects such as mosquitoes then instead of creating a pond you can use an existing damp area, plant a range of marsh plants and keep the soil moist, or you can make a flower bed or similar.

2 Ecosystems

In this unit students will:



- Recognise what is an ecosystem (e.g., forests, ponds, rivers, grasslands and deserts).
- Explain biotic (plants, animals and humans) and abiotic (light, temperature, soil and water) and their linkages Analyse the way these biotic and abiotic constituents create a balance to sustain any ecosystem.
- Recognise the interactions between animals and plants and the importance of maintaining balance within an ecosystem.
- Describe a few food chains and analyse its structure to understand its function.
- Describe the role of living things at each link in a simple food chain (e.g., plants produce their own food; some animals eat plants, while other animals eat the animals that eat plants).
- Identify and describe common predators and their prey.
- Recognise and explain that some living things in an ecosystem compete with each other for food and space.
- Recognise the value of a balanced ecosystem.
- Interpret that human actions such as urbanization, pollution and deforestation affect food chains in an ecosystem.
- Identify various actions and roles that humans can play in preserving various ecosystems.

Getting started

This unit introduces students to the idea that plants and animals are living things with complex interactions. Students become aware of the similarities and differences between plants and other living things and recognise that there are some interactions common to both. They explore the ways that living things are adapted to their environment and how they link in simple food chains. They also consider the importance of caring for the environment.

Science in context

Place the science in a relevant context for students by allowing them to study local habitats. They can visit these habitats to carry out observations and surveys. Invite local conservation workers into school to talk about their work. Show film and photographs of conservation problems and solutions from around the world to give a global context.

Visit local areas where habitats have been damaged – such as building sites or quarries. Students can carry out projects on how habitats near them have been changed and how they can be protected. Point out that people have not always understood how important it is to protect habitats and so in the past people took resources, burned fuels and got rid of waste without thinking about conservation. Explain that with more people on Earth, and more knowledge of environmental damage, we must be much more careful to protect habitats.

Scientific enquiry skills

An Investigation master sheet is given in this Teacher's Guide on pages 4–5 to help students plan their scientific enquiries. Throughout this unit students try to answer questions by collecting evidence through observation, contributing to discussions and making guesses (predictions) about scientific phenomena. They learn how to suggest ideas, follow instructions and record information. They make comparisons and compare whether their predictions match their results. Students model and communicate their ideas so they can develop their scientific thinking skills.

Resources

Student Book: writing materials; access to a local environment in which to set up observation stations; cameras; access to the internet; large sheets of paper; waterproof trays; sand; access to an area in which to carry out a litter survey; grabbers or tongs; gloves or strong plastic bags.

Key words for the unit

are in the Word cloud in the Student Book.

carnivore consumer digestive system food chain herbivore omnivore predator prey producer taste teeth

Scientific enquiry key words

ask questions use equipment observe measure compare notice patterns record carry out tests group/classify use secondary sources communicate findings

Language support

A useful starting point is the Word cloud in the introductory unit. Create a classroom Word wall so that students see the words often and can become familiar with them. Use pictures alongside the words wherever possible. Involve students in creating and maintaining the Word wall.

The students can also be encouraged to self-create a write-in glossary where students should regularly add definitions as they progress through the unit. You may have started using the glossary from the first unit; continue it with this unit. Regular use of the glossary will develop students' confidence in word recognition in English and familiarise them with the meanings on their own terms.

To reinforce familiarity with new words, ask students to listen, say, read and then write them. When introducing scientific concepts, such as share, illustrate them with games. For instance, ask students to share out some sweets or other items so that they each have the same amount. Reinforce this in later units by repeating the exercise.

Unit at a glance

The key teaching points for students in this unit are:

- to introduce the unit objectives
- to introduce the learning outcomes
- to engage students with the content of the unit
- to review and build on prior learning and understanding of the topics.

Tell students to look at the pictures and words on the introductory pages. Ask students to look at the Word cloud and tell them that they will be learning the meanings of these words. Talk through the objectives and indicate that students will learn about habitats and food chains during this unit.

Look at the large picture. With a partner, talk about what the picture shows. Why are the cheetahs chasing the antelope?

Are these animals carnivores, herbivores or omnivores?

This is an ideal opportunity to encourage and reinforce confidence in publicly sharing their ideas. You can also ask students to appreciate that a person may be nervous when talking to other people and they should support that person.

Possible response: *Students should realise that the the cheetahs are carnivores, chasing the herbivores antelope, in order to hunt and feed.*

Science fact Pakistan has a high altitude Cold Desert, also known as the Katpana Desert or Biama Nakpo, located near Skardu, Gilgit–Baltistan

Read out the Science fact or ask a student to volunteer to read it out. Ask students if they have visited this area. Share with them photographs of the area if possible. You can also assign this task as class research project.

Look carefully at these skulls. How are the teeth different?.

Ask students to work with a partner or in a small group. Explain that they are now able to apply knowledge acquired during previous lesson to their observations. Ask them to use the type of teeth visible to decide which skull is a carnivore and which skull is a herbivore.

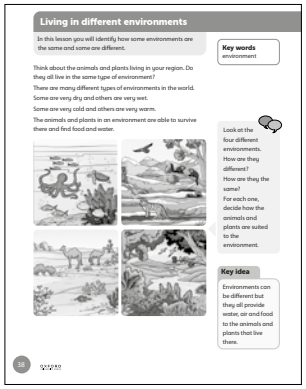
Possible response: *Students should identify the left skull as a carnivore (large canine teeth) and the right skull as a herbivore (large molars).*

Extra activities

1 Ask students to research other animals that live where the cheetahs live and find out about some of the foods these animals eat. They can also research animals that live in the rainforest and what they eat.

2 Students draw a circle to represent the Earth. They colour it in and then find and mark the Arctic, Antarctic, equator, Atlantic Ocean, Mediterranean Sea, Africa and Red Sea and also they locate their country if it is shown. They then write hot or cold, dry or wet to show what these areas of the world are like.

Living in different environments


Living in different environments

In this lesson you will identify how some environments are the same and some are different.

Key words
environment

Think about the animals and plants living in your region. Do they all live in the same type of environment?
There are many different types of environments in the world.
Some are very dry and others are very wet.
Some are very cold and others are very warm.
The animals and plants in an environment are able to survive there and find food and water.

Look at the four different environments. How are they different? How are they the same? For each one, decide how the animals and plants are suited to the environment.

Key idea
Environments can be different but they all provide water, air and food to the animals and plants that live there.

Getting started

In this lesson students learn about a range of different environments and consider how animals and plants are adapted to live there.

Language support

The key word for the lesson is complicated so you should spell it out for students and give them practice in pronouncing it. Write the words on a board or on large cards and say them out loud. Ask students to say them out loud after you three times.

Use movement for learning to help with recall of the words by asking students to wave their arms about and point to everything around them when you say 'environment'.

Resources

Student Book: access to a local environment in cameras.

Key words

environment

Other words in the lesson

animal coral reef mountains plant trap

Scientific enquiry key words

use equipment observe compare record group/classify

Lesson at a glance

The key teaching points for students in this lesson are:

- there are many different types of environments
- each environment has its own types of plants and animals, including minibeasts, living there
- the environment must provide water, air and food for the living things that live there.

Read out the text at the top of page of the Student Book. Do this one sentence at a time and ask students questions about the text each time.

After the first sentence ask students to tell you the names of any animals and plants they know that live near to them. Ask: Do these animals and plants all live in the same type of environment? How do they get water, air and food?

Explain that there are many different types of environments in the world. Ask: Which environments did you see in the picture of the Earth in the introductory lesson? Which different types of environments have you visited or seen on television?

Ask students which environments they have seen are very dry and which are very wet. Also ask them to tell you about some very cold and very warm environments. Explain that, even though environments are different, the animals and plants that live there must be able to find water, food and air. They are adapted to do this in different ways.

Look at the four different environments. How are they different? How are they the same? For each one, decide how the animals and plants are suited to the environment.

Point out the four drawings and ask students to work with a partner or in a small group to discuss the questions. Ask students to look at and discuss all four pictures; a more interactive way would be to ask groups to focus on one environment and answer the questions. They can then present their ideas to the rest of the class so they learn from each other. After each group has presented, ask others whether they agree with the answers. Encourage them to discuss any differences of opinion and point out that this is normal and encouraged in science.

This is another opportunity to stress the importance of admitting errors and learning from mistakes.

Possible response: *Students should observe that the environments vary in the amount of water, air and warmth present. They should also notice that each environment supports different animals and plants. The environments are similar in that each has some water and air and living things are found there. Similar non-living things such as rocks and sand are also found in the environments. When talking about adaptations students should mention breathing (fish have gills to be able to breathe underwater for example), movement (fins, body shape, wings, legs), warmth or cooling (thick fur or feathers to keep warm or pale fur to keep cool) and obtaining food and*

water (roots and leaves for plants, sharp teeth in some animals or strong teeth for eating plants in others). Some students may also know that camels have a food store in their hump and flat feet for walking on sand. Some plants may have thorns to stop them from being eaten.

Key idea *Environments can be different but they all give water, air and food to the animals and plants that live there.*

Summarise the lesson by asking students what they have learned. Let them share their ideas, read out and discuss the key idea. This will remind students that an environment must provide water, air and food to animals and plants. Ask students to think about how their environment gives them everything they need to survive. They can share ideas with another student or ask volunteers to share their ideas with the class.

Different environments

This activity links closely with the discussion activity in the Student Book.

Ask students to talk about each picture with a partner. Then they should draw a red circle around any animals they can see. Next, they draw a green circle around any plants they can see.

Once they have located the plants and animals students can write a short story about what would happen if the turtle moved from the coral reef to the mountains.

Story writing is a good opportunity to encourage students to use their creativity and imagination. They can take it in turns to read out their stories and add pictures. You could print the stories and make a class book.

Possible response: *In the top left picture students should identify the turtle, fish, octopus and coral as animals, and seaweed as a plant. In the top right picture students should identity the leopard, eagle, goat and koala as animals, and grass, shrubs and trees as plants. In the bottom left picture the animals are lizard, birds, camels and snake; the plants are cacti, trees and shrubs. In the bottom right picture the animals are monkeys, butterflies, owls and small birds; the plants are trees, vines (climbers), shrubs and small flowering plants.*

Review and reflect

Use the responses to the first discussion task in the Student Book to judge how well students understand the link between environments and the living things that live there. Encourage students to reflect on their learning and skills by giving and receiving feedback about their notes to others. Let them sit quietly for a few moments to set just one target for doing their work better. Ask: How well was your work presented? How much care did you take with it? Did you check it yourself after you had finished? What did other people say about your work?

Differentiation

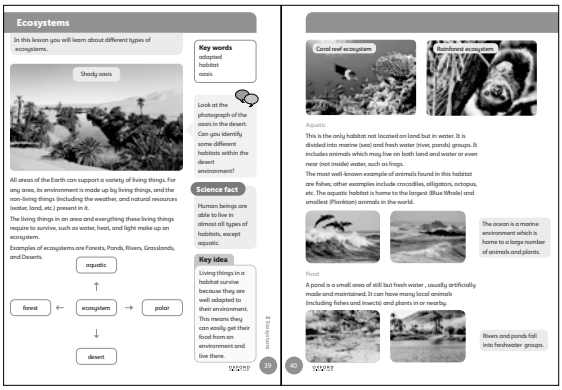
Supporting: Display a range of different environments and some animals and plants that live there. You could play a matching game and ask students to pick up an animal picture and stick it into the most appropriate environment.

Consolidating: Ask students to think about how a specific living thing such as a camel, shark or cactus is adapted to live in its environment. They could research one example and produce a short poster or presentation.

Extending: Ask students to look up some unusual environments and consider that all environments are split up into smaller habitats. Habitats can be defined as the home of an animal or plant within the environment. For example, a small log can be a habitat within a larger forest environment.

Differentiated outcomes	
All students	should be able to describe some different environments
Most students	will be able to set up a trap to investigate the minibeasts that live in an environment
Some students	may be able to describe some specific habitats (micro-habitats) within a wider environment

Ecosystems



Getting started

In this lesson students look at different types of ecosystems and recognise similarities and differences. They research plants and animals in hot, dry habitats to find out how the plants and animals are adapted to be able to carry out the life processes in such difficult conditions.

Language support

Students will be familiar with the terms 'adapted' and 'life processes'. Remind them that adaptations are characteristics that have developed in animals and plants to help them to survive in their habitats. Ask them to describe two adaptations of animals or plants to a partner and then share these with the class.

Resources

Student Book: access to the internet; books on animal life and plant life in hot, dry habitats; resources to make computer presentations.

Key words

adapted habitat oasis

Other words in the lesson

different seeds similar

Scientific enquiry key words

Make observations

Draw conclusions and give explanations

Lesson at a glance

The key teaching points for students in this lesson are:

- plants and animals have slightly different life processes
- plants need food (nutrients) and water, but green plants can make food with the help of energy from sunlight, unlike animals who need plants or animals to eat
- plants can grow but do not move from place to place, unlike animals who move from place to place.

Think back: Think about the differences between living and non-living things.

Ask students to reflect on what they learned in the last lesson and then discuss with a partner how they know whether something is living or non-living. Ask pairs to write down two examples of living things and two examples of non-living things.

Possible response: *Students should suggest that living things carry out the life processes (feeding, movement, reproduction, breathing, sensing the environment, growth) and non-living things do not. They may suggest any animals and plants as living things, and anything else as non-living.*

Look at the photograph of the oasis in the desert. Can you identify some different habitats within the desert environment?

Point out the picture at the top of page. Allow students to work with a partner and discuss the question. Encourage them to use their observation skills to find clues to the answers. Ask volunteers to share their answers with the class.

Possible response: *Students should identify the different mini-habitats, such as the wet habitat, the verdant surrounding area, the dry air and the surrounding desert.*

Do you know if Pakistan has any deserts? Find out how people live in the deserts.

Students can continue to work with a partner to sanswer this question. Ask them to prepare a small research project using the Internet and the library to gather information.

Possible response: *present mini posters on deserts in Pakistan, such as the Thar desert. They should focus on the average rainfall and the flora and fauna present in the area.*

Remind students that plants are living things so will have to carry out life processes to stay alive but mention that these are not all the same as in animals. Ask them focus on which life processes are the same in animals and plants and which are different. Ask volunteers to share ideas with the class. Elicit that plants and animals need food (nutrients) and water and they must grow and reproduce to make offspring. They are different as plants cannot move like most animals, flowering plants can reproduce using seeds and they can make their own food.

Can a polar bear survive in a grassland?

Ask students to think back to the physical features of the grassland habitat and of the polar bear. They should aim to find comparable differences to support their answers.

Possible response: *Students should explain that the physical features of a polar bear, such as their thick skin and heavy fur, do not provide an advantage in the grasslands where the temperature is much warmer than in the polar regions.*

Read out the text in the student book. Remind students that animals and plants have to be adapted to live in their habitats. Point out that these adaptations help living things carry out the functions of life. Refer them to the photographs of the different habitats and let them observe any adaptations.

Key idea

Living things in a habitat survive because they are well adapted to their environment. This means they can easily get their food from an environment and live there.

Read out the Key idea. Ask students if they can list any exception to this rule. Remind them to consider zoos, vivarium, botanical gardens, and aquariums etc. as specialized areas which simulate the living environments of the living things kept in them. Ask them to again list three things that all living things do to stay alive.

Review and reflect

Encourage students to reflect on their learning throughout the lesson. Use the discussion tasks and the research investigation activities to encourage students to think about what they understand and what they are finding less straightforward. Discuss the outcomes of each task with students. Encourage them to identify aspects they have not completed correctly and help them to identify improvements. This will help students to develop a positive approach to learning by understanding that learning is a process that will improve with practice and reflection.

Extra activities

1 **Computing link:** Ask students to research whether plants can detect their environment. They could look up research about talking to plants and playing music to them and also whether plants can detect damage or disease that occurs to nearby plants. They will find out that plants communicate in ways that scientists did not believe just a few years ago.

2 Students grow some plants adapted to very dry conditions (succulents) and learn about how to care for them. They could compare this to how they have to look after plants from wetter and cooler areas. They could share their ideas by making a short gardening advice leaflet.

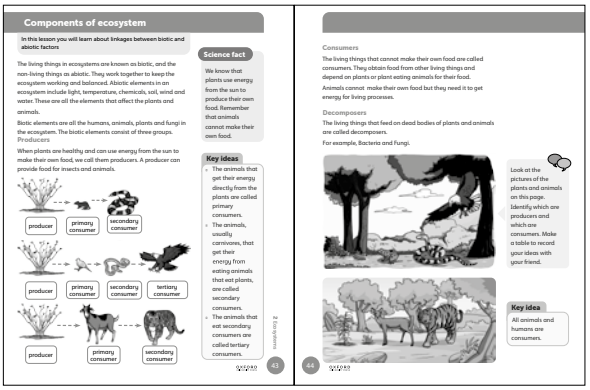
Differentiation

Consolidating: Show video clips from the internet about animals and plants adapted to their habitats and ask students to think about what would happen if the living things were not adapted.

Extending: Ask students to identify an animal adaptation to carry out each of the life processes of feeding, breathing and moving underwater.

Differentiated outcomes	
All students	should be able to list some differences between animals and plants
Most students	will be able to list specific differences and similarities between the life processes of animals and plants
Some students	may be able to link specific adaptations in animals to the performance of life processes

Components of ecosystem


Components of ecosystem

In this lesson you will learn about linkages between biotic and abiotic factors

Science fact

We know that plants use energy from the sun to produce their own food. Remember that animals cannot make their own food.

Key ideas

- The animals that get their energy directly from the plants are called primary consumers.
- The animals, usually carnivores, that get their energy from eating animals that eat plants, are called secondary consumers.
- The animals that eat secondary consumers are called tertiary consumers.

producer primary consumer secondary consumer

producer primary consumer secondary consumer tertiary consumer

producer primary consumer secondary consumer

Consumers

Decomposers

Look at the pictures of the plants and animals on this page. Identify which are producers and which are consumers. Make a table to record your ideas with your friend.

Key idea

All animals and humans are consumers.

Getting started

In this lesson students will review their knowledge that food chains begin with a plant. They will learn that this is because green plants can use the energy from sunlight to help them to make food. They will investigate evidence that one of the products of this process is sugar and this is stored as starch in leaves. They will learn that plants are called producers because, unlike animals, they produce their own food. They review the idea that plants are called producers and that animals are consumers because they cannot make their own food. Students explore examples of primary, secondary and tertiary consumers.

Language support

Repeat the movement task to review the word 'energy' – shout 'high energy' and students move quickly around the room; shout 'low energy' and they move around very slowly. Write the word 'produce' on the board and next to it write the word 'make'. Tell students the words mean the same thing. Then write the word 'maker' on the board and explain that when they make something they are the maker, so if a plant can produce something it is a producer. Explain the terms 'primary', 'secondary' and 'tertiary' by pointing out that prime or primary means first. Underline the part of the word secondary that spells out second and ask students what they think this means – you may have primary and secondary schools in your region and can use this as an example. Point out that the word 'tertiary' comes from the Latin word for third.

Resources

Student Book: plants; silver foil; hot water; paper towels; iodine.

Key words

energy producer Sun

Other words in the lesson

iodine starch sugars sunlight wilt

Scientific enquiry key words

ask questions observe compare

notice patterns record communicate findings

Lesson at a glance

The key teaching points in this lesson are:

- producers use energy from the Sun to help them make food
- food from producers is used by consumers
- there are many levels of consumers.

In the next lesson, students will learn more about how energy passes along a food chain and that energy is lost at each stage.

Encourage students to reflect on any previous work on plants and what plants need to grow. Ask them to work with a partner to make a list of the requirements for growth and then ask volunteer groups to share some of their ideas by reading out part of their list to the class. Write down ideas on the board to make a class list.

Possible response: *Students should recall that in addition to sunlight plants need something to grow in such as soil or compost, nutrients, water, space and air.*

Read out the text at the top of page. Remind students that animals and plants have to be adapted to live in their habitats. Point out that these adaptations help living things carry out the functions of life, in a given habitat, according to the features of that habitat. Refer them to the photographs and descriptions of the different habitats on the next few pages and let them brainstorm any advantageous adaptations to these habitats.

Producers

Read through the text explaining the importance of producers. It explains that when plants are healthy and can use energy from the Sun to make their own food, they are called producers. Link this to food chains by stressing that producers can provide food for insects and animals.

Remind students that food chains always start with producers and their investigation shows why. Ask students to study the examples. These show three different chains all starting with the same plants.

List the animals that eat plants. List the animals that eat other animals. Discuss why the food chains start with a producer.

Ask students to work with a partner or in a small group of three or four. Explain that they should study each of the three chains in turn and decide what is eating what. Remind them that the arrows show this – pointing from

what is being eaten to what is eating it. Students should then discuss why each chain must start with a producer. You can ask them to cover up the producer with their fingers and then think about how the next animal in the chain would survive.

Possible response: *Students should list the animals that eat plants as: rats; birds and goats. Animals that eat other animals are: snakes; birds of prey and tigers. Students should state that each chain starts with a producer because green plants can make their own energy, but animals have to eat plants or other animals. Without a producer no chains can survive.*

Different types of consumer

Point out the pictures and text at the top of page 44. These explain that in a food chain there may be different types of consumer. Point out to students that this depends upon how many plants and animals are in the chain.

Look at this food chain. Ask students to look carefully at the food chain and explain that we give special names to each consumer in this food chain. Write the phrase 'primary consumer' on the board and explain that these animals eat plants (producers). Remind students that animals that eat plants are also known as herbivores. Ask students to identify the primary consumer in the food chain.

Now write 'secondary consumer' on the board and explain that these animals eat the animals that eat plants. Ask students to identify the secondary consumer in the food chain.

Finally, write the term 'tertiary consumer' on the board and explain that these animals eat the animals that have eaten herbivores. Ask students to identify the tertiary consumer in the food chain.

Look at the pictures of the plants and animals on this page. Identify which are producers and which are consumers. Make a table to record your ideas with your friend.

Allow students to work with a partner. Ask them to study the pictures at the bottom of page 44 and decide which living things are consumers and which are producers. They should present their ideas in a table.

Possible response: *Students should identify the trees, shrubs, grass and flowering plants as producers and the bird of prey, snake, frog, caterpillar, tiger and deer as consumers.*

Science fact We know that plants use energy from the sun to produce their own food. Remember that animals cannot make their own food.

Ask a volunteer to read out the science fact and invite students to share their thoughts.

Investigation: Identifying producers and consumers

Explain to students that they are going to make a model of the food chain using paper plates. Point out that they have made food chains in this way before, but this time they have the challenge of identifying a producer and the different types of consumer.

Ask students to look at the picture of the eagle on page 44. Explain that the eagle represents another stage in a food chain – a quaternary consumer. Students should identify the food chain containing the eagle and represent it by using a different plate for each level of the food chain. You could hint that they will need five plates.

Ask students to draw and name the living things that form the chain with each one on a separate plate. On the back of the plate they should write if the living thing is a producer, primary consumer, secondary consumer, tertiary consumer or quaternary consumer.

Allow students to hang their plates from the ceiling of the classroom or a corridor. Check that they are in the correct sequence and as they spin they should show the living thing and the name of the food chain level that it belongs to.

Answer: *Students should label the plant or plants as producer, the caterpillar as primary consumer, the frog as secondary consumer, the snake as tertiary consumer and the eagle as quaternary consumer.*

Key idea

All animals and humans are consumers.

Read out the key idea or ask a volunteer to read it out. Ask students to think about the statement and then discuss with a partner. They can then both draw an example of a food chain they have studied, ideally from memory, and circle and label the consumers. Students can then work with a partner to write down three examples of a producer and some examples of primary, secondary and tertiary consumers. Ask some students to share their examples with the class.

Review and reflect

Ask students to look back at the key words for the lesson (energy, producer and Sun) and write a paragraph that includes these words and also explains why food chains start with a plant. They can show their paragraph to a partner and work together to make a joint paragraph they are happy to share with the class.

Students can then draw two large speech bubbles. Into one they can finish the sentence, 'One important thing I have learned about plants and food chains is ... ' and in the other they can finish the sentence, 'One thing I am most proud of in this lesson is ... '. Pin these to a wall so students can look at each other's answers and

achievements. Hold up cards with the phrases 'primary consumer', 'secondary consumer' and 'tertiary consumer' written on them. As quickly as possible students should write down the name of an example and hold up their answer. Repeat the process so that you raise each card three or four times. Make this a fun activity and not a competition.

Extra activities

1 You could point out that most plants can make their own food and these are usually green as they contain a green pigment that helps them. Other plants may not make their own food – such as those that feed off other plants as parasites. Ask students to research some plants that do not make their own food and present their ideas to the class.

2 As a challenge, students could research how plants make food by photosynthesis and find a word equation to show the reactants (carbon dioxide and water) and the products (sugar and oxygen). They could make a large poster of this equation and display it in the room.

3 Hand out a range of photographs of plants and animals downloaded from the internet or cut out from wildlife magazines. Ask students to work in small groups to discuss the photographs and arrange some into a food chain with three or four levels. Ask students to name the producer, primary consumer, secondary consumer and tertiary consumer.

Differentiation

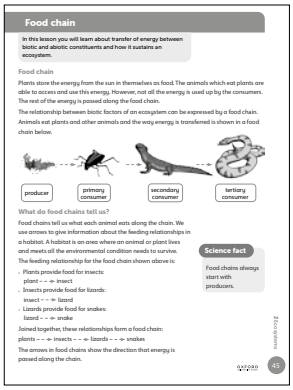
Supporting: Organise students into groups to ensure that at least one student in the group is confident in their understanding of food chains and the differences between the types of consumers. This person can act as a guide or mentor to other students.

Consolidating: Keep pyramid models and food chains created by students over the last few lessons on display to consolidate learning.

Extending: Ask students to research an inverted pyramid of numbers, for example one tree supporting thousands of insects and birds.

Differentiated outcomes	
All students	should be able to define the producer and consumer in food chains and food webs
Most students	will be able to differentiate between primary, secondary and tertiary consumers
Some students	may be able to define quaternary consumers and give examples

Food chains


Food chain

In this lesson you will learn about transfer of energy between biotic and abiotic constituents and how it sustains an ecosystem.

Food chain

Plants store the energy from the sun in themselves as food. The animals which eat plants are able to access and use this energy. However, not all the energy is used up by the consumers. The rest of the energy is passed along the food chain.

The relationship between biotic factors of an ecosystem can be expressed by a food chain. Animals eat plants and other animals and the way energy is transferred is shown in a food chain below.

producer | primary consumer | secondary consumer | tertiary consumer

What do food chains tell us?

Food chains tell us what each animal eats along the chain. We use arrows to give information about the feeding relationships in a habitat. A habitat is an area where an animal or plant lives and meets all the environmental condition needs to survive.

The feeding relationship for the food chain shown above is:

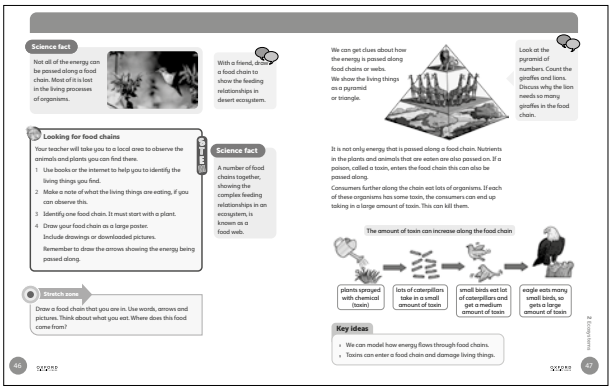
- Plants provide food for insects: plant → insect
- Insects provide food for lizards: insect → lizard
- Lizards provide food for snakes: lizard → snake

Joined together, these relationships form a food chain: plants → insects → lizards → snakes

The arrows in food chains show the direction that energy is passed along the chain.

Science fact

Food chains always start with producers.


Science fact

Not all of the energy can be passed along a food chain. Most of it is lost in the living processes of organisms.

With a friend, draw a food chain to show the feeding relationships in desert ecosystem.

We can get clues about how the energy is passed along food chains or webs. We show the living things as a pyramid or triangle.

Look at the pyramid of numbers. Count the giraffes and lions. Discuss why the lion needs so many giraffes in the food chain.

Looking for food chains

Your teacher will take you to a local area to observe the animals and plants you can find there.

1 Use books or the internet to help you to identify the living things you find.
2 Make a note of what the living things are eating, if you can observe this.
3 Identify one food chain. It must start with a plant.
4 Draw your food chain as a large poster. Include drawings or downloaded pictures. Remember to draw the arrows showing the energy being passed along.

Science fact

A number of food chains together, showing the complex feeding relationships in an ecosystem, is known as a food web.

It is not only energy that is passed along a food chain. Nutrients in the plants and animals that are eaten are also passed on. If a poison, called a toxin, enters the food chain this can also be passed along.

Consumers further along the chain eat lots of organisms. If each of these organisms has some toxin, the consumers can end up taking in a large amount of toxin. This can kill them.

The amount of toxin can increase along the food chain

plants sprayed with chemical (toxin) | lots of caterpillars take in a small amount of toxin | small birds eat lot of caterpillars and get a medium amount of toxin | eagle eats many small birds, so gets a large amount of toxin

Stretch zone

Draw a food chain that you are in. Use words, arrows and pictures. Think about what you eat. Where does this food come from?

Key ideas

- We can model how energy flows through food chains.
- Toxins can enter a food chain and damage living things.

Getting started

In this lesson students will study how food chains can be used to show feeding relationships. They will learn about the conventions for representing food chains and especially the significance of the direction of the arrows. Students will apply their understanding of food chains to survey some examples in their locality. students will also discover how energy passes along a food chain and through a food web. They will learn that animals need to eat many plants or other animals during their lifetime and that we can represent this using pyramids of numbers. Students will also learn that, as well as energy, toxins can enter and pass along a food chain and can damage living things.

Language support

Ensure that students understand that the word 'energy' is used in the lesson to mean 'the ability to move or do work'. Explain that without energy living things cannot survive and when a living thing eats it is obtaining energy from what it is eating. Ask students to stand up and when you say 'low energy' they move around the room very slowly. When you say 'high energy' they move around much quicker. Repeat this a few times.

Resources

Student Book: large pieces of paper; glue; pieces of card; access to local area containing different plants and

animals; access to books about living things or to the internet.

Key words

energy food chain habitat

Other words in the lesson

animal insect lizard plant snake

Scientific enquiry key words

use equipment observe compare record

use secondary sources communicate findings

Lesson at a glance

The key teaching points in this lesson are:

- feeding relationships describe what living things eat and what eats them.
- feeding relationships can be represented by food chains.
- the arrows in a food chain show how energy and raw materials are passed on.
- we can use pyramids of numbers to model how many plants and animals are needed in a food chain.
- a pyramid of numbers also shows how energy flows through food chains and webs.
- as well as energy and nutrients, toxins can enter and pass along a food chain and damage living things.

What do food chains tell us?

Read through the text and explain that food chains tell us what each animal eats along the chain. Remind students that we use arrows to give information about the feeding relationships in a habitat. Ask students to tell you what a habitat is and elicit that it is where an animal or plant lives.

The next section of the text explains the food chain by breaking it down into sections so allow students to read through it in stages.

Point out that plants provide food for insects, insects provide food for lizards and lizards provide food for snakes. Explain that joined together, these relationships form a food chain.

Again, stress that the arrows in food chains show the direction that energy is passed along the chain and that raw materials are also passed along the chain.

Science fact Not all of the energy can be passed along a food chain. Most is lost through the living things moving or materials not being digested.

The information in the Science fact outlines another fundamental biological principle. Make sure that students understand that if an animal eats food, a lot of the energy goes into allowing the animal to move and also, for many animals, to heat the body. This means that not all of the energy that an animal takes in as food is available to any animal that eats it.

Investigation: Looking for food chains

Explain that students are going to observe and identify some local plants and animals and arrange them into food chains. Arrange students into small groups of three or four. Take them to a local area to observe the animals and plants that are found there. Local parks, forests and botanical gardens are good choices, but if these are not possible you can use a corner of the school grounds and possibly set some bird feeding stations and leave logs and leaves to attract insects.

Computing link: Ask students to use books or the internet to help them to identify the living things they find. They can download identification guides and keys.

Remind students that if possible they should make a note of what the living things are eating. Once they have a list of some living things and what they eat they can identify one food chain. Remind them that it must start with a plant.

Ask students to draw their food chain as a large poster. They can include drawings or downloaded pictures. Remind them to draw the arrows showing the energy and raw materials being passed along.

Possible response: *Students should be able to identify a plant and an insect that eats the plant – or takes pollen from it such as a butterfly. They might be able to see birds, lizards or larger insects eating the animals that feed on plants. They could form food chains with two, three or four steps.*

How many living things are in this photograph? With a partner, draw a food chain to show the feeding relationships in this desert ecosystem.

Ask students to work with a partner. Point out the photograph of the camels eating grass and allow them to use their observation skills to identify the food chain being shown.

Possible response: *Students should draw the grass at the start of the food chain and then an arrow to a camel as the animal that eats grass. There are no animals shown that eat camels so the food chain has only two stages (these are called trophic levels but this detail is not needed at this stage).*

Stretch zone: Draw a food chain that you are in. Use words, arrows and pictures. Think about what you eat. Where does this food come from?

Read out the Stretch zone and explain that students will have to think about the original source of their food – for example milk and cheese from cows or goats and what these animals eat. Tell them that there may be two, three or four stages (or trophic levels) in their food chain.

Possible response: *Students should be able to place themselves at the head or end of a food chain – the highest trophic level. If they have only eaten plants, then there will be two stages. If they eat meat, there could be three – e.g. grass, cow, student. Some may suggest a four-stage food chain – algae, small fish, large fish, student, for example. Check that they have started with a plant and have included the arrows, and that these point in the correct left to right direction.*

Read through the text at the top of page 47. This reminds students that all living things need food because it provides the energy they need to live. Remind them that they have looked at food chains and food webs and that these all start with green plants called producers. Ask students whether animals can make their own food. They should reply that animals cannot make their own food: they have to eat something to get the energy they need.

Ask volunteers to each read out a sentence from the text about what happens to the energy. Students are told that the animal uses some of the energy – explain that this can be as movement or warming the animal, for example. The rest of the energy is passed along the food chain and web. Point out that this means that not all of the energy can be passed along. You can also explain that not 100% of a plant or animal that is eaten can be digested, so again some energy is lost at every stage.

It is vital to emphasise that a food chain only shows one type of animal or plant at each level. Ask students to look at the example of the chain with the leaves, giraffe and lion. Explain that the giraffe will eat hundreds of plants to stay alive and a lion will need to eat a few giraffes and similar animals to stay alive.

Point out the picture of the pyramid at the top of page. This shows the feeding relationships between living things as a pyramid or triangle. Explain that the producers, which start every chain or web, are shown at the base of the pyramid and each step (or trophic level – trophic means energy) is shown above this.

Look at the pyramid of numbers. Count the giraffes and lions. Discuss why the lion needs so many giraffes in the food chain.

To help students to understand pyramids of numbers encourage them to study the example carefully. They should count the giraffes and lions and talk to a partner about why a lion needs so many giraffes in its food chain.

Possible response: *Students should realise that a lion needs to eat all year to stay alive. Eating just one giraffe would not provide enough energy and nutrients to last all year.*

Read out the text at the bottom of page 47 or ask volunteers to read a sentence or paragraph each. As they do this the other students can follow the diagram of toxins passing along a food chain. Explain that it is not only energy that is passed along a food chain or web. Point out that nutrients in the plants and animals that are eaten are also passed on. If a poison, called a toxin, enters the food chain or web, this can also be passed along.

A crucial idea is that consumers further along the chain or web eat lots of organisms. If each of these organisms has some toxin, the consumers can end up taking in a large amount of toxin. This can kill them. This concept of the concentration of toxins along a food chain is a vital one in ecology.

Key idea

- *We can use pyramids of numbers to model how energy flows through food chains and webs.*
- *Toxins can enter a food chain and damage living things.*

Read out the key ideas or ask a volunteer to read them out. Ask students to turn to a partner and describe a pyramid of numbers they have seen. They should name the producers and the various consumers in the pyramid. Finally, they can think about how toxins become concentrated as they are passed along a food chain and then you can ask for suggestions from the class.

Review and reflect

Ask students to sit down for a few minutes and think about what they have learned from the lesson. They can then think of one idea from the lesson that they would like to investigate and find out more about. Ask them to make a plan about how they would do this. This planning time will allow students to think up some imaginative and original things to do and you could let them carry out these projects. They are highly motivating and reinforce learning.

Print out numerous pieces of paper with the title 'Evaluation report' and on them should be the statement: 'Two things I think you have done well are _____ and _____, and one suggestion I have is _____.' Make the gaps large enough for students to write their comments in. Ask students to walk around to observe the pyramid of numbers models made by other students. They should leave an evaluation report at each pyramid.

Students should then return to their own pyramid and read the evaluation reports. They can then enjoy the feedback and think of a target based on the suggestions.

Extra activities

1 Students can make a large class pyramid of numbers using cardboard boxes and pieces of card. This can be as high as a person and could be based on the one in

the Student Book or one they have researched. The large model could be placed on display in a school entrance or hall.

2 Ask students to work as part of a team of four. They should stand in a line and the first person should have a sign that says producer. All students then hold their hands out to make a cup shape. Pour water into the hands of the first person and they then pass as much water as they can to the second person. This person passes it onto the next and so on until the end of the chain. The final person tries to pour the water they have in their hands into a container. Ask them to think about how much water was passed on and how much was lost at each stage. Ask them what the water represents; they should realise it is representing energy.

Differentiation

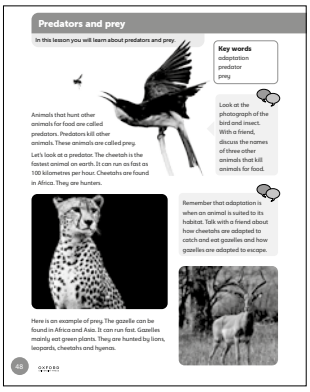
Supporting: When making the pyramid of numbers you can hand out a cut-out template for students to glue together.

Consolidating: Display a large version of the food chain showing the concentration of toxins.

Extending: Ask students to research some examples of toxins being passed along a food chain and affecting birds of prey or humans.

Differentiated outcomes	
All students	should be able to state that pyramids of numbers show how many plants and animals are in food chains
Most students	will be able to state that energy is lost at each stage of a food chain
Some students	may be able to calculate energy loss at each stage of a food chain

Predators and prey


Predators and prey

In this lesson you will learn about predators and prey.

Key words
adaptation
predator
prey

Animals that hunt other animals for food are called predators. Predators kill other animals. These animals are called prey.

Let's look at a predator. The cheetah is the fastest animal on earth. It can run as fast as 100 kilometres per hour. Cheetahs are found in Africa. They are hunters.

Look at the photograph of the bird and insect. With a friend, discuss the names of three other animals that kill animals for food.

Remember that adaptation is when an animal is suited to its habitat. Talk with a friend about how cheetahs are adapted to catch and eat gazelles and how gazelles are adapted to escape.

Here is an example of prey. The gazelle can be found in Africa and Asia. It can run fast. Gazelles mainly eat green plants. They are hunted by lions, leopards, cheetahs and hyenas.

48

Getting started

In this lesson students will study the relationship between predators and prey. They will learn that predators are animals that hunt and eat other animals and the animals that are eaten are called prey. Students will explore some adaptations of predators and prey, including camouflage.

Language support

To help students to understand and recall the difference between predators and prey you can play hide and seek. Take students outside to a safe area and ask half of them to hide – tell them they are the prey. The rest of the class are the predators and they have to look for the prey. When they find the prey they chase them to tap them on the arm. Any prey that are caught (tapped) should sit down quietly at the side until they have all been caught.

Resources

Student Book: card or paper; wide range of colouring pencils.

Key words

adaptation predator prey

Other words in the lesson

camouflage habitat

Scientific enquiry key words

observe compare group/classify

use secondary sources communicate findings

Lesson at a glance

The key teaching points in this lesson are:

- some animals are predators: they hunt and eat other animals

- animals that are eaten by predators are called prey
- predators and prey are adapted to either catch and eat animals or avoid being eaten.

Look at the photograph of the bird and insect. With a partner, discuss the names of three other animals that kill animals for food.

Point out the photograph of the bird and the insect at the top of page. Ask students to talk about what they think the bird is trying to do. They should then discuss other animals that kill animals for food.

Possible response: *Students should recognise that the bird is trying to catch the insect to eat it. Other animals that kill animals for food include lions, tigers, wolves, bears, sharks and killer whales but there are many other examples.*

Read through the text. This explains that animals that hunt other animals for food are called predators. Point out that predators kill other animals and that these animals are called prey. Remind students of the game they played as part of the language support and ask them which of them were prey and which of them were predators.

Explain to students that they are going to look at a predator in detail. Ask a volunteer to read out the information about the cheetah. Ask, 'Is there a faster animal than a cheetah? How fast can it run? Where are cheetahs found?'

Ask students to study the drawings of the cheetah and gazelle. They should also look carefully at the parts that are labelled. You could point out that an adaptation in a predator can lead to adaptations in the prey in a race or competition to survive.

Remember that adaptation is when an animal is suited to its habitat. Talk with a partner about how cheetahs are adapted to catch and eat gazelles, and how gazelles are adapted to escape.

Allow students to work with a partner or, as this is a more complex discussion, you could ask them to work in a small group of three or four. Suggest they first look at the cheetah and make a list of the adaptations for catching prey, and then look at the gazelle to see how the adaptations can help it escape. Ask volunteers to share their ideas with the class.

Possible response: *Students should suggest that the cheetah is adapted for speed but also has sharp teeth and claws for catching and eating the prey. The legs are strong and powerful with padded paws to make less noise and the coat is camouflaged so it can hide. Students may also point out that cheetahs have good eyesight, hearing and smell, though these are not labelled. The gazelle has good hearing, eyesight and smell to detect predators, is coloured to blend in with the background, has horns for defence and has powerful legs for running quickly.*

Computing link: Arrange students into small groups of three or four and provide access to the internet to allow them to research the methods of escaping predation mentioned in the Stretch zone task. You can either ask groups to research an example of an animal that uses each feature or allocate a feature, for example spines, to each group so they become experts in this and can share their expertise with the class. They can do this sharing by giving a short talk or by making a poster.

Possible response: *Students should discover that spines protect an animal by making it painful for any animal trying to eat it; horns can be used to fend off and injure a predator; hard shells make it difficult for a predator to grip and break into the soft parts of an animal; large size makes it difficult for an individual predator to attack and kill an animal; speed can help an animal run away from a predator.*

Review and reflect

Allow students a few moments of quiet reflection so they can enjoy the feeling of satisfaction from learning so many new things and working so well with others.

Extra activities

1 Arrange students into pairs. Ask each pair to act out a play showing a predator looking for a prey animal. They should take it in turns to imagine what the predator or prey animal might be thinking and say this out loud. You could ask some pairs to perform their play to the class.

2 Ask students to design a class science magazine. Arrange for each group to cover a particular topic or lesson and produce a short article containing text about the topic and drawings or downloaded photographs. Assemble all of the articles into a folder or, if they have been done digitally, print them off as a magazine, and keep it for future reference in your class library.

Differentiation

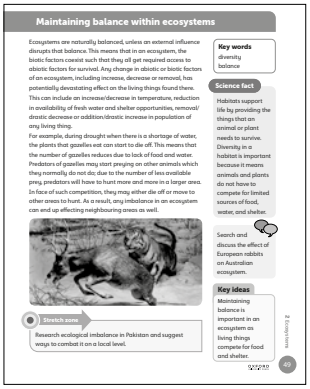
Supporting: Allow students to use the Internet to look up information when they are taking part in class discussions.

Consolidating: Encourage students to look back over all the review questions and statements in the Student Book.

Extending: Ask students to research the predator and prey relationship of the Canada lynx and the snowshoe hare and list some adaptations of both animals that help them to survive.

Differentiated outcomes	
All students	should be able to define the terms 'predator' and 'prey'
Most students	will be able to describe an example of a predator/prey relationship and how the animals are adapted
Some students	may be able to research and explain predator/prey relationships

Maintaining balance within ecosystems


Maintaining balance within ecosystems

Ecosystems are naturally balanced, unless an external influence disrupts that balance. This means that in an ecosystem, the biotic factors coexist such that they all get required access to abiotic factors for survival. Any change in abiotic or biotic factors of an ecosystem, including increase, decrease or removal, has potentially devastating effect on the living things found there. This can include an increase/decrease in temperature, reduction in availability of fresh water and shelter opportunities, removal/drastic decrease or addition/drastic increase in population of any living thing.

For example, during drought when there is a shortage of water, the plants that gazelles eat can start to die off. This means that the number of gazelles reduces due to lack of food and water. Predators of gazelles may start preying on other animals which they normally do not do; due to the number of less available prey, predators will have to hunt more and more in a larger area. In face of such competition, they may either die off or move to other areas to hunt. As a result, any imbalance in an ecosystem can end up affecting neighbouring areas as well.

Key words
diversity
balance

Science fact
Habitats support life by providing the things that an animal or plant needs to survive. Diversity in a habitat is important because it means animals and plants do not have to compete for limited sources of food, water, and shelter.

Search and discuss the effect of European rabbits on Australian ecosystem.

Key ideas
Maintaining balance is important in an ecosystem as living things compete for food and shelter.

Stretch zone
Research ecological imbalance in Pakistan and suggest ways to combat it on a local level.

2 ecosystems

49

Getting started

In this lesson students will learn in more detail how balance in an ecosystem help living things to survive and also how this survival allows the living thing to reproduce and produce offspring.

Language support

Encourage students to check their glossaries for completeness and to use key terms and words in their final presentation. Ask them to look back at the Word cloud from earlier and make a note of any words they are still unsure of. They can use a dictionary or look through the Student Book to help them to recall any definitions they are unsure of.

Resources

Student Book: thin blue, green and red card; scissors; materials to make posters; resources to make presentations; access to the internet or books to research a plant that became extinct because of its inability to adapt to changing surroundings.

Key words

Other words in the lesson

bark capture/recapture drought flooding generation identical polluted/unpolluted population predator rainforest

Scientific enquiry key words

Plan and/or carry out enquiries to answer questions

Make observations

Record data and results

Analyse data, notice patterns and group or classify things

Report and present findings

Draw conclusions and give explanations

Identify causal relationships

Lesson at a glance

The key teaching points for students in this lesson are:

- different relationships in an ecosystem result in different impact on survival of living things.
- an overall balance in ecosystem is essential for living things to survive changing conditions.

Think back: How are conifers and Arctic foxes adapted to live in their habitats?

Ask students to work on their own initially and try to write down two adaptations for the conifers and two for the Arctic fox. They can then work with a partner to compare lists. Ask some students to read out their list to the class.

Answer: *Conifers have waxy, spiny leaves to prevent water loss and the spines and branches point downwards to stop snow from building up. Arctic foxes have fur coats to keep them warm and are white in winter to camouflage themselves against the white background of snow.*

Ask students to read the text on the page. Explain that if an animal is found and eaten, it cannot have offspring and if an animal is not found and eaten, it can have offspring. This means that more and more of the variety of the animal best suited to a habitat are born. The predators help to remove those animals that are not well suited to a habitat. It is like a sorting process.

Search and discuss the effect of European rabbits on Australian ecosystem.

Encourage students to form discussion groups to to debate their findings to help them draw a conclusion. They can share their ideas with the class.

Possible response: *he European rabbits became and remain a major problem for the Australian ecosystem. They eat too many plants and crops, and they take food and space from the native animals. They also make holes in the ground, which can ruin the soil and the plants. They can harm the homes of many native animals, which are now endangered because of the rabbits. They have changed the land and the animals of the country. They have made trouble for the farmers and the environment. They are very hard to get rid of, and they need to be controlled..*

Science fact: Habitats support life by providing the things that an animal or plant needs to survive. Diversity in a habitat is important because it means animals and plants do not have to compete for limited sources of food, water, and shelter.

Read out the Science fact or ask a student to volunteer to read it out. Ask students if they agree or disagree with the above statement. Suggest they focus on the actions by human beings as extra pressure (or advantage!) on the environment and its resources.

Stretch zone: Research ecological imbalance in Pakistan and suggest ways to combat it on a local level.

Once the class discussions are finished, ask students to complete the Stretch zone challenge. In this challenge they are to research and discuss the impact of human activities on creating and disrupting the ecological imbalances in Pakistan. Remind them to include their observation on their locally changing surroundings. They can turn to a partner and explain their findings.

Key ideas

- *Maintaining balance is important in an ecosystem as living things compete for food and shelter.*

Read out the key ideas and ask students to turn to a partner and take it in turns to describe an example of ecological imbalance can result in loss of biodiversity. They can then list two other dangers to the survival of animals and plants other than predators.

Review and reflect

Encourage the students to look back through their notes and the Student Book for the unit. They can then draw two large speech bubbles. In one they can finish the sentence, 'Two important things I have learned about importance of biodiversity are …' and in the other they can finish the sentence, 'Two things I am committed to doing after studying this unit are …'. Pin these to a wall so students can look at each other's answers and achievements.

Extra activities

1 Ask students to design a poster detailing the findings of their research project on Australian rabbit problem.

2 Encourage students to design a handbook detailing the role they can play to correct ecological imbalance in Pakistan.

3 **Computing link:** Download photographs of endangered animals and plants from the internet for students to study.

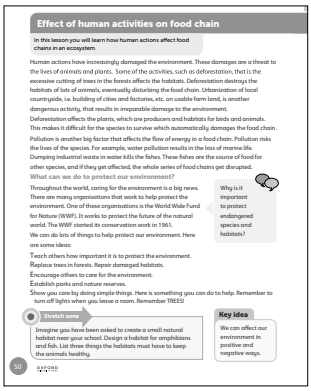
Differentiation

Supporting: You can direct students to the WWF website to discover more about ecological imbalance and biodiversity.

Consolidating: Allow students to watch clips of wildlife films and documentaries to identify impact of imbalances in ecology.

Differentiated outcomes	
All students	should be able to state that maintaining balance is important in an ecosystem as living things compete for food and shelter.
Most students	will be able to describe how diversity in a habitat means animals and plants do not have to compete for limited sources of food, water, and shelter.
Some students	may be able to use experimental data from secondary sources to support the idea ecosystems are naturally balanced, unless an external influence disrupts that balance.

Effect of human activities on food chain


Effect of human activities on food chain

In this lesson you will learn how human actions affect food chains in an ecosystem.

Human actions have increasingly damaged the environment. These damages are a threat to the lives of animals and plants. Some of the activities, such as deforestation, that is the excessive cutting of trees in the forests affects the habitats. Deforestation destroys the habitats of lots of animals, eventually disturbing the food chain. Urbanization of local countryside, i.e. building of cities and factories, etc. on usable farm land, is another dangerous activity, that results in irreparable damage to the environment.
Deforestation affects the plants, which are producers and habitats for birds and animals. This makes it difficult for the species to survive which automatically damages the food chain.
Pollution is another big factor that affects the flow of energy in a food chain. Pollution risks the lives of the species. For example, water pollution results in the loss of marine life. Dumping industrial waste in water kills the fishes. These fishes are the source of food for other species, and if they get effected, the whole series of food chains get disrupted.

What can we do to protect our environment?

Throughout the world, caring for the environment is a big news. There are many organisations that work to help protect the environment. One of these organisations is the World Wide Fund for Nature (WWF). It works to protect the future of the natural world. The WWF started its conservation work in 1961.
We can do lots of things to help protect our environment. Here are some ideas:

Why is it important to protect endangered species and habitats?

Teach others how important it is to protect the environment.
Replace trees in forests. Repair damaged habitats.
Encourage others to care for the environment.
Establish parks and nature reserves.
Show you care by doing simple things. Here is something you can do to help. Remember to turn off lights when you leave a room. Remember TREES!

Stretch zone

Imagine you have been asked to create a small natural habitat near your school. Design a habitat for amphibians and fish. List three things the habitats must have to keep the animals healthy.

Key idea

We can affect our environment in positive and negative ways.

50

Getting started

In this lesson students will study the risk of animals becoming extinct if their habitats are damaged. They will learn about some ways to protect the environment, and produce a leaflet informing people about the habitats and what can be done to protect the living things that live there.

Language support

To support language development and to extend students' knowledge, create a class display of some extinct and currently endangered species. Ask students to help you by either drawing or bringing in pictures of endangered plants or animals. This type of activity can engage students and also extend their vocabulary as they learn the names of different plants and animals. Put up large labels identifying the 'endangered species' and the 'extinct species' so students learn these phrases.

Resources

Student Book: access to an outdoor area suitable for a plant and animal survey; identification keys for common species found in a local habitat; writing materials; graph paper; rulers; materials to make leaflets.

Scientific enquiry key words

Plan and/or carry out enquiries to answer questions

Report and present findings

Draw conclusions and give explanations

Identify causal relationships

Lesson at a glance

The key teaching points for students in this lesson are:

- humans can affect the environment in many ways
- some of these effects are positive and some are negative
- if habitats are damaged, species can become endangered and eventually extinct.

In the next lesson, students will learn about the negative effects of air pollution.

Ask students to read the text on page about protecting the environment. To test understanding, ask, 'What is the biggest threat to an environment?

Why is it important to protect endangered species and habitats?

Students can continue to work with their partner or join with another pair to make a larger grouping. Ask them to talk about the need to protect animals and plants and their habitats.

Possible response: *Animals and plants are part of an interlocking food web, so damaging one part can have an effect on the rest. Many plants are important for food and medicines, so we should look after them.*

After the discussion students can read through the text on page about what we can do to protect the environment. Ask some students to take it in turns to read out each statement and write the acronym TREES on the board as they do this.

You can test understanding by asking, 'Name an organisation that was set up to protect the environment. When was it formed? What do the R and S stand for in TREES?'

Science fact Animals and plants are adapted to their habitats. If the habitat changes, they may not be able to survive. They will have to move or die.

Read out the Science fact or ask a volunteer to read it out. Point out that because many animals are adapted to a specific habitat, if the habitat is destroyed, it is difficult for the animals to fit in anywhere else.

How is the change in this habitat affecting the polar bear?

Allow students to work with a partner or their small team to talk about the question and reflect on their ideas about the habitat under threat. Ask some groups or pairs to share their ideas with the class and discuss any differences of opinion or interpretation – stressing that this is normal in science.

Possible response: *Students may realise that with climate change and global warming much of the Earth's ice is melting and this is reducing the habitat of the polar bear.*

Stretch zone: Imagine you have been asked to create a small natural habitat near your school. Design a habitat for amphibians and fish. List three things the habitats must have to keep the animals healthy.

Allow students to work in their small team. Point out that for this activity the emphasis is on planning and not constructing. You can ask students to use the internet to find out more about what fish and amphibians need to survive.

Possible response: *A sensible outcome would be a plan for a small pond that is deep enough for fish but has at least one shallow and sloping area for amphibians such as frogs to leave once they have hatched and grown past the tadpole stage. Check that students have added some plants because these put oxygen into the water and provide food and shade.*

Key idea

We can affect our environment in positive and negative ways.

Read out the key idea or ask a volunteer to read it out. Ask students to turn to a partner and tell them one way that they intend to help to protect the environment from now on. Remind them of the acronym from this lesson: TREES.

Review and reflect

Encourage students to identify aspects they have not completed correctly and help them to identify improvements. This will help students to develop a positive approach to learning by understanding that learning is a process that will improve with practice and reflection. For example, they can walk round and look at the information leaflets produced by others to identify what they have done well and what they can learn from others as targets to improve their work.

Extra activities

1 Allow students to construct the ponds they designed for the Stretch zone task. They can use a corner of the school grounds if one is available. They will need to dig out a circle shape that is 0.4 metres deep at its deepest and line it with sand and then a waterproof liner. The liner can be held in place by rocks around the edge and the pond filled. Plants such as reeds and water lilies can be added.

2 Invite a representative of a local conservation group to meet with your class and talk about their work. Ask them to bring in examples of scientific equipment that they use and also any photographs of the habitats and living things they are working to protect.

Differentiation

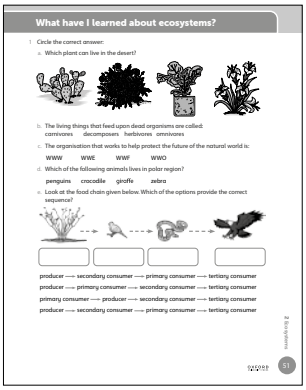
Supporting: Ask students to develop a presentation to understand the text about protecting the environment.

Consolidating: Make a large version of the TREES box and display it in the classroom so students can become familiar with it.

Extending: Students can research an animal that has recently become extinct and find out the reasons for its demise.

Differentiated outcomes	
All students	should be able to state that damaging habitats can create problems for living things
Most students	will be able to describe what extinct and endangered plants and animals are and give some examples
Some students	may be able to explain some examples of how environmental damage has led to the extinction of a named animal

What have I learned about Ecosystems?


What have I learned about ecosystems?

1 Circle the correct answer:

a. Which plant can live in the desert?

b. The living things that feed upon dead organisms are called:
carnivores decomposers herbivores omnivores

c. The organisation that works to help protect the future of the natural world is:
WWW WWE WWF WWO

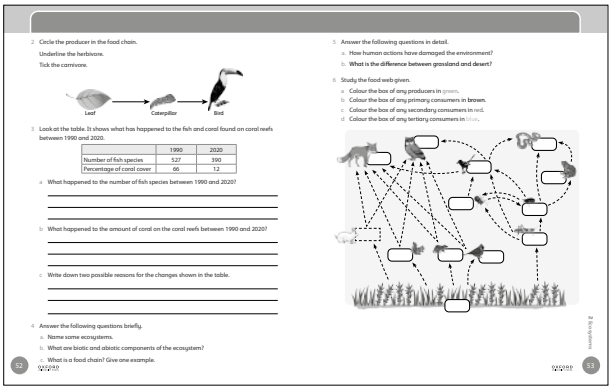
d. Which of the following animals lives in polar region?
penguins crocodile giraffe zebra

e. Look at the food chain given below. Which of the options provide the correct sequence?

producer → secondary consumer → primary consumer → tertiary consumer
producer → primary consumer → secondary consumer → tertiary consumer
primary consumer → producer → secondary consumer → tertiary consumer
producer → secondary consumer → primary consumer → tertiary consumer

2 Ecosystems

51


2 Circle the producer in the food chain.
Underline the herbivore.
Tick the carnivore.

Leaf → Caterpillar → Bird

3 Look at the table. It shows what has happened to the fish and coral found on coral reefs between 1990 and 2020.

	1990	2020
Number of fish species	527	300
Percentage of coral cover	66	12

a What happened to the number of fish species between 1990 and 2020?

b What happened to the amount of coral on the coral reefs between 1990 and 2020?

c Write down two possible reasons for the changes shown in the table.

4 Answer the following questions briefly.
a. Name some ecosystems.
b. What are biotic and abiotic components of the ecosystem?
c. What is a food chain? Give one example.

52

5 Answer the following questions in detail.
a. How human actions have damaged the environment?
b. What is the difference between grassland and desert?

6 Study the food web given.
a. Colour the box of any producers in green.
b. Colour the box of any primary consumers in brown.
c. Colour the box of any secondary consumers in red.
d. Colour the box of any tertiary consumers in blue.

2 Ecosystems

53

Getting started

The aim of this section is to encourage students to review their learning after each lesson in the unit and also to undertake some end-of-unit review and reflection. On these pages of the Student Book there are questions linked to concepts and topics covered in the unit. These will assess students' knowledge and understanding of the topic. You may have been using questions after each lesson where provided; there are links to relevant questions in the lesson sections in this Teacher's Guide.

However, it is also worth allowing students to answer all of the questions at the end of the unit. This will test longer-term understanding and recall. You can do this as an informal individual or pair activity and allow students to look information up as they work through the questions or you can set it as an individual 'closed-book' activity.

It is important that students report areas that they are not confident with. This information is useful for them in that they can think about what they need to review or ask advice about. It is also vital for you as it provides information about any topics you may wish to revisit.

"What have I learned about Ecosystems?" answers

1 Circle the correct answer:

a. Which plant can live in the desert?

b. The living things that feed upon dead organisms are called: carnivores decomposers herbivores omnivores

c. The organisation that works to help protect the future of the natural world is: WWW WWE WWF WWO

d. Which of the following animals lives in polar region? penguins crocodile giraffe zebra

e. Look at the food chain given below. Which of the options provide the correct sequence?

producer ; secondary consumer ; primary consumer ; tertiary consumer

producer ; primary consumer ; secondary consumer ; tertiary consumer

primary consumer ; producer ; secondary consumer ; tertiary consumer

producer ; secondary consumer ; primary consumer ; tertiary consumer

Answer: *a. cactus b. decomposers c. WWF d. penguins e. producer ; primary consumer ; secondary consumer ; tertiary consumer.*

2 Circle the producer in the food chain. Underline the herbivore. Tick the carnivore.

Leaf Caterpillar Bird

Students can continue to work with their partner or join with another pair to make a larger grouping.

Answer: *Circle the Leaf .Underline the Caterpillar . Tick the Bird.*

3 Look at the table. It shows what has happened to the fish and coral found on coral reefs between 1990 and 2020.

a. What happened to the number of fish species between 1990 and 2020?

b. What happened to the amount of coral on the coral reefs between 1990 and 2020?

c. Write down two possible reasons for the changes shown in the table.

Answer: *a. the number of fish species reduced from 527 to 390.*
b. the amount of coral on the coral reefs reduced from 66 to 12.
c. Water pollution and overfishing maybe two possible reasons for this change.

4 Answer the following questions briefly.

a. Name some ecosystems.

b. What are biotic and abiotic components of the ecosystem?

c. What is a food chain? Give one example.

Answer: *a. any of these: aquatic, forest, polar, desert.*
b. living things in ecosystems are known as biotic components of the ecosystem. whereas, non-living things are the abiotic components.
c. The relationship between biotic factors of an ecosystem can be expressed by a food chain.
For example, plants --> insects --> lizards --> snakes

5 Answer the following questions in detail.

a. How human actions have damaged the environment?

b. What is the difference between grassland and desert?

Answer: *a. Encourage students to share the answer in their own words. They can use the text on page 50 of the student books to help them.*
b. Though both grassland and desert about the same amount of sunlight, their difference is due to the type of soil in each one of them.
Grasslands have fertile soil with enough moisture and nutrients to support life. Desert soil however is dry and sandy, with very little moisture and so not fertile at all.

6 Study the food web given.

a. Colour the box of any producers in green.

b. Colour the box of any primary consumers in brown.

c. Colour the box of any secondary consumers in red.

d. Colour the box of any tertiary consumers in blue.

Answer: *Students should colour the box near the plants green. The next level is rabbits, squirrel, mouse, bird and locust, which should be coloured brown. Colour spider, beetle frog and black bird in red. Finally colour the snake, owl and fox in blue.*

Summative assessment

You can read out the answers for students to self-assess or you can take in the pages and mark them to award an overall score. You could allocate marks as follows: question 1 = 5; question 2 = 1; question 3a = 1, question 3b = 1, question 3c = 2; question 4a = 2, 4b = 2, 4c = 2; question 5a = 3, 5b = 2; question 6 = 4. This makes a total of 25 marks.

If necessary, ask students to revisit topics and questions to help them to learn more about any they did not score well on. In this way the questions are both summative and formative. All assessments should be linked to enhancing learning and in this way the 'What have I learned about?' pages will support this as well as providing data to report back to students, parents and/or other significant adults.

3 Human Health

In this unit students will:

- Observe and recognise some common symptoms of illness (e.g., fever, coughing, etc.).
- Differentiate between contagious diseases (hepatitis, T.B, influenza and polio) and non-contagious diseases (cancer and diabetes).
- Relate the transmission of common communicable diseases (e.g., touching, sneezing, and coughing) to human contact.
- Explain some methods of preventing common diseases and their transmission (e.g., vaccination, washing hands, wearing mask).
- Describe the importance of maintaining good health.
- Recognise everyday behaviours that promote good health (e.g., a balanced diet, drinking clean water, exercising regularly, brushing teeth, getting enough sleep).
- Define balanced diet and explain its components.
- Identify common food sources included in a balanced diet (e.g., fruits, vegetables, grains, milk and meat group).
- Understand the value of clean drinking water and inquire about the factors that generally make it unclean.
- Explore a few ways that can help make water clean and suitable for drinking (water filtration and boiling).

Getting started

In this unit students learn about the basic needs of humans. They learn more about how humans need water, food and air, and that a healthy diet involves eating the right amounts of different foods. They also studyin detail about the various illnesses and the role of hygiene in preventing these illnesses.

Science in context

When studying the for a healthy lifestyle, you can encourage students to think holistically, keeping in consideration both diet and general health, especially with respect to illness. Encourage them to share ideas about the topic and any relevant detail they see in their daily life. You could invite some healthcare professionals in to talk to students.

When studying diet and health issues, such as exercise and hygiene, use examples that students will be familiar with. Discuss what students eat at home and use menus from local restaurants and cafes. If there are local sports teams or individual athletes known to students, you can use these as a local context. Perhaps some could visit school to talk about exercise and the importance of healthy eating. A local doctor or nurse could talk to students about ways to keep healthy. Point out that people did not always understand about health and the body. Early scientists did not know about the circulation of blood or the causes of diseases. You can also discuss students' own experiences of medical care, medicines and treatments. Deal with this sympathetically but encourage them to link what they learn in the unit to the importance of their own health and lifestyles.

Arrange visits for students to meet with people who work in jobs related to diet, health and medicine or invite them into school. This can be doctors, nurses, pharmacists, sports trainers or coaches and athletes.

Relate the topic to people the students know. You can use family members as examples and also download photographs of people from around the world – some famous and some not – to include a global perspective.

Scientific enquiry skills

An Investigation master sheet is given in this Teacher's Guide on pages 4–5 to help students plan their scientific enquiries. Students can think of research questions and plan to answer these by collecting evidence through observation. They will contribute to discussions and make predictions about scientific phenomena. They will learn how to suggest ideas, follow instructions and record information. They will compare evidence and compare whether their predictions match their results. They will model and communicate their ideas so they can share, explain and develop their scientific thinking skills.

Resources

Student Book: writing materials; marker pens; access to the internet or magazines for pictures of food; example menus; food labels; timers (stopwatch or smartphone); large sheets of paper; hand-washing facilities including warm water and soap; cooking oil; sand; rulers or tape measures; paper plates; long pieces of string; drawing pins; clips to attach paper plates to the string.

Key words for unit

are in the Word cloud.

diseases symptoms virus bacteria parasite hygiene foods contagious good health balanced diet

Scientific enquiry key words

ask questions use equipment observe measure compare notice patterns record carry out tests group/classify use secondary sources communicate findings

Language support

You can start by reading out the words in the Word cloud. Ask students to discuss each word and define those they are familiar with. You can create a Word wall for the unit so students see the words often and become familiar with them.

To reinforce familiarity with new words, ask students to listen, say, read and then write them. To support English language development, ask students to make a list of other words they use in lessons that they are not familiar with. They could write these down in a notebook.

Consider making a small science library in one corner of your classroom. Include general science books and magazines, science encyclopaedias and dictionaries. You can also download information from the internet about specific topics to make information booklets.

Unit at a glance

The key teaching points for students in this unit are:

- to introduce the unit objectives
- to introduce the learning outcomes
- to engage students with the content of the unit
- to review and build on prior learning and understanding of the topics
- to start the first unit of the book.

Ask students to look at the pictures on the introductory pages. Explain the unit objectives in simple terms: students will think about what they need to survive and remain healthy. They will also study the importance of exercise and hygiene to a healthy life.

Look closely at the image of a boy cycling. Do you think cycling is a good exercise? How?

Ask students to look again at the main photograph. Allow them to talk about what the child is doing. You can ask students to act out what is happening. This movement can help to make the science enjoyable and there is good evidence that movement in lessons helps with learning. Ask students why movement is good and then ask them where they are getting their energy from. You can offer some clues and support by asking: If children did not eat for a week, how long could they jump up and down? Ask students to volunteer answers and remember to praise all attempts.

Possible response: *Students should identify that the child is cycling, which is a form of exercise.*

Students may realise that this movement is good for the children as it helps to build their bodies and keeps them fit. They should link energy to the food that is eaten. They should ideally be able to share that the energy to play, exercise and all life functions come from nutritious food.

Science fact Scientists have shown that how long people live is closely linked to having clean water and healthy food. The amount of exercise they take is also important. Good doctors and hospitals also play a big part.

Point out the Science fact to the children. Read out the information or ask a student to read it out. Ask students what exercise they like to do. The same can be repeated for foods they like to eat and the foods their parents want them to eat. You can also ask students to tell you four things that help people to live a long life. Ask them to think about how doctors and hospitals have helped people to live longer. Tell them that they are going to study more about this in the unit.

Possible response: *Students should list clean water, healthy food, exercise and good medical support.*

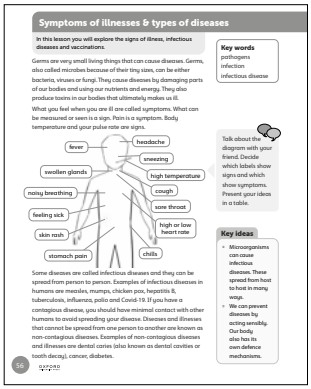
Extra activities

1 **Computing link:** Students download photographs of healthy life habits and make a poster or computer presentation to share with the class.

2 **Maths link:** Ask students to look back at the main photograph in the unit opener of the Student Book. Tell them they are going to do a scientific survey. Ask them to list out names of games and exercises, popular among students and note how frequently

they are done and record the results in a table to share. They can also make a simple bar chart. Ask them to work out the most popular game or exercise and the least popular game or exercise among the students.

Symptoms of illnesses and types of diseases


Symptoms of illnesses & types of diseases

In this lesson you will explore the signs of illness, infectious diseases and vaccinations.

Key words
pathogens
infection
infectious disease

Germs are very small living things that can cause diseases. Germs, also called microbes because of their tiny size, can be either bacteria, viruses or fungi. They cause diseases by damaging parts of our bodies and using our nutrients and energy. They also produce toxins in our bodies that ultimately makes us ill.

What you feel when you are ill are called symptoms. What can be measured or seen is a sign. Pain is a symptom. Body temperature and your pulse rate are signs.

headache
fever
sneezing
swollen glands
high temperature
noisy breathing
cough
sore throat
feeling sick
high or low heart rate
skin rash
stomach pain
chills

Talk about the diagram with your friend. Decide which labels show signs and which show symptoms. Present your ideas in a table.

Key ideas
- Microorganisms can cause infectious diseases. These spread from host to host in many ways.
- We can prevent diseases by acting sensibly. Our body also has its own defence mechanisms.

Some diseases are called infectious diseases and they can be spread from person to person. Examples of infectious diseases in humans are measles, mumps, chicken pox, hepatitis B, tuberculosis, influenza, polio and Covid-19. If you have a contagious disease, you should have minimal contact with other humans to avoid spreading your disease. Diseases and illnesses that cannot be spread from one person to another are known as non-contagious diseases. Examples of non-contagious diseases and illnesses are dental caries (also known as dental cavities or tooth decay), cancer, diabetes.

56

Getting started

In this lesson students learn the difference between the signs and the symptoms of an infectious and a non-contagious disease. They discuss some examples of both infectious and non-contagious diseases.

Language support

There are some complicated key words in this lesson so introduce them carefully from the start. Read out each word as students point to them in the key words box. Ask students to volunteer examples of when they have heard the words before.

Resources

Student Book: books giving information about infectious diseases and/or access to the internet; materials to make a leaflet.

Key words

pathogens infection infectious disease
microorganism vaccination

Other words in the lesson

pathogens signs symptoms

Scientific enquiry key words

use secondary sources communicate findings

Lesson at a glance

The key teaching points in this lesson are:

- infectious diseases are caused when microorganisms enter the body and make us feel unwell

- diseases that cannot be spread from one person to another are known as non-contagious diseases

Show students the outline of the person on the page. A lot of text accompanies this diagram so you will need some strategies to help students to understand this. You can read it out to students and stop after each sentence, and ask for volunteers to explain what you have just said in their own words. You could ask some questions. For example, 'What is a disease? What are pathogens and what do they do? What is an infectious disease? Can you name one example?'

Write difficult words on the board as they are introduced: infectious disease; microorganism; pathogen; symptom; sign.

Take special care when you explain the final two. Point out that what you feel when you are ill are called symptoms. If a doctor can see or measure something about your illness, this is a sign. Pain is a symptom. Body temperature and pulse rate are signs.

Ask students to then study the outline of the person again and read through the label boxes. Explain that they should use the diagram to help them to answer the discussion questions.

You can further add that vaccinations can help to prevent us having the symptoms of a disease by helping our immune system destroy the microorganisms.

Discussion

Talk about the diagram with your partner. Decide which labels show signs and which show symptoms. Present your ideas in a table.

Ask students to work with a partner. They should read out each label in turn and decide if it is a symptom or a sign. They can design and complete a table.

> ***Answer:*** *Students should decide that the symptoms are: fever; headache; sore throat; chills; feeling sick; stomach pain. The signs are: sneezing; high temperature; cough; high or low heart rate; skin rash; noisy breathing; swollen glands.*

Point out the text at the bottom of the page. Read this out slowly and ask students if they are surprised that some diseases do not spread from one person to the other. Ask students if are willing to share y examples by telling the class.

Review and reflect

Ask students to work in pairs. Ask one of the pair to be a doctor and the other to be a patient. They should decide on a disease and plan a short play to show what happens when the person visits the doctor with the disease. They should review the signs and symptoms and also discuss if a vaccine is possible. They then perform their short plays to the class and you could film these to show at a later stage.

Extra activities

1 Students can collect and send off for health information leaflets related to infectious diseases. They can make a collage on the wall to show some examples. They should try to include how the disease spreads, the signs and symptoms, and any treatments, including vaccines.

2 Signs and symptoms. Ask students to read the list of signs and symptoms around the diagram in their Student Book. Ask them to work with a partner to discuss all of the words and decide which are signs and which are symptoms. Once they have decided they should complete the table. Finally, students should write down one word which describes microorganisms that cause infectious diseases. (put below section in a grey box as for all answers)

> ***Answer:*** *Students should decide that the symptoms are: fever; headache; sore throat; feeling sick; stomach pain. The signs are: sneezing; high body temperature; low body temperature; coughs; high heart rate; low heart rate; skin rash; noisy breathing; swollen glands. The word which describes microorganisms that cause infectious diseases is pathogens.*

3 **Computing link:** Ask students to research some examples of infectious diseases in plants. They can download pictures of what the plants look like before and after infection and find out the pathogen involved. Students can also look into some treatments and the problems the disease causes.

Differentiation

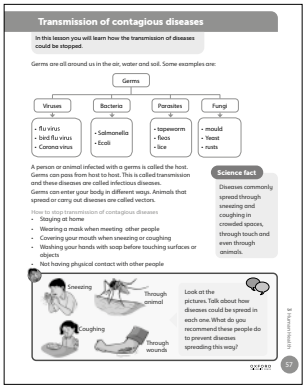
Supporting: Remind students that a symptom is what they feel. Anything a doctor can see or measure is a sign.

Consolidating: Display examples of health information leaflets in the room. This will give students opportunities to look up examples of diseases and be surrounded by real-life contexts.

Extending: Challenge students to learn more about the types of pathogens, for example the differences between viruses, bacteria and fungi.

Differentiated outcomes	
All students	should be able to state that infectious diseases can be passed from person to person.
Most students	will be able to describe how pathogens can cause signs and symptoms and give some examples.
Some students	may be able to explain how vaccines work to help to protect people from infectious diseases.

Transmission of a contagious diseases



Getting started

In this lesson students learn how the transmission of diseases can be stopped. They will focus especially on the contagious diseases.

Language support

Students should be familiar with the words 'germs', 'transmission', 'infectious' and 'vectors' from earlier work. However, write these on the board and ask students to take it in turns to explain to a partner what the words mean. Then explain the meanings from the text.

Resources

Student Book: materials to make information leaflets.

Key words

amphibian bird egg froglet gills tadpole

Other words in the lesson

breathe hatch hatchling hopping life cycle waterproof

Scientific enquiry key words

Make observations

Report and present findings in a variety of ways

Lesson at a glance

The key teaching points for students in this lesson are:

- germs are pathogens which can cause contagious diseases
- there are standard modes of transmission for spread of contagious diseases

Look at the pictures. Talk about how diseases could be spread in each one. What do you recommend these people do to prevent diseases spreading this way?

Ask students to discuss the photograph and share experiences how they and/or their friends behaved, when unwell, in a public setting. As them to recall any advice they received on how to cover their mouth when coughing or sneezing, etc. Ask them how do they behave when they come in contact with someone who is unwell.

Possible response: *Students should suggest that mouth should either be covered with tissue when coughing or sneezing, or the cough and sneeze should be directed into the elbow. Open wounds should be covered with dressing and gauze and not touched with unclean hands. Finally regular insect control should be maintained and ideally insect repellent and long sleeved clothing should be used.*

Point out the text on the page and especially focus on the modes of transmission of diseases and the role vectors play. Review with class the flowchart at the top of the page and invite students to suggest what could be the possible modes of prevention of transmission of diseases by the given germs/pathogens.

Science fact: Diseases commonly spread through sneezing and coughing in crowded spaces, through touch and even through animals.

Read out the Science fact or ask a volunteer to read it out. Ask students to suggest why the given modes of transmission are generally accepted as standard. Encourage a class discussion in form of small groups. Raise the question of which mode of transmission may be most responsible for spread of contagious diseases. Further, you can ask if they can suggest modes of transmission of fungal diseases.

Review and reflect

Ask students to sit for a few minutes and think about what they have learned from the lesson. They can then think of one idea from the lesson that they would like to find out more about. Ask them to make a plan about how they would do this. This planning time will allow students to think up some imaginative and original things to do and you could let them carry out these projects. They are highly motivating and reinforce learning.

Extra activities

1 Ask students to design and make large posters of the modes of transmission of diseases. They can further elaborate their posters by adin gin examples of specific diseases. You could invite other people in and students could describe their posters and arrange a guided tour of the exhibition.

Differentiation

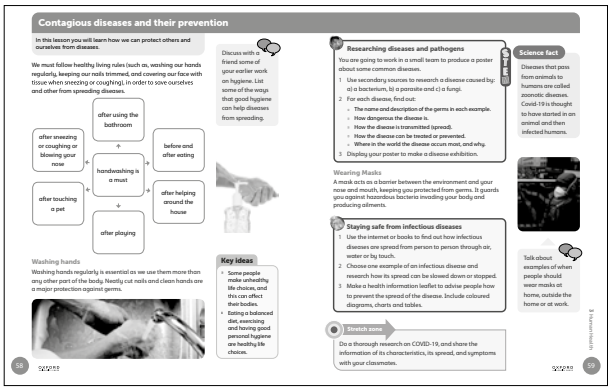
Supporting: Allow students to replicate the flowchart given in the Student Book.

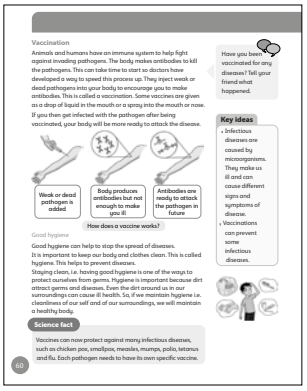
Consolidating: The posters are an excellent way of consolidating learning so encourage students to create and display a poster for every pathogen studied.

Extending: Encourage students to research other diseases and pathogens.

Differentiated outcomes	
All students	should be able to state what are germs and list some common pathogens
Most students	will be able to draw and replicate the flowchart from memory
Some students	may be able to describe common modes of disease transmission and ways of prevention.

Contagious diseases and their prevention





Getting started

In this lesson students learn the difference between the signs, the symptoms and prevention of an infectious disease. They will learn how vaccinations can protect us from some diseases.

Language support

There are some complicated key words in this lesson so introduce them carefully from the start. Read out each word as students point to them in the key words box. Ask students to volunteer examples of when they have heard the words before.

Resources

Student Book: books giving information about infectious diseases and/or access to the internet; materials to make a leaflet.

Key words

illness infection infectious disease
microorganism vaccination

Other words in the lesson

pathogens signs symptoms

Scientific enquiry key words

use secondary sources communicate findings

Lesson at a glance

The key teaching points in this lesson are:

- healthy living rules can help prevent spread of infectious diseases
- vaccinations can help to prevent us having the symptoms of a disease by helping our immune system destroy the microorganisms.

Show students flow chart on the page. A lot of text accompanies this diagram so you will need some strategies to help students to understand this. You can read it out to students and stop after each sentence, and ask for volunteers to explain what you have just said in their own words. You could ask some questions. For example, 'What is a disease? What are pathogens and what do they do? What is an infectious disease? Can you name one example?'

Write difficult words on the board as they are introduced: infectious disease; microorganism; pathogen; symptom; sign.

Take special care when you explain the final two. Point out that what you feel when you are ill are called symptoms. If a doctor can see or measure something about your illness, this is a sign. Pain is a symptom. Body temperature and pulse rate are signs.

Discussion

Discuss with a friend some of your earlier work on hygiene. List some of the ways that good hygiene can help diseases from spreading.

Ask students to work with a partner. They should begin by recalling the previous lesson. Suggest that they read out each label in the infogram and decide iwhich are the three most important points.

Answer: *Students should be encouraged to share their reasoning behined their choice of ways good hygiene prevents spread of diseases.*

Point out the text at the bottom of page. Read this out slowly and ask students if they are surprised thathandwashing is so effective against spread of diseases. . Ask students if they have seen any evidence to the contrary. They can share their examples by telling the class.

Ask students to read the sentence about treating plant disease and ask, 'How can plant disease be treated? What happens to plants that cannot be treated?'

Investigation: Researching diseases and pathogens

Computing link: The purpose of this investigation is to allow students to carry out their own research to into infectious diseases and pathogens. Allow students to work in small groups of three or four and have access to the internet or biology books that include sections on diseases.

Each group should choose one example of an infectious disease and research which pathogen is responsible for it. They should take notes and download information and diagrams, then use these to make a health information leaflet to advise people how to prevent the spread of the disease. Point out that they must include coloured diagrams, charts and tables so people can read the advice easily.

You could add the leaflets in a booklet to your class library or keep them as digital documents to be added to the school intranet for sharing as a resource.

Possible response: *Students should find that pathogens responsible for common and/or well-known diseases including but not limited to the fl**u,** common cold, typhoid fever, dengue, athletes foot, covid-19, etc. Remind to also focus on modes of spread of the pathogen, whether by air, water, food or touch.*

Point out the text under the STEM box. Either read it out slowly yourself or ask a volunteer to read it out for the class. Encourage a discussion on wearing a mask. Ask the students if they have seen people wearing a mask in public and what was their reaction?

Science fact: Talk about examples of when people should wear masks at home, outside the home or at work.

Point out the Science fact. Ask students if they can recall any incident when/where they were advised to wear masks in public.

You may lead them to recall the Covid-19 pandemic. Exercise sensitivity when asking for further information as students may have had loved ones succumb to the same or visited them in a hospital.

Investigation: Staying safe from infectious diseases

Computing link: The purpose of this investigation is to allow students to carry out their own research to find out how infectious diseases are spread and how this can be reduced or prevented. Allow students to work in small groups of three or four and have access to the internet or biology books that include sections on diseases.

Each group should choose one example of an infectious disease and research how its spread can be slowed down or stopped. They should take notes and download information and diagrams, then use these to make a health information leaflet to advise people how to

prevent the spread of the disease. Point out that they must include coloured diagrams, charts and tables so people can read the advice easily.

You could add the leaflets in a booklet to your class library or keep them as digital documents to be added to the school intranet for sharing as a resource.

Possible response: *Students should find that pathogens spread through the air as droplets made by coughing and sneezing and this can be reduced by using a handkerchief or mask and by washing hands. Pathogens spread in water when people add waste, such as human and farm animal sewage, to rivers and streams. This can be prevented by treating the sewage before it enters the water supply or by treating the water before it is used. Infectious diseases can spread by touching if a person has pathogens on their skin – especially their hands. These pathogens can pass into food if the person handles the food or directly onto another person if they touch the skin. This can be reduced or prevented by washing hands regularly, especially after going to the toilet, and wearing gloves.*

Stretch zone: Do a thorough research on COVID-19, and share the information of its characteristics, its spread, and symptoms with your classmates.

Encourage students to use the internet, as well as their personal account to create their research reports. Encourage them to back their anecdotes with actual scientific facts and figures.

You could run a competition and display the reports in the classroom. Remind them that in order to win the information must be accurate.

Discussion

Have you been vaccinated for any diseases? Tell your partner what happened.

Before they tackle the discussion task ask students to read through the text about vaccinations. Ask them to share their experiences of vaccinations. Ask, 'Have you been vaccinated? What disease was it protecting you from? What did it feel like? Why is vaccination so important?'

Next you can talk students though the diagram showing how vaccination works. Explain that when pathogens enter the body the body responds by making antibodies which help to kill the pathogens. This is part of the immune response. If there are too many pathogens or the body is slow to make the antibodies then the person can become very ill.

To speed up the production of antibodies a vaccine is used. This is a weakened or altered piece of the pathogen. When it enters the body it cannot cause the disease but it does kick-start the production of antibodies. This means the body is ready if the pathogen does enter the body at a later stage.

Vaccines can now protect against many infectious diseases, such as chicken pox, smallpox, measles, mumps, polio, tetanus and flu. Each pathogen needs to have its own specific vaccine.

Ask students if they discovered any of the diseases which have vaccines against them during their investigation. Ask them to think about what problems might be caused if vaccinations did not exist. You may wish to talk about the impact of Covid-19 and the eventual vaccines.

Key ideas

Infectious diseases are caused by microorganisms. They make us ill and can cause different signs and symptoms of disease.

Vaccinations can prevent some infectious diseases.

Summarise the lesson by asking students what they have learned. Let them share their ideas, read out and discuss the key ideas. This will remind students that microorganisms that cause disease are called pathogens. Ask them to tell their partner one symptom and one sign of a disease. Finally, ask them to tell you one disease that can be vaccinated against.

Review and reflect

Ask students to work in pairs. Ask one of the pair to be a doctor and the other to be a patient. They should decide on a disease and plan a short play to show what happens when the person visits the doctor with the disease. They should review the possible causes (mode of transmission) and symptoms and also discuss if a vaccine is possible. They then perform their short plays to the class and you could film these to show at a later stage.

Extra activities

1 Students can collect and send off for health information leaflets related to infectious diseases. They can make a collage on the wall to show some examples. They should try to include how the disease spreads, the signs and symptoms, and any treatments, including vaccines.

2 **Computing link:** Ask students to research some examples of infectious diseases in plants. They can download pictures of what the plants look like before and after infection and find out the pathogen involved. Students can also look into some treatments and the problems the disease causes.

Differentiation

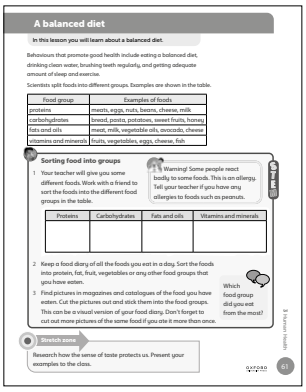
Supporting: Remind students that a symptom is what they feel. Anything a doctor can see or measure is a sign.

Consolidating: Display examples of health information leaflets in the room. This will give students opportunities to look up examples of diseases and be surrounded by real-life contexts.

Extending: Challenge students to learn more about the methods of mass production of vaccines.

Differentiated outcomes	
All students	should be able to state that infectious diseases can be passed from person to person.
Most students	will be able to describe how pathogens can cause signs and symptoms and give some examples.
Some students	may be able to explain how vaccines work to help to protect people from infectious diseases.

A balanced diet


A balanced diet

In this lesson you will learn about a balanced diet.

Behaviours that promote good health include eating a balanced diet, drinking clean water, brushing teeth regularly, and getting adequate amount of sleep and exercise.

Scientists split foods into different groups. Examples are shown in the table.

Food group	Examples of foods
proteins	meats, eggs, nuts, beans, cheese, milk
carbohydrates	bread, pasta, potatoes, sweet fruits, honey
fats and oils	meat, milk, vegetable oils, avocado, cheese
vitamins and minerals	fruits, vegetables, eggs, cheese, fish

Sorting food into groups

1 Your teacher will give you some different foods. Work with a friend to sort the foods into the different food groups in the table.

Proteins	Carbohydrates	Fats and oils	Vitamins and minerals

2 Keep a food diary of all the foods you eat in a day. Sort the foods into protein, fat, fruit, vegetables or any other food groups that you have eaten.

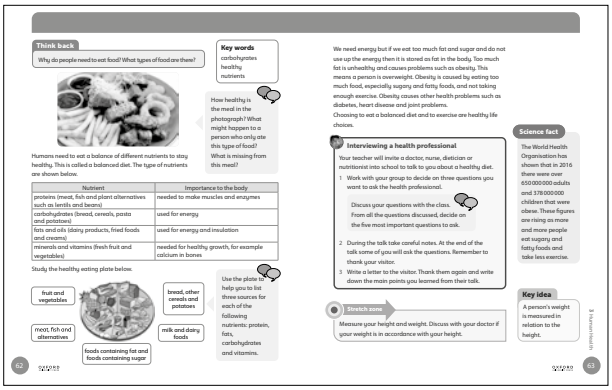
3 Find pictures in magazines and catalogues of the food you have eaten. Cut the pictures out and stick them into the food groups. This can be a visual version of your food diary. Don't forget to cut out more pictures of the same food if you ate it more than once.

Warning! Some people react badly to some foods. This is an allergy. Tell your teacher if you have any allergies to foods such as peanuts.

Which food group did you eat from the most?

Stretch zone

Research how the sense of taste protects us. Present your examples to the class.


Think back

Why do people need to eat food? What types of food are there?

Key words

carbohydrates

healthy

nutrients

How healthy is the meal in the photograph? What might happen to a person who only ate this type of food? What is missing from this meal?

Humans need to eat a balance of different nutrients to stay healthy. This is called a balanced diet. The type of nutrients are shown below.

Nutrient	Importance to the body
proteins (meat, fish and plant alternatives such as lentils and beans)	needed to make muscles and enzymes
carbohydrates (bread, cereals, pasta and potatoes)	used for energy
fats and oils (dairy products, fried foods and creams)	used for energy and insulation
minerals and vitamins (fresh fruit and vegetables)	needed for healthy growth, for example calcium in bones

Study the healthy eating plate below.

fruit and vegetables

bread, other cereals and potatoes

meat, fish and alternatives

milk and dairy foods

foods containing fat and foods containing sugar

Use the plate to help you to list three sources for each of the following nutrients: protein, fats, carbohydrates and vitamins.

We need energy but if we eat too much fat and sugar and do not use up the energy then it is stored as fat in the body. Too much fat is unhealthy and causes problems such as obesity. This means a person is overweight. Obesity is caused by eating too much food, especially sugary and fatty foods, and not taking enough exercise. Obesity causes other health problems such as diabetes, heart disease and joint problems.

Choosing to eat a balanced diet and to exercise are healthy life choices.

Interviewing a health professional

Your teacher will invite a doctor, nurse, dietician or nutritionist into school to talk to you about a healthy diet.

1 Work with your group to decide on three questions you want to ask the health professional.

Discuss your questions with the class. From all the questions discussed, decide on the five most important questions to ask.

2 During the talk take careful notes. At the end of the talk some of you will ask the questions. Remember to thank your visitor.

3 Write a letter to the visitor. Thank them again and write down the main points you learned from their talk.

Stretch zone

Measure your height and weight. Discuss with your doctor if your weight is in accordance with your height.

Science fact

The World Health Organisation has shown that in 2016 there were over 650 000 000 adults and 378 000 000 children that were obese. These figures are rising as more and more people eat sugary and fatty foods and take less exercise.

Key idea

A person's weight is measured in relation to the height.

Getting started

In this lesson students will learn about the different nutrients needed as part of a balanced diet; they will carry out a food label survey to identify common foods that contain these nutrients.

Language support

Explain to students that the word 'nutrients' includes the substances found in food and drink. Point out that these are split into groups named carbohydrates, proteins, fats, minerals and vitamins. Write these words on the board and ask students to say them out loud and practise writing the words.

Resources

Student Book: a range of food packets and/or tins showing food labels.

Key words

carbohydrate healthy nutrients protein

Scientific enquiry key words

notice patterns group/classify

use secondary sources communicate findings

Lesson at a glance

The key teaching points in this lesson are:

- nutrients can be divided into groups called carbohydrates, proteins, fats, vitamins and minerals
- each of these nutrients is needed for specific jobs in the body
- a healthy diet needs to have a balance of nutrients.

Read out the text at the top of page. This points out that common food groups (nutrients) and in which foods are they found.

Ask students to discuss which foods they eat the most and then ask them to think about what the foods give their body that helps it to stay healthy and grow. They

can use both the information in the boxes and prior learning to address this question.

Remind the students that humans are omnivores and therefore we need to eat lots of different types of food to stay healthy. Ask them to remember Year 2 when they investigated the need to eat the right amounts of different foods to stay healthy.

Investigation: Sorting food into groups Warning!

Some people react badly to some foods. This is an allergy. Tell your teacher if you have any allergies to foods such as peanuts. Read out the warning and point out that some people react badly to some foods. This is an allergy. Insist that students tell you if they have any allergies to foods such as peanuts.

Hand out some different foods and ask students to work with a partner to sort the foods into the different food groups in the table.

Ask students to keep a food diary of all the foods they eat in a day. They should sort the foods into protein, fruit, vegetables or any other groups that they have eaten.

Ask students to find pictures in magazines and catalogues of the food they have eaten. They can cut the pictures out and stick them into the food groups. Explain this will be a visual version of their food diary. Remind them to cut out more pictures of the same food if they ate it more than once.

Possible response: *Students should be able to classify examples of food rich in carbohydrates (such as bread, pasta and cereals), proteins (such as meat, fish, pulses and eggs), fats (such as cheese, butter and fatty meats) and minerals and vitamins (such as fruit and vegetables).*

Stretch zone: Research how the sense of taste protects us. Present your examples to the class.

Computing link: Allow students access to the internet and ask them to search for examples of how spoiled, polluted or toxic foods can be detected by taste. They can present their examples to the class as a computer presentation, a poster or verbal presentation.

Possible response: *Students should find that foods spoiled by microorganisms have an unpleasant taste. Many poisonous substances, such as from certain mushrooms and plants, can also have an unpleasant taste. However, you could stress that some harmful substances have no taste so students should always be careful what they eat and drink.*

Discussion

How healthy is the meal in the photograph? What might happen to a person who only ate this type of food? What is missing from this meal?

over the last 24 hours. Point out the picture of the healthy eating plate. Explain to students that there are many similar plates in books and on the internet that might have some differences. For example, parts of the world may use the term 'staples' for carbohydrates and 'foods from animals' to describe meat, eggs, cream, cheese and milk. However, all have the same principle. Each group of nutrients does a particular job in the body and should be eaten in the correct amounts.

You could use this as an opportunity to discuss science in context and explain that some people have a job that involves researching about diet and finding out new things that add to or change the advice given. For example, we now know we should eat a lot less sugar and fat than was considered acceptable even a few years ago.

Ask students to look at all of the parts of the plate very carefully and identify the foods that are shown. Explain that most foods contain more than one type of nutrient but they are grouped based on which nutrient is the most important. They can then list any that they have eaten in the last 24 hours. Ask them to look at the healthy eating plate and decide which food group each food would belong in.

Possible response: *Students should identify a range of carbohydrates, proteins and fats in their diet and various fruits and vegetables that provide minerals and vitamins. They should identify that greens and fruits are missing from this meal and a person eating such a deficient meal will suffer from loss of vitamins and minerals.*

Read through about the text explaining the healthy eating plate. The text reminds students that scientists have grouped the foods by what they do for our bodies and that when we eat some foods from each of these groups we have a balanced diet and we keep healthy.

Discussion: Use the plate to help you to list three sources for each of the following nutrients: protein, fats, carbohydrates and vitamins.

The purpose of this discussion is to allow students to apply their knowledge of food groups in a real-life situation. Ask students if they have considered the nutritional content of their food before. Ask, 'Do you look at food labels before you eat the food? Do you or your family look at the labels before you buy food? Are there any things on a label that would put you off eating a certain food?'

Ask students to work in small groups of three or four. Give each group a range of food. Ask students to record how much protein, fat, carbohydrates, minerals and vitamins are found in each food.

Students should use the evidence to sort the foods into three groups: high protein; high fat; high carbohydrate.

Maths link: You can ask students to use their maths skills to record the information into a table. They can also compare the number of grams of protein, carbohydrates and fats in certain foods and produce bar charts.

Ask students to discuss which of the people listed in the investigation box would need to eat the most carbohydrates. Point out that they should explain why.

Possible response: *Students should identify a range of different protein-rich, carbohydrate-rich and fat-rich foods depending on the labels you give them. They should suggest the marathon runner would have to eat more carbohydrates than an office worker as a marathon runner would use up more energy and carbohydrates provide energy.*

Science fact The World Health Organisation has shown that in 2016 there were over 650 000 000 adults and 378 000 000 children that were obese. These figures are rising as more and more people eat sugary and fatty foods and take less exercise.

Read out the Science fact and stop when you get to the word obese. Explain that this is the scientific term used to indicate medically overweight. You can link this back to food intake and point out how over eating or excessive ingestion of sugar and fats, coupled with reduced or lack of exercise, can lead to obesity. Ask students toresearch the answer to the question, 'How much energy does a 9-year-old child need?'

Investigation: Interviewing a health professional

This activity is a very valuable opportunity to help students to set science in context as they will meet a person who uses science as part of their job. They can also reflect on their own health issues and diet choices.

Invite a doctor, nurse, dietician or nutritionist into school to talk to students about a healthy diet. Prior to the visit, write to the visitor to explain where the activity fits into the curriculum and to help the visitor determine the level of talk they will give. You can help students to prepare, and review their knowledge so far, by asking them to work in a small group to decide up to five questions they want to ask the health professional.

Possible response: *Students should suggest that if a person did not eat enough of the right foods they would lack energy, may not be able to grow healthy bones, teeth and muscles and they would have little fat for warmth. They may know from earlier work and health information that fatty and sugary foods and drinks should only be eaten in small amounts.*

Stretch zone: Measure your height and weight. Discuss with your doctor if your weight is in accordance with your height.

Encourage students to discuss this question with their primary healthcare provider.

Key idea

A person's weight is measured in relation to the height.

Summarise the lesson by asking students what they have learned. Let them share their ideas, read out and discuss the key idea. This will remind students that a balance of the different nutrients is needed in a healthy diet. You could show photographs, and ask pairs to work together to decide if they are mainly rich in carbohydrates, protein, fat or minerals and vitamins.

Explain that energy content is worked out per gram or 100 grams, as it wouldn't be fair to compare the energy in one grape and one loaf of bread. Also point out that fibre is a special type of carbohydrate.

Healthy eating

Explain to students that they are going to design a healthy breakfast. Point out the list of foods they can select from. Ask students to look at the picture of a healthy eating plate. Remind them that if we eat the correct amount of foods from each group, we have a balanced diet. Hand out poster paper and ask students to draw a large circle for their plate. They then choose some foods for a healthy breakfast. Ask them to draw the foods or write their names on their plate.

Computing link: Students could decide on the breakfast menu and then download photographs of the food to stick onto their healthy eating plate.

Ask students to think about each food carefully. Stress that they should not just choose their favourite foods but think carefully about making a healthy, balanced meal. Display the plates – for example you could suspend them from the ceiling by string so they slowly turn.

Review and reflect

You can ask students to walk around the healthy eating plates and food label displays and leave feedback comments at each. These can be written onto small pieces of paper in the form of two stars and a wish. This means two positive comments and one suggestion for improvement.

Students can have some thinking time to evaluate the comments they receive and set one target for when they do similar work.

Extra activities

1 Hand out menus from local restaurants, cafés and food stands and ask students to read through them and identify the food groups that are represented. They can write a letter 'H' next to healthy foods and a letter 'U' next to foods or meals that are less healthy.

2 Take students out on an educational visit to a supermarket, food shop or market. Tell them they are going to survey the different foods they see and then record which are rich in protein, carbohydrates, fats and minerals and vitamins. Ask them to design a table to record their findings.

Differentiation

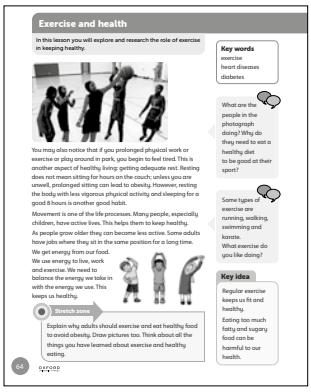
Supporting: You can obtain and use model foods that are used in a child's toy kitchen to allow students to move them around and group them.

Consolidating: Display pictures of examples of the different nutrient groups on the classroom walls. Label them clearly as: protein-rich; carbohydrate-rich; fat-rich, mineral-rich and vitamin-rich.

Extending: Students can research the different types of carbohydrates so they understand the difference between simple sugars, manufactured sugars, starch and fibre.

Differentiated outcomes	
All students	should be able to state that a healthy diet must have a balance of foods.
Most students	will be able to name the different nutrient groups and give examples of foods rich in them.
Some students	may be able to plan a meal based on the recommended ration of the different food groups.

Exercise and health


Exercise and health

In this lesson you will explore and research the role of exercise in keeping healthy.

Key words
exercise
heart diseases
diabetes

What are the people in the photograph doing? Why do they need to eat a healthy diet to be good at their sport?

You may also notice that if you prolonged physical work or exercise or play around in park, you begin to feel tired. This is another aspect of healthy living: getting adequate rest. Resting does not mean sitting for hours on the couch; unless you are unwell, prolonged sitting can lead to obesity. However, resting the body with less vigorous physical activity and sleeping for a good 8 hours is another good habit.

Movement is one of the life processes. Many people, especially children, have active lives. This helps them to keep healthy.

As people grow older they can become less active. Some adults have jobs where they sit in the same position for a long time.

We get energy from our food.

We use energy to live, work and exercise. We need to balance the energy we take in with the energy we use. This keeps us healthy.

Some types of exercise are running, walking, swimming and karate. What exercise do you like doing?

Key idea

Regular exercise keeps us fit and healthy.

Eating too much fatty and sugary food can be harmful to our health.

Stretch zone

Explain why adults should exercise and eat healthy food to avoid obesity. Draw pictures too. Think about all the things you have learned about exercise and healthy eating.

64 OXFORD

Getting started

In this lesson students will explore what happens when humans exercise. They will investigate how it feels to exercise and the impact of exercise on breathing and heart rate.

Language support

Students will be familiar with 'breathing', 'exercise' and 'heart' but will be less familiar with the term 'diabetes'. Explain that disease occurs when the blood sugar or glucose is too high. It occurs due to inability of body to completely utilize the glucose.

Resources

Student Book: stopwatch or timer.

Key words

exercise heart diseases diabetes

Scientific enquiry key words

use equipment observe measure
notice patterns record data carry out tests
use secondary sources communicate findings

Lesson at a glance

The key teaching points in this lesson are:

- energy from food helps us move
- when we exercise the body needs more oxygen and sugars for energy
- the heart beats faster and we breathe more often to provide the sugars and oxygen to the muscles.

Discussion

Some types of exercise are running, walking, swimming and karate. What exercise do you like doing?

Ask students to study the pictures of the children exercising.

You could include some movement for learning at this stage by asking students to stand up and model the exercises that the children are doing. You could add some fun to this by suddenly saying, 'Stop' and students have to pause in whatever shape they are in.

Students can then talk about the exercises they like doing. You could ask them to list three and share these with the class.

Maths link: Students could survey each other to find the forms of exercise they most like doing. These can be recorded in a table and charts, such as a bar chart, made to display the findings.

Read through the text. This talks about movement as one of the life processes.

Explain that as people grow older they can become less active. Some adults have jobs where they sit in the same position for a long time. Ask students why this might be a problem for these people. What advice would they give them?

The text also informs students that we get energy from our food which we need to balance with the energy we need to live, work and exercise.

Discussion

What are the people in the photograph doing? Why do they need to eat a healthy diet to be good at their sport?

Students should work with their partner. Point out the photograph and ask them to talk about the activity they can see taking place. Ask them to talk about when they have done similar activities. To link back to work on diet, ask students to consider why a healthy diet is needed if doing a lot of exercise.

Possible response: *The people are playing basketball. They need a healthy diet to give them enough energy and the raw materials for growing and repairing muscles.*

Read through the text on the page. You can make the text more interactive by asking the following questions, 'What pumps blood to every part of our body? What does the blood contain that helps with exercise? What does the body need more of when we exercise? What do our lungs breathe in that helps with exercise?'

Stress that how fast the heart beats is called the heart rate. Explain that when an artery passes over a bone near the skin, it is possible to feel the blood pumping through it. This is called a pulse and the pulse rate is the same as the heart rate.

Explain that the easiest way to calculate the pulse rate is to count the pulse for 30 seconds and double the number, as pulse rates and heart rates are always given in beats per minute. Demonstrate the taking of a pulse and allow students to practise feeling a pulse, as they will need to do this in the following investigation. Stress that they should use two fingers as shown in the picture and never use their thumb as the thumb has a small pulse and can confuse the results.

Stretch zone: Explain why adults should exercise and eat healthy food to avoid obesity. Draw pictures too. Think about all the things you have learned about exercise and healthy eating.

Computing link: Allow students to have access to the internet so that they can research what recovery rate is and its significance. Ask them to think about how they could determine their own recovery rate and then allow them to carry out their investigation. Encourage them to compare their recovery rates to other people in the class.

Possible response: *Students should find out that recovery rate is the time taken for the heart rate to return to normal after exercise. They should find that recovery rates vary between people.*

Key idea

Regular exercise keeps us fit and healthy.

Summarise the lesson by asking students what they have learned. Let them share their ideas, read out and discuss the key idea. This will remind students that regular exercise keeps us fit and healthy. Ask them which exercise they selected as their favourite. Also ask them to demonstrate how they would take a pulse to determine heart rate. You could write the numbers 70 and 130 on the board and tell students they are the heart rates per minute for a sportsperson. Ask them which represents the resting rate and which represents the rate after exercise.

Review and reflect

Ask students to write down their favourite form of exercise on a piece of paper and fold this up and put it into a bowl. Ask a student to come to the front and pull out a piece of paper and read it to the class. The class then discuss in pairs why this exercise is important and how it can help to keep people healthy. You can then ask for volunteers to share their ideas with the class before asking a student to pull out another piece of paper.

Extra activities

1 Play students some video clips of athletes performing. You can select some local athletes as well as those from other nations. Ask students to discuss what the event is and how much energy the people are using to perform the activity. Students could talk about how the people would need to practise and train and they

can think about the personal determination needed to improve in a sport or any activity.

2 Take students out to a local play park to use the equipment and also observe younger children using it. They can make a note of how the equipment helps people to stay flexible and helps muscles to develop. They can also explore how some of the activities increase breathing and heart rates.

Differentiation

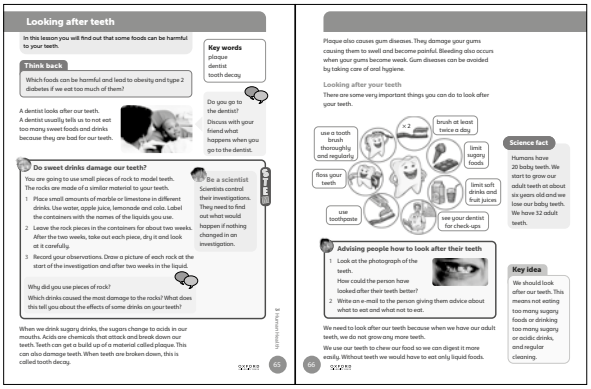
Supporting: Take students through a one-minute exercise and ask them to hold their hands on their chest so they can feel the chest moving and their heart beating faster.

Consolidating: Download animations of a heart beating at different rates from the internet, or you can hold a microphone up to your chest. This will help students to link the heart with exercise.

Extending: Ask students to find out about the volume of blood a resting heart pumps round the body each minute and then contrast this with the volume pumped during and after exercise.

Differentiated outcomes	
All students	should be able to state that regular exercise helps to keep us fit and healthy.
Most students	will be able to link exercise with an increase in breathing and heart rates.
Some students	may be able to explain that breathing and heart rates increase to provide more food and oxygen to the muscles.

Looking after teeth



Getting started

In this lesson students will learn about the importance of looking after their teeth. They will learn how some foods and drinks can produce acids that can attack the teeth and make holes. They will study the importance of regular cleaning.

Language support

Students will be familiar with the words 'tooth' and 'toothbrush'. However, 'plaque' and 'decay' may be new words. You can also point out that the word is pronounced 'plack'. Ask students if anyone can volunteer a definition of the word 'decay'. If not, explain that it means to rot away. Synonyms that might be useful are break down or spoil.

Resources

Student Book: pieces of marble or limestone; cups containing (separate) samples of water, apple juice, lemonade and cola.

Key words

plaque dentist tooth decay

Scientific enquiry key words

ask questions use equipment observe
measure compare notice patterns record
carry out tests group/classify
communicate findings

Lesson at a glance

The key teaching points in this lesson are:

- teeth can be damaged by acids that decay the teeth and make holes

- it is important to look after our teeth, for example by not eating or drinking too many sugary or acidic foods and by regular cleaning.

In the next lesson, students will learn more about food chains and how they are represented to show how energy passes along them.

Think back: Which foods can be harmful and lead to obesity and type 2 diabetes if we eat too much of them?

Ask students to work with a partner. Allow them a few minutes to think about the last lesson and recall their work on the links between diet and obesity and diabetes. If you wish, you can let them look back at their notes from earlier.

It is a useful learning strategy to encourage students to keep looking back at earlier work and not regarding this as a failure or cheating, unless you specifically ask them not to for a particular purpose. The more often they review work the more they will learn and understand it. This is sometimes called 'fire together, wire together'. The neuroscience basis is that practice helps neurons in the brain to link together to help recall and processing.

> ***Possible response:*** *Students should recall that sugary and fatty foods can be harmful and can lead to obesity and type 2 diabetes.*

Discuss the text on the page. This explains that a dentist looks after our teeth. A dentist usually tells us to not eat too many sweet foods and drinks because they are bad for our teeth.

Do you go to the dentist? Discuss with your partner what happens when you go to the dentist.

Ask students to work with a partner to discuss their experiences of visiting the dentist. The availability of dentists will vary around the world and so will the frequency of visits, but students should have some experiences to share. You can use this activity as an opportunity to address any fears about dental visits that some students may have. Dental visits are pain-free and regular check-ups will spot problems when they are small and easy to treat.

> ***Possible response:*** *Students may mention that the dentist checks each tooth in turn – using a mirror to see the back of the teeth. They check for the condition of the teeth, for example if there are any small holes or areas of discolouration – and also the condition of the gums. A dental hygienist may clean the teeth thoroughly. Any small holes are drilled to remove decay and the holes are filled with a filling.*

Investigation: Do sweet drinks damage our teeth?

Students can work in a small team of three or four. Explain to students that they are going to use small pieces of rock to model teeth. This is because it isn't easy to obtain human teeth and many students find this disturbing. They can use their own tooth when it falls out as a 'baby tooth'. Point out that scientists often use models in this way and the rocks have been chosen because they are made of a material similar to human teeth. It isn't exactly the same as the rocks are calcium carbonate and enamel is made up of calcium and phosphate ions in the form of a large high-strength crystal, and 1% of enamel is organic (mainly proteins). However, the rocks are a suitable model for teeth.

Ask students to place small amounts of marble or limestone in different drinks. They can use water, apple juice, lemonade and cola – or any drinks you wish as long as some are fizzy and many are acidic. Always include water as this will act as a control and students can discuss this as part of the Be a scientist feature mentioned below.

Remind students to label the containers with the names of the liquids they use. They then leave the rock pieces in the containers for about two weeks. At regular intervals (possibly every two days) students can observe what is happening, and at the end of the two weeks they can take out each piece, dry it and look at it carefully. Students should record their observations during and at the end of the investigation.

Computing link: Students can draw pictures of each rock at the start of the investigation and after two weeks in the liquid, or they can use digital cameras for this purpose. Any photographs can be downloaded and used in a scientific report.

> ***Possible response:*** *Students should observe that the rocks are worn away slightly and often a darker colour after being in any sugary or acidic drink.*

Be a scientist: Scientists control their investigations. They need to find out what would happen if nothing changed in an investigation. That is why you added one piece of rock to water.

You can read out the Be a scientist information at the start of the investigation or leave it to the end to encourage students to reflect on fair testing. Ask them to think about why water was used and elicit that water is not very acidic (if at all) and so they will see what the model teeth would look like when left in a liquid with no acid in it. This will rule out any chance that the rocks wore away and discoloured naturally over time. It must be the acid in the liquids that caused the changes.

Read through the text at the top of the next page or ask a volunteer to read it out. Explain that plaque is like a paste that collects on the teeth and this can provide a habitat for microorganisms. These break down sugar as their food and make acid as a by-product. It is this acid that can dissolve the teeth and make holes.

Point out the drawings on the page. Explain that there are some very important things students can do to look

after their teeth. Ask them to study each picture carefully and tell them they will need to use the information for the investigation. Ask students to think back to the types of teeth found in humans; they should recall incisors, canines, pre-molars and molars.

Science fact Humans have 20 baby teeth. We start to grow our adult teeth at about six years old and we lose our baby teeth. We have 32 adult teeth.

Read out the Science fact or ask a volunteer to read it out. Point out that humans only have two sets of teeth: once the 'baby teeth' have fallen out the teeth that replace them must last us for life. Stress that this is why it is so important to look after our teeth. Once they have gone they will leave a gap or false teeth will be needed.

Investigation: Advising people how to look after their teeth

Ask students to look at the photograph of the person's teeth. Ask them to discuss how the person could have looked after their teeth better. Explain that students should write an email to the person giving them advice about what to eat and what not to eat. Explain that they will not send the email but this will allow them to draw together what they have learned about teeth.

will not send the email but this will allow them to draw together what they have learned about teeth.

Possible response: *Students should include the following in their email: don't eat or drink as many sugary or acidic drinks and foods, clean teeth regularly and visit the dentist regularly.*

Key idea

We should look after our teeth. This means not eating too many sugary foods or drinking too many sugary or acidic drinks, and regular cleaning.

Read out the key idea and the text at the bottom of page 79. Ask students to list two foods or drinks they will try to eat or drink less of. You can also ask them to discuss what advice about dental hygiene they would pass on to a person who did not know about it.

Review and reflect

Hold up word cards for the key words in the lesson: decay; dentist; toothbrush; toothpaste; floss; acid; plaque. Each time you hold up a word ask students to turn to a partner and use the word in a sentence. They should write down any of the words they are unsure of and look these up.

Extra activities

1 Students can look at the labels and claims on toothpaste tubes and packaging to read any instructions for using the paste for dental care and also any chemical additives such as fluoride. They can find out about the claims for fluoride as a substance that protects teeth.

2 **Computing link:** Ask students to research the composition of teeth in adult humans. They know that adults have 32 teeth, but ask them to find out how many are incisors, canines, pre-molars and molars. They could also compare this to other mammals and find out if human dentition is similar or different to herbivores and carnivores.

3 **Computing link:** Students can use the internet to find and download photographs of animal teeth placed in acidic drinks to add to their investigation reports.

Differentiation

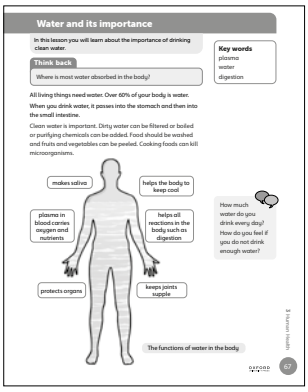
Supporting: Display a large version of the diagram to highlight ways of carrying out dental hygiene.

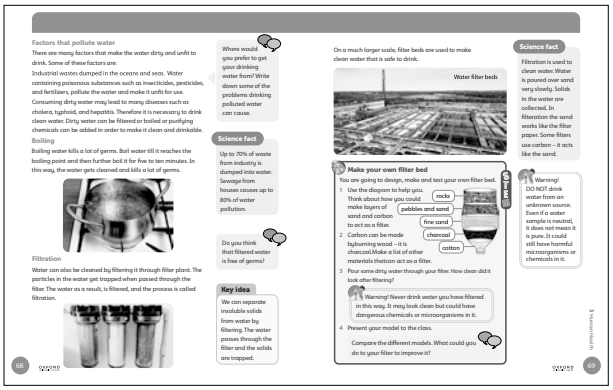
Consolidating: Ask students to design a poster for a shopping centre or school to show people how to look after their teeth and why this is important.

Extending: Students could find out about the bacteria in plaque and how the bacteria can change sugars to acids that attack the teeth.

Differentiated outcomes	
All students	should be able to state that it is important to look after teeth by reducing sugary and acidic foods and drinks
Most students	will be able to describe the different ways that dental hygiene can be used to look after teeth
Some students	may be able to explain how sugars in the mouth are changed to acids by bacteria in the plaque

Water and its importance





Getting started

In this lesson students will learn that without water living things cannot survive. They will investigate how much water they drink in a single day and explore ways to clean dirty water. They will also look at how we can use the technique known as filtering to separate insoluble substances from a mixture with water. Students use filtering to demonstrate the importance of the technique to clean water.

Language support

Discuss the key words 'cell' and 'filter' with students. Point out that a cell is the smallest part of a living thing and we have many different types of cells. You can introduce some history of science by explaining that the British scientist Robert Hooke first used the word. In 1665 he was using one of the early microscopes and thought the parts of the living things he could see looked like the small rooms used by monks. These were called cells. Ask students when they have heard of the word 'filter' before. They may recall the earlier lesson where they filtered dirty water. Explain that a filter traps large pieces and lets smaller pieces run through. You could ask students to help you to create a wall display of the key words. This could be visually stimulating. For example, download and display pictures of filter beds and filtration units near the appropriate words. Write the words 'filter' and 'filtration' on the board. Show students a filter and say that 'filter' is the name of the equipment and 'filtration' is the process that happens when the equipment is used.

Resources

Student Book: large jugs; containers to hold water collected from around the school; sand; water; beakers or jars; spoons; sieves; filter paper; filter funnels; materials to design, make and test a filter bed such as large plastic bottles, scissors, cotton wool, charcoal, fine sand, pebbles, sand and rocks; dirty water. materials to make posters.

Key words

plasma water digestion

Scientific enquiry key words

use equipment observe measure record data carry out tests

Lesson at a glance

The key teaching points in this lesson are:

- humans lose water as sweat and this has to be replaced by drinking and by getting water from food
- water may contain dirt and harmful microorganisms and so must be cleaned
- water can be cleaned by filtering.

Read through the text on page or ask volunteer students to read out a sentence each. This explains that all living things are made up of cells, and that if cells dry up the life processes cannot take place.

Stress to students that plants, animals and humans need water so their bodies can work properly. Point out that humans can survive three weeks without food but only three to four days without water. Tell students they are going to investigate how much water they drink in one day.

Investigation: How much water do you drink in one day?

The purpose of this investigation is to encourage students to reflect on how much water they consume in a single day. Explain to students that every time they have a drink, they should measure out the same amount of water as they drank into a bottle or measuring jug. For example, if they have a glass of orange juice for breakfast, pour a glass of water into the jug. Tell students they should measure how much water they have collected at the end of the day.

Ask students to write down the volume of water they drank in the day and pin these on to a wall so students can compare the amounts. They can use these figures to inform the following discussion.

Possible response: *Students will probably find that they drank between 1.3 and 1.5 litres per day. Remind them that they also obtain water from the food they eat.*

Discussion

Where would you prefer to get your drinking water from? Write down some of the problems drinking polluted water can cause.

Ask students to work with a partner andshare their thoughts. Encourage them to present atleast a two line reason behined their choice. Encourage them to decide if everyone has similar opinions.

Read the text discussing pollution, boiling and filteration and holding a short class discussion about why these are important.

Allow students to work in small groups of three or four.

Science fact: Up to 70% of waste from industry is dumped into water. Sewage from houses causes up to 80% of water pollution.

Encourage students to share their thoughts with reasoning. Encourage them to design experiments to test their hypotheses.

Discussion

Do you think that filtered water is free of germs?

Ask students to imagine that they had to drink water from where the dirtiest water sample was collected. Stress again that it would not be safe to do this but as part of their science learning it is useful to imagine things happening. Tell students to discuss some possible ways of making the water safer.

Computing link: You could use this as an opportunity to allow students to research ways of purifying water, other than filteration. They could download photographs and diagrams or develop an online information page, sometimes called a wiki.

Possible response: *Students should suggest one or more of the following techniques: filtering through paper or sand; boiling the water; evaporating the water and collecting the vapour; or adding purifying chemicals.*

Point out the photograph of the water filter beds on and read out the text alongside it. This explains that on a much larger scale, filter beds use filtration to make clean water that is safe to drink.

Tell students that they are going to make their own filter bed using their understanding of filtering. They should continue to work in their groups for this investigation.

Investigation: Make your own filter bed

Warning! Never drink water you have filtered in this way. It may look clean but could have dangerous chemicals or microorganisms in it.

Point out the warning at the start of the investigation. Ask students where the chemicals or microorganisms might come from. Explain that in a science room the equipment is not always clean because it is not intended for food or drinks to be consumed there. This is another reason why students should never eat or drink in a science room.

At the start of the investigation show students the equipment that is available for them to make their filter beds. Remind them that they can use the diagram to help them design their filter bed. They could research other materials that can be used in a filter bed or use the ones described in the investigation. You could make a batch of dirty water using soils and leaf debris or compost. Give each group a jug of dirty water to investigate. Students might decide to filter the water more than once and compare the two samples of water.

Possible response: *Students should suggest that the water looked surprisingly clean after using this simple filter bed. They should present their findings to the class, in a two-minute presentation, for example.*

Science fact: Filtration is used to clean water. Water is poured over sand very slowly. Solids in the water are collected. The sand works like the filter paper. Some filters use carbon – it acts like the sand.

Ask a student to read out the Science fact or have students read it to each other in pairs. Ask them to think about what would happen if the sand was soluble. Would the filter bed still work? This should demonstrate the importance of some solids not being soluble.

Compare the different models. What could you do to your filter to improve it?

Ask students to discuss the question in their groups after observing the other models presented by the class.

Possible response: *Students should suggest that they might add more levels or make some of the levels thicker. They might also suggest repeating the filtration until the water is as clean as possible.*

Key idea

We can separate insoluble solids from water by filtering. The water passes through the filter and the solids are trapped.

Read out the Key idea. One way to do this is to read it out and stop occasionally and ask students to tell you what the next word should be. For example, you could stop and miss out the words 'solids', 'filtering', 'filter', 'solids'.

Review and reflect

Ask students to sit quietly for a few minutes and think back over the lesson. They can then turn to a partner and finish the statement: 'The most important thing I have learned this lesson is…' Ask for volunteer pairs to share their answers with the class. Hold up word cards for the key words in the lesson: 'filter', 'filtration', 'insoluble', 'mixture' and 'separate'. Each time you hold up a word ask students to turn to a partner and use the word in a sentence. They should write down any of the words they are unsure of.

Ask students to reflect on the investigations they carried out and think about how well they worked as a team member and how well they communicated with each other. Ask them to think of one way of working that they are proud of. Now they should think of one thing they could improve on. Tell them this is their target. They can see if they meet their target in the next few lessons.

Extra activities

1 Tell students to imagine being stranded on a desert island. Ask them to make a poster to show how they would make the water from a pond cleaner. They have found some paper towels, fishing nets and plastic soda bottles on the island.

2 Ask students to write a diary entry about an imaginary day when everything except humans and animals became soluble. Volunteers could read out extracts to the class.

Differentiation

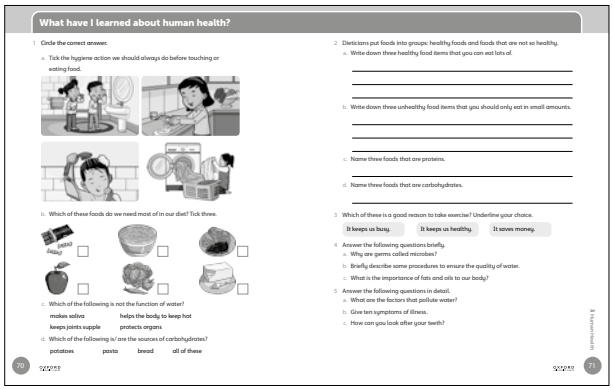
Supporting: Encourage students to practise using filter paper to separate different solids from water.

Consolidating: Ask students to explore different materials to use in a filter before adding the best ones to make a filter bed.

Extending: Ask students to research the materials that are used in modern water filter systems in their country.

Differentiated outcomes	
All students	should be able to identify the equipment used to separate solids from water
Most students	will be able to select the most appropriate equipment to use to separate different solids from water
Some students	may be able to select the best materials used to clean water

What have I learned about human health?


What have I learned about human health?

1 Circle the correct answer.

a. Tick the hygiene action we should always do before touching or eating food.

b. Which of these foods do we need most of in our diet? Tick three.

c. Which of the following is not the function of water?
makes saliva | helps the body to keep hot
keeps joints supple | protects organs

d. Which of the following is/ are the sources of carbohydrates?
potatoes | pasta | bread | all of these

2 Dieticians put foods into groups: healthy foods and foods that are not so healthy.
a. Write down three healthy food items that you can eat lots of.

b. Write down three unhealthy food items that you should only eat in small amounts.

c. Name three foods that are proteins.

d. Name three foods that are carbohydrates.

3 Which of these is a good reason to take exercise? Underline your choice.
It keeps us busy. | It keeps us healthy. | It saves money.

4 Answer the following questions briefly.
a. Why are germs called microbes?
b. Briefly describe some procedures to ensure the quality of water.
c. What is the importance of fats and oils to our body?

5 Answer the following questions in detail.
a. What are the factors that pollute water?
b. Give ten symptoms of illness.
c. How can you look after your teeth?

Getting started

The aim of this section is to encourage students to review their learning after each lesson in the unit and also to undertake some end-of-unit review and reflection. On these pages of the Student Book there are questions linked to concepts and topics covered in the unit. These will assess students' knowledge and understanding of the topic. You may have been using questions after each lesson where provided; there are links to relevant questions in the lesson sections in this Teacher's Guide.

However, it is also worth allowing students to answer all of the questions at the end of the unit. This will test longer-term understanding and recall. You can do this as an informal individual or pair activity and allow students to look information up as they work through the questions or you can set it as an individual 'closed-book' activity.

It is important that students report areas that they are not confident with. This information is useful for them in that they can think about what they need to review or ask advice about. It is also vital for you as it provides information about any topics you may wish to revisit.

"What have I learned about human health?" answers

1 Circle the correct answer.

a. Tick the hygiene action we should always do before touching or eating food.

b. Which of these foods do we need most of in our diet? Tick three.

c. Which of the following is not the function of water?
makes saliva helps the body to keep hot keeps joints supple protects organs

d. Which of the following is/ are the sources of carbohydrates? potatoes pasta bread all of these

Answer: *a. Students should tick the image showing the child washing their hands.*
b. Rice (for carbohydrates), meat (for protein) and either fruits or vegetables (for fiber, vitamins and minerals).
c. helps the body to keep hot.
d. all of these.

2 Dieticians put foods into groups: healthy foods and foods that are not so healthy.

a. Write down three healthy food items that you can eat lots of.

b. Write down three unhealthy food items that you should only eat in small amounts.

c. Name three foods that are proteins.

d. Name three foods that are carbohydrates.

Answer: *a. proteins, fruits and vegetables and in case of extra physical activity, carbohydrates.*

b. fats and oils, sugars, and we should aim to eat moderate amounts of carbohydrates.

c. meats, eggs, nuts, beans, cheese, milk, legumes.

d. bread, pasta, potatoes, sweet fruits, honey.

3 Which of these is a good reason to take exercise? Underline your choice.It keeps us busy. It keeps us healthy. It saves money.

Tell students to stir the sand and observe whether this helps it to dissolve.

Answer: *It keeps us healthy.*

4 Answer the following questions briefly.

a. Why are germs called microbes?

b. Briefly describe some procedures to ensure the quality of water.

c. What is the importance of fats and oils to our body?

Answer: *a. because germs are microscopic i.e. tiny sized.*

b. filtration and boiling.

c. they provide energy and insulation to our body..

5 Answer the following questions in detail.

a. What are the factors that pollute water?

b. Give ten symptoms of illness.

c. How can you look after your teeth?

Ask students to discuss the question in their groups after observing the other models presented by the class.

Answer: *a. Factors that pollute water and make it unfit to drink include Industrial wastes dumped in the oceans and seas. Other poisonous substances such as insecticides, pesticides, and fertilizers, also pollute the water and make it unfit for use.*
b. fever; headache; sore throat; chills; feeling sick; stomach pain; cough; skin rash; noisy breathing; swollen glands.
c. some of the ways we can look after our teeth include the following: brush at least twice a day; limit sugary foods; limit soft drinks and fruit juices; use a tooth brush thoroughly and regularly; floss your teeth; use toothpaste; see your dentist for check-ups.

Summative assessment

You can read out the answers for students to self-assess or you can take in the pages and mark them to award an overall score. You could allocate marks as follows: question 1a = 1, 1b = 3, 1c = 1, 1d = 1; question 2a = 3, 2b = 3, 2c = 1, 2d = 1; question 3 = 1; question 4a = 1, 4b = 2, 4c = 1; question 5a = 2, 5b = 2, 5c = 2. This makes a total of 25 marks.

If necessary, ask students to revisit topics and questions to help them to learn more about any they did not score well on. In this way the questions are both summative and formative. All assessments should be linked to enhancing learning and in this way the 'What have I learned about?' pages will support this as well as providing data to report back to students, parents and/or other significant adults.

Extra activities

1 Tell students to imagine being stranded on a desert island. Ask them to make a poster to show how they would make the water from a pond cleaner. They have found some paper towels, fishing nets and plastic soda bottles on the island.

2 Ask students to write a diary entry about an imaginary day when everything except humans and animals became soluble. Volunteers could read out extracts to the class.

Differentiation

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Consolidating: Ask students to explore different materials to use in a filter before adding the best ones to make a filter bed.

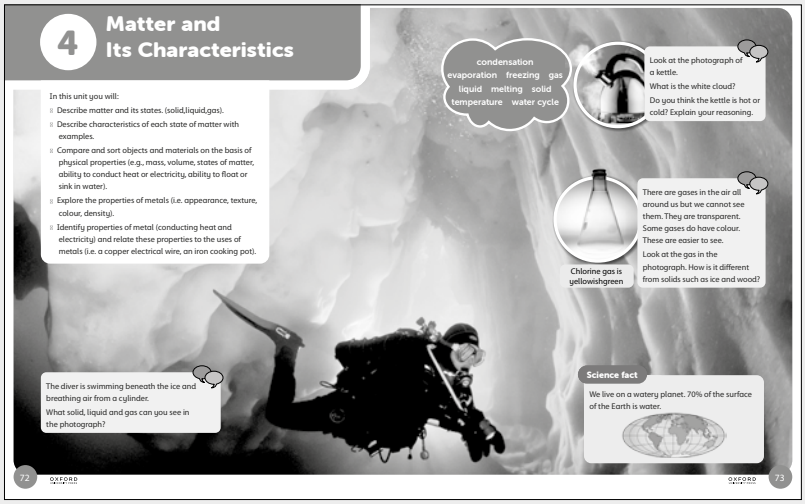
Extending: Ask students to research the materials that are used in modern water filter systems in their country.

Differentiated outcomes	
All students	should be able to identify the equipment used to separate solids from water
Most students	will be able to select the most appropriate equipment to use to separate different solids from water
Some students	may be able to select the best materials used to clean water

4 Matter and Its Characteristics

In this unit students will:

- Describe matter and its states. (solid,liquid,gas).
- Describe characteristics of each state of matter with examples.
- Compare and sort objects and materials on the basis of physical properties (e.g., mass, volume, states of matter, ability to conduct heat or electricity, ability to float or sink in water).
- Explore the properties of metals (i.e. appearance, texture, colour, density).
- Identify properties of metal (conducting heat and electricity) and relate these properties to the uses of metals (i.e. a copper electrical wire, an iron cooking pot).



Getting started

The aim of this unit is for students to understand the states of matter and how changes of state occur. Students have considered the nature of materials and what happens when materials change earlier.

In this unit students learn that matter or materials can be in the form of a solid, liquid or gas. They study what happens when materials are heated and cooled and investigate examples of melting and freezing to discover that freezing is the reverse process of melting. They also explore the characteristics and properties of metals and their subsequent uses.

Science in context

In this unit students have opportunities to develop their awareness of science in context. They are not presented with science as a series of fixed facts, but rather that science ideas grow and develop through observation, investigation, predicting and testing. They look at some ideas that have developed over time – such as the particulate nature of matter – and consider that current science knowledge has emerged due to people using their imaginations over many centuries to create theories.

Encourage opportunities for students to study and visit people who use science ideas about changes of state as part of their work – such as people drying materials or heating liquids in cooking or other processes. This will help students to see the science they are learning about in everyday and important contexts. Invite some of these people into school to talk to students.

Also allow students to observe changes of state in the natural world around them. They can visit rivers and seashores to see liquid water and observe puddles drying up, for example. You can relate this to the evaporation and condensation patterns that drive the weather across the world.

Scientific enquiry skills

Students will be collecting evidence in a variety of contexts. They will have opportunities to plan and test their ideas and predictions and to explain them based on their growing understanding of scientific principles. To do this they will design fair tests and select and use appropriate apparatus. They will also learn how to work safely when doing investigations.

Students will develop their ability to make relevant observations, take measurements and record these in a suitable way. Students also identify trends and patterns in their results. They use a wide range of methods to communicate their ideas and present their results, including tables, diagrams and models.

An Investigation master sheet is given in this Teacher's Guide to help students plan their scientific enquiries.

Resources

Student Book: small pieces of materials (or small objects) for students to identify as solids, liquids or gases; three beakers (one containing water, one ice cubes and the other air); a large space to move around in; transparent plastic containers; water; sugar cubes; bowls; pestle and mortar or two pieces of wood for crushing sugar;

grain sugar (if lumps cannot be crushed); hand lenses or microscopes with microscope slides; materials to make posters; thin wires (about 20 centimetres long); soapy water; balloons; small funnels; spoons; baking soda; vinegar; small clean empty plastic bottles; goggles; squares of chocolate; heatproof bowl; large saucepan; spoon; very hot water (only the teacher should handle this); a kettle or pan of water; electric hotplate; pieces of cloth; ice cubes; beakers or jars; plastic bowls larger than the beakers or jars; cloth (such as cotton); newspaper; clamps; thermometers; test tubes; warm water; ice; small mirrors; drinking glasses; writing materials; paper, card or blank flip books.

Key words for unit

are in the Word cloud.

condensation evaporation freezing gas
liquid melting solid temperature water cycle

Scientific enquiry key words

ask questions use equipment observe
measure compare notice patterns
record carry out tests group/classify
use secondary sources communicate findings

Language support

This unit's key vocabulary is included in the key word list above – this will help you develop a Word wall and word games for the unit.

Students should become familiar with the words 'solid', 'liquid' and 'gas'. At the start, it is sufficient to explain that solids are hard, liquids are runny and gases are spread out. Students will develop a fuller understanding throughout the unit.

To avoid confusion later between water vapour and steam, and evaporation and boiling, keep stressing that steam is made when water boils. Later, students will learn that water changes to water vapour at lower temperatures as it evaporates, but at this stage it is important to be clear about how steam is made.

Unit at a glance

This opening lesson introduces the different states of matter and links these to temperature changes. It contains examples of solids, liquids and gases.

The key teaching points for students in this unit are:

- to introduce the unit objectives
- to introduce the learning outcomes
- to engage students with the content of the unit
- to review and build on prior learning and understanding of the topics
- to start the first unit of the book.

In the next lesson, students will learn about grouping materials according to their properties.

Ask students to look at the photographs on the introductory pages and refer to the science fact. After looking at and discussing the photographs, ask students what they think the topic of this unit is.

Organise students into pairs. Ask them to think about:

- any solids they have eaten and liquids they have drunk
- the materials they can see in the classroom.

Lead into a discussion of gases. Point out that often gases are not easy to see because they are transparent.

Ask students to wave their hands backwards and forwards. Can they feel the air? Then ask them to wave a piece of paper backwards and forwards. Ask, 'What happens to the paper? It is moved by the air?' Now ask students to read the first discussion.

The diver is swimming beneath the ice and breathing air from a bottle. What solid, liquid and gas can you see in the photograph?

Possible response: *Students say that they see liquid water, solid frozen ice and the gas bubbles from breathing.*

Look at the photograph of a kettle. What is the white cloud? Do you think the kettle is hot or cold? Why?

Answer: *The cloud is steam coming from the hot kettle. Students should suggest that the kettle is hot – they can apply prior knowledge that steam is made when water is very hot.*

There are gases in the air all around us but we cannot see them. They are transparent. Some gases do have colour. These are easier to see. Look at the gas in the photograph. How is it different from solids such as ice and wood?

Possible response: *The gas fills the container.*

Explain that some gases do have a colour. Ask students to look at the photograph of green chlorine gas. Chlorine is very toxic and is used in very small (and therefore safe) amounts in drinking water and swimming pools to kill bacteria.

Science fact We live on a watery planet. 70% of the surface of the Earth is water.

Read out the Science fact to students or ask a volunteer to read it out. Show them a map of the world or a globe and point out the land and oceans.

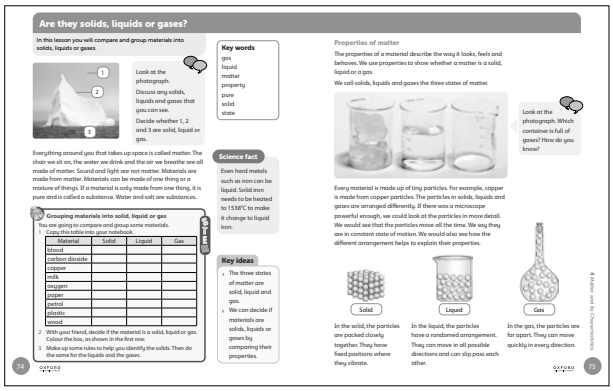
Maths link: Remind students about percentages. You could hold up a piece of A4 paper with 70% of it coloured blue. Alternatively, this would be an interesting maths task for students to complete with their own pieces of paper and a ruler.

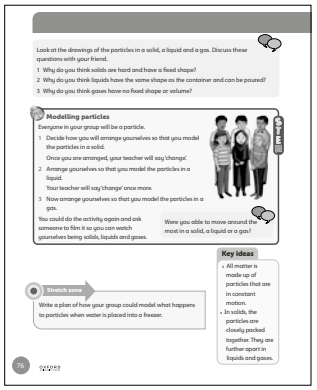
Extra activities

1 Remind students about what happens when a kettle boils (they will have covered this previously in Year 2 when learning about heating materials). Demonstrate boiling water in a kettle and let students observe the steam rising. Ask them to think about where the steam goes and what it could be used for. Students should suggest that the steam rises. Some may know that it can be used for steam engines and in power stations.

2 Ask students to start a collection of examples of solids, liquids and gases. They could collect photographs from magazines and newspapers and label the photographs with 'solid', 'liquid' or 'gas' and the name of each material.

Are they solids, liquids or gases?





Getting started

In this lesson students recognise materials that are solids, liquids and gases. They begin to group these. Students learn that the properties of solids, liquids and gases are different and that they are known as the three states of matter. It is important that students begin to understand the differences between materials, substances and particles. Explain that materials are made from matter and that all matter is made up of smaller particles. Students should learn that materials can be made of one thing or a mixture of things. If a material is only made from one thing, it is pure and is called a substance. Water and salt are substances.

Students investigate a range of materials and group them into the three states of matter. They practise recording their observations in tables of results. They learn that the property of a material can describe how it looks, feels or behaves. Students use this knowledge of the properties of materials to group them into the three states of matter.

Language support

There are some important words in this unit that describe key characteristics of materials. Make sure students add these words to the unit Word wall. Allow them to experience how water flows, stones are dense and sponges can be squashed. This is an opportunity

to explain the difference between a material and a substance. This isn't easy as they are words that are often used interchangeably but stress that substances are pure and materials are made up of one or more substance.

Resources

Student Book: small pieces of materials (or small objects) for students to identify as solids, liquids or gases.

Key words

gas liquid matter property pure solid state

Other words in the lesson

dense flow squash volume

Scientific enquiry key words

observe compare notice patterns record group/classify

Lesson at a glance

The key teaching points in this lesson are:

- the words matter, material and substance have different meanings
- materials have different properties
- the properties of materials can be used to group them into the three states of matter.

They will also learn about the arrangement of particles in different states of matter.

Look at the photograph. Discuss any solids, liquids and gases that you can see. Decide whether 1, 2 and 3 are solid, liquid or gas.

Answer: *1 gas (air); 2 solid (ice); 3 liquid (water)*

Point out the photograph of the iceberg and read out the text beneath. Alternatively, ask volunteers to read a sentence each. Emphasise the key words in the text (matter, materials, substances) and explain the differences to pick up on the work you did as language support.

Point out to students that the objects around them are made of solids, liquids or gases. Ask them to tap their chair and move their hands through the air. What differences do they notice?

Investigation: Grouping materials into solid, liquid or gas

Students can record their work in a table.

The aim of this investigation is for students to use the characteristics of materials to identify a range of substances as solids, liquids or gases. They look at the list of materials in the table and decide if each is a solid, a liquid or a gas. The example of blood is done for them. Students can use different colours for liquid, solid and gas if they wish.

Ask students to study their results and discuss their answers. They should identify that blood, milk and petrol are liquids; carbon dioxide and oxygen are gases; copper, paper, plastic and wood are solids.

Finally, ask students to discuss any rules they can think of to identify solids. Ask for ideas and write them on the board. Explain to students that the way a substance looks, feels and behaves is called a characteristic. Tell them that they have just suggested some characteristics of solids.

Science fact Even hard metals such as iron can be liquid. Solid iron needs to be heated to 1538°C to make it change to liquid iron.

Read out the Science fact. Discuss how hot this temperature is. Elicit the idea that some materials like iron need to be heated to very high temperatures to melt or change into a liquid.

Students will review and extend their knowledge on the properties of materials by reading the text at the top of page 75. They will then relate these properties to whether a material is a solid, a liquid or a gas. Explain that we call solids, liquids and gases the three states of matter.

Look at the photograph. Which container is full of gases? How do you know?

Possible response: *Students may identify that the last container, which appears to be empty, in fact contains air, which is a mixture of gases.*

Students might have used different words, but they should be able to spot some of the characteristics they identified.

Discussion

Look at the drawings of the particles in a solid, a liquid and a gas. Discuss these questions with your friend.

1 Why do you think solids are hard and have a fixed shape?

2 Why do you think liquids have the same shape as the container and can be poured?

3 Why do you think gases have no fixed shape or volume?

Students should work in a group to identify some solids, liquids and gases. They will need to name the material and draw a table in their notebook to record their findings.

Possible response: *Students may suggest: 1 the particles are closely packed together so they cannot*

move much. This makes them have a fixed shape and be hard; 2 the particles in liquids are not packed as closely and they can be poured or can flow into the container; 3 the particles in a gas are far apart and they can move quickly in all directions. This means they do not have a fixed shape or volume.

Investigation: Modelling particles

Take students to an open space where they will not disturb the learning of other students. Explain that each person will model a single particle. They will model the arrangement of particles in the three states of matter. When they are ready to start and in position, remind them that the particles, even in a solid, are in constant motion. This is an opportunity to explain it is the amount or degree of motion that varies between solids, liquids and gases. Then you or a volunteer says, 'Change into a liquid!' and they all have to model the particles. Then call, 'Change into a gas!' If possible, film the activity and let students watch it back in the classroom. Discuss the modelling and how accurate it was. Make sure the students have modelled the particles moving around according to the state of matter.

Be a scientist: Good scientists ask questions and discuss their ideas. Talk about each material before making a decision.

Remind students that scientists discuss and share their ideas and findings to make sense of the world around them. This is a skill they are developing in this activity.

Key ideas

- *The three states of matter are solid, liquid and gas.*
- *We can decide if materials are solids, liquids or gases by comparing their properties.*

Summarise the lesson by asking students what they have learned. Let them share their ideas and then read out, or ask a volunteer to read out, the key ideas. Ask them to turn to a partner and take it in turns to name a solid, a liquid and a gas. You can then ask for volunteers to share their ideas with the class and make a class list under three headings – solid, liquid and gas. Then ask students to tell you some of the properties that solids have that liquids and gases do not, and then move on to liquids and finally to gases.

Stretch zone: Write a plan of how your group could model what happens to particles when water is placed into a freezer.

Possible response: *Students should comment that the particles will move quite freely as liquid water but then move closer together and not be able to move much as solid ice.*

Key ideas

- *All matter is made up of particles that are in constant motion.*
- *In solids, the particles are closely packed together. They are further apart in liquids and free to move in gases.*

Summarise the lesson by asking students what they have learned. Ask two volunteers to read out the key ideas. Students should discuss what particles are and how they can be arranged differently in materials. The behaviour of the particles determines the properties of the materials. A solid is strong and has a fixed shape and density because the particles are arranged closely packed together. Discuss how the spaces between liquids and gases means they can be squashed, flow or move more freely.

Review and reflect

Students should take some quiet time to think about what they have learned in the lesson. They should discuss their ideas with a partner or a group to encourage the wellbeing skills of communicating and respecting each other's ideas.

Students could also concentrate on content that they found challenging and consider why this was the case. They should then decide if they need further help or support with this or if they are ready to move on.

Extra activities

1 Split the class into three teams. Each team is responsible for collecting information and photographs about one of the states of matter. Allow students one week to do the collecting and then give each team a wall to cover as a display.

2 Students play a game where they decide if they are a solid or a liquid. They describe themselves, for example, 'I can be poured.' They continue until someone guesses what state of matter they are.

Differentiation

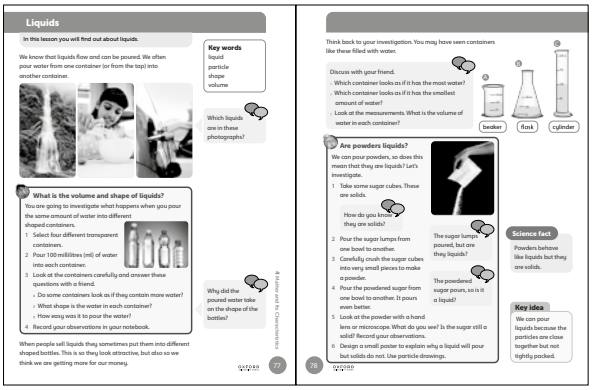
Supporting: Students can practise the terms solid, liquid and gas by having a diagram of a solid, a liquid and a gas on separate sticky notes. When you or a volunteer calls out a state, they hold up the appropriate diagram.

Consolidating: Students can practise drawing particle diagrams showing all three states of matter. Regularly ask them to act out particles in solids, liquids and gases and remind them that the particles are in constant motion.

Extending: Students can be encouraged to describe the particles for each state and relate this to their properties.

Differentiated outcomes	
All students	should be able to represent particles using diagrams
Most students	will be able to draw the correct diagram for each state of matter
Some students	may be able to describe the property of a material based on the particle diagram

Liquids



Getting started

Students begin by thinking about the properties of liquids and they consider the important property of pouring. They then look at powders and whether the fact that they can be poured makes them liquids.

Language support

Ask questions to elicit from students that a powder is a solid that has been crushed into very small pieces. An investigation with a hand lens or microscope will show this. Let students see examples of powders such as flour.

The word 'pour' means to tip from one place to another. Similar words are 'flow' and 'stream', which will provide the useful mental image of a small river flowing from one container to another.

Resources

Student Book: transparent plastic containers; water; sugar cubes; bowls; pestle and mortar or two pieces of wood for crushing sugar; grain sugar (if lumps cannot be crushed); hand lenses or microscopes with microscope slides; materials to make posters.

Key words

liquid particle
shape volume

Other words in the lesson

flow pour transparent

Scientific enquiry key words

ask questions use equipment observe
measure compare record carry out tests

Lesson at a glance

The key teaching points in this lesson are:

- we can investigate the properties of liquids
- we can measure the volume of liquids
- we can investigate powders and compare them to liquids.

In the next lesson, students will learn about the properties of gases.

Which liquids are in these photographs?

Ask students which liquids they can see. Ask a volunteer to describe each photograph. Make sure they mention that each is a liquid and that it is flowing or being poured.

Possible response: *Students should recognise that the milk is a liquid that is being poured over the cereal. The waterfall shows liquid water flowing and the petrol pump demonstrates how some fuels can be a liquid.*

Investigation: What is the volume and shape of liquids?

Students investigate how the shape of a container can alter our perception of volume. The expected outcome is that certain shapes appear to have a larger volume.

Ask students which bottle in the photograph contains the most water. Create a tally chart on the board to see which bottle has the most votes. Tell students the bottles may all contain the same volume of water. Water takes on the shape of the container so it is difficult to work out the volume by just looking.

Students may not believe you, so tell them that they are going to test this for themselves by pouring the same amount of water into different containers.

Ask them to carry out instructions 1 and 2. The group members take turns to pour 100 millilitres of water into each container. Then ask students to discuss the questions:

- Do some containers look as if they contain more water?

Answer: *Narrow containers look fuller because the level of the liquid is higher.*

- What shape is the water in each container?

Answer: *The water is the same shape as the container.*

- How easy was it to pour the water?

Answer: *Very easy.*

Finally, ask students to record their observations. Remind them that a liquid changes shape to fit the container but it has its own volume.

Why did the poured water take on the shape of the bottles?

Answer: *Students should recall that liquids fill the shape of the container they are poured into. Liquids do not have a fixed shape like solids do.*

Explain that when people sell liquids they sometimes put them into different shaped bottles. This makes us think we are getting more for our money. The next discussion activity consolidates this.

Discuss with your partner.

- **Which container looks as if it has the most water?**
- **Which container looks as if it has the smallest amount of water?**
- **Look at the measurements. What is the volume of water in each container?**

Possible response: *Students might suggest that the tallest bottle will contain the most water as it looks bigger. The shortest bottle might be thought to contain the least amount of water as it looks smaller. They should find that the volume of water in each is the same in all three containers.*

Investigation: Are powders liquids?

The aim of this investigation is to address the common misconception that powders are liquids because they can be poured. By making the powders themselves, students discover that they are solids.

Allow students to work with a partner or in a small group of three or four so they can discuss their ideas and share equipment. Demonstrate that we can pour powders using flour, sugar or sand. Ask, 'We can pour powders, so does this mean that they are liquids?'

Some students might think that the answer is yes, because the ability to pour is one of the rules they have learned for liquids. Tell them they are going to investigate this. Having a question to find out the answer to is good science. Ask each student to predict the answer.

Ask students to read parts 1 to 4 of the investigation and work with a partner to discuss the questions. For part 3, if students find it difficult to crush the cubes into powder, you could provide grain sugar the same colour as the lumps, but make sure students understand the powder is made from crushed lumps.

Possible response: *Students may suggest that the widest or tallest containers contain the most liquids. This is not always the case. They should test the volume of liquid in each container accurately by using a measuring cylinder or jug with graduations and by making sure all of the liquid is transferred from the container to the measuring cylinder.*

How do you know they are solids?

Possible response: *Students could suggest they have a fixed shape and volume.*

The sugar lumps poured, but are they liquids?

Possible response: *Students may note that the sugar lumps do not pour easily. They are solids as they have a fixed shape and volume. A liquid does not have these properties.*

The powdered sugar pours, so is it a liquid?

Possible response: *Students may say that they could pour the crushed or powdered sugar lumps more easily. When the powdered sugar is observed with a hand lens it is clear to see that the powder contains very small particles that are solid.*

Ask students to record their observations and then design a small poster to explain what they have learned. Encourage them to use particle drawings in their poster.

Science fact Powders behave like liquids but they are solids.

Use the Science fact to sum up the learning from the investigation. Remind students how the powder looked using a hand lens or microscope. Explain that powders pour because the small solid pieces can run over each other.

Key idea

We can pour liquids because the particles are close together but not tightly packed.

Summarise the lesson by asking students what they have learned. Let them share their ideas, and read out and discuss the key idea. Ask students to share their ideas about how powders behave like liquids and to explain why they are not liquids. Remind students how the particles of crushed sugar still looked like sugar cubes, only much smaller.

Review and reflect

Encourage students to think about the content of the lesson. Ask them to write down three things that they enjoyed and feel confident about. Then ask them to think about one thing that they might have found challenging. Ask them to think about this challenge and how they can support their own learning. They should write a note to themselves saying how they will improve. This could be by asking a friend, someone at home or the teacher for help.

Extra activities

1 Students could research different powders and the way that they behave like liquids. In factories, powders such as flour are pumped around just like liquids. Students can share their ideas with other students by giving a short talk or making a poster for display.

2 Students could practise decanting liquids. If you mix sand and water, students can decant off the water so the sand remains in the bottom of the first container.

Differentiation

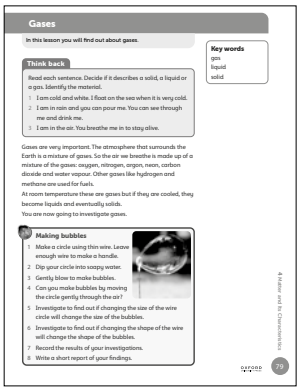
Supporting: Allow students to use a range of containers and measure the amount of water that each contains.

Consolidating: Students review the properties of solids and liquids and compare these with the powdered sugar. Allow them to explore the idea that they appear to behave like a liquid but on close inspection they don't.

Extending: Students investigate other powders, for example talcum powder, to compare them to the sugar powder. This will enforce their understanding further.

Differentiated outcomes	
All students	should be able to state the properties of a liquid
Most students	will be able to describe how some powders have the properties of a liquid
Some students	may be able to explain how a powder is a finer example of a solid

Gases


Gases

In this lesson you will find out about gases.

Think back

Read each sentence. Decide if it describes a solid, a liquid or a gas. Identify the material.

1 I am cold and white. I float on the sea when it is very cold.
2 I am in rain and you can pour me. You can see through me and drink me.
3 I am in the air. You breathe me in to stay alive.

Key words
gas
liquid
solid

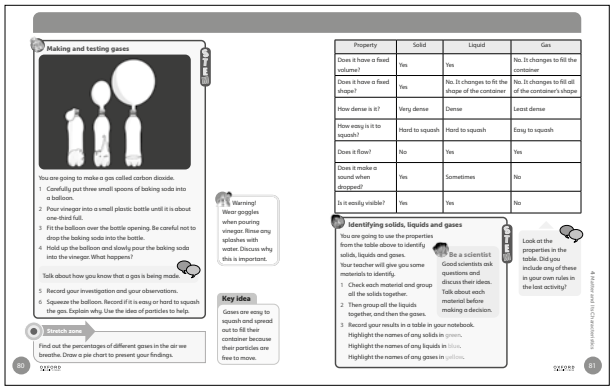
Gases are very important. The atmosphere that surrounds the Earth is a mixture of gases. So the air we breathe is made up of a mixture of the gases: oxygen, nitrogen, argon, neon, carbon dioxide and water vapour. Other gases like hydrogen and methane are used for fuels.
At room temperature these are gases but if they are cooled, they become liquids and eventually solids.
You are now going to investigate gases.

Making bubbles

1 Make a circle using thin wire. Leave enough wire to make a handle.
2 Dip your circle into soapy water.
3 Gently blow to make bubbles.
4 Can you make bubbles by moving the circle gently through the air?
5 Investigate to find out if changing the size of the wire circle will change the size of the bubbles.
6 Investigate to find out if changing the shape of the wire will change the shape of the bubbles.
7 Record the results of your investigations.
8 Write a short report of your findings.

A matter and its characteristics

79


Making and testing gases

You are going to make a gas called carbon dioxide.

1 Carefully put three small spoons of baking soda into a balloon.
2 Pour vinegar into a small plastic bottle until it is about one-third full.
3 Fit the balloon over the bottle opening. Be careful not to drop the baking soda into the bottle.
4 Hold up the balloon and slowly pour the baking soda into the vinegar. What happens?

Talk about how you know that a gas is being made.

5 Record your investigation and your observations.
6 Squeeze the balloon. Record if it is easy or hard to squash the gas. Explain why. Use the idea of particles to help.

Stretch zone
Find out the percentages of different gases in the air we breathe. Draw a pie chart to present your findings.

Warning! Wear goggles when pouring vinegar. Rinse any splashes with water. Discuss why this is important.

Key idea
Gases are easy to squash and spread out to fill their container because their particles are free to move.

Property	Solid	Liquid	Gas
Does it have a fixed volume?	Yes	Yes	No. It changes to fill the container
Does it have a fixed shape?	Yes	No. It changes to fit the shape of the container	No. It changes to fill all of the container's shape
How dense is it?	Very dense	Dense	Least dense
How easy is it to squash?	Hard to squash	Hard to squash	Easy to squash
Does it flow?	No	Yes	Yes
Does it make a sound when dropped?	Yes	Sometimes	No
Is it easily visible?	Yes	Yes	No

Identifying solids, liquids and gases

You are going to use the properties from the table above to identify solids, liquids and gases.
Your teacher will give you some materials to identify.

1 Check each material and group all the solids together.
2 Then group all the liquids together, and then the gases.
3 Record your results in a table in your notebook.
Highlight the names of any solids in green.
Highlight the names of any liquids in blue.
Highlight the names of any gases in yellow.

Be a scientist
Good scientists ask questions and discuss their ideas. Talk about each material before making a decision.

Look at the properties in the table. Did you include any of these in your own rules in the last activity?

A matter and its characteristics

80 81

Getting started

In this lesson students explore and investigate the properties of gases. They learn that air is a mixture of different gases. They have learned about solids and liquids and now they compare the different properties of gases through investigation.

Language support

The word 'squash' is used in the lesson to mean that gases can be compressed. Illustrate this with a balloon filled with air for students to squash and contrast with a hard solid that they cannot squash.

Resources

Student Book: thin wires (about 20 centimetres long); soapy water; balloons; small funnels; spoons; baking soda; vinegar; small clean empty plastic bottles; goggles.

Key words

gas liquid solid

Other words in the lesson

air bubbles squash squeeze

Scientific enquiry key words

ask questions use equipment observe measure compare notice patterns record carry out tests

Lesson at a glance

The key teaching points in this lesson are:

- air is a mixture of different gases
- gases spread out to fill the space they are in because the particles in a gas move around freely.

In the next lesson, students will learn about how materials change when they are heated.

Think back: Read each sentence. Decide if it describes a solid, a liquid or a gas. Identify the material.

1 I am cold and white. I float on the sea when it is very cold.

2 I am in rain and you can pour me. You can see through me and drink me.

3 I am in the air. You breathe me in to stay alive.

Ask students to work independently to complete the questions in the Think back activity. Ask students to compare their answers with a partner and amend them if necessary. Take feedback and ask students to name each substance.

Read out the text or ask a volunteer to read it out. This explains that the air we breathe is made up of a mixture of different gases. As each gas is mentioned ask students to write down the name as you write it on the board. Each time ask students if they have heard of the gas before. They should be aware of oxygen, carbon dioxide and water vapour.

You could draw a circle to represent the Earth and a very thin circle around it as the atmosphere. Draw a line from the names of the gases to the part of your drawing representing the atmosphere.

Investigation: Making bubbles

The aim of this investigation is for students to explore how to make bubbles and try different ways of changing the size of the bubbles.

Demonstrate making a loop with a handle in a piece of wire, and ask students to make one. It should look a bit like the shape of a hand lens.

Students take turns to dip the loop into a small amount of soapy water. You could add food colourings to make different coloured bubbles. Students blow gently into the loop to make bubbles. Then they move the loop gently through the air instead of blowing.

Ask students to investigate with different sizes of wire circle, to see how this affects the size of the bubbles. Ask, 'How does the size of the bubble change when you increase/decrease the size of the wire circle?'

Ask students to investigate with different wire shapes, to see how this affects the shape of the bubbles. Ask, 'How does the shape of the bubble change?'

Answer: *Students will find that whatever the initial shape of the bubbles leaving the wire shapes, the bubbles will always form a sphere.*

Suggest that students can design and complete a results table. They could also take photographs or film their bubbles being formed by using a digital camera or a smartphone. These can be downloaded into their report. This can be a written report like a scientific paper or a computer presentation. Remind students that bubbles are made when gases are trapped inside a liquid. The next investigation will give students an opportunity to make a gas.

Investigation: Making and testing gases

Warning! Wear goggles when pouring vinegar. Rinse any splashes with water. Discuss why this is important.

Start by reading out the warning about the need for goggles and rinsing splashes. Ask students if they have ever had vinegar in a small cut. If not, tell them that it stings because it is a weak acid. Ask them why it would be very harmful to have vinegar splash into their eyes and elicit that it would be painful and might damage their eyes. Explain that if vinegar spills onto their clothes or skin, they have time to gently rinse it off but they should tell you so you can check none is left to cause irritation.

The aim of this investigation is for students to understand how the gas carbon dioxide is made and also to provide them with a sample to test. Students should discover that the gas can be squashed easily.

Show students how to place a funnel into the opening of the balloon to keep the hole open and then pour the baking soda in. Students then pour vinegar into a small plastic bottle until it is about one-third full, and carefully fit the balloon over the bottle opening. Tell them to be careful not to drop the baking soda into the bottle until they are ready because the reaction will start and carbon dioxide will escape.

Once the balloon is firmly fixed, they can tip it so that all of the baking soda slowly drops into the vinegar. Ask them to observe and record what happens. Students should also report that they can squeeze the balloon as there are spaces between the particles.

Talk about how you know that a gas is being made.

Possible response: *Students can see the balloon inflating. They should also be able to see the bubbles in the liquid rising into the space in the bottle.*

Stretch zone: Find out the percentages of different gases in the air we breathe. Draw a pie chart to present your findings.

Students could use the internet or textbooks to research this. Remind them that a pie chart starts with a circle and that if there was only one thing to add to the circle, all of the circle would be one colour. If two equal things are added, then the circle would be half one colour and half the other. Point out that their pie chart will have the circle split into three sections of different sizes (oxygen, nitrogen, and a third section made up of argon, neon, carbon dioxide and water vapour).

Answer: *Students should discover that there are a lot of different gases in the atmosphere but some are in very small amounts. Encourage students to draw a pie chart showing three segments only: oxygen (21%), nitrogen (78%) and other (1%) including argon, neon, water vapour and carbon dioxide.*

Key idea

Gases are easy to squash and spread out to fill their container because their particles are free to move.

Summarise the lesson by asking students what they have learned. Let them share their ideas and then read out, or ask a volunteer to read out, the key idea. They should discuss how the arrangement of the particles determines the properties of a gas. Encourage students to discuss their investigations and relate their observations to the properties of a gas.

Look at the properties in the table. Did you include any of these in your own rules in the last activity?

Possible response: *Students may have used rules about how easy the material was to squash or flow, but it is likely that this is their first experience of volume and density.*

Students might have used different words, but they should be able to spot some of the characteristics they identified.

Investigation: Identifying solids, liquids and gases

Students should work in a group to identify some solids, liquids and gases. They will need to name the material and draw a table in their notebook to record their findings.

Explain to students that they are going to use the properties from the table above to identify solids, liquids and gases. Hand out some materials for students to identify. These can be a mix of actual materials and cards with materials written on them. Ask them to check each material and then start by grouping all the solids together. When they have done this, they can then group all the liquids together, and then the gases. Ask students to record their results in the table in their notebook. Finally, explain the colour-coding system for highlighting the names of the solids, liquids and gases.

Possible response: *Students should recall that the rules for identifying solids will include them having a fixed shape and volume, high density (usually), they do not flow, and are not easy to squash. For liquids, they should include having a fixed volume but no fixed shape (they take the shape of the container), they are dense, they flow but are not easy to squash. For gases, they should include having no fixed shape or volume, low density, they flow, and are very easy to squash.*

Review and reflect

Students discuss the lesson with a partner. They should talk about the investigations carried out and how these show the properties they have learned about gases. Encourage students to list the facts that they have found out about gases. They can share them with other pairs of students and discuss their ideas. They should listen and respect the ideas of other students.

Extra activities

1 Allow students to explore different shapes and sizes of wire loops. It is possible to use a large flat tray of soapy water and a large loop made from a coat hanger to create a bubble around a student. The student stands in the tray with the loop around their feet. Slowly lift the loop past their knees and upwards as far as you can.

2 **Computing link:** Ask students to research some common and useful gases: the gases that make up most of the air (oxygen, nitrogen and carbon dioxide); rarer but useful gases in the air (helium and neon); some vitally important gases (hydrogen, chlorine and ammonia).

Differentiation

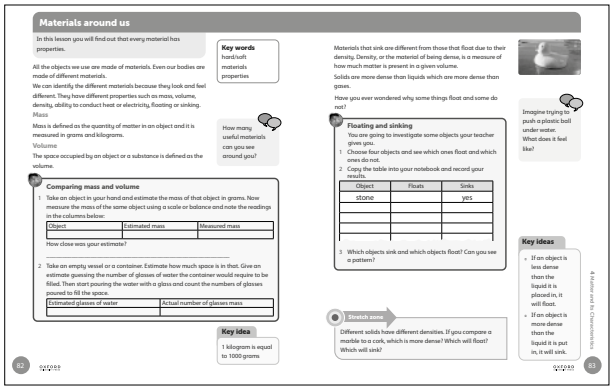
Supporting: Ask students to inflate balloons to help them understand that the gases exist though they cannot see them.

Consolidating: It may help some students to observe the bubbles as evidence of the presence of a gas.

Extending: Ask some students to test the properties of gases using blown-up balloons.

Differentiated outcomes	
All students	should be able to identify a gas using some of their properties
Most students	will be able to list the properties of a gas and provide evidence from their investigations for them
Some students	may be able to name different gases that are present in the air

Materials around us


Materials around us

In this lesson you will find out that every material has properties.

Key words
hard/soft
materials
properties

All the objects we use are made of materials. Even our bodies are made of different materials.
We can identify the different materials because they look and feel different. They have different properties such as mass, volume, density, ability to conduct heat or electricity, floating or sinking.

Mass
Mass is defined as the quantity of matter in an object and it is measured in grams and kilograms.

Volume
The space occupied by an object or a substance is defined as the volume.

How many useful materials can you see around you?

Comparing mass and volume

1 Take an object in your hand and estimate the mass of that object in grams. Now measure the mass of the same object using a scale or balance and note the readings in the columns below:

Object	Estimated mass	Measured mass

How close was your estimate?

2 Take an empty vessel or a container. Estimate how much space is in that. Give an estimate guessing the number of glasses of water the container would require to be filled. Then start pouring the water with a glass and count the numbers of glasses poured to fill the space.

Estimated glasses of water	Actual number of glasses mass

Key idea
1 kilogram is equal to 1000 grams

62 OXFORD

Materials that sink are different from those that float due to their density. Density, or the material of being dense, is a measure of how much matter is present in a given volume.
Solids are more dense than liquids which are more dense than gases.
Have you ever wondered why some things float and some do not?

Floating and sinking
You are going to investigate some objects your teacher gives you.
1 Choose four objects and see which ones float and which ones do not.
2 Copy the table into your notebook and record your results.

Object	Floats	Sinks
stone		yes

3 Which objects sink and which objects float? Can you see a pattern?

Imagine trying to push a plastic ball under water. What does it feel like?

Key ideas
- If an object is less dense than the liquid it is placed in, it will float.
- If an object is more dense than the liquid it is put in, it will sink.

Stretch zone
Different solids have different densities. If you compare a marble to a cork, which is more dense? Which will float? Which will sink?

A World of Materials

83 OXFORD

Getting started

In this lesson students are encouraged to understand that all the objects around them are made from materials. There are many different materials that could be used but it is their properties that determine their use. Students learn to recognise the properties of different materials.

Language support

Read through the key words at the beginning of the lesson. Encourage students to talk about the words and say them out loud. Hold up examples of the words to allow students to make a visual link as they say the words out loud.

Resources

Student Book: boxes with lids; selection of objects made of different materials; writing materials.

Key words

hard/soft materials properties

Scientific enquiry key words

observe notice patterns record carry out tests group/classify use secondary sources

Lesson at a glance

The key teaching points for students in this lesson are:

- all materials have properties
- mass and weight are often confused
- mass is measured in kilograms
- identifying simple properties of materials.

Read out the text at the top of page. Explain that materials look and feel different and this is known as a material's properties. Ask them to pick up one of the materials and discuss how it feels. Ask them to discuss the materials and, if possible, to suggest examples of their use in some objects. As students give their ideas, write the properties and uses under the material on the board.

Read out the discussion question and ask students to put their hands up to name a useful material.

How many useful materials can you see around you?

> ***Possible response:*** *Students will see a variety of materials but the most likely are wood, glass, metal and plastic.*

Encourage students to sit quietly for few moments to think about the properties of materials they learned about in Year 1.

Read the text describing the words Mass and Volume. Explain that these two quantities determine the use of a material.

Investigation: Comparing mass and volume?

Students continue to work with a partner to encourage collaboration and the comprehension of science vocabulary. Students should be provided a box differently sized objects made of varied materials. Or they can choose to bring varied items themselves - anything from a cushion to ball or pen or pot cover or glass or plastic, etc. It for their partner to identify. The idea is that students use their senses and intuition to identify the materials' mass and volumebefore using instruments to accurately determine the same. Encourage them carefully note their guesses and observations about the objects is during the investigation. As an alternative, a cloth sensory bag could be used. This would allow students to feel the objects through the bag but without seeing the object.

To perform the second estimation activity, ensure students have an area where they work freely with water. Perform the activity and ask the students if their guesstimates are close to the accurate answer.

Elicit their responses regarding verifying accuracy of results. Explain that a scientist must ensure their result(s) can be replicated and verifiable. Key idea

1 kilogram is equal to 1000 grams.

Summarise the lesson by asking students what they have learned.

Let them share their ideas, read out and discuss the key idea. This will remind students that materials have different properties. Ask students to review the word display of properties formed at the beginning of the lesson. Talk about the usefulness of some of the properties. Ask students how the property could be used in an object that they know.

Read in class the text at top of page 83 and then lead students to perform the investigative activity.

Investigation: Floating and sinking

Students will need to prepare a table of results to record their results from this investigation. Ask them to choose three objects to investigate. They should test each one and note down whether it floats or sinks. They should look for a pattern in their results.

> ***Possible response:*** *Students should find that larger objects with big surface areas float better than smaller ones with small surface areas. More dense objects will not float but students are focusing on the surface area and floating in this lesson.*

Ask students to discuss the question in their groups after the investigation.

Imagine trying to push a plastic ball under water. What does it feel like?

Students could attempt this using a small plastic ball.

> ***Possible response:*** *Students should find it is very difficult to push the ball under the water because it has quite a large surface area and doesn't weigh much. This means that upthrust is greater than gravity. They might find that the upthrust is so strong acting on the ball that the ball shoots out of the water when they hold it under and then release it.*

Key ideas

- If an object is less dense than the liquid it is placed in, it will float.
- If an object is more dense than the liquid it is put in, it will sink.

As an extension to the above key ideas, you can suggest students attempt the Stretch zone activity. You may choose to help them with the planning but ask them to document the steps and observations carefully, to ensure their methods can be replicated and results can be verified.

Review and reflect

Remember to praise the process of learning as much as the outcomes. Encourage students to ask questions and to look back through prior work to review and revise. Use every opportunity to allow students to work together to check understanding and share ideas. After the investigation ask students to share and discuss their findings.

Extra activities

1 Ask students what it would be like if we only had paper to use as a material. Ask them to think about which inventions would be more difficult and the ones that would be the same.

2 Ask students what material they would miss the most and why if they were not able to use it anymore. Ask them to explain what the material is used for in their lives and why they would miss it.

Differentiation

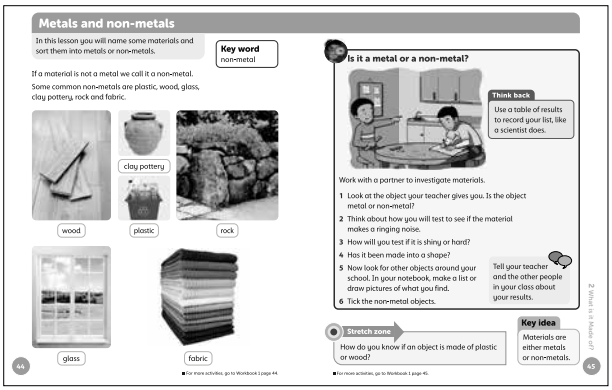
Supporting: Allow students to work with a partner to read out the key words and the descriptions in the investigation.

Consolidating: Students will begin to work independently to match the properties to the materials, but support by asking them to work with a partner to discuss the properties and suggest uses for them.

Extending: Ask students to identify the properties of materials independently and to suggest how the materials could be used to make an object.

Differentiated outcomes	
All students	should be able to identify that materials have different properties
Most students	will be able to predict which objects will sink or float
Some students	may be able to explain what is Mass and Volume

Metals and non-metals



Getting started

Metals are introduced as a very important material and students find out about the properties of metals. Students list some of the many uses of metals and link these to the properties. They demonstrate their understanding of how to recognise metals by identifying all the metal objects in the room. They are also encouraged to identify how a metal object is used. Students compare the properties of non-metals and metals. They then carry out an investigation of metal and non-metal objects, and then match their example materials to other similar materials around school.

Language support

Explain that the properties of a material are how it looks and how it feels. Help students to understand this by passing around examples of materials with different properties, and asking students to say, e.g. 'A property of this material is that it is soft' or 'A property of this material is that it is hard'. As students suggest some properties as part of the Think back task you can write them down at the front of the class to reinforce key words. Use the photographs of metals and non-metals in the Student Book to illustrate the properties of non-metals – often the opposite of metals. For example, they are often brittle, and snap rather than bend. Explain to students that in English the small word 'non' put in front of a word means 'not'.

Resources

Student Book: selection of metal objects and non-metal objects (e.g. made of clay, steel, brass, copper, aluminium, glass (not sharp), wood, plastic).

Key word

non-metal metal

Scientific enquiry key words

observe compare record group/classify

Lesson at a glance

The key teaching point for students in this lesson is that materials are either metals or non-metals.

Read out the text at the top of page and explain that in terms of properties the non-metals are almost opposite of metals. They are not usually bendy and cannot be stretched to make wires or hammered into shape. They do not make a ringing noise when hit. Ask students to look at the photographs of different materials in the Student Book and read the captions together. Point out that these materials are all non-metals.

You could display the table below for the class. This lists the properties of metals and non-metals. They can then use this information to identify metals and non-metals. The information has been simplified for use with young students, but the properties listed will apply to most metals or non-metals.

Metals	Non-metals
Most feel heavy	Most feel light
Feel hard	Most feel hard
Thin pieces are bendy	Thin pieces snap easily
Can be stretched into wires	Cannot be stretched into wires
Can be hammered into shapes	Break apart if hammered
Make a ringing sound when they are hit	Do not make a ringing sound when they are hit
Strong	Usually not strong

The table looks complicated but if you help students to use it they will find it useful. Read through each row carefully.

Science fact One metal is not hard. It is liquid, like water. It is called mercury. It is a dangerous material.

Read out the science fact in class. Explain to the students that mercury is an exception to the rule. Students will then review and extend their knowledge on the properties of metals by reading the text and then relating the properties of metals to investigate whether a material is a metal or non-metal.

Investigation: Is it a metal or a non-metal?

In this investigation, students can apply their knowledge of materials and their properties to identify some materials within the school building and grounds. This will help them practise the scientific enquiry skills of observation, identification and grouping. Hand out the range of materials and ask students to examine them to find out the properties. Students then decide if each is a metal or a non-metal.

Think back Use a table of results to record your list, like a scientist does.

Talk to students about the type of table they can use to record their results. You could draw an example for them to give a clue. One with the headings below would work well.

Object and material	What are its properties?	Is it a metal or a non-metal?

Next, inform students that they are going to carry out a survey of materials in the school. Explain that this means they are going to walk around and try to find some materials. Remember to tell the other teachers that you will be carrying out the survey.

Ask students to use the questions to help them to make up their minds about each material. Does the material make a ringing noise? Is it shiny or dull? Is it hard or soft? Has it been made into a shape? Ask students to think about what would happen if the material was bent or hit with a hammer. They should not test things to destruction but they may be able to estimate if the material is brittle or not.

Discussion

Tell your teacher and the other people in your class about your results.

At the end of the survey ask each pair in turn to tell you about their findings. Encourage students to link the use of each object they find with the material it is made from. Link this in turn to its properties as a metal or non-metal.

Computing link: When students tell others about their idea this can be as a short talk, poster or a computer presentation such as PowerPoint.

Stretch zone: How do you know if an object is made of plastic or wood?

What are the uses of metals in the photographs? Discuss with a partner all the uses of metals you can think of.

Encourage students to discuss the photographs with a partner. Ask them if they have seen metals used in construction to build scaffolding so that builders can work high up and safely. Encourage them to think about where they might have seen metal used in jewellery or for metal pans and pots for cooking. Metals are strong and can be heated to high temperatures so this makes them useful for the uses in the photographs in the Student Book on page 85.

Possible response: *Metals have different uses but in the photographs they are used in construction, jewellery and pans for cooking.*

Now ask students to look at the photograph of the rusty screws and compare them to the other metals shown. Ask them if the screws are made out of a different material. Ask them if they know what has happened to the screws. Encourage them to recognise that the screws are made out of metal but that air and water has made them go rusty. They might have seen this happen on other metal objects.

This has no straightforward answer. Point out, for example, that some plastic is made to look like wood for effect. However, generally encourage students to look at and think about examples and then ask for some ideas from the class to share them. Remind them of properties such as texture (rough and smooth) and whether a material is dull or bright.

Explain to students that this challenge will help them to develop their thinking skills. Point out that sometimes there isn't an easy or straightforward answer and at times they may be wrong. They can learn from their mistakes.

Possible response: *Students may suggest that wood is rougher, duller and has patterns called grain. Plastics are more shiny and smooth.*

Key idea

Materials are either metals or non-metals. Different materials have different properties. This makes them useful for different jobs.

Summarise the lesson by asking students what they have learned.

Let them share their ideas, read out and discuss the Key idea. This will remind students that materials can be classified as either metals or non-metals. Show some examples and ask students to tell you if these are metals or non-metals.

Let them share their ideas, read out and discuss the key idea. This will remind them that different materials have different properties and so are used for different jobs. Suggest incorrect uses of properties and ask students to discuss as a class why this would not be a good use. They can then suggest a better property to be used. Examples could be a wooden window, soft fabric car, glass shoe and concrete scarf.

Review and reflect

You can ask volunteer students to share their answers and findings with the class. Then ask the class to raise their hands if they agree. If the first response was correct, this will show you how many students seem to grasp the concepts. If a response is incorrect, you can ask for the thinking behind an answer and then guide students towards the desired answers.

Extra activities

1 Ask students which material is used most in the world (concrete). If they don't know, ask them to try to find out. Access to the internet will help with this, but many other secondary sources could be checked. You can prepare some suitable secondary sources to support students with this task (e.g. simple tables and charts).

2 **Maths link:** Ask students to survey the people in their class to find out which metal object they use the most. Tell them to record this in a table. You could include some mathematical analysis to find out which object was the most used and which the least used.

Differentiation

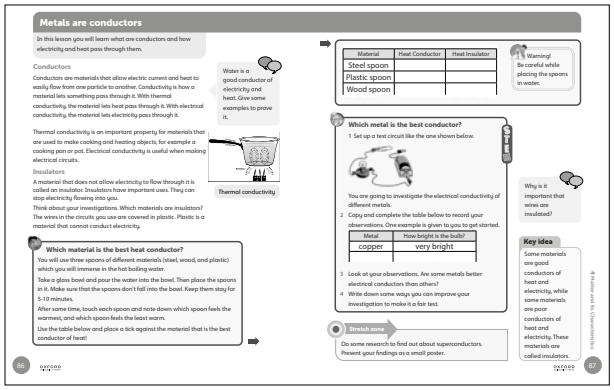
Supporting: You may have to demonstrate the differences between metals and non-metals by showing students one example of each and showing the properties as a demonstration. For example, ask them what would happen if you dropped a metal cup and a glass cup.

Consolidating: You can keep reminding students about the properties of metal and you could display the table of differences between metals and non-metals on the wall.

Extending: You could challenge students by asking them to predict whether non-metals would conduct heat and electricity.

Differentiated outcomes	
All students	should be able to name some non-metals.
Most students	will be able to describe some differences between metals and non-metals.
Some students	may be able to predict whether non-metals are good or poor conductors of heat and electricity.

Metals are conductors


Metals are conductors

In this lesson you will learn what are conductors and how electricity and heat pass through them.

Conductors

Conductors are materials that allow electric current and heat to easily flow from one particle to another. Conductivity is how a material lets something pass through it. With thermal conductivity, the material lets heat pass through it. With electrical conductivity, the material lets electricity pass through it.

Thermal conductivity is an important property for materials that are used to make cooking and heating objects, for example a cooking pan or pot. Electrical conductivity is useful when making electrical circuits.

Insulators

A material that does not allow electricity to flow through it is called an insulator. Insulators have important uses. They can stop electricity flowing into you.

Think about your investigations. Which materials are insulators? The wires in the circuits you use are covered in plastic. Plastic is a material that cannot conduct electricity.

Water is a good conductor of electricity and heat. Give some examples to prove it.

Thermal conductivity

Which material is the best heat conductor?

You will use three spoons of different materials (steel, wood, and plastic) which you will immerse in the hot boiling water.

Take a glass bowl and pour the water into the bowl. Then place the spoons in it. Make sure that the spoons don't fall into the bowl. Keep them stay for 5-10 minutes.

After some time, touch each spoon and note down which spoon feels the warmest, and which spoon feels the least warm.

Use the table below and place a tick against the material that is the best conductor of heat!

Material	Heat Conductor	Heat Insulator
Steel spoon		
Plastic spoon		
Wood spoon		

Warning! Be careful while placing the spoons in water.

Which metal is the best conductor?

1 Set up a test circuit like the one shown below.

You are going to investigate the electrical conductivity of different metals.

2 Copy and complete the table below to record your observations. One example is given to you to get started.

Metal	How bright is the bulb?
copper	very bright

3 Look at your observations. Are some metals better electrical conductors than others?

4 Write down some ways you can improve your investigation to make it a fair test.

Stretch some

Do some research to find out about superconductors. Present your findings as a small poster.

Why is it important that wires are insulated?

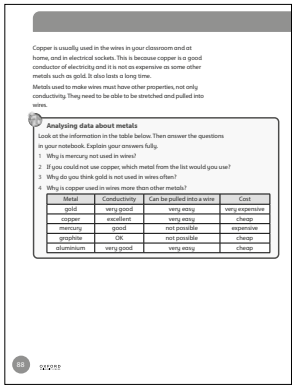
Key idea

Some materials are good conductors of heat and electricity, while some materials are poor conductors of heat and electricity. These materials are called insulators.

4 Matter and Its Characteristics

86 OXFORD

87


Copper is usually used in the wires in your classroom and at home, and in electrical sockets. This is because copper is a good conductor of electricity and it is not as expensive as some other metals such as gold. It also lasts a long time.

Metals used to make wires must have other properties, not only conductivity. They need to be able to be stretched and pulled into wires.

Analysing data about metals

Look at the information in the table below. Then answer the questions in your notebook. Explain your answers fully.

1 Why is mercury not used in wires?

2 If you could not use copper, which metal from the list would you use?

3 Why do you think gold is not used in wires often?

4 Why is copper used in wires more than other metals?

Metal	Conductivity	Can be pulled into a wire	Cost
gold	very good	very easy	very expensive
copper	excellent	very easy	cheap
mercury	good	not possible	expensive
graphite	OK	not possible	cheap
aluminium	very good	very easy	cheap

88 OXFORD

Getting started

In this lesson students consider the properties that different materials have and how these link to the uses of the materials. They classify a selection of objects based on the materials they are made from and consider the different properties of the materials. They are encouraged to use scientific procedures to record their observations in a results table. Students also investigate thermal and electrical conductivity of materials. These are useful properties that are commonly used.

Language support

To help develop language skills discuss what the word 'property' means. Tell them that this explains how a material looks, feels or behaves. For example, is an object bendy or not? Explain that some materials conduct different types of energy including thermal (heat) and electrical energy. Explain that conduct means to pass energy along. You could ask students to pass along a ball or piece of paper to show how the energy conducts through a material.

Resources

Student Book: several objects made from different materials (e.g. wood, metal, cloth, glass, stone, brick); magnets; wooden spoons; metal spoons; plastic spoons; thermometers or thermometer strips; glass beakers; boiling water; batteries, bulbs and connectors to make test circuits; access to the internet or information sheets about newly developed materials.

Key words

electrical conductivity property

thermal conductivity

Other words in the lesson

hard magnetic/non-magnetic material rough smooth soft transparent

Scientific enquiry key words

Plan and/or carry out enquiries to answer questions

Recognise and control variables

Make observations

Take measurements, using equipment accurately

Record data and results using diagrams and labels, tables, keys and graphs

Make predictions

Report and present findings in a variety of ways

Identify causal relationships

Lesson at a glance

The key teaching points in this lesson are:

- materials can be electrical conductors or insulators;
- materials can be tested to find out if they are insulators or conductors.

This can be a plenary session where you write what students say on a board. Students should recall the characteristics and properties of metals.

Conductors

Ask students to work with a partner to read the information under the heading. Ask them to look at all of the labelled diagrams as well. Explain that conductivity is how a material lets something pass through it: thermal conductivity allows heat to pass through and electrical conductivity allows electricity to pass through. Detail that thermal conductivity is an important property for materials used in cooking and electrical conductivity is useful when making electrical circuits.

Insulators

Ask students to continue to work together to read the information about insulators. Discuss how an insulator works in the opposite way to a conductor: it stops the flow of heat and electricity. Some materials are good insulators and some are not so good in the same way that some conductors can be better than others. Ask students to remind you why we cover wires in plastic. Then ask them to work on the investigation.

Investigation: Investigating the conductivity of materials

Ask students to work in groups of three or four. Explain that they are going to investigate the conductivity of different materials.

Thermal conductivity

Warning! Some of the spoons will get very hot, so be careful not to touch them.

Read out the information in the warning. Ask students to talk about why the spoons might become hot and why they should not touch them. They could make a list of three other hot things they must be careful with. Remind students that they are responsible for their safety and that of others.

Explain that thermal conductivity means that the material can transfer heat. Provide students with the equipment they will need and tell them they will need to make a table to record their results. Alternatively, you could demonstrate the investigation.

Students start by predicting which spoon will be a good thermal conductor. Remind them to consider the properties that a good thermal conductor might have. They measure and record the temperature of each spoon and then place the spoons in boiling water for one minute. They measure the temperatures again after this time. Remind students that the spoon that shows the largest increase in temperature is a good conductor of thermal energy as the thermal energy or heat from the water has been transferred into the spoon. Encourage students to analyse their results and decide whether their prediction was supported or refuted by the results they collected. Then they need to consider their method and suggest any changes they could make.

Electrical conductivity

Explain that electrical conductivity allows electrical charge to move around a circuit. Students set up a simple test circuit using the diagram to test a range of materials for conductivity. First, they predict which material will be a good electrical conductor, then they test their prediction. They connect the material to the loose connectors and if the material conducts electricity the bulb will light up. Encourage students to analyse their observations and decide whether their prediction was supported or refuted by the results.

Possible response: *Students should suggest that the metal spoon is the best conductor of both thermal energy and electrical energy.*

Why is it important that wires are insulated?

Use this discussion to encourage students to look at their results and recall their observations and information about the insulators. Ask them to talk about the uses of insulators and discuss the reason why they are used here.

Possible response: *Students smay state that electrical wires are insulated by protective covering usually of plastic to to prevent the flow of electricity from the wire to other conductors or to the environment, in order to prevent electrical shock and fires caused by short circuits.*

Stretch zone: Do some research to find out about superconductors. Present your findings as a small poster.

Computing link: Read out the Stretch zone task and allow students to continue to work in their groups to research answers to the task. Access to the internet would be useful or you can download information sheets to ensure the correct level of detail. Point out to students that new materials are being developed all the time, to have specific properties and for specific uses. Students' findings will depend on current developments so check they are legitimate and have been developed in the last three years.

Possible response: *Students may chooseto focus on one or more uses of superconductors, or they may focus specifically on the properties of the same. Their report should include how the new material was developed and why it will be useful.*

Key idea

Some materials are good conductors of heat and electricity, while some materials are poor conductors of heat and electricity. These materials are called insulators.

Summarise the lesson by reading out the Key idea then asking students what they have learned. Let them share their ideas. Ask them to close their books and then list from memory the main points or examples from the lesson. You can also ask them to tell a partner how to test whether a material is a conductor of thermal or electrical energy.

Students should record their observations and findings in the table provided.

Investigation: Analysing data about metals

Students use their knowledge to answer the given questions. It is recommended that this investigation is done as a class activity, involving recall and discussion. They should use the table to record their readings.

This provides an opportunity for students to make predictions based off of data.

Encourage students to understand that tests should always be repeated to give us confidence that the results are correct.

Students work through the questions and use the table to answer the questions.

Possible response: *1- mercury is a liquid at room temperature and therefore impractical for use as a*

wire. 2- aluminium as it is much cheaper and yet a very good conductor. 3- Because it is very expensive. 4- Because it is not only an excellent conductor but also available cheaply and can be easily pulled into a wire shape.

Review and reflect

Encourage students to look back on their work to identify aspects they have not completed correctly and help them to identify areas for improvement. This will help students to develop a positive approach to learning by understanding that learning is a process that will improve with practice and reflection.

Extra activities

1 Ask students to record when they observe electrical and thermal conductivity of a material being used at school.

2 **Maths link:** Students continue their survey of electrical and thermal conductivity at home. They bring in their recordings and compile a class list, recording the results as a bar chart if appropriate.

3 Ask students to predict which materials will be good electrical conductors.

Differentiation

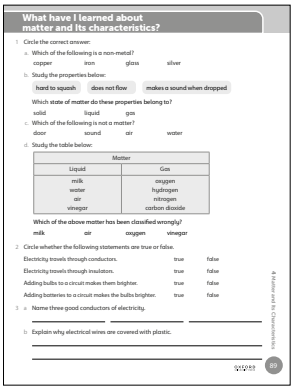
Supporting: Allow students to handle and observe different materials to gain confidence in what the materials' properties are.

Consolidating: Students test materials for thermal and electrical conductivity several times to gain confidence in their results.

Extending: Students make predictions about electrical and thermal conductivity and test them using investigation skills.

Differentiated outcomes	
All students	should be able to identify a property of most materials
Most students	will be able to identify more than one property of most materials
Some students	may be able to predict accurately the properties of materials and suggest a use for each one in line with its properties

What have I learned about matter and Its characteristics ?


What have I learned about matter and its characteristics?

1 Circle the correct answer:

a Which of the following is a non-metal?
copper iron glass silver

b Study the properties below:
hard to squash | does not flow | makes a sound when dropped
Which state of matter do these properties belong to?
solid liquid gas

c Which of the following is not a matter?
door sound air water

d Study the table below:

Matter	
Liquid	Gas
milk water air vinegar	oxygen hydrogen nitrogen carbon dioxide

Which of the above matter has been classified wrongly?
milk air oxygen vinegar

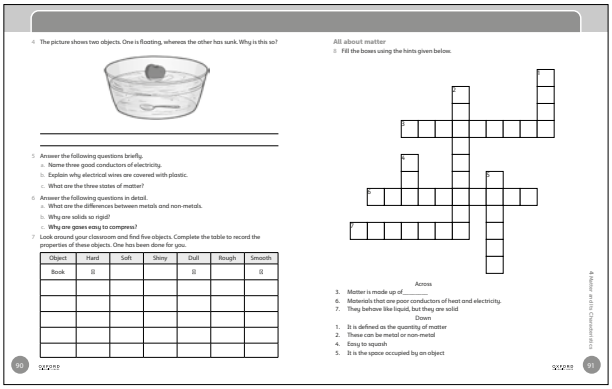
2 Circle whether the following statements are true or false.
Electricity travels through conductors. true false
Electricity travels through insulators. true false
Adding bulbs to a circuit makes them brighter. true false
Adding batteries to a circuit makes the bulbs brighter. true false

3 a Name three good conductors of electricity.

b Explain why electrical wires are covered with plastic.

4 Matter and Its Characteristics

89


4 The picture shows two objects. One is floating, whereas the other has sunk. Why is this so?

5 Answer the following questions briefly.
a. Name three good conductors of electricity.
b. Explain why electrical wires are covered with plastic.
c. What are the three states of matter?

6 Answer the following questions in detail.
a. What are the differences between metals and non-metals.
b. Why are solids so rigid?
c. Why are gases easy to compress?

7 Look around your classroom and find five objects. Complete the table to record the properties of these objects. One has been done for you.

Object	Hard	Soft	Shiny	Dull	Rough	Smooth
Book	☒			☒		☒

All about matter

8 Fill the boxes using the hints given below.

Across
3. Matter is made up of _____.
6. Materials that are poor conductors of heat and electricity.
7. They behave like liquid, but they are solid

Down
1. It is defined as the quantity of matter
2. These can be metal or non-metal
4. Easy to squash
5. It is the space occupied by an object

4 Matter and Its Characteristics

90 91

Getting started

The aim of this section is to encourage students to review their learning after each lesson in the unit and also to undertake some end-of-unit review and reflection. The questions given in this section will assess students' knowledge and understanding of the topic. You may have been using questions after each lesson where provided. However, it is also worth allowing students to answer all of the questions at the end of the unit. This will test longer-term understanding and recall. You can do this as an informal individual or pair activity and allow students to look information up as they work through the questions or you can set it as an individual 'closed-book' activity.

It is important that students report areas that they are not confident with. This information is useful for them in that they can think about what they need to review or ask advice about. It is also vital for you as it provides information about any topics you may wish to revisit.

What have I learned about matter and its characteristics ? answers

1 Circle the correct life answer.

Make sure students understand that they should only circle one choice.

Answer: *a- glass. b- solid. c- sound. d- air.*

2 Circle whether the following statements are true or false.

Answer: *True (Electricity travels through conductors; Adding batteries to a circuit makes the bulbs brighter). False (Electricity travels through insulators; Adding bulbs to a circuit makes them brighter).*

3 a. Name three good conductors of electricity.

b. Explain why electrical wires are covered with plastic.

Answer: *a- copper, gold, aluminium.*

b- Plastic is a material that cannot conduct electricity.

4 The picture shows two objects. One is floating, whereas the other has sunk. Why is this so?

Answer: *Because apple is less dense than water, whereas a metal spoon is more dense than water.*

5 Answer the following questions briefly.

a. Name three good conductors of electricity.

b. Explain why electrical wires are covered with plastic.

c. What are the three states of matter?

Answer: *a- copper, gold, aluminium.*

b- Plastic is a material that cannot conduct electricity.

c- solid, liquid, gas.

6 Answer the following questions in detail.

a What are the differences between metals and non-metals.

b Why are solids so rigid?

c Why are gases easy to compress?

Answer: *aa. Metals are mostly solid, hard and shiny but some are very soft. Metals can be can be heated up to make them soft and then shaped to make different objects. They can be hammered to make shapes or stretched to make wire. Metals makes a ringing noise when hit.*

b. Solids are rigid because their particles are closely packed together.

c. Because their particles are far apart with lots of space in between them.

7 Look around your classroom and find five objects. Complete the table to record the properties of these objects.

Answer: *Students may choose many of the normal classroom items. Some may include their lunch items or water inside water bottles.*

8 Fill the boxes using the hints given below.

Answer: *across: 3. particles; 6. insulators; 7. powders. down: 1. mass; 2. materials; 4. gas; 5. volume .*

Summative assessment

You can read out the answers to the What have I learned about matter and its characteristics ? section in the Student Book for students to self-assess or you can take in the pages and mark them to award an overall score. You could allocate marks as follows: question 1 = 4; question 2 = 2; question 3 = 2; question 4 = 1; question 5 = 3; question 6 = 6; question 7 = 5; question 8 = 7. This makes a total of 30 marks.

If necessary, ask students to revisit topics and questions to help them to learn more about any they did not score well on. In this way the questions are both summative and formative. All assessments should be linked to enhancing learning and in this way the 'What have I learned about?' pages will support this as well as providing data to report back to students, parents and/or other significant adults.

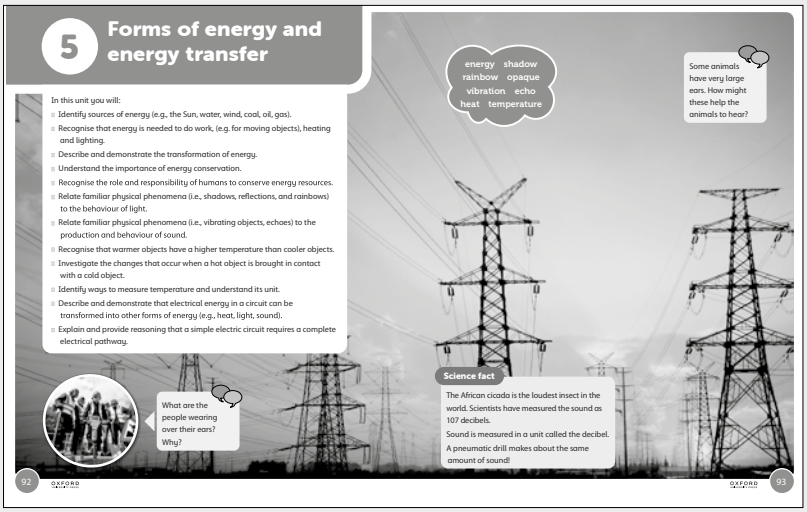
This information may also be used to create end-of-term reports for each student. It may also be useful to keep a record of overall confidence levels for the whole class to identify areas that may need revision later.

This feedback can then be used to form support strategies to help students improve. Keep the recording and analysis of students' self-evaluations simple. A general impression of the self-evaluation of the class is all that is required, for example: 50% of the class were not confident about … .

5 Forms of energy and energy transfer

In this unit students will:

- Identify sources of energy (e.g., the Sun, water, wind, coal, oil, gas).
- Recognise that energy is needed to do work, (e.g. for moving objects), heating and lighting.
- Describe and demonstrate the transformation of energy.
- Understand the importance of energy conservation.
- Recognise the role and responsibility of humans to conserve energy resources.
- Relate familiar physical phenomena (i.e., shadows, reflections, and rainbows) to the behaviour of light.



- Relate familiar physical phenomena (i.e., vibrating objects, echoes) to the production and behaviour of sound.
- Recognise that warmer objects have a higher temperature than cooler objects.
- Investigate the changes that occur when a hot object is brought in contact with a cold object.
- Identify ways to measure temperature and understand its unit.
- Describe and demonstrate that electrical energy in a circuit can be
- transformed into other forms of energy (e.g., heat, light, sound).
- Explain and provide reasoning that a simple electric circuit requires a complete electrical pathway.

Getting started

In this unit students explore the sources and forms of energy present on Earth. They learn about how light, heat, sound are all forms of energy and how they can be observed in our everyday life.

Science in context

Use the lessons in this unit to encourage students to learn more about the importance of using their observational skills and then validating their observations using scientific tests and data. Encourage students to find out about the uses of different forms of energy and how this affects our daily lives.

Scientific enquiry skills

An Investigation master sheet is given in this Teacher's Guide on pages 4–5 to help students plan their scientific enquiries. Students plan and carry out investigations, make observations and use secondary data. They take measurements using equipment accurately, make predictions and produce conclusions. Sometimes investigations take place over a number of hours or even days. This places greater emphasis on students' abilities to plan their work and keep accurate records.

Resources

Student Book: access to internet, circuit making equipment, glass pyramid, light sources, small mirrors, bells, poster/booklet making material.

Key words for the unit

are in the Word cloud.

energy shadow rainbow opaque vibration echo heat temperature

Scientific enquiry key words

Plan and/or carry out enquiries to answer questions
Recognise and control variables
Make observations
Take measurements, using equipment accurately
Record data and results using diagrams and labels, tables, keys and graphs
Make predictions
Report and present findings in a variety of ways
Draw conclusions and give explanations
Identify causal relationships

Identify causal relationships Use scientific evidence to support or refute ideas

Language support

Students should remember terms given in the keywords. Encourage them to add the words their notebooks in glossary form, updating their meanings as they progress. This could be a regular end-of-lesson task or a starter for the following lesson to encourage recall.

Start the unit by reading out the words in the Word cloud. Ask students to discuss each word and define those they are familiar with. As with other units, it is a good idea to create a Word wall for the unit so students see the words often and can become familiar with them.

When learning new words, especially specific science words and terms, it is important that they are repeated regularly and used in context. Ask students to listen, say, read and then write the words. Students can also make a list of other, non-science specific words they use in lessons that they are not familiar with. Some of these are listed in the individual lesson notes that follow. They could write these down in their notebook.

Consider adding to any science library you have organised in your classroom. As well as general science books and magazines, science encyclopaedias and dictionaries you may have collected for other units, you can download specific information. This will allow you to make small information booklets to support each lesson and especially Stretch zone activities.

Unit at a glance

The key teaching points for students in this unit are:

- to introduce the unit objectives
- to introduce the learning outcomes
- to engage students with the content of the unit
- to review and build on prior learning and understanding of the topics.

In this introductory lesson students are introduced to the electricity grid lines. They are reminded that electricity is the most commonly acknowledged form of energy, though there are other types as well. Encourage them to share what they understand by the word Energy and how many types of energy they know of?

Ask students to study the photographs in the Student Book with a partner. Encourage them to look at the photographs and discuss their ideas about them. Ask students what they think the unit might be about and what they would like to learn about based on the photographs. Then ask them to read through the learning outcomes and talk about each of them. Encourage them to say the key words and ask whether they recognise or are familiar with any of them.

What are the people wearing over their ears? Why?

Ask students to work with a partner. Allow them to talk about when they have seen the jackhammer equipment being used. If not, you may play a short clip for them. Point out that the jackhammer is very powerful and makes a lot of noise; encourage them to share Why there is a lot of noise produced.

Possible response: *Students should relate their experiences or their observations from the video clips to make guesses. They may suggest that since there is a lot of noise produced, it may make the person using the jackhammer and people nearby feel dizzy and unwell or develop a headache. Noise dampening headphones/ear covers are therefore used to protect the ears of construction workers and other people who work in high noise area.*

Some animals have very large ears. How might these help the animals to hear?

Ask students to discuss the statement with their partner.

Students can stay in their pairs or you could put them into groups of three or four for the discussion work. A useful strategy is to start with students in pairs and then move pairs together to make small groups so that students can share their ideas and discussions with others.

Possible response: *Students may incorrectly say that that bigger ears help animals to hear better. Encourage them to share what they mean by 'better'. Explain that sound travels in form of waves and is also a form of energy.*

Science fact: The African cicada is the loudest insect in the world. Scientists have measured the sound as 107 decibels.

Sound is measured in a unit called the decibel. A pneumatic drill makes about the same amount of sound!

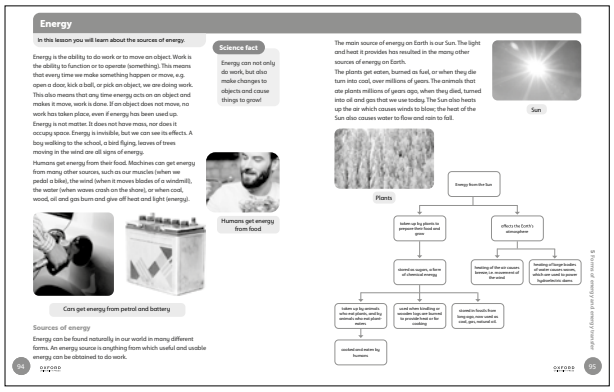
Read out the Science fact or ask a volunteer to read it out. APoint out that the noise levels of a pneumatic drill (similar to a jackhammer shown in the photo) and of cicada are very similar, and can be harmful with long term exposure.

Extra activities

1 Photographs of alternative energy sources modern powerful telescope are a good stimulus for discussion. Encourage students to link the evidence we have about the Earth's atmosphere with the impact of traditional sources of energy on the planet.

2 **Computing link:** Ask students to download from the internet some pictures of Earth and energy sources and make a collage to be displayed as a stimulus to learning.

Energy



Getting started

This lesson introduces students to the idea that there are different forms of energy all around us and on us all of the time. Students learn that there are many different forms of energy and we can often feel them acting on us.

Resources

Scientific enquiry key words

Make observations

Record data and results using diagrams and labels, tables, keys and graphs

Report and present findings in a variety of ways

Lesson at a glance

The key teaching points for students in this lesson are:

- not all forms of energy can be seen
- the effects of different forms of energy can be felt in our daily life.

Ask students to read the information on page 94 of the Student Book. This section discusses in detail what is Energy and how it impacts our ability to live our lives. Ask them what happens when a force acts on something.

Science fact Energy can not only do work, but also make changes to objects and cause things to grow!

Divide the students into small groups of up to three each. Encourage them to discuss and attempt to identify how energy can impact our daily lives. Suggest that growth, movement, play and even simply breathing requires and is possible due to energy. Ask them if they can identify how plants use energy.

Possible response: *Students should be able to give specific examples of how energy helps us work, live and grow. They should be able to point out that plants use the energy from sunlight to make their food and grow more leaves, flowers and fruits/vegetables.*

Ask students to read the information. They should also study the table, which sdetails how the energy from the Sun drives all the life processes on our planet.X

Ask students to summarise what they have learned in the lesson.

Review and reflect

Encourage students to find a quiet place to think about their learning in this lesson. Ask them if they found any part of the lesson challenging. Remind them that when they overcome a challenge, they are making their brain work harder. This is like going for a run to make your lungs work harder. Ask students how they felt when the learning was challenging and how they overcame the challenge. Ask them to record the strategies they used as this will help them in future situations. If all of the students found some part more difficult than others you might want to review this as a class before moving on to the next lesson.

Extra activities

1 Ask students to take photographs or draw diagrams of energy sources at home. They should try to find one example at least 5 different forms of energy.

Differentiation

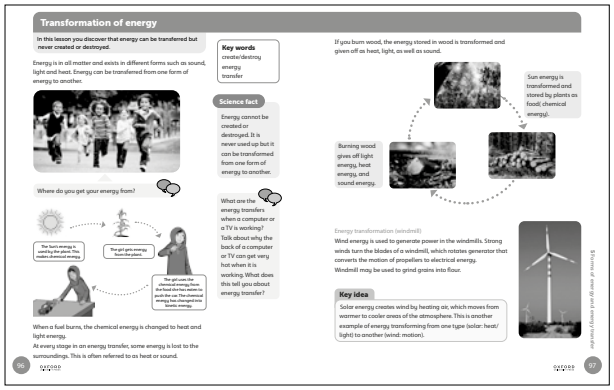
Supporting: Encourage students to practise identifying sources and forms of energy in daily life or in different photos or on diagrams.

Consolidating: Allow students to practise identify sometimes changes from one form to another.

Extending: Ask students to mark on the infogram the points where they identify the form of energy is changed.

Differentiated outcomes	
All students	should be able to describe what is energy
Most students	will be able to describe the different forms and sources of energy
Some students	may be able to describe how energy changes from one form to another as it moves through a system.

Transformation of energy



Getting started

In this lesson students investigate energy. They consider the different forms of energy and the fact that energy is all around us and in all matter. They learn that energy cannot be created or destroyed, but can change from one form of energy into another. They consider the amount of energy required for some tasks and make links to the amount and type of force this represents.

Language support

There are some unusual words in this lesson that students might not have experienced before. Ask students to discuss each of the words with a partner then ask them to share their ideas as a class. Students might give examples of using energy when they run and how this can be transferred to heat when they get hot. Ask them to give a definition for 'destroy' and explain that 'create' is the opposite. For example, a student can create a brick model and if someone knocks it over, they destroy it.

Resources

Student Book: materials to make information leaflets.

Key words

create/destroy energy transfer

Other words in the lesson

matter travel

Scientific enquiry key words

Make observations

Report and present findings in a variety of ways

Draw conclusions and give explanations

Identify causal relationships

Lesson at a glance

The key teaching points for students in this lesson are:

- energy is used when forces are applied
- energy cannot be created or destroyed but transferred from one form to another.

Ask students to discuss the Think back activity with a partner.

Think back: Discuss any forms of energy that you know about or have heard of. Make a list in your notebook. Add more to the list as you learn about them.

Pairs should make a list of all the forms of energy they know. They compare their list with another pair's and add to the list if necessary. Ask the class to share their lists and write a collated list on the board.

Possible response: *Students may suggest kinetic, electrical, thermal (heat), gravitational, chemical, light and sound energy. Other examples are nuclear, potential, mechanical and electromagnetic but they might not have experienced these.*

Ask students to read the text on page before discussing the questions. It gives examples of how different forms of energy can be changed. It explains that forces use energy. Ask students what would happen to a push or a pull if there wasn't any energy. Explain that when we burn a fuel we do not make heat – the chemical energy in the fuel is transferred into heat and light energy.

Where do you get your energy from?

Point out the photograph of the children running in a race and ask students to think about all the things they do in a day and remind them that all of these require energy.

Possible response: *Students should suggest that we use chemical energy transferred from our food into our bodies.*

What are the energy transfers when a computer or a TV is working? Talk about why the back of a computer or TV can get very hot when it is working. What does this tell you about energy transfer?

Ask students to think about what a computer or a TV needs in order to work. They should know that the items need electricity from either the mains or a battery. You could extend the discussion by asking students to think about what sort of energy is inside a battery and what this energy tranfers into. Elicit that a battery contains chemicals and that this chemical energy is changed into electrical energy.

Possible response: *Students should suggest that electrical energy is transferred to light (so we can see*

the action on the screen) and sound. Some of the electrical energy is transferred to heat energy which is why the computer or TV can get hot.

Ask students to continue to work with their partner to read the information on page 97. The information is presented diagrammatically on these pages so allow students time to read it more than once and to talk about the information so they can process what they are reading. Students are provided examples of energy transformation in nature as well as by using technology.

Key ideas

S*olar energy creates wind by heating air, which moves from warmer to cooler areas of the atmosphere. This is another example of energy transforming from one type (solar: heat/light) to another (wind: motion).*

- *Energy is in all matter. It can be transferred but never created or destroyed.*
- *Energy is used when forces are applied.*

Ask students to read the Key ideas and share their ideas. This will remind students that there are different forms of energy – they could try to list as many as they can from memory. You can also ask them to give examples to a partner of how energy is not created or destroyed but transferred from one form to another.

Review and reflect

Ask students to sit for a few minutes and think about what they have learned from the lesson. They can then think of one idea from the lesson that they would like to find out more about. Ask them to make a plan about how they would do this. This planning time will allow students to think up some imaginative and original things to do and you could let them carry out these projects. They are highly motivating and reinforce learning.

Extra activities

1 Ask students to observe energy transfers at home. They should draw energy transfer diagrams using arrows to show how the energy is transferred. These can be simple one-step diagrams or more complicated multiple-step diagrams.

2 Ask students to label their diagrams with energy transfers that are useful and those, such as heat energy from a TV, that are not useful.

Differentiation

Supporting: Allow students opportunities to practise identifying different types of energy.

Consolidating: Allow students opportunities to practise identifying energy transfers in different situations.

Extending: Ask students to draw diagrams to show energy transfers and forces for different situations.

Differentiated outcomes	
All students	should be able to name some types of energy
Most students	will be able to identify the energy transfers in some situations
Some students	may be able to describe how energy cannot be destroyed or created

Energy conservation


Energy conservation

In this lesson you will learn the ways to conserve energy.

It is important to conserve energy because we are currently dependent on non-renewable sources of energy. As these sources run out, it will get more and more expensive to run industries, light up our cities, travel for leisure, use electrical appliances, etc.

Energy powers our life

Ways to conserve energy

- Turn off the lights, fans, and electric appliances when you move out of your room.
- Use energy savers or LED bulbs instead of incandescent light bulbs.
- Limit the use of air conditioners as they consume a lot of energy.
- You can use solar panels. They convert the sunlight into electricity.
- Do not waste water. Turn off the taps when not using water.
- Prefer a walk or a ride on bicycle when travelling for short distance, to conserve the fuel.
- Prefer public transport over private transport.

Switch off the lights and fan

Energy conservation practices are to make sure that Earth's energy sources do not run out. These practices help conserve fossil fuel, make the environment clean and safe, and can also reduce your utility bills!

Use solar panels | Turn off the top | Use energy savers | Use LED bulbs

98

Getting started

In this lesson students will study how the energy we use costs money and causes pollution. They will explore ways of saving energy and carry out a school energy survey to record the different uses of electricity. They will consider the differences between renewable and non-renewable energy sources and discuss the advantages of renewable energy sources.

Language support

You can support language development by creating classroom displays of each type of renewable energy source with a simple explanation of how each energy source produces energy.

Resources

Student Book: materials to make leaflets.

Scientific enquiry key words

Plan and/or carry out enquiries to answer questions

Make predictions

Make observations

Record data and results

Analyse data, notice patterns and group or classify things

Report and present findings

Lesson at a glance

The key teaching points for students in this lesson are:

- many human activities affect local and global environments
- to protect the environment we have to think about energy consumption
- saving energy and using renewable energy sources can reduce pollution.

The text provides information about the need to protect the environment because human activities can have impacts both locally and globally. Ask students to read the information and then tell them that we need to work together to protect the environment. Explain that the activities in this lesson will focus on energy use, how to reduce energy consumption, and ways to produce energy that don't negatively affect the environment.

Ask students to work with their group of four. They can talk about the various devices that use electricity and make a list to share with the class.

Possible response: *Examples include TVs, laptops, tablets, mobile phones, cookers, heaters and lights.*

The section headed 'Ways to conserve energy' is designed to encourage students to discuss and think about ways of saving energy. Ask students to read it and then elicit some ideas from them on ways to save energy. Write their suggestions on the board.

Share with the students that Scientists have calculated that 75% of the electricity used to power devices is used while the products are 'on standby'.

Ask for a show of hands to find out how many students realise that devices use electricity when they are on standby. Ask them what they will do in future to save some of this energy.

Maths link: Allow students to work with a partner and provide access to the internet. Ask students to find out how much electricity an energy-saving bulb uses over an hour and compare this to a more conventional bulb. Students can then plan how to calculate how much electricity could be saved over a year. This is a good opportunity for a cross-curricular link with maths.

Possible response: *Students should find various figures depending on the types of bulbs but, for example, a typical energy-saving bulb (12 W) uses 75% less energy than a traditional 100 W bulb. They also last up to 25 times longer. If students find typical cost savings per bulb, they can count the bulbs in the school and calculate the overall saving.*

Review and reflect

Remember to praise the process of learning as much as, if not more than, the outcomes. Encourage students to ask questions and to look back through prior work to review and revise. Use every opportunity to allow students to work together to check understanding and share ideas. After the school energy survey ask students to reflect on how they found out about the devices – and to discuss and list which skills they used.

Extra activities

1 Ask students to produce a poster about renewable energy. They can download photographs of different examples and label them to show how they cause less pollution than fossil fuels.

2 Invite a visitor who works for a local company or government body in electricity generation into the classroom. Ask them to talk to students about the sources of energy used to generate the electricity and a little bit about the process. They can also mention the balance between renewable and non-renewable energy planned for the future.

3 Students can research the development of electric cars and the advantages and disadvantages of using them now.

Differentiation

Supporting: Make a collage to display photographs of examples of renewable energy sources on one side of the classroom and non-renewable sources on the other to help students remember these.

Consolidating: Demonstrate the burning of a fossil fuel (a piece of coal or a piece of cotton wool soaked in diesel or oil) to show the pollution that is produced.

Extending: Students can research countries where geothermal energy or hydroelectric power is used a lot. They could also find out why these are not possible in many other countries.

Differentiated outcomes	
All students	should be able to state that using less energy saves money and reduces pollution
Most students	will be able to describe some renewable and non-renewable energy sources
Some students	may be able to explain the advantages of renewable energy sources but that not all are suitable for every country

Light


Light

In this lesson you will explore light.

Light is a form of energy which helps us to see things and their colours. It is a form of energy which travels in straight lines. A collection of light rays is called a beam.
A source of light is an object which produces and gives off light energy. Some sources of light energy are- the Sun, the stars, light bulbs, candles, and fire.
It is night-time in the first photograph, but the people can see each other.

Key words
light
reflect

How can these people see each other?
Where is the light coming from?

There are some shiny things that we think are sources of light, but they are not. They 'bounce' or reflect the light from another source, which enters our eyes and helps us to see. This is called reflection.
Look at these buildings. The shiny surfaces are reflecting the light.

Where have you seen or used a mirror?
A mirror is an example of a shiny surface which reflects light, but is not the source of light. Can you think of other such examples?

Science fact
The moon is not a source of light energy, as it reflects the light given by the Sun. It does not produce any light of its own.

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99

Getting started

In this lesson students learn that we need light to see. Show students the photograph of the Sun going down at night. Explain that when the Sun goes down, we are dependent on human-made light to see things.

Language support

Read out the key words and discuss their meanings – students should be able to describe what 'light' and 'reflect' mean. Ask them to find an image in the Student Book of a scene demonstrating these words. Discuss how light means that we can see things and dark means the absence of light so we can't see things. Discuss the word 'dim'. Ask students what they think this might mean. Explain that this is between light and dark. Ask if they have seen or used a dimmer switch. If possible, show one in a video clip or real life. Discuss how this varies the amount of light. Encourage students to make predictions about what happens to light that is reflected in darkness or light. They predict what will happen to their reflection in a mirror when the intensity of light changes.

Resources

Student Book: blindfolds; candles; matches; mirrors; torches; pens with on and off buttons that click.

Key words

light reflect

Scientific enquiry key words

notice patterns use secondary sources
communicate findings

Lesson at a glance

The key teaching points in this lesson are:

- we need light to see things
- objects that are not sources of light can reflect light
- mirrors are objects that reflect light well.

Discussion

How can these people see each other? Where is the light coming from?

Elicit discussion about human-made or artificial sources of light that might help us to see well. Ask students to discuss with the person next to them how many types of artificial lights there are and what powers them. Encourage them to give examples. Compile a class list and discuss students' ideas. Prepare some relevant and familiar answers in case students have trouble expressing themselves.

Possible response: *Some students may recognize that there are numerous human-made lights in the area. The Sun is not visible and it is night-time, or it is dark. The human made lights are providing lights to help people see.*

Point out how the shiny, reflective surfaces are not sources of light but that they reflect the light from other sources. Elicit from the students how the shiny surfaces on the buildings are reflecting the light from the Sun to our eyes.

Discussion

Where have you seen or used a mirror? Talk to your partner about what a mirror looks like. Have you ever touched a mirror? What did it feel like?

You could display mirrors or mirrored surfaces to stimulate the discussion of what a mirror looks like. Discuss how the mirror looks and feels shiny and smooth. Some might say it also feels cold as the heat is also reflected away.

Possible response: *Students may say that they have used a mirror as they go about their daily life. They may share specific examples.*

Key idea

Shiny surfaces, like mirrors, are not sources of light. They reflect light from another source.

Summarise the lesson by asking students what they have learned. Let them share their ideas, read out and discuss the key idea. Ask students to share other sources of light that they use at home when it is dark. Ask students to discuss what is the source of light when they look in the mirror. Ask if they could still see themselves when the amount of light was changed.

Review and reflect

Ask questions throughout the lesson and listen for any misunderstandings. Allow students to express their ideas and encourage them to discuss and share their ideas as they learn. This will allow you to address areas immediately before misconceptions can begin.

Remind students that it is not important if they don't always get the correct answer. What is important is having the confidence to solve problems and to know that it is the process that is important, not always the outcome.

Extra activities

1 Ask students to carry out some creative writing to describe what life would be like without any reflective surfaces. Ask students to read out their stories to the class or print them off and make a class storybook.

2 Ask students to list how many materials they can see themselves in today. Ask them to record how they looked. If they used a spoon, for example, ask if it created a good reflection.

3 **Computing link:** Students could research different uses of reflective objects, and make a fact file of one use.

Differentiation

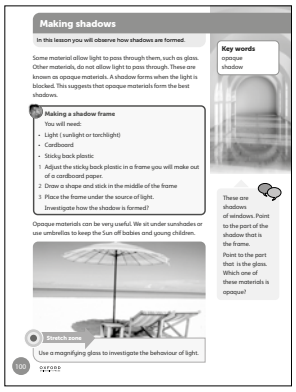
Supporting: Hand out pictures of places that are in the dark with human-made lighting. Ask students to imagine what it would be like if the lights were not available. Ask what they would be able to see.

Consolidating: Students could imagine they are reading this book when the Sun goes down and sets. What would they suggest to be the best human-made source of light to use to carry on reading?

Extending: Ask students to research how animals that live at the bottom of the ocean move around safely and find food.

Differentiated outcomes	
All students	should be able to understand that we need light to see things.
Most students	will be able to understand that artificial lights and reflective surfaces can help us to see after dark.
Some students	may be able to discuss if how we can use mirrors even in the dark.

Making shadows


Making shadows

In this lesson you will observe how shadows are formed.

Some material allow light to pass through them, such as glass. Other materials, do not allow light to pass through. These are known as opaque materials. A shadow forms when the light is blocked. This suggests that opaque materials form the best shadows.

Key words
opaque
shadow

Making a shadow frame

You will need:
- Light (sunlight or torchlight)
- Cardboard
- Sticky back plastic

1 Adjust the sticky back plastic in a frame you will make out of a cardboard paper.
2 Draw a shape and stick in the middle of the frame
3 Place the frame under the source of light.
Investigate how the shadow is formed?

These are shadows of windows. Point to the part of the shadow that is the frame.
Point to the part that is the glass. Which one of these materials is opaque?

Opaque materials can be very useful. We sit under sunshades or use umbrellas to keep the Sun off babies and young children.

Stretch zone
Use a magnifying glass to investigate the behaviour of light.

103 OXFORD

Getting started

The concept of shadows is introduced in this lesson. Students learn that a shadow is made or cast when something blocks light. Any source of light can make a shadow.

Language support

Students should be familiar with the term 'shade' so tell them that a shadow is the shade created by an object when it blocks the light. Ask students to think about when they have been in the shade, such as under a tree or an umbrella. Explain that a tree blocks the light from the Sun to form a shadow on the ground and create shade from the Sun for you. The word 'opaque' is tricky so write this on the board and ask students to sound out the word as you move your finger along it. Say that it rhymes with 'shake' but has a different spelling for the 'aque' sound.

Resources

Student Book: Light (sunlight or torchlight); Cardboard; Sticky back plastic.

Key words

opaque shadow

Other words in the lesson

shade shape

Scientific enquiry key words

measure record data carry out tests

group/classify

Lesson at a glance

The key teaching points in this lesson are:

- shadows are made when an object blocks light
- opaque materials make shadows.

You can see shadows in the day and at night.

Ask students to think about and discuss the the reason why they are able to see shadows during both day and night. This will help them to review previous learning about sources of light.

These are shadows of windows. Point to the part of the shadow that is the frame. Point to the part that is the glass. Which one of these materials is opaque?

Arrange students into pairs or groups of three or four. Ask them to study the photograph at the top of page and read the information about how opaque materials block light and form shadows.

Answer: *Students should suggest the shadow is the opaque window frame and the white part is the transparent glass.*

Investigation: Making a shadow frame

Ask students to discuss with the person next to them how shadows are made. Make sure that they are clear that a shadow is formed when light is blocked. Confirm their knowledge by asking them comprehension questions after they have silently read the text.

Students work with a partner to explore shadows. They use a torch as a source of light and try to find objects that will make a good shadow. Students test the objects that they select to see if they will make a shadow. Students record their investigations by drawing around the shadows that they have made onto a large sheet of paper. Encourage students to compare the diagrams of the shadows that they have made.

Ask students why scientists would repeat their investigations and complete them before making any decisions. Elicit that scientists repeat investigations to check that the results are reliable. For example, they may make a mistake in one investigation but think the result is accurate. They always finish investigations to make sure they have measured or observed all of the changes that could take place.

Answer: *Students should predict and find that the opaque materials will make the best shadows. Their results should support their predictions.*

Stretch zone: Use a magnifying glass to investigate the behaviour of light.

Possible response: *Students should report that light seems to show many colours when it passes through*

a magnifying glass. They may also report how objects can appear smaller or larger as the magnifying glass is moved close to or away from an object.

Summarise the lesson by asking students what they have learned. Let them share their ideas, read out and discuss the key ideas. Ask students how they made a shadow. What was the object that they used and what was the source of light? Ask them if they could change the size or shape of the shadow using the same object. Ask them to tell their partner how to do this.

Review and reflect

You can ask students to produce a scientific report of their investigation. This can include a prediction, method, results and their conclusions. You can read through these and look for evidence of sensible predictions and an understanding of variables.

Encourage students to celebrate success during the lesson as this raises confidence and engagement. It also reminds them that learning is a process and they can learn from the things that did not go as well as they hoped.

Extra activities

1 Students stand outside in sunlight. They investigate how to make their shadows smaller and bigger. They make a poster to show how they did this. Point out to students that this will help them to recall work in Year 5 when they studied how shadows change during the day. Also tell students they will get a chance to study this in more detail in a forthcoming lesson.

2 Students make a collage of pictures cut out from magazines to show what materials make the best shadows.

Differentiation

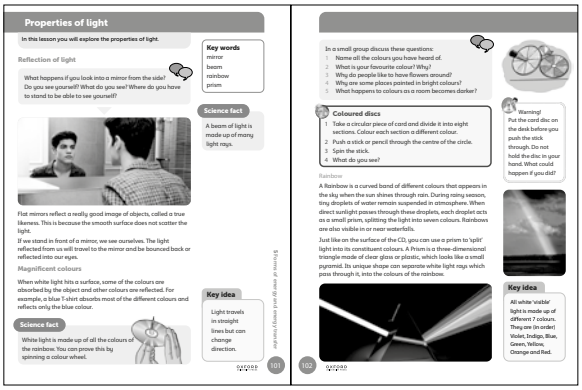
Supporting: Display photographs of sunshades, blinds and curtains being used to create shade to show students some examples in context.

Consolidating: Students can make sketches of areas of shadow around the school and label the materials that are casting the shadows.

Extending: Students can research the uses of translucent materials based on their property of letting some light through.

Differentiated outcomes	
All students	should be able to predict which objects will cast shadows
Most students	will be able to state that opaque materials cast the best shadows as they block light
Some students	may be able to relate the properties of transparent, translucent and opaque materials to the type of shadow they will cast

Properties of light



Getting started

In this lesson students look at how we can use mirrors to reflect light. The image reflected is a true likeness to the objects using a normal or flat mirror. Students investigate how white light is made up of all the colours of the spectrum. Students will also explore other properties of light such as splitting into colours, and the formation of rainbows.

Language support

You could create a wall display with the help of students to display the key words. This could be visually stimulating. For example, download and display pictures of light prisms splitting light.

Resources

Student Book: cd, pencil, light source; glass prism; writing materials; large sheets of paper.

Key words

mirror beam rainbow prism

Other words in the lesson

likeness scatter

Scientific enquiry key words

Plan and/or carry out enquiries to answer questions

Recognise and control variables

Make observations

Take measurements, using equipment accurately

Record data and results

Analyse data, notice patterns and group or classify things

Report and present findings

Draw conclusions and give explanations

Identify causal relationships

Lesson at a glance

The key teaching points for students in this lesson are:

- flat mirrors reflect light to give a true reflection
- white light is made up of the different colours of the spectrum.

In the next lesson, students will study refraction and colour.

Think back: A beam of light is made up of many light.

Ask students to read the text above the investigation box and study the pictures. Point out that when a mirror is flat with a smooth surface the image reflected is known as a true image. Ask students where the light comes from when we look in a mirror. Elicit that the light from a light source is reflected from us to the mirror.

What happens if you look into a mirror from the side? Do you see yourself? What do you see? Where do you have to stand to be able to see yourself?

Students can observe the picture of the student sideways onto the mirror. This should act as a hint to address the discussion questions.

Possible response: *Students should suggest that when they look from the side they see a side view of themselves only if they change their position so that they can see the mirror.*

Key idea

Light travels in straight lines but can change direction.

Read through the key idea or ask a volunteer to read it out to the class. Check understanding by asking, 'Describe how the mirror reflects light. How would you show how the ray of light is reflected from a normal mirror? What angle should the normal line be at to the mirror and what fact do you know about the angles of incidence and reflection?'

Magnificent colours

The first part of this topic is a discussion task. This is intended to check on students' understanding about colour and light before they carry out the investigation. Split the class into small groups to discuss the questions one by one, and you can circulate to check on their baseline knowledge about colour. You can write the colours students mention on the board as a reminder for the investigation. It is important that you clarify the answer to question 5 to the class.

In a small group discuss these questions:

1. **Name all the colours you have heard of.**
2. **What is your favourite colour? Why?**
3. **Why do people like to have flowers around?**
4. **Why are some places painted in bright colours?**
5. **What happens to colours as a room becomes darker?**

Possible response: *1 Students should suggest that they have heard of colours like red, orange, yellow, blue, green and purple. 2 Their favourite colours will vary. 3 Flowers and other objects are pretty to look at. 4 People paint things different colours to make them look appealing. 5 When there is reduced light, colours appear duller as they do not reflect as much light.*

Investigation: Coloured discs

Warning! Put the card disc on the desk before you push the stick through. Do not hold the disc in your hand. What could happen if you did?

This investigation encourages students to think about the relationship between light and colour. This can be an independent task. Before they start, ask a volunteer to read out the warning information. Ask students to tell you what could happen if they hold the disc in their hand.

Students can then follow the instructions to divide the circular card into eight sections and colour each section a different colour. They then push a stick or pencil through the centre of the circle and spin the stick. Encourage them to talk about their observations.

You might want to attach a coloured disk to a drill bit on an electric drill. Make sure the card is securely in place. The drill will be able to spin the disc so fast that students can see the card looks white.

Possible response: *Students should see that the disc looks white. It doesn't matter what colours they have made the disc – if it is spinning fast enough, it should still appear white.*

Ask students to read the information below the investigation box. Explain that some colours are absorbed by an object and we see the colours that are reflected. White objects reflect all of the colours. There are many things – including raindrops – that can disperse or separate white light and this is how we see the colours of the rainbow.

Science fact White light is made up of all the colours of the rainbow. You can prove this by spinning a colour wheel.

Ask a volunteer to read out the Science fact. This acts as a summary of the learning about colours in the lesson.

Key idea

Light rays bend as they pAll white 'visible' light is made up of different 7 colours. They are (in order) Violet, Indigo, Blue, Green, Yellow, Orange and Red..

Read out the key idea or ask volunteers to read it aloud. Ask students to think back over the lesson and then on a blank piece of paper write a description of what white light is. Ask them how they would show that the light we see is actually made up of the rainbow or spectrum of colour. Ask students to list the seven colours of the rainbow, which we accept as being the parts of white light, from memory.

Review and reflect

Ask students to reflect on the investigations they carried out and think about how well they worked as a team member and how well they communicated with each other. Ask them to think of one way of working that they are proud of and one thing they could improve on. Tell them this is their target and they can see if they can meet this target in the next few lessons.

Extra activities

1 Ask students to research how designers and architects use mirrors inside buildings to allow light through the building and to give a feeling of space. They could download photographs of some examples.

2 Students change the shape of bendable mirrors and observe how it changes the shape of their face and the faces of the people at home. They see who can make the funniest reflection.

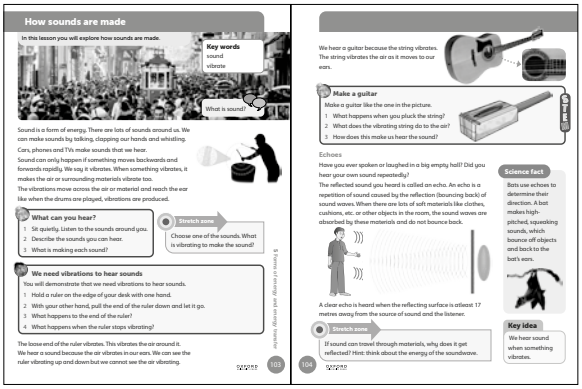
Differentiation

Supporting: While students observe their reflections, talk to them about how the light is being reflected from each surface.

Extending: Encourage students to observe light splitting using a glass prism to extend their understanding of how white light is made up of 7 different colours.

Differentiated outcomes	
All students	should be able to explain how an image is reflected using a flat mirror
Most students	will be able to state that white light is made up of different colours
Some students	may be able to explain how angles of reflection change when mirrors are not flat

How sounds are made



Getting started

In this lesson students learn that sound is made when objects vibrate. The vibrations travel through the air. These vibrations are picked up by the ear and the hearing system makes sense of the vibrations. Students investigate the vibrations and the sounds that they can hear.

Language support

Ask students to write definitions of the key words in their glossaries. You will need to revisit these and remind students of the meanings. There are many opportunities in this unit to demonstrate the meaning of the word 'vibrate'. Demonstrate how a tuning fork vibrates. Students should be able to feel the vibrations if they put the fork close to but not touching their lips.

Resources

Student Book: plastic rulers; large bowls; cling film; sticky tape (to make drums); sticks; rice; tuning forks; containers of water; empty tissue boxes; pencils or short pieces of dowel; elastic bands or string; cardboard tubes; glue or sticky tape.

Key words

sound vibrate

Other words in the lesson

loud quiet

Scientific enquiry key words

ask questions use equipment observe measure compare notice patterns record carry out tests use secondary sources communicate findings

Lesson at a glance

The key teaching points in this lesson are:

- sounds are made when objects vibrate
- we can see vibrations and can link these to the sounds being made.

Students should look at the photograph of the busy street and discuss the question with a partner.

Encourage students to think about their prior learning on senses and to think about what sound is and why it is important.

Ask students to read the text beneath the photograph. Students are introduced to the idea that there are many sounds around us all of the time. These sounds can come from many different sources, including vehicles and phones. We are also capable of making different sounds. Discuss how sounds are made as a result of vibrations. These vibrations move across air and other materials to the ear, where our brain makes sense of them. Ask students to discuss as a class what vibrations are. Explain that they are the backwards and forwards motion of an object or material.

Investigation: What can you hear?

Introduce this first investigation to the class. Ask students to stay in their seats and to stay as quiet as possible for the investigation. Tell them that they should not make any sounds but should listen carefully to the sounds around them. They could make notes as they listen to discuss at the end of the investigation. They are then asked to identify what is making each sound. Ask them to make a list of all the sounds with one adjective to describe it and what is making the sound. Write a list of the sounds on the board, so students can check and add to their own lists.

Stretch zone: Choose one of the sounds. What is vibrating to make the sound?

Students might have heard children talking or shouting. Their vocal cords make the air vibrate. Encourage students to think deeply about the sounds that they hear and unpick what is happening to cause the vibrations. They might need some support with this at this stage.

Investigation: We need vibrations to hear sounds

The aim of this investigation is to prove that vibrations are necessary to make a sound.

Students should be able to observe and report that the end of the ruler vibrates when it is held over the edge of a desk, pulled down and then let go. This vibration causes the sound that we hear. When the ruler stops vibrating, the sound stops.

Ask the students to describe how the ruler disturbed the air around it. Explain that this investigation is a way of seeing the vibrations that are happening in the air around. Normally, when there is a sound, we cannot see it.

Organise students into pairs or small groups and ask how they can investigate how the vibrations cause sound to be heard.

Investigation: Make a guitar

Students make a model guitar to further investigate how vibrations produce sounds. They can use the picture to help them make their guitar. They will need to help each other stretch the elastic bands or string around the box.

Ask students to discuss the questions in their groups. Bring the class together for a plenary session to discuss the answers to the questions together.

> ***Possible response:*** *When the string is plucked it vibrates. These vibrations make the air vibrate. The vibrating air reaches our ears, so we hear a sound.*

Stretch zone: If sound can travel through materials, why does it get reflected? Hint: think about the energy of the soundwave.

Explain that sound gets reflected (as echo) or absorbed depending on the reflecting surface. If the reflecting surface is hard and smooth, the sound waves will reflect. If the reflecting surface is soft , then the sound will get absorbed. And if the reflecting surface is irregular, the sound waves will get scattered and dampened.

Read the topic on Echoes with class. Ask the students if they have ever noticed what happens to their voice in a large empty room. Encourage them to share their ideas and discuss, in light of the topic they have just read.

Key idea

We hear sound when something vibrates.

Read out the key idea, or ask a volunteer to read it out. This will remind students that some materials vibrate and sounds are made. Remind students that the vibrations disturb the air and the vibrations are carried to the ear. This is how we hear sounds. Twang an elastic band to illustrate this. Ask students to share some of their investigations where they have observed vibrations.

Review and reflect

Encourage students to reflect on their own learning by pausing for a few moments and thinking about which parts of the work they found a challenge. Talk about how they managed this and suggest that next time they stop for a short while and take a few deep breaths. Also remind them that when they are doing tricky work, they are training their brain and this will help their future learning

Some students might find that identifying the trends in their observations difficult. Encourage them to repeat their observations and to discuss these with other students. As they collaborate, they will understand the concept to a deeper level and their confidence levels will increase.

Extra activities

1 Students can use their guitar to explore how sounds can be changed by shortening the elastic bands or strings, or by plucking them harder or softer. Students might also understand that by placing their fingers on the strings they can change the pitch, but they might simply say it changes the 'sound' of the string at this stage.

2 Students can change the vibrations on a drum by hitting it differently: lighter or harder or in different places on the drum.

Differentiation

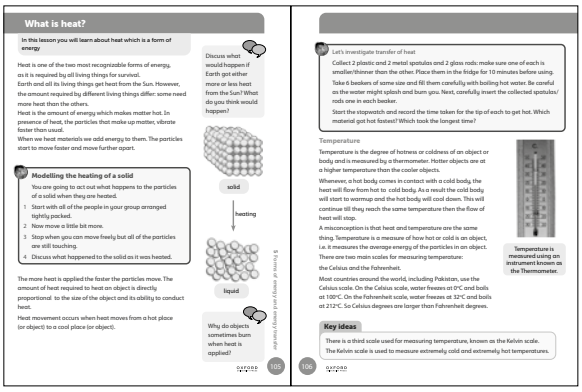
Supporting: Allow students many opportunities to observe the vibrations made by different objects.

Consolidating: Students can repeat the investigations observing the vibrations and the sound produced.

Extending: Students can explore how changing the vibration affects the sound made.

Differentiated outcomes	
All students	should be able to observe sounds being made by vibrations
Most students	will be able to make sounds using different materials that vibrate
Some students	may be able to change the sound made by changing the vibrations

What is heat?



Getting started

In this lesson students learn about Heat energy. They will understand the concept in terms of energy and movement (vibrations) of particles, i.e. the arrangement of particles and what happens when the energy of the particles increases due to heating. They will further also explore the transfer of heat and the units used to measure heat.

Language support

Ask students to identify and note down the new and/or difficult vocabulary they encounter in the unit. Encourage them to note down the meaning in a glossary in their notebooks.

Resources

Student Book: plastic rulers; large bowls; cling film; sticky tape (to make 2 plastic and 2 metal spatulas and 2 glass rods; the fridge; 6 beakers; boiling hot water; stopwatch; thermometer; notepads; pens.

Scientific enquiry key words

ask questions use equipment observe
measure compare notice patterns record
carry out tests use secondary sources
communicate findings

Lesson at a glance

The key teaching points in this lesson are:

- heat is a form of energy
- we can measure heat using different scales.

Ask students to read the text at the top of the page. Students are introduced to the idea that when we heat materials we add energy to them. The particles start to move faster and move further apart. You could draw

attention the students attention to the illustration showing what happens to particles in a solid as it is heated. As the the particles in a solid move further apart and are only loosely linked when it becomes a liquid. The structure and shape of the solid breaks down and the liquid takes on the shape of the bottom part of its container.

Discussion: Discuss what would happen if Earth got either more or less heat from the Sun? What do you think would happen?

ncourage students to recall and apply their knowledge of particles and energy to discuss the answer to this question.

> ***Answer:*** *f the Earth received less energy from the Sun, the overall energy in the environment would decrease. The reason is that plants would receive less light and heat and so would not be able to make enough food to survive as a specie. This would reduce the amount of food present on the Earth, resulting in death of many living things. If the energy recived*

Investigation: Modelling the heating of a solid

You will need a clear space for students to safely move around in. Each student models a particle in a solid. Ask them to move around very slowly; they are particles that are cold. Now ask them to run around; they are particles that have been heated, so they have more energy. Students gradually move further apart to demonstrate how the energy is transferred to a solid when it is heated until it becomes a liquid.

Ask students to read the text before the investigation box. Encourage a class discussion on heat movement.

Why do objects sometimes burn when heat is applied?

Ask students to share their ideas with a partner and then discuss this as a class. Some students should be able to recall and apply their knowledge of particles and energy to support their answers.

> ***Answer:*** *Generally when heat is applied to an object, the atoms and molecules in the object start to move faster and gain energy. The temperature at which an object burns depends on how much energy the particles can take up before they begin to break apart, react and burn.*

Investigation: Let's investigate transfer of heat

Ask students to work in small groups. Provide aid by pouring hot water into the beakers for them.

Give each group a container with boiling hot water in it. Ask students to carefully insert the hot and cold rods and spatulas into the water.

Show students how to use the stopwatch to take time measurements. Ensure students do not get burnt.

Ask a volunteer to read out the information below the investigation box. Discuss the meaning of Temperature and then explain that there are there different scales to measure temperature. Ask students to work in a small group to discuss how they could investigate how the vibration of the strings results in sound being heard. They then make a guitar in the next investigation.

Key ideas

- *There is a third scale used for measuring temperature, known as the Kelvin scale.*
- *The Kelvin scale is used to measure extremely cold and extremely hot temperatures.*

Read out the key ideas, or ask a volunteer to read them out. This will remind students that there is another temperature scale, used mostly for scientific measurements. Encourage the students to share any examples they can think of where the Kelvin scale will be useful.

Review and reflect

Encourage students to reflect on their own learning by pausing for a few moments and thinking about which parts of the work they found a challenge. Talk about how they managed this and suggest that next time they stop for a short while and take a few deep breaths. Also remind them that when they are doing tricky work, they are training their brain and this will help their future learning

Some students might find that identifying the trends in their observations difficult. Encourage them to repeat their observations and to discuss these with other students. As they collaborate, they will understand the concept to a deeper level and their confidence levels will increase.

Extra activities

Differentiation

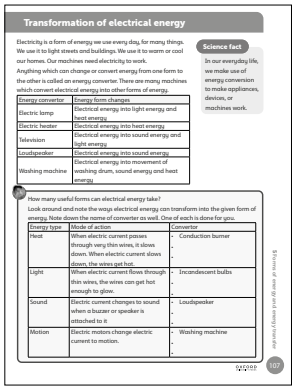
Supporting: Allow students many opportunities to measure temperature using thermometers.

Consolidating: Students can repeat the investigations measuring the melting of solids and temperature.

Extending: Students can explore how changing the temperature can delay or increase the process of melting.

Differentiated outcomes	
All students	should be able toexplain the process of heating
Most students	will be able to measure the temperature using a thermometer
Some students	may be able to share the relationship between heat and melting of solids.

Transformation of electrical energy


Transformation of electrical energy

Electricity is a form of energy we use every day, for many things. We use it to light streets and buildings. We use it to warm or cool our homes. Our machines need electricity to work.
Anything which can change or convert energy from one form to the other is called an energy converter. There are many machines which convert electrical energy into other forms of energy.

Energy convertor	Energy form changes
Electric lamp	Electrical energy into light energy and heat energy
Electric heater	Electrical energy into heat energy
Television	Electrical energy into sound energy and light energy
Loudspeaker	Electrical energy into sound energy
Washing machine	Electrical energy into movement of washing drum, sound energy and heat energy

Science fact
In our everyday life, we make use of energy conversion to make appliances, devices, or machines work.

How many useful forms can electrical energy take?
Look around and note the ways electrical energy can transform into the given form of energy. Note down the name of converter as well. One of each is done for you.

Energy type	Mode of action	Convertor
Heat	When electric current passes through very thin wires, it slows down. When electric current slows down, the wires get hot.	• Conduction burner • . • .
Light	When electric current flows through thin wires, the wires can get hot enough to glow.	• Incandescent bulbs • . • .
Sound	Electric current changes to sound when a buzzer or speaker is attached to it	• Loudspeaker • . • .
Motion	Electric motors change electric current to motion.	• Washing machine • . • .

Science at work
107

Getting started

This lesson builds upon the earlier knowledge of energy and its many forms. They will focus on electrical energy, its uses and transformation that powers many devices which make our life easier.

Language support

You could create a wall display with the help of students to display the key words. This could be visually stimulating through the use of pictures or small objects.

Resources

Student Book: booklet/chart making materials.

Scientific enquiry key words

Plan and/or carry out enquiries to answer questions

Make predictions

Make observations

Record data and results

Analyse data, notice patterns and group or classify things

Report and present findings

Draw conclusions and give explanations

Identify causal relationships

Lesson at a glance

The key teaching points for students in this lesson are:

- electricity is a form of energy.
- similar to other forms of energy, electricity can also be transformed to different forms of energy.

Arrange students into pairs or groups of three or four. Ask them to study the text on page describing electricity and its uses. Encourage the student groups to focus on the electrical energy transformations which make work possible.

Direct their focus towards the table listing electrical converters and the converted forms of energy. Encourage a class discussion on the electrical conversions, incorporating the investigation box given.

Investigation: How many useful forms can electrical energy take?

Ask students to work with their group to investigate the different energy conversions that can take place in our daily life.

As this is a thought experiment, encourage students to realize that even such activities require accurate observations, recall and synthesis processes. Encourage them to move beyond the given conversions and add their own observations to the answers.

Science fact In our everyday life, we make use of energy conversion to make appliances, devices, or machines work.

Read out the Science fact or ask a volunteer to read it out. Ask students if they think it would be possible to spend a day without using energy at all. When they say no, ask them what is minimum use of energy they can imagine.

Review and reflect

You can ask students to produce a scientific report of their investigation. This can include a prediction, method, results and their conclusions. You can read through these and look for evidence of sensible predictions and an understanding of variables.

Extra activities

1 Studentscan extend their investigation on energy converters by surveying areas outside of the classroom. They should extend the table and make a booklet based on their findings.

Differentiation

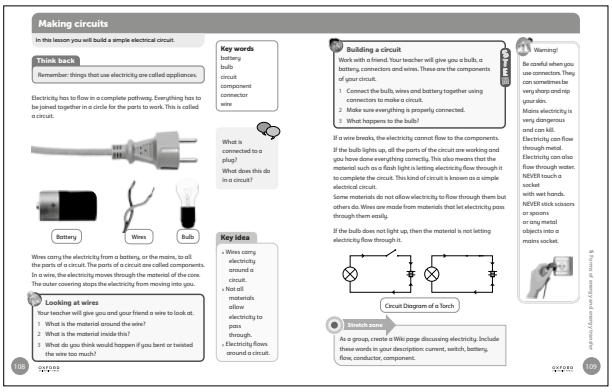
Supporting: Display photographs of electrical converters.

Consolidating: Students can sketch the energy conversions they have observed in their daily life.

Extending: Students can relate the energy conversions to the food chains in the natural world and draw their conclusions.

Differentiated outcomes	
All students	should be able to describe what is electricity and its uses
Most students	will be able to state how energy conversions help our daily life
Some students	may be able to provide certain examples of energy conversions, and relate it to food chains and web in terms of energy conversion and transfers

Making circuits


Making circuits

In this lesson you will build a simple electrical circuit.

Think back

Remember: things that use electricity are called appliances.

Electricity has to flow in a complete pathway. Everything has to be joined together in a circle for the parts to work. This is called a circuit.

Battery Wires Bulb

Wires carry the electricity from a battery, or the mains, to all the parts of a circuit. The parts of a circuit are called components. In a wire, the electricity moves through the material of the core. The outer covering stops the electricity from moving into you.

Looking at wires

Your teacher will give you and your friend a wire to look at.

1 What is the material around the wire?
2 What is the material inside this?
3 What do you think would happen if you bent or twisted the wire too much?

108 OXFORD

Key words
battery
bulb
circuit
component
connector
wire

What is connected to a plug?
What does this do in a circuit?

Key idea

- Wires carry electricity around a circuit.
- Not all materials allow electricity to pass through.
- Electricity flows around a circuit.

Building a circuit

Work with a friend. Your teacher will give you a bulb, a battery, connectors and wires. These are the components of your circuit.

1 Connect the bulb, wires and battery together using connectors to make a circuit.
2 Make sure everything is properly connected.
3 What happens to the bulb?

If a wire breaks, the electricity cannot flow to the components.

If the bulb lights up, all the parts of the circuit are working and you have done everything correctly. This also means that the material such as a flash light is letting electricity flow through it to complete the circuit. This kind of circuit is known as a simple electrical circuit.

Some materials do not allow electricity to flow through them but others do. Wires are made from materials that let electricity pass through them easily.

If the bulb does not light up, then the material is not letting electricity flow through it.

Circuit Diagram of a Torch

Stretch zone

As a group, create a Wiki page discussing electricity. Include these words in your description: current, switch, battery, flow, conductor, component.

Safety

Warning!

Be careful when you use connectors. They can sometimes be very sharp and nip your skin.
Mains electricity is very dangerous and can kill.
Electricity can flow through metal.
Electricity can also flow through water.
NEVER touch a socket with wet hands.
NEVER stick scissors or spoons or any metal objects into a mains socket.

Sources of energy and energy transfer

109 OXFORD

Getting started

This lesson introduces students to some components used to construct simple circuits. They construct a series circuit that they will use as a test circuit throughout the unit. They explore and test different wire materials to find out if they are suitable as conductors of electricity.

Language support

Check students' understanding of the key words for this unit and ask them to add to their glossary. Students should be able to use the words 'battery' and 'wire' in a sentence successfully after the last lesson. In this lesson they will use the word 'bulb', which they probably have experienced before.

Explain that all of the components or parts of a circuit have to be joined together in a circuit or they will not work. Ask them to think about sports circuits and how the athletes or racing cars move around the continuous loop that we call a circuit.

Ask students what they think a connector does and if it sounds like another word they might have used, for example connect or connection. Use this to explain how a connector connects components in the circuit.

Resources

Student Book: wires; bulbs; batteries; connectors (crocodile clips); various objects to test in a simple series circuit.

Key words

battery bulb circuit component connector wire

Other words in the lesson

conductor insulator

Scientific enquiry key words

ask questions use equipment observe measure compare notice patterns record carry out tests

Lesson at a glance

The key teaching points in this lesson are:

- components join together in a circuit
- simple circuits include wires, batteries, bulbs and connectors.

Think back: Remember: things that use electricity are called appliances.

Ask students to read the Think back statement. Remind students that an appliance is anything that helps us to carry out tasks and jobs and uses electricity to work. Ask students to suggest any appliances that they have observed in school or at home. They might suggest a computer, a toothbrush or lights, for example.

Hold up some appliances or pictures of appliances and ask students to say their names. Ask, 'Can you list any other electrical appliances? Think about things you use at home.' You could inform students that an electrical appliance is a machine that uses electricity and a component is anything that is part of a circuit, for example a switch or a bulb.

What is connected to a plug? What does this do in a circuit?

Answer: *Students should note that a wire is connected to the plug. This takes the electricity from the mains to the appliance.*

Ask students to discuss with their neighbour what the components are called, reading out the labels. Ask students to read the text on the page. They could read the information independently or with a partner. To make sure that they understand the information, ask students a series of questions. You could ask them why we have wires as part of a circuit. They should know that the wires carry electricity around the circuit to the components. Wires are made up of different materials with different functions. The centre of a wire is a good conductor of electricity and carries the electricity well. The part that we see on the outside is usually plastic. This acts as an insulator and protects us from the electricity running through the centre of the wire.

Investigation: Looking at wires

Organise students into pairs and give them a wire to observe. They should discuss what materials the parts of the wire are made from. The outer casing will probably be plastic, but it could be rubber if it is an older type. They might notice the different colours of plastic but this is not important at this stage. Inside the wire they should recognise that the material is a metal but may not be able to name it as copper.

To help students to answer question 3 of this activity, you could have some short pieces of wire for students to test to demonstrate what happens if they bend and twist a wire: it breaks.

This activity will help students learn that bending and twisting the wire could break the metal core. This is often the reason why students get frustrated when their circuits do not work: because the current cannot jump across broken wires. Remind them that they should respect wires and store them correctly. Wires are important as they carry the flow of electricity from one part to the next. If a wire is broken, the electricity will stop flowing and nothing in the circuit will work.

In the next activity, students will build their own series circuit.

Investigation: Building a circuit

Warning! Be careful when you use connectors. They can sometimes be very sharp and nip your skin.

Read out the warning at the start of this investigation and demonstrate how a connector should be used.

The aim of this investigation is to introduce students to connecting components together to produce a simple series circuit. Students should work in pairs to construct a circuit using the components. You may need to demonstrate this before students make their own circuits.

Allow students to explore the different ways they can construct a circuit using the same basic components. They should realise that the bulb will only light if the circuit is complete, so they need to check that everything is properly connected.

If the bulb does not light, ask students to start by checking the connections and then make sure the bulb itself is not broken. If it still does not light, ask students what else might have happened. A wire may be broken and will need to be replaced.

Ask students to work with a partner to read out the information below the investigation. Allow them to discuss and process the information. This is a fundamental part of understanding electricity and how it flows around a circuit making all of the components work. Students will learn that there are different types of circuit. The circuit described is known as a simple series circuit because all of the components are joined together in one loop. It is called simple because most circuits are much more complex than this. Wires carry electricity around the circuit so it is important that they are made out of a material that can allow the electricity to pass or be conducted easily. Inform students that they will investigate different materials to find out which will allow electricity to flow through them.

Summarise the lesson by asking students what they have learned. Ask a volunteer to read out the key ideas. Ask students what each of the components in their circuit does. Discuss how the wires carry the electricity to the different components in the circuit. Ask students to describe how they investigated if all materials carry electricity. Ask if they could now be more confident making predictions about which materials will conduct electricity.

Stretch zone: As a group, create a Wiki page discussing electricity. Include these words in your description: current, switch, battery, flow, conductor, component.

Encourage the students to work together to create an engaging Wikipage. They should add images, text and if possible, small videos to illustrate their learning.

Review and reflect

Ask students to silently reflect on their learning. Ask them to write on a whiteboard all of the things that they have enjoyed learning about in the lesson and what they are confident about. They can use drawings and key words. Then ask them to list anything that they still find challenging. Ask them to discuss these with a partner.

After the discussions, ask students to share any areas that they would like more support with. Students should learn to respect the comments from other students and listen carefully when ideas are being shared.

Extra activities

1 Students make a small poster to show how to safely store the wires used in investigations. They use drawings and simple explanations to explain how students should take care of the wires and why they should do this.

2 Students create a diagram of all of the components they have learned and label them with the correct name.

Differentiation

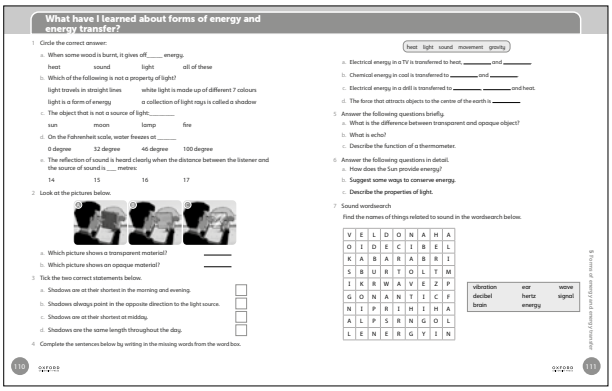
Supporting: Allow students more time to explore the wires and test a range of samples.

Consolidating: Students can use their circuits to test their predictions. They can suggest other objects that they think will conduct electricity in their circuits.

Extending: Students can practise setting up more complex circuits with a range of objects.

Differentiated outcomes	
All students	should be able to set up a working simple circuit
Most students	will be able to use a circuit to test materials
Some students	may be able to suggest how to repair a circuit

What have I learned about form of energy and energy transfer?


What have I learned about forms of energy and energy transfer?

1 Circle the correct answer:

a. When some wood is burnt, it gives off _____ energy.
heat sound light all of these

b. Which of the following is not a property of light?
light travels in straight lines white light is made up of different 7 colours
light is a form of energy a collection of light rays is called a shadow

c. The object that is not a source of light: _____
sun moon lamp fire

d. On the Fahrenheit scale, water freezes at _____
0 degree 32 degree 46 degree 100 degree

e. The reflection of sound is heard clearly when the distance between the listener and the source of sound is ___ metres:
14 15 16 17

2 Look at the pictures below.

a. Which picture shows a transparent material? _____
b. Which picture shows an opaque material? _____

3 Tick the two correct statements below.

a. Shadows are at their shortest in the morning and evening. ☐
b. Shadows always point in the opposite direction to the light source. ☐
c. Shadows are at their shortest at midday. ☐
d. Shadows are the same length throughout the day. ☐

4 Complete the sentences below by writing in the missing words from the word box.

heat light sound movement gravity

a. Electrical energy in a TV is transferred to heat, _____ and _____
b. Chemical energy in coal is transferred to _____, _____ and _____
c. Electrical energy in a drill is transferred to _____, _____ and heat.
d. The force that attracts objects to the centre of the earth is _____

5 Answer the following questions briefly.

a. What is the difference between transparent and opaque object?
b. What is echo?
c. Describe the function of a thermometer.

6 Answer the following questions in detail.

a. How does the Sun provide energy?
b. Suggest some ways to conserve energy.
c. Describe the properties of light.

7 Sound wordsearch

Find the names of things related to sound in the wordsearch below.

V	E	L	D	O	N	A	H	A	
O	I	D	E	C	I	B	E	L	
K	A	B	A	R	A	B	R	I	
S	B	U	R	T	O	L	T	M	
I	K	R	W	A	V	E	Z	P	
G	O	N	A	N	T	I	C	F	
N	I	P	R	I	H	I	H	A	
A	L	P	S	R	N	G	O	L	
L	E	N	E	R	G	Y	I	N	

vibration ear wave
decibel hertz signal
brain energy

5 Forces of energy and energy transfer

110 OXFORD UNIVERSITY PRESS 111

Getting started

The aim of this section is to encourage students to review their learning after each lesson in the unit and also to undertake some end-of-unit review and reflection. On pages 110 - 111 of the Student Book there are questions linked to concepts and topics covered in the unit. These will assess students' knowledge and understanding of the topic. You may have been using questions after each lesson where provided; However, it is also worth allowing students to answer all of the questions at the end of the unit. This will test longer-term understanding and recall. You can do this as an informal individual or pair activity and allow students to look information up as they work through the questions or you can set it as an individual 'closed-book' activity.

It is important that students report areas that they are not confident with. This information is useful for them in that they can think about what they need to review or ask advice about. It is also vital for you as it provides information about any topics you may wish to revisit.

What have I learned about form of energy and energy transfer?

1 Circle the correct answer.

Make sure students understand that they have four options but they should only circle one choice – A, B, C or D.

Answer: *a. all of these; b. a collection of light rays is called a shadow; c. moon; d. 32 degree; e. 17.*

2 Look at the pictures A B C.

a. Which picture shows a transparent material?

b. Which picture shows an opaque material?

Answer: *a. C; b. A.*

3 Tick the two correct statements.

Answer: *Statements b and c are correct..*

4 Complete the sentences below by writing in the missing words from the word box.

Remind the students that some of the words in the word box will be used multiple times.

Answer: *a. light, sound; b. heat, light; c. sound, movement; d. gravity.*

5 Answer the following questions briefly.

a. What is the difference between a transparent and opaque object?

b. What is echo?

c. Describe the function of a thermometer.

Explain that in this question they have three smaller questions to answer.

Answer: *a. materials which do not allow light to pass through are known as opaque materials. A shadow forms when the light is blocked. Transparent materials allow light to pass through easily.*

b. An echo is a repetition of sound caused by the reflection (bouncing back) of sound waves.

c. the degree of hotness or coldness of an object or body (i.e. its temperature) is measured by a thermometer.

6 Answer the following questions in detail.

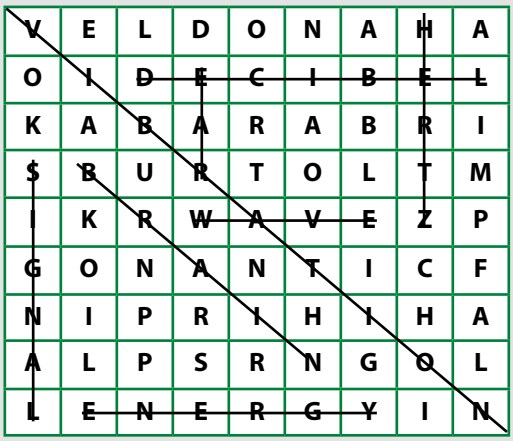
a. How does the Sun provide energy?

b. Suggest some ways to conserve energy.

c. Describe the properties of light.

Answer: *a. The main source of energy on Earth is our Sun. The light and heat it provides has resulted in the many other sources of energy on Earth. The plants get eaten, burned as fuel, or when they die turn into coal, over millions of years. The animals that ate plants millions of years ago, when they died, turned into oil and gas that we use today. The Sun also heats up the air which causes winds to blow; the heat of the Sun also causes water to flow and rain to fall. b. Encourage students to provide their own answers or to prepare a poster in response to this question. c. Light travels in straight lines but can change direction. All white 'visible' light is made up of different 7 colours. They are (in order) Violet, Indigo, Blue, Green, Yellow, Orange and Red.*

7 Find the names of things related to sound in the wordsearch.



V	E	L	D	O	N	A	H	A
O	I	D	E	C	I	B	E	L
K	A	B	A	R	A	B	R	I
S	B	U	R	T	O	L	T	M
I	K	R	W	A	V	E	Z	P
G	O	N	A	N	T	I	C	F
N	I	P	R	I	H	I	H	A
A	L	P	S	R	N	G	O	L
L	E	N	E	R	G	Y	I	N

Summative assessment

You can read out the answers to the 'What have I learned about the lives of animals and humans?' section for students to self-assess or you can take in the pages and mark them to award an overall score. You could allocate marks as follows: question 1= 5; question 2 = 2; question 3 = 2; questions 4 = 4; question 5 = 3; question 6 = 6; question 7 = 3. This makes a total of 25 marks.

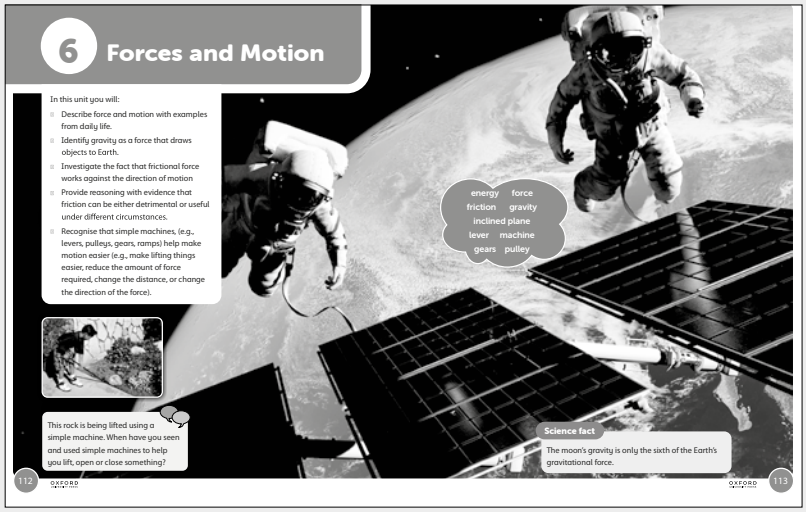
If necessary, ask students to revisit topics and questions to help them to learn more about any they did not score well on. In this way the questions are both summative and formative. All assessments should be linked to enhancing learning and in this way the 'What have I learned about?' pages will support this as well as providing data to report back to students, parents and/or other significant adults.

This feedback can then be used to form support strategies to help students improve. Keep the recording and analysis of students' self-evaluations simple. A general impression of the self-evaluation of the class is all that is required, for example: 50% of the class were not confident about

6 Forces in Action

In this unit students will:

- Describe force and motion with examples from daily life.
- Identify gravity as a force that draws objects to Earth.
- Investigate the fact that frictional force works against the direction of motion
- Provide reasoning with evidence that friction can be either detrimental or useful under different circumstances.
- Recognise that simple machines, (e.g., levers, pulleys, gears, ramps) help make motion easier (e.g., make lifting things easier, reduce the amount of force required, change the distance, or change the direction of the force).



Getting started

This unit explores in detail what forces are and the impact they have on things around us. The unit lends itself well to observing forces and their impact in the world. There are many everyday settings where forces in action can be observed, although provision is also made for examples within a classroom setting where there are not suitable opportunities to observe real-life examples of forces in action. Students will benefit from measuring forces using a forcemeter or newton meter but they will also gain a great deal from observing the results of forces acting on objects. Other means of studying forces in action are also included as alternatives, such as using video clips and watching demonstrations. The unit also looks at how simple machines can be used to make some tasks easier in everyday life and in industrial settings.

Science in context

Use the lessons in this unit to encourage students to learn more about the importance of forces in action and how they affect our lives both locally and at a global level. Allow students to survey and investigate forces in action in their local area. Take them out to see forces in action in parks and on construction sites. Remember to find out where they have visited in previous years to add to this experience rather than duplicating it. Encourage students to find out about how forces work and are used. Invite mechanics or construction workers to school to discuss how forces help them carry out tasks or how simple machines reduce the amount of effort needed to carry out tasks. Students could visit areas such as building sites, examples of road building, factories or markets to observe forces in action and experience mass and weight in everyday situations.

Scientific enquiry skills

An Investigation master sheet is given in this Teacher's Guide to help students plan their scientific enquiries. Scientific enquiry skills for this unit focus on the collection and presentation of data, and on observing forces in action. Students consider what is meant by a fair test and plan how to collect sufficient evidence. Students choose apparatus and decide what to measure. When conducting investigations students make relevant observations and comparisons in a variety of contexts, for example different forces in action, and present their results in drawings, bar charts and tables. Students should be able to link evidence to scientific knowledge and understanding in other contexts, for example unfamiliar forces or machines being used.

Resources

Student Book: selection of objects to measure mass and weight, and to lift with pulleys; objects that float and others that will not float; plastic lids; pins; small plastic balls (optional); forcemeters; scales; calculators; springs; rulers; arrows made from card; 1 kg mass; thick elastic bands; large containers of water; toy cars; planks of wood; angle measurers; piles of books; metre sticks; tape measures; aluminium foil; range of rough and smooth materials; tall plastic drinks bottles; trays; water; modelling clay; long pieces of cotton; timers or stopwatches; pulleys; boards with a pin or nail hammered into them; claw hammers; string; sticky tape; marker pens; A4 paper; wipe boards (optional); materials to make information leaflets and posters; access to the internet; books to find photographs relating to air resistance.

Key words for the unit

are in the Word cloud and in the Student Book.

energy force friction gravity inclined plane lever machine gears pulley

Scientific enquiry key words

Plan and/or carry out enquiries to answer questions

Recognise and control variables

Make observations

Take measurements, using equipment accurately

Record data and results using diagrams and labels, tables, keys and graphs

Make predictions

Report and present findings in a variety of ways

Draw conclusions and give explanations

Identify causal relationships

Use scientific evidence to support or refute ideas

Language support

Start the unit by reading out the words in the Word cloud. Students discuss each word and try to use familiar ones in a sentence. They should write definitions when they have used the words and learned them in lessons. As with other units, it is a good idea to create a Word wall for the unit so students see the words often and can become familiar with them.

When learning new words, especially specific science words and terms, it is important that they are repeated regularly and used in context. Ask students to listen, say, read and then write the words. Students can also make a list of other, non-science specific words they use in lessons that they are not familiar with. Some of these are listed in the individual lesson notes that follow. They could write these down in their notebook.

Consider adding to any science library you have organised in your classroom. As well as general science books and magazines, science encyclopaedias and dictionaries you may have collected for other units, you could also download specific information. This will allow you to make small information booklets to support each lesson and especially Stretch zone activities.

Unit at a glance

The key teaching points for students in this unit are:

- to introduce the unit objectives
- to introduce the learning outcomes
- to engage students with the content of the unit
- to review and build on prior learning and understanding of the topics.

The purpose of this introductory lesson is for students to start thinking about different forces that are in action around them and how simple machines such as levers can make some jobs or tasks easier to do. The photographs show some different forces in action, including a lever being used to raise mass, and are used as a stimulus and starting points for discussions.

Ask students to look at the photographs on pages 112 - 113 of the Student Book and then discuss how the boy is using the lever.

This rock is being lifted using a simple machine. When have you seen and used simple machines to help you lift, open or close something?

Ask students to talk to their partner about the photograph of the boy and how he is using the stick. Discuss their ideas as a whole class.

Possible response: *Students should suggest that the simple machine in this case is a lever that is being used to raise the rock, using less effort. They might have used a lever to open the lid on a tin of paint or opened a door with a lever handle.*

Ask students to look at the main photograph of two astronauts floating in space and to work with a partner to answer the discussion questions.

This astronaut is floating in space. Can we do this on Earth? Why can you jump much higher on the Moon than you can on Earth?

Ask students to suggest what they know about space and the way that astronauts work. Ask if any of them have seen images or video footage of astronauts on the Moon. You could try to find examples on the internet to show students.

Possible response: *Students should suggest that the astronauts look as if they are floating in space, but this is not possible on Earth. The force of gravity attracts objects to each other. We stay on the surface of Earth because the force of gravity pulls us to Earth. The force of gravity is weaker on the Moon so we are not pulled as much. This means that we can jump higher.*

Science fact: The moon's gravity is only the sixth of the Earth's gravitational force.

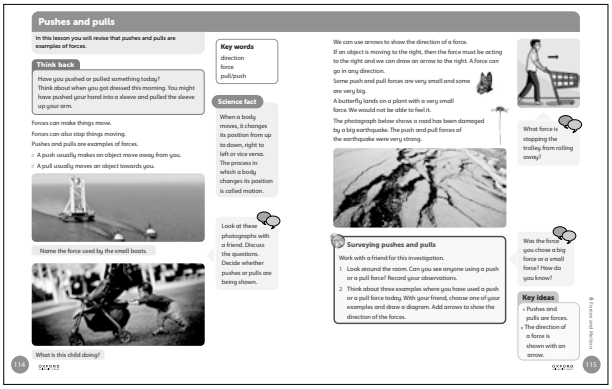
Ask students to work in small groups to read out the Science fact. Ask them if they have ever encountered this fact before. You can at this point also play a YouTube video for them on this topic.

Extra activities

1 **Maths link:** Ask students to find out about the equipment that is used to measure forces. They should draw a diagram and label the scale and correct units that should be used.

2 Computing link: Allow students to research on the internet how pulleys can be used. Ask them to find one example and make a poster to show how this simple machine is used. They should include diagrams in their explanation.

Pushes and pulls


Pushes and pulls

In this lesson you will revise that pushes and pulls are examples of forces.

Think back

Have you pushed or pulled something today? Think about when you got dressed this morning. You might have pushed your hand into a sleeve and pulled the sleeve up your arm.

Forces can make things move.
Forces can also stop things moving.
Pushes and pulls are examples of forces.
- A push usually makes an object move away from you.
- A pull usually moves an object towards you.

Name the force used by the small boats.

What is this child doing?

Key words
direction
force
pull/push

Science fact

When a body moves, it changes its position from up to down, right to left or vice versa. The process in which a body changes its position is called motion.

Look at these photographs with a friend. Discuss the questions. Decide whether pushes or pulls are being shown.

We can use arrows to show the direction of a force.
If an object is moving to the right, then the force must be acting to the right and we can draw an arrow to the right. A force can go in any direction.
Some push and pull forces are very small and some are very big.
A butterfly lands on a plant with a very small force. We would not be able to feel it.
The photograph below shows a road has been damaged by a big earthquake. The push and pull forces of the earthquake were very strong.

What force is stopping the trolley from rolling away?

Surveying pushes and pulls

Work with a friend for this investigation.
1 Look around the room. Can you see anyone using a push or a pull force? Record your observations.
2 Think about three examples where you have used a push or a pull force today. With your friend, choose one of your examples and draw a diagram. Add arrows to show the direction of the forces.

Was the force you chose a big force or a small force? How do you know?

Key ideas
- Pushes and pulls are forces.
- The direction of a force is shown with an arrow.

Forces and motion

114

115

Getting started

In this lesson students explore how pushes and pulls are used in daily life. Students are encouraged to identify from photographs the force in action. Arrows are introduced to show the direction of a force. At this stage students just use the arrow to show the direction of a force and not the size of the force. To demonstrate how strong forces can be, a photograph shows the effects of an earthquake - showing the reality of very large pushes and pulls.

Language support

The key words for this lesson have been introduced in earlier years so should be familiar to students. To reinforce familiarity with these words, ask students to say the words aloud by, for example, writing a word on the board and asking them what the word is. There are many opportunities to repeat these key words throughout the unit to reinforce students' understanding of them.

Key words

direction force pull/push

Other words in the lesson

arrow survey

Scientific enquiry key words

observe communicate findings

Lesson at a glance

The key teaching points in this lesson are:

- pushes and pulls can be identified in everyday situations
- arrows are used to show the direction of a force.

Think back Have you pushed or pulled something today? Think about when you got dressed this morning. You might have pushed your hand into a sleeve and pulled the sleeve up your arm.

Students should think about pulling on clothes, opening and closing doors or picking up their bag or book. Show students examples such as picking up a cup or squeezing a toothpaste tube. This should encourage them to think about all the times they have used forces.

Go on to explain that push and pull are forces. Students sometimes find this a difficult topic as they cannot see the force, but point out that they can see the result of the force or an action.

Discussion

Look at these photographs w*ith a partner. Discuss the questions. Decide whether push*es or pulls are being shown.

Make sure students understand what is happening in the top photograph: the tall structure is a crane and the two small vessels are tug boats. Point out that the child is walking forwards behind the pushchair. Model this with a chair in the room, or ask a student to show the rest of the class how a pushing force will move the chair forwards.

Possible response: *Students might recognise that the tug boats are pulling the crane across the water and the child is pushing the stroller.*

Read through the text at the top of page and show or model how to draw arrows on the board. Use examples to demonstrate this such as picking up a book or pushing a book across the desk. Ask students to think about the direction of movement. Then ask them to show the direction of movement with their hands. Discuss how arrows are useful when drawing diagrams to show forces because you cannot always see clearly what direction a force is being applied in. For example, a diagram of a hand on a window catch could be pushing the window open or pulling it closed.

Discussion

What force is stopping the trolley from rolling away?

Ask students to look at the man pushing the shopping trolley, and to discuss what forces are being used to make the trolley move. They should suggest that the man is pushing the trolley away from himself. Ask students what the purpose of the arrow is on the diagram.

Possible response: *Students might have experienced friction, and they may suggest that it is acting against the pushing force from the man.*

Read the text about the butterfly and the earthquake. Discuss how forces can be very tiny and very large. Whatever their size, we cannot see forces, but we can see the effects of forces. Earthquakes are caused when the plates that make up the Earth's surface are pushed together or pulled by very large push and pull forces.

Investigation: Surveying pushes and pulls

This investigation encourages students to observe pushes and pulls in everyday situations. They should be able to observe other students pushing and pulling chairs, bags and other equipment. Point out that even writing uses pushes and pulls of a pen or pencil across the paper. Encourage students to discuss the pushes and pulls that they have used. They should agree on one example and record this as a drawing or diagram. Ask them to show the direction of the force by adding arrows to the diagram. Compare the drawings and discuss them as a whole group.

Discussion

Was th*e force you chose a big force or a small force? How do you know*?

Possible response: *Students should suggest that if it is a big force there will be a big result.*

Key ideas

Pushes and pulls are forces.

The direction of a force is shown with an arrow.

Summarise the lesson by asking students what they have learned. Let them share their ideas, read out and discuss the key ideas. This will remind students that everyday actions can be considered forces.

Review and reflect

Use the discussion questions and your questioning throughout the lesson as a measure of students' understanding. Listen to their discussions and identify any misunderstanding or misconceptions that are developing. Encourage students to make a list of any queries that they still have about pushes and pulls and the effect of forces on objects. They could ask other students these and discuss their ideas. Address these queries in whole-class discussions.

Students gain confidence in knowing when to ask a question to solve a problem and who to address the question to.

Extra activities

1 **Computing link:** Students could use the internet to find examples of forces to extend learning. You could also provide students with further diagrams, pictures and photographs of forces in action for them to identify forces and draw arrows to show the direction of the force.

2 **Maths link:** Students continue their learning by surveying and recording pushes and pulls at home. They can record their findings using a tally chart showing the number of pushes and pulls they observe.

Differentiation

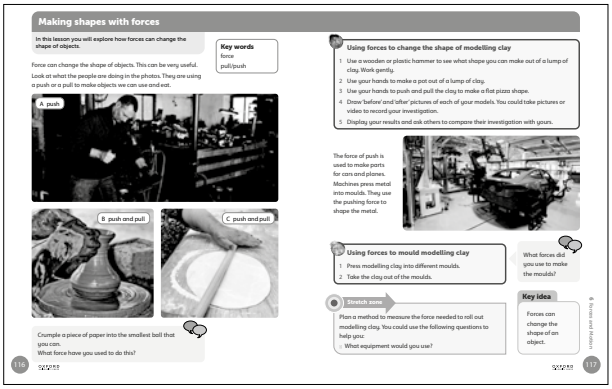
Supporting: Ask students to identify pushes and pulls in action when they see them during the lesson. Review their observations at the end of the lesson and discuss examples of what they observed.

Consolidating: Ask students to put their hand out to the front when they see a push in action and to the back when they see a pull. They can practise this during the day to embed the direction of the force.

Extending: Students could make a note of pushes and pulls they see throughout the day. They could record the biggest and smallest forces that they have seen and describe the effect these had on objects.

Differentiated outcomes	
All students	should be able to identify a push or a pull force in different situations.
Most students	will be able to use arrows to show the direction of a force.
Some students	may be able to discuss the size of the force.

Making shapes with forces


Making shapes with forces

In this lesson you will explore how forces can change the shape of objects.

Force can change the shape of objects. This can be very useful. Look at what the people are doing in the photos. They are using a push or a pull to make objects we can use and eat.

Key words
force
pull/push

A push

B push and pull

C push and pull

Crumple a piece of paper into the smallest ball that you can.
What force have you used to do this?

116

Using forces to change the shape of modelling clay

1 Use a wooden or plastic hammer to see what shape you can make out of a lump of clay. Work gently.
2 Use your hands to make a pot out of a lump of clay.
3 Use your hands to push and pull the clay to make a flat pizza shape.
4 Draw 'before' and 'after' pictures of each of your models. You could take pictures or video to record your investigation.
5 Display your results and ask others to compare their investigation with yours.

The force of push is used to make parts for cars and planes. Machines press metal into moulds. They use the pushing force to shape the metal.

Using forces to mould modelling clay

1 Press modelling clay into different moulds.
2 Take the clay out of the moulds.

What forces did you use to make the moulds?

Stretch zone

Plan a method to measure the force needed to roll out modelling clay. You could use the following questions to help you:
1 What equipment would you use?

Key idea

Forces can change the shape of an object.

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117

Getting started

In this lesson students will look at how forces can change the shape of things and how this is useful in lots of areas of life. Students learn that hammering and pressing metal uses a push force and how clay and pizza dough can be pulled and pushed into different shapes. Students use modelling clay to investigate how forces can change shapes.

Language support

'Push' and 'pull' are used extensively in this lesson. These words should now be very familiar to students. The word 'mould' can also be used to describe a type of fungus, so make sure that students understand its meaning in this context. To reinforce the meaning, as students work on their investigations, ask them questions such as, 'Which mould are you using?'

Resources

Student Book: scrap paper; modelling clay; wooden or plastic hammers; various moulds.

Key words

force pull/push

Other words in the lesson

mould shape

Scientific enquiry key words

use equipment observe notice patterns
record data group/classify

Lesson at a glance

The key teaching points in this lesson are:

- forces can change the shape of materials
- we can use forces to mould modelling clay.

Ask students to look at the photographs on page 116. Ask, 'What are the people using to change the shape of the materials?' Discuss the equipment the people are using. Can students think of other equipment that could be used?

Ask students to look at the photograph of the blacksmith hammering the hot metal into a shape. Ask them to check with the person next to them what force is being used when hammering. Establish that it is a pushing force. Repeat the discussion with the photographs of the potter and the pastry chef rolling dough. Ask what forces are being used: push or pull?

Discussion

Crumple a piece of paper into the smallest ball that you can. What force have you used to do this?

Hand each student a piece of scrap paper. Ask them to crumple it up into the smallest ball they can. In groups of two or three, ask students to discuss what force they have just used. Use this to demonstrate how forces can change the shape of objects.

> ***Answer:*** *Students should state that they used push forces to change the shape of the paper.*

Investigation: Using forces to change the shape of modelling clay

The aim of this investigation is to allow students to experience how forces can be used to change the shape of objects. They should use a wooden or plastic hammer and see what shapes they can make out of a lump of clay. Students can carry out this investigation independently.

Hand each student some modelling clay or similar material and a hammer. If no modelling clay is available, it is possible to make dough using: 2 cups of plain flour, half a cup of salt, 2 tablespoons of cream of tartar, 2 tablespoons of vegetable oil, 1.5 cups of boiling water, food colouring (optional), glycerine (optional). Mix all the ingredients in a bowl. When it starts to look like dough, knead it on a board or work top. This is a safe, non-toxic dough.

Allow students to explore pushing and pulling the clay. Demonstrate how to gently mould the clay and use the hammer safely to change the shape of it. Then use your hands to make a pot out of a lump of clay, demonstrating how to pull and push the clay to model it into a pot.

Now use your hands to push and pull the clay to make a flat pizza shape. Show students how to pat the clay to make it flat. They could use rolling pins to push and pull the clay too. Encourage students to make a record of the different stages their clay has gone through. These records can be displayed and compared with others.

Read the text below the investigation and show students the photograph of the car body that has been pressed into shape in a mould. This also uses a pushing force. Point out that it is the same as hammering but the machine is applying the force. This makes it much quicker and therefore cheaper to make the car body parts.

Explain that car manufacturers and designers use their knowledge of how materials can be made into different shapes to design crumple zones. Here the material is designed to change shape when a force, for example from an impact, is applied to the vehicle. This protects the passengers.

Investigation: Using forces to mould modelling clay

The aim of this investigation is to show students how forces, together with moulds, can change the shapes of materials into specific shapes.

Students can work independently for this investigation. Hand out the moulds and clay, and ask students to press the modelling clay into the moulds. Demonstrate how to do this safely. Remind students not to pack the clay in too hard or it will be difficult to get it out of the mould and may lose its shape.

Discussion

What forces did you use to make the moulds?

> ***Possible response:*** *Students should suggest that they pushed the clay into the mould.*

Stretch zone: Plan a method to measure the force needed to roll out modelling clay. You could use the following questions to help you: What equipment would you use? What unit of measurement would you use?

Read through the Stretch zone challenge with students and remind them that when they are challenged by a task their brain is working harder and they will learn more.

> ***Possible response:*** *Students may suggest using a rolling pin to roll out the clay. They may suggest using a forcemeter attached to the rolling pin to measure the force needed to roll it out.*

Key idea

Forces can change the shape of an object.

Summarise the lesson by asking students what they have learned. Let them share their ideas, read out and discuss the key idea. This will remind students that although they can't see forces they can see the results of forces being applied as objects change shape.

Ask them which forces they used when they changed the shape of the modelling clay.

Review and reflect

Ask students to take time out to review and reflect on their learning in this lesson. Ask them to write a description about how they changed the modelling clay. They could write bullet points about the actions they took to change its shape, or list the forces that they used and describe how this changed the shape of the clay.

Students can swap their reflections with a partner and discuss them, helping each other with any knowledge gaps. If there is anything they are unsure of, encourage them to ask questions.

Extra activities

1 Students can research where pushes and pulls are used around them, for example, they could observe an activity such as cooking or cleaning and could draw small diagrams annotated with arrows to show the forces involved.

2 **Maths link:** Ask students to work in pairs. One student can push and pull some modelling clay to make a shape. The other student can keep a tally of all the pushes and pulls they use to do this. They can then swap roles and see if a different amount of pushes and pulls affects the final shape of the clay.

Differentiation

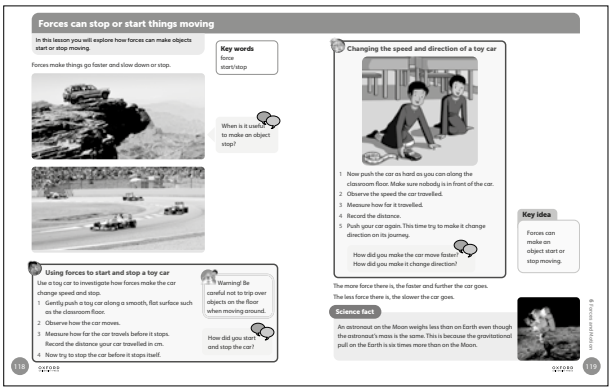
Supporting: Provide students with modelling clay or pieces of scrap paper. Tell them to make a shape out of the material. Encourage them to think about how they are using pushes and pulls.

Consolidating: Students can make a ball or a pizza shape out of modelling clay, recording how many pushes and pulls they use to finish the model.

Extending: Provide students with some string and ask them to tie a knot. Ask them to record how many pushes and pulls they use to tie the knot.

Differentiated outcomes	
All students	should be able to recognise that forces can change the shape of objects.
Most students	will be able to use forces to change the shape of different materials.
Some students	may be able to predict what will happen to the shape of a material when a force is applied.

Forces can stop or start things moving


Forces can stop or start things moving

In this lesson you will explore how forces can make objects start or stop moving.

Forces make things go faster and slow down or stop.

Key words
force
start/stop

When is it useful to make an object stop?

Changing the speed and direction of a toy car

1 Now push the car as hard as you can along the classroom floor. Make sure nobody is in front of the car.
2 Observe the speed the car travelled.
3 Measure how far it travelled.
4 Record the distance.
5 Push your car again. This time try to make it change direction on its journey.

How did you make the car move faster?
How did you make it change direction?

Key idea
Forces can make an object start or stop moving.

The more force there is, the faster and further the car goes.
The less force there is, the slower the car goes.

Using forces to start and stop a toy car

Use a toy car to investigate how forces make the car change speed and stop.
1 Gently push a toy car along a smooth, flat surface such as the classroom floor.
2 Observe how the car moves.
3 Measure how far the car travels before it stops. Record the distance your car travelled in cm.
4 Now try to stop the car before it stops itself.

Warning! Be careful not to trip over objects on the floor when moving around.

How did you start and stop the car?

Science fact
An astronaut on the Moon weighs less than on Earth even though the astronaut's mass is the same. This is because the gravitational pull on the Earth is six times more than on the Moon.

118 OXFORD 119

Getting started

In this lesson students will explore how forces can make things go faster or slower, or even stop, using toy cars. Prior to the investigations find suitable areas for students to work where toys cars are not going to cause a hazard.

Language support

Students need to use words to describe and compare speed and distance throughout this lesson, such as far, further, furthest. Use these words when demonstrating the activities to reinforce their meaning. Ask questions while students are carrying out the investigations such as, 'Is the car travelling quickly or slowly? Whose car travelled the furthest?'

Resources

Student Book: toy cars; tape measures.

Key words

force start/stop

Other words in the lesson

direction faster move

Scientific enquiry key words

use equipment observe measure
notice patterns record data carry out tests
communicate findings

Lesson at a glance

The key teaching points in this lesson are:

- forces can make an object move
- forces can stop an object moving.

Discussion

When is it useful to make an object stop?

In pairs, ask students to think of at least four examples of when it is useful to make an object stop. Suggest that they look at the photograph of the car on a cliff to give them some ideas!

> ***Possible response:*** *Students should suggest that it is useful for the car on the cliff edge to stop moving before it falls over the cliff. All moving vehicles need to be able to stop so that they do not crash into other things or even people.*

Ask students to look at the photograph of the cars in the race. Ask, 'When do the cars need to start moving? When do they need to stop moving? When do they need to go faster/speed up?' You could ask students to slowly model the movements of the cars in the race if you have access to an open space.

Investigation: Using forces to start and stop a toy car

Warning! Be careful not to trip over objects on the floor when moving around.

Read out the warning information and make sure students have a clear space for working in.

The aim of this investigation is for students to explore forces in action, using a toy car.

Demonstrate how to do this investigation safely. Remind students that they are not playing with the cars but investigating how the forces can start and stop the car.

Ask students to observe how the car moves, using language such as 'faster', 'slower' and 'stop'.

Discussion

How did you start and stop the car?

> ***Possible response:*** *Students should say that they used their hands to apply a push force to the car, making it start moving. They should also say that they used their hands again, using a push force, to make it stop moving.*

Investigation: Changing the speed and direction of a toy car

The aim of this investigation is to show how forces can change the direction of a toy car as well as the speed it travels at. Make sure the area is safe to carry out the investigation.

Demonstrate how to do this investigation safely. This may work better if you allocate a start point and students take it in turns to push the car as hard as they can from it.

Discussion

How did you make the car move faster? How did you make it change direction?

Discuss the speed of the car. Has it increased or decreased compared to when they pushed the car gently in a previous investigation? Unless the force is applied in a straight line, the car will not run in the expected direction. It will appear to have changed direction. Another factor that might change the direction of the car is an uneven surface.

> ***Possible response:*** *Students might suggest that they applied a bigger force to make it move faster. They might have pushed from one side of the car or the other to make it change direction.*

Read the text below the investigation and explain that you would expect the car to go faster when there is more force. This is because as the force increases the speed of the car should increase, unless there is an opposing force such as friction. Students will learn more about friction in a later lesson.

Key idea

Forces can make an object start or stop moving.

Summarise the lesson by asking students what they have learned. Let them share their ideas, read out and discuss the key idea. This will again remind students that although we can't see forces we can see the effect of them on objects. Ask students to think about the importance of stopping and starting.

Science fact: An astronaut on the Moon weighs less than on Earth even though the astronaut's mass is the same. This is because the gravitational pull on the Earth is six times more than on the Moon.

Read the science fact or request one of the students to read it aloud. You should point out that this science fact indicates the effect of gravitational force.

Review and reflect

Students could interview each other about the lesson. Allow them to have a few minutes to think up some questions. For example: How did they make the car go further? What force did they use to stop the car? How is speed calculated?

Extra activities

1 **Maths link:** Ask students to investigate how forces affect the movement of a ball. Take them outside to the playground. Ask them to investigate whether a ball travels further when they push it with their hand or kick it with their foot. They could measure and record the distance travelled.

2 **Maths link:** To investigate speed and force further, ask students to use soft balls such as footballs. Ask them to bounce them gently and see how high they bounce and how quickly they bounce. Then they can bounce them as hard as they can and do a comparison. You could set a challenge: ask students to throw a ball at a wall so it takes 5 seconds, then 4 seconds, then 3 seconds, then 2 seconds and finally 1 second to bounce back.

Differentiation

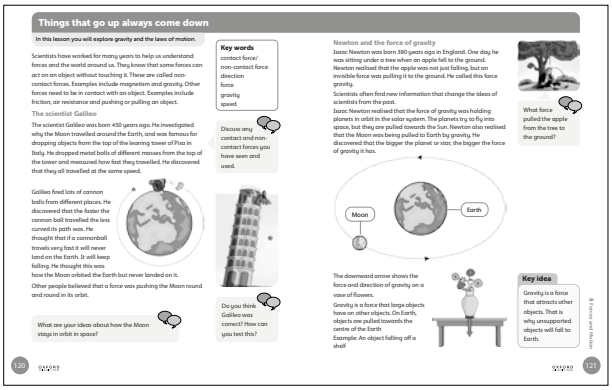
Supporting: Provide students with a small ball and allow them to practise observing how it moves with different forces.

Consolidating: Students could practise measuring distance using a ruler or tape and speed using a stopwatch.

Extending: Students could practise calculating speed by timing a toy car travelling a set distance and then dividing the distance travelled by the time taken.

Differentiated outcomes	
All students	should be able to make an object move using forces.
Most students	will be able to understand how force can produce a change in direction.
Some students	may be able to extrapolate the relationship of distance and impact of force on to other types of forces.

Things that go up always come down


Things that go up always come down

In this lesson you will explore gravity and the laws of motion.

Scientists have worked for many years to help us understand forces and the world around us. They know that some forces can act on an object without touching it. These are called non-contact forces. Examples include magnetism and gravity. Other forces need to be in contact with an object. Examples include friction, air resistance and pushing or pulling an object.

The scientist Galileo

The scientist Galileo was born 450 years ago. He investigated why the Moon travelled around the Earth, and was famous for dropping objects from the top of the leaning tower of Pisa in Italy. He dropped metal balls of different masses from the top of the tower and measured how fast they travelled. He discovered that they all travelled at the same speed.

Galileo fired lots of cannon balls from different places. He discovered that the faster the cannon ball travelled the less curved its path was. He thought that if a cannonball travels very fast it will never land on the Earth. It will keep falling. He thought this was how the Moon orbited the Earth but never landed on it.

Other people believed that a force was pushing the Moon round and round in its orbit.

What are your ideas about how the Moon stays in orbit in space?

Key words
contact force/ non-contact force
direction
force
gravity
speed

Discuss any contact and non-contact forces you have seen and used.

Do you think Galileo was correct? How can you test this?

Newton and the force of gravity

Isaac Newton was born 380 years ago in England. One day, he was sitting under a tree when an apple fell to the ground. Newton realised that the apple was not just falling, but an invisible force was pulling it to the ground. He called this force gravity.

Scientists often find new information that change the ideas of scientists from the past.

Isaac Newton realised that the force of gravity was holding planets in orbit in the solar system. The planets try to fly into space, but they are pulled towards the Sun. Newton also realised that the Moon was being pulled to Earth by gravity. He discovered that the bigger the planet or star, the bigger the force of gravity it has.

What force pulled the apple from the tree to the ground?

Moon
Earth

The downward arrow shows the force and direction of gravity on a vase of flowers.

Gravity is a force that large objects have on other objects. On Earth, objects are pulled towards the centre of the Earth.

Example: An object falling off a shelf

Key idea

Gravity is a force that attracts other objects. That is why unsupported objects will fall to Earth.

Getting started

This lesson introduces students to the idea that gravity is a force that attracts objects to each other. Students become aware of how the force of gravity makes things fall because they are attracted and pulled to the centre of the Earth. They will explore the ways that gravity was first observed by the scientist Galileo and then later Newton who realised that gravity was responsible for keeping planets in orbit around the Sun.

Language support

Introduce students to the key words. Read them out to the class to model how to pronounce them. Students then discuss each of the key words with a partner. Ask them to write a sentence or say a sentence to their partner using the words they are confident with. They write each of the words they are less confident with on a sticky note or small piece of card. As they learn about these, they add definitions, diagrams and pictures to the notes. When they are confident with the words, they can fill in the definitions in a glossary.

Resources

Key words

contact force/non-contact force direction force gravity speed

Other words in the lesson

cannon ball objects orbit

Scientific enquiry key words

Plan and/or carry out enquiries to answer questions

Recognise and control variables

Make observations

Take measurements, using equipment accurately

Record data and results using diagrams and labels, tables, keys and graphs

Make predictions

Draw conclusions and give explanations

Identify causal relationships

Lesson at a glance

The key teaching points for students in this lesson are:

- gravity is a non-contact force
- the force of gravity attracts objects to each other.

Ask students to work in small groups to think about all the forces they know. This could be from prior learning or experiences. Ask students to share their lists and make a collective list to leave in place for the rest of the learning in this unit.

Possible response: *Students might suggest pushes and pulls or friction, air resistance, or weight, for example.*

Ask students to read the information on page 120 of the Student Book. There is a lot of information to learn so allow them time to read the text several times and process what they have read. First make sure that they understand the difference between contact and non-contact forces. Ask them what forces are called that act on objects from a distance. If you have a magnet and an iron or steel object you could quickly demonstrate a non-contact force.

Discuss any contact and non-contact forces you have seen and used.

Ask students to continue to work in their groups to hold this discussion.

Possible response: *Students might suggest that gravity and magnetism are non-contact forces but pushes and pulls are contact forces.*

The scientist Galileo

Students will understand that scientists have been working to understand the forces around us for many years. Ask them to summarise the work of Galileo and how he helped us to understand forces. Ask students if they are surprised that the metal balls of different weights all landed at the same time when they were dropped from the tower. Ask them how Galileo used the evidence from the cannon ball experiments to prove how the Moon orbited the Earth.

Do you think Galileo was correct? How can you test this?

Students continue to work in their groups. They may find it difficult to suggest how to test Galileo's ideas but encourage any suggestions as prompts for discussion.

Possible response: *Students should suggest that Galileo was correct and that the Moon is falling in orbit around the Earth. This was tested using cannon balls and later by firing objects at even higher speeds in a similar way. Scientists have made many observations to help them understand this.*

What are your ideas about how the Moon stays in orbit in space?

Students continue to work in their groups. Listen to students' ideas and focus on their reasoning for their beliefs at this stage. They will learn about gravity throughout this unit and might change their opinion as they learn and understand more about the subject.

Possible response: *Students might think that Galileo was correct and that the Moon is falling in orbit but others might agree with the idea that the Moon is being pushed around in its orbit. Some students might have heard or learned that the force of gravity keeps the Moon and planets in orbit.*

Newton and the force of gravity

Ask students to read the information at the top of page 121 of the Student Book about the work of Sir Isaac Newton and his understanding of the force of gravity. Ask students what observation Newton made to make him explore gravity. Ask them what the Moon is pulled towards (the Earth) and what the planets are pulled towards (the Sun). Discuss what Newton discovered about the force of gravity when the object is bigger.

Investigating how objects fall

Warning! Take extra care if standing on a raised area of ground or by an open window to drop your object from three metres up. Discuss why this is important.

Read out the warning information and make sure they are aware of the hazard of working from a height and how to control the risk by working sensibly with each other and keeping each other safe.

This is an opportunity for students to practise enquiry skills by observing, measuring, predicting and recording results. Students test the work of Galileo. They work in a team outside to follow the method and record their results. They find evidence to answer the question: Do objects of different mass travel at the same speed?

Students first find the mass of their four objects then predict which will fall the fastest. They test their predictions by dropping the objects from a height of

3 m and timing how long they take to fall. They work out the speed of each object and check to see whether their prediction was correct. They then suggest ways to make their results more reliable and repeat the investigation to see whether this affects their results. Students also consider how they can make sure they carry out a fair test.

> ***Possible response:*** *Students may predict that the heaviest object will fall the fastest. However, their results should show that all the objects fell at the same speed – as Galileo's findings. They may suggest that in order to make their results more reliable they should repeat the test until they have a set of data that are all roughly the same. If they calculate an average they should find that most of their results will be very similar to the average. Students should suggest that dropping all the objects from the same height will make it a fair test.*

What force pulled the apple from the tree to the ground?

Students continue to work in their groups to discuss this question.

> ***Answer:*** *Students should suggest that it was the force of gravity that pulled the apple from the tree to the ground.*

Ask students to look at the diagram on page 121 of the Moon orbiting Earth. Encourage them to understand the importance of Johnson's work and how the calculations helped space flight. This is a good opportunity to demonstrate the varied work of scientists and how they often help behind the scenes of major discoveries.

Key idea

Gravity is a force that attracts other objects. That is why unsupported objects will fall to Earth.

Summarise the lesson by asking students what they have learned. Let them share their ideas. Read out and discuss the Key idea. This will remind students of how gravity is a force that attracts other objects. Ask them to describe to a partner why an object that is dropped will fall down to Earth. Ask them to describe what would happen if they threw a ball up into the air.

Review and reflect

Ask students to sit for a few minutes and think about what they have learned from the lesson. They can then think of one idea from the lesson that they would like to find out more about. Ask them to make a plan about how they would do this. This planning time will allow them to think up some imaginative and original things to do and you could let them carry out these projects. They are highly motivating and reinforce learning.

Extra activities

1. **Maths link:** Ask students to investigate whether changing the height from which the objects are dropped has any impact on the speed at which the objects fall.
2. Provide resources for students to make a poster explaining the laws of motion. Ask them to include pictures that show each law of motion in everyday life.

Differentiation

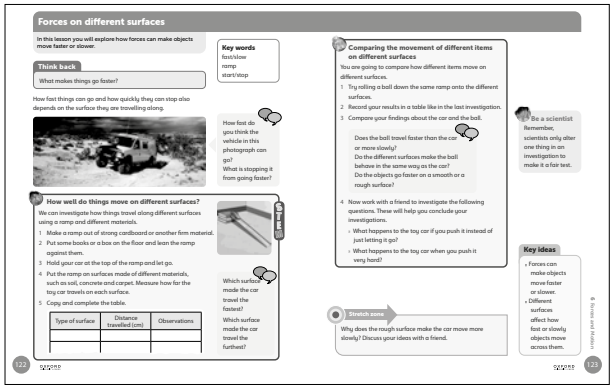
Supporting: Demonstrate the conclusions students make about the speed at which different objects fall by dropping a range of objects from your hands onto the floor.

Consolidating: Model on the board how to calculate the speed at which the different objects fall.

Extending: Ask students what other factors might affect the speed at which objects fall.

Differentiated outcomes	
All students	should be able to measure the time taken for an object to fall
Most students	will be able to explain that mass does not affect speed
Some students	may be able to explain how and why the satellites are able to remain in orbit

Forces on different surfaces


Forces on different surfaces

In this lesson you will explore how forces can make objects move faster or slower.

Think back

What makes things go faster?

How fast things can go and how quickly they can stop also depends on the surface they are travelling along.

Key words
fast/slow
ramp
start/stop

How fast do you think the vehicle in this photograph can go?
What is stopping it from going faster?

How well do things move on different surfaces?

We can investigate how things travel along different surfaces using a ramp and different materials.

1. Make a ramp out of strong cardboard or another firm material.
2. Put some books or a box on the floor and lean the ramp against them.
3. Hold your car at the top of the ramp and let go.
4. Put the ramp on surfaces made of different materials, such as soil, concrete and carpet. Measure how far the toy car travels on each surface.
5. Copy and complete the table.

Type of surface	Distance travelled (cm)	Observations

Which surface made the car travel the fastest?

Which surface made the car travel the furthest?

Comparing the movement of different items on different surfaces

You are going to compare how different items move on different surfaces.

1. Try rolling a ball down the same ramp onto the different surfaces.
2. Record your results in a table like in the last investigation.
3. Compare your findings about the car and the ball.

Does the ball travel faster than the car or more slowly?
Do the different surfaces make the ball behave in the same way as the car?
Do the objects go faster on a smooth or a rough surface?

4. Now work with a friend to investigate the following questions. These will help you conclude your investigations.
   - What happens to the toy car if you push it instead of just letting it go?
   - What happens to the toy car when you push it very hard?

Be a scientist
Remember, scientists only alter one thing in an investigation to make it a fair test.

Key ideas
- Forces can make objects move faster or slower.
- Different surfaces affect how fast or slowly objects move across them.

Stretch zone
Why does the rough surface make the car move more slowly? Discuss your ideas with a friend.

Getting started

In this lesson students investigate how well objects move over different surfaces. They set up ramps and test how far objects move down them.

Language support

Demonstrate 'fast' and 'slow' to students and clarify that these are relative terms. Encourage students to use the key words by asking them questions about the movement of the car. Show them photographs or video clips of objects moving. Ask students to write 'fast' and 'slow' on either side of a wipe board or piece of paper. When you hold up an image, they select the appropriate word and hold it up.

Resources

Student Book: toy cars; ramps (made of cardboard or other firm material such as wood or guttering); boxes or books to support the ramp; variety of surfaces, e.g. soil, concrete, carpet, plastic, grass; tape measures; balls.

Key words

fast/slow ramp start/stop

Other words in the lesson

distance surface

Scientific enquiry key words

use equipment observe measure
notice patterns record data carry out tests
communicate findings

Lesson at a glance

The key teaching points in this lesson are:

- forces can make things move
- the surface an object travels on can affect how it moves.

Think back What makes things go faster?

Ask students to work with a partner and to think about any times they have moved an object to make it move faster. You could hint by asking them about the car in the last lesson and any sports they play.

Possible response: *Students might say that increasing the force can make things move faster.*

Discussion

How fast do you think the vehicle in this photograph can go? What is stopping it from going faster?

Read the text above the photograph and ask students to look carefully at the vehicle in the photograph and what it is driving over. Suggest they think about vehicles they have seen on roads and then ask them to think about what it is like to try to walk or run in loose sand. Ask volunteer students to share their ideas with the class.

Possible response: *Students might say that the vehicle is not moving very fast because the surface is rocky and uneven.*

Investigation: How well do things move on different surfaces?

The aim of this investigation is to explore how things travel along different surfaces. Find locations with a variety of surfaces such as soil, concrete, carpet, plastic or grass.

Make a ramp out of cardboard, guttering or a piece of wood. The ramp works best if it is about 1 metre in length and 20 cm wide. Put some books or a box on the floor and set one end of the ramp on top.

Demonstrate how to hold a car at the top of the ramp and let it go safely. If the ramp is too high the car will go too fast and fall off the ramp. Adjust the height of the ramp if necessary. Demonstrate how to put the car in the same position on the ramp each time. Make sure students do not push the car in this investigation. They simply let it go.

Remind students that to be a fair test they must have the ramp at the same height on each surface. Students should measure the distance from the bottom of the ramp to where the car stops.

Discussion

Which surface made the car travel the fastest? Which surface made the car travel the furthest?

Possible response: *Students might say that smooth and level surfaces, such as concrete, made the car travel the fastest and the furthest.*

Investigation: Comparing the movement of different items on different surfaces

Encourage students to predict what might happen when they roll other objects (e.g. a ball, other toys, etc.) down the ramp. Ask them to carry out this investigation and compare their results with the results using a toy car.

Discussion

Does the ball travel faster than the car or more slowly? Do the different surfaces make the ball behave in the same way as the car? Do the objects go faster on a smooth or a rough surface?

Students should recognise that the smoother the surfaces, the faster the object travels and that this is the same for the car and the ball. The rougher the surface is, the more friction there is and the object is slowed down.

Possible response: *Students might say that the ball travelled faster than the car because it rolled on the surface. The different surfaces affect the speed of both the car and the ball. Objects move faster on a smooth surface.*

Conclude the investigation by asking students to work with a partner to consider what happens to the toy car if it is pushed rather than just being let go and what happens to the toy car if it is pushed very hard.

Possible response: *Students might suggest that when you push the toy car it moves faster down the ramp and further across the surfaces. When you push it very hard it travels faster and further.*

Be a scientist Remember, scientists only alter one thing in an investigation to make it a fair test.

Read out the Be a scientist information and ask students to name all the parts of their investigations on this page that have not been altered – such as the toy car, the ball, the ramp, the height of the ramp, the starting point of the car and the ball, and the way they let each go without pushing. Then they should name the one thing that has been altered – the surface at the bottom of the ramp.

Stretch zone: Why does the rough surface make the car move more slowly? Discuss your ideas with a partner.

Possible response: *Students may suggest that the rough surface slows down the car because the wheels have to travel over bumps in the surface.*

Key ideas

Forces can make objects move faster or slower.

Different surfaces affect how fast or slowly objects move across them.

Summarise the lesson by asking students what they have learned. Let them share their ideas, read out and discuss the key ideas. This will remind students that objects can move at different speeds according to the size of the force applied and the surface they move across.

Review and reflect

Allow students to practise reviewing and reflecting on their learning in private. Give them a comfortable and quiet space to focus on their learning.

Students consider their attitude to their learning in the lesson not just on the content. Encourage students to be positive about their learning. They may have learned skills such as working within a team or being a group leader.

Extra activities

1 Ask students to make observations of the surfaces of roads near the school or their home. They could describe the surfaces and suggest why roads are made of these materials. Ask them to think about what might happen if the roads were very smooth. Remind students to take care near roads and to ask an adult to help them stay safe.

2 Students could make predictions about how the movement of the car or ball will be affected on as many different surfaces as they can find. They could then test their predictions.

3 **Maths link:** Students could create bar charts of the results of their investigations to present their findings in a visual way.

Differentiation

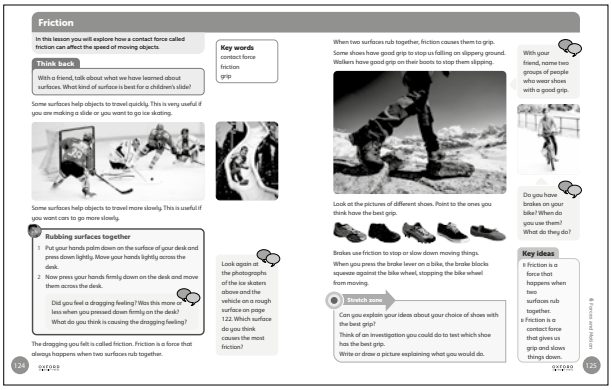
Supporting: Demonstrate the toy car going down the ramp onto some different surfaces and ask students to say 'fast' or 'slow' depending on how the car moves.

Consolidating: Ask students to identify surfaces (from a selection of images) that would cause the toy car to travel slower. They should recognise that the rougher the surface the slower the speed.

Extending: Students could research the term 'friction' and apply this to their findings in their investigations.

Differentiated outcomes	
All students	should be able to understand that different surfaces affect the speed an object moves at.
Most students	will be able to understand that rougher surfaces slow down moving vehicles.
Some students	may be able to predict which surfaces will help an object move faster.

Friction


Friction

In this lesson you will explore how a contact force called friction can affect the speed of moving objects.

Think back

With a friend, talk about what we have learned about surfaces. What kind of surface is best for a children's slide?

Some surfaces help objects to travel quickly. This is very useful if you are making a slide or you want to go ice skating.

Some surfaces help objects to travel more slowly. This is useful if you want cars to go more slowly.

Rubbing surfaces together

1 Put your hands palm down on the surface of your desk and press down lightly. Move your hands lightly across the desk.
2 Now press your hands firmly down on the desk and move them across the desk.

Did you feel a dragging feeling? Was this more or less when you pressed down firmly on the desk? What do you think is causing the dragging feeling?

The dragging you felt is called friction. Friction is a force that always happens when two surfaces rub together.

124 Oxford University Press

Key words
contact force
friction
grip

Look again at the photographs of the ice skaters above and the vehicle on a rough surface on page 122. Which surface do you think causes the most friction?

When two surfaces rub together, friction causes them to grip.

Some shoes have good grip to stop us falling on slippery ground. Walkers have good grip on their boots to stop them slipping.

With your friend, name two groups of people who wear shoes with a good grip.

Do you have brakes on your bike? When do you use them? What do they do?

Look at the pictures of different shoes. Point to the ones you think have the best grip.

Brakes use friction to stop or slow down moving things. When you press the brake lever on a bike, the brake blocks squeeze against the bike wheel, stopping the bike wheel from moving.

Stretch zone

Can you explain your ideas about your choice of shoes with the best grip?
Think of an investigation you could do to test which shoe has the best grip.
Write or draw a picture explaining what you would do.

Key ideas

1 Friction is a force that happens when two surfaces rub together.
2 Friction is a contact force that gives us grip and slows things down.

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Getting started

In this lesson students will explore the contact force of friction. They will realise that friction is useful in slowing things down or making things stop moving altogether. They will explore how friction is important in everyday life, such as in footwear soles or bicycle brakes.

Language support

Students may not be familiar with the word 'grip'. Demonstrate how there are grips on bicycle handlebars, on the handles of tools and on some sporting equipment like tennis racquet handles. These are rough surfaces designed to increase friction and therefore to hold the object securely.

Resources

Key words

contact force friction grip

Scientific enquiry key words

use equipment observe measure
notice patterns record data carry out tests
communicate findings

Lesson at a glance

The key teaching points in this lesson are:

- friction is a contact force
- friction can slow moving objects down.

Think back With a partner, talk about what we have learned about surfaces. What kind of surface is best for a children's slide?

Remind students of what they learned in the previous lesson. What did they find out about different surfaces and how this affected the movement of objects? Ask questions about slides they know of, for example, is there a slide in the playground? Ask, 'Is it good? Do you use it? Does the school need a new one? What kind of surface do you want on a slide?'

Read the text above and below the photograph of the ice hockey players. Point out that it is sometimes useful to have a surface that makes things move quickly, and sometimes useful to have a surface that makes things move more slowly. Ask students to suggest some examples for each.

Investigation: Rubbing surfaces together

The aim of this investigation is to model the force of friction. Ask students to put their hands palm down on the surface of their desks and press down. They should spread out their fingers, and their hands must not be wet, or friction will be reduced. At first they should press lightly, and then more firmly.

Discussion

Did you feel a dragging feeling? Was this more or less when you pressed down firmly on the desk? What do you think is causing the dragging feeling?

> ***Possible response:*** *Students should say that they felt a dragging feeling and some might know that this is due to friction. They should note that the dragging feeling was greater when they pressed down harder on the desk.*

Explain that the dragging feeling that they experienced is called friction, and that it can be very useful in slowing things down. Point out that friction comes from two surfaces being rubbed together. When rough surfaces are rubbed together they produce more friction.

You could extend the investigation by asking students to put different substances on their hands before moving them across the desk to see how this affects the amount of friction. They could test a variety of lubricants such as hand wash or water. Cooking oil works well but can be very messy. They can also test different gloves such as leather, wool or rubber washing-up gloves for different effects.

Discussion

Look again at the photographs of the ice skaters above and the vehicle on a rough surface on page. Which surface do you think causes the most friction?

> ***Possible response:*** *Students should suggest that the vehicle is on the surface that causes the most friction.*

Ask students to look at the photograph of the walker and point to the boots, which have a good grip so that the walker doesn't slip and fall.

Discussion

With your partner, name two groups of people who wear shoes with a good grip.

> ***Possible response:*** *Students might suggest climbers, construction workers or footballers as examples.*

Ask students to look at the pictures of the different shoes and point to the ones they think have the best grip. They should say the football boot and the trainer.

Discussion

Do you have brakes on your bike? When do you use them? What do they do?

Use the text below the pictures of the shoes to explain how brakes work. Brakes in vehicles use the force of friction to slow the wheels down and reduce the speed of the vehicle. The brake blocks rub against the wheel when the brake lever is pressed, creating this friction.

> ***Possible response:*** *Students should recall that bikes have brakes to help them to slow down or stop moving.*

Stretch zone: Can you explain your ideas about your choice of shoes with the best grip? Think of an investigation you could do to test which shoe has the best grip. Write or draw a picture explaining what you would do.

Read out the Stretch zone text and ask students for suggestions.

> ***Possible response:*** *Students may suggest using different shoes with varying grips. They could attach a forcemeter to each shoe and drag it across a surface for a set distance, measuring and recording the force needed for each shoe.*

Key ideas

Friction is a force that happens when two surfaces rub together.

Friction is a contact force that gives us grip and slows things down.

Summarise the lesson by asking students what they have learned. Let them share their ideas, read out and discuss the key ideas. This will remind students that objects that are moving can be slowed down or stopped by friction. Ask students how they could show other people how friction can slow objects down.

Review and reflect

Encourage students to use the vocabulary for this lesson in conversation and discussions. This will highlight any

misunderstandings. Take the opportunity to use all of the discussion questions and listen to their answers.

Students can write one piece of information they have learned in the lesson onto a small piece of card or sticky note. These can be fixed onto a wall under the heading 'Something I have learned today'. Allow students to walk along the wall and see other peoples' ideas.

Extra activities

1 Students could look at the pattern of treads on different shoes and take rubbings of them. They could make a wall display of shoe rubbings They may be able to see how the force required to move each shoe changes with the type of tread on the shoe.

2 **Computing link:** Students could observe the different surfaces in buildings and make suggestions why these have been used. They could use the internet to research one type of flooring and find out why it is used in that location.

Differentiation

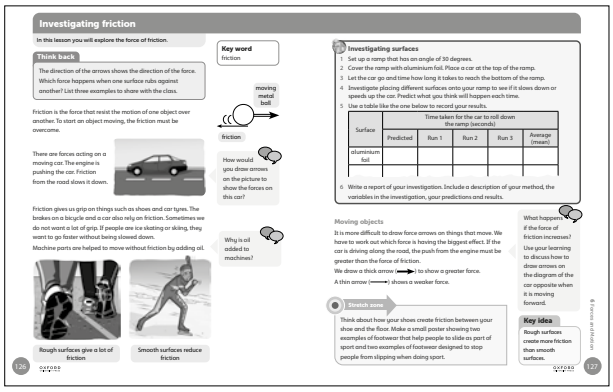
Supporting: Provide students with pieces of different materials and ask them which one would create the most friction.

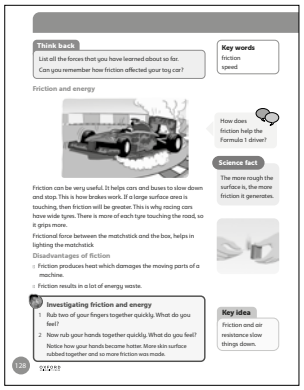
Consolidating: Provide students with different shoes (or pictures of shoes) that are designed for a specific purpose. Ask them which would be the best to use when running on a shiny gymnasium floor and which would help them to slide across a carpet.

Extending: Ask students to think about the ways in which friction is used in everyday life.

Differentiated outcomes	
All students	should be able to experience the dragging force of friction.
Most students	will be able to predict which surfaces will give more grip.
Some students	may be able to measure the force needed to move shoes with different grips.

Investigating friction





Getting started

This lesson introduces students to the force of friction. This is a contact force between two surfaces that are touching. Friction can be useful as it provides us with grip between our shoes and the surface we are walking on, for example. It also opposes motion and can be useful when slowing down. Students investigate how some surfaces can increase the force of friction. They recap using arrows to show forces.

Language support

Ask students to rub their hands together or pull their hand across the surface of their desk. Ask them what they feel. Explain that this is the force of friction. Use the word 'friction' as often as possible in the lesson to model pronunciation and how the word is used.

Resources

Student Book: planks of wood to make ramps; angle measurers; aluminium foil; toy cars; range of rough and smooth materials to cover a ramp; materials to make posters.

Key words

friction

Other words in the lesson

forces surfaces

Scientific enquiry key words

Plan and/or carry out enquiries to answer questions

Recognise and control variables

Make observations

Take measurements, using equipment accurately

Record data and results using diagrams and labels, tables, keys and graphs

Make predictions

Report and present findings in a variety of ways

Draw conclusions and give explanations

Identify causal relationships

Lesson at a glance

The key teaching points for students in this lesson are:

- friction is a force between two surfaces
- rougher surfaces result in more friction than smoother surfaces.

Ask students to work through the Think back task to help them recall prior learning.

Think back: The direction of the arrows shows the direction of the force. Which force happens when one surface rubs against another? List three examples to share with the class.

Students should recall how they used arrows in previous lessons to show the size and direction of a force.

Possible response: *Students should suggest that friction is the force when one surface rubs against another. Examples could be rubbing their hands together, dragging hands across a surface, grips on bicycle handles and braking systems in vehicles.*

Ask students to read the information and study the pictures on page 126 of the Student Book. Ask them to look at the picture of the car.

How would you draw arrows on the picture to show the forces on this parked car?

Possible response: *Students should draw an arrow pointing down to show the force of gravity pulling down on the car and another arrow pointing upwards to show the normal force which is equal to the force of gravity as the car is not moving.*

Students should read the information under the picture of the car. Ask them to suggest other examples of when friction is useful and when it is not useful.

Why is oil added to machines?

Possible response: *Students should suggest that oil can act as a lubricant and reduce the effect of friction between the moving parts of the machine. This can help the parts move without causing much damage, and it can make them less noisy and less hot as less energy is transferred through friction to heat and sound.*

Tell students that they are going to work in small groups to investigate how friction changes on different surfaces.

Investigation: Investigating surfaces

Students predict and investigate how different surfaces on a ramp affect the time it takes for a toy car to travel down it. First they try with aluminium foil on the ramp. Then they select different materials to cover the ramp with. They make their results reliable by repeating the test a number of times and timing how long the car takes to roll down the ramp. To make it a fair test they let the car roll without applying any forces by pushing it. Remind students to record their predictions before testing each material.

Possible response: *Students make their predictions and record their results. They write a report of their investigation, describing a repeatable method that is a fair test and the variables (only the surface should change each time). They should find that rougher surfaces slow the car down making it take longer to travel down the ramp.*

Moving objects

Students recap using arrows of different sizes to show larger or smaller forces by reviewing their investigation by answering the following question.

What happens if the force of friction increases? Use your learning to discuss how to draw arrows on the diagram of the car opposite when it is moving forward.

Students look back at the car on page 126 of the Student Book and think about the arrows they would draw when it was parked, and how they would change if it was moving forwards.

Possible response: *Students should find that as the force of friction increases, the car takes longer to travel the same distance. If the car is moving forwards then the forces are unbalanced. This means that the driving or push force from the engine is greater than friction. Students should suggest showing a larger arrow pointing to the left in the direction in which the car is moving, and a smaller arrow pointing to the right showing the friction between the tyres and the road surface.*

Ask the groups to discuss the Stretch zone task. They can work on the poster individually or as a group where they will communicate and collaborate.

Stretch zone: Think about how your shoes create friction between your shoe and the floor. Make a small poster showing two examples of footwear that help people to slide as part of sport and two examples of footwear designed to stop people from slipping when doing sport.

> ***Possible response:*** *Students may suggest: ice skates (with a narrow and sharp surface made of a shiny and smooth material which makes the skates move faster as there is less friction); skis (with smooth, flat surfaces that glide across snow as there is less friction); rugby boots (with grips and metal studs that dig into and grip the ground and provide lots of friction); climbing shoes (with soft rubber soles that shape themselves around lumps and bumps in rocks to increase the amount of surface area that touches the rock and so increase the friction).*

Key idea

- *Rough surfaces create more friction than smooth surfaces.*

Ask a volunteer to read out the Key idea. This will remind students that some materials reduce friction and others increase it. Remind them that this means that some surfaces are useful because they slow us down or help us to grip. Others help us to move faster and slide. Show students different materials and ask them if they would increase or decrease the force of friction. Encourage them to share ideas. Ask them to name some uses of friction.

Think back: List all the forces that you have learned about so far. Can you remember how friction affected your toy car?

> ***Possible response:*** *Students should recall the different forces they have learned about so far (e.g. push, pull, gravity, upthrust and friction). They should recall that friction slowed the toy car down because it opposed the push force acting on the car.*

Friction and energy

Ask students to look at the picture of the racing car on page of the Student Book and to read the text below it. This points out how friction can be very useful as it can slow down vehicles. Ask students to explain to each other in their own words how friction works to slow down vehicles. Then ask students to answer the discussion question.

How does friction help the Formula 1 driver?

> ***Possible response:*** *Students should suggest that the wide tyres increase the amount of grip that the tyres have on the road, so the car can go faster without sliding around. Friction also helps the driver by being the force that is applied when the driver presses on the brakes, and so it slows down and stops the car quickly.*

Tell students that they are going to investigate friction and energy.

Investigation: Investigating friction and energy

Students work with a partner. They follow the instructions in the investigation and observe the result of rubbing their hands together.

> ***Possible response:*** *Students should notice that their skin heats up when their fingers and then their hands are rubbed together.*

Key idea

F*riction and air resistance slow things do*wn.

Read out the Key idea, or ask a volunteer to read it out. Then ask students to turn to a partner and tell them how friction and air resistance can slow things down. Ask them to give a simple demonstration of each, for example by dragging their hand across the desk and by dropping a flat piece of paper.

Review and reflect

Encourage students to reflect on their learning throughout the lesson. Use the discussion tasks, the investigation and the activities to encourage students to think about what they understand and what they are finding less straightforward. Discuss the outcomes of each task with students. Encourage them to identify aspects they have not completed correctly and help them to identify improvements. This will help them to develop a positive approach to learning by understanding that learning is a process that will improve with practice and reflection.

Extra activities

1 Arrange for students to investigate how lubricants change the force of friction. They pull a shoe across a table for 50 cm. They repeat this with cooking oil or baby oil on a cover on the table. They should find that they need less force when using oil.

2 **Computing link:** Ask students to research how lubricants are used to make machines move better. They might observe oil being used on hinges to stop them squeaking.

Differentiation

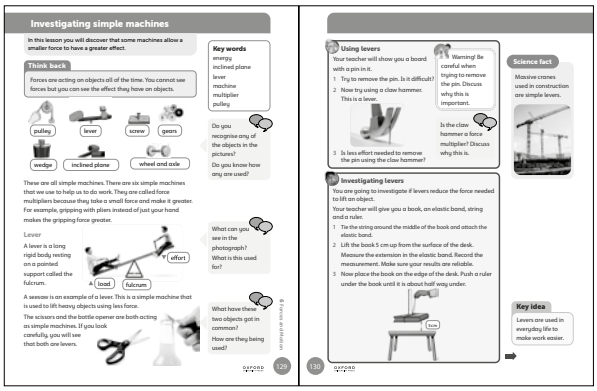
Supporting: Ask students to observe different surfaces around the classroom and make predictions about the likely force of friction that they would create.

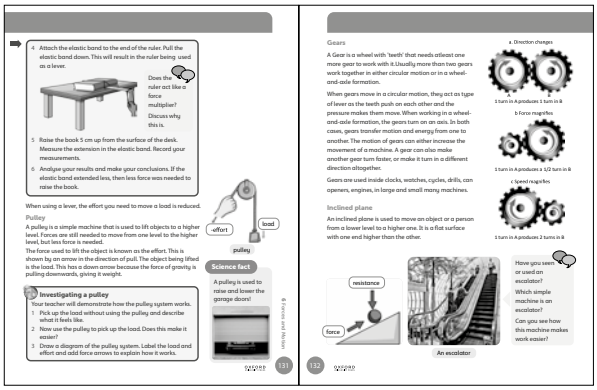
Consolidating: Allow students to practise measuring the time taken for a toy car to move over different surfaces.

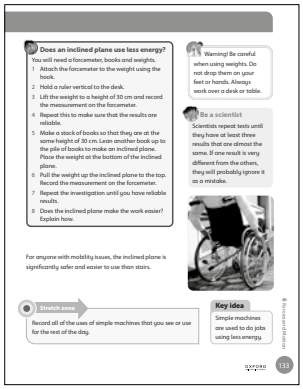
Extending: Ask students to calculate the average time taken and the average speed of a toy car travelling down the different surfaces**.**

Differentiated outcomes	
All students	should be able to describe how the force of friction occurs
Most students	will be able to predict which surfaces will result in more friction
Some students	may be able to explain how lubricants can reduce friction

Investigating simple machines







Getting started

This lesson introduces students to the idea that we use many different simple machines in our daily lives. Students learn about the simple machines that we use including pulleys and inclined planes. Students investigate how simple machines mean that less force is needed to have a greater effect. They explore the ways in which some simple machines work and measure the forces that are needed to have an effect on objects.

Language support

Ask students to look at the pictures of the simple machines at the top of page 129 of the Student Book. This is a useful tool in supporting language progression. Students should say the words as they study each picture. Remind students to refer to these pictures as

they learn about simple machines to remind them of what they look like. 'Multiplier' is a tricky word. Write it on the board and ask students what the word 'multiply' means. Ask them to give you an example – a simple maths equation would work here. Tell them that a multiplier is something that makes something bigger.

Resources

Student Book: wipe boards (optional); pulleys; objects to lift with pulleys; forcemeters; piles of books; weights; boards with a pin or nail hammered into them; claw hammers; books; elastic bands; string; rulers.

Key words

energy inclined plane lever machine multiplier pulley

Other words in the lesson

escalator load

Scientific enquiry key words

Plan and/or carry out enquiries to answer questions

Make observations

Take measurements, using equipment accurately

Record data and results using diagrams and labels, tables, keys and graphs

Make predictions

Draw conclusions and give explanations

Identify causal relationships

Lesson at a glance

The key teaching points for students in this lesson are:

- there are different types of simple machines
- simple machines mean that less force is required to carry out tasks
- pulleys and inclined planes are simple machines.

In the next lesson students will investigate levers and discover how they are simple machines used to make work easier.

Ask students to read the Think back text and discuss it with a partner. This should remind students of prior learning.

Think back: Forces are acting on objects all of the time. You cannot see forces but you can see the effect they have on objects.

Ask students to think about when they have seen the action of forces on objects, for example when they pushed a car or dropped a ball to the ground.

Ask students to look at the pictures at the top of page 129 of the Student Book and discuss them.

Do you recognise any of the objects in the pictures? Do you know how any are used?

> ***Possible response:*** *Students might recognise a lever, screw or inclined plane as these are probably the most common. They might suggest that a pulley is used to lift things to a higher level, a lever is used to raise heavy objects or as a seesaw, a wheel and axle is used in a bicycle, an inclined plane could be used as a ramp to push a pram up and a screw holds things together.*

Ask students to read the rest of the information on page with a partner. Ask them how many simple machines there are. Make sure they are confident in using the term 'multiplier' when discussing simple machines.

What can you see in the photograph? What is this used for?

> ***Possible response:*** *Students should suggest that the people are on a seesaw. They may know that this is an example of a lever, which is a simple machine. They should know that a seesaw is used for play in a playground and one person and then the other is raised.*

Students read the information about how levers are used. Ask them to give an additional example of a lever from the information they read. Using these levers means that the person's hands use less force because the simple machines multiply the force. Ask students to continue to work with a partner to discuss the questions.

What have these two objects got in common? How are they being used?

> ***Possible response:*** *Students should suggest that the objects in the photographs are both simple machines or levers. They are multiplying the force applied from the person's hands.*

Tell students that they are going to investigate how levers are used.

Investigation: Using levers

Warning! Be careful when trying to remove the pin. Discuss why this is important.

Read out the warning. Ask students to suggest why they should be careful when removing the pin or nail. (These are sharp objects that could damage students' skin.)

Organise students into small groups for this investigation. Students try to remove a pin or nail from a board first with their hands and then with a claw hammer, which is a lever. They compare the effort required in each case.

Possible response: *Students should find that trying to pull out the pin or nail from the board with their fingers is very difficult and takes a great deal of force. Less effort is needed when using the claw hammer.*

Science fact: Massive cranes used in construction are simple levers.

Ask them if they can see why the cranes are classed as levers. Can they identify the load, fulcrum and effort on one of the cranes? Elicit that the fulcrum is where the arm of the crane meets the upright part. The load is what is being lifted and the effort is the cable being worked by a machine. You could also point out that to balance the lever large weights are added on the small arm opposite to where the load will be lifted. These can be pointed out in the photograph.

Tell the groups that they are going to investigate how a lever reduces the effort needed to raise a book.

Investigation: Investigating levers

Students investigate the amount of force required to lift a book straight up and the amount required to lift it using a lever. Students use the extension of the elastic band to represent the force that is needed to raise the book. The more it extends the more the force is required. They should make this a fair test by using the same book and the same elastic band and by raising the book by 5 cm for each test. They should repeat each measurement to make their results reliable.

Possible response: *Students should suggest that using the ruler as a lever reduced the effort needed to raise the book 5 cm.*

Ask students to review their investigation by using the discussion question.

Does the ruler act like a force multiplier? Discuss why this is.

Possible response: *Students should suggest that the ruler acts as a force multiplier because when they pulled on the elastic band attached to the ruler it extended less than when lifting the book using just the elastic band.*

Key idea

Levers are used in everyday life to make work easier.

Read out the Key idea, or ask a volunteer to read it out. Ask students to turn to a partner and tell them how levers reduce the effort needed to carry out a job. Ask students to name the other simple machines they have learned about and give examples of their uses in everyday life.

Pulley

Students should read the text about pulleys and study the diagram of a simple pulley system near the bottom of page. Make sure they understand the terms 'load' and 'effort' in this context. You could ask a volunteer to explain what the blue and red arrows on the diagram represent.

Explain that students will work as a whole class to observe how a pulley system works.

Investigation: Investigating a pulley

You will demonstrate using a pulley. Arrange students around the demonstration so that they can all clearly see and hear what is happening. You could hand out wipe boards to allow students to draw a diagram of the pulley and to make notes during the demonstration or students could use their notebooks. This helps students to stay on task when they are observing.

Ask for a volunteer to pick up a small load and describe this to the rest of the class. Demonstrate how to use the pulley and allow students to take turns to allow them to experience how the pulley makes moving the load much easier.

Possible response: *Students should suggest that using the pulley makes moving the load easier. They can compare their diagrams to the one on page 131.*

Gears

Ask students to read the text about inclined plane and to study the diagrams. These show how gears work to change direction or amplify/reduce the force or speed.

Inclined plane

Ask students to read the text at the bottom of page 132 of the Student Book and to study the diagram. This shows how an inclined plane can move an object or person to a higher level with less force than moving it straight up. The diagram shows how the force is moving the ball up the inclined plane and resistance is acting downwards on it.

Have you seen or used an escalator? Which simple machine is an escalator? Can you see how this machine makes work easier?

Ask students to work with a partner to discuss the questions.

Possible response: *Students may have used an escalator in a department store or a large building. An escalator is an example of an inclined plane. The escalator moves a person from one level to another up an angle which requires less effort than lifting them straight up.*

Explain that students will work in small groups to investigate how less energy is needed to move a load to a higher level using an inclined plane.

Investigation: Does an inclined plane use less energy?

Warning! Be careful when using weights. Do not drop them on your feet or hands. Always work over a desk or table.

Read out the warning. Ask students why they should work over a desk or table when using weights. Ask them to think about how they will keep themselves and others safe when using weights.

Students compare the force required to lift a load straight up with the force required to pull the load up an inclined plane. Students should work together to follow the method. They should carefully attach the load to the forcemeter. They could put small or odd-shaped weights into a bag with handles to make it easier to attach. They record on a suitable table of results the force required to lift the load to 30 cm. They repeat this using an inclined plane to lift the load to 30 cm. To make the results reliable, students should repeat each test.

Possible response: *Students should find that the force needed when using the inclined plane is less than when just lifting it vertically. This proves that the inclined plane means less effort is needed to complete a task.*

Be a scientist: Scientists repeat tests until they have at least three results that are almost the same. If one result is very different from the others, they will probably ignore it as a mistake.

Ask students when they have repeated tests in their investigations. Ask if they have ever measured something and then repeated the measurement and found a completely different result. How do they know which one is correct? Elicit that they need to keep repeating the measurement and if they find more results the same as one of theirs, they will have more confidence that this one is correct.

Stretch zone: Record all of the uses of simple machines that you see or use for the rest of the day.

Possible response: *Students should observe many simple machines throughout the day including scissors, rulers, door knobs, screws holding furniture together, inclined planes on entry to buildings, and perhaps seesaws in a park.*

Key idea

Simple machines are used to do jobs using less energy.

Read out the Key idea to remind students that we use simple machines to make tasks easier as less force is needed to do a job. Ask students to name the six simple machines and to share ideas about how each one is used.

Review and reflect

Discuss the outcomes of each task, such as the investigations into pulleys and inclined planes, with students during and at the end of the lesson. Encourage them to identify aspects they have not completed correctly and help them to identify improvements. They could write down two achievements and one target for improvement.

Encourage students to find a quiet place to think about their learning in this lesson. Ask them if they found any part of the lesson challenging. Remind them that when they overcome a challenge, they are making their brain work harder. Ask them how they felt when the learning was challenging and how they overcame the challenge. Ask them to record the strategies they used as this will help them in future situations. If all of the students found some part more difficult than others you might want to review this as a class before moving on to the next lesson.

Extra activities

1 **Computing link:** Allow students access to the internet to research as many different examples of simple machines used in everyday life as they can find. They could make a poster to show their findings.

Arrange for students to set up a seesaw using a block as the fulcrum and a ruler. They observe what happens when they change the position of the fulcrum by moving it along the ruler. They report whether the position of the fulcrum changes the force needed to carry out tasks.

Differentiation

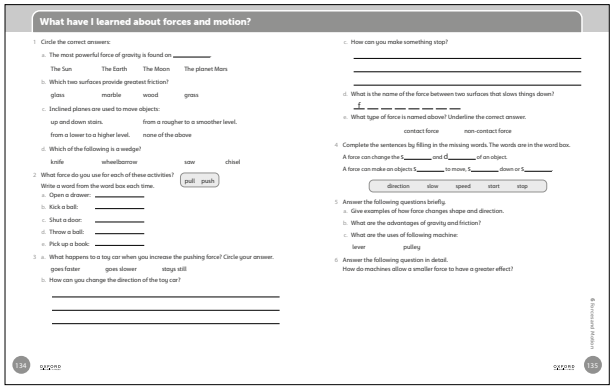
Supporting: Demonstrate how to lift the book with the elastic band and with the ruler lever, and show students how they measure the extension in the elastic band.

Consolidating: Allow students to repeat the investigation on page 131 of the Student Book using a different weight to see how it changes the forces required.

Extending: Ask students to do more research about levers to answer these questions: How do levers reduce the effort required to lift a load? How does changing the length of the lever and the position of the fulcrum affect the amount by which the force is multiplied?

Differentiated outcomes	
All students	should be able to name some of the simple machines
Most students	will be able to describe how a pulley and an inclined plane are used
Some students	may be able to explain how a pulley and an inclined plane results in less force being used to move a load

What have I learned about forces and motion?


What have I learned about forces and motion?

1 Circle the correct answers:

a. The most powerful force of gravity is found on _____
The Sun The Earth The Moon The planet Mars

b. Which two surfaces provide greatest friction?
glass marble wood grass

c. Inclined planes are used to move objects:
up and down stairs. from a rougher to a smoother level.
from a lower to a higher level. none of the above

d. Which of the following is a wedge?
knife wheelbarrow saw chisel

2 What force do you use for each of these activities?
Write a word from the word box each time.
pull push
a. Open a drawer: _____
b. Kick a ball: _____
c. Shut a door: _____
d. Throw a ball: _____
e. Pick up a book: _____

3 a. What happens to a toy car when you increase the pushing force? Circle your answer.
goes faster goes slower stays still
b. How can you change the direction of the toy car?
_____
_____
_____

c. How can you make something stop?
_____
_____
_____

d. What is the name of the force between two surfaces that slows things down?
f _ _ _ _ _ _ _ _
e. What type of force is named above? Underline the correct answer.
contact force non-contact force

4 Complete the sentences by filling in the missing words. The words are in the word box.
A force can change the s_____ and d_____ of an object.
A force can make an objects s_____ to move, s_____ down or s_____.
direction slow speed start stop

5 Answer the following questions briefly.
a. Give examples of how force changes shape and direction.
b. What are the advantages of gravity and friction?
c. What are the uses of following machine:
lever pulley

6 Answer the following question in detail.
How do machines allow a smaller force to have a greater effect?

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134 SCORE

SCORE 135

Getting started

The aim of this section is to encourage students to review their learning after each lesson in the unit and also to undertake some end-of-unit review and reflection. On pages 134-135 of the Student Book there are questions linked to concepts and topics covered in the unit. These will assess students' knowledge and understanding of the topic. You may have been using questions after each lesson where provided. However, it is also worth allowing students to answer all of the questions at the end of the unit. This will test longer-term understanding and recall. You can do this as an informal individual or pair activity and allow students to look information up as they work through the questions or you can set it as an individual 'closed-book' activity.

It is important that students report areas that they are not confident with. This information is useful for them in that they can think about what they need to review or ask advice about. It is also vital for you as it provides information about any topics you may wish to revisit.

What have I learned about forces and motion? answers

1 Circle the correct answers

Answer: *a. The Sun; b. wood, grass; c. from a lower to a higher level; d. chisel.*

2 What force do you use for each of these activities? Write a word from the word box each time.

Answer: *a, e , maybe c: pull; b, d, maybe c: push.*

3 a. What happens to a toy car when you increase the pushing force? Circle your answer.

b. What happens to a toy car when you increase the pushing force? Circle your answer.

c. How can you make something stop?

d. What is the name of the force between two surfaces that slows things down?

e. What type of force is named above?

Answer: *a. goes faster; b. by applying push force in an angled direction; c. Students should write that they could stop the force or increase friction, for example using brakes; d. Friction; e. contact force.*

4 Complete the sentences by filling in the missing words. The words are in the word box.

Answer: *give the answers in this order: speed; direction; start; slow; stop.*

5 Answer the following questions briefly.

a. Give examples of how force changes shape and direction.

b. What are the advantages of gravity and friction?

c. What are the uses of following machine: lever, pulley.

Answer: *a. Examples of how force changes shape: shaping of clay, rolling out of dough, crumpling of piece of paper; forcing of metal to create car parts, etc. Examples of how force changes direction: pulling of a ship by tug boats, drag toy, pushing of a cart or pram, etc.*

b. The force of gravity is essential to holding planets in orbit in the solar system. The force of friction helps two surfaces to grip each other, preventing slippage.

c. A lever reduces the effort required to move a load. A pulley is used to lift objects to a higher level.

6 Answer the following question in detail. How do machines allow a smaller force to have a greater effect?

Answer: *Simple machines such as lever and gears are able to transform small forces (or motion) into bigger forces (or motion). In some cases, they are also able to change bigger force or motion into smaller, incremental force or motion. Simple machines such as levers, pulleys, and gears are examples of machines which can transform effort o lift or move loads. For example, a pulley can change the direction of the force to lift a heavy object using lesser force. A lever, similarly, can also lift a heavy object using less force. Similarly, a pulley is able to lift a heavy object with less force by changing the direction of the force.*

Summative assessment

You can read out the answers to the 'What have I learned about the lives of animals and humans?' section in the Student Book for students to self-assess or you can take in the pages and mark them to award an overall score. You could allocate marks as follows: question 1 = 4; question 2 = 5; question 3a = 1, question 3b = 2, 3c = 2, 3d = 1, 3e = 1; question 4 = 2; question 5a = 2, 5b = 1, 5c = 1; question 6 = 3. This makes a total of 25 marks.

If necessary, ask students to revisit topics and questions to help them to learn more about any they did not score well on. In this way the questions are both summative and formative. All assessments should be linked to enhancing learning and in this way the 'What have I learned about?' pages will support this as well as providing data to report back to students, parents and/or other significant adults.

This information may also be used to create end-of-term reports for each student. It may also be useful to keep a record of overall confidence levels for the whole class to identify areas that may need revision later.

This feedback can then be used to form support strategies to help students improve. Keep the recording and analysis of students' self-evaluations simple. A general impression of the self-evaluation of the class is all that is required, for example: 50% of the class were not confident about … .

7 The Earth and its Resources

In this unit students will:

- Recognise that earth's surface is made up of land and water and is surrounded by air.
- Recognise that water in rivers and streams flows from mountains to oceans or lakes.
- Identify some of Earth's natural resources that are used in everyday life (e.g., water, wind, soil, forests, oil, natural gas, minerals).
- Recognise that some remains (fossils) of animals and plants that lived on Earth a long time ago are found in rocks, soil and under the sea.
- Differentiate between renewable and non-renewable resources.
- Investigate the impact of human activities on Earth's natural resources.
- Suggest ways to conserve natural resources.

Getting started

In this unit students discover the natural resources of Earth and where they are found. They learn that fossils are formed when things that lived long ago become trapped within rock. They observe and make models of them.

Students then move on to discuss water as an important resource that has been used for hundreds of years by humans to decide where to live.

Finally, the unit moves on to a consideration of renewable and non-renewable energy sources and potential sources of pollution on the planet.

Science in context

This unit will allow you to discuss with students the work of people who use knowledge of environment and resources in their work. These include geologists, structural engineers, builders, gardeners, farmers, conservationists and environmental scientists.

You can relate this to students' lives by asking them to share examples of when they have experienced pollution and pollution causing activities in their everyday life. Encourage students to question why it is important to know about therenewable resources. Also ask why fossils are important and what they can tell us.

Scientific enquiry skills

An Investigation master sheet is given in this Teacher's Guide to help students plan their scientific enquiries. In this unit, students can use their first-hand experiences of rocks to help them to carry out observations and measurements to classify types of resources. They will be using simple information sources to help them to explore the uses of different types of resources.

Resources

Student Book: different coloured modelling clay; hand lenses; magnifying glasses; digital cameras (optional); samples of fossils in rocks; dough; models of small animals; leaves; wax or chocolate; clay; water; tall glasses or plastic containers such as water bottles with the tops cut off; long spoons; booklet and poster making material.

Key words for unit

are in the Word cloud.

fossils condensation water cycle natural resources recycling environment

Scientific enquiry key words

use equipment observe measure notice patterns record data carry out tests

group/classify use secondary sources
communicate findings

Language support

A useful starting point is the Word cloud. Create a Word wall for each unit so that students become familiar with the words. Involve students in creating and maintaining it.

Develop the glossary from the first lesson. Regular use will develop students' confidence in word recognition in English and familiarise them with the meanings on their own terms. To reinforce familiarity with new words ask students to listen, say, read and then write the words.

Unit at a glance

The key teaching points for students in this unit are:

- to introduce the unit objectives
- to introduce the learning outcomes
- to engage students with the content of the unit
- to review and build on prior learning and understanding of the topics.

Science fact The oldest rocks on Earth are nearly four billion years old.

Read out the information in the Science fact and discuss how old this is. Discuss how old the students are, and how old buildings or statues that they might have seen or experienced are. Talk about how old the rocks that they are familiar with might be, and what the Earth might have looked like when they were formed.

Discussion

What is seen in the rock? Is it living, non-living or once living?

Discuss how the object got into the rock.

Allow students to continue to work with their partner or small group to talk about the picture showing the fossil plant. Point out that they will be studying fossils and making their own versions in a later lesson. Ask them to consider if they have seen any living things like

the one shown in the photograph. Remind them of the classification of living, non-living and once living and let some students share their ideas with the class so you can check answers and deal with any misconceptions. Listen to their ideas about how the object got into the

rock. Don't correct any but tell students to remember their suggestions as they can check them soon and may change their minds.

Possible response: *A plant fossil is seen in the rock. It can be classified as once living. Students may suggest many theories, but the scientifically accepted one is that the plant died, was covered with sand and mud, and eventually turned to stone.*

Discussion

Can you identify which resources are shown in the image?

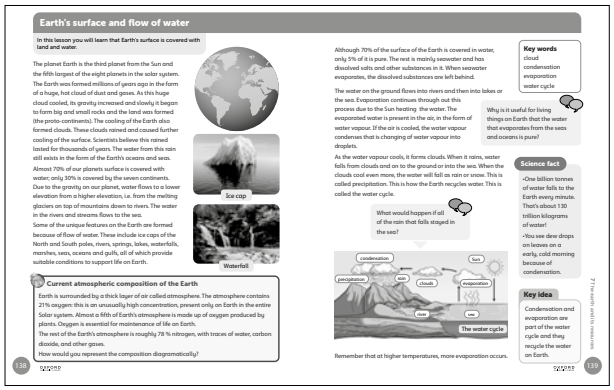
Possible response: *Students might recognise the land, air, plants, trees, shrubs and grasses all as resources, all with different uses. Encourage them to share some of the uses of these resources.*

Extra activities

1 **Computing link:** Ask students to use the internet to research somelatest fossil discoveries. These can be local to your region or worldwide, such as the Grand Canyon, the Himalayas or New Zealand.

2 Read the Science fact and ask students if they know who studies and finds out how old fossils are. Ask students to find out more about why this work is important. They should research the work of geologists and archaeologists from around the world and how their findings affect everyone.

Earths surface and flow of water



Getting started

In this lesson students learn about the features which cover the surface of the Earth: i.e. land and water. Students are introduced to the term 'condensation', the importance of the water cycle and how it uses evaporation and condensation to recycle water on Earth. Water is a valuable commodity and it has to be recycled so that we can use it to sustain life.

Language support

The key words in this unit are 'condensation' and 'evaporation'. Condensation is when gases such as water vapour change to a liquid. Condense also means 'cut down' or 'make briefer'. Both indicate that something that takes up a lot of space (a gas) changes to take up much less space (a liquid). There are condensed dictionaries, condensed novels and condensed milk. Evaporation is the reverse process where a liquid changes state into a gas.

Resources

Student Book: writing materials; paper, card or blank flip books.

Key words

cloud condensation evaporation water cycle

Other words in the lesson

precipitation recycle water vapour

Scientific enquiry key words

use equipment observe carry out tests
use secondary sources communicate findings

Lesson at a glance

The key teaching points in this lesson are:

- gases can change state into a liquid
- condensation is the reverse of evaporation.

Begin by reading with the students, the text on page 138 and instruct them to observe the photographs given alongside the text.

Students should recall that the change of state from a liquid to a gas is called evaporation. Very hot water is called steam. Help them relate these states of matter with the natural states of water.

Investigation: Current atmospheric composition of the Earth

Read through or ask a volunteer to read through the text in the investigation box. Review and discuss why this specific combination of gases makes our atmosphere habitable. You can ask questions such as, "what would happen if the level of oxygen in the atmosphere increases?' or "what would be the consequence of decreased level of oxygen?" or "why the current level of nitrogen gas essential to maintain life?'

It is important to develop in the students the habit of discussion backed by scientific data. Remind them of the properties of oxygen and nitrogen when discussing these questions. You could ask them to search the uses of these gases and relate the uses to the Why of the questions.

Help the students visualize which type of chart would best demonstrate the data given and encourage them to make the chart individually.

Possible response: *Students should discover that there are a lot of different gases in the atmosphere but some are in very small amounts. Encourage students to draw a pie chart showing three segments only: oxygen (21%), nitrogen (78%) and other (1%) including argon, neon, water vapour and carbon dioxide.*

Read through the text on the next page. This explains to students that when it rains, water falls from clouds and onto the ground or into the sea. Ask students where the water in rivers and streams flows. Point out that eventually most of the water ends up back in the seas and oceans. Stress that it is heat from the Sun that drives the evaporation of water from the seas and oceans.

Remind students that the air in the atmosphere contains water vapour. Explain that if the air is cooled, the water vapour condenses. This water can fall as rain. Write the words 'evaporation' and 'condensation' on the board and tell students they are going to study how these two processes drive the recycling of water around the whole world.

Why is it useful for living things on Earth that the water that evaporates from the seas and oceans is pure?

Ask students to work with a partner. Allow them to think back to their earlier work on living things and ask them to list what living things need in order to survive. They can then reflect on what would happen if most of the water on Earth was salty and why it is important that water evaporates from the seas and oceans as pure water.

> ***Possible response:*** *Students may suggest that evaporation removes the salt from the water. We cannot drink salt water so this provides us with water that we can drink.*

What would happen if all of the rain that falls stayed in the sea?

Ask students to talk to a partner about the discussion question. Ask some students to volunteer their ideas to the class.

> ***Possible response:*** *Students may suggest that water mixed with the salt water in the sea would become salty and we would not have fresh water to drink; also there would be floods.*

Investigation: Slowing down evaporation

Use prompt questions to remind students about the process of planning an investigation. You could discuss what a fair test is to support students with their plans. Encourage them to repeat readings so that they can be confident with their results. Read through the information in the speech bubbles and then ask students to share their plans. If possible, they could carry out the plans to see if they work.

Science fact One billion tonnes of water falls to the Earth every minute. That's about 130 trillion kilograms of water!

Read out the Science fact and ask students if one billion tonnes of water is a lot of water. Hand around a one-kilogram mass and tell students that they would need to pass round 130 trillion of them to equal the mass of water that falls every minute.

Key ideas

- *Condensation is the opposite of evaporation*
- *Condensation and evaporation are part of the water cycle and they recycle the water on Earth.*

Summarise the lesson by asking students what they have learned. Let them share their ideas, then read out and discuss the key idea. Review learning of how the water cycle uses condensation and evaporation with other actions to result in the water cycle. The importance of the water cycle should be appreciated. Students should recognise how life on Earth would not survive without the continuous recycling of water to provide fresh water.

Summarise the lesson by asking students what they have learned. Let them share their ideas. Ask a volunteer to read out the key ideas. Ask students what changes of state take place during condensation and evaporation. Ask them to draw a particle diagram showing the changes of state for each one. Ask them to suggest how the rate of evaporation could be slowed down.

Review and reflect

Students write down the key learning points from this lesson. They tick everything they feel confident with and underline the things they need to work on more. They should write bullet points of what they plan to do about the areas they need more support with.

Extra activities

1 Students could build a model of the water cycle.

2 Students could find out how they could prevent drinking water from evaporating if they were stuck on a desert island.

Differentiation

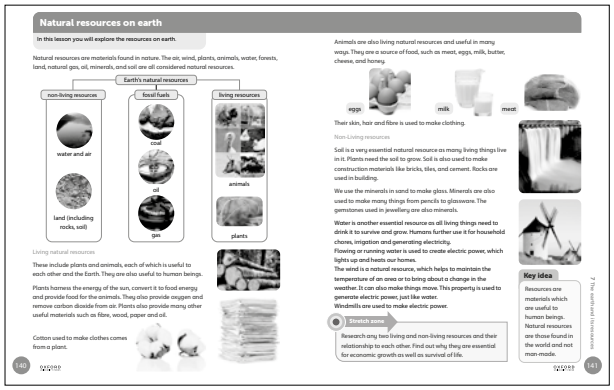
Supporting: Students can trace the water cycle using the diagram.

Consolidating: Students can record the different places where they have seen condensation and evaporation.

Extending: Students can practise drawing the water cycle diagram from memory, labelling each part correctly.

Differentiated outcomes	
All students	should be able to recognise condensation
Most students	will be able to describe the changes of state that take place during water cycle
Some students	may be able to describe the factors that affect water cycle

Natural resources on earth



Getting started

This lesson introduces students to the importance of the natural resources and their presence on Earth. Water, for example, is a precious natural resource, essential to sustain life.

Language support

The key words linked to this unit have been used and experienced in earlier lessons. Explain that water is natural resources, as are trees, land, animals, etc. Talk about other materials that are included in the list of resources: you may use the infogram on page 140 for this purpose.

Resources

Student Book: writing materials; paper, card or blank flip books.

Scientific enquiry key words

record use secondary sources

Lesson at a glance

The key teaching points in this lesson are:

- natural resources may be living or non-living.
- natural resources are found naturally and are not man made.

Point out the infogram on page 140. It provides an overview and listing of different types of natural resources found on the planet.

Explain to the students what is meant by fossil fuels and how they power the world. Discuss the environmental impact of extracting and using fossil fuels and how they are not renewable.

Read through the text on page 140- 141. This explains to students the overview of living and non-living natural resources. It also provides some description of examples of such resources. Draw the students attention towards the photographs given alongside the text. If possible, take students on a visit to a nearby park or nature reserve to first hand observe and classify natural resources.

Stretch zone: Research any two living and non-living resources and their relationship to each other. Find out why they are essential for economic growth as well as survival of life.

> ***Possible answer:*** *Students may choose to illustrate the relationship between plants, animals, and non-living resources such as air and soil. They may state that while non-living resources depend on living resources for their maintenance and renewal, the living resources depend on non-living resources for their very surviva*

Key idea

- *Resources are materials which are useful to human beings.*
- *Natural resources are those found in the world and not man-made.*

Summarise the lesson by asking the students to review and reflect on what they have learned. Encourage them to share their ideas, continuing the discussion from the stretch zone.

Review and reflect

Students take some time to reflect on their learning. They review the learning objectives and the key words that are used in this lesson. Students should take time to consider what would happen if we did not have clean and fresh water to drink. Students might want to reflect on the importance of nature and how it provides for us.

Extra activities

1 Students can make a list of natural resources in their local parks.

Differentiation

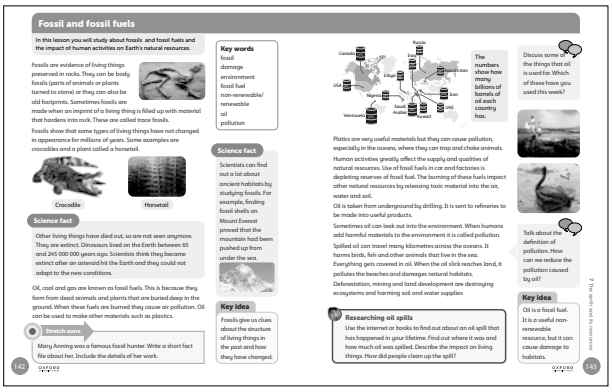
Supporting: Students can recreate the infogram of natural resources.

Consolidating: Students can practise the meanings of difficult words.

Extending: Students can psearch for details of fossil fuels in preparation for the next lesson.

Differentiated outcomes	
All students	should be able to recognise some natural resources in their immediate surroundings
Most students	will be able to describe the roles and interaction of living and non living natural resources
Some students	may be able to discuss the impact of natural resources

Fossil and fossil fuels


Fossil and fossil fuels

In this lesson you will study about fossils and fossil fuels and the impact of human activities on Earth's natural resources.

Fossils are evidence of living things preserved in rocks. They can be body fossils (parts of animals or plants turned to stone) or they can also be old footprints. Sometimes fossils are made when an imprint of a living thing is filled up with material that hardens into rock. These are called trace fossils.

Fossils show that some types of living things have not changed in appearance for millions of years. Some examples are crocodiles and a plant called a horsetail.

Crocodile

Horsetail

Science fact

Other living things have died out, so are not seen anymore. They are extinct. Dinosaurs lived on the Earth between 65 and 245 000 000 years ago. Scientists think they became extinct after an asteroid hit the Earth and they could not adapt to the new conditions.

Oil, coal and gas are known as fossil fuels. This is because they form from dead animals and plants that are buried deep in the ground. When these fuels are burned they cause air pollution. Oil can be used to make other materials such as plastics.

Stretch zone

Mary Anning was a famous fossil hunter. Write a short fact file about her. Include the details of her work.

142 OXFORD

Key words

fossil
damage
environment
fossil fuel
non-renewable/
renewable
oil
pollution

Science fact

Scientists can find out a lot about ancient habitats by studying fossils. For example, finding fossil shells on Mount Everest proved that the mountain had been pushed up from under the sea.

Key idea

Fossils give us clues about the structure of living things in the past and how they have changed.

Russia
Canada
USA
Nigeria
Venezuela
Saudi Arabia
Kuwait
Iran
Iraq
United Arab Emirates

The numbers show how many billions of barrels of oil each country has.

Plastics are very useful materials but they can cause pollution, especially in the oceans, where they can trap and choke animals.

Human activities greatly affect the supply and qualities of natural resources. Use of fossil fuels in car and factories is depleting reserves of fossil fuel. The burning of these fuels impact other natural resources by releasing toxic material into the air, water and soil.

Oil is taken from underground by drilling. It is sent to refineries to be made into useful products.

Sometimes oil can leak out into the environment. When humans add harmful materials to the environment it is called pollution.

Spilled oil can travel many kilometres across the oceans. It harms birds, fish and other animals that live in the sea. Everything gets covered in oil. When the oil slick reaches land, it pollutes the beaches and damages natural habitats.

Deforestation, mining and land development are destroying ecosystems and harming soil and water supplies

Researching oil spills

Use the internet or books to find out about an oil spill that has happened in your lifetime. Find out where it was and how much oil was spilled. Describe the impact on living things. How did people clean up the spill?

Discuss some of the things that oil is used for. Which of these have you used this week?

Talk about the definition of pollution. How can we reduce the pollution caused by oil?

Key idea

Oil is a fossil fuel. It is a useful non-renewable resource, but it can cause damage to habitats.

7 The earth and its resources

143 OXFORD

Getting started

In this lesson students explore the effects of fossil fuels on the environment. Students gain some basic knowledge of how fossils and fossil fuels are formed and then study a map showing the world's oil reserves and oil production. The main part of the lesson considers the impact of oil spills. Students make suggestions on how to prevent environmental damage caused by oil spills.

Language support

Ask students to create a poster showing the uses of fossil fuels. Encourage them to use the correct names, for example, aeroplanes, cooking stoves, cars, etc. Students could create a mind map activity to ensure they are familiar with the words met during the discussion about the uses of oil.

Resources

Student Book: access to the internet; resources to make a film or presentation.

Key words

fossil damage environment fossil fuel
non-renewable/renewable oil pollution

Other words in the lesson

drilling plastics reserves underground

Scientific enquiry key words

ask questions use equipment observe
measure compare record carry out tests
use secondary sources communicate findings

Lesson at a glance

The key teaching points in this lesson are:

- oil is formed from tiny animals that lived millions of years ago – it is a fossil fuel
- oil has many uses but it can cause pollution and environmental damage.

Read out the text at the top of page. This explains to students that oil, coal and gas are known as fossil fuels. This is because they form from dead animals and plants that are buried deep in the ground. When these fuels are burned they cause air pollution.

Ask volunteers to read out the two blocks of science facts. They could each read a paragraph. The text explains thow fossils formed on Earth and how they can help us understand the ancient habitats and extinction events.

Explain that oil, coal and gas, take millions of years to form naturally, deep within the Earth. Stress that this means that these are non-renewable material. Once used up they are gone forever.

Remind students that some energy sources, such as the wind, waves and solar power using the Sun, do not run out. These are called renewable.

Ask students to look at the world map on the next page. Talk about the map and point out the main regions where oil is found.

Allow students to study the pictures and talk about any examples of oil spills that they might have seen on TV or heard about. Explain that drilling and transporting crude oil are often not a great problem; the problem occurs when oil is spilled. When this happens it makes headline news.

Read out the text about oil spills and point out that large oil spills cause big problems. Explain that if oil is spilled in the sea, it makes an oil slick that can travel many kilometres across the oceans. It harms birds, fish and other animals that live in the sea. Everything gets covered in oil. When the oil slick reaches land, it pollutes the beaches and damages natural habitats.

Ask questions to elicit from students the problems associated with oil spills, e.g. loss of money, damage to the environment, harming wildlife, etc. They damage coastal regions and habitats along beaches, as well as harming marine and bird life as they travel.

Discuss some of the things that oil is used for. Which of these have you used this week?

Point out the diagram of the various products made from oil. Students are not expected to know the names of each of the products, just the uses. Ask students to talk about when they have seen and used the various products. Ask volunteers to tell the class about one example each.

Possible response: *Students should identify common products and objects such as plastic brushes and toothbrushes, paints, lubricating oil, fabrics, petrol and diesel, and plastic bottles.*

Talk about the definition of pollution. How can we reduce the pollution caused by oil?

Students have learned about pollution before. Ask questions to elicit their understanding that pollution is caused by humans and is when harmful materials enter the environment.

Remind students that we use many products from oil but suggest there might be ways to use less oil. Allow students to discuss their ideas with a partner and then take it in turns to stand up and share some of their ideas with the class.

Possible response: *The definition of pollution is when humans add harmful materials to the environment. Students should suggest cutting down on the use of plastic by reusing or recycling, using alternative materials such as wood, and reducing petrol and diesel use by using electric trains and vehicles. They may even suggest alternative energy sources to replace oil heating and power stations – such as wave, solar and wind power.*

Investigation: Researching oil spills

Computing link: Allow students to use the internet or books to find out about an oil spill that has happened in their lifetime. Ask them to find out where it was and how much oil was spilled. They should also research and describe the impact on living things. Suggest that they also find out how people cleaned up the spill.

To present their ideas ask students to make a short film or presentation about the spill to encourage people to be more aware of the dangers. They can create a poster, a computer presentation or even a short play.

Possible response: *Students should be able to identify at least one oil spill in their region. They will find examples of living things, such as birds and fish, being damaged by the oil and will also find out that oil spills have a long-lasting impact on the environment. They will find out that detergents can be used to break down spills and clean animals and coastlines.*

Stretch zone: Mary Anning was a famous fossil hunter. Write a short fact file about her. Include the details of her work.

Students should again have access to the internet or alternatively use books. Ask students to prepare a small booklet including all the information they collect.

Key idea

Fossils give us clues about the structure of living things in the past and how they have changed. Oil is a fossil fuel. It is a useful non-renewable resource, but it can cause damage to habitats.

Summarise the lesson by asking students what they have learned. Ask a volunteer to read out the key idea. This will remind students that oil has many uses but extracting it, transporting it and processing it can cause serious environmental damage. The products that are made from oil – such as plastics and vehicle fuels – can also damage the environment.

Review and reflect

Discuss the outcomes of each task with students during and at the end of the lesson. Encourage them to identify aspects they have not completed correctly and help them to identify improvements. This will help students to develop a positive approach to learning by understanding that learning is a process that will improve with practice and reflection.

Extra activities

1 **Maths link:** Ask students to use the information in the map about oil reserves to complete a bar chart. This should show the billions of barrels of oil reserves in each country featured.

2 You can make the oil spill investigation more realistic by including model animals in the investigation, or by making this an additional investigation. You can use various fabrics and balls of feathers to represent animals and ask students to investigate gentle ways of cleaning the oil from the model animals.

Differentiation

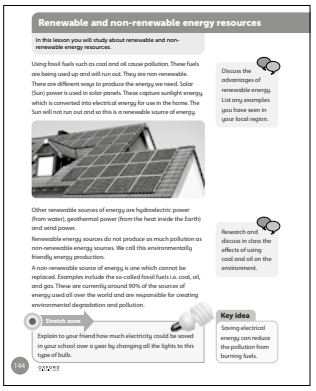
Supporting: Download information about some recent and fairly local oil spills to present to students as an information pack.

Consolidating: Demonstrate what happens when a drop of detergent is added to a thin film of oil on water. You could film this and show it in slow motion.

Extending: Students could research the amount of water and air pollution caused by oil and oil products and make a poster for display in the classroom.

Differentiated outcomes	
All students	should be able to state that oil and oil products can cause damage to the environment
Most students	will be able to describe specific examples of how oil and its products can damage wildlife
Some students	may be able to explain ways of reducing oil pollution

Renewable and non-renewable energy resources


Renewable and non-renewable energy resources

In this lesson you will study about renewable and non-renewable energy resources.

Using fossil fuels such as coal and oil cause pollution. These fuels are being used up and will run out. They are non-renewable. There are different ways to produce the energy we need. Solar (Sun) power is used in solar panels. These capture sunlight energy, which is converted into electrical energy for use in the home. The Sun will not run out and so this is a renewable source of energy.

Discuss the advantages of renewable energy. List any examples you have seen in your local region.

Other renewable sources of energy are hydroelectric power (from water), geothermal power (from the heat inside the Earth) and wind power.

Renewable energy sources do not produce as much pollution as non-renewable energy sources. We call this environmentally friendly energy production.

A non-renewable source of energy is one which cannot be replaced. Examples include the so-called fossil fuels i.e. coal, oil, and gas. These are currently around 90% of the sources of energy used all over the world and are responsible for creating environmental degradation and pollution.

Research and discuss in class the effects of using coal and oil on the environment.

Stretch zone

Explain to your friend how much electricity could be saved in your school over a year by changing all the lights to this type of bulb.

Key idea

Saving electrical energy can reduce the pollution from burning fuels.

144

Getting started

In this lesson students will consider the differences between renewable and non-renewable energy sources and discuss the advantages of renewable energy sources.

Language support

You can support language development by creating classroom displays of each type of renewable energy source with a simple explanation of how each energy source produces energy.

Resources

Student Book: materials to make leaflets.

Scientific enquiry key words

Plan and/or carry out enquiries to answer questions

Make predictions

Make observations

Record data and results

Analyse data, notice patterns and group or classify things

Report and present findings

Lesson at a glance

The key teaching points for students in this lesson are:

- to protect the environment we have to think about energy consumption
- saving energy and using renewable energy sources can reduce pollution.

Discuss the advantages of renewable energy. List any examples you have seen in your local region.

Ask students to use the information in the text and any prior knowledge to list advantages of renewable energy and list some examples. Volunteers can share their ideas with the class.

> ***Possible response:*** *Advantages are that renewable energy sources will not run out and they cause less pollution than other sources, such as fossil fuels.*

Ask students to read the section of text headed 'Renewable and non-renewable energy sources' and to study the image of solar panels to stimulate thought and discussion about alternative and renewable sources of energy. Encourage students to think about and discuss environmentally-friendly ways of producing electricity. Ask, 'What is the difference between renewable and non-renewable energy sources? List two examples of non-renewable energy sources. List three examples of renewable energy sources.'

Research and discuss in class the effects of using coal and oil on the environment.

Ask students to work with their group of four. They can talk about the uses and impact of using coal and oil as fuels. Make a list to share with the class.

> ***Possible response:*** *Students can use recall of the previous unit to provide answers for this question.*

Stretch zone: Research energy-saving bulbs. Explain to your partner how much electricity could be saved in your school over a year by changing all the lights to this type of bulb.

Maths link: Allow students to work with a partner and provide access to the internet. Ask students to find out how much electricity an energy-saving bulb uses over an hour and compare this to a more conventional bulb. Students can then plan how to calculate how much electricity could be saved over a year. This is a good opportunity for a cross-curricular link with maths.

> ***Possible response:*** *Students should find various figures depending on the types of bulbs but, for example, a typical energy-saving bulb (12 W) uses 75% less energy than a traditional 100 W bulb. They also last up to 25 times longer. If students find typical cost savings per bulb, they can count the bulbs in the school and calculate the overall saving.*

Key idea

Saving electrical energy can reduce the pollution from burning fuels.

Read out the key idea and ask students to turn to a partner and take it in turns to suggest ways to use less electricity.

Review and reflect

Remember to praise the process of learning as much as, if not more than, the outcomes. Encourage students to ask questions and to look back through prior work to review and revise. Use every opportunity to allow students to work together to check understanding and share ideas. After the school energy survey ask students to reflect on how they found out about the devices – and to discuss and list which skills they used.

Extra activities

1 Ask students to produce a poster about renewable energy. They can download photographs of different examples and label them to show how they cause less pollution than fossil fuels.

2 Invite a visitor who works for a local company or government body in electricity generation into the classroom. Ask them to talk to students about the sources of energy used to generate the electricity and a little bit about the process. They can also mention the balance between renewable and non-renewable energy planned for the future.

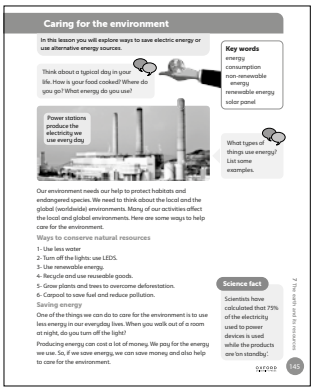
Differentiation

Supporting: Make a collage to display photographs of examples of renewable energy sources on one side of the classroom and non-renewable sources on the other to help students remember these.

Consolidating: Demonstrate the burning of a fossil fuel (a piece of coal or a piece of cotton wool soaked in diesel or oil) to show the pollution that is produced.

Differentiated outcomes	
All students	should be able to state that using renewable energy sources reduces pollution
Most students	will be able to describe some renewable and non-renewable energy sources
Some students	may be able to explain the advantages of renewable energy sources but that not all are suitable for every country

Caring for the environment


Caring for the environment

In this lesson you will explore ways to save electric energy or use alternative energy sources.

Think about a typical day in your life. How is your food cooked? Where do you go? What energy do you use?

Key words
energy consumption
non-renewable energy
renewable energy
solar panel

Power stations produce the electricity we use every day.

What types of things use energy? List some examples.

Our environment needs our help to protect habitats and endangered species. We need to think about the local and the global (worldwide) environments. Many of our activities affect the local and global environments. Here are some ways to help care for the environment.

Ways to conserve natural resources

1- Use less water
2- Turn off the lights: use LEDS.
3- Use renewable energy.
4- Recycle and use reuseable goods.
5- Grow plants and trees to overcome deforestation.
6- Carpool to save fuel and reduce pollution.

Saving energy

One of the things we can do to care for the environment is to use less energy in our everyday lives. When you walk out of a room at night, do you turn off the light?

Producing energy can cost a lot of money. We pay for the energy we use. So, if we save energy, we can save money, and also help to care for the environment.

Science fact

Scientists have calculated that 75% of the electricity used to power devices is used while the products are 'on standby'.

7 The earth and its resources

Getting started

In this lesson students will study how the energy we use costs money and causes pollution. They will explore ways of saving energy and carry out a school energy survey to record the different uses of electricity.

Language support

You can support language development by creating classroom displays of each type of energy source with a simple explanation of how each energy source produces energy.

Resources

Student Book: materials to make leaflets.

Key words

energy consumption non-renewable energy
renewable energy solar panel

Other words in the lesson

alternative environment fossil fuels geothermal
global hydroelectric source wind power

Scientific enquiry key words

Plan and/or carry out enquiries to answer questions

Make predictions

Make observations

Record data and results

Analyse data, notice patterns and group or classify things

Report and present findings

Lesson at a glance

The key teaching points for students in this lesson are:

- many human activities affect local and global environments
- to protect the environment we have to think about energy consumption
- saving energy and using renewable energy sources can reduce pollution.

Think about a typical day in your life. How is your food cooked? Where do you go? What energy do you use?

Ask students to work with a partner to discuss the questions. They can then share their answers with a nearby pair. Ask the fours to make a list to share with the class.

Possible response: *Examples of how food is cooked can include gas, coal, electricity and wood. Students can list examples of transport they use that require energy and also if they watch TV, use laptops or other devices, and visit places with electric lighting such as shops.*

The first section of text on page provides information about the need to protect the environment because human activities can have impacts both locally and globally. Ask students to read the information and then tell them that we need to work together to protect the environment. Explain that the activities in this lesson will focus on energy use, how to reduce energy consumption, and ways to produce energy that don't negatively affect the environment.

What types of things use energy? List some examples.

Ask students to work with their group of four. They can talk about the various devices that use electricity and make a list to share with the class.

Possible response: *Examples include TVs, laptops, tablets, mobile phones, cookers, heaters and lights.*

The section headed 'Saving energy' is designed to encourage students to discuss and think about ways of saving energy. Ask students to read it and then elicit some ideas from them on ways to save energy. Write their suggestions on the board.

Science fact Scientists have calculated that 75% of the electricity used to power devices is used while the products are 'on standby'.

Read out the Science fact and ask for a show of hands to find out how many students realise that devices use electricity when they are on standby. Ask them what they will do in future to save some of this energy.

Investigation: School energy survey

Explain to students that they are going to survey the school to record the different uses of electricity. Ask them to make a note of any electrical devices they see. Suggest they design a table for this purpose and point out the for each device they find they should write down an example of how the device could be used less. After the survey, ask students to produce an energy-saving leaflet for the school. In it they should describe how energy use could be reduced and why this would help the environment.

> ***Possible response:*** *Examples will vary but students should suggest that devices could be switched off when not in use. Some could be changed for low-energy varieties – and it may be possible to use the devices less.*

Explain to students that they are going to survey the school to record the different uses of electricity.

Before they start, ask students to predict where they think the highest use of energy will be found. They then use the table to list the devices they found and how each device could be used less. Next, they can plan an energy-saving leaflet for the school. Point out they should use the checklist to help with their leaflet design.

Review and reflect

Remember to praise the process of learning as much as, if not more than, the outcomes. Encourage students to ask questions and to look back through prior work to review and revise. Use every opportunity to allow students to work together to check understanding and share ideas. After the school energy survey ask students to reflect on how they found out about the devices – and to discuss and list which skills they used.

Extra activities

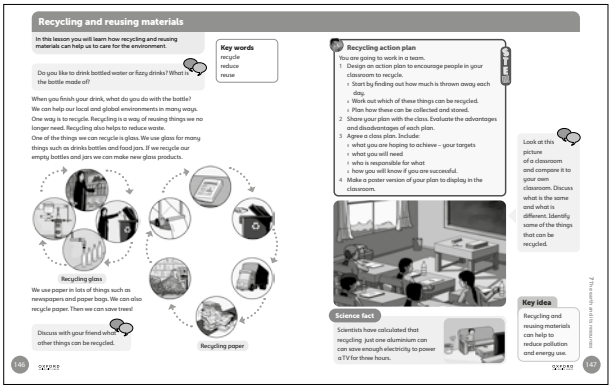
1 Students can research the development of electric cars and the advantages and disadvantages of using them now.

Differentiation

Extending: Students can research countries where geothermal energy or hydroelectric power is used a lot. They could also find out why these are not possible in many other countries.

Differentiated outcomes	
All students	should be able to state that using less energy saves money and reduces pollution
Most students	will be able to describe some measures to conserve energy
Some students	may be able to explain the advantages of renewable energy sources but that not all are suitable for every country

Recycling and reusing materials



Getting started

In this lesson the focus is on recycling and reusing materials as a way to care for the environment. Students are given the opportunity to identify items that can be recycled and items that cannot be recycled.

Language support

To support language development, you could create flashcards of some of the main key words and concepts in the lesson, for example 'recycle', 'environment', 'glass', 'paper', and ask students to tell you what the word is.

Resources

Student Book: materials to make posters.

Key words

recycle reduce reuse

Other words in the lesson

glass plastic waste

Scientific enquiry key words

Record data and results

Analyse data, notice patterns and group or classify things

Draw conclusions and give explanations

Lesson at a glance

The key teaching points for students in this lesson are:

- many materials can be recycled and this reduces energy use and pollution
- reusing materials also saves energy and reduces pollution.

Do you like to drink bottled water or fizzy drinks? What is the bottle made of?

The starter discussion activity asks students to think about the water and fizzy drinks they like and what the bottles are made of. Ask students to raise their hands if they drink fizzy drinks or water from bottles. Then ask, 'What is the container made of?'

Ask students to read the text on page and ask them to talk about what they do with plastic bottles when they have finished with them. Then ask students to look at the picture of glass recycling and tell you what they think is happening. Explain in simple terms how glass is recycled using the picture to help with the explanation.

Do the same thing with the picture of recycling paper. Again, ask students to tell you what they think is happening and then provide a simple explanation of the process of recycling paper.

Discuss with your friend what other things can be recycled.

Ask students to think about, in addition to paper and glass, which other materials might be recycled. They might have seen recycling bins near to where they live or they may have taken items to recycling collection points.

Possible response: *Metals such as steel and aluminium can be recycled and also wood and cardboard. Objects such as batteries and electrical devices can also be recycled.*

Investigation: Recycling action plan

Arrange students so they can work in a team of three or four. Ask them to design an action plan to encourage people in their classroom to recycle. They should start by finding out how much is thrown away each day. They can either research waste in their area by looking on the internet or ask people in the class how much they throw away. Encourage them to list some of the things that are thrown away and decide which of these things can be recycled. Next, they can devise a plan to show how these items can be collected and stored. Ask students to share their plan with the class and evaluate the advantages and disadvantages of each plan. Help them to agree a class plan and make a poster version of this plan to display in the classroom.

Possible response: *Students should plan to recycle plastic, wood, metal, glass and paper/cardboard items and may suggest separate bins to collect each type of waste. They could have a rota for people in the class to collect the bins and take the waste to a general recycling centre or to the school recycling bins.*

Look at this picture of a classroom and compare it to your own classroom. Discuss what is the same and what is different. Identify some of the things that can be recycled.

Ask students to look closely at the picture of a typical classroom and then ask them to look around their classroom. This activity is designed to reinforce the idea that some items can be recycled and some cannot.

Answer: *Students should notice the paper, plastic and metal objects that could be recycled.*

Science fact Scientists have calculated that recycling just one aluminium can can save enough electricity to power a TV for three hours.

Ask a volunteer to read out the Science fact and ask the class if the saving in electricity is more or less than they expected. They can think back to the last lesson on energy sources and add recycling to their list of ways to save energy.

Stretch zone: Find out about the system used to label plastics so that we know if they can be recycled or not. Take a photograph of an example label on food packaging or a bottle and explain the information to your class.

Computing link: Ask students to work with a partner so they can discuss their ideas. Allow them to have access to the internet to research the labels used to show if something can be recycled. They can also look at some packaging such as clean plastic bottles and plastic wrapping. Let them use a digital camera or a smartphone to take some photographs; they could also download examples.

Key idea

Recycling and reusing materials can help to reduce pollution and energy use.

Read out the key idea or ask a volunteer to read it out. Ask students to tell each other the name of one material that can be recycled and where it should be placed to allow this to happen.

Review and reflect

Ask students to sit down for a few minutes and think about what they have learned from the lesson. They can then think of one idea from the lesson that they would like to investigate and find out more about. Ask them to make a plan about how they would do this.

Extra activities

1 Ask students to create a poster about recycling. They can investigate other things that can be recycled and create recycling diagrams for these to show how it is done using the paper and glass recycling diagrams to guide them. They can then add the recycling diagrams to their poster.

2 Students can design and construct a machine that can sort aluminium cans from steel cans and containers.

Allow them to research the properties of aluminium and steel that might help them with their designs. They should test and evaluate their machine. You can hint by handing magnets out to students.

3 Ask students to research how clothing can be recycled and how this can help the environment.

Differentiation

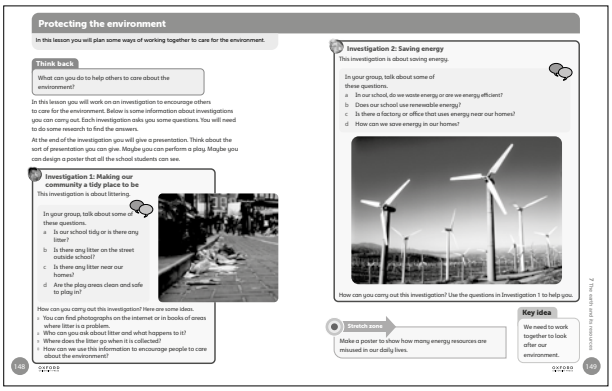
Supporting: Copy the recycling diagrams and cut them into sections so students can reassemble them as a cut-and-paste task.

Consolidating: Show clips from the internet to show the recycling processes for glass and paper so students see the processes in real life.

Extending: Ask students to explain how recycling saves energy and reduces waste but does not eliminate waste completely.

Differentiated outcomes	
All students	should be able to state that recycling and reusing materials reduces pollution
Most students	will be able to describe how paper and glass are recycled
Some students	may be able to explain how recycling reduces energy use and pollution, but that there is still some energy used and pollution produced

Protecting the environment


Protecting the environment

In this lesson you will plan some ways of working together to care for the environment.

Think back

What can you do to help others to care about the environment?

In this lesson you will work on an investigation to encourage others to care for the environment. Below is some information about investigations you can carry out. Each investigation asks you some questions. You will need to do some research to find the answers.

At the end of the investigation you will give a presentation. Think about the sort of presentation you can give. Maybe you can perform a play. Maybe you can design a poster that all the school students can see.

Investigation 1: Making our community a tidy place to be

This investigation is about littering.

In your group, talk about some of these questions.

a Is our school tidy or is there any litter?

b Is there any litter on the street outside school?

c Is there any litter near our homes?

d Are the play areas clean and safe to play in?

How can you carry out this investigation? Here are some ideas.

- You can find photographs on the internet or in books of areas where litter is a problem.
- Who can you ask about litter and what happens to it?
- Where does the litter go when it is collected?
- How can we use this information to encourage people to care about the environment?

Investigation 2: Saving energy

This investigation is about saving energy.

In your group, talk about some of these questions.

a In our school, do we waste energy or are we energy efficient?

b Does our school use renewable energy?

c Is there a factory or office that uses energy near our homes?

d How can we save energy in our homes?

How can you carry out this investigation? Use the questions in Investigation 1 to help you.

Stretch zone

Make a poster to show how many energy resources are misused in our daily lives.

Key idea

We need to work together to look after our environment.

Getting started

In this lesson students will carry out an investigation from a choice of investigations to explore the different ways that communities can care for the environment. They will consider the impact of littering in their area and then look at ways the community could save energy. Finally, they will investigate the problems associated with acid rain and what communities can do to reduce this.

Language support

This lesson is the final one in the unit, unless you plan a review lesson (see next section). Encourage students to check their glossaries for completeness and to use the key terms and words in their final presentation. Ask them to look back at the Word cloud and make a note of any words they are still unsure of. They can use a dictionary or look through the Student Book to help them to recall any definitions they are unsure of.

Resources

Student Book: pre-prepared packages of information about litter, saving energy, acid rain; additional stimulus materials to capture the imagination of students; access to the internet or books on littering, saving energy, acid rain; access to specialist speakers where possible; writing materials and materials to make leaflets or posters; magazines with suitable images to cut and stick on the leaflets or posters.

Scientific enquiry key words

Plan and/or carry out enquiries to answer questions

Make observations

Record data and results

Analyse data, notice patterns and group or classify things

Report and present findings

Draw conclusions and give explanations

Lesson at a glance

The key teaching points for students in this lesson are:

- communities can work together to care for the environment
- by working together we can reduce problems such as littering, energy waste and acid rain.

Think back: What can you do to help others to care about the environment?

The Think back activity is a rhetorical question as the lesson centres on researching different projects associated with caring for the environment. Tell students that in this lesson they will work in groups to investigate and research one aspect of the environment. They will present their findings to the class.

You can either guide students to choose one of the three projects identified or to suggest a project they are particularly interested in. The projects are:

- Making our community a tidy place to be
- Saving energy
- The problems with acid rain

The main part of the lesson will consist of students working in groups to use their knowledge and understanding to come up with answers to the research questions and to start thinking about creating their leaflets, plays, information posters or other type of presentation. The research questions are merely suggestions to get students thinking about their project and how to present their findings.

Keep the tasks as open-ended as possible but be ready to support students and ensure they have access to the materials they need to conduct their investigations. Make sure that each student is playing an active role in the group. It is suggested that group size be limited to three or four students.

Ideally, the research project will provide an opportunity for all the key words and scientific key words to be included in students' presentations.

Your role throughout the research phase of the project is to facilitate and guide students to find out the relevant information from the resources you have provided and to encourage and stimulate discussions in the groups.

Conducting the research project:

- Ask students to get into groups.
- Ask students to elect a group leader.
- Ask each group to discuss the project proposals given in the Student Book.
- Ask the group leader to make a decision about which project the group is the most interested in based on the interests of the group as a whole.
- Provide a pre-package of information to each group about the project the members have identified as being the one they want to study. This could be in the form of existing leaflets, internet access, access to visiting experts, etc.
- Ask each group leader how the group would prefer to present its findings.
- Provide resources to each group for the production of the end product.
- Ask students to present their findings to the rest of the class. Ensure that every student in the group plays a part in the presentation.

Investigation 1: Making our community a tidy place to be

Explain to students that if they choose this investigation, they are going to be exploring littering. Point out that they will need to think about how they plan to carry out this investigation. Ask them to discuss the questions in the discussion box and study the suggested ideas. Suggest that they find photographs on the internet or in books of areas where litter is a problem and decide on answers to the questions posed in the bullet points. They can then decide how they want to present their ideas and then plan and carry this out.

Investigation 2: Saving energy

Explain to students that if they choose this investigation, they are going to be exploring how to save/conserve energy. Ask them to discuss the questions in the discussion task and then use the internet to prepare for their chosen presentation. Remind them to modify the bullet points in investigation 1 as a prompt.

Once students have finished their research and planned their presentations, you can hold a class conference where each group presents their ideas in turn.

Key idea

We need to work together to look after our environment.

Read out the key idea or ask a volunteer to read it out. Ask students to think about the presentations they have seen and how their ideas need people to work together to care for the environment.

Stretch zone: *Make a poster to show how many energy resources are misused in our daily lives.*

Encourage the students to gather information from their daily life. They can provide facts and figures by researching using books and online resources.

Review and reflect

Ask students to write down two changes they are going to make personally and two things they are going to do to encourage their community to care for the environment from now on. They can show their points to a partner and work together to agree on the points they are happy to share with the class.

Extra activities

1 Ask students to create a mind map covering the unit content including key words and concepts. This will remind students what they have studied and provide the opportunity to revisit words and ideas that they may have found problematic.

2 Students can design and make their own wordsearch or crossword puzzle using some of the key words and ideas from the unit. You can ask them to use one of the free wordsearch or crossword maker websites on the internet, or you can hand out squared paper for them to use. They can test their puzzles on other students and evaluate them.

Differentiation

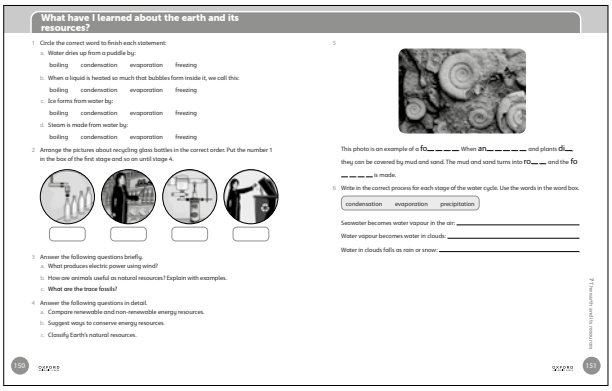
Supporting: Print out information sheets from the internet to support students in finding information for their presentation.

Consolidating: Film the presentations and show them back after a few weeks to remind students of the concepts.

Extending: Ask students to prepare one presentation that deals with two or three of the themes and not just one.

Differentiated outcomes	
All students	should be able to state that communities working together can help them to care for the environment
Most students	will be able to research a way to help to protect the environment and present their ideas on this
Some students	may be able to research and present ideas on a range of ways to protect the environment

What have I learned about the Earth and its resources?


What have I learned about the earth and its resources?

1 Circle the correct word to finish each statement:
a. Water dries up from a puddle by:
boiling condensation evaporation freezing
b. When a liquid is heated so much that bubbles form inside it, we call this:
boiling condensation evaporation freezing
c. Ice forms from water by:
boiling condensation evaporation freezing
d. Steam is made from water by:
boiling condensation evaporation freezing
2 Arrange the pictures about recycling glass bottles in the correct order. Put the number 1 in the box of the first stage and so on until stage 4.
3 Answer the following questions briefly.
a. What produces electric power using wind?
b. How are animals useful as natural resources? Explain with examples.
c. What are the trace fossils?
4 Answer the following questions in detail.
a. Compare renewable and non-renewable energy resources.
b. Suggest ways to conserve energy resources.
c. Classify Earth's natural resources.
5
This photo is an example of a fo_ _ _ _ _. When an_ _ _ _ _ _ and plants di_ _ they can be covered by mud and sand. The mud and sand turns into ro_ _ _ and the fo _ _ _ _ _ is made.
6 Write in the correct process for each stage of the water cycle. Use the words in the word box.
condensation evaporation precipitation
Seawater becomes water vapour in the air: _____
Water vapour becomes water in clouds: _____
Water in clouds falls as rain or snow: _____
7 The earth and its resources
150 OXFORD
OXFORD 151

Getting started

The aim of this section is to encourage students to review their learning after all of the lessons in the unit. All the lessons in the unit have questions and discussion tasks for students. You will have been using these formatively during lessons to help you assess students' knowledge and understanding of the topics.

On pages 150-151 of the Student Book there are questions related to the content of the unit. The questions are arranged in increasing order of conceptual demand and not topic order. Students can tackle these one at a time after individual lessons – specific advice on which questions are most appropriate is given under the 'review and reflect' heading in each relevant lesson. The questions could also be answered as a single summative activity. This could be done by reading out the questions to the class and asking for volunteers to answer them, carrying out the activity as a group work task with students talking about each question, or as an individual written task. Whichever approach is adopted, the questions are designed to give you and the students feedback about progress and to help in identifying targets for development.

What have I learned about the Earth and its resources? answers

1 Circle the correct phrase or word to finish each sentence.

Stress how important it is to follow question instructions exactly.

Answer: *a. evaporation b. boiling c. freezing d. evaporation.*

2 Arrange the pictures about recycling glass bottles in the correct order. Put the number 1 in the box of the first stage and so on until stage 4.

Answer: *stage 3, stage 1, stage 4, stage 2.*

3 Answer the following questions briefly.

a. What produces electric power using wind?

b. How are animals useful as natural resources? Explain with examples.

c. What are the trace fossils?

Answer: *a. wind mills.*

b. Animals a source of food, such as meat, eggs, milk, butter, cheese, and honey. Their skin, hair and fibre is used to make clothing.

c. fossils made when an imprint of a living thing is filled up with material that hardens into rock are called trace fossils.

4 Answer the following questions in detail.

a. Compare renewable and non-renewable energy resources.

b. Suggest ways to conserve energy resources.

c. Classify Earth's natural resources.

Answer: *Encourage students to answer by reviewing the relevant units.*

5 Observe carefully and fill in the blanks related to the diagram.

Answer: *fossil; animals; die; rock; fossil.*

6 Write in the correct process for each stage of the water cycle. Use the words in the word box.

Answer: *evaporation precipitation condensation*

Summative assessment

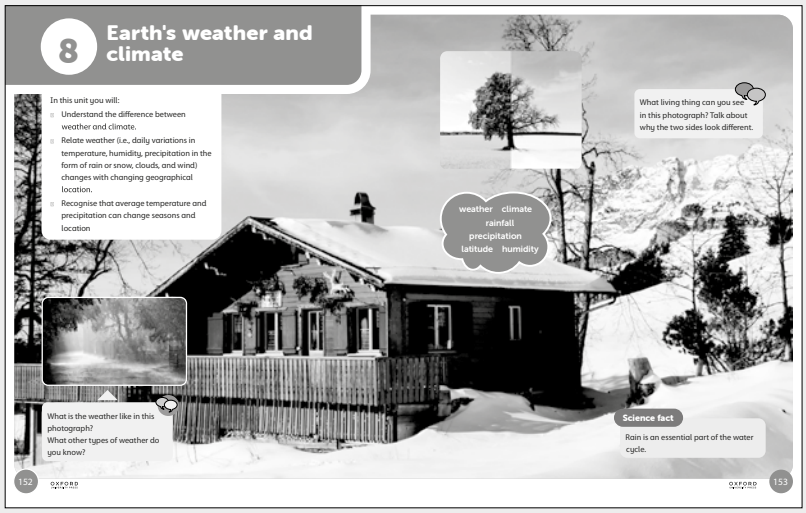
The questions in the 'What have I learned about the Earth and its resources?' section can be used to consider the progress of each student individually. You can also use the information to create summative reports – such as end-of-term reports – for each student. If you wish to allocate a score or mark for the questions, then the total number of marks you could allocate is 30 (question 1 = 4 marks; question 2 = 4 marks; question 3 = 3 marks; question 4 = 6 marks; question 5 = 5 marks; question 6 = 3 marks.

By reviewing responses to the questions and the self-review of confidence levels you can tailor specific interventions to help students improve. Keep the recording and analysis of the student self-evaluations simple. A general impression of the class's self-evaluation, not individual student records, is all that is required, e.g. 'Fifty per cent of the class were not confident about ….'

8 Earth's weather and climate

In this unit students will:

- Understand the difference between weather and climate.
- Relate weather (i.e., daily variations in temperature, humidity, precipitation in the form of rain or snow, clouds, and wind) changes with changing geographical location.
- Recognise that average temperature and precipitation can change seasons and location



Getting started

This unit explores in detail what weather and climate are and the impact they have on things around us. The unit lends itself well to observing everyday living conditions and their impact on our lives. Students will benefit from measuring daily tempurature using a thermometer.

Science in context

Use the lessons in this unit to encourage students to learn more about the importance of weather in action and how it affects our lives both locally and at a global level. Allow students to survey and investigate climate in their local area. The unit will also allow you to discuss with students the work of people who use knowledge the weather in their work. These include weather forecasters and meteorologists, gardeners, farmers, even chefs, scientists making medicines, conservationists and environmental scientists, sailors, sports people and pilots. Students can talk about how these people need to know about and study the weather.

You can relate this to students' lives by asking them to share examples of when the weather has interrupted an activity they were hoping to do.

Scientific enquiry skills

An Investigation master sheet is given in this Teacher's Guide on pages 4–5 to help students plan their scientific enquiries. Scientific enquiry skills for this unit focus on the collection and presentation of data, and on observing forces in action. Students consider what is meant by a fair test and plan how to collect sufficient evidence. Students choose apparatus and decide what to measure. When conducting investigations students make relevant observations and comparisons in a variety of contexts, and present their results in drawings, bar charts and tables. Students should be able to link evidence to scientific knowledge and understanding in other contexts, for example unfamiliar forces or machines being used.

Resources

Student Book: selection of marker and pens; A4 paper; wipe boards (optional); materials to make information leaflets and posters; access to the internet; books to find relevant information.

Key words for the unit

are in the Word cloud

weather climate rainfall precipitation latitude humidity

Scientific enquiry key words

Plan and/or carry out enquiries to answer questions

Recognise and control variables

Make observations

Take measurements, using equipment accurately

Record data and results using diagrams and labels, tables, keys and graphs

Make predictions

Report and present findings in a variety of ways

Draw conclusions and give explanations

Identify causal relationships

Use scientific evidence to support or refute ideas

Language support

Start the unit by reading out the words in the Word cloud. Students discuss each word and try to use familiar ones in a sentence. They should write definitions when they have used the words and learned them in lessons. As with other units, it is a good idea to create a Word wall for the unit so students see the words often and can become familiar with them.

Remind students that they can add definitions of the words in a glossary as they progress through the unit. This could be a regular end-of-lesson task or starter for following lessons to encourage recall.

When learning new words, especially specific science words and terms, it is important that they are repeated regularly and used in context. Ask students to listen, say, read and then write the words. Students can also make a list of other, non-science specific words they use in lessons that they are not familiar with. Some of these are listed in the individual lesson notes that follow. They could write these down in their notebook.

Consider adding to any science library you have organised in your classroom. As well as general science books and magazines, science encyclopaedias and dictionaries you may have collected for other units, you could also download specific information. This will allow you to make small information booklets to support each lesson and especially Stretch zone activities.

Unit at a glance

The key teaching points for students in this unit are:

- to introduce the unit objectives
- to introduce the learning outcomes
- to engage students with the content of the unit
- to review and build on prior learning and understanding of the topics.

In the next lesson students will learn that gravity is a force that attracts other objects.

You can introduce the unit by allowing students to spend time looking at the introductory spread and then read through the key words with them. Ask if they have heard of any of the words before and they can offer any definitions and examples. Then you can work through the discussion tasks and Science fact. You could also give different groups one of the discussion points to discuss and then report back to the class.

What is the weather like in this photograph? What other types of weather do you know?

Allow students to look closely at the photograph and talk about what it shows. They can then share ideas about the different types of weather they know about. Gather suggestions from the class and write down the names of the weather so students can build up experience of key words for later in the unit.

Possible response: *Students should recognise that the weather shown in the photograph is rain. They may also have experience of wind, snow, sun and hail.*

What living thing can you see in this photograph? Talk about why the two sides look different.

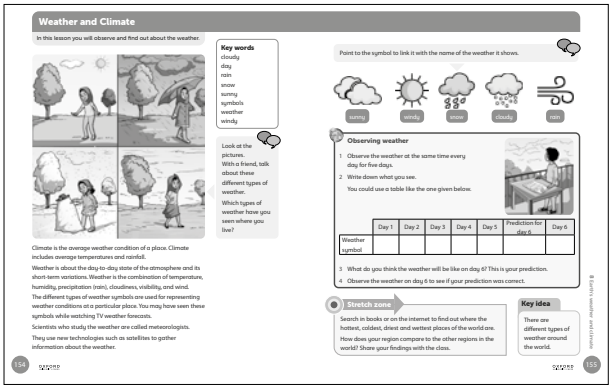
Point out the photograph of the tree. Explain that it is a combination of two photographs taken at different times. Ask students to discuss the type of plant it is and why the two sides look different.

Possible response: *Students should recognise that the plant is a tree. The left-hand side shows the tree with leaves and the right-hand side shows it with all of the leaves missing. Students may notice that on the lefthand side there is grass showing and on the right-hand side there is snow cover. They may realise that the latter is winter and the tree has lost its leaves for this reason.*

Science fact: Rain is an essential part of the water cycle.

Ask students to work in small groups to read out the Science fact. Ask them if they can recall the water cycle and why it is important. Explain that the rainy season is considered one of the main seasons on our planet.

Weather and climate


Weather and Climate

In this lesson you will observe and find out about the weather.

Key words
cloudy
day
rain
snow
sunny
symbols
weather
windy

Look at the pictures. With a friend, talk about these different types of weather. Which types of weather have you seen where you live?

Point to the symbol to link it with the name of the weather it shows.

sunny windy snow cloudy rain

Observing weather

1 Observe the weather at the same time every day for five days.
2 Write down what you see.
You could use a table like the one given below.

	Day 1	Day 2	Day 3	Day 4	Day 5	Prediction for day 6	Day 6
Weather symbol							

3 What do you think the weather will be like on day 6? This is your prediction.
4 Observe the weather on day 6 to see if your prediction was correct.

Stretch zone

Search in books or on the internet to find out where the hottest, coldest, driest and wettest places of the world are. How does your region compare to the other regions in the world? Share your findings with the class.

Key idea

There are different types of weather around the world.

Climate is the average weather condition of a place. Climate includes average temperatures and rainfall.

Weather is about the day-to-day state of the atmosphere and its short-term variations. Weather is the combination of temperature, humidity, precipitation (rain), cloudiness, visibility, and wind.

The different types of weather symbols are used for representing weather conditions at a particular place. You may have seen these symbols while watching TV weather forecasts.

Scientists who study the weather are called meteorologists.

They use new technologies such as satellites to gather information about the weather.

154 WORD 153

Getting started

In this lesson students will consider the difference between weather and climate and also different types of weather that each can be represented by a weather symbol. They will carry out observations of the weather and record their findings in a weather chart. They will use their recordings to make predictions about the weather. Finally, they will learn that meteorologists use modern technologies to help them to predict the weather.

Language support

You can use the weather symbols to help students learn the words for the weather. Make large word cards for the types of weather and large symbols. Play matching games by asking students to place the symbols onto the word cards and vice versa. Point out that each type of weather, for example a day when there is lots of wind, can be described by putting the letter y at the end – so it is a windy day.

Resources

Student Book: weather symbol cards; writing materials; large sheets of paper.

Key words

cloudy day rain snow sunny symbols weather windy

Other words in the lesson

forecasts meteorologists satellites

Scientific enquiry key words

observe compare notice patterns record use secondary sources

Lesson at a glance

The key teaching points for students in this lesson are:

- symbols represent the different types of weather
- there are many types of weather around the world.

You could introduce the lesson by asking students about their favourite weather and why they like it. Ask them to talk about times when they have had to change an activity because of the weather.

Discussion

Look at the pictures. With a partner, talk about these different types of weather. Which types of weather have you seen where you live?

Allow students time to study each picture. First, they should identify the four types of weather being shown. Next, they can share ideas about the weather they have seen and experienced. Ask them if they see a lot of rain where they live. Is it sunny and hot a lot of the time? Do they see snow? They may only know hot and dry weather. You can ask them about what living in a cold, snowy country would be like. Ask them to think about what they might need to wear to stay warm. Ask students to feed back their ideas to the class. Ask individuals or groups to describe one picture in turn.

Answer: *Students should report that the top left picture shows sunny weather, the top right shows rainy weather, the bottom left shows snowy weather and the bottom right shows windy weather.*

Next you can read out the text at the bottom of the page to explain that the different types of weather are given symbols. Ask students if they have seen these in TV weather forecasts. You could download some examples of weather forecasts or collect examples of weather maps and charts from newspapers or the internet to show students.

Then ask students to look at the weather symbols on the next page, and to point to the symbol then link it with the name of the weather it shows.

Possible response: *Students should link the symbols in the following way, left to right: cloudy, sunny, rain, snow and windy.*

Investigation: Observing weather

Start by explaining that students are going to observe the weather at the same time every day for five days. Ask students to make a large version of the weather chart shown in the investigation box. Remind them that they should always have a results table before they start an investigation. You can then record the time and allow students to carry out their first observation. They should write down what they see. Explain that this is done by

drawing in the appropriate weather symbol. On day 5 you can ask students to think about what the weather might be like on day 6.

Students should use any patterns or trends they see in their weather observations. They can record their prediction and then observe the weather on day 6 to see if their prediction was correct. Explain that scientists who study the weather use patterns to help them predict what the weather will be like in the near future.

After the weather observations are completed you can read through the text underneath it to let students know that scientists who study the weather are called meteorologists. Explain that as well as observations of the weather every day they also use new technologies such as satellites to gather information about the weather. You could show students some satellite pictures of weather patterns so they can see how a meteorologist could see weather such as storms approaching from a long way away.

Stretch zone: Research in books or on the internet to find out where the hottest, coldest, driest and wettest parts of the world are. How does your region compare? Share your findings with the class.

Computing link: Allow students to work with a partner or in a small group to carry out their research. If access to the internet is difficult you could gather the information and make small information sheets for the students to study.

Possible response: *Students should find out that there is sometimes dispute about what are the hottest, coldest, driest and wettest parts of the world. Tell them that it is normal for science results to not always be straightforward. For example, some people may only record areas where people live rather than deserted areas. However, it is commonly recorded that the hottest place on Earth, not counting near volcanoes and hot springs, is Death Valley in the USA. This has a record temperature of 57°C. The coldest place on Earth is Antarctica, with a lowest recording of minus 100°C. The two driest places reported are the Dry Valleys in Antarctica, with no recorded rainfall for 2 million years, and the Atacama Desert in Chile, with between zero and 1 mm of rainfall in the past few years. The wettest place on Earth is usually credited to Mawsynram in India. This has a record yearly rainfall of 11, 871 mm. Tell the students that is almost 12 metres.*

Key idea

There are different types of weather around the world.

Summarise the lesson by asking students what they have learned.

Let them share their ideas, read out and discuss the Key idea. This will remind students that there are different types of weather. Ask students to take it in turns to tell a partner the names of two types of weather. They could act out the weather and ask their partner to guess which it is.

Review and reflect

Encourage students to think about their weather predictions and to reflect on what they used to help them make their predictions. They can consider if their predictions were accurate or not. Ask them if they had enough information or if they could have observed the weather for a longer period of time to gather more. This will help them realise that they sometimes have to make decisions based on what they know at the time, but they can always reconsider these decisions when they know more.

Extra activities

1 You could develop the work in the Stretch zone activity from the Student Book by asking students to write stories about what it would be like to live in the hottest, coldest, driest and wettest parts of the world.

2 **Maths link:** Carry out a weather observation task that covers three weeks and see if students can spot patterns they could not see when they observed the weather for only six days. You could incorporate even longer observations by carrying out weather surveys during the different seasons you experience in your area.

Differentiation

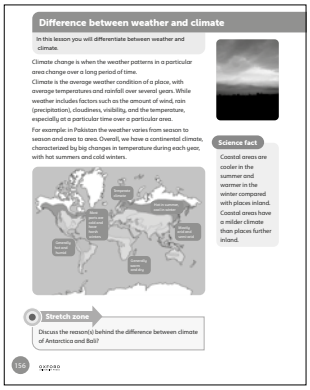
Supporting: The use of weather symbols and weather word cards will be very useful for many students and allow them to match these often.

Consolidating: Display examples of weather maps and charts in your room and have a large daily weather symbol that students can pin to a board to represent that day's weather.

Extending: Encourage students to 'adopt' three places in the world and allow them to look up the weather there every day to compare with the weather where they live.

Differentiated outcomes	
All students	should be able to describe the types of weather as windy, rainy, snowy, sunny and cloudy and link these to a weather symbol.
Most students	will be able to understand the weather can be a combination of the different weather types.
Some students	may be able to use patterns in their weather recordings to help them to make predictions or forecasts.

Difference between Weather and climate


Difference between weather and climate

In this lesson you will differentiate between weather and climate.

Climate change is when the weather patterns in a particular area change over a long period of time.
Climate is the average weather condition of a place, with average temperatures and rainfall over several years. While weather includes factors such as the amount of wind, rain (precipitation), cloudiness, visibility, and the temperature, especially at a particular time over a particular area.
For example: in Pakistan the weather varies from season to season and area to area. Overall, we have a continental climate, characterized by big changes in temperature during each year, with hot summers and cold winters.

Science fact
Coastal areas are cooler in the summer and warmer in the winter compared with places inland. Coastal areas have a milder climate than places further inland.

Stretch zone
Discuss the reason(s) behind the difference between climate of Antarctica and Bali?

156

Getting started

In the lesson students will learn about the changes in the climate of a region observed over the years. These changes include changes in the length of days and temperatures.

Language support

Elicit prior knowledge of the words used to describe the four seasons by asking students what their favourite time of the year is, and see if they use the terms winter, spring, summer or autumn (or fall). Make sure the words for the seasons are clearly displayed.

Resources

Student Book: writing materials.

Scientific enquiry key words

compare notice patterns record carry out tests
group/classify use secondary sources

Lesson at a glance

The key teaching point for students in this lesson is that the climate changes across the seasons.

Start by reading through the text on the page, before focussing on the map given further down.

Remember to explain that not all countries have four clear seasons. Point out that some have wet and dry seasons. Stress that some countries and parts of the world seem to have winter or summer all year.

Science fact Coastal areas are cooler in the summer and warmer in the winter compared with places inland.

Coastal areas have a milder climate than places further inland.

Read out the Science fact and point out that the presence of large bodies of water play an important role in climate of a region. Land tends to heat up faster and stays warmer for longer. Water, on the other hand, heats and cools much slower. This results in coastal areas remaining cooler during summer and warmer during winters, compared to areas further inland.

Stretch zone: Discuss the reason(s) behind the difference between climate of Antarctica and Bali?

Begin by asking the students to locate Antartica and Bali on a map or globe. Ask them their thoughts on why there would be a climate difference between the two regions. Encourage them to look up information using books or the internet.

Summarise the lesson by asking students what they have learned. Let them share their ideas, read out and discuss the Key idea. This will remind students that the weather and the length of day changes from season to season.

Review and reflect

Ask students to think about how they carried out their observations during the survey outside. Ask them how they could make their survey more accurate. Encourage them to think about every survey and investigation this way – always thinking about improving their work.

Extra activities

1 Students could locate countries such as Sweden, Canada, New Zealand, Jamaica and their own country on a map or a globe; they could predict the seasons they will have and whether climate will change a lot or a little across next 3 years.

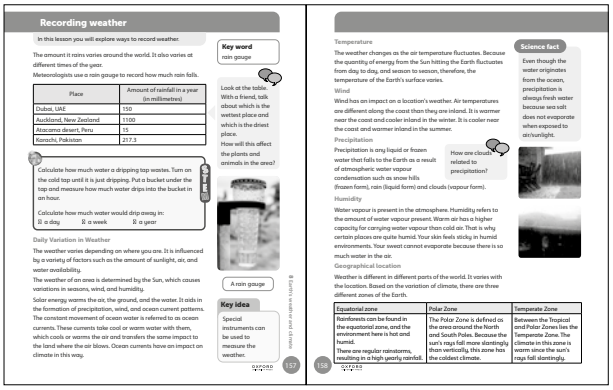
Differentiation

Consolidating: Display mate data and day lengths from your own country and others to show how seasons vary.

Extending: Students could select their own country to research and find out about the seasons and day lengths.

Differentiated outcomes	
All students	should be able to differentiate between climate and weather of a region.
Most students	will be able to describe the differences in day length, weather and climate for different regions.
Some students	may be able to provide projections of climate change and explain the logic behined their working.

Recording weather


Recording weather

In this lesson you will explore ways to record weather.

The amount it rains varies around the world. It also varies at different times of the year.

Meteorologists use a rain gauge to record how much rain falls.

Place	Amount of rainfall in a year (in millimetres)
Dubai, UAE	150
Auckland, New Zealand	1100
Atacama desert, Peru	15
Karachi, Pakistan	217.3

Key word
rain gauge

Look at the table. With a friend, talk about which is the wettest place and which is the driest place. How will this affect the plants and animals in the area?

Calculate how much water a dripping tap wastes. Turn on the cold tap until it is just dripping. Put a bucket under the tap and measure how much water drips into the bucket in an hour.

Calculate how much water would drip away in:
a day a week a year

Daily Variation in Weather

The weather varies depending on where you are. It is influenced by a variety of factors such as the amount of sunlight, air, and water availability.

The weather of an area is determined by the Sun, which causes variations in seasons, wind, and humidity.

Solar energy, warms the air, the ground, and the water. It aids in the formation of precipitation, wind, and ocean current patterns. The constant movement of ocean water is referred to as ocean currents. These currents take cool or warm water with them, which cools or warms the air and transfers the same impact to the land where the air blows. Ocean currents have an impact on climate in this way.

A rain gauge

Key idea
Special instruments can be used to measure the weather.

157

Temperature

The weather changes as the air temperature fluctuates. Because the quantity of energy from the Sun hitting the Earth fluctuates from day to day, and season to season, therefore, the temperature of the Earth's surface varies.

Wind

Wind has an impact on a location's weather. Air temperatures are different along the coast than they are inland. It is warmer near the coast and cooler inland in the winter. It is cooler near the coast and warmer inland in the summer.

Precipitation

Precipitation is any liquid or frozen water that falls to the Earth as a result of atmospheric water vapour condensation such as snow hills (frozen form), rain (liquid form) and clouds (vapour form).

How are clouds related to precipitation?

Humidity

Water vapour is present in the atmosphere. Humidity refers to the amount of water vapour present. Warm air has a higher capacity for carrying water vapour than cold air. That is why, certain places are quite humid. Your skin feels sticky in humid environments. Your sweat cannot evaporate because there is so much water in the air.

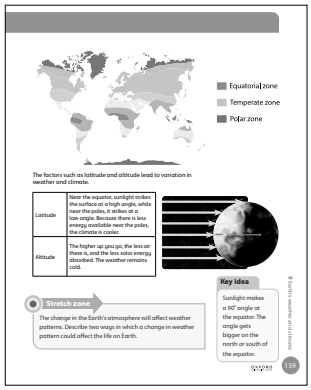
Geographical location

Weather is different in different parts of the world. It varies with the location. Based on the variation of climate, there are three different zones of the Earth.

Science fact
Even though the water originates from the ocean, precipitation is always fresh water because sea salt does not evaporate when exposed to air/sunlight.

Equatorial zone	Polar Zone	Temperate Zone
Rainforests can be found in the equatorial zone, and the environment here is hot and humid. There are regular rainstorms, resulting in a high yearly rainfall.	The Polar Zone is defined as the area around the North and South Poles. Because the sun's rays fall more slantingly than vertically, this zone has the coldest climate.	Between the Tropical and Polar Zones lies the Temperate Zone. The climate in this zone is warm since the sun's rays fall slantingly.

158



The factors such as latitude and altitude lead to variation in weather and climate.

Latitude	Near the equator, sunlight strikes the surface at a high angle, while near the poles, it strikes at a low angle. Because there is less energy available near the poles, the climate is cooler.
Altitude	The higher up you go, the less air there is, and the less solar energy is absorbed. The weather remains cold.

Stretch zone
The change in the Earth's atmosphere will affect weather patterns. Describe two ways in which a change in weather pattern could affect the life on Earth.

Key idea
Sunlight makes a 90° angle at the equator. The angle gets bigger on the north or south of the equator.

159

Getting started

In this lesson students will learn about how scientists measure the amount of rain that falls in an area. They will construct a rain gauge and use it to measure rainfall. Students then focus on how weather is recorded and the different terms used for this purpose. They will relate geographical zones with the different weather across the globe.

Language support

Explain that the word 'gauge' means a device that measures something and gives a number or a value as the answer. Give students some other examples such as a ruler, a fuel gauge and a thermometer. Point out that the word 'wettest' is linked to places with the most rainfall and the word 'driest' is linked to places with the least rainfall.

Encourage them to maintain a glossary of all the new terms they will encounter in this unit. These words include "tempurature, precipitation, humidity, latitude, longitude". The students may have come across these words during their geography lessons. Encourage them to recall what they have learned about these terms.

Resources

Student Book: world map or globe; small pebbles; rulers; plastic bottles to fill with water; tape.

Key word

rain gauge

Other words in the lesson

driest evaporate meteorologists pebbles rainfall weather wettest

Scientific enquiry key words

observe notice patterns record carry out tests use secondary sources

Lesson at a glance

The key teaching point for students in this lesson is that weather can be measured using special instruments.

Read out the text at the top of page 157 to explain that the amount it rains varies around the world. Point out that rainfall also varies at different times of the year. Tell students that meteorologists – scientists they have heard about before – use a rain gauge to record how much rain falls. Then ask them to look closely at the photograph of the rain gauge. Point out the marks up the side – these are the graduations or scale so measurements can be taken. The units will be millimetres.

Discussion

Look at the table. With a partner, talk about which is the wettest place and which is the driest place. How will this affect the plants and animals in the area?

Show students a world map or a globe. Point to the equator and the poles. Ask students to name these parts of the world and then ask them which of these would have the hottest weather. Show students where the four places mentioned in the table are in the world. Ask them to predict if the weather would be hot and dry, hot and wet, cold and dry, or cold and wet in each place. They can also predict which place is likely to have the most and least rainfall. You can then point out the table and read through the headings to the columns and the countries mentioned. Students can then look at the numbers – explain that these show the number of millimetres of rain that falls over a whole year. Encourage students to talk about the figures in the table and decide the wettest place (most rain) and the driest place (least rain). Ask them if their predictions were correct. Finally, they should think about how rainfall impacts on living things.

Answer: *Students should decide that the driest place is the Atacama Desert and the wettest is Auckland. They should link the level of rainfall to plants having too little or too much water. With too little water the plants may dry up and die. With too much water the plants may not get enough light.*

STEM: Explain to students that they are going to calculate how much water is wasted from a dripping tap faucet. Remind them that wastage of usable water is dangerous for the world and our own future.

Instruct the students to prepare fair test conditions, but let them come up with their own details.

This is an opportunity for the students to prepare and conduct experiments, take observations and make accurate measurements, and to finally use the data to draw conclusions.

Encourage students to read the section on daily variation in weather on page 157. Explain that weather is dependent on a number of factors, such as the amount of sunlight an area receives. Encourage the students to recreate the explanation given in the text, in a diagram format, for ease of review.

Ask volunteers to read sections of text on page 158, explaining Temperature, Wind, Precipitation, Humidity and Geographical location.

Science Fact: Even though the water originates from the ocean, precipitation is always fresh water because sea salt does not evaporate when exposed to air/sunlight.

Encourage the students to discuss the science fact when the precipitation section is read. Follow up by asking the

Discussion question: *How are clouds related to precipitation?*

When reading the Geographical location section, encourage students to recall what they have studied in their geography class about climate zones. This recall and review will make the discussion of this section much more interesting. Discuss the climate zones and then guide the class to observe colour coded map on page 159. Encourage the students to compare this map with the latitude and altitude information given in the table below the map.

Stretch zone: The change in the Earth's atmosphere will affect weather patterns. Describe two ways in which a change in weather pattern could affect the life on Earth.

Encourage the students to use the internet to collect data for their arguments. Help them use class discussions to refine their data backed hypothesis.

Key ideas

Special instruments can be used to measure the weather. Sunlight makes a 90 angle at the equator. The angle gets bigger on the north or south of the equator.*

Summarise the lesson by asking students what they have learned.

Let them share their ideas, read out and discuss the Key ideas. This will remind students that the weather differs according to different geographical zones and is measured using special scientific equipment. Ask students to tell you which instrument is used to measure rainfall.

Review and reflect

You could have a simple plenary activity at the end of the lesson. Once everything is cleared away you can ask students to think about some simple questions: What have I learned about the weather today? How well did I make and use my rain gauge? What could I have done better?

Extra activities

1 Ask students to investigate if the size of the bottle and funnel make any difference to the amount of rainfall they collect and measure. This is a possible misconception about rain gauges as they might think a wider bottle will show more rain has fallen. If they need a clue then point out that if it rains into a small cup and a swimming pool they will each rise up by the same amount.

2 Ask students to investigate whether the location of the rain gauges outside affects the amount of rainfall collected. For example, compare a hill and a hollow, or a windy place and a calm place.

Differentiation

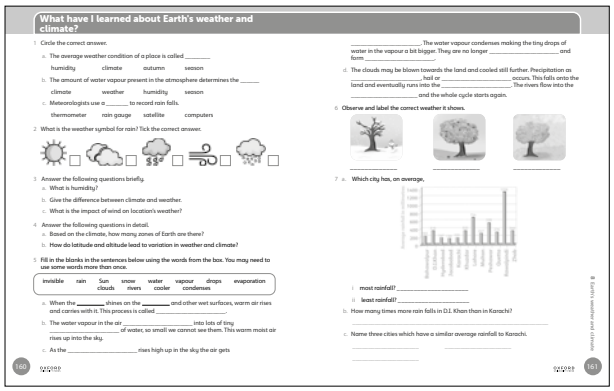
Supporting: You can have some rain gauges set up and pre-made – especially the rulers set at the correct level.

Consolidating: Allow students to practise taking readings from the rain gauges before they are set up outside by adding different volumes of water to each gauge and asking students to walk around and take readings. They could practise on measuring jugs from a kitchen.

Extending: Set up a permanent weather station and allow students to measure rainfall over a longer period of a month or longer to practise looking for patterns.

Differentiated outcomes	
All students	should be able to state that different instruments are used to measure weather conditions
Most students	will be able to set up a rain gauge and take readings to measure the amount of rainfall
Some students	may be able to explain how geographical zones are related to the weather and recognise patterns

What have I learned about Earth's weather and climate?


What have I learned about Earth's weather and climate?

1 Circle the correct answer.

a. The average weather condition of a place is called _____
humidity climate autumn season

b. The amount of water vapour present in the atmosphere determines the _____
climate weather humidity season

c. Meteorologists use a _____ to record rain falls.
thermometer rain gauge satellite computers

2 What is the weather symbol for rain? Tick the correct answer.

3 Answer the following questions briefly.
a. What is humidity?
b. Give the difference between climate and weather.
c. What is the impact of wind on location's weather?

4 Answer the following questions in detail.
a. Based on the climate, how many zones of Earth are there?
b. How do latitude and altitude lead to variation in weather and climate?

5 Fill in the blanks in the sentences below using the words from the box. You may need to use some words more than once.

invisible rain Sun snow water vapour drops evaporation clouds rivers cooler condenses

a. When the _____ shines on the _____ and other wet surfaces, warm air rises and carries with it. This process is called _____.
b. The water vapour in the air _____ into lots of tiny _____ of water, so small we cannot see them. This warm moist air rises up into the sky.
c. As the _____ rises high up in the sky the air gets _____. The water vapour condenses making the tiny drops of water in the vapour a bit bigger. They are no longer _____ and form _____.
d. The clouds may be blown towards the land and cooled still further. Precipitation as _____, hail or _____ occurs. This falls onto the land and eventually runs into the _____. The rivers flow into the _____ and the whole cycle starts again.

6 Observe and label the correct weather it shows.

7 a. Which city has, on average,
i. most rainfall? _____
ii. least rainfall? _____
b. How many times more rain falls in D.I. Khan than in Karachi?
c. Name three cities which have a similar average rainfall to Karachi.

160 161

Getting started

The aim of this section is to encourage students to review their learning after each lesson in the unit and also to undertake some end-of-unit review and reflection. On pages 160-161 of the Student Book there are questions linked to concepts and topics covered in the unit. These will assess students' knowledge and understanding of the topic. You may have been using questions after each lesson where provided. However, it is also worth allowing students to answer all of the questions at the end of the unit. This will test longer-term understanding and recall. You can do this as an informal individual or pair activity and allow students to look information up as they work through the questions or you can set it as an individual 'closed-book' activity.

It is important that students report areas that they are not confident with. This information is useful for them in that they can think about what they need to review or ask advice about. It is also vital for you as it provides information about any topics you may wish to revisit.

What have I learned about Earth's weather and climate? answers

1 Circle the correct answer.

Answer: *a. climate; b. humidity; c. rain gauge.*

2 What is the weather symbol for rain? Tick the correct answer.

Answer: *Students should tick rain indicated by the third box.*

3 Answer the following questions briefly.

a. What is humidity?

b. Give the difference between climate and weather.

c. What is the impact of wind on location's weather?

Answer: *a. the amount of water vapour present in the atmosphere of an area. b. Climate is the average weather condition of a place, and includes average temperatures and rainfall. Weather is the day-to-day state of the atmosphere and its short-term variations. c. Air temperatures are different along the coast than they are inland. The wind is warmer near the coast and cooler inland in the winter, but cooler near the coast and warmer inland in the summer.*

4 Answer the following questions in detail.

a. Based on the climate, how many zones of Earth are there?

b. How do latitude and altitude lead to variation in weather and climate?

Answer: *Students should write i answers in their own words, using the information given in the unit.*

5 Fill in the blanks in the sentences using the words from the box. You may need to use some words more than once.

Answer: *a. Sun, rivers, evaporation; b. condenses, drops; c. water vapour, cooler, invisible, clouds; d. rain, snow, rivers, sea.*

6 Observe and label the correct weather shown.

Answer: *in order: snowy, sunny, rainy.*

7 a. Which city has, on average,

i. most rainfall?

ii. least rainfall?

b. How many times more rain falls in D.I. Khan than in Karachi?

c. Name three cities which have a similar average rainfall to Karachi.

Answer: *a. i Rawalpindi, ii Jacobabad; b. double or 2 times more rainfall; c. Jacobabad, Hyderabad, Bahawalpur.*

Summative assessment

You can read out the answers to the 'What have I learned about Earth's weather and climate?' section for students to self-assess or you can take in the pages and mark them to award an overall score. You could allocate marks

as follows: question 1 = 3; question 2 = 1; question 3 = 3; question 4 = 4; question 5 = 4; question 6 = 3; question 7a = 2, 7b = 2, 7c = 3. This makes a total of 25 marks.

If necessary, ask students to revisit topics and questions to help them to learn more about any they did not score well on. In this way the questions are both summative and formative. All assessments should be linked to enhancing learning and in this way the 'What have I learned about?' pages will support this as well as providing data to report back to students, parents and/or other significant adults.

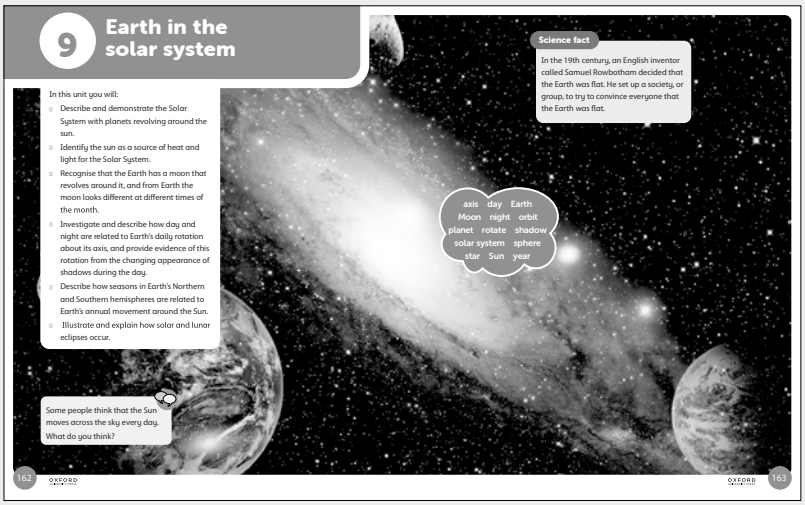
This information may also be used to create end-of-term reports for each student. It may also be useful to keep a record of overall confidence levels for the whole class to identify areas that may need revision later.

This feedback can then be used to form support strategies to help students improve. Keep the recording and analysis of students' self-evaluations simple. A general impression of the self-evaluation of the class is all that is required, for example: 50% of the class were not confident about … .

9 Earth in the solar system

In this unit students will:

- Describe and demonstrate the Solar System with planets revolving around the sun.
- Identify the sun as a source of heat and light for the Solar System.
- Recognise that the Earth has a moon that revolves around it, and from Earth the moon looks different at different times of the month.
- Investigate and describe how day and night are related to Earth's daily rotation about its axis, and provide evidence of this rotation from the changing appearance of shadows during the day.



- Describe how seasons in Earth's Northern and Southern hemispheres are related to Earth's annual movement around the Sun.
- Illustrate and explain how solar and lunar eclipses occur.

Getting started

In this unit students explore place of Earth in the solar system. They learn about how the movement of the Earth creates day and night. They model how the rotation of the Earth is responsible for day and night and how seasons are created due to revolution around the Sun. They construct scaled models of the Earth, Sun and Moon in the correct order. Students can extend the use of these models to show the movement of the Earth around the Sun. Students repeatedly address the misconception that the Sun moves across the sky. They also find out about the Earth's orbit around the Sun and examine evidence about the eclipses of the Earth, Sun and Moon.

Science in context

Use the lessons in this unit to encourage students to learn more about the importance of Earth's location and movement in space from a local and global point of view. As students find out about the spin, tilt and orbit of the Earth try to expand their learning to think about how the Earth as a whole is affected, not just where they live. Remember to find out how they have studied the solar system in previous years to add to this experience rather than duplicating it. Encourage students to find out about the movement of the Sun, Moon and Earth and how this affects our daily lives.

Invite astronomers and local amateur star gazers into school to share their experiences in the local area. Students could visit a museum or university that might house a telescope or viewing facilities for studying the planets.

Scientific enquiry skills

An Investigation master sheet is given in this Teacher's Guide on pages 4–5 to help students plan their scientific enquiries. Students plan and carry out investigations, make observations and use secondary data. They take measurements using equipment accurately, make predictions and produce conclusions. Some of the investigations take place over a number of hours or even days. This places greater emphasis on students' abilities to plan their work and keep accurate records.

Resources

Student Book: string and a means of attaching it to the walls; scissors; a clock; pegs or clips; copies of a diagram of the classroom clearly showing the position of the windows; modelling clay in various colours; sticks or pencils; torches; long tape measures; rulers; chalk; stickers (optional); cameras (optional); large balls; coloured pens or pencils; materials to make posters and information leaflets; cardboard; access to the internet; books on the Moon and planets and their shape; access to a clean, flat surface outdoors.

Key words for unit

are in the Word cloud in the student book.

axis day Earth Moon night orbit planet rotate shadow solar system sphere star Sun year

Scientific enquiry key words

Plan and/or carry out enquiries to answer questions Recognise and control variables

Make observations

Take measurements, using equipment accurately Record data and results using diagrams and labels, tables, keys and graphs

Make predictions

Report and present findings in a variety of ways Draw conclusions and give explanations

Identify causal relationships

Use scientific evidence to support or refute ideas

Language support

Students should remember terms such as 'spin', 'day', 'night' and 'stars'. A difficult term is 'axis'. Explain this as being an imaginary line that some planets and stars spin on – the Earth's axis runs from the North Pole all the way through the centre of the planet to the South Pole. This will be modelled and demonstrated in later lessons.

Start the unit by reading out the words in the Word cloud. Ask students to discuss each word and define those they are familiar with. As with other units, it is a good idea to create a Word wall for the unit so students see the words often and can become familiar with them.

Remind students that they should add definitions of the words a glossary as they progress through the unit. This could be a regular end-of-lesson task or a starter for the following lesson to encourage recall.

When learning new words, especially specific science words and terms, it is important that they are repeated regularly and used in context. Ask students to listen, say, read and then write the words. Students can also make a list of other, non-science specific words they use in lessons that they are not familiar with. Some of these are listed in the individual lesson notes that follow. They could write these down in their notebook.

Consider adding to any science library you have organised in your classroom. As well as general science books and magazines, science encyclopaedias and dictionaries you may have collected for other units, you can download specific information. This will allow you to make small information booklets to support each lesson and especially Stretch zone activities.

Lesson at a glance

The key teaching points for students in this unit are:

- to introduce the unit objectives
- to introduce the learning outcomes
- to engage students with the content of the unit
- to review and build on prior learning and understanding of the topics.

In this introductory lesson students are introduced to the fact that the Earth is spinning. Ask students to share ideas about the relative speed of things. As prompts, ask them how fast they think a car or a plane travels. Later lessons will explain in more detail how the Earth spins on its axis.

Ask students to study the photographs on pages 162-163 of the Student Book with a partner. Encourage them to look at the photographs and discuss their ideas about them. Ask students what they think the unit might be about and what they would like to learn about based on the photographs. Then ask them to read through the learning outcomes and talk about each of them. Encourage them to say the key words and ask whether they recognise or are familiar with any of them.

Some people think that the Sun moves across the sky every day. What do you think?

Ask students to discuss the statement with their partner.

Students can stay in their pairs or you could put them into groups of three or four for the discussion work. A useful strategy is to start with students in pairs and then move pairs together to make small groups so that students can share their ideas and discussions with others.

Ask students to discuss why some people might think that the Sun moves across the sky during the day. Students will respond to this question differently, depending on their prior knowledge and understanding. Listen out for the misconception that the Sun moves across the sky. If this is raised, ask where the Sun goes after it has set at the end of the day – does it just wait there and come back across in the morning? Tell students that they will find out more about this in a later lesson.

Possible response: *Students may incorrectly say that the Sun rises in one part of the sky and sets in another, and this shows that it moves during the day. Some students may have prior knowledge and may correctly suggest that it is the Earth that is moving, not the Sun.*

Science fact: In the 19th century, an English inventor called Samuel Rowbotham decided that the Earth was flat. He set up a society, or group, to try to convince everyone that the Earth was flat.

Read out the Science fact or ask a volunteer to read it out. Ask students to sdiscuss this question and then share ideas as a whole class. Explain to them that Samuel Rowbotham set up a society, or group, to try to convince everyone that the Earth was flat. Samuel carried out tests but since he did not know that his experiments were wrong, so his results were also wrong. Many other people tried to convince everyone that the Earth was flat. In 1956, Samuel Shenton set up the Flat Earth Society based

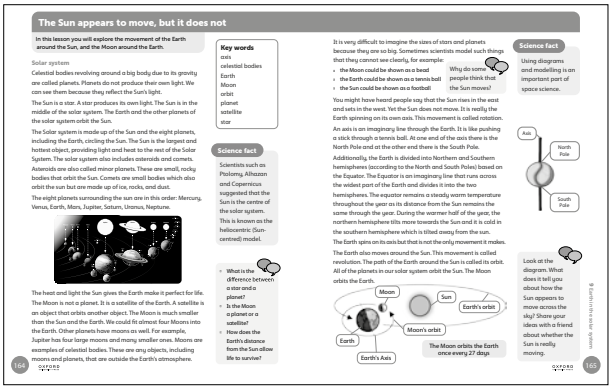
on Samuel Rowbotham's work. The Flat Earth Society is still active today. Ask them whether they are surprised that the Flat Earth Society is still active today. Ask them what evidence we have that tells us that the Earth is not flat. Elicit that it is the evidence of images from space.

Extra activities

1 Photographs of a modern powerful telescope are a good stimulus for discussion. Encourage students to link the evidence we have about the Sun, Moon and Earth with the space technology that has been developed.

2 **Computing link:** Ask students to download from the internet some pictures of Earth and space and make a collage to be displayed as a stimulus to learning.

The Sun appears to move, but it does not


The Sun appears to move, but it does not

In this lesson you will explore the movement of the Earth around the Sun, and the Moon around the Earth.

Key words
axis
celestial bodies
Earth
Moon
orbit
planet
satellite
star

Solar system

Celestial bodies revolving around a big body due to its gravity are called planets. Planets do not produce their own light. We can see them because they reflect the Sun's light.

The Sun is a star. A star produces its own light. The Sun is in the middle of the solar system. The Earth and the other planets of the solar system orbit the Sun.

The Solar system is made up of the Sun and the eight planets, including the Earth, circling the Sun. The Sun is the largest and hottest object, providing light and heat to the rest of the Solar System. The solar system also includes asteroids and comets. Asteroids are also called minor planets. These are small, rocky bodies that orbit the Sun. Comets are small bodies which also orbit the sun but are made up of ice, rocks, and dust.

The eight planets surrounding the sun are in this order: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune.

The heat and light the Sun gives the Earth make it perfect for life. The Moon is not a planet. It is a satellite of the Earth. A satellite is an object that orbits another object. The Moon is much smaller than the Sun and the Earth. We could fit almost four Moons into the Earth. Other planets have moons as well. For example, Jupiter has four large moons and many, smaller ones. Moons are examples of celestial bodies. These are any objects, including moons and planets, that are outside the Earth's atmosphere.

Science fact
Scientists such as Ptolemy, Alhazen and Copernicus suggested that the Sun is the centre of the solar system. This is known as the heliocentric (Sun-centred) model.

- What is the difference between a star and a planet?
- Is the Moon a planet or a satellite?
- How does the Earth's distance from the Sun allow life to survive?

It is very difficult to imagine the sizes of stars and planets because they are so big. Sometimes scientists model such things that they cannot see clearly, for example:

- the Moon could be shown as a bead
- the Earth could be shown as a tennis ball
- the Sun could be shown as a football

Why do some people think that the Sun moves?

You might have heard people say that the Sun rises in the east and sets in the west. Yet the Sun does not move. It is really the Earth spinning on its own axis. This movement is called rotation.

An axis is an imaginary line through the Earth. It is like pushing a stick through a tennis ball. At one end of the axis there is the North Pole and at the other end there is the South Pole.

Additionally, the Earth is divided into Northern and Southern hemispheres (according to the North and South Poles) based on the Equator. The Equator is an imaginary line that runs across the widest part of the Earth and divides it into the two hemispheres. The equator remains a steady warm temperature throughout the year as its distance from the Sun remains the same through the year. During the warmer half of the year, the northern hemisphere tilts more towards the Sun and it is cold in the southern hemisphere which is tilted away from the sun.

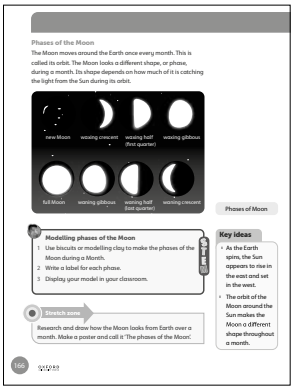
The Earth spins on its axis but that is not the only movement it makes. The Earth also moves around the Sun. This movement is called revolution. The path of the Earth around the Sun is called its orbit. All of the planets in our solar system orbit the Sun. The Moon orbits the Earth.

Moon
Sun
Earth's orbit
Moon's orbit
Earth
Earth's Axis
The Moon orbits the Earth once every 27 days

Science fact
Using diagrams and modelling is an important part of space science.

Axis
North Pole
South Pole

Look at the diagram. What does it tell you about how the Sun appears to move across the sky? Share your ideas with a friend about whether the Sun is really moving.


Phases of the Moon

The Moon moves around the Earth once every month. This is called its orbit. The Moon looks a different shape, or phase, during a month. Its shape depends on how much of it is catching the light from the Sun during its orbit.

new Moon
waxing crescent
waxing half (first quarter)
waxing gibbous
full Moon
waning gibbous
waning half (last quarter)
waning crescent

Phases of Moon

Modelling phases of the Moon

1 Use biscuits or modelling clay to make the phases of the Moon during a Month.
2 Write a label for each phase.
3 Display your model in your classroom.

Stretch zone

Research and draw how the Moon looks from Earth over a month. Make a poster and call it 'The phases of the Moon'.

Key ideas

- As the Earth spins, the Sun appears to rise in the east and set in the west.
- The orbit of the Moon around the Sun makes the Moon a different shape throughout a month.

Getting started

This lesson explores the movement of the Earth around the Sun, and the Moon around the Earth. Students can to track the changes in the sunlight throughout the day. The shadows can be used to tell us the time of day and this is how sundials work. Shadows are investigated over the course of a day and students try to find midday using their investigations.

Language support

Students are introduced to a number of key terms within this lesson. It is important that they are able to recognise these words and understand their meanings. As new words are introduced, allow students time to practise the spelling and pronunciation.

Resources

Student Book: black and white biscuits or modelling clay; writing materials; paper.

Key words

axis celestial bodies Earth Moon orbit planet satellite star

Other words in the lesson

midday

Scientific enquiry key words

Plan and/or carry out enquiries to answer questions

Make observations

Take measurements, using equipment accurately

Record data and results

Analyse data, notice patterns and group or classify things

Report and present findings

Draw conclusions and give explanations

Lesson at a glance

The key teaching points for students in this lesson are:

- all planets of the Solar system revolve around the Sun
- the Earth moves around the Sun and the moon moves around the Earth.

Ask students to read carefully the top section explaining the Solar system, till the illustration. Ask them if they have ever seen one of these illustrations. It is a sundial. Encourage a discussion on their understanding of this model of the solar system.

Possible response: *Students should suggest that the picture is a model which shows the relative distance of the planets in the solar system from the Sun in the center. It also shows their relative sizes.*

Continue reading the rest of the text, either yourself, through volunteers, or with students as paired activity. encourage discussion of new concepts and terms.

Science fact: Scientists such as Ptolomy, Alhazan and Copernicus suggested that the Sun is the centre of the solar system. This is known as the heliocentric (Sun centred) model.

You may ask students to identify which model they are studying currently, and why that may or may not be true?

After they have carried out the reading activity, ask the students to attempt to answer the given discussion questions.

- What is the difference between a star and a planet?
- Is the Moon a planet or a satellite?
- How does the Earth's distance from the Sun allow life to survive

Possible response: *Students should suggest that the difference between a star and a planet is that a star produces its own light, whereas planets do not produce their own light. The moon is not a planet, rather it is a satellite of Earth. And the Earth's distance from the Sun provides optimal heat and light for life to survive.*

Why do some people think that the Sun moves?

Answer: *Students should think back to the introductory pages and recall that since people talk about the Sun rising in the morning, moving across the sky and setting in the evening, it is natural to assume incorrectly that the Sun is moving across the sky.*

Ask volunteers to continue reading the text. They could read a paragraph each. Explain that the terms axis, rotation and equator may not be real but they are essential to our understanding of how the celestial bodies move. You could demonstrate using a ball or even a globe as the Earth – ask a student to slowly turn it round and round. Ask another student to be the Sun – they stand still and shine a torch on the model Earth. You can also use a smaller ball to indicate the moon in a similar manner. You can fix small pieces of modelling clay to the surface to cast shadows and test students' predictions.

Science fact: Using diagrams and modelling is an important part of space science.

Explain to the students that models help us visualize and understand difficult concepts easily. encourage them to discuss how the activity helped them understand rotation and axis.

Look at the diagram. What does it tell you about how the Sun appears to move across the sky? Share your ideas with a partner about whether the Sun is really moving.

Remind students that the apparent movement happens because the Earth is turning around and moving around the Sun. At some points, where we are on Earth is closer to the Sun than other places.

Possible response: *The Sun appears to rise in the east and set in the west. At midday or noon, it is at its highest point in the sky.*

Read the Phases of the moon section wit the class. Encourage students to share their observations of the moon and whether they know what a full moon or a new are known as in Urdu.

STEM Investigation: Modelling phases of the Moon

This investigation is best done in small groups. You will need to decide whether to use biscuits (or cookies) or modelling clay for this activity. If you allow students to eat the biscuits, check for allergies and make sure students' hands and the biscuits are kept clean during the activity.

If using biscuits, provide groups with several and ask them to make the phases of the Moon by breaking or by eating the biscuits into the shapes shown on page 166 of the Student Book. If you are using modelling clay, ask students to make the shapes of the Moon phases shown on page 166 of the Student Book.

Ask students to write clear labels for each phase. They can display their labelled phases of the Moon to share with the class.

Stretch zone: Research and draw how the Moon looks from Earth over a month. Make a poster and call it 'The phases of the Moon'.

Continue from the STEM investigation and ask the students to replicate their results into a poster.

Key ideas

- *As the Earth spins, the Sun appears to rise in the east and set in the west.*
- *The orbit of the Moon around the Sun makes the Moon a different shape throughout a month.*

Read through the key ideas or ask a volunteer to read out to the class. Ask students to comment on the key learnings from the unit.

Review and reflect

Use the activities in the Student Book to encourage students to identify aspects they have not completed correctly and help them to identify improvements. For example, they can walk around and look at the sundials made by other students to identify what they have done well and what they can learn from others as targets to improve their work.

Extra activities

1 Students can create a small booklet on the either of these topics: Helioentric model, Flat Earth theory, or Phases of the Moon.

Differentiation

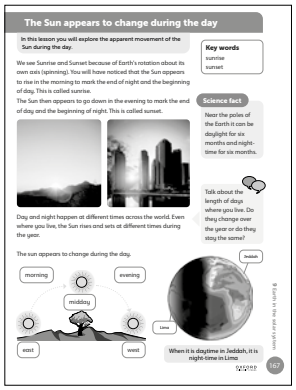
Supporting: Allow students time to practise using models to understand rotation and revolution.

Consolidating: Allow students time tounderstand and compare the difference between rotation and revolution.

Extending: Students can explain why the sun appears to move through the sky.

Differentiated outcomes	
All students	should be able to explain changes in the shape of the moon
Most students	will be able to describe difference between rotation and revolution, and planet and satellite
Some students	may be able to discuss how the the Sun and the Moon appear to change shape due to Earth's rotation

The Sun appears to change during the day



Getting started

This lesson investigates and explores how the Sun appears to move across the sky. Students carry out a survey of the apparent movement of the Sun at different times of the day. They are encouraged to observe the Sun's movement using a pinhole.

Language support

Ask students if they know the word 'tracking'. Use an infra-red beam and ask them to track this as you move it around a shady room. Ask if they remember the word 'phases'. Show them a couple of images of two different phases of the Moon. Review that the word just reflects the shape of the Moon at different times of the month.

Resources

Student Book: access to the internet.

Key words

sunrise sunset

Other words in the lesson

direction tracking

Scientific enquiry key words

ask questions observe compare

notice patterns record use secondary sources

Lesson at a glance

The key teaching point for students in this lesson is:

- the Sun appears to move across the sky during the day

Remind students that the Sun gives us daylight by asking students to think about what it is like when the Sun has gone down. Ask students to remember where we get light from at night. Remind them that the Sun is our most important source of light.

Science fact: Near the poles of the Earth it can be daylight for six months and night-time for six months.

Ask students to imagine what it would be like to be in near darkness for six months. What would they miss and what would change? Ask them if they could sleep if it was constantly daylight. Ask students to read the text and discuss the question below.

Ask students to look at the illustration that tracks the Sun through a day. Point to 'east/west' in the key words. Remind students that these are directions. Read out the other key words and ask students what they do at each time of the day. As a prompt, ask when they eat their lunch or breakfast, or when they get up or go to bed. Remind them that morning is when they usually get up, lunch is around midday and bedtime is during the evening.

Talk about the length of days where you live. Do they change over the year or do they stay the same?

Students discuss the question with a partner. Prompt them to think about events that happen at different times of the year to help them think about the length of the day at those times.

> ***Possible response:*** *Students should suggest that the times do change over a year. They might think about an important date, such as when they go back to school after a holiday, or a religious festival, to help them think about different times in the year.*
> *Ask students to study the diagram of the Earth with Jeddah and Lima labelled. Point out the caption which highlights that when it is daytime in Jeddah it is nighttime in Lima. Ask them what it would be like in Jeddah when it is daytime in Lima.*

Remind students that the apparent movement happens because the Earth is turning around and moving around the Sun. At some points, where we are on Earth is closer to the Sun than other places.

Key idea

- *As the Earth spins, the Sun appears to rise in the east and set in the west.*

Summarise the lesson by asking students what they have learned.

Let them share their ideas, read out and discuss the key ideas. This will remind them that the Sun does not move but the Earth spins. Use a ball model or ask students to act out how the Earth orbits the Sun. Ask: Does the Sun move across the sky? Discuss why some people think this. Then ask them for evidence that this does not happen. Review students' understanding of why some people think the Sun moves across the sky.

Review and reflect

Listen to students' discussions to review their understanding and to correct any misconceptions. Summarise the lesson as suggested after the 'Key ideas' above. Support students to use the models or to act out the orbits of the Earth and the Moon.

Extra activities

1 Encourage students to make a link between the Sun at midday and the heat it generates. Ask students to think about their observations of the Sun. When did it feel hottest on their skin? Remind them that the Sun is a burning ball of fire, and even though it is a long way from us it gives out enough energy to burn our skin.

2 Students use a torch and a mirror to show how the Moon reflects the light from the Sun. A partner stands in different positions around the set-up to observe how this action can result in the phases of the Moon.

Differentiation

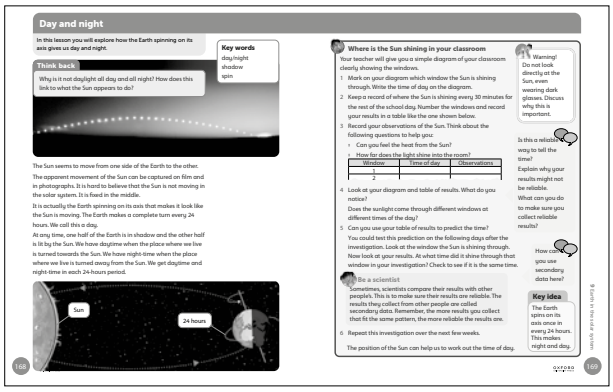
Supporting: Provide support in observing the direction of the Sun. Display images of the phases of the Moon for reference.

Consolidating: Make sure students recognise that the Sun changes during the day. Remind them about the different phases of the Moon and how they happen using a ball in front of a lamp, pointing out how the shape of the ball or the shadow on it resembles the phases of the Moon.

Extending: Ask students to use a model to explain that the Sun changes during the day. To help them recognise some of the phases of the Moon, hold up different images and ask them what the phase is called.

Differentiated outcomes	
All students	should be able to observe the Sun at different times of the day and know that the Moon looks different throughout a month
Most students	will be able to track the position of the Sun in the sky during the day and understand that Moon phases occur because of the position of the Sun, Earth and Moon
Some students	may be able to measure and record the direction of the Sun at different times during the day and explain that the orbits of the Sun, Earth and Moon relate to the Moon phases

Day and night


Day and night

In this lesson you will explore how the Earth spinning on its axis gives us day and night.

Think back

Why is it not daylight all day and all night? How does this link to what the Sun appears to do?

Key words
day/night
shadow
spin

The Sun seems to move from one side of the Earth to the other.

The apparent movement of the Sun can be captured on film and in photographs. It is hard to believe that the Sun is not moving in the solar system. It is fixed in the middle.

It is actually the Earth spinning on its axis that makes it look like the Sun is moving. The Earth makes a complete turn every 24 hours. We call this a day.

At any time, one half of the Earth is in shadow and the other half is lit by the Sun. We have daytime when the place where we live is turned towards the Sun. We have night-time when the place where we live is turned away from the Sun. We get daytime and night-time in each 24-hours period.

Sun

24 hours

168

Where is the Sun shining in your classroom

Your teacher will give you a simple diagram of your classroom clearly showing the windows.

1 Mark on your diagram which window the Sun is shining through. Write the time of day on the diagram.
2 Keep a record of where the Sun is shining every 30 minutes for the rest of the school day. Number the windows and record your results in a table like the one shown below.
3 Record your observations of the Sun. Think about the following questions to help you:
- Can you feel the heat from the Sun?
- How far does the light shine into the room?

Window	Time of day	Observations
1		
2		

4 Look at your diagram and table of results. What do you notice?
Does the sunlight come through different windows at different times of the day?
5 Can you use your table of results to predict the time?
You could test this prediction on the following days after the investigation. Look at the window the Sun is shining through. Now look at your results. At what time did it shine through that window in your investigation? Check to see if it is the same time.
6 Repeat this investigation over the next few weeks.
The position of the Sun can help us to work out the time of day.

Warning!
Do not look directly at the Sun, even wearing dark glasses. Discuss why this is important.

Is this a reliable way to tell the time?
Explain why your results might not be reliable.
What can you do to make sure you collect reliable results?

How can you use secondary data here?

Be a scientist
Sometimes, scientists compare their results with other peoples. This is to make sure their results are reliable. The results they collect from other people are called secondary data. Remember, the more results you collect that fit the same pattern, the more reliable the results are.

Key idea
The Earth spins on its axis once in every 24 hours. This makes night and day.

OXFORD

169

Getting started

This lesson explores the apparent movement of the Sun. Students monitor and observe the movement of the Sun throughout the day. They make predictions about the time of day based on earlier observations.

Language support

Ask students to read the key words. For those they are familiar with, they discuss with a partner meanings or examples of the words being used. Remind them how they used the word 'spin' when they modelled the movement of the Earth and the Moon. Remember that students understand words better if they are linked to actions.

Resources

Student Book: a clock; a diagram of the classroom clearly showing the position of the windows.

Key words

day/night shadow spin

Other word in the lesson

daytime

Scientific enquiry key words

Plan and/or carry out enquiries to answer questions

Recognise and control variables

Make observations

Record data and results using diagrams and labels, tables, keys and graphs

Make predictions

Draw conclusions and give explanations

Identify causal relationships

Lesson at a glance

The key teaching points for students in this lesson are:

- the Sun appears to move across the sky during a day
- it takes 24 hours for the Earth to spin on its axis.

Think back: Why is it not daylight all day and all night? How does this link to what the Sun appears to do?

Students should recall the previous lesson where they modelled the movement of the Earth. They will know that the Earth turns away from the Sun as it spins on its axis.

> ***Possible response:*** *Students may suggest that when the Earth turns away from the Sun, that part of the Earth will turn away from the Sun's light and into darkness. They may link this with the fact that the Sun appears to come up into the sky in the morning and drop down from the sky in the evening.*

Point out the image at the top of page of the Student Book. This is a slow-time image showing the apparent movement of the Sun across the sky during the day. Explain that this leads people to believe that the Sun moves around the Earth.

Students read the text below the image with a partner. Ask students if they can understand why people think that the Sun actually moves – what is it that makes people view the Sun in this way? Ask students to study the diagram at the bottom of page 100 and suggest what the diagram shows. Ask whether it helps them to understand why it is dark at night-time and light during the daytime. Ask how many hours it takes for Earth to make one full turn on its axis.

Tell students that they are going to investigate and observe the Sun during the day. They could work with a partner or in small groups for this investigation.

Investigation: Where is the Sun shining in your classroom?

Warning! Do not look directly at the Sun, even wearing dark glasses. Discuss why this is important.

At the start of the investigation, read out the warning. Ask students why they should not look directly at the Sun. They should suggest that the Sun is very powerful and the energy can damage our eyes or even blind us.

The aim of this investigation is to explore how the position of the Sun appears to move over time. Students follow the steps in the investigation method to observe and record where the Sun shines in the classroom every 30 minutes during the school day. They use their results to predict the time on the following days, by looking at where the Sun is shining in the room. They then compare their predictions with the time on the clock.

You could ask: Does the light come through different windows at different times of the day? Ask students to look at their results. Discuss which windows the light shone through at different times. Ask: Did the Sun seem to move in a certain direction?

Is this a reliable way to tell the time? Explain why your results might not be reliable. What can you do to make sure you collect reliable results?

Remind students that reliable data is where there are two or more results that are the same or very similar. In this case, the results should be the same, as all students should have marked the position of the light. If they are not, you can extend the discussion to explain possible errors in recording data and students can modify their investigation to ensure that reliable results are collected. Explain that to get more reliable results, more results are needed.

> ***Possible response:*** *Students might suggest that this is not a reliable way to tell the time as on cloudy days there will be no sunshine in the room. They may also consider the reliability of their results, and if all the students recorded the same results then they may say they are very reliable.*

Ask students to discuss the Be a scientist information in their groups.

Be a scientist: Sometimes, scientists compare their results with other people's. This is to make sure their results are reliable. The results they collect from other people are called secondary data. Remember, the more results you collect that fit the same pattern, the more reliable the results are.

Ask whether students have practised repeating tests to give them reliable results. Ask whether they have more confidence in their results when others record similar ones.

How can you use secondary data here?

Encourage the class to compare their observations and results. Explain that scientists share results or use secondary data to support their hypothesis or the questions they ask.

> ***Possible response:*** *Students should suggest using the results from other pairs or groups as secondary data.*

Key idea

The Earth spins on its axis once in every 24 hours. This makes night and day.

Read out the Key idea or ask a volunteer to read it out. Ask students to recall how many hours there are in a day. Ask whether this is evidence that the spin of the Earth gives us day and night.

Review and reflect

Encourage students to reflect on their own learning by pausing for a few moments and thinking about which parts of the work they found tricky. Talk about how they managed this and suggest that next time they stop for a short while and take a few deep breaths. Remind them that when they are doing tricky work they are training their brain and this will help their future learning.

Extra activities

1 Ask students to keep a diary at home to record observations of where the Sun is at a set time before or after school each day.

2 **Computing link:** Ask students to research whether the length of daylight changes at different times of the year. They record which time of year gives them the most night-time to sleep.

3 **Maths link:** During the investigation, ask students to measure the distance the Sun reaches into the classroom. They plot the results as a line graph to show how the distance changes throughout the day.

Differentiation

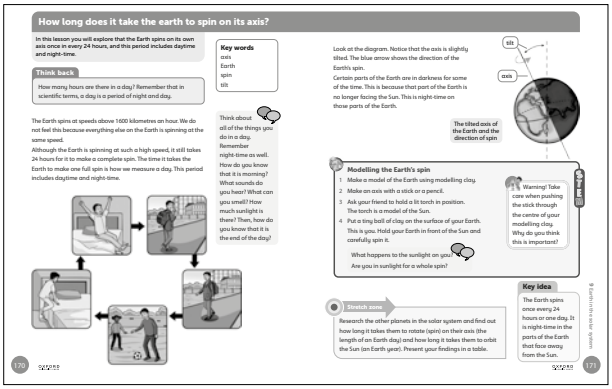
Supporting: Encourage students to repeat the investigation over a number of days to gain confidence in their observations.

Consolidating: Ask students to observe the position of the Sun over several days and compare the patterns that the results show.

Extending: Ask students to repeat the moving Sun activity over a weekend to collect more data.

Differentiated outcomes	
All students	should be able to track the apparent movement of the Sun
Most students	will be able to explain why we think the Sun moves
Some students	may be able to explain why the Sun appears to move across the sky over a 24-hour period

How long does it take the Earth to spin on its axis?


How long does it take the earth to spin on its axis?

In this lesson you will explore that the Earth spins on its own axis once in every 24 hours, and this period includes daytime and night-time.

Think back

How many hours are there in a day? Remember that in scientific terms, a day is a period of night and day.

Key words
axis
Earth
spin
tilt

The Earth spins at speeds above 1600 kilometres an hour. We do not feel this because everything else on the Earth is spinning at the same speed.
Although the Earth is spinning at such a high speed, it still takes 24 hours for it to make a complete spin. The time it takes the Earth to make one full spin is how we measure a day. This period includes daytime and night-time.

Think about all of the things you do in a day. Remember night-time as well. How do you know that it is morning? What sounds do you hear? What can you smell? How much sunlight is there? Then, how do you know that it is the end of the day?

Look at the diagram. Notice that the axis is slightly tilted. The blue arrow shows the direction of the Earth's spin.
Certain parts of the Earth are in darkness for some of the time. This is because that part of the Earth is no longer facing the Sun. This is night-time on those parts of the Earth.

tilt
axis

The tilted axis of the Earth and the direction of spin

Modelling the Earth's spin
1 Make a model of the Earth using modelling clay.
2 Make an axis with a stick or a pencil.
3 Ask your friend to hold a lit torch in position. The torch is a model of the Sun.
4 Put a tiny ball of clay on the surface of your Earth. This is you. Hold your Earth in front of the Sun and carefully spin it.

What happens to the sunlight on you? Are you in sunlight for a whole spin?

Warning! Take care when pushing the stick through the centre of your modelling clay. Why do you think this is important?

Key idea
The Earth spins once every 24 hours or one day. It is night-time in the parts of the Earth that face away from the Sun.

Stretch zone
Research the other planets in the solar system and find out how long it takes them to rotate (spin) on their axis (the length of an Earth day) and how long it takes them to orbit the Sun (an Earth year). Present your findings in a table.

9 Earth in the solar system

170 121

Getting started

This lesson explains that the length of a day is 24 hours. This is the time it takes for the Earth to make one complete spin. Modelling the spin of the Earth will support this understanding.

Language support

The imaginary axis of the Earthmay be a complex concept. Ask students to discuss the word 'imaginary'. Support students by using images and models to show how the axis works. You could also model the word 'tilt' through a visual demonstration, by holding something such as a ruler straight up and down and then tilting it.

Resources

Student Book: modelling clay in various colours, particularly green and blue to model the Earth; sticks or pencils; torches; access to the internet or textbooks.

Key words

axis Earth spin tilt

Other words in the lesson

morning night-time period sunlight

Scientific enquiry key words

Plan and/or carry out enquiries to answer questions

Recognise and control variables

Take measurements, using equipment accurately

Record data and results using diagrams and labels, tables, keys and graphs

Make predictions

Draw conclusions and give explanations

Identify causal relationships

Lesson at a glance

The key teaching points for students in this lesson are:

- we measure a day by the time it takes the Earth to make one complete spin on its axis
- at some time during the spin the Earth is in darkness.

Think back: How many hours are there in a day? Remember that in scientific terms, a day is a period of night and day.

Ask students to discuss this question in groups of three.

Possible response: *Students should recall that there are 24 hours in a day, which is the time it takes for the Earth to make one complete spin on its axis.*

Students read the information at the top of page of the Student Book. Ask them to compare how fast the Earth spins to the speed of a fast racing car, which can travel at about 300 km per hour. Explain that even though the Earth is spinning at 1600 km every hour it still takes 24 hours to complete one spin. During this time the Earth is in darkness for some of the time and sunlight at other times.

Think about all of the things you do in a day. Remember night-time as well. How do you know that it is morning? What sounds do you hear? What can you smell? How much sunlight is there? Then, how do you know that it is the end of the day?

Ask students to discuss these questions with a partner. They can use the pictures in the flow diagram at the bottom of page as prompts.

Possible response: *Students will most likely say that they know it is morning because it is no longer dark. They may hear sounds like birds singing or traffic moving along roads. They may smell breakfast foods coming from the kitchen. They may be able to suggest that the amount of sunlight will depend on the time of year it is, and that they know it is the end of the day as the light is fading and it is beginning to get dark.*

Ask students to study the diagram at the top of next page of the Student Book. Explain that the Earth's axis is slightly tilted. The diagram is explained in the text; the blue arrow shows the direction of the Earth's spin and the black arrows show how much the axis is tilted.

Explain that students will work in a small group to make a model of how the Earth spins on its axis.

Investigation: Modelling the Earth's spin

Warning! Take care when pushing the stick through the centre of your modelling clay. Why do you think this is important?

At the start of the investigation, read out the warning. Students should recognise that the stick could scratch or cut their hands so they need to take care when constructing this part of the model.

The aim of this investigation is to demonstrate how the Earth spins on its axis by making a model of the Earth with an axis and spinning it around. Students will use a torch to model the light of the Sun and will focus on one small part of the Earth so will see how the light in that part changes as the Earth spins around.

Each group should use their model to investigate how the spinning movement of the Sun results in part of Earth being in shade and other parts in sunlight. Allow students time to explore this fully. Ask them to mark 'their' position with a tiny ball of clay and to review their model by discussing the questions below.

What happens to the sunlight on you? Are you in sunlight for a whole spin?

Encourage students to identify that some of the time they are in the shade and at other times in direct sunlight.

Possible response: *Students should answer that as the Earth spins the sunlight is on them for some of the time. They are not in sunlight for the whole spin.*

Stretch zone: Research the other planets in the solar system and find out how long it takes them to rotate (spin) on their axis (the length of an Earth day) and how long it takes them to orbit the Sun (an Earth year). Present your findings in a table.

Students could work on the Stretch zone activity as home learning to allow them to work independently and at their own pace. Alternatively, they could work with a partner at school. The best sources of information would be the internet or textbooks.

Key idea

The Earth spins once every 24 hours or one day. It is night-time in the parts of the Earth that face away from the Sun.

Read out the Key idea. This will remind students that the Earth's spin takes 24 hours to complete. Remind students that this means it is night-time on parts of the Earth when these parts are in the shade and daytime in other parts that are in the sunlight. Show one of the models that students have made to remind them of this.

Summarise the lesson by asking students to share ideas about what they have learned.

Review and reflect

Ask students to sit for a few minutes and think about what they have learned from the lesson. They can then think of one idea from the lesson that they would like to find out more about. Ask them to make a plan about how they would do this. This planning time will allow them to think up some imaginative and original things to do and you could let them carry out these projects. They are highly motivating and reinforce learning.

Extra activities

1 Ask students to model the spin of the Earth to the people at home and explain how this gives us day and night.

2 **Computing link:** Allow students to research on the internet how some countries do not have night-time for weeks in the summer and do not have any sunlight in the winter. They make a poster about the country explaining how this could happen.

3 **Maths link:** Ask students to work out how long it would take the Earth to complete one spin if each day was half as long as it is now.

Differentiation

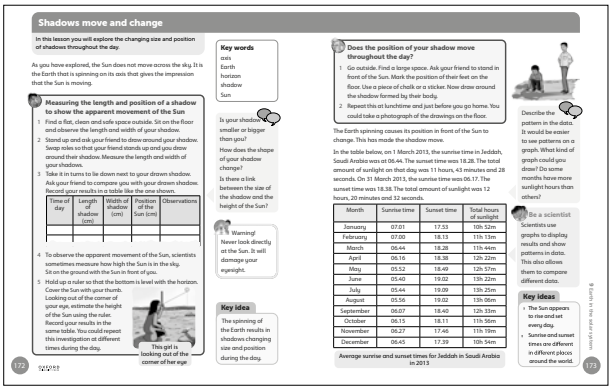
Supporting: Encourage students to practise using the model of the Earth to observe the spin.

Consolidating: Ask students to explore how the position of the Earth during its spin gives us day and night.

Extending: Ask students to investigate the tilt of the axis and how this affects daylight in one place on Earth.

Differentiated outcomes	
All students	should be able to model how the Earth spins on its axis
Most students	will be able to model day and night on Earth
Some students	may be able to describe how the tilt of Earth affects daylight at various places on Earth

Shadows move and change


Shadows move and change

In this lesson you will explore the changing size and position of shadows throughout the day.

As you have explored, the Sun does not move across the sky. It is the Earth that is spinning on its axis that gives the impression that the Sun is moving.

Measuring the length and position of a shadow to show the apparent movement of the Sun

1 Find a flat, clean and safe space outside. Sit on the floor and observe the length and width of your shadow.
2 Stand up and ask your friend to draw around your shadow. Swap roles so that your friend stands up and you draw around their shadow. Measure the length and width of your shadows.
3 Take it in turns to lie down next to your drawn shadow. Ask your friend to compare you with your drawn shadow. Record your results in a table like the one shown.

Time of day	Length of shadow (cm)	Width of shadow (cm)	Position of the Sun (cm)	Observations

4 To observe the apparent movement of the Sun, scientists sometimes measure how high the Sun is in the sky. Sit on the ground with the Sun in front of you.
5 Hold up a ruler so that the bottom is level with the horizon. Cover the Sun with your thumb. Looking out of the corner of your eye, estimate the height of the Sun using the ruler. Record your results in the same table. You could repeat this investigation at different times during the day.

This girl is looking out of the corner of her eye

Key words
axis
Earth
horizon
shadow
Sun

Is your shadow smaller or bigger than you?
How does the shape of your shadow change?
Is there a link between the size of the shadow and the height of the Sun?

Warning! Never look directly at the Sun. It will damage your eyesight.

Key idea
The spinning of the Earth results in shadows changing size and position during the day.

Does the position of your shadow move throughout the day?

1 Go outside. Find a large space. Ask your friend to stand in front of the Sun. Mark the position of their feet on the floor. Use a piece of chalk or a sticker. Now draw around the shadow formed by their body.
2 Repeat this at lunchtime and just before you go home. You could take a photograph of the drawings on the floor.

The Earth spinning causes its position in front of the Sun to change. This has made the shadow move.

In the table below, on 1 March 2013, the sunrise time in Jeddah, Saudi Arabia was at 06.44. The sunset time was 18.28. The total amount of sunlight on that day was 11 hours, 43 minutes and 28 seconds. On 31 March 2013, the sunrise time was 06.17. The sunset time was 18.38. The total amount of sunlight was 12 hours, 20 minutes and 32 seconds.

Month	Sunrise time	Sunset time	Total hours of sunlight
January	07.01	17.53	10h 52m
February	07.00	18.13	11h 13m
March	06.44	18.28	11h 44m
April	06.16	18.38	12h 22m
May	05.52	18.49	12h 57m
June	05.40	19.02	13h 22m
July	05.44	19.09	13h 25m
August	05.56	19.02	13h 06m
September	06.07	18.40	12h 33m
October	06.15	18.11	11h 56m
November	06.27	17.46	11h 19m
December	06.45	17.39	10h 54m

Average sunrise and sunset times for Jeddah in Saudi Arabia in 2013

Describe the pattern in the data. It would be easier to see patterns on a graph. What kind of graph could you draw? Do some months have more sunlight hours than others?

Be a scientist
Scientists use graphs to display results and show patterns in data. This also allows them to compare different data.

Key ideas
- The Sun appears to rise and set every day.
- Sunrise and sunset times are different in different places around the world.

Earth in the solar system

172 173

Getting started

This lesson introduces students to the changing size and position of shadows throughout the day. Students measure the size and position of their shadow and compare this with the height of the Sun.

Language support

The term 'shadow' will have been used before so it should be familiar to students. Reinforce the written word with images of shadows. 'Horizon' may be a new word for some students so write it on the board and ask students to say it aloud. Ask for volunteers to give a definition. Link it to the adjective 'horizontal' and ask students to hold a pencil in a horizontal position.

Resources

Student Book: a clean, flat surface outside; chalk; stickers (optional); long tape measures; rulers; cameras (optional).

Key words

axis Earth horizon shadow Sun

Scientific enquiry key words

Plan and/or carry out enquiries to answer questions
Recognise and control variables
Make observations
Take measurements, using equipment accurately
Make predictions
Report and present findings in a variety of ways
Draw conclusions and give explanations
Identify causal relationships

Lesson at a glance

The key teaching points for students in this lesson are:

- shadows can be formed when light from the Sun is blocked by an object
- shadows can change in size and position during the day.

Explain that students are going to investigate the length and position of a shadow during a day.

Investigation: Measuring the length and position of a shadow to show the apparent movement of the Sun

The aim of this investigation is to demonstrate how the position of the Sun appears to change over time, using shadows to show this. The way that shadows change over the course of the day demonstrates the apparent movement of the Sun.

Survey the grounds of the school and find enough space for all students to lie down. Make sure that the area is clean and safe. Students could lie on paper instead of the ground and draw around themselves on the paper.

Some students may not want to take part in the investigation. If so, it could be carried out using shadow sticks. This will give similar results and the same prompt questions can be used with a little modification.

Warning! Never look directly at the Sun. It will damage your eyesight.

Remind students not to look directly at the Sun and ask them to explain why this is. Ask them how they will keep themselves and the other students safe.

Students work with a partner or in a small group to carry out this investigation. Guide students to the area that you have located. Students draw around each other's shadows and measure and record the length and width of their own shadow. Students then measure the height of the Sun in the sky using the technique described. Remind students to look out of the corner of their eye and never directly at the Sun. They use the ruler to estimate the height of the Sun at different times of the day and link this to measurements they make about their shadows. To make comparable observations, the more time that passes between taking readings the better. Suggested times would be first thing in the morning, at midday and then at the end of the school day.

Is your shadow smaller or bigger than you? How does the shape of your shadow change? Is there a link between the size of the shadow and the height of the Sun?

Students should analyse the results in the results table to answer the questions.

> ***Possible response:*** *Students should suggest that their shadow is bigger than them. In the morning and evening the shadows are long and thin and at midday they are smaller and wider. The size of the shadow changes according to the height of the Sun in the sky.*

Tell students that they will continue to work in their pairs or groups to investigate whether the position of the shadow moves during the day.

Investigation: Does the position of your shadow move throughout the day?

Students investigate the effect that the Earth's spin has on the position of their shadow throughout the day. Again, find enough space that is clean, safe and big enough for all students to work in.

They work together to follow the instructions. One student marks the position of their feet on the ground and a partner draws around the shadow. The longer the time spent on this the more changes will be observed.

Key idea

The spinning of the Earth results in shadows changing size and position during the day.

Ask a volunteer to read out the Key idea. This will remind them of the spinning Earth and how this affects shadows. Ask students to discuss this and share ideas. Then ask them to close their books and, in pairs, describe from memory how the shadows changed during the day. Students could also share ideas about why the shadows changed.

Has the position of the shadow moved on the floor? Why? Your partner did not move.

> ***Possible response:*** *Students should suggest that the position of the shadow moved throughout the day. This is because as the Earth spins in front of the Sun the direction the sunlight comes from changes.*

Next, ask students to look at the data in the table. This shows average sunset and sunrise times, and total hours of sunlight, for each month of the year in Jeddah, Saudi Arabia. Allow them time to digest the information and discuss it with a partner.

Describe the pattern in the data. Do some months have more sunlight hours than others?

This question prompts students to analyse the data carefully to pick out patterns and find answers.

> ***Possible response:*** *Students should suggest that sunrise times get earlier from January to June and hen start getting later again until December. Sunset times get later from January to July and then start getting earlier again until December. Total hours of sunlight increase from January to July and then start decreasing again until December. June, July and August are the months with the most sunlight hours.*

Discuss with students the amount of data in the table and how it is difficult to analyse it in this format. Encourage them to display the data in a graph.

Be a scientist: Scientists use graphs to display results and show patterns in data. This also allows them to compare different data.

Ask students if they think graphs and charts are easier to read than the data in the table. You could show them some charts or graphs in magazines to demonstrate how these have many uses in showing people trends and patterns quickly and easily.

Continue to encourage data analysis by asking the pairs of students the following questions.

Which month has the earliest sunrise? (June, at 05.40)

Which month has the latest sunset? (July, at 19.09)

Are the days with the most sunlight hours at the same time of year? (Yes, in the summer months of June, July and August)

Which month has the fewest sunlight hours? (January, with 10h 52m)

Ask students to read the Be a scientist information.

Key idea

- *The Sun appears to rise and set every day.*
- *Sunrise and sunset times are different in different places around the world.*

Read out the Key ideas to remind students of sunrise and sunset and how these times differ around the globe. Ask them to explain to a partner what sunrise and sunset are. Summarise the lesson by asking them what they have learned. Let them share and discuss ideas.

Review and reflect

Encourage students to find a quiet place to think about their learning in this lesson. Ask them if they found any part of the lesson challenging. Remind them that when they overcome a challenge, they are making their brain work harder. This is like going for a run to make your lungs work harder. Ask students how they felt when the learning was challenging and how they overcame the challenge. Ask them to record the strategies they used as this will help them in future situations. If all of the students found some part more difficult than others you might want to review this as a class before moving on to the next lesson.

Extra activities

1 **Maths link:** Ask students to continue measuring and recording observations about shadows after school. They could present their results in a table or a line graph.

2 Students use the drawings of shadows they have made. Tell them to cover the times and ask other students to predict the time using the shadow.

Differentiation

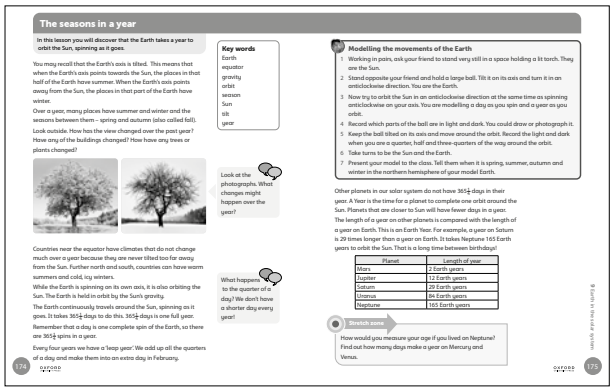
Supporting: Encourage students to practise drawing around the shadows cast by various objects at different times of the day.

Consolidating: Ask students to compare shadows drawn with others drawn at different times of the day.

Extending: Ask students to practise reading the data by answering questions such as: How many hours of sunlight are there in April? Which month has the latest sunrise time? Which month has the latest sunset time?

Differentiated outcomes	
All students	should be able to describe how a shadow is made
Most students	should be able to find sunrise and sunset times using secondary data
Some students	may be able to compare sunrise, sunset and sunlight hours to calculate sunlight hours

The seasons in a year


The seasons in a year

In this lesson you will discover that the Earth takes a year to orbit the Sun, spinning as it goes.

You may recall that the Earth's axis is tilted. This means that when the Earth's axis points towards the Sun, the places in that half of the Earth have summer. When the Earth's axis points away from the Sun, the places in that part of the Earth have winter.
Over a year, many places have summer and winter and the seasons between them – spring and autumn (also called fall).
Look outside. How has the view changed over the past year? How many of the buildings changed? How have any trees or plants changed?

Key words
Earth
equator
gravity
orbit
season
Sun
tilt
year

Look at the photographs. What changes might happen over the year?

What happens to the quarter of a day? We don't have a shorter day every year!

Countries near the equator have climates that do not change much over a year because they are never tilted too far away from the Sun. Further north and south, countries can have warm summers and cold, icy winters.
While the Earth is spinning on its own axis, it is also orbiting the Sun. The Earth is held in orbit by the Sun's gravity.
The Earth continuously travels around the Sun, spinning on it goes. It takes 365¼ days to do this. 365¼ days is one full year.
Remember that a day is one complete spin of the Earth, so there are 365¼ spins in a year.
Every four years we have a 'leap year'. We add up all the quarters of a day, and make them into an extra day in February.

Modelling the movements of the Earth
1 Working in pairs, ask your friend to stand very still in a space holding a lit torch. They are the Sun.
2 Stand opposite your friend and hold a large ball. Tilt it on its axis and turn it in an anticlockwise direction. You are the Earth.
3 Now try to orbit the Sun in an anticlockwise direction at the same time as spinning anticlockwise on your axis. You are modelling a day as you spin and a year as you orbit.
4 Record which parts of the ball are in light and dark. You could draw or photograph it.
5 Keep the ball tilted on its axis and move around the orbit. Record the light and dark when you are a quarter, half and three-quarters of the way around the orbit.
6 Take turns to be the Sun and the Earth.
7 Present your model to the class. Tell them when it is spring, summer, autumn and winter in the northern hemisphere of your model Earth.

Other planets in our solar system do not have 365¼ days in their year. A Year is the time for a planet to complete one orbit around the Sun. Planets that are closer to Sun will have fewer days in a year.
The length of a year on other planets is compared with the length of a year on Earth. This is an Earth Year. For example, a year on Saturn is 29 times longer than a year on Earth. It takes Neptune 165 Earth years to orbit the Sun. That is a long time between birthdays!

Planet	Length of year
Mars	2 Earth years
Jupiter	12 Earth years
Saturn	29 Earth years
Uranus	84 Earth years
Neptune	165 Earth years

Stretch zone
How would you measure your age if you lived on Neptune? Find out how many days make a year on Mercury and Venus.

Getting started

This lesson introduces students to the idea that the Earth orbits the Sun. This means that the Earth is not only spinning on its axis but is also travelling around the Sun in an orbit. This orbit takes $365\frac{1}{4}$ days. This is how we get a year on Earth. Students will explore how the quarter year is addressed by a leap year and how Earth's orbit of the Sun also gives us the seasons of the year.

Language support

Ask students to read out the key words. Ask them to sort them into words they are confident with and words they are less confident with. Remind them that this is the beginning of the lesson and by the end they will have had opportunities to learn all the words.

Resources

Student Book: torches; large balls; cameras (optional); access to the internet.

Key words

Earth equator gravity orbit season Sun tilt year

Other words in the lesson

autumn climate spring summer winter

Scientific enquiry key words

Record data and results using diagrams and labels, tables, keys and graphs

Report and present findings in a variety of ways

Lesson at a glance

The key teaching points for students in this lesson are:

- the Earth orbits the Sun and this takes one year
- the tilted axis of the Earth means that we have seasons.

Read out the text at the top of page or ask a volunteer to read it out. This reminds students that the Earth's axis is tilted, which results in many places having seasons throughout the year as the tilt changes to point towards and away from the Sun.

Ask students to study the photographs on page 174 and discuss the question with a partner.

Look at the photographs. What changes might happen over the year?

Possible response: *Students should see that the tree changes over the year. In the left-hand photograph it has green leaves and the surrounding area is full of growing plants. In the right-hand photograph the tree has no leaves and the surrounding area is dark and not green in colour. There is snow on the ground and it looks cold and gloomy.*

Ask students to read the information under the photographs of the tree and to study the diagram of the Earth's tilted axis. The text explains why areas near the equator have climates that do not change much and how the Earth takes $365\frac{1}{4}$ days to orbit the Sun.

What happens to the quarter of a day? We don't have a shorter day every year!

Prompt students by asking them how many quarter days it takes to make a whole day.

Possible response: *Students should say that every four years we add up the quarter days and have one full extra day in February. Some students may already know this is called a leap year.*

Tell students that they will investigate the movement of the Earth next.

Investigation: Modelling the movements of the Earth

Students work in pairs to model the spin and orbit of the Earth around the Sun, observing how the light from the Sun shines on different places on the Earth throughout the orbit because of the tilt of the Earth's axis. The idea for this is to allow students to experience a hands-on model of how the movements of the Earth results in a year and in a day in addition to the tilted axis giving us seasons. Students could also film the model and you could hold a viewing with the rest of the class. Discuss the movements and when students record it as spring or summer. This will support other students in understanding how the model works.

Possible response: *Students will model the movements of the Earth and record where the light falls on the Earth at four points in the orbit. They should record that different parts of the Earth are lit up at two (opposite) points in the orbit (summer and winter) and that at the other two points the tilt is neither towards nor away from the Sun so there are equal light and dark periods across the whole Earth (spring and autumn).*

Ask students to continue to work with their group to read the text and look at the table at the bottom of page. Ask which planet has the longest and shortest year. Ask students to use the data to complete the Stretch zone task.

Stretch zone: How would you measure your age if you lived on Neptune? Find out how many days make a year on Mercury and Venus.

Possible response: *Students should divide their age in Earth years by 165 years to find out how old they would be in Neptune years. They could use the internet to find out how many days in a year there are on Mercury and Venus – for Mercury it is 88 days and for Venus it is 225 days.*

Summarise the lesson by asking students what they have learned. Let them share their ideas, reading and discussing the ext. Remind them that one orbit time of $365\frac{1}{4}$ days is one Earth year. Students explain how the quarter days are made into one full day to make an extra day every four years.

Review and reflect

Encourage students to reflect on their own learning by pausing for a few moments and thinking about which parts of the work they found tricky. Talk about how they managed this and suggest that next time they stop for a short while and take a few deep breaths. Remind them that when they are doing tricky work they are training their brain and this will help their future learning.

Extra activities

1 Ask students to find out how many seasons there are in the place you live. Do all countries have the same seasons?

2 Suggest that students look through photographs at home and make a poster showing how things are different in the seasons where you live.

Differentiation

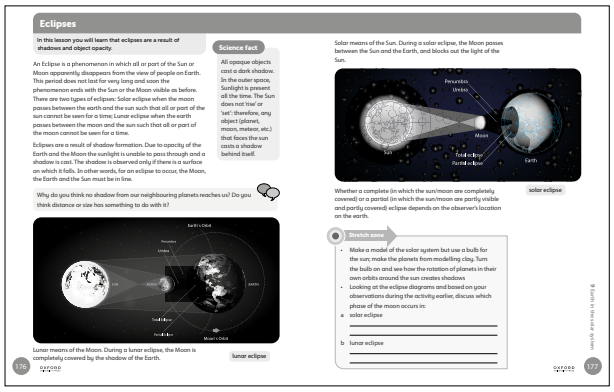
Supporting: Allow students to practise modelling the movements of the Earth. You could place a sticker on the large ball in the north part of the northern hemisphere to make it clearer to students how the light changes throughout one orbit.

Consolidating: Make sure that students start their orbit with the tilt of the axis pointing away from the Sun in the northern hemisphere. Tell them that it is currently winter in the northern hemisphere before they model how the movement results in seasons.

Extending: Ask students to research what 'equinox' means and when this happens in the Earth's orbit.

Differentiated outcomes	
All students	should be able to show the orbit of the Earth around the Sun
Most students	will be able to describe how the Earth orbits the Sun in $365\frac{1}{4}$ days
Some students	may be able to explain why different planets have different lengths of a year

Eclipses


Eclipses

In this lesson you will learn that eclipses are a result of shadows and object opacity.

Science fact

All opaque objects cast a dark shadow. In the outer space, Sunlight is present all the time. The Sun does not 'rise' or 'set': therefore, any object (planet, moon, meteor, etc.) that faces the sun casts a shadow behind itself.

An Eclipse is a phenomenon in which all or part of the Sun or Moon apparently disappears from the view of people on Earth. This period does not last for very long and soon the phenomenon ends with the Sun or the Moon visible as before. There are two types of eclipses: Solar eclipse when the moon passes between the earth and the sun such that all or part of the sun cannot be seen for a time; Lunar eclipse when the earth passes between the moon and the sun such that all or part of the moon cannot be seen for a time.

Eclipses are a result of shadow formation. Due to opacity of the Earth and the Moon the sunlight is unable to pass through and a shadow is cast. The shadow is observed only if there is a surface on which it falls. In other words, for an eclipse to occur, the Moon, the Earth and the Sun must be in line.

Why do you think no shadow from our neighbouring planets reaches us? Do you think distance or size has something to do with it?

Earth's Orbit
Penumbra
Umbra
Sun
Moon
Earth
Total eclipse
Partial eclipse
Moon's Orbit

Lunar means of the Moon. During a lunar eclipse, the Moon is completely covered by the shadow of the Earth.

lunar eclipse

176

Solar means of the Sun. During a solar eclipse, the Moon passes between the Sun and the Earth, and blocks out the light of the Sun.

Penumbra
Umbra
Sun
Moon
Earth
Total eclipse
Partial eclipse

solar eclipse

Whether a complete (in which the sun/moon are completely covered) or a partial (in which the sun/moon are partly visible and partly covered) eclipse depends on the observer's location on the earth.

Stretch zone

- Make a model of the solar system but use a bulb for the sun; make the planets from modelling clay. Turn the bulb on and see how the rotation of planets in their own orbits around the sun creates shadows
- Looking at the eclipse diagrams and based on your observations during the activity earlier, discuss which phase of the moon occurs in:

a solar eclipse

b lunar eclipse

177

Getting started

In this lesson students investigate eclipses. The focus of this lesson is on understanding the types of eclipses and how they occur in space. Students are introduced to the concept that eclipses are a result of shadows and object opacity.

Language support

Most students should be familiar with the key words in this topic, although the term 'partial eclipse' may be unfamiliar. Remind students to fill in the glossary as they encounter unfamiliar words and note down the examples of their usage.

Resources

Student Book: model making material including bulb, modelling clay, etc; notebooks, notepads.

Scientific enquiry key words

Plan and/or carry out enquiries to answer questions

Make observations

Take measurements, using equipment accurately

Record data and results

Analyse data, notice patterns and group or classify things

Report and present findings

Draw conclusions and give explanations

Identify causal relationships

Lesson at a glance

The key teaching points for students in this lesson are:

- eclipses are shadows in space
- eclipses occur due to the same principles as shadow formation by opaque objects.

Science fact: All opaque objects cast a dark shadow. In the outer space, Sunlight is present all the time. The Sun does not 'rise' or 'set': therefore, any object (planet, moon, meteor, etc.) that faces the sun casts a shadow behind itself.

Begin by asking the students to recall as many facts about shadow formation requirements as they remember. They can do this individually and then compare their list with a partner and make a joint list. Elicit from students that all opaque objects facing a light source cast shadows. And as the Sun is a light source and planets, moons, meteors, are opaque objects of differing sizes, they all cast shadows behind themselves. Write their answers on the board.

Read in class the text on page 176 defining the term Eclipse and the principle behined eclipse formation. Ensure that the students understand that an eclipse is a shadow that falls on the surface of a planet/moon/meteor.

Why do you think no shadow from our neighbouring planets reaches us? Do you think distance or size has something to do with it?

Ask students to read the text and look at the photographs of the two types of eclipses. Encourage them to look at the similarities between the two eclipses and consider the distances between the Sun, the Moon and the Earth.

Answer: *no shadow from our neighbouring planets reaches us, due to both the distances between the planets and the sizes of the planets. For example, Mercury and Venus are both smaller than the Earth and so if they do fall between the Sun and the Earth, they may only appear as a small dot on the Sun.*

Read out the definitions of the Lunar and Solar eclipses. Ask the students if they have heard about complete or partial eclipse. Read out the description, then guide the students through the stretch zone activity.

Stretch zone: Make a model of the solar system but use a bulb for the sun; make the planets from modelling clay. Turn the bulb on and see how the rotation of planets in their own orbits around the sun creates shadows

- Looking at the eclipse diagrams and based on your observations during the activity earlier, discuss which phase of the moon occurs in:

  a solar eclipse

  b lunar eclipse

Answer: *the new moon phase of the moon occurs during a solar eclipse, whereas during a lunar eclipse, the fukl moon phase of the moon occurs.*

Possible response: *Some metals are better conductors Summarise the lesson by asking volunteers to share*

their learning. Then ask students to close their books and on a piece of blank paperdraw and label a complete eclipse (either solar or lunar). They should also explain why using an ammeter improves their investigations.

Review and reflect

Encourage students to reflect on their own learning by pausing for a few moments and thinking about which parts of the work they found tricky. Talk about how they managed this and suggest that next time they stop for a short while and take a few deep breaths. Also remind them that when they are doing challenging work, they are training their brain and this will help their future learning. Allow them to walk around the displays of posters and information leaflets about Ampère to compare their work with others and pick up ideas for improvements.

Extra activities

1 Ask students to research historical significance of Eclipses. They can prepare a small report and present to the class.

Differentiation

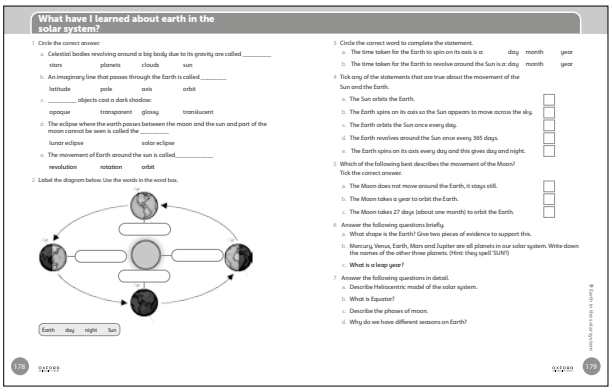
Supporting: Set up the a model of the Sun, Moon and the Earth to work out how eclipses occur.

Consolidating: Ask students to make posters of Lunar and Solar eclipses , marking out the partial and complete eclipse zones.

Extending: Students can research the precautions associated with observing Solar eclipse. Ask them to explain why there are no risks to eye sight when observing a lunar eclipse.

Differentiated outcomes	
All students	should be able to state that eclipses are results of shadow formation
Most students	will be able to describe a lunar, solar, complete and partial eclipse
Some students	may be able to explain why we are not able to observe eclipses of other planets from Earth with our naked eye

What have I learned about Earth in the solar system?


What have I learned about earth in the solar system?

1 Circle the correct answer.
a. Celestial bodies revolving around a big body due to its gravity are called _____
star planets clouds sun
b. An imaginary line that passes through the Earth is called _____
latitude pole axis orbit
c. _____ objects cast a dark shadow:
opaque transparent glassy translucent
d. The eclipse where the earth passes between the moon and the sun and part of the moon cannot be seen is called the _____
lunar eclipse solar eclipse
e. The movement of Earth around the sun is called_____
revolution rotation orbit

2 Label the diagram below. Use the words in the word box.

Earth day night Sun

3 Circle the correct word to complete the statement.
a. The time taken for the Earth to spin on its axis is a day month year
b. The time taken for the Earth to revolve around the Sun is a day month year

4 Tick any of the statements that are true about the movement of the Sun and the Earth.
a. The Sun orbits the Earth.
b. The Earth spins on its axis so the Sun appears to move across the sky.
c. The Earth orbits the Sun once every day.
d. The Earth revolves around the Sun once every 365 days.
e. The Earth spins on its axis every day and this gives day and night.

5 Which of the following best describes the movement of the Moon?
Tick the correct answer.
a. The Moon does not move around the Earth, it stays still.
b. The Moon takes a year to orbit the Earth.
c. The Moon takes 27 days (about one month) to orbit the Earth.

6 Answer the following questions briefly.
a. What shape is the Earth? Give two pieces of evidence to support this.
b. Mercury, Venus, Earth, Mars and Jupiter are all planets in our solar system. Write down the names of the other three planets. (Hint: they spell 'SUNY)
c. What is a leap year?

7 Answer the following questions in detail.
a. Describe Heliocentric model of the solar system.
b. What is Equator?
c. Describe the phases of moon.
d. Why do we have different seasons on Earth?

9 Earth in the solar system

178 OXFORD 179

Getting started

The aim of this section is to encourage students to review their learning after each topic in the unit. On pages 178-179 of the Student Book there are some consolidation questions for students to answer. These will assess students' knowledge and understanding of the topic.

It is important that students report areas that they are not confident with. This information is vital for you to provide remediation in the end-of-unit summative assessment.

You may have been asking students to tackle questions and review statements after some lessons – links to appropriate ones have been pointed out in the lesson sections of this Teacher's Guide. If this is the case it is worth considering asking students to revisit them as a single activity so they can think back over the whole unit. If you have been saving up the questions and statements for an end-of-unit review session, you can ask students to complete them in this lesson. This can be done as an individual challenge, a pair activity or a whole-class question and answer session. After students have completed the questions read out the expected answers and let them check their progress.

'What have I learned about Earth the solar system?' answers

1 Circle the correct answer.

Answer: *Students should answer as a. planets b. axis c. opaque d. lunar e. revolution.*

2 Label the diagram using the words in the word box.

Answer: *clockwise from the top: Earth, Sun, night, day.*

3 Circle the correct word to complete the statement.

Answer: *Students should answer a. day; b. year.*

4 Tick any of the statements that are true about the movement of the Sun and the Earth.

Here, you can give a hint to the students that only three statements are correct so they should tick only three.

Answer: *Students should tick statements b, d, and e.*

5 Which of the following best describes the movement of the Moon?

Tick the correct answer.

Answer: *c.*

6 Answer the following questions briefly.

a. What shape is the Earth? Give two pieces of evidence to support this.

b. Mercury, Venus, Earth, Mars and Jupiter are all planets in our solar system. Write down the names of the other three planets. (Hint: they spell 'SUN'!)

c. What is a leap year?

Answer: *a.Students should answer that the Earth is spherical. Evidence is images from space, space centres and landings on the Moon, and from people who have travelled around the world. b. Make sure students understand that the 'SUN' hint means that one planet begins with 'S', one with 'U' and the other with 'N'. Answer: Saturn, Uranus, Neptune.*

c. a leap year occurs every four years, when all the quarters of a day (from the 365 1/4 days it takes Earth to complete one full year around the Sun) and make them into an extra day in February.

7 Answer the following questions in detail.

a. Describe Heliocentric model of the solar system.

b. What is Equator?

c. Describe the phases of moon.

d. Why do we have different seasons on Earth?

Answer: *Students should be encouraged to answer the questions using the information from the units, rewritten in their own words.*

Summative assessment

The questions in the 'What have I learned about Earth the solar system?' section of the Student Book can be used to consider the progress of each student individually. You can also use the information to create summative reports – such as end-of-term reports – for each student. As with all of the units this year, you can allocate scores based on the number of questions answered correctly or by splitting the questions into smaller sections. You could allocate marks as follows: question 1 = 5 marks; question 2 = 4; question 3 = 2 marks; question 4 = 3 marks; question 5 = 1; question 6 = 3; question 7 a,c, d = 2 marks each, 7b = 1 mark. This makes a total of 25 marks.

This information may also be used to create end-of-term reports for each student. It may also be useful to keep a record of overall confidence levels for the whole class to identify areas that may need revision later.

This feedback can then be used to form support strategies to help students improve. Keep the recording and analysis of the students' self-evaluations simple. A general impression of the self-evaluation of the class is all that is required, for example: 50% per cent of the class were not confident about … .

Investigate like a scientist

The Investigate like a scientist activities are designed to encourage students to apply their investigative and creative skills and review key aspects of the content of the unit.

Resources: access to the internet or books and magazines for research required into a timeline about solar system discoveries.

Discovering the solar system

Students work in groups to produce a timeline about solar system discoveries, using books, magazines and the internet for their research. They find out about four scientists – who they were, what they discovered, and where and when they did this.

Possible response: *Based on their own research, students should create a timeline. Check that the text and any visual elements they have included are relevant and accurate.*

Sunrise and sunset times

Resources: access to the internet; a globe or world map; materials to make a poster.

Students research sunrise and sunset times for their area and for four other countries of their choice. They compare the data and try to find patterns. They find the other four countries on a globe or world map and investigate whether the position of each country affects

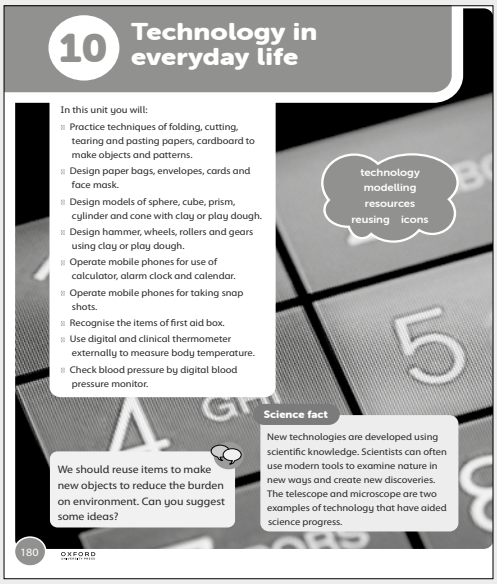
the sunrise and sunset times. They make a poster of the information they find. Before making their posters, you could allow students to compare their findings with others' findings, then add or change information if they wish. Students could work on this activity to assess and review their learning in this unit. You could display the work as part of a science event.

Possible response: *Students' answers will vary according to the research they carried out. Discuss answers as a class and ensure that students have used reliable and trustworthy sites for their information. Students compare their findings with others and can add information or change it if they think an alternative is more accurate.*

10 Technology in everyday life

In this unit students will:

- Practice techniques of folding, cutting, tearing and pasting papers, cardboard to make objects and patterns.
- Design paper bags, envelopes, cards and face mask.
- Design models of sphere, cube, prism, cylinder and cone with clay or play dough.
- Design hammer, wheels, rollers and gears using clay or play dough.
- Operate mobile phones for use of calculator, alarm clock and calendar.
- Operate mobile phones for taking snap shots.
- Recognise the items of first aid box.
- Use digital and clinical thermometer externally to measure body temperature.
- Check blood pressure by digital blood pressure monitor.



Getting started

This unit explores how the application of technology in real life, from the simple to the sophisticated. Students will discover that technology is application of skills and scientific knowledge to solve simple to complex issues. They will learn about items in the first aid and how to use the thermometers and blood pressure monitor. Students learn about renewable uses of paper and practice creating such items. Finally, students can discover the uses of mobile phone devices.

Science in context

Use the lessons in this unit to encourage students to learn more about the application of science and maths in real life. Allow students to survey and investigate the domains where these subjects overlap and can be observed, e.g. in their local playground. Encourage students to find out about people who use science, maths as well as arts, as part of their work and introduce them to the concept of STEAM and STEM.

Scientific enquiry skills

Scientific enquiry skills for this unit focus on reminding students that science is also a creative human endeavour. Imagination is vital to scientific progress.

Students are encouraged to plan and carry out full-scale project work and apply the skills learned earlier. Students are encouraged to evaluate their work. And to present their results in a variety of ways, including drawings, bar charts, graphs and tables. Students should be encouraged to use computer technologies to help in collecting and presenting data.

Resources

Student Book: newspaper; a pair of scissors; glue; pen/pencil; a piece of cardboard; thick string, rope or ribbon; colouring pens, paints, stickers, or crayons; a ruler, a pencil, and an eraser; coloured paper (used wrapping paper or magazines); tape; 13 cm by 20 cm sized stiff paper/card; stickers or small pictures; playdough or clay; cell phone; a bandana, scarf or cloth (roughly 50 by 50 cm); two rubber bands or elastics; first aid box; digital thermometer; climical thermometer; BP apparatus.

Key words for unit

are in the Word cloud.

technology modelling resources reusing icons

Scientific enquiry key words

Plan and/or carry out tests

Make predictions

Recognise and control variables

Make observations

Take measurements, using equipment accurately

Record data and results

Analyse data, notice patterns and group or classify things

Report and present findings

Draw conclusions and give explanations

Identify causal relationships

Language support

At this age, students are likely to be able to read independently and look up any words they find unfamiliar, so encourage them to use scientific dictionaries. Start the unit by reading out the words in the Word cloud. Ask students to discuss each word and define those they are familiar with. This monitoring of prior knowledge is vital and can help you enormously in setting the level of work in the first few lessons. For every unit it is worth creating a Word wall so students see the words often and can become familiar with them. Students are old enough to make their own word cards for display so this could be an early task. Have daily quizzes about the words – point to one and ask, 'What does this word mean? Use it in a sentence.'

Remind students that they should note definitions of key words as they progress through the unit. This could be a regular end-of-lesson task or starter to encourage recall.

Repeat any new words regularly and use them in context. Students should listen, say, read and then write the words. They can also make a list of new non-science specific words they use in lessons. Some of these are listed in the individual lesson notes that follow.

You could create a science library in your room. Collect resources such as science books and magazines, science encyclopaedias and dictionaries. You can also collect or download specific information about topics for each lesson or activity and make a booklet of these like a class magazine. Students will enjoy helping with the production of these small information booklets and they can include some of their own work. You will find these specific booklets very valuable support for lessons and especially activities.

Unit at a glance

The key teaching points for students in this unit are:

- to introduce the unit objectives
- to introduce the learning outcomes
- to engage students with the content of the unit
- to review and build on prior learning and understanding of the topics.

The purpose of this introductory lesson is for students to start thinking about and reviewing prior knowledge of recycling, reusing and aspects of technology usage in daily life.

Read through the key words and then allow students time to enjoy looking over the page before you start the sequence of discussion tasks.

Arrange students into pairs or small groups of three or four for discussion work. A useful strategy is to start with students in pairs and then move pairs together to make small groups so students can share their ideas and discussions with others.

We should reuse items to make new objects to reduce the burden on environment. Can you suggest some ideas?

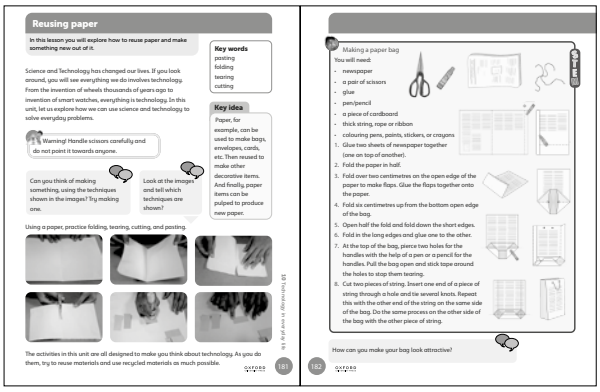
Ask students to carefully consider their earlier lesson on pollution and environment. They can discuss it, make a list of any suggestions they may have, and then decide if the suggestions are doable.

> ***Possible response:*** *Students should identify a range of uses for items made from paper, cardboard, plastics, even furniture and clothes.*

Science fact New technologies are developed using scientific knowledge. Scientists can often use modern tools to examine nature in new ways and create new discoveries. The telescope and microscope are two examples of technology that have aided science progress.

Read out the Science fact or ask a volunteer to read it out. Ask students if they have any other examples similar to the ones shared in the science fact.

Reusing paper



Getting started

In this lesson students will learn how to reuse paper and make something new out of it. They will get hands on practice of paper reuse and creative thinking.

Language support

To help develop language skills and review key words you can write the words that students will have heard of before on the board and ask students to tell their partner what each word means.

Resources

Student Book: writing materials; materials to make leaflets.

Key words

pasting folding tearing cutting

Other words in the lesson

conifer falcon fern fungi (moulds, mushrooms, toadstools) genus moss prokaryotes (algae and bacteria) protists

Scientific enquiry key words

Plan and/or carry out activities

Make observations

Record data and results

Analyse patterns and group or classify things

Report and present findings

Lesson at a glance

The key teaching points for students in this lesson are:

- Paper can be used to make bags, envelopes, cards, etc.
- Paper can be reused to make other decorative items.
- Paper items can be pulped to produce new paper.

Ask students to think carefully and share with class any examples of uses of technology in their daily life. Point out that something as simple as drawing a straight line using a ruler can be considered as application of technology.

Direct their attention to the photos showing the different paper manipulation techniques. You can encourage them to identify the techniques and answer the suggested discussion questions.

Investigation: Making a paper bag

Ask students topay heed to the warning about scissors and to treat them with caution. Use the step by step guide to create paper bags to each student. Alternatively, the students may work in groups to create paper bags.

Ask them to decorate the said paper bags, using recycled/recyclable materials.

Key idea

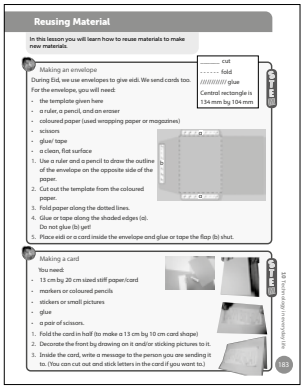
Paper, for example, can be used to make bags, envelopes, cards, etc. Then reused to make other decorative items. And finally, paper items can be pulped to produce new paper.

Read through the key idea or ask a volunteer to read it out to the class. Encourage students to share their thoughts on the activity they have just done and how they can recycle the said items.

Review and reflect

Allow some quiet time for students to reflect on what they found easy and/or interesting in the unit.

Reusing Material


Reusing Material

In this lesson you will learn how to reuse materials to make new materials.

Making an envelope

During Eid, we use envelopes to give eidi. We send cards too. For the envelope, you will need:

- the template given here
- a ruler, a pencil, and an eraser
- coloured paper (used wrapping paper or magazines)
- scissors
- glue/ tape
- a clean, flat surface

1. Use a ruler and a pencil to draw the outline of the envelope on the opposite side of the paper.
2. Cut out the template from the coloured paper.
3. Fold paper along the dotted lines.
4. Glue or tape along the shaded edges (a). Do not glue (b) yet!
5. Place eidi or a card inside the envelope and glue or tape the flap (b) shut.

cut
fold
glue
Central rectangle is 134 mm by 104 mm

Making a card

You need:

- 13 cm by 20 cm sized stiff paper/card
- markers or coloured pencils
- stickers or small pictures
- glue
- a pair of scissors.

1. Fold the card in half (to make a 13 cm by 10 cm card shape)
2. Decorate the front by drawing on it and/or sticking pictures to it.
3. Inside the card, write a message to the person you are sending it to. (You can cut out and stick letters in the card if you want to.)

183

Getting started

This lesson is a practical extension to the previous unit. It it kept separate to allow teachers and student to explore alternate methods of teaching learning. The activities can be given as class collaborative tasks, as Stretch zone activities, as homework or as part of sustainability research.

Resources

Student Book: coloured paper and stiff cardboards; stickers; colour pencils or markers; stickers; scissors; glue.

Scientific enquiry key words

Plan and carry activities

Make observations

Take measurements, using equipment accurately

Analyse patterns

Report and present findings

Draw conclusions and give explanations

Identify causal relationships

Lesson at a glance

The key teaching points for students in this lesson are:

- materials can be reused to make useful items.
- paper based items are easier to use, reuse, and recycle.

Students can work with a partner. Ask them to recall the techniques they used in the previous unit. Remind them that they will use the same techniques in the activities listed in this unit.

Guide them to understand and follow the template key given in the book. The different symbols indicate the different actions which have to take place.

Remind the students they can size the template up or down, i.e. make it bigger or smaller. Help them reproduce the template either through a photocopier or manual method.

Investigation: Making an envelope

Use the given materials list and the template to encourage students to make envelopes from recycled paper.

The template given in the textbook is easy and simple to scale up and down, so you can easily help students make the envelopes bigger or smaller. You can also get a bigger template by asking the photocopier to produce a bigger copy of the template.

Encourage students to follow the simple steps. Ensure they follow the action key to fold and or cut at the proper places. The students can decorate their envelopes using the leftover scrap paper.

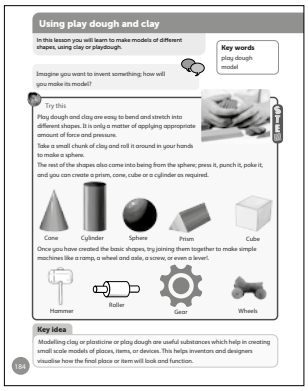
Investigation: Making a card

This is a simpler activity as it does not require much in the way of paper tearing or pasting. However, the learning lies in encouraging students to actively seek out used papers or cardboards as design materials. how the birds' beaks are adapted to the food they eat.

Review and reflect

Encourage students to reflect on their own learning by pausing for a few moments and thinking about the way they undertook the investigations. Talk about how they managed this and how they worked as a team. Remind them that when they are doing tricky work they are training their brain and this will help their future learning.

Using play dough and clay


Using play dough and clay

In this lesson you will learn to make models of different shapes, using clay or playdough.

Key words
play dough
model

Imagine you want to invent something; how will you make its model?

Try this

Play dough and clay are easy to bend and stretch into different shapes. It is only a matter of applying appropriate amount of force and pressure.

Take a small chunk of clay and roll it around in your hands to make a sphere.

The rest of the shapes also come into being from the sphere; press it, punch it, poke it, and you can create a prism, cone, cube or a cylinder as required.

Cone Cylinder Sphere Prism Cube

Once you have created the basic shapes, try joining them together to make simple machines like a ramp, a wheel and axle, a screw, or even a lever!

Hammer Roller Gear Wheels

Key idea

Modelling clay or plasticine or play dough are useful substances which help in creating small scale models of places, items, or devices. This helps inventors and designers visualise how the final place or item will look and function.

184

Getting started

In this lesson students will learn to use clay or playdough to make models of different shapes. This lesson can be extended to review the lesson on effects of force on objects.

Language support

Students are generally familiar with the terms playdough and model. Explain further the role of model making in scientific investigation and review the key terms from the study about Forces to enhance learning.

Resources

Student Book: playdough or plasticine or clay.

Key words

playdough model

Scientific enquiry key words

Plan and/or carry out investigations

Make observations

Record results

Report and present findings

Draw conclusions and give explanations

Lesson at a glance

The key teaching points for students in this lesson are:

- models can be constructed using simple materials.
- model making can start from simple and become more complex as required by the investigation.

Ask students to look at the photographs on the page. You can also display a variety of other model making techniques. Ensure that you are able to guide the students through the process of model making. Begin by asking students the discussion question and then lead them to create simple shapes, and then models of simple machines. Encourage them to discuss how they can create small working models of simple machines: would it require different materials? Why ? or Why not?

Imagine you want to invent something; how will you make its model?

Students can work in pairs or small groups. Ask them to list the ways an object or process can be modeled. They may respond with poster-making or drawing. Ask them to consider the usefulness of 3D models.

Guide the students towards the investigation on the page. Begin by using the material at hand to create simpler objects.

Investigation: Try this

Guide the students to create 3D models of shapes using clay or playdough. Once they are done, ask them if they can combine the shapes to form models of simple machines.

Key idea

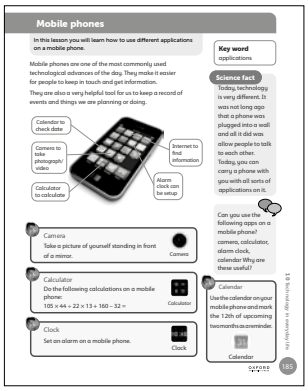
Modelling clay or plasticine or play dough are useful substances which help in creating small scale models of places, items, or devices. This helps inventors and designers visualise how the final place or item will look and function.

Read through the key idea or ask a volunteer to read it out to the class. Ask students to share what other materials may be useful in a modelling activity.

Review and reflect

Encourage students to reflect on their own learning by pausing for a few moments and thinking about which parts of the work they found tricky. Ask them how they tried to learn the names of the five groups of microorganisms. Talk about how well they managed this.

Mobile phones



Getting started

In this lesson students will get hands-on idea of how easily available technology, such as a mobile phone, is versatile enough to be used in scientific investigations.

Resources

Student Book: a cell phone with calender, camera, calculator, internet access and alarm clock.

Key word

applications

Scientific enquiry key words

Make observations

Record data and results

Analyse data, notice patterns and group or classify things

Report and present findings

Draw conclusions and give explanations

Lesson at a glance

The key teaching points for students in this lesson are:

- a number of applications in a cell phone are very useful in our daily life
- applications such as camera, calculator, alarm-stopwatch, etc. can be used in simple scientific investigations.

Point out the text an labeled image on top of the page. Ask them to read and review the images before beginning the discussion and hands-on activities.

Ask students to work with a partner to share a mobile devise and attempt the given activities. As these activities are simple, and easy to follow, encourage the students to perform them on own initiative.

As a teacher instructor, you may encourage the students to design a small project which utilizes all these applications to gather data and evidence. Help the students ensure a fair test along the way and instill in them the importance of data and evidence in scientific investigations.

The activities in the boxes labeled Camera, Calculator, Clock and Calender can be used as a warm-up before asking students to design an experiment on any of the unit topics they have studied earlier.

Explain to students that scientists need to monitor their experiments and observations points (e.g. in a habitat) regularly and check if animals and plants are dying out, if they are growing well, or if there is any new, expected or unexpected development of any kind. Remind them that a cell phone with the multiple applications is a useful tool when used to gather data and evidence of data in a scientifically accurate manner.

Key idea

Today, technology is very different. It was not long ago that a phone was plugged into a wall and all it did was allow people to talk to each other. Today, you can carry a phone with you with all sorts of applications on it.

Read through the key idea or ask a volunteer to read it out. This will help students to review the main themes of the lesson.

Review and reflect

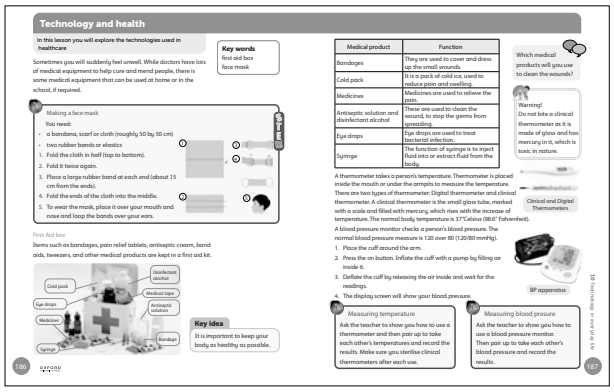
Encourage students to display their keys and allow them to walk around to see what others have produced. They can have some quiet time to reflect on how they could modify their keys to improve them. Point out that reflecting on their work and learning from others is a very important part of learning.

Differentiation

Extending: Allow students to design or redesign earlier investigations (from previous units) using the apps to collect data. Does rigorous data collection have an impact on the results? Why? or Why not?

Differentiated outcomes	
All students	should be able to use the apps in the cell phone
Most students	will be able to use the apps for scientific data collection in the earlier investigations
Some students	may be able to design and test their own project/experiment

Technology and health



Getting started

This lesson can be used as an extension or review for the Human Health chapter. the activities included in this lesson provide a good review and cap opportunity for the topics of disease transmission and maintaining health.

Resources

Student Book: a first aid box with thermometers and blood pressure apparatus; a bandana, scarf or cloth (roughly 50 by 50 cm); two rubber bands or elastics.

Key words

first aid box face mask

Scientific enquiry key words

Report and present findings

Draw conclusions and give explanations

Identify causal relationships

Lesson at a glance

The key teaching points for students in this lesson are:

- healthy living requires constant care of our body and surroundings
- there are many protocols and aids available to ensure we lead healthy lives.

Allow students to work with a partner to read the introductory paragraph of the unit. Ask them to recall what they learned earlier about the human health. Remind them that nowadays there are many medical aids which can help us heal, diagnose or prevent ill health. Ask them if they can recall any such aid from the previous few years.

Answer: *Students may talk about cough syrups, band-aids, allergy medicines, etc. Some may recall the Covid era and remember hand sanitizers and face masks.*

Ask students to recall the purpose of using face masks. This is a good opportunity to recall and review the healthy living and prevention of infection related information with the students. You can then guide them to the activity.

Investigation: Making a face mask

This activity is designed to give students the opportunity to understand how household items can be used, reused, and upcycled to create useful items.

Ensure that the students use clean cloth for this activity and their own hands are also clean and dry. Guide them to follow the instructions in the books; you may need to help them measure accurately and affix the bands.

Read out the description of first aid box and point out the different items contained within. At this point, it would be good to show students the school first aid box and point out different items within. Encourage a discussion within the class on the role of different items of the first aid kit.

Which medical products will you use to clean the wounds?

Allow students to brainstorm and share their ideas. Then direct them towards the table on page 187, listing the function of different products.

Next, although students have probably already had some experience of using a thermometer, ensure that they are adequately warned of the dangers of mercury contained within. Make sure they remember to never, ever, under any circumstance bite or chew the glass bulb of a thermometer.

Read through or ask a volunteer to read the text describing the types of thermometers. Demonstrate in class the correct way to use a thermometer and how to take readings.

Next, divide the students into groups. First read through the description of a sphygmomanometer (pronounced sFig-mo-mAno-meter), aka the blood pressure apparatus. This is a good opportunity to recall the role of blood and the importance of a steady pulse. Encourage the students to practice taking blood pressure readings.

Key idea

It is important to keep your body as healthy as possible.

Read out the key idea or ask a volunteer to read it out. Ask students to turn to a partner and tell them one way that they intend to help to protect the environment from now on. Remind them of the acronym from this lesson: TREES.

Review and reflect

Encourage students to identify aspects they have not completed correctly and help them to identify improvements. This will help students to develop a positive approach to learning by understanding that learning is a process that will improve with practice and reflection. For example, they can walk round and look at the information leaflets produced by others to identify what they have done well and what they can learn from others as targets to improve their work.

Extra activities

1 Allow students to construct the ponds they designed for the Stretch zone task. They can use a corner of the school grounds if one is available. They will need to dig out a circle shape that is 0.4 metres deep at its deepest and line it with sand and then a waterproof liner. The liner can be held in place by rocks around the edge and the pond filled. Plants such as reeds and water lilies can be added.

2 Invite a representative of a local conservation group to meet with your class and talk about their work. Ask them to bring in examples of scientific equipment that they use and also any photographs of the habitats and living things they are working to protect.

Differentiation

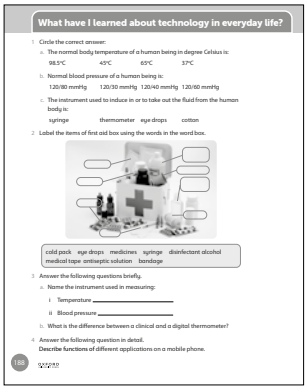
Supporting: Ask students to use thethermometers to note down temperature. Remember to wash and clean the thermometers between each use.

Consolidating: Students can collect data on where the most accurate temperature reading can be observed: through the mouth or the underarm.

Extending: Students can note down each others blood pressure and then run small tests to see if exercise and eating different types of foods can bring about change in the blood pressure.

Differentiated outcomes	
All students	should be able to state the different items in a first aid kit
Most students	will be able to describe the functions of items in a first aid kit
Some students	may be able touse a sphygmomanometer to take blood pressure.

What have I learned about Technology in everyday life?


What have I learned about technology in everyday life?

1 Circle the correct answer:

a. The normal body temperature of a human being in degree Celsius is:
98.5°C 45°C 65°C 37°C

b. Normal blood pressure of a human being is:
120/80 mmHg 120/30 mmHg 120/40 mmHg 120/60 mmHg

c. The instrument used to induce in or to take out the fluid from the human body is:
syringe thermometer eye drops cotton

2 Label the items of first aid box using the words in the word box.

cold pack eye drops medicines syringe disinfectant alcohol medical tape antiseptic solution bandage

3 Answer the following questions briefly.

a. Name the instrument used in measuring:
i Temperature _____
ii Blood pressure _____

b. What is the difference between a clinical and a digital thermometer?

4 Answer the following question in detail.
Describe functions of different applications on a mobile phone.

188

Getting started

The aim of this section is to encourage students to review their learning after all of the lessons in the unit. All the lessons in the unit have questions and discussion tasks for students. You will have been using these formatively during lessons to help you assess students' knowledge and understanding of the topics.

On page 188 of the Student Book there are four questions related to the content of the unit. The questions are arranged in increasing order of conceptual demand and not topic order. Students can tackle these one at a time after individual lessons The questions could also be answered as a single summative activity. This could be done by reading out the questions to the class and asking for volunteers to answer them, carrying out the activity as a group work task with students talking about each question, or as an individual written task. Whichever approach is adopted, the questions are designed to give you and the students feedback about progress and to help in identifying targets for development.

Time to reflect may make a student more or less confident and later learning may support understanding of a topic that had been causing problems for some students. As teachers, we know that not all learning takes place at the time the teaching takes place.

What have I learned about Technology in everyday life? answers

1 Circle the correct answer.

a. The normal body temperature of a human being in degree Celsius is:
98.5°C 45°C 65°C 37°C

b. Normal blood pressure of a human being is:
120/80 mmHg 120/30 mmHg 120/40 mmHg
120/60 mmHg

c. The instrument used to induce in or to take out the fluid from the human body is:
syringe thermometer eye drops cotton

Point out that one of the multiple words or phrases will be correct and students must circle the answer. Stress how important it is to follow question instructions exactly.

Answer: *a. 37°C; b. 120/80 mmHg; c. syringe.*

2 Label the items of first aid box using the words in the word box.

Answer: *in clockwise order the answers are: disinfectant alcohol; medical tape; antiseptic solution; bandage; syringe; medicines; eye drops; cold pack.*

3 Answer the following questions briefly.

a. Name the instrument used in measuring:

i. Temperature

ii. Blood pressure

b What is the difference between a clinical and a digital thermometer?

Answer: *a. i Thermometer; ii Blood pressure monitor or a sphygmomanometer.*

b. A clinical thermometer is made of a small glass tube, marked with a scale and filled with mercury, which rises with the increase of temperature. A digital thermometer has a digital screen to display the tempurature.

4 Answer the following question in detail.

Describe functions of different applications on a mobile phone.

Answer: *Students can list out the following apps and provide personal experience as well: Calendar helps us to check dates, Camera is used to take photograph/ video, Alarm clock can be setup to remind us of specific times and tasks, and the Calculator helps us calculate sums. There is also the web browser app which helps us browse the internet to find information.*

Summative assessment

The questions in the 'What have I learned about Technology in everyday life?' activity on page 188 of the Student Book can be used to consider the progress of each student individually. You can also use the information to create summative reports – such as end-of-term reports – for each student. If you wish to allocate a score or mark for the questions, then the total number of marks you could allocate is 20 (question 1 = 3 marks; question 2 = 8 marks; question 3a = 4 marks; question 3b = 2 marks; question 4 = 3 marks).

By reviewing responses to the questions and the self-review of confidence levels you can tailor specific interventions to help students improve. Keep the recording and analysis of the student self-evaluations simple. A general impression of the class's self-evaluation, not individual student records, is all that is required, e.g. 'Fifty per cent of the class were not confident about ….'