CHRISTINE MOORCROFT

WORLD WATCH GEOGRAPHY

SECOND EDITION

A Geography Course for Grade 7

TEACHING GUIDE

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Introduction

An outline of the course

World Watch Geography (Second Edition) is a geography course for the 21st century. It is designed for secondary grades that want to stimulate curiosity, thinking skills, and a love of learning. The course comprises four components: Student's Textbooks, Skills Books, My E-Mate companion website, and Teaching Guides.

Core features

- It draws its content and skills from the National Curriculum for Pakistan (2022) and international secondary school syllabuses with special focus on Pakistan.
- At all levels, learning is built on students' knowledge; the teacher eliciting what they already know and building on this, not simply loading them with facts.
- The language, content, and tasks are progressively graded according to class levels.
- Each level is split into separate units, each focusing on a different topic.
- High priority is given to independent and critical thinking skills and building geospatial skills.
- Ideas for discussion are provided to help students to express their own ideas in open-ended tasks.
- Mapping skills are taught in a progressive way that builds on the students' previous learning.
- Diagrams and charts/tables are used to vary the presentation of content.
- Students are encouraged to make connections between the geographical environment and the way people live.

Student's Books

- The Student's Books form the core of the course. The illustrations, photographs, and maps bring alive the familiar environment and distant places, and both natural and man-made geographical features.
- The 'Contents' page details the learning outcomes for each unit.
- Each unit of the Student's Book consists mainly of reading texts and making observations, followed by assessment questions.
- The 'Overview' at the end of each unit virtually represents the various topics in the unit and how they are interlinked to each other.
- Fact boxes contain interesting information about the relevant topics.
- The 'Building Skill' feature box serves as a valuable tool for students to develop geospatial skills and actively engage with the subject matter. These suggested activities

provide practical exercises, real-world scenarios, and opportunities for critical thinking, allowing the students to apply their learning in a meaningful and relevant way.

Skills Books

- At each level, there is an accompanying Skills Book.
- The tasks are varied and enjoyable, and include maps, diagrams, charts or tables, crosswords, fill-in-the-blanks, and situational questions.
- Skills Book pages should be introduced in class and can be completed either in class or for homework.
- Students are usually expected to write in the Skills Book.
- There is a brief learning outcome at the top of every page.

Teaching Guides

Teaching Guides are an invaluable resource for the teacher. It provides a framework for formative assessment of students during each lesson. It has the following features:

- background knowledge
- before we proceed
- expected learning outcomes
- step-by-step lesson plans
- ideas for further activities and student research
- answer keys for Assessments and Skills Book activities
- scheme of work
- geography skills

Components of the Lesson Plan

- **Topics and Page Numbers:** Knowing the topics and page numbers helps the teacher quickly locate and reference the textbook's content.
- **Introduction:** A well-crafted introduction sets the stage for the lesson to help the teacher grab students' attention and provide context. It helps in making the lesson more engaging and relevant to the students.
- **Steps Using Student Books:** These steps guide the teacher in effectively presenting the textbook's content. The logical sequence of actions for content delivery includes strategies, explanations, and activities that promote learning and understanding.
- **Homework:** Assignments and assessments allow students to practice what they have learned during the lesson. Teachers can assign exercises or tasks from the textbook to reinforce the concepts.
- **Discussion and Review:** A summarised review of the lesson allows for active learning by students, encouraging metacognition and critical thinking. Discussions provide students with the opportunity to ask questions and clarify doubts.

Contents

UNIT 1

Plains and Rivers

Background knowledge

Plains: Plains are large areas of flat or gently sloping lowland. There are different types of plain, formed in different ways:

- erosion of highland by glaciers and streams
- volcanic eruptions causing magma to spill across the surface of the land
- tectonic activity, where a number of small pieces of continental crust collide and then join up; later, glaciers, rivers, and streams running down from mountains erode the mountains and leave debris on the plains
- deposits from melting snow and heavy rains, which fill rivers and overflow their banks, flooding the surrounding land; they deposit the mud, sand, and silt that they would normally carry downstream, building up floodplains; examples include the Indus and the Nile floodplains
- rivers and streams rushing down from steep mountains and valleys towards flatter land; water carrying sediment is spread across flat land in fan shapes which become alluvial plains; an example is the Huang He River (Yellow River) in China
- build-up of sediment on the ocean floor from rivers forms stretches of lowland called coastal plains; these form beside seas or oceans with mountains or plateaus between the plain and the inland area; the submerged parts of coastal plains are the continental shelves; an example is the Atlantic Coastal Plain along the eastern coast of North America, which has underwater plains that slope down gradually under the ocean

There are large plains in North America, South America, Asia, and Eastern Europe, Central and North Africa, South Africa, and Australia. The Eurasian Steppe is the largest plain on the Eurasian Plate. There are mountains around this plain where smaller tectonic plates collided and formed this large plate. The North American Plain formed on the North American Plate as the Pacific and the North American Plates collided, and the pressure forced the Rocky Mountains upwards. Most of the rain comes with winds that blow from the Pacific Ocean on the west. Hence, the eastern, sheltered, side of the mountains on the North American Plain has too low an annual rainfall for trees, but enough for grass and small flowering plants.

Rivers: Rivers are bigger and wider than streams, but there is no precise distinction between a river and a stream. A river or stream is a natural flow of fresh water whose source begins on high ground (or several sources that produce streams that meet). It can be difficult to find the exact source of a river. The course of a river consists of the

upper course (near the source), the middle course, and the lower course. Each course has distinctive features because of the landforms it flows through, the amount of water the river carries, the force of the water, and how the river changes the landforms.

Rivers and streams alter the land they flow through by erosion and by deposition of sediment. Some rivers disappear underground, where they may form subterranean (underground) lakes, and eventually flow out from under the ground. Rivers usually run from inland to a coast because land near the coast is usually lower than inland; or they might flow into a lake. If a lake is below sea level, no rivers or streams run out of it. The mouth of a river is where it meets the sea, but people disagree over the exact locations of the mouths of rivers. They also disagree over the length of a river because of different ways of measuring a river that passes through a lake, or they disagree over which tributaries to include. Therefore, the published lengths of many rivers vary.

Before we proceed

A useful way to introduce the topic of plains is to provide photos of different plains (including deserts, tundra, prairies, savannahs, and floodplains), and ask the students to work in groups to describe the distinctive features of plains. In a similar way, a selection of photos of rivers and streams can help the students to come up with a definition of a river or stream.

Expected learning outcomes

Students should be able to:

- recognise and describe different types of plains
- identify and describe the features of different parts of the course of a river
- describe the climate and vegetation of plains
- explain how rivers can change the landscape
- identify how river factors in setting up rural and urban settlements
- recognise diverse river habitats River habitats as ecosystems and environments found along the course of a river and their importance with reference to Indus dolphins
- identify ways in which rivers have a significant impact on plains, shaping their landscape and influencing various ecological and geological processes

Lesson Plan # 1	
Reference pages 1-3	
Topics	**Resources**
• What is a plain? • What are plains like?	• photographs of plains (including deserts, tundra, prairies, savannahs, and floodplains), rivers, and streams (including different parts of the courses of rivers) • *Oxford School Atlas for Pakistan* • Skills Book activity 'The course of a river' • Skills Book activity 'Parts of a river'
Introduction	**Duration: 5-10 min**
Ask the students to look at a collection of photos of different types of plains and to say what is similar about them. They should be able to come up with a definition of a plain (a large, wide area of flat land). Ask how the plains are different—they are all fairly flat, but the vegetation will differ because of the different climates. Ask if the town or city where they live is on a plain. Tell the students that they are going to find out about other types of plains: Arctic tundra and river plains. Ask where they would look on a map of the world for Arctic tundra plains (in and around the Arctic Circle). What do they think the conditions are like on these plains? They should know from their previous work on climates, that the Arctic and Antarctic Circles have cold climates, few trees grow there, the ground has permafrost (a permanently frozen layer), and even the top layer of the ground is frozen for most of the year, while in some places it remains frozen throughout the year. Ask them to name any river plains and locate them on the map. They should be able to find the Nile floodplain in Egypt and the Indus Plain in Pakistan.	**Teacher's Notes**

Using the Student's book	**Duration: 35-40 min**
Ask the students to read 'What is a plain?' and 'What are plains like?' on page 1. They should then read 'Grasslands' and 'Deserts'. Ask what causes the differences between deserts and grasslands. . Ask the students to read 'Arctic tundra' to find out more about these plains. They could also describe what it is like there, referring to the photo on page 2. Ask how plains have lakes and bogs, even though very little rain falls there. They should read 'River plains', after which they could try to explain how rivers form plains, without referring to the Student's Book.	**Teacher's Notes**
Homework	
After reading this section, the students should read 'It's a fact.' and then complete Questions B, using a political map in *Oxford School Atlas for Pakistan* to help them to identify the countries where the plains are located. They can also answer Skills Book activities 'The course of a river' and 'Parts of a river.'.	
Discussion and review	
Ask the students what they have learnt in this lesson. They could make a note of this, summarising the lesson, for example: ✓ I learned the locations of the world's main plains. ✓ I learned the main ways in which plains are formed. ✓ I learned about the different types of plains in different regions of the world. ✓ I learned how plains are formed.	

Lesson Plan # 2	
Reference pages 4-6	
Topics	**Resources**
• Locating plains on the world map (Time zone) • Rivers • Course of a river (till dams)	• a torch • a globe • *Oxford School Atlas for Pakistan* • Skills Book (Erosion and deposition; Fertile floodplains of River Nile; Times around the World)
Introduction	**Duration: 5-10 min**
Locating plains on map (timezone): Ask the students whether different places in the world have the same timings of sunrise and sunset. Explain that as the Earth moves around the Sun, the parts that face the Sun have day while those parts which are turned away from the Sun have night. **Suggested activity:** Invite a student to use the torch while you hold the globe to demonstrate how sunrise moves around the Earth. Make sure you rotate the Earth in the correct direction. (Sunrise travels from east to west as the Earth rotates anticlockwise.) The students should notice that the sunrays (represented by the torch) fall on those parts of the Earth that face the Sun. The ones away from the Sun have night. **River and the upper course of a river:** Explain that this section is about the different stages of rivers, called courses: the upper course (beginning with the source of the river), the middle course, and the lower course (near the sea). Tell the students that they are going to find out about the courses of rivers by referring to the River Indus in Pakistan and how it affects the landscape it flows through, beginning with the source and learning about some features of the upper course of a river. Ask where rivers come from. The students might remember from their previous learning about the water cycle, that rivers come from rainfall and ground water (or from a glacier). Remind them that the source of a river is usually a tiny spring that comes out of high ground and flows downhill.	**Teacher's Notes**

Using the Student's book	Duration: 35-40 min
Mapping and time zones: Read the text on page 4 and ask them to spot types of plains and rivers in Asia near Pakistan. Ask them to brainstorm about time zones. Ask the students why the people in the very distant past did not need to measure the exact time of day. (They needed only to know when it was night or day. If necessary, they could tell when it was midday by the position of the Sun.) Ask what they have learnt about ancient civilisations that needed more accurate times. (They used shadows.) Explain that they developed other ways of measuring time when there were no shadows or no sunlight, including water clocks and candles. They also made mechanical clocks. Explain to students that lines of longitude were used for a long time before this to help in navigation, but not for measuring time. Ask them to look at the diagram of lines of longitude on this page. Ask whether lines of longitude are parallel. (No—parallel lines never meet, but these lines meet and cross at the Poles. They are not parallel.) Ask two students to use the globe and torch again to demonstrate the Earth's rotation and sunrise around the world. Look at the diagram of the International Date Line in the *Oxford School Atlas for pakistan* and ask which line of longitude it follows. Elicit that the International Date Line is not one straight line but changes direction in places. Ask why this happens. (It would be confusing if parts of a small island had different times and dates, so the line has been drawn so that it goes around islands.) They can now do the Skills Book activity 'Time zones around the world'. **Rivers and Upper course of a river:** Ask the students to look at the diagram of the upper course of a river (page 4) and ask what determined the course of the river. (Did the river flow this way because there was a valley, or did the river cut the valley?) Explain that when water flows downhill, it follows the easiest route, but over time it cuts away and erodes the rock. Ask if they are surprised that water can wear away rock. To help them understand this, ask them to think about the force of water coming out of a tap turned on fully, or through a hosepipe—then imagine this water carrying tiny bits of grit and soil (called sediment).	**Teacher's Notes**

The force of these tiny particles of sediment can wear away a lot of rock over millions of years. (Note that softer rock wears away more easily than harder rock.) Now ask the students to read pages 4-5 about 'Rivers' and 'The upper course of a river'. Then ask if they remember the word for the place where a river starts as a tiny spring (the source), what we call a young river as it begins to flow downhill (a stream), and how the stream changes the landscape over time. Ask them to describe the shape of the valley that the stream cuts (V-shaped) and about any small landforms that are common in the upper courses of rivers (spurs and interlocking spurs). Invite volunteers to describe other features of the upper course of a river, and how they are formed (rapids, waterfalls, gorges, canyons). They might be surprised to see the size of the gorge cut by the River Allen, which is not at all unusual, because of the power of the fast-flowing water and the abrasive action of the stones and sediment it carries. Explain that fast-flowing water carries sediment (bits of sand, soil, and silt) but once it slows down, it deposits (drops) the sediment. They might find it interesting to know that since this photo was taken, the river flooded its banks and washed away sections of the footpath where the photographer stood! The sediment and other material that was washed away was deposited farther downstream.	
Using the Skills Book	**Duration: 35-40 min**
Times around the World: Split the class into groups of three or four and ask them to discuss the scenario shown on pages of the Skills Book 'Times around the world' before writing their answers. They will need an atlas to find the cities. They might be able to help one another if some do not know which countries, they are in. They could check on the Internet. They should write the time differences between different cities on this page. Ask the students which of the cities mentioned in the Skills Book activity has sunrise first: London, Islamabad, Toronto, Sydney, or Honolulu. (Toronto). Honolulu gets sunrise last, but it has the latest time in the scenario in the Skills Book. Ask why. (Because it is still one day ahead of the others.) Ask the students to re-read the pages of this unit and complete page 40 of the Skills Book 'Fertile floodplains of the River Nile'. They should try to remember what they have read—or take notes, to help them to complete activity 'Erosion and deposition' for homework.	**Teacher's Note**

Homework

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Discussion and review

Ask the students what they have learnt in this lesson. They could make a note of this, summarizing the lesson, for example:

- ✓ I learned that the Sun rises gradually round the world from east to west.
- ✓ I learned that countries around the world agreed on international time zones separated by lines of longitude.
- ✓ I learned that the Prime Meridian is the line of longitude that passes through Greenwich Observatory in London and that the other lines of longitude are numbered away from it to the east and west.
- ✓ I learned that longitude 180° is the International Date Line and indicates where one day ends and another begins.
- ✓ I learned that rivers begin at a source, which is a small spring where water pushes through a weak point in the ground.
- ✓ I learned that in the upper course, the ground slopes quite steeply and the river flows quickly, carrying sediment.
- ✓ I learned that the force of the fast-flowing water of a river in its upper course cuts many features in the landscape.

Lesson Plan # 3	
Reference pages 6-9	
Topics	**Resources**
• Dams • Middle course of a river • Lower course of a river • Rural urban settlements on plains	• Skills Book (The course of a river; Parts of a river; Shapes of landforms; Depositional, erosional, or both landforms)
Introduction	**Duration: 5-10 min**
Tell the students that they are going to learn about the middle course of a river, where the fast-flowing water reaches land that slopes much less steeply. Ask how this change in the landscape will affect the flow of the river. (The gradient here is gentle and sideways erosion has enlarged the river channel. The river channel has also deepened, and the river flows more powerfully and has a larger volume of water. Because the river channel is larger, there is less friction, so the water flows faster. It spreads out sideways where the land is flatter, creating a floodplain.) Discuss what the students know from previous lessons, and from history studies, about the floodplains of the Indus and the Nile rivers, and how these floodplains have been useful since ancient times because of the rich soil deposited by the river, and for irrigation. Tell the students that they are going to find out about the lower course of a river, where the rivers approach the sea, and have collected a lot of water and become deeper and wider. Ask what the part of the river where it meets the sea (mouth) is called. Explain that here rivers are usually flowing through much flatter, lower land. Introduce two new words that they will encounter for the different forms of the mouth of a river: delta and estuary. They have probably heard of the Indus and the Nile Deltas. Ask/Explain what the terms mean before they read the next section of the Student's Book.	**Teacher's Notes**
Using the Student's book	**Duration: 35-40 min**
Explain that the features of the middle course of a river are different from those of the upper course, and that human activity has changed the features of the middle course of some rivers. Ask what kinds of human activity might change the middle course of rivers. These include the construction of canals that take away river water for irrigation and transport, and dams that have several purposes. Ask how a dam changes a river. (It stops the flow of water so that the water builds up to form a lake. So, a dam would not be useful	**Teacher's Notes**

on a wide plain, as the plain might flood, but it would be useful in a valley, which could contain a lake.)

Ask the students to read the information about dams and to look at the photo of the Tarbela Dam on page 6. After they have read this, ask them to explain how the Tarbela Dam has changed the course of the River Indus and the landscape the river flows through, and how the dam is useful (if possible, without looking back at the Student's Book).

Tell the students that they are now going to learn about the natural features of the middle course of a river, focusing on the Indus. They should read 'The middle course of a river' to find out why rivers take a much more winding course when they reach their middle course. After they have read it, see if they can explain this winding course—and how oxbow lakes form, without looking back at the book. Ask the students to read 'The lower course of a river' on pages 8-9. They should look at the photos and map of rivers on these pages to find out what a delta looks like from the air. Ask how the delta got this name. Then ask them to describe the differences between a delta and an estuary. Invite the students to explain how each of these types of river mouth were formed.

Rural Urban settlement near rivers: Discuss the importance of rivers in human settlements and their impact on the development of rural and urban areas. Using the *Oxford School Atlas for pakistan,* show different local and international administrative maps to compare rural and urban settlements in other regions. Divide the class into small groups and give each group chart paper and markers. Assign one group to rural settlements near a river and another to urban settlements on a plain. Instruct students to brainstorm and list advantages and challenges associated with their assigned settlement type. e. Each group presents their findings to the class, and the teacher facilitates a discussion to compare and contrast the advantages and challenges of rural and urban settlements. They can gather information from books, online resources, or other reference materials. Please encourage students to give a short presentation highlighting their chosen settlements' characteristics, geographical.

Advantages	Disadvantages
• Access to water: Rivers provide a source of drinking water, water for irrigation, and water for industrial use. • Fertile soil: Rivers often deposit fertile soil along their banks, which is ideal for farming.	• Flooding: Rivers are prone to flooding, which can damage property and infrastructure. • Pollution: Rivers can be polluted by industrial waste, agricultural runoff, and sewage.

• Transportation: Rivers can be used for transportation, both for people and goods. • Recreation: Rivers provide opportunities for recreation, such as swimming, fishing, boating, and hiking. • Natural beauty: Rivers can be a source of beauty and inspiration.	• Erosion: Rivers can erode river banks and floodplains, which can damage property and infrastructure. • Wildlife: Rivers can be home to dangerous wildlife, such as alligators, crocodiles, and snakes. • Noise pollution: Rivers can be noisy, especially near busy shipping lanes.	

Homework

For homework, they could complete activities The course of a river; Parts of a river; Shapes of landforms; Depositional, erosional, or both landforms from the Skills Book.

Discussion and review

Ask the students what they have learnt in this lesson. They could make a note of this, summarizing the lesson, for example:

- ✓ I learned about the different natural features of the middle course of a river.
- ✓ I learned how human activity has changed the features of the middle course of rivers, through building dams, and how dams are useful.
- ✓ I learned the meaning of the word delta and the different ways in which a delta is formed.

Lesson Plan # 4	
Reference pages 10-12	
Topics	**Resources**
• River habitats • Indus dolphins • Changing plains and rivers	• Multimedia or Internet access (pictures of the wetlands and Indus dolphin and maps to explain river avulsions)
Introduction	**Duration: 5-10 min**
Using multimedia or images as flashcards, discuss the biodiversity in some regions to explain the importance of some famous river habitats: • Amazon Rainforest and the Amazon River: The Amazon River is the largest river by volume and the second-longest river in the world. It flows through the Amazon Rainforest, which is one of the most biodiverse regions on the planet. The river and its surrounding habitat are home to countless species of fish, reptiles, mammals, birds, and plants. • Nile River and the Nile Delta: The Nile River is the longest river in the world, flowing through several countries in northeastern Africa. The Nile Delta, where the river meets the Mediterranean Sea, is a significant river habitat. It supports diverse wildlife and provides fertile soil for agriculture, historically supporting ancient civilizations like Ancient Egypt. • Mississippi River and the Mississippi River Basin: The Mississippi River is the second-longest river in North America, flowing through several states in the United States. The river and its basin provide essential habitats for a variety of fish, migratory birds, and other wildlife. The river is known for its cultural and historical significance in the United States. • Ganges River and the Sundarbans: The Sundarbans, a vast mangrove forest and river delta formed by the Ganges and Brahmaputra rivers, is a UNESCO World Heritage site. It is home to the Royal Bengal Tiger, numerous bird species, and a rich biodiversity of flora and fauna.	**Teacher's Notes**
Using the Student's book	**Duration: 35-40 min**
Ask students to read pages 10-11 and 'It's a fact'. Explain the types of wetlands via a diagram. Referring to the map on page 10, speak about the following habitats: • Indus River is the longest river in Pakistan, flowing through the country from north to south. It supports a wide range of aquatic	**Teacher's Note**

life, including various species of fish, amphibians, and water birds. The Indus River Basin is an important agricultural region, with extensive irrigation systems supporting the growth of crops. • Jhelum River is one of the major tributaries of the Indus River. It originates from the Indian-administered territory of Jammu and Kashmir and flows through Azad Kashmir and Punjab in Pakistan. The river provides habitats for aquatic species and supports the agriculture and hydroelectric power generation in the region. • Chenab River is another significant tributary of the Indus River. It flows through the provinces of Khyber Pakhtunkhwa and Punjab, and it forms part of the border between Pakistan and India. The Chenab River supports diverse fish populations and provides water for irrigation, hydropower generation, and domestic use. • The Ravi River flows through the provinces of Punjab and Khyber Pakhtunkhwa in Pakistan. It is an important river for irrigation and agricultural activities. The river provides habitats for various aquatic species and supports the livelihoods of communities living along its banks. • The Swat River is in the scenic Swat Valley in Khyber Pakhtunkhwa. It is known for its crystal-clear waters and picturesque landscapes. The river is home to several species of fish and supports tourism and recreational activities like fishing and boating. Now make a concept map using a diagram from *https://www.wwt.org.uk/wetlands-can/how-wetlands-work/* or *https://www.wetlands.org/wetlands/why-wetlands-matter/* to illustrate importance of wetlands.	

Discuss the ecological significance but also contribute to the country's economy, water supply, and agricultural productivity. Discuss what efforts are being made to conserve and protect these river habitats to sustain their biodiversity and the services they provide to local communities. Engage students in formative assessment through questions about examples of famous river habitats, its characteristics, biodiversity, and cultural significance, how does it support ecosystems, provide resources, and sustain the livelihoods of local communities. You may also refer to *https://www.fisheries.noaa.gov/national/habitat-conservation/river-habitat#:~:text=Rivers%20have%20three%20distinct%20habitat,spreading%20out%20from%20the%20channel* for further engagement.

Ask students to read page 10-11 and discuss which human activities have endangered Indus dolphins and what can be done to protect them. Ask what a river avulsion (a river avulsion is the sudden and rapid abandonment of a river channel and the formation of a new channel) is and in what cases are they common (most common in braided rivers, where the river channel constantly shifts and are less common in meandering rivers) There are several factors that can cause river avulsions, including:

- Floodwaters: Floodwaters can cause a river to overflow and erode the riverbed. This can weaken the banks of the river and make them more likely to collapse.
- Tectonic activity: Tectonic activity can cause the ground to rise or fall, changing the course of a river.
- Human activity: Human activity, such as dam construction or channelization, can also increase the risk of river avulsions.
- River avulsions can have many negative consequences, including:
- Flood damage: Avulsions can cause flooding, damaging property and infrastructure.
- Loss of habitat: Avulsions can destroy river habitats like wetlands and forests.
- Changes in water quality: Avulsions can change the water quality of a river, which can impact fish and other aquatic life.

River avulsions can be challenging to predict and prevent. However, we can reduce the risk of avulsions by:

- Floodplain management: building levees and floodwalls and planting trees and vegetation along the riverbanks can help to reduce the risk of flooding and avulsions.

• Tectonic hazard mitigation: Tectonic hazard mitigation can help to reduce the risk of avulsions caused by tectonic activity. This can include building earthquake-resistant structures and developing early warning systems. • Human activity: Human activity can increase the risk of river avulsions. Dam construction and channelization can both increase the risk of avulsions. It is essential to carefully consider the potential dangers of these activities before undertaking them. Discuss the following examples to illustrate how rivers affect land and how land affects the course of a river over time: • *https://www.mcgeo.me/blog/changing-course-historical-avulsions-and-the-old-river-control-structure* (Mississippi River) • *https://phys.org/news/2022-05-rivers-global-river-avulsions.html* (River Nile)	
Homework	
Students can now do Questions A, F and G.	
Discussion and review	
Ask the students what they have learnt in this lesson. They could make a note of this, summarizing the lesson, for example: ✓ I learned about different types of wetlands in Pakistan ✓ I learned that river avulsions occur due to heavy rainfall, weaker riverbanks, and from the absence of levees (natural or artificial). ✓ I learned about major river avulsions such as Mississippi, River Nile, and River Indus'.	

Answers for Assessments

A. Choose the correct answer:

I. Eurasian Steppe
II. Tundra
III. Indus
IV. Spring
V. Gorge
VI. Khyber Pakhtunkhwa
VII. Nile
VIII. Wetlands

B. 1. A large, wide area of land that is flat, or almost flat 2 a–c)

Type of Grassland plain	Climate	Example
steppe	temperate with very low rainfall, hot summers, and cold winters	Eurasian Steppe
prairie	temperate with a warm summer and cold winter, and low rainfall	Great Plains of North America
pampas	warm temperate, with warm summers and mild winters, and low annual rainfall	Pampas of South America
savannah	tropical savannah: warm throughout the year, with a dry, mild winter and more rain in summer, but fairly low annual rainfall	Serengeti Plains of Central Africa

C 1 a–b) students' own answers

2 a) They have very dry climates; few trees grow there; the land is flat.

b) Desert plains have a very hot climate; Arctic tundra plains have a very cold climate. Desert plains are near the Equator or the Tropics; tundra plains are near the Poles.

3 a) northern regions of the USA and some parts of Canada

b) Europe and northern Asia, stretching from Moldavia, through Ukraine, Russia, Kazakhstan, Xinjiang (China), and Mongolia and Manchuria, with part in Hungary

c) Northern Tanzania to south-western Kenya

4 a–b)

Type of plain	Countries	Vegetation
steppe	Mongolia, Russia, Siberia	grass
prairie	Canada, the USA	grass
pampas	Argentina, southern Brazil, Uruguay	grass
savannah	Kenya, Tanzania	grass
	Afghanistan, Algeria, Angola, Australia, Botswana, Chad, Chile, China Egypt, Eritrea, India, Iraq, Jordan, Kazakhstan, Kuwait, Libya, Mali, Mauritania, Mexico, Mongolia, Morocco, Namibia, Niger, Oman, Pakistan, Peru, Qatar, Saudi Arabia, South Africa, Sudan,	

desert	Tunisia, Turkmenistan, United Arab Emirates, Uzbekistan, Western Sahara, Yemen, the USA	very little
tundra	Alaska (USA), Canada, Finland, Greenland, Russia, Sweden	grass and low-growing plants; very few trees

D 1 a) source
b) spur
c) interlocking spurs
d) gorge

2. The students' own explanations should include:
   - The river flows fast and carries sediment that erodes the rock and cuts a V-shaped valley.
   - It flows around harder rock, leaving spurs, or a series of spurs called interlocking spurs.
   - A fuller answer will include reference to cascades, rapids, and waterfalls, and how they are formed, also the formation of gorges or canyons.
3. A floodplain is formed in the middle course of a river, where the river spreads out across gently sloping land.
4. Students should draw a sketch of the river based on the photo on page 88, with the directions 'upstream' and 'downstream', and the right bank, and the left bank correctly marked. The slope on the right of the meander shows the direction in which the river is flowing:

E 1. Not all rivers flow directly to the nearest coast. The nearest coast might be on the far side of higher land, but the river cannot flow uphill. (You can also share that there are rivers that flow into closed drainage basins without an outlet to the ocean. These rivers usually end up in lakes or marshes within the bay, where the water is eventually lost through evaporation or seepage. Other rivers can merge with each other before reaching the coast. Sometimes, rivers may take an indirect path by flowing inland before eventually reaching the ocean. This happens because of geological formations such as mountain ranges or plateaus.)
2. delta, estuary
3. It deposits sediment where it slows down: for example, where it spreads out to form a delta, and in the middle course, on the insides of bends.

F 1. a) The habitat is the organism's natural environment that provides the necessary support for its life and growth; where things live and grow naturally
b) An ecosystem is a collection of living things that depend on each other.
c) A wetland is an ecosystem that has either permanent or seasonal water and certain types of plants that are adapted to wet conditions. This area is where the land is saturated or flooded, forming a transition zone between terrestrial and aquatic environments.

d) (From class discussion) The Ramsar Convention is an international treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.

e) sensing position of objects by sending out sounds that objects reflect

f) variety of life (genes, species, and ecosystems) on the Earth

2. a) marine (coastal wetlands including lagoons, rocky shores and coral reefs); estuarine (deltas, tidal marshes, and mangrove swamps); lakes and the land around them; riverine (wetlands along rivers and streams); marshes (swamps and bogs)

b) natural storage of water; supports fiber and fuel production; fodder for livestock; reduces global warming; breaks down organic pollution; protects from floods and streams.

c) The answers will vary.

G 1 a) meanders, oxbow

b) outside, inside

c) cliff

d) sediment, beach

2 a) mouth

b) delta

c) estuary

d) sediment

Answers to Skills Book

'The course of a river'

A 1. Source
2. Meander
3. Levee
4. Confluence
5. Tributary
6. River
7. Estuary
8. Delta
9. Mouth
10. Oxbow lake
11. Channel

'Parts of a river'

A 1. Across:
2. Delta,
3. Downstream,
4. Tributary,
5. Estuary,
7. Sediment,
8. Spring
9. channel

Down: 1. Stream,
3. Deposits,
6. Upstream,
10. erode

'Erosion and deposition'

A 1. middle course
2. students' own responses. Refer to page number 7 of the Student Textbook.
3. students' own responses. Refer to page number 7 of the Student Textbook.

'Fertile floodplains of the River Nile'

A 1. Egypt, Sudan, South Sudan, Ethiopia, Kenya

B-C. students' own responses

Plains and rivers of Pakistan

Refer to the *Oxford School Atlas for Pakistan*.

Shapes of landforms

Line drawings will vary for students. Refer to the following for example:

V-shaped valley (Book page number 5)

Rapids (page number 6)

Waterfall (page number 6)

Gorges (Book page number 5)

Depositional, erosional, or both landforms

Depositional	Erosional	Both
beach	arete	
Meander		
Esker	cave	cliff
loess	Cirque	
moraine	desert pavement	
Sandbar		
sand dune	Headland	
sand spit	Horn	
	playa lake	
	Stump	
	U-shaped valley	
	wave-cut platform	
	yardang	

Times around the world

A 1 a) Sunday

b) Saturday

c) Honolulu is several hours behind Islamabad.

B 1 a) London: −4 hours

b) Toronto: −9 hours

c) Sydney: +5 hours

d) Honolulu: −15 hours

C 1 a) London: −5 hours

b) The time in the picture story must have been in the summer, when London was using 'daylight saving time', when clocks are moved forward 1 hour. In some countries, especially in northern Europe, clocks are moved forward one hour in the summer so that there is an extra hour of daylight in the evening. The clocks are then moved back one hour in October. The effect of this is to give an extra hour of daylight in the morning. The purpose of this was to give farmers and other outdoor workers an extra hour of daylight during their normal working day.

UNIT 2 Water Resources and Management

Background knowledge for the unit

Scientists have estimated that the total amount of water on the Earth and in its atmosphere is about 1,385,000,000 km3. Of this, about 97% is in the oceans, seas, and bays. The remaining 3% portion is split as follows: just over three-quarters in glaciers, ice caps, and inland seas; just under a quarter is groundwater; leaving around one hundredth, a tiny fraction. That tiny fraction (one hundredth of the total) is split as follows: lakes about 3/5, atmosphere and soil moisture just under 2/5, and rivers less than 1/5.

There is always water in the atmosphere. We see this in clouds, fog, and mist, but even clear air contains water, in particles that are too small for us to see. But water in the atmosphere accounts for only about 0.001% of the Earth's total water volume. If all of the water in the atmosphere came down as rain, it would only cover the Earth to a depth of about 2.5 cm!

The atmosphere is the main route for water to be transported through the water cycle. In addition to downhill flows on land, water continuously cycles via the atmosphere through transpiration, evaporation, condensation, freezing, and precipitation. About 90% of the water in the atmosphere comes from evaporation from water bodies such as oceans and lakes: the remaining 10% is from transpiration from plants.

Factors that affect evaporation are:

- The strength of the wind: A strong wind moves the water molecules near the surface of the ground up into the air.
- Temperature: Warmer air has greater capacity for water vapour. This capacity doubles with every increase of 11.1°C.
- Humidity slows the rate of evaporation. This is why we feel hotter in humid air than in drier air. Our bodies cool down mainly by evaporation of perspiration. Humid air slows down the rate of evaporation, so we cannot cool down so quickly.
- The dew point is the temperature to which the air must be cooled before water condenses from it. The air cools at night. If it cools to the dew point, we see dew on the grass and other plants early in the morning when the humidity is high. The dew point depends on a combination of humidity, temperature, the strength of the wind, and how clear the sky is.

- Fog is the same as clouds—water droplets in the air—but we call it fog when it is nearer to the ground (or mist when visibility is better). We see fog near the ground when the surface of the Earth cools at night, cooling the air near it to dew point. The water vapour in this cooled air condenses into droplets. We cannot see water vapour, but we can see droplets of water.

The water we are using today has existed in one form or another for millions of years, and the amount of fresh water on Earth has stayed fairly constant over time, as it is recycled through the atmosphere and back through evaporation and condensation. However, the Earth's human population has increased enormously, and continues to do so. So, there are more people who need a share of that water. The amount of water there is will not increase, so we have to look after it.

Fresh water is a very small proportion of the Earth's water—only about 2.5 per cent; the rest is salty. Only 1% of the available fresh water is easily accessible, because a large amount is trapped in glaciers, ice caps, and snow. Only about 0.007% of the water is accessible to people.

This water is not fairly shared: some places have plenty while others face droughts and pollution, especially in developing countries. Rich arid countries, for example Kuwait, can cope with the shortage of fresh water because they can fund desalination plants and effective wastewater treatment.

Many human activities use water very inefficiently, for example: crops such as cotton that need a lot of water, are grown in arid areas, where water is wasted through irrigation. Many industries use large amounts of water, for example: most of the water used in industry is used for cooling purposes in power plants. However, there are schemes in action which use 'grey water' for this purpose. Grey water is the relatively clean wastewater from baths, sinks, washing machines, and other household appliances.

Also, many industries pollute the water system with nutrients, germs, chemicals, oil, sediment, and heat. Heat is a 'thermal pollutant' where water from an industry warms the water in a lake or river. The warmer the water, the less oxygen it can hold. This can harm or kill many aquatic plants and animals, but algae can thrive.

Before we proceed

This unit provides information, illustrations, and diagrams that help students to understand the water cycle and the different conditions that produce different types of precipitation and related weather, such as fog, mist, and dew. The students also learn about domestic and industrial water supplies: the sources, treatment, and transportation of water, and treatment and disposal. They learn about the solutions being tried in Pakistan to cope with insufficient water, floods, and waste treatment. These include some innovative solutions that sometimes solve other problems at the same time and can help sustainably manage water resources.

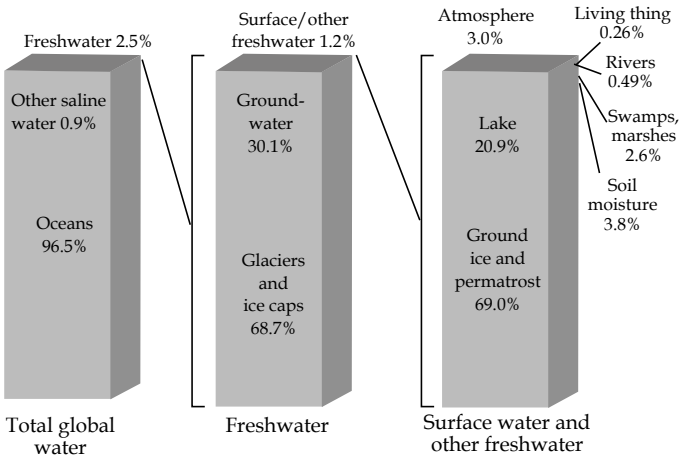
Expected learning outcomes

Students should be able to:

- describe the water cycle
- describe that water can exist in three states: water vapour, liquid, and ice
- explain how different forms of precipitation occur
- conduct, record, and draw conclusions from an investigation about water purification
- investigate some of the ways in which water is supplied to industries and settlements in Pakistan
- investigate some of the ways in which wastewater is treated in Pakistan
- describe how water wastage can be managed

<table>
<tr><th colspan="2">Lesson Plan 1</th></tr>
<tr><th colspan="2">Reference Page 15-16</th></tr>
<tr><th>Topics</th><th>Resources</th></tr>
<tr><td>• Sources of water
• Where is water stored on the Earth?
• Water cycle</td><td>• Multimedia or pictures
• Skills Book activity 'The water cycle'</td></tr>
<tr><th>Introduction</th><th>Duration: 5-10 min</th></tr>
<tr><td>Begin by discussing the difference between sources and resources (sources are the specific places where water can be found, while water resources are the total amount of water that is available in a particular area). Ask the students what they know about the water cycle. They could try drawing and labelling a diagram of the water cycle based on their existing knowledge. This revision will help to consolidate their understanding and prepare them to develop it further. You can show or ask students to watch the water cycle video from NASA on YouTube (https://www.youtube.com/watch?v=oaDkph9yQBs)</td><td>Teacher's Notes</td></tr>
<tr><th>Using the Student's Book</th><th>Duration: 35-40 min</th></tr>
<tr><td>Brainstorm about the sources of water and its distribution on the Earth and share facts. Sources of water refer to the various natural reservoirs or locations from which water is obtained. Discuss that:
• Surface Water includes lakes, rivers, streams, and reservoirs. Surface water is typically collected and used for various purposes, such as drinking, irrigation, and industrial processes.
• Groundwater is water that is stored beneath the Earth's surface in underground aquifers. Wells are drilled into these aquifers to extract groundwater, which is commonly used for drinking water supply, agricultural irrigation, and industrial purposes.
• Rainwater is a natural source of freshwater that is collected from precipitation. It can be harvested and utilized for non-potable purposes like irrigation, toilet flushing, and cleaning.
• Springs are locations where groundwater emerges naturally at the Earth's surface. Springs often provide a steady flow of water and are used as drinking water sources or to feed streams and rivers.
• In regions with cold climates, glaciers and snowpacks serve as significant water sources. As the ice melts, it contributes to the water supply in rivers and lakes, especially during the warmer months.</td><td>Teacher's Notes</td></tr>
</table>

- Desalination removes salt and other impurities from seawater, making it suitable for drinking or irrigation. Desalination plants are common in coastal regions where freshwater resources are scarce.
- Wastewater from various sources, such as domestic, industrial, or agricultural activities, can be treated and recycled for non-potable uses like irrigation, industrial processes, and groundwater recharge.



credit: U.S. Geological Survey, Water Science School. https://www.usgs.gov/special-topic/water-science-school
Data source: Igor Shiklomanov's chapter "World fresh water resources" in Peter H. Gleick (eidtor), 1993, Water in Crisis:
A Guide to the World's Fresh Water Resources. (Numbers are rounded).

Ask students to read page 15-16 and check their water cycle diagrams by comparing them with the one on page 16 of the Student's Book, and to mark anything they got wrong. They could discuss this with a partner and use their diagrams to present an explanation of the water cycle. They can then continue to read the section of this page headed 'Where is water stored on the Earth?', including 'It's a fact'.

In their notebooks, they could compile a glossary of words connected with water, for example: water cycle, groundwater, percolation, run-off, water table, reservoir, etc. Before they read page 16 'Precipitation', ask them to cover the page with a notebook and then to reveal only the first paragraph, which asks them to name as many types of precipitation as they can. They can then continue to read the pages, including the charts. Ask them to add the words for changes of state of water to their glossaries.

Homework
The students can answer question B and complete Skills Book activity 'The water cycle' for homework.
Discussion and review
Ask the students what they have learnt in this lesson. They could make a note of this, summarizing the lesson, for example: ✓ I learned the difference between water resources and sources and the distribution of water on the Earth. ✓ I learned how the water cycle moves water around between the ground, bodies of water, and the air. ✓ I learned about different types of precipitation. ✓ I learned that the Earth always has the same amount of water.

<table>
<tr><th colspan="2">Lesson Plan 2</th></tr>
<tr><th colspan="2">Reference Page 16-19</th></tr>
<tr><th>Topics</th><th>Resources</th></tr>
<tr><td>• Precipitation
• Fog
• Mist
• Uses of water
• Water supply in Pakistan
• Indus floods</td><td>• Skills Book activity ‘Precipitation’
• Administrative map of the city they live in
• Information about the school’s water supply</td></tr>
<tr><td>Introduction</td><td>Duration: 5-10 min</td></tr>
<tr><td>Ask the students what they found out about their water supply at home. Provide a city map and ask them to find the source on a map and see if they can trace its route to their homes. Explain that in Pakistan, it is likely that the water has travelled via the river Indus from the mountains in the north. Discuss how the water is treated before it comes to their homes, and how good they think its quality is. In some places, ground water may be supplied to homes. In some places like Quetta, water is supplied to homes from streams, springs, rivers, and karez. Water from underground is pumped up to the surface using water pumps or tube wells. Also talk about tap water and discuss whether it is fit for drinking or not. Ask if they use bottled water at home for drinking purposes and why.</td><td>Teacher’s Notes</td></tr>
<tr><td>Using the Student’s book 30 min</td><td>Duration: 35-40 min</td></tr>
<tr><td>Tell the students that they are going to learn about precipitation, beginning with different types of frozen precipitation. Ask them to look at the pictures on page 16 and 17 and discuss the differences between these types of precipitation.
Ask the students to read pages 18-19 and ask what they have learnt about Pakistan’s water supplies and the problems they face. Ask if floods help, and why, when there is suddenly a lot of flood water, this does not help with water shortages. (Flood water is usually polluted, runs off, and is wasted.) Discuss how Pakistan is trying to solve its water supply problem. Also discuss the differences between the water supplies in a city, a town, or a rural village; why they differ; and how things could be improved.are some of the critical benefits and problems associated with the flooding of the River Indus:
Benefits of flooding in River Indus
• Soil Fertility: The flooding of the river Indus deposits rich sediments and nutrients onto the floodplains. These sediments enhance soil fertility, making the floodplains highly productive for agriculture.</td><td>Teacher’s Notes</td></tr>
</table>

The annual flooding has historically supported the cultivation of crops and contributed to food production.

- Recharge of Groundwater: Flooding can replenish groundwater reserves in areas adjacent to the river. The floodwaters infiltrate the ground and recharge aquifers, helping to maintain water availability for drinking, irrigation, and other purposes during drier periods.
- Biodiversity Support: The periodic flooding of the river Indus and the associated wetland habitats contribute to preserving biodiversity. Floodplains and wetlands provide substantial breeding grounds, feeding areas, and habitats for various plant and animal species. The diverse ecosystems support a variety of flora and fauna, including migratory birds and aquatic organisms.
- Nutrient Cycling: Flooding facilitates the natural cycling of nutrients in the ecosystem. The flooded areas act as nutrient sinks, trapping and storing excess nutrients. Over time, these nutrients are released back into the environment, supporting the growth of plants, and contributing to the overall ecological balance.

Problems from flooding in River Indus

- Infrastructure Damage: Severe flooding can cause significant damage to infrastructure, including roads, bridges, buildings, and agricultural fields. The force of the floodwaters can erode riverbanks, wash away structures, and disrupt transportation and communication networks.

  Displacement of People: Flooding can lead to the removal of communities residing in flood-prone areas. People may be forced to evacuate and seek temporary shelter, resulting in social and economic disruptions. Displacement can also have long-term impacts on livelihoods and community well-being.
- Loss of Crops and Livestock: Excessive flooding can destroy standing crops and result in the loss of livestock. This can have severe economic consequences for farmers and communities that rely on agriculture for their livelihoods.
- Spread of Waterborne Diseases: Flooding can lead to increased waterborne diseases due to contamination of water sources. The floodwaters can carry pollutants, pathogens, and debris, posing health risks to the affected population.

Mention the efforts to manage and mitigate the impact of flooding along the river Indus include the construction of flood protection infrastructure, such as dams and reservoirs, and implementing of early warning systems to help communities prepare for and respond to flood events. Ask the students to write a short report in their notebooks about the water supply to cities, villages, and towns in Pakistan; what is good about it and the problems it faces, and what can be done to improve things.	
Home work	
Students can complete the activity 'Precipitation' for homework.	
Discussion and review	
Ask the students what they have learnt in this lesson. They could make a note of this, summarizing the lesson, for example: ✓ I learned how snow and hail form. ✓ I learned how fog and mist form, and that they are the same as clouds. ✓ I learned the difference between fog and humidity. ✓ I learned about the water supply in our hometown. ✓ I learned about the problems with Pakistan's water supply ✓ I learned the benefits and problems from the flooding in River Indus.	

<table>
<tr><th colspan="2">Lesson #3</th></tr>
<tr><th colspan="2">Reference Page 20-21</th></tr>
<tr><th>Topics</th><th>Resources</th></tr>
<tr><td>• How can Pakistan solve its water problems?
• Water supply
• Recycled water</td><td>• Skills Book activity ‘Location of glaciers and ice’
• Skills Book activity ‘Do we have enough water?’</td></tr>
<tr><td>Introduction</td><td>Duration: 5-10 min</td></tr>
<tr><td>Ask students what they know about water problems in Pakistan, or by showing them a video or infographic about the issue. Explain the different types of water problems. This could include water scarcity, water pollution, and waterlogging. Discuss the causes of water problems. This could include climate change, population growth, and unsustainable agricultural practices. Present suggestions to resolve water problems. This could include improving water management, reducing water pollution, and educating the public about water conservation. Have students brainstorm their own suggestions to resolve water problems.</td><td>Teacher’s Notes</td></tr>
<tr><td>Using the Student’s book</td><td>Duration: 35-40 min</td></tr>
<tr><td>Ask students to read page 20-21 and discuss the map to make observations about water supply in Pakistan. Ask students to point out provinces with the greatest number of dams; areas with most modern and conventional water supply systems; most populated areas; common industrial areas and agricultural areas, etc. Encourage students to use the Internet and discuss research measures taken by Pakistan in the last ten years to address its water problems. You can share the following information as a mind map/ concept map.
Over the last ten years, Pakistan has implemented several measures to address its water problems and improve water management. Here are some critical measures taken during this period:
1. In 2018, Pakistan introduced the National Water Policy, which aims to establish a detailed plan for managing water resources. This policy focuses on essential areas such as water conservation, improved irrigation practices, efficient water usage, and infrastructure development.</td><td>Teacher’s Notes</td></tr>
</table>

2. Pakistan has started building the Diamer-Bhasha and Mohmand Dams to increase water storage capacity and generate hydropower. These dams are essential water infrastructure projects that will aid in regulating water flow, alleviating water scarcity, and producing renewable energy. 3. There are multiple initiatives to encourage rainwater harvesting techniques, specifically in rural areas. These initiatives involve building small-scale water storage structures, such as ponds, check dams, and rooftop rainwater harvesting systems, to collect rainwater for domestic and agricultural purposes. 4. Pakistan has prioritized the construction of wastewater treatment plants in urban areas to treat sewage and prevent water pollution effectively. These plants significantly enhance water quality and facilitate water reuse for irrigation and industrial purposes. 5. Efforts have been made to improve irrigation efficiency and decrease water loss in agriculture. This has involved lining canals, implementing sprinkler and drip irrigation systems, and encouraging modern farming techniques to optimize water usage. 6. Pakistan has taken steps to manage its groundwater resources better. These measures include the installation of monitoring wells, regulating tube well drilling, and promoting the adoption of water-efficient technologies for extracting groundwater. 7. Pakistan acknowledges the effects of climate change on its water resources and has taken measures to adapt to it. This involves integrating climate change adaptation strategies into its water management plans, such as constructing climate-resilient infrastructure, water storage systems, and early warning systems to manage floods. 8. Pakistan has actively promoted water conservation practices and efficient water use by conducting awareness campaigns and capacity-building programs. These programs also aim to educate communities about the significance of water resource management.	

You can show the YouTube videos mentioned at the end to show different ways large scale recycling of water happens. There are several ways to recycle water. Some of the most common methods include: • Wastewater treatment plants use a variety of processes to remove pollutants from wastewater, making it safe to reuse. The treated water can then be used for irrigation, industrial processes, or even drinking water. • Greywater is the water that comes from sinks, showers, and bathtubs. It is not contaminated with human waste, so it can be recycled for non-potable uses, such as watering plants or flushing toilets. • Rainwater harvesting is the collection of rainwater for reuse. Rainwater can be collected from roofs, gutters, and other surfaces. It can then be used for irrigation, washing cars, or other non-potable uses.	
Homework	
Guide students to use their *Oxford School Atlas for Pakistan* and do the Skills Book activities 'Location of glaciers and ice' and 'Do we have enough water?'	
Discussion and review	
Ask the students what they have learnt in this lesson. They could make a note of this, summarizing the lesson, for example: ✓ I learned about how water problems in Pakistan are being tackled. ✓ I learned about the differences between rural and urban water supplies. ✓ I learned how treated water can help meet water requirements for an overpopulated country like Pakistan.	

Lesson #4	
Reference Page 22-24	
Topics	**Resources**
• A village water supply- from drains • Water pollution • Sustainable water management	• Multimedia or the Internet • Skills Book activity 'Purification of water'
Introduction	**Duration: 5-10 min**
Tell the students that in this lesson they are going to carry out an investigation into how water can be purified through filtering. Give them an example of how tea is strained with a strainer.	**Teacher's Notes**
Using the Student's book	**Duration: 35-40 min**
Remind the students of what they learned about a useful way of treating sewage and wastewater and tell them that they are going to find out about another interesting way of treating it to produce clean water! They can then read about 'A village water supply—from drains'. Then ask them how the system works. What happens to the solid material in the sewage, and how the water that runs out of the system can be used. Ask why this system is very useful for rural villages. (Many do not have proper drains and have water shortages.) They also have plenty of land that can be used for these projects, which is not the case in most cities. Discuss what makes this system better than just filtering the sewage. Ask students to read pages 23-24 and ask what is meant by sustainable water management (Management of water resources in a way that meets the needs of the present without compromising the ability of future generations to meet their own needs. It is a holistic approach that considers water use's social, economic, and environmental aspects.) You can show different pictures through multimedia to help students understand different ways to conserve water. You can have students build a water filtration system model, or you could have them plant a garden and learn how to water it efficiently. Share stories (both local and international) about communities that are facing water shortage, or you could tell a story about a person making a difference in the fight against water pollution. Ask students to find a correlation between water management and climate change and which water management methods are conducive to climate action and which are not.	**Teacher's Notes**

Using the Skills Book

If you have enough equipment for the activity on page 19 'Purification of water', the students can work on this investigation in groups. If not, some groups could work from the Student's Book, while others carry out the investigation and then write a report about it.

The students should set up the investigation as shown in the Skills Book, pour the muddy water from one jar slowly though the filter, but keep the other jar of muddy water. They should then compare the water that comes through the filter with the muddy water and describe what they see, then answer the questions.

Ask them how the filter worked. (It has tiny holes that allow water through, but not solid material.) Explain that this principle is used in sewage treatment works to separate solids from liquid, but the water that comes out still contains germs and other liquid pollution.

Homework

Students can do question A, C, D, E, and F to review the chapter now. They can also answer Skills Book activity 'Purification of water' independently.

Discussion and review

Ask the students what they have learnt in this lesson. They could make a note of this, summarizing the lesson, for example:

- ✓ I learned about the dangers of open sewers.
- ✓ I learned about how sewage can be treated in ways that make it useful.
- ✓ I learned about how drainage systems help to keep sewage out of the freshwater supply.
- ✓ I learned simple everyday measures to sustainably manage water resources around myself.
- ✓ I learned about projects in Pakistan for converting sewage into biogas and for converting sewage into water suitable for irrigation.

Answers for Assessments

A. Choose the correct answer

I. Pakistan
II. Hydrosphere
III. 3
IV. Haro
V. V-shaped valley
VI. Monsoon
VII. WAPDA
VIII. microbes

B. 1 a) troposphere

b) The students' own responses, which should indicate that they know that:

- Water vapour in the air comes mainly from water that has evaporated from oceans, seas, lakes, and rivers, and from the surface of the ground.
- Clouds are collections of drops of water that have condensed from water vapour in the air.
- When drops of water in clouds become large and heavy, they fall from the clouds as rain.

2. Matching

Words	Definition
a) run-off	water flowing along the ground
b) percolation	water soaking through the ground
c) water table	the highest level of ground that is saturated with water
d) transpiration	water given off by plants
e) evaporation	water changing from liquid to vapour
f) condensation	water vapour changing to liquid
g) precipitation	water in any state that falls from the air
h) freezing	liquid water changing into solid
i) sewage	human waste from toilets and drains
j) sludge	solid waste from sewage
k) microbe	tiny living things such as bacterium
l) biogas	a natural gas made when microbes digest waste material

C 1. They treat waste material; but they also make use of the waste to produce gas for stoves and boilers, and even for vehicle fuel.

2 a) to control water flow to reduce flooding.

b) to store water when there is plenty

c) to protect water from pollution

3. If they get blocked, pools of sewage can form near residences and lead to the spread of germs that cause disease.

4 a i) It can be taken to tanks where solid material is separated from liquid. The liquid goes through filter materials such as pumice, gravel, or sand, and chemicals can be added to kill germs.

ii) Sewage can be converted into biogas.

iii) Sewage can be purified in wetlands.

b) the students' own responses

5 a) biogas plant

b) wetland filter

D. The answers will vary.

E. 1. a. Water is also used for irrigation to grow crops and in the making of agricultural products like fertilisers, pesticides, insecticides, etc.

b. Industries use water to generate electricity, making iron and steel, chemicals, medicines, textiles, leather, processing of food, etc.

c. The answers will vary.

2. The answers will vary.

F 1. a) The water supply in Pakistan comes mainly from the River Indus. There is plenty of water in the monsoon season, but very little in the dry season. Three solutions to this problem are: controlling water flow, storing water; and reducing waste of water.

b) Most of our water pollution comes from sewage. This spreads disease through drinking water and through vegetables and other crops irrigated with polluted water. It pollutes rivers and kills plants and animals, including fish.

c) Plastic is very harmful to wildlife; animals become trapped in plastic bags, other containers or tangled in fishing lines, netting or cord. Many starve because their stomachs fill up with tiny pieces of plastic or because birds and mammals mistake these for food and feed them to their young. When plastic reaches the sea, sunlight, wind, and waves break it down into small particles called microplastics.

Answer to Skills Book activities

Skills Book Activity 'The Water Cycle'

A. The student's completed diagrams should match those on page 16 of the Student's Book.

B. The students' own responses should consider all stages of the water cycle, and might also include the water being drunk by an animal or taken up through the roots of a plant, being boiled during cooking or to make a hot drink, being used to wash something/someone, and so on.

Skills Book Activity 'Precipitation'

'Across'

1. snow
2. Drizzle
3. hail
7. condense
8. Evaporate
9. Mist
10. Sleet
11. fog

Down

1. sublimation,
4. Precipitation,
5. Freeze,
6. melt

Skills Book Activity 'Purification of water'

A 1. The students carry out the practical investigation as instructed.

2 a) The students' own responses should describe the change in the muddy water.

b) The students' own responses should include uses such as watering plants, flushing toilets, or any use that does not require germ-free water.

c) It would need more filtering, and a way of killing any microbes. This is very thorough treatment but can be done; it is how water in the International Space Station is recycled.

Skills Book Activity 'location of glacier and ice masses on Earth'

Refer to the Internet to access World Glacier Monitoring Service and fill in the map.

Skills Book Activity 'Do we have enough water'

A. water vapour – less – shortage – more – less -

B. Answers will vary.

C. Answers will vary.

UNIT 3

Settlements and Land Use

Background knowledge for the unit

The earliest settlements developed because people lived together in groups, which probably began as family groups and became extended family groups and tribes. These groups stayed together for protection from invaders, and to share work and services. They chose a location that provided for their needs:

- A good water supply: many settlements developed around water supplies in regions that are otherwise quite dry; for example, oases in deserts, and villages near water supplies in arid regions, such as the Indus Valley and the Nile Valley, where settlers found ways to adapt their lives to annual flooding because the floods provided rich farmland.
- Safety from flooding: for example, villages on hills surrounded by plains, unless the floods were useful (see above).
- Protection from attacks: defensive sites are often on ground that is higher than its surroundings so that invaders could be seen approaching from a distance. Defending downhill is easier than defending uphill.
- Climate: higher land provides a cooler climate in hot regions.
- Aspect: settlements are often on the sunny side of a deep valley, especially in cooler climates. This helps in growing crops.
- Shelter: provided by hills or forests from cold prevailing winds and rain; some towns developed in a gap between areas of higher ground, for example, Quetta, which has a high altitude, but has developed along valleys high in the mountains.
- Resources: these include raw materials (such as wood, metal ores, or coal) that are important for industry, especially where the materials are heavy, bulky, or difficult to transport. Modern settlements depend less on these factors now that water supplies can be piped for long distances and essential items can be transported more easily. Settlements also develop around activities:
- Trading centres have grown up at the junctions of natural land routes or where routes meet rivers. Examples include towns and villages along the ancient Silk Route. This often led to the development of roads, railways, and canals. An example is Quetta, which developed on the Bolan Pass, which used to be the only way through the mountains from Central Asia to South Asia.

- Trading centres have also grown up along coasts, especially at natural harbours or the mouths of rivers where ports developed: examples include Gwadar, in Pakistan, and Liverpool, in the UK. The purposes of settlements have changed: for example, many ports, such as Karachi, have become industrial and commercial centres; resorts in attractive locations not far from cities have promoted the development of the tourism industry.
- Settlements can also be classified according to:
- size and services: but there are variations in the ways in which geographers classify settlements by size and services.
- shape depending on the location: for example, along a road or river a settlement has a natural linear or ribbon shape; a settlement that has developed around crossroads or bridging point over a river has a clustered or nucleated shape; a rural settlement, consisting mainly of farms, is dispersed, or may even be classed as isolated— where single dwellings are far from others.

Before we proceed

This unit helps the students to develop an understanding of the factors that determine the locations of settlements, the extent to which they develop, their purposes, shapes, and the natural and human influences that change them.

Expected learning outcomes

Students should be able to:

- compare settlements of different sizes and explain how and why they developed
- give a simple explanation of the factors that affect the layouts and shapes of settlements
- investigate their own settlement and describe its layout, development, and purpose
- explain the causes of expansion of some settlements into large cities
- explain the interactions between settlements

Lesson #1	
Reference Page 27-30	
Topics	**Resources**
• What is a settlement?	• Skills Book activity 'The settlements hierarchy' • *Oxford School Atlas for Pakistan* for population maps of different countries, or online access to population maps • a map of the Pakistan that shows the main towns. • a physical map of the Pakistan • a map of a developed country of your choice for contrast with its main towns
Introduction	**Duration: 5-10 min**
Ask the students to name some different types of settlement. If necessary, explain 'settlement' as 'a collection of people and their homes, and the services they need'. You could start them off with 'town'. At this point they may not know all the terms that will be introduced in this unit such as conurbation, megalopolis, or megacity, but should have heard the terms village, hamlet, town, city, and perhaps, metropolis. **Activity** Ask the students to work in pairs to arrange the completed list in order of size. They could then share this as a whole class and give descriptions of the different settlements they named. Invite them to suggest distinctions between village/town, town/city, and so on.	**Teacher's Notes**
Using the Student's book	**Duration: 35-40 min**
The students should now read page 27-28 of the Student's Book including the settlements hierarchy diagram and 'It's a fact'. Ask them where they would place their own settlement on the settlement hierarchy, and to explain how they decided. They could carry out the same exercise for other settlements they know or know about. Discuss any they found difficult to place (perhaps because they needed extra information, such as population figures).	**Teacher's Notes**

They could copy the settlement hierarchy into their notebooks, ready to add examples as they work through this unit. The students should now read the sections on page 28 headed 'Services' and 'The influence of a settlement' and describe the two settlements shown in the photos. Ask them to locate Hyderabad and Karachi on a map of Pakistan. They could also look at a physical map, which might help them to suggest why the two settlements developed in these locations. The population of the surrounding area has a low density, so its influence is not great, as people who live farther away than about 50 kilometres are

Karachi	Hyderabad
Karachi is the largest city in Pakistan, with a population of over 20 million people. It is the country's financial, commercial, and industrial hub. Karachi is also a major cultural center, with a vibrant arts scene and a diverse population.	Hyderabad is the second largest city in Sindh province, with a population of over 10 million people. It is a major commercial and industrial center, and it is also home to a few educational institutions. Hyderabad is a popular tourist destination, with several historical and cultural sites.
Natural harbors: Both Karachi and Hyderabad have natural harbors, which made them ideal locations for trade and commerce.	
Access to water: The two cities are located on the banks of rivers, which provided a source of water for drinking, irrigation, and industry.	
Fertile land: The surrounding land is fertile, which supported agriculture and livestock farming.	
Trade routes: Karachi and Hyderabad were located on important trade routes, which brought people and goods from all over the region.	
Government support: The Pakistani government has invested heavily in Karachi and Hyderabad, which has helped to promote their development.	

The students should then read the sections on page 29 headed 'Megalopolis' and 'Conurbation'. Ask them to locate the megacities Manila, in the Philippines, and Gauteng City Region, in South

Africa, on a map of the world and to consider how far the influences of these megacities extend, and for what. This might require further research for homework or during another lesson. They could also locate Karachi, Rawalpindi, Islamabad, and Faisalabad on maps of Pakistan, and on a world map, and to comment on the influence of these settlements. Which regions come into the range of influence of these settlements? They should consider where visitors come from and for what, and how far the influence of these settlements might reach beyond Pakistan, how, and for what. (For example, via various forms of transport and via the Internet for trading.)	
Home work	
The students should be able to complete the activity 'The settlements hierarchy' using information from page 27 of the Student's Book to help. The questions in section B require them to explain their answers.	
Discussion and review	
Ask the students what they have learnt in this lesson. They could make a note of this, summarising the lesson, for example: ✓ I learned how settlements can be classified according to their size and services. ✓ I learned about some large settlements on different continents and in Pakistan. ✓ I learned about the influence of settlements and why large settlements influence a large area.	

<table>
<tr><th colspan="2">Lesson #2</th></tr>
<tr><th colspan="2">Reference Page 30-33</th></tr>
<tr><td>Topics</td><td>Resources</td></tr>
<tr><td>• Settlements in Pakistan
• What makes a place suitable for settlement?</td><td>• political and physical maps of Pakistan
• Skills Book activity ‘The sites for settlements’
• Skills Book activity ‘Settlements in Pakistan: a case study’</td></tr>
<tr><td>Introduction</td><td>Duration: 5-10 min</td></tr>
<tr><td>Point out that people often use the words ‘town’ or ‘city’ for any large settlement and remind the students of the terms they learnt from the settlement’s hierarchy. Using a political or a physical map of Pakistan, spot Kotri, Rasool Pur, and Siddique Roonjho on the map. Spot neighbouring urban areas and industries in the regions.
Kotri: Ask the students to name any large towns near to where they live. They should check the definition of a large town on page 28 but remind them that people often refer to large towns as cities, and sometimes call smaller cities towns. Explain that they are going to find out about the large town Kotri and ask if they know where it is. They should locate Kotri on a map of Pakistan. Ask them to describe its location, including the province it is in, the land, and any geographical features they can find, for example, mountains, lakes, plains, rivers, roads, and railways.
Rasool Pur: Ask the students to name any villages near where they live. They should check the definition of a village on page 28. Ask how a village differs from a town. (It has a smaller population, fewer buildings, and fewer services.) Tell them that they are going to find out about a village in Punjab named Rasool Pur. Explain that, although its population has now reached 3000, and it has primary and high schools, and a range of shops and other services, it is still called a village.
Siddique Roonjho: Ask the students to name any hamlets near where they live. They should check the definition of a hamlet on page 28. Ask how a hamlet differs from a village. (It has a smaller population, fewer buildings, and fewer services.) Tell them that they are going to find out about a hamlet in Sindh named Siddique Roonjho. Explain that it has no services such as schools, shops, or businesses.</td><td>Teacher’s Notes</td></tr>
</table>

Using the Student's book	Duration: 35-40 min
Ask for examples of large settlements such as a megalopolis or megacity, a conurbation, and a metropolis in Pakistan. Ask them to name any large cities in Pakistan. Examples include Quetta, Muzaffarabad, Hyderabad, Lahore, Rawalpindi, Karachi, Bahawalpur, Sargodha, Sialkot, Larkana, Sukkhur, Gujrat, and Mardan. They can refer to the settlements hierarchy on page 72 to find the population range of large cities as defined by many geographers. (300,000 to 1 million) Explain that they are going to find out how Quetta developed and how its location affected this. Ask where Quetta is. They should know that it is the capital city of Balochistan. Ask them to find Quetta on a map of Pakistan, and to describe its location. They should now read about Quetta on pages 30 and look carefully at the map and photographs. **Kotri:** Ask the students to read page 31. Explain that Kotri has developed on flat land on the banks of the River Indus, near a port called Jhirk, and that it has developed at a meeting place for transport: ships, railways, and roads (now including the N5 and N55 motorways and the M9 Hyderabad bypass). Kotri is situated close to Hyderabad and this proximity to a large settlement should provide trading links. Ask about the advantages and disadvantages of a settlement being located on low, flat land near a river. (Flat land on the rich soil of the Indus flood plain is good, fertile farmland, providing a food supply for the settlement; it is easy to build roads, railways, and buildings on flat land; however, flat land near a river can flood.) Ask what they have found out about Kotri Barrage on this page. (The Kotri Barrage is used for controlling the flow of the Indus.) Ask about the main differences (other than size) between the settlements of Kotri and Quetta. **Rasool Pur:** If possible, allow time for the students to watch a video on the Internet about Rasool Pur, and invite their comments about life there. Otherwise, ask them to watch it at home under the supervision of an adult and discuss it in class. They should note the absence of crime and the cleanliness of the streets. They could describe how life in Rasool Pur differs from life in a city such as Karachi, Quetta, or even a large town such as Kotri. Ask the students to read page 31-32. Ask them to describe its location, including the province it is in, and the land. Ask about the	**Teacher's Notes**

advantages and disadvantages of living on low, flat land. (It is easy to build roads, railways, and buildings on flat land, but if it is near a river, it could be flooded.) Ask about the main differences (other than size) between Rasool Pur, Kotri, and Quetta. **Siddique Roonjho:** Ask the students to read page 32, and to look at the photos of Siddique Roonjho. They should find out that the village developed in a place that had a water supply and that the people who settled there migrated from the Indus Delta because the water supply there became too salty. Ask them to describe the differences between Siddique Roonjho and Rasool Pur, and to comment on the lives and work of the people of Siddique Roonjho, and the problems they face. The students could discuss why the people of Siddique Roonjho stay there with such a difficult way of life: months with no water supply, no schools, and where one must make a long and difficult journey to the nearest medical centre and shops. If necessary, point out that it can be hard for people to leave their homes, whatever difficulties they face; they try to overcome problems to stay. They could also discuss the ways in which they think the problems faced by the people of Siddique Roonjho could be put right, and whether (and why) this should be done—and whether any organisation should take responsibility. Draw attention to the fact that their water shortage is caused by the lack of fresh water from the Indus River—mainly due to the building of barrages. Ask what factors influenced the building of many settlements. The can then read 'It's a fact' and identify any factors they think influenced the building of any of the settlements they have studied in this unit. Ask the students to work in groups on a role-play where local government officials try to persuade the people of Siddique Roonjho to leave their settlement and go to Karachi, where they will have a better water supply, more services, and so on. Different students could take on the roles of government officials, men from the village, and women from the village. After reading the box for differentiation of advantages and disadvantages of living in rural areas, ask students to support the points by giving examples for each point.	

Ask students to read 'What makes a situation suitable for settlement?' on page 32-33 and to suggest some natural factors that made Karachi a good site for settlement, and factors that helped it to develop into a city, and then a large metropolitan area. They should list these and will be able to find out more as they work through this unit. They can then complete Question D.	

Home work

Students can answer Skills Book activities 'The sites for settlements' and 'Settlements in Pakistan: a case study' by referring to the lessons learnt in the chapter so far. The first question can be answered by a simple referral to the map and spotting the most densely populated areas by looking at the key. They can also answer question E from Assessments.

Discussion and review

Ask the students what they have learnt in this lesson. They could make a note of this, summarising the lesson, for example:

- ✓ I learned how a large city developed in Pakistan.
- ✓ I learned how the shape of Quetta was influenced by the landscape.
- ✓ I learned that Quetta developed because it was on an ancient trade route.
- ✓ I learned how a settlement near a port can develop into a large town with many services.
- ✓ I learned how flat, fertile land and good transport links can help a settlement to grow.
- ✓ I learned about life in a rural settlement in Pakistan.
- ✓ I learned about the work of some of the people of Rasool Pur, a village in Punjab.
- ✓ I learned some factors that makes places good locations for settlements.
- ✓ I learned some of the factors that cause settlements to change or become disused.
- ✓ I learned about the advantages and disadvantages of living in rural areas.
- ✓ I learned more about the factors that make places good locations for settlements.
- ✓ I learned how Karachi developed as a settlement, from a fishing village to a metropolitan area.

Lesson #3	
Reference pages 34-36	
Topics	**Resources**
• Functions of a settlement • The pattern of settlements	• *Oxford School Atlas for Pakistan* • Skills Book activity 'The patterns of settlements' • Skills Book activity 'The functions of settlements'
Introduction	**Duration: 5-10 min**
Explain that settlements often have a function or purpose, as well as being a collection of homes, but that this function sometimes changes over time: use Karachi as an example. Elicit what its first function was (fishing port), and what its function is now (still a port, but also an industrial and commercial centre). This lesson could be spread over two teaching sessions where appropriate.	**Teacher's Notes**
Using the Student's book	**Duration: 35-40 min**
Ask the students to read the sections on pages 34-35, 'The functions of settlements', 'Market town', 'Port', 'Industrial town' and 'Resort', to find out about the main functions of settlements. They should locate each settlement using the *Oxford School Atlas for Pakistan*. Ask them to close their Student's Books, then ask what the first functions of Amboise (France), Khewra (Punjab), and Malam Jabba (Khyber Pakhtunkhwa) were. They should also be able to explain how and why the functions of each of these settlements has changed. The students could also be asked to name other settlements whose functions are a) port b) industrial town c) market and d) resort. On a board or flipchart, draw the diagram of settlements on page 36, but omit all features except for the buildings. Add the heading for each type of settlement: nucleated (cluster), linear (ribbon), dispersed, and isolated. Ask the students to look at the nucleated settlement diagram and see if they can explain what geographical features could have led to the development of a settlement with this shape. (a central point, such as a harbour, market, meeting place, or religious centre). Repeat this for the other types of settlement. Then ask the students to look at the diagram on page 35 and compare it with their answers.	**Teacher's Notes**

Home work
Skills Book activity 'The patterns of settlements' should be completed first, and then the students' work could be checked, before they decide which settlements to choose for the activity in Skills Book 'The functions of settlements'.
Discussion and review
Ask the students what they have learnt in this lesson. They could make a note of this, summarising the lesson, for example: ✓ I learned why settlements develop in specific types of shape and layout. ✓ I learned that settlements have a function and how this function can change.

<table>
<tr><th colspan="2">Lesson #4</th></tr>
<tr><th colspan="2">Reference pages 36-42</th></tr>
<tr><th>Topics</th><th>Resources</th></tr>
<tr><td>Planned settlements
Mombasa: a large settlement in Kenya, Africa
Naro Moru: a small settlement in Kenya, Africa</td><td>Oxford School Atlas for Pakistan
If possible, access to the Internet
an outline map (or several small outline maps) of Africa with no countries or towns named</td></tr>
<tr><td>Introduction</td><td>Duration: 5-10 min</td></tr>
<tr><td>Planned settlements: Explain that the settlements they have learnt about so far developed naturally, but that some settlements are planned, instead of building homes and other buildings when they are needed, in places that are available, the layout of the settlement is planned. Ask if they can think of any planned settlements. They should know about Islamabad, the capital city of Pakistan. Ask if they know of any much older settlements in Pakistan. They should know from their social studies lessons, about the Indus Valley settlements Harappa, Lothal, and Mohenjo-Daro.

Activity for Brasilia vs Islamabad: Ask the students to name as many planned modern cities as they can. List their answers, which can be checked for accuracy later. Examples (and the dates they were founded) include: La Plata, Argentina; Abuja, Nigeria (1991); Aracaju, Sergipe, Brazil (1855); Ankara, Turkey (1923); Austin, Texas, USA (1839); Belmopan, Belize (1970); Bhubaneswar, India (1948); Dhaka, Bangladesh (1971); Brasilia, Brazil (1960); Canberra, Australia (1927); Chandigarh, India (1966); Gandhinagar, India (1960); Indianapolis, Indiana, USA (1825); Islamabad, Pakistan (1960); Jefferson City, Missouri, USA (1821); Jhongsing, Taiwan (1955); New Delhi, India (1911); Ottawa, Ontario, Canada (1857); Quezon City, Philippines (1948–76); Washington D.C., USA (1800); and Wellington, New Zealand (1865).

Settlement for workers: Explain that this lesson will focus on settlements that were planned to provide homes for workers for a particular business. They will learn about a settlement in the north of England, which was named Port Sunlight because the company that built it was a soap manufacturer that produced a soap called ‘Sunlight’.</td><td>Teacher’s Notes</td></tr>
</table>

Mombasa: Explain that this lesson will focus on a settlement in Africa, then display a large outline map of Africa (or give each group of students a smaller outline map to share) and ask them if they can locate Kenya on this map. They could mark where they think it is. Then let them check, to see how close they were in their *Oxford School Atlas for Pakistan*. **Naro Moru:** Explain that they are now going to find out about a small settlement in Kenya, called Naro Moru. Ask them to consider, while reading about this settlement, why it developed as a small settlement, rather than a larger one like Mombasa.	
Using the Student's book	**Duration: 35-40 min**
Ask the students to read the sections on pages 36-39, 'Planned settlements'. They should be able to locate each settlement on map the world in their *Oxford School Atlas for Pakistan*, even if they are not marked, as they can find the country or region of each settlement. Ask what they notice about the layout of each planned settlement. (The roads are laid out in a grid pattern to make the best use of the land for building.) Point out that although the Ancient Greeks built Miletus, it is in Turkey, not Greece. Ask about the purposes of some of the planned settlements they have learnt about: capital cities, homes for workers. Ask if they can think of other purposes for which a settlement might be planned, for example, for a specific industry or craft (or collection of industries or crafts), a defensive site such as a fort or castle, a sports complex, or an entertainment centre. Ask the students to look at the map of Brazil in their *Oxford School Atlas for Pakistan*, and to compare the locations of the old capital, Rio de Janeiro, and the new capital, Brasilia. Ask them to read about Brasilia and to look at the photos to find out why a new site was chosen for the capital city, and how the city was organised. Then ask about the purpose of this new capital and what made this location good; also, about any problems about the location, and how these were solved. Ask why unexpected migration happened there. (The city was planned to house government authorities and their staff, but many of the construction workers stayed there after their work was complete, and many other people migrated there to find work, so its population became much larger than expected.) The students could focus on the way in which the city is organised and comment on whether they think having different sectors for different purposes is a good idea, or not, and why. Ask how the Monumental Axis affects the city.	**Teacher's Notes**

Ask the students if they think Brasilia looks a pleasant place to live, and why. They can then read about a similar process that took place in Pakistan—the building of a new capital city, far from the old one. Ask them to read about Islamabad and to look at its photo, and a map of Pakistan in their *Oxford School Atlas for Pakistan*, to find out why a new site was chosen for the capital city and how the city was organised. Then ask about the purpose of this new capital and what made this location good; also, about any problems about the location, and how these were solved.

Ask the students to read pages 39 about Port Sunlight and to look at the photo. Ask them about the good and bad points of the site. (The site was near the company's factory. It had good road, rail, and canal links to other parts of the UK, especially the nearby cities of Manchester and the port of Liverpool. Sea transport was useful in the late 19th century because this was before air travel.) The land is flat, which is good for building, but it was marshland. Ask the students why marshes were less of a problem in 1888 than they were in ancient times. (More modern technology, after the Industrial Revolution, made it easier to drain them.)

The students could comment on how the planners of Port Sunlight tried to provide a pleasant environment for the workers, and how they tried to influence how they spent their time.

(The layout had plenty of open spaces and parkland, with a hospital and schools as well as a leisure centre, art gallery, and a church.) Ask why the population of Port Sunlight has shrunk, rather than increasing, unlike most settlements.

Activity: Invite students to work in groups to discuss how an industry in their region might plan a settlement for its workers. They should consider the ways in which it might be like Port Sunlight, as well as the differences. They can then write an explanation of their ideas and draw labelled sketches and maps.

The students should read the section on pages 40-41 headed 'Mombasa: a large settlement in Kenya, Africa' to find the answers to the following questions:

- What size settlement is Mombasa? (They should refer to the settlements hierarchy on page 27.)
- What factors made this a good place for a settlement?
- What shape or layout of settlement might the early settlement of Mombasa have had? (They should explain their answers.)

• What was the purpose of this settlement? • What new purposes did it develop, and what factors helped? • Is it a natural or planned settlement? The students should read the section on pages 42 headed 'Naro Moru: a small settlement in Kenya' to find the answers to the following questions: • What size settlement is Naro Moru? (They should refer to the settlements hierarchy on page 27.) • What factors made this a good place for a settlement? • What shape or layout of settlement might the early settlement of Naro Moru have had? (They should explain their answers.) • What was the purpose of this settlement? • What new purposes did it develop, and what factors helped? • Is it a natural or planned settlement? • Students can do Question F from the assessments on page 45.	
Homework	
Students can answer question D and E independently.	
Discussion and review	
Ask the students what they have learnt in this lesson. They could make a note of this, summarising the lesson, for example: ✓ I learned about the layouts of ancient and modern planned settlements. ✓ I learned that settlements have a function, and how this function can change. ✓ I learned some of the reasons why new capital cities are planned. ✓ I learned how sites are chosen for planned capital cities, and how they are organised. ✓ I learned about a small, planned settlement in England, and considered how to plan a settlement for workers in Pakistan. ✓ I learned how settlements can be planned to give workers a healthy and pleasant life. ✓ I learned about Mombasa in Kenya: the size and type of this settlement, and its purpose. ✓ I learned about the factors that helped Mombasa to develop from a fishing village to a large industrial settlement. ✓ I learned about the Naro Moru in Kenya: the size and type of this settlement, and its purpose. ✓ I learned about the factors that helped Naro Moru to develop.	

<table>
<tr><th colspan="2">Lesson #5</th></tr>
<tr><th colspan="2">Reference pages 43-44</th></tr>
<tr><th>Topics</th><th>Resources</th></tr>
<tr><td>Impact of settlements on landforms
Sustainable settlements</td><td>Oxford School Atlas for Pakistan
If possible, access to the Internet
Pictures for practical examples of sustainable settlements / multimedia</td></tr>
<tr><th>Using the Student's book</th><th>Duration: 35-40 min</th></tr>
<tr><td>Begin the lesson by engaging students in a discussion about cause and effect and which human activities do they know of that has an impact on the environment. Ask students to brainstorm examples of human activities that can influence landforms and ecosystems. Read page 43.
Introduce the concept of urban geomorphology and explain that settlements can have significant effects on the natural terrain. Discuss with students cause for disorganised settlements which can lead to overcrowding, traffic congestion, and other problems. Some of the most common causes for this include:
Rapid growth: Urban settlements can become disorganised with a sudden influx of people, such as when a new factory or university is built. When a settlement grows too quickly, providing adequate infrastructure and services, such as roads, schools, and hospitals, can take time and effort.
Inadequate planning: This can happen when there is no clear vision for the future of the settlement or when there is a lack of coordination between different levels of government. When there is inadequate planning, it can be challenging to ensure that the settlement is well-designed and meets its residents' needs.
Social and economic factors: Social and economic factors can also contribute to the disorganisation of urban settlements. For example, poverty, unemployment, and crime can all create a sense of disorder and chaos. When people need help to make ends meet, they may be less likely to invest in their communities or take care of their surroundings. This can lead to declining quality of life in urban settlements.
Ask students to read pages 43-44 and share images of practical examples for each measure listed.</td><td>Teacher's Notes</td></tr>
</table>

Homework
Students can answer questions A and F to review the topic.
Discussion and review
Ask the students what they have learnt in this lesson. They could make a note of this, summarising the lesson, for example: ✓ I learned about the different ways in which human settlements can impact geological landforms. ✓ I learned about how human activities accelerate transmission of diseases. ✓ I learned about individual and community-based measures to form sustainable settlements. ✓ I learned about unsustainable choices while planning or making settlements.

Answers for assessments

A. Choose the correct answer

I. Size
II. Megalopolis
III. Islands
IV. Mountains
V. Raw material
VI. Islamabad
VII. Causeway
VIII. Karachi

B 1 a) hamlet, village, town, city, metropolis, conurbation, megalopolis

2 a) Islamabad (metropolis, but combined with Rawalpindi—a conurbation)
b) Siddique Roonjho (village)
c) London (conurbation)
d) Quetta (large city)
e) Kotri (large town)
f) Rasool Pur (small town)
g) Faisalabad (metropolis, but becoming a conurbation)

3 a) water supply, safety from flooding, defence, aspect, shelter, trading, resources
b) raw materials for industry, a nearby port, good land transport, an attractive setting

C. 1 a) Mohenjo-Daro, Sindh, Pakistan
b) Miletus, Turkey
c) Port Sunlight, England

d) Islamabad, Pakistan, and Brasilia, Brazil

2. They are inland, rather than on the coast. There were no existing inhabitants. They had a water supply.

3 a) land suitable to build on, good transport links to nearby settlements, national cities, and international destinations.

b) Answers will vary.

D 1. Answers will vary, but should include: the natural harbour for fishing and trade; flat land for farming and building; river for a water supply, transport and fishing; gently sloping hills to higher ground for safety from flooding; a cooler climate than other nearby places; more fertile than nearby desert regions.

2 a–b) Being near the coast and a river, Karachi was ideally placed for transport for trading. This drew in more settlers, and opportunities for industries to develop, making use of materials that were traded there and serving the local population. It developed into an industrial centre. Roads and railways, and later an airport, were not difficult to build on the flat or gently sloping land. So Karachi's influence grew to become national, and then international.

3 a–b) Answers will vary, but the students should refer to their previous learning about different settlements included on pages 34-35 of this unit: Frankfurt Rhine-Main (Germany), Greater Boston (USA), Faisalabad (Pakistan), Greater Manchester.

E 1 a) the students' own discussions

Life in Siddique Roonjho	
Advantages	**Disadvantages**
• unpolluted air—which is not found in a city • a better water supply than the villagers had in their old settlement • flat land for farming; supplies of fish and wood	• an unreliable water supplies • having to travel to buy expensive bottled water • hardly any services like schools or hospitals • far from shops and other services

2 a) Answers will vary, but should consider the villagers' skills, and what work they might find, whether they would easily find somewhere to live (and be able to afford it), whether they would be happy in a city, and so on.

b) They might gain an income and a more secure water supply and other services, such as medical help, schools, and shops. They might lose their sense of community, traditional skills, and way of life, and their freedom to organise their community.

F 1 a–c) Answers will vary, depending on where the children live.

Answers for Skills Book activities

Skills Book activity 'The settlements hierarchy'

A 1. The students should have completed the diagram as it appears on page 27 of the Student's Book.

2. Siddique Roonjho—hamlet
   Islamabad/Rawalpindi—conurbation
   Mega Manila—megacity or megalopolis
   Faisalabad—metropolis
   Rasool Pur—village
   Quetta—large city
   Kotri—large town

B 1. The settlements were classified according to their populations and the services they have.

2. There are fewer people to use the services.

3. They provide a greater range of services, especially services that cannot be found in smaller settlements.

Skills Book activity 'The sites for settlements'

A 1. Students should mark four ideal sites for early settlements. Good choices for a) to d) can include:

a) on the bay, on the coast, near the streams: sheltered harbour for fishing and trading; a track, so there is a useful route to other places; nearby woods for fuel and building materials; river or streams for a water supply and fish; flat land for farming and building

b) in or near the woods by the river: water supply and fish for food; river—possible boat transport and fish; trees for shelter; wood for fuel and building materials; flat land for farming and building; a track providing a route to other places (The woods in the northeast might not be so good—there might not be a water supply, although they would provide shelter and there is a track leading to other places.)

c) near the woods in the south-west; wood for fuel and building materials; food supply—fish from the sea or streams; water supply; shelter (woods and mountains); track—route to other places; sea for fishing

d) where three routes meet near the river: water supply, nearby woods for fuel and building materials; food supply—fish; some flat land for farming and building on; a possible trading or marketplace

e) on the plateau near the centre of the map: a high point—good for defence; water supply from stream; flat land for farming

Skills Book activity 'The patterns of settlements'

A 1. The students should have drawn two examples of each of the following types of settlement, to match those shown in the diagram in the Student's Book page 35-36:
   a) nucleated b) linear
   c) dispersed d) isolated
2. Answers will vary. The students should have named each settlement they drew on the map to match the function it might have.
3. Answers will vary. The students should have listed the settlements they drew (by name) and explained why they developed in these patterns: for example, along a road, a river, or a valley; around a central point such as a harbour, market, meeting place, or religious centre); around a bridging point in a river; around a place where routes meet; scattered around in small farms on agricultural land; single families living far apart because of their work (such as forestry or on large farms).

Skills Book activity 'The functions of settlements'

A 1. Answers will vary. The students should have drawn two examples of the settlements they drew on the previous page.
2 a) Answers will vary.
   b) Answers will vary.

B 1. Answers will vary.

Skills Book activity 'Settlements in Pakistan: a case study'

A. Sindh: Karachi, Hyderabad
Punjab: Lahore, Faisalabad
KP: Peshawar, Mardan
Balochistan: Quetta, Gawadar
Gilgit-Baltistan: Gilgit and Skardu

B. Answers will vary. Natural: Balochistan's arid and desert landscapes limit its capacity for sustained human habitation. The province faces water scarcity, extreme weather conditions, and rugged terrain, making it difficult to access and cultivate. Its interior location and distance from coastal areas contribute to its lower population density. Balochistan has rich mineral and natural resources, but their extraction and utilization may require relatively small populations, leading to lower concentration. Overall, Balochistan's harsh environmental conditions result in a lower carrying capacity for human populations.

Human: Balochistan has a scattered population due to nomadic and semi-nomadic communities. Limited job opportunities discourage population growth and encourage outmigration. Security challenges and political unrest also deter growth. Infrastructure development is lacking, leading to disparities with other provinces. Land ownership and property rights issues can discourage investment. Rural-urban migration leads to lower population densities in some rural areas.

C. Answers will vary. Upper Punjab, Pakistan is a fertile region with five rivers running through it - Jhelum, Chenab, Ravi, Beas, and Sutlej. The region has a rich history dating back to ancient times, with cities like Lahore, Multan, and Faisalabad being important centers of trade, commerce, and cultural exchange. Today, Upper Punjab is a major economic hub with industrial centers, commercial areas, and educational institutions. It's also a political and administrative center with government institutions and offices. Urbanization has caused cities to grow, with higher population densities compared to rural areas.

D. Karachi's hot and dry climate reduces spoilage, making it an ideal location for storing and exporting goods. With a population of over 20 million, it is Pakistan's economic hub, home to industries such as manufacturing, shipping, and finance. The government has invested in infrastructure, making it easy to do business and attracting companies from all over the world. Karachi is well-connected to other parts of Pakistan and the world, making importing and exporting goods easy. Its natural and human determinants have made it a significant trading hub, and its future looks bright.

UNIT 4

Agriculture

Background knowledge for the unit

Agriculture means keeping animals and cultivating plants and fungi, for food, fibre, fuel, medicines, and other products. Agriculture began when people started to live in fixed settlements. Foods include cereals (grains), vegetables, herbs, spices, fruit, oil, and meat, and other animal products such as eggs and milk. Fibres include cotton, wool, hemp, silk, and flax. Raw materials include wood, bamboo, rubber, oil, and resins.

Materials from plants are also refined for use as dyes, drugs, perfumes, and biofuels; and plants are also grown for decorative use, as indoor pot plants, for gardens, and for cut flowers. Agriculture provides employment for more than a third of the world's working population.

In Pakistan, agriculture contributes 19.2 percent to the GDP and provides employment to around 38.5 percent of the labour force. More than 65-70 percent of the population depends on agriculture for its livelihood. Agricultural growth rate has been constrained by shrinking arable land, climate change, water shortages, and large-scale population and labour shift from rural to urban areas. Increasing agricultural productivity, therefore, requires adoption of new approaches. With strong forward and backward linkages with the secondary (industrial) and tertiary (services) sectors, it can play a pivotal role to spur economic growth. However, this sector has remained prone to several challenges like climate change, variance in temperature, water shortage, and changes in pattern of precipitation along with increase in input prices.

The websites of the World Bank and FAO (Food and Agriculture Organization, a department of the United Nations) provide interesting statistics about agriculture: www.worldbank.org and www.fao.org. For example, the percentage of the world's land that is used for agriculture, including the percentages for different countries, and the changes over time.

In 2013, 37.7% of the world's land was used for agriculture. The highest percentage for any country was 82.1% in Uruguay. The second highest in 2013 was Saudi Arabia with 80.6% of land being used for agriculture—a sharp rise from 1961 (40.1%), mainly because of a government restructuring programme for agriculture during the 1970s and 1980s, which developed irrigation and desalination, promoted the use of chemical pesticides and fertilizers, and introduced subsidies for farmers. In 2013 the area of Pakistan's agricultural land was 47.1%—an increase from 46.3% in 1961.

Before we proceed

In this unit students learn about different types, systems, and methods of agriculture, and develop an understanding of the ways in which the shape of the land, the underlying rock and soil, and the climate influence agriculture in different places. The students learn about the importance of agriculture to Pakistan's economy, including the different types of agriculture and how they are suited to different regions, building on their understanding of weather, climate, and landforms.

They use maps, photographs, and tables to explore Pakistan's place in world agriculture. The students also learn about the uses of plant and animal products, and about the ways in which many of these are being developed in the interest of protecting the environment as well as supplying a growing population.

Expected learning outcomes

Students should be able to:

- give an outline explanation of the main methods and types of agriculture: subsistence, intensive, organic, arable, livestock, forestry, and fishing
- name the world's main agricultural products
- identify the factors that influence the type of agriculture that is suitable for any location
- identify the factors that influence the farming methods used in any location
- explain how agriculture affects the environment
- explain how safe farming methods can protect the environment

<table>
<tr><th colspan="2">Lesson #1</th></tr>
<tr><th colspan="2">Reference pages 51-53</th></tr>
<tr><th>Topics</th><th>Resources</th></tr>
<tr><td>What is agriculture?
Methods of farming
Organic farming in Pakistan
Smart farms</td><td>Skills Book activity ‘Different types of agriculture’
Oxford School Atlas for Pakistan
Pictures of, or actual, everyday items some that are made from agricultural products and some that are not: for example, clothing made from cotton, linen, and synthetic fibres, shoes made from leather, plastic, and rubber; foods (including meat, fish, ice cream, nuts, pasta, rice, and spices); items made from wood, bamboo, and paper.</td></tr>
<tr><td>Introduction</td><td>Duration: 5-10 min</td></tr>
<tr><td>Invite the students to share any knowledge they have of agriculture. This might be very limited if they live in a city and have not visited rural areas. The students could list any plants they know about that are agricultural crops. Also ask them to list livestock animals that they know about.</td><td>Teacher’s Notes</td></tr>
<tr><td>Using the Student’s book</td><td>Duration: 35-40 min</td></tr>
<tr><td>Ask the students to sort the pictures or everyday items into two sets: those made from agricultural products and those that are not. They could set aside any they are not sure about. Then ask what each item is made from. Tell them any they do not know and ask if that material comes from agriculture. Then point out any that are wrongly sorted and explain why. Tell them that forestry and fishing are usually included with agriculture, and that agricultural crops and animals are kept for other products as well as food.</td><td>Teacher’s Notes</td></tr>
</table>

Read and discuss Pakistan's status as an agricultural country. Refer to the Economic survey report for latest records. Agriculture accounts for about 19% of Pakistan's GDP and employs about 42.3% of the labor force. Pakistan is a major producer of wheat, cotton, sugarcane, and rice. It is also a significant producer of fruits, vegetables, and livestock. Ask students to name agricultural imports and exports of Pakistan. Ask the students to make their own mind maps to link some of the animals and plants to the items they sorted. They should keep their mind maps for later reference, to help them to assess what they have learnt from this unit. Invite the students to give a definition of agriculture. They should make a note of this before beginning to read the Student's Book. Ask them to look at the diagram on page 48, and to compare this with their original ideas about agriculture. They can then read pages 47-49. They should also look at the photos and maps on these pages. Ask about the differences between subsistence and commercial farms. Then ask how organic farming differs from other types of farming. In small groups, they could discuss the advantages and disadvantages of organic farming, and why organic farming is only practiced by a minority of farmers. Explain the concept of smart farms and the integration of technology in agriculture. Discuss the importance of sustainable farming practices and the challenges faced by traditional agriculture. Read page 49 and give an overview of various smart farming technologies, such as IoT sensors, drones, precision agriculture, data analytics, and automated systems. Explain how each technology works and its potential benefits for farmers and the environment. . You can show a video or present a case study of a successful smart farm implementation to engage students in a discussion about the impact of technology on agricultural productivity and sustainability. . Have students work in pairs to discuss and prioritize these benefits based on their understanding. Discuss the potential challenges and limitations of smart farming, such as initial investment costs, data privacy concerns, and access to technology in rural areas.	

Homework
They should then answer Question B. Ask the students to complete Skills Book activity 'Different types of agriculture'. This activity provides a summary of some of the main vocabulary introduced in the first section of this unit. The students should be able to begin the crossword for homework. They may need to leave out some answers until they have completed later sections of this unit.
Discussion and review
Ask the students what they have learnt in this lesson. They could make a note of this, summarizing the lesson, for example: ✓ I learned about Pakistan as an agricultural country. ✓ I learned about the crops grown in Pakistan. ✓ I learned about different types and methods of farming. ✓ I learned about modern and traditional methods of farming. ✓ I learned about the advantages and disadvantages of using traditional and modern methods of famring.

Lesson #2	
Reference pages 50-53	
Topics	**Resources**
• Irrigation • Arable farming • Wheat	• Use of Atlas or World maps to show the distribution of wheat farming across the world.
Introduction	**Duration: 5-10 min**
Students will gain an understanding of irrigation wheat farming in Pakistan, its importance as a staple crop, and the challenges faced by farmers. They will explore the factors affecting wheat production and propose potential solutions to improve wheat farming practices.	**Teacher's Notes**
Using the Student's book	**Duration: 35-40 min**
Ask students to read page 50-51 and discuss the irrigation methods used in Pakistan. Ask students to break down the natural and physical inputs of farming as determinants of farming. Variation in these factors determine the quantity and quality of the agricultural output. Ask students to read page 52-53. Ask them to name the world's leading wheat producing countries (China and India). Also, as which parts of Pakistan are the main wheat growing areas, and what makes them suitable for wheat farming. (Punjab and Sindh, because they have the right conditions for wheat: there is plenty of flat or gently sloping land, rich soil from the Indus, plenty of sunshine and warm weather, and although they do not have enough rain, they have good irrigation systems.) Invite a volunteer to explain what is meant by a cereal crop and a staple food. (a grass grown for the food from its grain, and a food most people eat every day, respectively) They should be able to give some examples of foods made from wheat, such as bread, pasta, cakes, and biscuits. Ask the students to explain what is meant by kharif and rabi crops, and to give examples of each. Point out/ elicit that being able to plant these winter and summer harvest crops enables arable farms in Pakistan to have two good crops each year.	**Teacher's Notes**

Ask about the geographical regions where wheat is grown and its importance in the national economy. Ask students to look at the map and spot all places in provinces where wheat is grown in abundance and less. Give an overview of wheat farming practices, including soil preparation, sowing methods, irrigation, and harvesting techniques. Discuss the role of climate and seasonality in wheat production. Explain the various challenges faced by wheat farmers, such as water scarcity, pest and disease management, outdated technology, and market prices. Encourage students to brainstorm potential solutions to these challenges. Discuss the importance of efficient water management in wheat farming, especially in regions facing water scarcity. Introduce modern irrigation techniques and their impact on water conservation. Highlight the role of technology in improving wheat farming practices, such as precision agriculture, crop monitoring systems, and improved seed varieties.	
Homework	
Using GIS or Google Earth maps, ask students to make a presentation on the agricultural regions around the world. Ask students to find out why some areas have a higher output than others?	
Discussion and review	
Ask the students what they have learnt in this lesson. They could make a note of this, summarizing the lesson, for example: ✓ I learned about the inputs and outputs of arable farming. ✓ I learned about irrigation methods in Pakistan. ✓ I learned about the irrigation problems Pakistan is facing ✓ I learned why wheat is the world's main food crop and about the main wheat growing countries. ✓ I learned why wheat can be grown in some regions but not in others.	

Lesson #3	
Reference pages 54-57	
Topics	**Resources**
• Rice • Cotton • Sugar cane	• Skills Book activity 'Arable farming' • Skills Book activity 'Products from crops'
Introduction	**Duration: 5-10 min**
To recap the previous lesson, ask the students to explain why a great deal of wheat is grown in Punjab and Sindh. They should be able to explain that these provinces have plenty of flat or gently sloping land with rich soil, and a climate that is warm and sunny, as well as irrigation canals. Ask if they can name Pakistan's second most important cereal crop (rice), and if they know where it is grown (north-eastern Pakistan).	**Teacher's Notes**
Using the Student's book	**Duration: 35-40 min**
Explain that they are going to begin by finding out about the rice growing regions of the world and why they are suitable for growing rice. They should then read pages 54-57 of the Student's Book 'Rice' and look at the map and pictures to find out more. Point out that rice needs these conditions while it is growing, but the land needs to be dry for the harvest. Ask whether rice is a staple food; they should know the meaning of this term from the previous pages. They should also be able to describe the conditions needed for growing rice and to explain why the countries marked on the map are the world's main rice-growing countries, and what makes northeastern Pakistan suitable for rice-growing. Tell the students that the next crops they will learn about are cotton and sugar cane—another two important crops around the world, and important cash crops for Pakistan. Explain/elicit that a cash crop is a crop grown for making a profit, not just for the farmer's own use, so it is not a subsistence crop. Pakistan's textiles industry grew because of the large supply of cotton grown in the country. Also point out that sugar cane is grown as a food crop, but cotton is not, but they might be surprised to learn about the non-food products of sugar cane and the food products from cotton.	**Teacher's Notes**

Ask what makes southern Punjab and central Sindh good cotton-growing areas. (Their climates protect the plants from disease-carrying pests, the hot summers are perfect for cotton plants, and, although the rainfall is too low, irrigation is good.) Also, cotton can survive in quite saline (salty) soil, so the saline soil that is found in many parts of Pakistan is not a problem, unless it becomes too saline. Cotton crops can survive short droughts so the dry seasons are not a problem and can be supported by irrigation if the droughts are prolonged. Ask what they notice on the map about the locations of cotton-producing countries. (They are mainly in warm climatic zones.) The students should also be able to explain what makes Punjab and parts of Sindh, Khyber Pakhtunkhwa, and Balochistan suitable for growing sugar cane. (There is higher rainfall than in most of Pakistan, combined with good irrigation and rich alluvial soil.) Invite them to talk about any surprising facts they have read about these crops.	
Homework	
Students can do question C. There are two pages in the Skills Books that will support the students' learning from this section of 'Arable farming' and 'Products from crops'. They should be able to complete these for homework and will need to refer to the Student's Book or notes they have made in class.	
Discussion and review	
Ask the students what they have learnt in this lesson. They could make a note of this, summarizing the lesson, for example: ✓ I learned the meaning of arable farming. ✓ I learned why different regions are suitable for growing different crops. ✓ I learned about the world's most important crops, and Pakistan's main crops.	

Lesson #4	
Reference pages 57-59	
Topics	**Resources**
• Livestock farming	• Skills Book activity 'Products from livestock' • *Oxford School Atlas for Pakistan*
Introduction	**Duration: 5-10 min**
Summarize the last lesson by reminding the students that they learned about the worlds and Pakistan's main agricultural crops, what makes places suitable for growing them, and their products. Tell them that they are going to learn about agriculture where animals are reared. Ask if they know the word that means all animals kept for food or non-food products (livestock) and ask if they can list all the animals kept as livestock.	**Teacher's Notes**
Using the Student's book	**Duration: 35-40 min**
Ask them to read the section of pages 57-58 headed 'Cattle' including the diagram and table, to find out about the numbers of each animal on farms around the world, the conditions they need, and the main countries where each type of animal is farmed. Ask them to look at the map to find the main cattle farming areas and to think about what they know about the climate and land in these regions, in order to understand why cattle are farmed there and why few are kept in some other regions of the world. They could share their ideas about this. Ask how cattle can damage the land, and what they think could be done to minimize this damage. Ask the students to name any products that come from sheep. They should know meat, wool, and skins—also milk and the cheese that is made from it. Point out that sheep can be good for the land, especially on mixed farms (those that also grow crops) and on farms that also have cattle, because they break up the soil, which helps seedlings to grow, fertilize the land with their waste, and eat many types of unwanted plants, including those that are poisonous to cattle, such as ragwort.	**Teacher's Notes**

Ask them to read pages 58-59, to find out why sheep are often found on high land, with poor soil, that is not suitable for growing any crops. They will also find out about another common animal in Pakistan, the goat, and about other livestock that are common in Pakistan. Ask which animal could easily be kept in: a) an arid region, b) a hilly area with short grass on poor soil, c) large plains. They should also read the section about poultry, after which they could write an explanation of why and how the government of Pakistan encouraged poultry farming.	

Homework

To complete Skills Book activity 'Products from livestock', the students could work in groups, without looking at the Student's Book, to name as many products as they can that come from cattle, and the part of the animal or natural product they come from.

Discussion and review

Ask the students what they have learnt in this lesson. They could make a note of this, summarizing the lesson, for example:

- ✓ I learned about the different animals that are farmed around the world.
- ✓ I learned what makes cattle very useful animals to farm.
- ✓ I learned about the ways in which over-grazing can damage the land.
- ✓ I learned about the main types of livestock kept in Pakistan and the places that are suitable for keeping particular animals.
- ✓ I learned about the many products that come from animals.
- ✓ I learned about some of the positive and negative effects of livestock on the environment.

Lesson #5	
Reference pages 58-60	
Topics	**Resources**
• Forestry • Problems in agriculture • Fishing	• *Oxford School Atlas for Pakistan* • Skills Book activity 'Problems in agriculture' • Skills Book activity 'Major crops of Pakistan'
Introduction	**Duration: 5-10 min**
Ask the students what they remember from their previous work in Grade 6 about the products that come from forests, for example, timber, chipboard, firewood, charcoal, rubber, Brazil nuts and other nuts, berries, and materials for papermaking. If they have visited any forests they could describe the type of trees they saw and anything they found out about the products and uses of the forest. Remind them that forests are useful in other important ways as well as for their products: for leisure and tourism; for shade in and around towns; for their contribution to the environment (preventing water and wind erosion; retaining moisture; providing shelter from wind and storms; and, very importantly, storing carbon, which helps to keep carbon dioxide out of the atmosphere and so reduce global warming). Tell them that they are going to find out about the forestry industry around the world and in Pakistan.	**Teacher's Notes**
Using the Student's book	**Duration: 35-40 min**
Ask the students to read pages 59-61, and to look at the map. Beginning with the map of the world's forests, ask them what they notice immediately about where the forests are and where the places with little woodland are. They should think about what they know about climates around the world. Large land masses in the northern hemisphere (especially northern USA, Canada, Russia, and northern Europe) are noticeably forested, including very cold places, as are places around the Tropics (including Brazil, Peru, Bolivia, Chad, Equatorial Guinea, and the Central African Republic). Arid areas and deserts have no forests.	**Teacher's Notes**

Ask which countries have the highest percentage of land that is forested. They should use political maps to find out which countries are shown these include several countries in central Africa, Guinea Bissau, Congo, and Cameroun; a large area of South America, including Brazil, Bolivia, Paraguay, and Uruguay; Vietnam, Cambodia, Laos, Papua New Guinea, and Malaysia; Finland, Sweden, and Russia.

Discuss old and modern problems from agriculture. Here is a sample differentiation:

Traditional problems from agriculture	**Modern problems from agriculture**
• Low Productivity: Traditional farming methods may have lower yields due to limited use of modern inputs and technology. • Soil Erosion: Traditional agricultural practices often lead to soil erosion, as plowing and tilling can expose the soil to wind and water erosion. • Water Scarcity: Traditional irrigation methods may not efficiently utilize water resources, leading to water scarcity in some regions. • Pest and Disease Management: Lack of modern pest and disease management practices may result in crop losses. • Dependence on Climate:	• Agrochemical Overuse: Excessive use of chemical fertilizers and pesticides can lead to soil and water pollution. • Land Degradation: Intensive agriculture can cause land degradation, including soil compaction and loss of biodiversity. • Loss of Genetic Diversity: Modern agriculture favors high-yielding varieties, leading to the loss of traditional crop varieties and genetic diversity. • Water Depletion: Modern irrigation practices may deplete groundwater and contribute to water scarcity. • Climate Change Impact: Agriculture is affected by climate change, leading to unpredictable weather patterns and extreme events.

Traditional farmers heavily rely on natural weather patterns, making them vulnerable to climate fluctuations.	• High Input Costs: The cost of modern agricultural inputs, such as seeds and fertilizers, can be a burden for small-scale far.	
The students should now read the section on page 60-61 headed 'Fishing'. Ask them to describe different methods of fishing. Ask what they have found out about the fishing industry in Pakistan, and what makes it important for the country. For homework they could find out more about some of the fish that are caught in Pakistan, and record what they find in the form of a scrapbook or notebook that includes drawings, photographs, and information about fish, ports, and the fishing methods used.		
Homework		
They can then complete Questions **C4, D1–2, and E1.**		
Discussion and review		
Ask the students what they have learnt in this lesson. They could make a note of this, summarizing the lesson, for example: ✓ I learned about the locations of the world's main forests and the main products of forests. ✓ I learned about Pakistan's main forests. ✓ I learned about the fishing industry around the world and in Pakistan. In addition to answering the assessment questions about this unit, the students could also return to the mind maps they made at the start of the unit, and make a new version, using what they have learnt. Comparing the two mind maps helps them to assess their own learning.		

Lesson #5	
Reference pages 58-60	
Topics	**Resources**
• Globalisation and agriculture • Sustainable agriculture	• Skills Book activity 'Sustainable farming' • Skills Book activity 'Food insecurity' • Skills Book activity 'Impact of climate change'
Introduction	**Duration: 5-10 min**
Students will be able to define globalisation and explain how it affects agriculture. Students will be able to identify the positive and negative impacts of globalization on agriculture and discuss the future of agriculture in a globalized world.	**Teacher's Notes**
Using the Student's book	**Duration: 35-40 min**
Ask students to read pages 61-62. Discuss that globalisation is the process of increasing interconnectedness between countries and cultures. This can be seen in the movement of goods, services, capital, and people across borders. Globalisation has had a significant impact on agriculture, as it has led to the increased trade of agricultural products, the spread of new agricultural technologies, and the changing of agricultural practices. Ask students to carefully study the numbers for revenue and bulk of import and export and discuss the positives and negatives of globalisation in agriculture through a mind map. Using the examples shared in the textbook and other case studies, explain to students the impact of globalisation on society. This can help students gain a comprehensive understanding of the diverse impacts and complexities of agricultural globalisation. Present an overview of the agricultural sector in the USA/Russia/ Pakistan/China etc., highlighting key crops, agricultural practices, and export-oriented agriculture. Ask students to find and discuss how the selected country's agricultural policies, technological advancements, and trade agreements have shaped its role in the global food system.	**Teacher's Notes**

Engage students in a comparative analysis of the case study. Have them identify common trends, differences, and the implications of agricultural globalization for each country. Divide the students into groups and assign each group a specific topic related to globalization and agriculture (e.g., GMOs, water scarcity, land grabbing). Facilitate a class discussion on the ethical, social, and environmental implications of agricultural globalization in different countries. Encourage students to share their perspectives and propose solutions for addressing challenges. By using case studies from different countries, students can gain a holistic understanding of the complex interplay between globalization and agriculture, fostering critical thinking and a broader perspective on global food systems.	
Homework	
Students can answer question A, …	
Discussion and review	
Ask the students what they have learnt in this lesson. They could make a note of this, summarizing the lesson, for example: ✓ I learned about the positive and negative impact of agricultural globalisation on economy and society. ✓ I learned how globalisation has improved food security across the world. ✓ I learned about environmental cost of globalisation in agriculture. ✓ I learned about sustainable measures taken to improve agriculture and protect the environment.	

Answer to Assessments

A. Choose the correct answer:

I. Agricultural
II. Herbicides
III. 35%
IV. Rice
V. Rice
VI. Rice
VII. Cattle
VIII. 1058 km

B 1 a) Between 1970-80.
b) 2010-2011

2. Refer to the Internet for this. Between 1950 and 2000, the population of Pakistan went up gradually, and from 2000 onwards, it increased sharply.

3.

Subsistence farming	Cash crop farming
• Done to meet the food and basic survival needs of the farmer and their family. • Usually practiced on small plots of land, and the focus is on producing enough food for personal consumption. • Subsistence farmers often grow a variety of crops to ensure food security and reduce the risk of crop failure. • Limited use of modern agricultural technology and inputs due to financial constraints. • There is little or no surplus for sale, so the income generated is mainly from non-agricultural activities.	• Done for commercial purposes, where the main objective is to generate income from the sale of crops. • Practiced on larger farms and involves a more extensive use of land and resources. • The focus is on growing high-value crops that have a market demand, such as coffee, tea, cotton, or sugarcane. • Involves the use of modern agricultural technology, machinery, and chemical inputs to maximize yields and profits. • The income comes from the sale of the crops in the market.

4. Answers may vary. Pakistan's agriculture is struggling to keep up with the growing population. Food shortages and reliance on imports are common due to factors such as a shortage of arable land, water scarcity, outdated farming methods, and climate change.

5. Answers may vary. To improve farming in Pakistan, farmers can adopt modern practices, optimize water usage, invest in research, improve infrastructure, access financial support, and enhance their skills through training.
6. Answers may vary. Cash crops are grown for profit, like cotton, sugarcane, and fruits. Staple crops, like wheat, rice, and maize, provide essential nutrients for basic dietary needs and food security.

C 1 a) Pakistan imports more food than it exports.

b) It means that the country produces more than enough food to feed its population.

2 a) any two from: Angola, Burkina Faso, Cameroun, Central African Republic, Chad, Congo (Democratic Republic), Côte d'Ivoire, Egypt, Ethiopia, Ghana, Guinea, Cuba, Kenya, Madagascar, Malawi, Mali, Morocco, Mozambique, Niger, Nigeria, Senegal, Somalia, South Africa, Sudan, Tanzania, Togo, Tunisia, Uganda, Zambia, Zimbabwe

b) any two from: Argentina, Brazil, Bolivia, Ecuador, Paraguay, Peru, Venezuela

c) It is a very large country, with plenty of flat land and a range of suitable climates, including places with average rainfall as well as arid and semi-arid areas, and a range of temperatures. Cotton can even be grown in the arid and semi-arid areas.

d) Southern Punjab and central Sindh are suitable, even though they do not have enough rain, because their arid climate protects the plants from attacks by microbes that cause disease, and pests that damage them. They have good irrigation that provides enough water to make up for the low rainfall; also, the hot summer weather is just right for the growing season.

e) any from: cotton textiles, cushion fillings, paper, plastics, foods such as margarine and salad oil, livestock feed, soap, floor coverings, humus for agricultural land, paper, chipboard, biomass fuel, and disposable cups and plates

f) Answers will vary. They could include lint (fibre) for making cotton textiles; the short fluff on the seed for making cushion fillings, paper, plastics, and other products; cotton seed oil for making margarine and salad oil; meal from the seeds in livestock feed; other leftover materials for making soap and floor coverings; stalks and leaves for humus, bagasse for making paper, chipboard, biomass fuel, and disposable cups and plates.

3. Eco-friendly means that is not likely to cause pollution or other damage to the environment.

D 1 a) Answers may vary. Agricultural automation can increase productivity and efficiency, resulting in higher crop yields and improved farm management. However, small-scale farmers in developing areas may struggle to afford or adapt to new technologies, and there may be concerns about job displacement for agricultural workers.

b) Answers may vary. Several factors can affect agricultural output, including climate, soil quality, technology, pest management, water access, market access, government support, socioeconomic factors, and environmental sustainability. Proper soil management, modern farming techniques, and access to markets and fair prices are important for increasing productivity. Sustainability practices can also promote long-term productivity and ensure food security for growing populations.

2. a) buffalo, camels, cattle, goats, pigs, sheep, rabbits

b) In addition to meat, milk, and hides, various products come from many parts of cattle; for example, fertilizer; leather for gloves, clothing and shoes; skin for drums and violin strings; and materials used in making asphalt, cosmetics, soap, plastic, medicine, insulation, tyres, china, ice cream, piano keys, chewing gum, capsules for vitamins, wallpaper paste, and candles.

c) Overgrazing causes the grass to become very short for cattle to graze. When cattle tramples the soil, air, water, and nutrients are squeezed out and so the grass cannot grow. The hooves of the cattle leave holes in the soil which kill the grass. These holes get filled with water and once the water has evaporated, weeds grow in these holes.

3 a) Cattle are mostly farmed in the temperate climatic zones. Students should be able to recall that the climate of temperate zones is neither too cold nor too warm. Such climate is ideal for farming cattle.

4. any four from the following: hens, ducks, geese, turkey, quail

5. inland fishing (lakes and rivers); fish farming (aquaculture); commercial fishing (seas and oceans)

E 1 a) Parts of Asia and Africa have little or no forests at all. The reason for this could be that these parts lie in the arid climate zone.

b) Students' own answers could include Finland, Sweden, and Gabon.

c) The correct option is i).

2 a) Answers will vary. They could include paper, rubber, wood, medicine, food, etc.

b) protecting land from soil erosion; generating income from the products of the forests; slowing down global warming

c) An alpine forest grows on very high elevations. The unusual factor about the alpine forests in Pakistan is that they grow at or above the heights of 4000 metres above sea level.

F 1. Answers may vary.

2. Agriculture provides essential employment, food, and income for millions worldwide. It contributes significantly to GDP, exports, and raw material supply for industries. It also supports rural development and other sectors.

3. Answers may vary.

G 1. 1 a) farming to produce food for the farmer and family
b) large-scale farming for earning an income
c) using hand tools, and no machines or tractors
d) using machinery and tractors
e) using no chemical pesticides, herbicides, or fertilizers
f) growing crops

2 a) It is a staple food, eaten all over the world.
b) China
c) Punjab and Sindh are the main growers of wheat because of suitable climate and land. Their soil is fertile and they have a large irrigation network to supply water to their agricultural land.

3 a) China, because it is a very big country and has plenty of flat land and terraced valleys, with enough rain and high enough temperatures in the growing season, with warm sunshine and dry weather when the rice is ripening.
b) North-eastern parts because they have a higher rainfall than other parts of the country.
c) It is an important export crop and 90%of the world's rice is eaten in Asia.

4. Answers may vary. Mention soil erosion due to removal of topsoil, water and air pollution, deforestation, and loss of biodiversity.

5. Farmers can reduce their environmental impact by reducing the number of inputs they use, such as water, fertilizers, and pesticides. This can be done by using more efficient irrigation systems, applying fertilizers more carefully, and using integrated pest management (IPM) techniques. Farmers can reuse agricultural waste products, such as manure and crop residues. This can help to reduce the amount of waste that goes to landfills and can also provide nutrients for crops. Farmers can recycle materials, such as plastic and metal, that are used in agriculture. This can help to reduce the amount of waste that goes to landfills and can also conserve resources.

Answer to Skills Books

Skills Book activity 'Different types of agriculture'

A 1. Across: (5) livestock (8) arable
(2) poultry (7) organic (9) agriculture

Down: (1) subsistence (3) commercial (4) pesticide (6) fertilizer

B. The sentences will vary and should use each word from the crossword in a way that shows that the students know its meaning.

Skills Book activity 'Arable farming'

A 1.

Land	Crop	Climate
gently sloping land with well-drained clay/loam soil	cotton	plenty of water in the growing season; hot weather but short frosts do not harm it
soil that is rich in nutrients	sugar cane	high temperatures (summer average around 32°C) and moderate rainfall (250 mm per year)
flat land or terraced valley sides	wheat	temperate climate; plenty of water in the growing season; sunshine in the ripening season

B 1. Wheat is mainly grown in Punjab and Sindh, which have plains with rich soil brought by the Indus and other rivers. They do not have enough rain, but they have one of the world's largest linked up irrigation systems. They have plenty of flat or gently sloping land and a warm climate.

2. Rice is grown in the north-eastern regions of Pakistan because they have more rain than the rest of the country. (But even here the plants need irrigation to provide enough slow-flowing water in the growing season.) When the plants mature, they need less water, and while they are ripening, the fields need to be almost dry to make harvesting easy, so the region's dry weather is just right currently.

3. Southern Punjab and central Sindh are Pakistan's main cotton-growing areas. There is not enough rainfall, but their arid climate protects the plants from attacks by microbes that cause disease, and pests that damage them. Irrigation provides enough water to make up for the low rainfall. The hot summer weather (32°C average in June) is just right for the growing season, as cotton needs plenty of sunshine. It grows best in alluvial soil, but it can grow in places that have some salt in the soil and can survive short droughts, so it can be grown in arid and semi-arid areas.

4. Sugar cane is a tropical plant that needs plenty of water in the growing season, and soil that is rich in nutrients. It is grown all over Punjab and Sindh, a small area in Khyber Pakhtunkhwa that has rich alluvial soil and good irrigation, and a little is grown in Balochistan. It can be grown in regions where temperatures can become quite low and can survive short periods of frost.

Skills Book activity 'Products from crops'

A. products of the cotton plant: fibre for making cotton textiles; cushion fillings, paper, plastics, cotton seed oil used in foods such as margarine and salad oil; leftover meal from the seeds is used in feed for livestock; other leftover materials are used in soap and floor.

coverings: the stalks and leaves are used as humus.

B. products of sugar cane: white sugar and gur, alcohol for the pharmaceutical industry, press mud, used in organic fertilizers for crops and in animal feed; bagasse, used in making paper and chipboard; for biomass fuel, and disposable cups and plates.

C. 1-2. Answers will vary. The students should describe a product from each of the plant crops mentioned on this page, saying what part of the plant it comes from.

Skills Book activity 'Products from livestock'

A. Answers should include some of the following: meat (from flesh), milk (produced to feed their young), and hides (from skin); fertilizer (from dung); gloves, clothing, and shoes, and skin for drums and violin strings (from skin and intestines); materials used in making asphalt, cosmetics, soap, plastic, medicine, insulation, and tyres (from glands and organs): china, ice cream, piano keys, chewing gum, capsules for vitamins, wallpaper paste, and candles (from bones and horns).

Skills Book activity 'Sustainable farming'

A 1-3. Chemical fertilisers: Chemical fertilizers provide essential nutrients like nitrogen, phosphorus, and potassium that crops need for healthy growth, higher yields, and better-quality produce.),

High yield variety seeds: High yield seeds produce more crops per unit of land. They'recreated through selective breeding or genetic modification and have traits that improve yields, such as resistance to pests and diseases and tolerance to adverse environmental conditions.),

Tractor: Using tractors to mechanize agricultural processes reduces the need for manual labor and enhances the effectiveness of farm operations. Tractors can swiftly prepare the land, plant seeds in evenly spaced rows, and apply fertilizers and pesticides with accuracy. This results in better crop management, leading to increased yields and lower labor expenses.

B. Answers may vary. If a student agrees with Alina then they should write in favour (advantages) of her views and point out limitations (disadvantages) of Ali's view and vise versa. Discourage students to write in support of both views or disadvantages of both views.

Advantages of Alina's view	Disadvantages of Alina's view
Alina supports use of bioengineered and high yield variety seeds for greater output: HYV seeds give increased yield, improved crop quality, shorter growth cycle, resistant to diseases and pests, adaptable to variety of environmental conditions such as droughts, floods, some seeds have high nutrition value	Ali does is against the use of bioengineered seeds for greater output, which means he supports use of organic farming methods: low yields can lead to food insecurity; higher cost of inputs such as more land required for farming; labour intensive for weeding, pest control etc

Disadvantages of Alina's view	Advantages of Ali's view
HYV seeds are dependent on high irrigation, costly seeds, fertilisers, and pesticides; less crop biodiversity; small scaler farmers struggle to afford it; gives out allergic reactions; antibiotic resistant; mostly lack nutrition	Organic farming is environment friendly as it reduces soil erosion, conserves water, prevents pollution; contains more nutrients and less toxins; supports local economies

Skills Book activity 'Food insecurity'

A 1. Food insecurity is the condition of not having access to sufficient food, or food of an adequate quality, to meet one's basic needs.

2. Possibilities:
   - Capacity Building by provide training and technical support to farmers on organic farming practices.
   - Invest in research to develop region-specific organic farming techniques.
   - Create awareness and promote the benefits of organic produce among consumers.
   - Offer financial incentives such as subsidies, grants, and low-interest loans to encourage farmers.
   - Encourage farmers to grow diverse crops under organic practices, including traditional and indigenous varieties, to enhance food security and resilience.

Limitations:

- Initial transition period from conventional to organic farming may lead to lower yields.
- Organic farming may require larger land areas than conventional farming to produce the same amount of food due to lower yields in the short term.
- Organic produce may face challenges accessing premium markets, and price fluctuations could affect farmer incomes.

- Availability and affordability of organic fertilisers and biopesticides may be limited in certain regions.
- Organic farming relies on natural pest and disease control, which may be challenging in areas with severe pest outbreaks.
- Organic farming's reliance on natural processes may make crops susceptible to climate variability and extreme weather.

3. Possibilities:
   - Improving Livestock Breeding by implementing selective breeding programs. It can enhance the genetic potential of livestock for better growth, productivity, and disease resistance.
   - Promoting the use of balanced and nutritious feed for livestock to improve their health and productivity.
   - Ensuring proper healthcare and disease control measures for livestock to prevent losses and improve overall productivity.
   - Supporting the cultivation and conservation of quality fodder to meet the nutritional needs of livestock during periods of scarcity.
   - Encouraging value addition in the livestock sector, such as milk processing and meat packaging, to improve market access and value for farmers.
   - Training and educating livestock farmers on modern and sustainable livestock management practices.
   - Offering financial support and access to credit for livestock farmers to invest in improved breeding stock and infrastructure.
   - Establishing direct linkages between livestock farmers and processors or retailers to ensure fair prices and reduce the role of intermediaries.

Limitations:

- Limited availability and high cost of quality feed can lead to insufficient nutrition for livestock, affecting their productivity.
- Livestock are susceptible to diseases, and outbreaks can lead to significant losses if not properly managed.
- Unsustainable livestock practices, such as overgrazing and water pollution, can contribute to environmental degradation.
- Small-scale livestock farmers may need help accessing modern technology and knowledge to improve their practices.
- Climate variability and extreme weather events can affect livestock production and health.
- Limited grazing land and competition with agriculture can challenge livestock farming.

- Weak value chains and marketing systems can lower livestock farmers' profits.
- Inadequate infrastructure, such as cold storage and processing facilities, can limit value addition and market opportunities.

Skills Book activity 'Problems in agriculture'

A 1. Kohistan, Charsadda, Swabi,
Mardan, Peshawar, Sargodha,

2. cultivated area above 90%
3. Answers will vary. Punjab is the most cultivated province in Pakistan due to its temperate climate, better irrigation system, fertile soil, and modern and we connected infrastructure. In contrast, Balochistan is the least cultivated province due to water scarcity, unsuitable land, security concerns, and inadequate infrastructure. The difference in agricultural development between the two provinces is multifaceted.
4. Answers will vary. Pakistan's agriculture faces challenges due to water scarcity, unsuitable land, desertification, and poor practices. Urbanisation and low profitability have led to a decline in cultivated areas. Government policies, such as slow investment in irrigation and water conservation, have also contributed to this decline.

Skills Book activity 'Major crops of Pakistan'

A. Students will make the pie graph as per percentage.

B. Answers will vary. Pakistan's climate and soil are ideal for wheat production, with adequate rainfall and average temperatures ranging from 12 to 25 degrees Celsius. Wheat is a staple food in Pakistan and a significant source of export revenue to countries in the Middle East, Africa, and Asia. Government subsidies support wheat production to keep it affordable and ensure Pakistan remains a major producer.

C. Similarities:

- Temperate climate: Both wheat and rice are grown in temperate climates. This means that they need warm temperatures, but not too hot.
- Water: Both wheat and rice need a lot of water to grow. They are both irrigated crops, which means that they are grown in areas that are regularly watered.

Differences:

- Soil: Wheat is grown in loamy soils, while rice is grown in clay soils. Loamy soils are loose and well-drained, while clay soils are sticky and hold water.
- Rainfall: Wheat is grown in areas that receive moderate rainfall, while rice is grown in areas that receive heavy rainfall. Wheat can be grown in areas with as little as 500 mm of rainfall per year, while rice needs at least 1,000 mm of rainfall per year.

D. In Pakistan, floods and droughts can have devastating effects on the agricultural industry, resulting in substantial economic harm. These natural disasters cause damage to crop, livestock, infrastructure, and employment opportunities for farmers. Pakistan's economy relies heavily on agriculture, making it particularly vulnerable to the consequences of floods and droughts, which can lead to food insecurity and income loss for farmers. Rehabilitation expenses and the requirement for disaster response measures only add to the economic burden. To decrease the damage, it is critical to implement early warning systems, utilize climate-resilient agriculture methods, and invest in agricultural research.

Skills Book activity 'Impact of climate change'

A 1. cotton, rice, and sugarcane.

2. The flood inundation is highest in the rice crop zone, which has resulted in an overall estimated loss of 1.9 million tons of rice, or an 80% loss of the expected total rice production in Sindh.

3. Heat waves are bad for farming because they hurt crops, animals, people's health, and forests. It makes more land dry, which is bad for countries like Pakistan whose main source of income is agriculture. In Pakistan, food safety and food security are affected by heat waves. Pakistan's water shortage is expected to worsen due to climate change. This could cause infrastructure damage, agricultural disruptions, displacement of people, and increase the risk of heat-related illnesses and vector-borne diseases. Climate change could also damage infrastructure like roads, bridges, and dams, leading to disrupted transportation, communication, and power supplies.

4. Answers may vary.

Possibilities: Farmers can benefit from crop diversification and efficient water management practices to reduce water scarcity and withstand diverse weather conditions. Conservation and crop rotation can improve soil health and break pest cycles. Early warning systems, climate-resilient infrastructure, and research and development are essential to protect crops and resources. Training programs, financial incentives, and climate insurance schemes can support farmers in adopting sustainable practices. Rural infrastructure development, community engagement, and supportive policies and regulations are critical for promoting climate-resilient agriculture.

Limitations: Small-scale farmers in developing countries face challenges in adopting climate-smart practices due to limited financial resources, access to information and technology, inadequate rural infrastructure, weak institutional support, traditional farming practices, unpredictable weather patterns, insecure land tenure, limited research on climate-resilient crops, market access, and political and economic uncertainties.

UNIT 5

Climate Change

Background knowledge for the unit

The Earth's climate has been changing since time began, but there have been great increases in temperature during the past 150 years, and the hottest 10 years ever recorded have been during the past 20 years.

Changes in climates have occurred naturally since the Earth first formed around 4.54 billion years ago. Geologists have named the different stages of the Earth's development according to the events and conditions on Earth. Events such as the formation of land masses, continents, mountains, and volcanoes affected the climate during Earth's evolution. After the Cretaceous period, around 100 million years ago, the Earth began to cool down, leading to the Ice Age, when ice sheets up to 3 km thick covered North America and Europe. (This was when mammals began to diversify, and humans evolved near the Tropics.) Some of this ice remains, for example, near the Poles.

When humans evolved, they had little effect on the Earth's climate, but since the Industrial Revolution of the eighteenth century, they have had a considerable effect. Most scientists believe that human activity is now having a greater effect on climate change than natural factors, and that the most significant human action is the burning of fossil fuels for energy to support industry and transport, and for domestic heating, lighting, and cooling. Deforestation has also had a significant effect, since forests provide a 'carbon sink' (an area that absorbs carbon and so reduces the amount of carbon dioxide released into the atmosphere).

Computer modelling can be used to predict climate changes; this is based on the possible effects of population growth, changes in industry, carbon dioxide emissions, changes in the carbon sinks of the oceans and forests, the shrinking of glaciers and polar ice, and on the effects of the United Nations Environmental Programme. There has been an average increase of 0.8°C in the global temperature since 1880 and an increase of 3.4 mm in sea levels per year. If possible, check out the website: https://climatekids.nasa.gov in class and discuss. You can also ask the students to browse this website at home.

Scientists have predicted that, due to climate change, temperature increases will lead to an increase in droughts and cause deserts to spread. Rises in sea level would affect low-lying regions, such as the Netherlands, the Maldives, and other island groups, and places situated in the lower courses of river valleys, such as Amsterdam, Manhattan, and London. Melting glaciers could cause floods in regions downstream: for example, in parts

of Pakistan and Bangladesh. Melting permafrost releases carbon dioxide and methane from frozen peat bogs into the atmosphere.

Storms and cyclones will become more frequent and more severe. These would affect South-east Asia, and the south-east of the USA. Most scientists agree that reducing greenhouse gas emissions and protecting and increasing carbon sinks are vital actions in counteracting global warming.

Before we proceed

This unit explains the ozone layer, climate change, the greenhouse effect, and global warming, and their effects on the Earth and its inhabitants. It explains how humans are contributing to these, and the actions they must take to mitigate them.

Expected learning outcomes

Students should be able to:

- explain climate change, global warming, and the greenhouse effect.
- discuss the importance of the ozone layer and explain how human activity affects it.
- discuss what can be done to combat global warming.
- identify the main greenhouse gases, their sources, and some of their effects on the Earth.
- identify the natural features that act as carbon sinks.

Lesson #1	
Reference pages 65-68	
Topics	**Resources**
• What is climate change • Greenhouse effect	• *Oxford School Atlas for Pakistan* • Skills Book activity 'Climate change vocabulary' • Skills Book activity 'How the greenhouse works'
Introduction	**Duration: 5-10 min**
Ask the students what they know about the meaning of climate. They should know the difference between weather and climate. Explain that they are going to learn about how the climate is changing—not only changes in the climates of specific regions but changes in the climate around the world. Elicit what they know about climate change. They will probably have heard about it on television or read about it in newspapers and heard people talking about it. They could be asked to discuss with their parents at home how the climate has changed over the past 20 years. Ask about the evidence of climate change that people are already noticing—both in their own regions and in other parts of the world. They should know about effects such as rises in air temperatures, desertification, flooding, perhaps rising sea levels, and the melting of some glaciers. Ask what they know about the changes to gases in the Earth's atmosphere. (Greenhouse gases are being produced, causing the greenhouse effect.) Ask what they know about 'greenhouse gases' and check that they know what a greenhouse is. Explain that the term 'greenhouse effect' suggests that greenhouse gases have the same effect as a greenhouse. Tell the students that they are going to find out what these terms mean and why greenhouse gases are a problem.	**Teacher's Notes**
Using the Student's book	**Duration: 35-40 min**
Ask the students to read page 65-66 and to make a note of any facts they find on this page. Ask them to share these with the class. Ask why scientists are particularly worried about the changes that are happening now, rather than thinking that they are just part of the Earth's natural changes. (The current changes are happening very quickly compared with those in the past, and the gases in the Earth's atmosphere are changing.)	**Teacher's Notes**

Ask the students to read about the greenhouse effect on page 66-67. After they have read this page they should be able to name some greenhouse gases and to explain how they can be helpful and why they can cause problems. Explain that the greenhouse effect is beginning to melt the permafrost and ask what they know about the permafrost. They should be able to name places that have permafrost (Alaska, USA, parts of Russia and Greenland, and some areas in the Arctic Circle). They could look at a world map and maps of the Arctic and Antarctic to locate the places with this type of climate. The students can then read pages 67, including the diagram and the 'It's a fact' to find out where the extra greenhouse gases are coming from, and the effects they are having on the Earth's climate. Ask how greenhouse gases are affecting the seas and oceans, and the permafrost, and about the problems that these changes could cause.	
Homework	
They can then complete Question B.	
Discussion and review	
Ask the students what they have learnt in this lesson. They could make a note of this, summarizing the lesson, for example: ✓ I learned that the Earth's climate is changing. ✓ I learned about the meaning and effects of global warming. ✓ I learned that the Earth's climate changes naturally.	

Lesson #2	
Reference pages 65-67	
Topics	**Resources**
• What is ozone layer? • Disappearing ice	• *Oxford School Atlas for Pakistan* • Skills Book activity 'Reducing greenhouse gases' • Skills Book activity 'Impact of climate change'
Introduction	**Duration: 5-10 min**
Explain that in this lesson they are going to learn the meaning of the ozone layer, why it is important to the Earth's climate, and how greenhouse gases are affecting it. Ask what ozone is. (It is a gas that is present in the troposphere—the lower part of the Earth's atmosphere—in small amounts, but there is a layer of ozone higher in the atmosphere, near the outer part of the stratosphere.) They should now be familiar with the different levels of the Earth's atmosphere.	**Teacher's Notes**
Using the Student's book	**Duration: 35-40 min**
Ask the students to look at the diagram of the Earth's atmosphere on page 67 of the student's Book, to check that they know the order of the different layers of the atmosphere and the names that scientists have given to them. They should then read page 67-68 to find out about the ozone layer. They could write a summary of this without looking at the Student's Book before continuing to read about the importance of the ozone layer in protecting living things from too much radiation from the Sun. Explain that too much ozone low in the atmosphere can be harmful. Ask the students to read on to find out why, and to find out about the effect of greenhouse gases on the ozone layer. Students might have heard about international agreements to take action to reduce greenhouse gases and should read to find out about them. They will be aware of many examples of activities that produce greenhouse gases near where they live and might know about some of the ways in which people are trying to reduce these. Ask them to read on to the end of the unit to find out about some of the main ways of doing this. Ask the students to look at a map of the world in their *Oxford School Atlas for Pakistan* to find the places that have glaciers and	**Teacher's Notes**

ice caps or sea ice. Discuss how global warming could affect these places. Ask the students to read pages 69-70 'Disappearing ice' and 'What happens to the ice from a retreating glacier?' Ask if they read anything that surprises them. (They might be surprised to find that not all glaciers are retreating due to global warming; although most glaciers are retreating, a few in the highest regions of the Karakoram Mountains are advancing.) Ensure that they understand the terms 'advancing' (spreading, due to an increase in the area covered) and 'retreating' (reduction in the area they cover). Explain that glaciers are constantly moving downhill. The ice tends to melt when it reaches lower elevations. A few glaciers have periods during which they advance very quickly. Their movement is normal until they accelerate suddenly, then they continue to move normally. There are different causes for these periods of sudden movement, including changes in the bedrock below, or meltwater pooling at the base of the glacier. Ask them to read page 70. Ask what they have learnt about the effects of melting sea ice and land ice, and why these differ. They should be able to locate Greenland and Antarctica on a map of the world and to explain why the ice in Greenland is more likely to melt than that in Antarctica. Ask them to read the 'It's a fact' and to say what trends are being recorded in sea levels.	
Homework	
They can then complete Question C and E. The students should attempt the Skills Book activity 'Reducing greenhouse gases' and 'Impact of climate change'.	
Discussion and review	
Ask the students what they have learnt in this lesson. They could make a note of this, summarizing the lesson, for example: ✓ I learned how people can help to reduce greenhouse gases. ✓ I learned how I can help to reduce greenhouse gases. ✓ I learned how global warming is affecting the Earth's Sea ice and land ice. ✓ I learned about the effects of melting glaciers. ✓ I learned about the effects of melting sea ice and ice caps.	

Lesson #3	
Reference pages 70-76	
Topics	**Resources**
• Causes of climate change • Impact of climate change on animals and plants	• Skills Book activity 'Carbon footprint' • Skills Book activity 'Droughts in Europe: a case study'
Introduction	**Duration: 5-10 min**
Explain that this lesson will focus on the effects of climate change on living things: plants, humans, and other animals. Ask if they have heard or read about people, other animals, or plants being affected by climate change.	**Teacher's Notes**
Using the Student's book	**Duration: 35-40 min**
Ask students to read page 70-71. Share some of the following resources they could go through as wider reading review before or during the lesson: E.P.A. | The Basics of Climate Change (https://www.epa.gov/climate-change) The New York Times | Short Answers to Hard Questions About Climate Change (https://www.nytimes.com/article/climate-change-global-warming-faq.html) NASA | Global Climate Change (https://climate.nasa.gov/evidence/) The Learning Network | Teaching About Climate Change With The New York Times (https://archive.nytimes.com/learning.blogs.nytimes.com/2014/04/02/teaching-about-climate-change-with-the-new-york-times/) Provide a concise explanation of how the greenhouse effect works and its impact on Earth's temperature regulation. Additionally, elaborate on the primary natural elements that can contribute to climate change, such as volcanic activity, solar radiation, and orbital changes. Finally, introduce the human-induced factors that may affect climate change, including deforestation, fossil fuel burning, industrial processes, and agriculture. Ask students to explain the links between multiple causes and effects of climate change. Ask the students to read pages 71-73 'How does climate change affect animals and plants?'. They should then be able to give a summary of these without looking at the Student's Book. For homework, different groups could then use the Internet to find out more about the effects on one of the animals mentioned, and to write a report about it.	**Teacher's Notes**

Discuss how plants are being affected and how climate change might affect the plants in the region where they live. They should then read pages 73-76 to find out how climate change is affecting people around the world, beginning with places near where they live. They could begin to collect information about any of these effects that they can find in the newspaper, television, or the Internet in Pakistan.	
Homework	
The students can then complete Question A and D and calculate their carbon footprint for Skills Book activity Carbon footprint' and study the impact of climate change by answering questions in Skills Book activity 'Droughts in Europe: a case study'.	
Discussion and review	
Ask the students what they have learnt in this lesson. They could make a note of this, summarizing the lesson, for example: ✓ I learned how climate change is affecting animals and plants, and what they might do in order to survive. ✓ I learned how climate change is affecting people. ✓ I learned about the effects of climate change in Pakistan.	

Answer to Assessments

A. Choose the correct Answer:

I. Climate change
II. Methane
III. Floods
IV. Fossil fuels
V. Acidic
VI. O3
VII. Permafrost
VIII. Peat

B 1 a) Climate change means a change in the Earth's normal weather patterns.
b) The Earth's average climate is getting warmer. We call this global warming.
c) Greenhouse gases radiate heat in all directions. They keep the atmosphere warm.
d) Carbon dioxide, nitrous oxide, and methane are examples of greenhouse gases.
e) Most of the methane in the atmosphere comes from agriculture, decaying landfill, and decaying peat bogs.

f) Most of the carbon dioxide in the atmosphere comes from burning fossil fuels for power.

2 a) manufacturing/industry, agriculture and forestry, energy production, transport, buildings (including air conditioning), other energy uses, including homes and shops

b) energy (25%), agriculture, forestry, and other land use (24%), industry (21%), transport (14%), buildings (6%), other energy (10%)

c) any four from the following:

- Do not leave television sets or other electrical equipment on standby.
- Do not leave land bare: plants, especially trees, are good at absorbing carbon dioxide from the atmosphere.
- Change from vehicles running on petrol or diesel (fossil fuels) to electric or solar-powered vehicles which do not produce greenhouse gases.
- Do not leave the engine running while the vehicle is parked.
- Make the shape of a vehicle more streamlined: put a deflector at the front of trucks and do not leave a roof box on a car if it is not needed; and do not drive with the windows open.
- Drive more slowly.
- Make sure vehicle tyres are inflated enough.

d) hotter summers and more heatwaves; droughts in some places but very heavy rainfall in others

3 a) healthy peat bogs c) forests e) permafrost

3. a gradual change towards something, for example: higher or lower rainfall, higher or lower temperatures, more or fewer storms, or higher or lower sea levels

4. Answers will vary.

C 1. partly because global warming is melting the ice around the Poles.

2. The permafrost stores carbon but, if it melts, it releases carbon dioxide into the atmosphere. If it continues to melt, it will also release methane from peat bogs that are normally frozen.

3 a) False; most of the world's glaciers are retreating and some are forming glacial lakes. A few glaciers in the Karakoram Range are advancing. A few are not changing.

b) true

c) true

4 a) Greenland is not as cold as Antarctica.

b) Sea levels around the world would rise by more than 75 metres.

5 a) The students' own responses, for example:

- Melting sea ice means that polar bears' habitats are shrinking. They must

swim longer distances to find food. Many become exhausted and die from starvation.

- Baleen whales feed on plankton (tiny living organisms). Warmer water contains less plankton, so baleen whales are dying from starvation. They travel farther in search of food and they are being found washed up on beaches in areas where whales have never been seen before.
- Rising sea levels could endanger sea turtles' eggs or very young hatchlings, which are laid and hatch on beaches in Brazil. Higher temperatures are more suitable for female hatchlings but cooler temperatures are better for males, so the population of male sea turtles is reducing. This could threaten turtle populations.
- Some birds that migrate to cooler climates for the summer are beginning to migrate earlier. They could starve if the insects they usually feed on have not yet hatched.
- The world's oceans are absorbing more and more carbon dioxide. This makes the water more acidic. In more acidic water, coral, and shellfish cannot absorb the calcium carbonate they need for healthy skeletons or shells. When the sea stays warm for longer than normal, coral becomes white and does not regain its pink colour. This makes it less able to
- fight off disease.
- In some places, floods in the spring wash away salmon eggs laid in stream beds. This could wipe out whole salmon populations.

b) students' own responses, for example:

- Alpine plants grow on high ground, where temperatures do not get very high. If their habitat becomes too warm, there is nowhere higher for them to grow.
- Some plants are producing flower buds earlier because of warmer temperatures. But there can still be overnight frosts that kill the buds.

6 a–b) students' own responses, for example:

- Climate change is affecting water supplies, for example: Pakistan is one of many countries that already have very little water. Higher temperatures and other changing weather patterns are changing the amount of water in lakes, rivers, and streams. Some regions are facing droughts. This change means that many people could face water shortages at home and for farms or other businesses.
- In some places, temperatures could become too high for the crops normally grown there. Changing weather patterns are also affecting the amount of water that can be used for irrigation. Stronger storms and floods can damage crops, so there could be food shortages.
- As well as producing greenhouse gases, the burning of coal, oil, and natural gas produces air pollutants such as ozone, sulphur dioxide, and nitrogen

oxides. These can cause health problems. Sunlight and low-level ozone can increase the effects of pollutants. For example, Tokyo, Islamabad, New York, and London already have high levels of pollution that harm health, especially for very young or very old people or those who have breathing problems.

- Heatwaves are becoming more common. These are especially dangerous to infants, older people, and people with poor health. For example: in 2003, a heatwave in Europe caused about 50,000 deaths. In June 2015, the heatwave in southern Pakistan had temperatures as high as 49°C. It caused the deaths of about 2000 people, mainly from dehydration and heatstroke.
- As winters become warmer, ticks and mosquitoes that carry diseases can survive longer throughout the year. Bites from these insects could cause disease or even death.
- Settlements along some coasts and small islands, especially on lowland, will be threatened by floods if sea levels rise. Hundreds of millions of people around the world could lose their homes or businesses and face danger.
- As temperatures rise, more and more people need to use air conditioning, which uses a lot of electricity. However, many will use less energy for heating in the winter.
- Droughts, floods, and damage to dams could cause problems for hydroelectricity plants, so there could be power shortages.

D 1 a) Sea levels are rising and the seas are becoming less salty in places.

b) i) Due to global warming, polar bears' habitats are shrinking. They must swim longer distances to find food. Many become exhausted and die from starvation.

ii) Baleen whales feed on plankton (tiny living organisms). Warmer water contains less plankton, so baleen whales are dying from starvation. They travel farther in search of food and they are being found washed up on beaches in areas where whales have never been seen before.

iii) Alpine plants grow on high ground, where temperatures do not get very high. If their habitat becomes too warm, there is nowhere higher for them to grow.

iv) Rising sea levels could endanger sea turtles' eggs or very young hatchlings, which are laid and hatch on beaches in Brazil. Higher temperatures are more suitable for female hatchlings, but cooler temperatures are better for males, so the population of male sea turtles is reducing. This could threaten turtle populations.

E 1 a) stratosphere

b) The Sun's radiation keeps the Earth warm enough for plants and other living things to live, but some of its ultraviolet radiation is harmful. The ozone layer keeps out most of the harmful ultraviolet radiation.

c) chlorofluorocarbons (CFCs), carbon dioxide

d) Ozone depletion can cause increased amounts of UV radiation to reach the Earth which can lead to more cases of skin cancer, cataracts, and impaired immune systems. Too much exposure to UV is believed to be contributing to the increase in melanoma, the most fatal of all skin cancers.

2 a) Answers will vary. They could include problems caused by:

- droughts, higher temperatures that reduce rainfall, affecting water supplies for homes and irrigation
- temperatures that become too high for the crops normally grown, leading to food shortages
- stronger storms and floods can damage crops, leading to food shortages
- pollutants such as ozone, sulphur dioxide, and nitrogen oxide from the burning of fossil fuels that can cause many health problems, particularly in cities
- heat waves that can be especially dangerous to infants, older people, and people with poor health, causing dehydration and heat stroke
- flooding in coastal settlements (for example in the Indus Delta) if sea levels rise
- damage to dams from droughts and floods that could cause problems for hydroelectricity plants, leading to power shortages

b) In some places, melting ice from glaciers has caused floods: for example, in Chitral, in 2015, when melting ice and heavy rainfall caused a glacial lake to overflow the Khanpur Dam on the Haro River in Khyber Pakhtunkhwa. In 2010, there was a landslide near Attabad that created a dam across the Hunza River. A lake formed behind the dam and flooded towns, fields, and roads, including part of the Karakoram Highway. In recent years, Pakistan has experienced several devastating floods (2022), which have caused significant damage to infrastructure and livelihoods. The melting of glaciers is also affecting the country's hydropower generation, which accounts for approximately 29% of its electricity production.

3 a) Answers will vary. They could include reports of floods, droughts, heatwaves, pollution, and so on.

b) Answers will vary.

4. Pakistan can reduce greenhouse gas emissions by transitioning to renewable energy sources, planting more trees, and implementing energy-efficient technologies in industries, transportation, and buildings. These efforts, supported by policies, public awareness, and international cooperation, can mitigate the effects of greenhouse gases and address climate change in Pakistan.

Answer to Skills Book activities

Skills Book activity 'Climate change vocabulary'

A 1. The students should have completed the crossword with the following answers:
Across

3. greenhouse
4. carbon
5. fossil
8. methane
9. stratosphere
10. atmosphere

Down

1. global
2. troposphere
6. ozone
7. change

Skills Book activity 'How the greenhouse works'

A–B. Students should follow the instructions and record the temperature in the table. They should then give their own answers on based on their observation and calculate of the differences between the temperatures. The should draw a diagram of a greenhouse in the given space.

Skills Book activity 'Impact of climate change'

A 1 a) The students' own responses should mention islands and regions with lowland elevation; coastal places at low elevations; regions that are prone to drought; regions that can be affected by downstream melting from glaciers; regions that have monsoons, cyclones, and storms, and regions near the Equator.

b) The students' own responses should include the effects of rising sea levels, higher temperatures, melting ice caps, and glaciers; also the effects of melting permafrost, the loss of forests/other changes in land use, and increase in greenhouse gases.

c) These should include: reducing the burning of fossil fuels and other activities that increase greenhouse gases, and reducing deforestation.

2 a) As the sea ice melts, polar bears, which live on the sea ice around the North Pole and feed mainly on seals, have to swim farther to find large enough, stable pieces of ice. This makes them very tired, especially females who have cubs to look after. Because of this, many adults and cubs are dying from starvation.

b) Rising sea levels could endanger sea turtles' eggs or very young hatchlings, which are laid and hatch on beaches in Brazil. Higher temperatures are more suitable for female hatchlings but cooler temperatures are better for males, so the population of male sea turtles is reducing. This could threaten turtle populations.

c) Students' answers should include that flash floods, droughts, storms etc. and rising temperature affect the production of good and livestock.

Skills Book activity 'Carbon footprint'

A 1-2. Students will calculate and answer independently.

3. An individual can reduce their carbon footprint by walking, biking, or using public transportation instead of driving alone. Eating less meat, recycling and compost, using energy-efficient appliances, and unplugging electronics when not in use can also be helpful. We can choose sustainable products and get involved in our community. Bring reusable water bottles and coffee mugs, buy used clothes and furniture, plant trees, and get involved in climate activism.

Skills Book activity 'Droughts in Europe: a case study'

A 1. Natural: Drought can be caused by climate variability from the positioning of high and low-pressure systems; oceanic influences, topography, and low river flow. These factors affect precipitation patterns and moisture availability, leading to prolonged dry periods.

Human: Mismanagement of water resources, deforestation, inefficient irrigation, soil degradation, and pollution, can contribute to water scarcity during low rainfall periods. Urbanisation and climate change can also worsen the situation. Population growth and increasing water demands in urban areas can strain resources during dry periods.

Agriculture	Industries	Local and global trade	Domestic needs and budget
Crop failure; reduce forage availability for livestock that can also affect its health; economic losses from less yield, high irrigation cost; dependence on food imports	Less energy from hydel power projects; economic loss when industries do not function at full capacity; loss of raw material; disruption of supply chains	Low yields can cause countries to export less, which impacts international trade; drought-related supply chain problems can affect the availability and prices of traded goods, resulting in effects on global markets and supply chains.	Water scarcity leads to problems for households and cities, affecting clean water supply, sanitation, and hygiene; expensive to fix and maintain infrastructure for water supply, leading to higher utility bills; government has to allocate funds for emergency aid, support for farmers, and water management, impacting budget allocation.

3. A climate emergency occurs when fast and severe climate changes threaten ecosystems, communities, and economies. Urgent action is needed to prevent irreversible harm.

It conveys the need for decisive and transformative actions to mitigate greenhouse gas emissions, adapt to changing conditions, and protect vulnerable populations. The droughts in Europe are considered a climate emergency. Mention details from the passage such as driest summer in 500 years, anthropogenic changes from droughts, state of alert declared by countries like France to adapt to water scarcity, etc.

Skills Book activity 'Reducing greenhouse gases'.

A. Answers may vary.

1 a) Develop the production of power from wind, solar radiation, and water (hydro and tidal). Find ways to use less energy: for example, making energy efficient electrical goods such as fridges that use less power.

b) Improve the management of drainage, fertilizers, manure, and other waste products, by using waste products to produce energy; prevent deforestation.

c) Use less energy in manufacturing and find ways of using alternative energy from non-fossil sources for heat and light in factories. Use recycled materials where possible: for example, in steel and aluminum manufacturing. Reduce waste and leakage of chemicals.

d) Develop biofuels (fuels made from living things or their products, such as plant sugar and plant oils) to replace fossil fuels such as petrol and diesel, and because the plants grown for producing biofuels absorb carbon dioxide from the atmosphere.

e) Insulate buildings to reduce energy consumption by introducing and enforcing regulations for new buildings to improve their insulation and so reduce the use of heating and air-conditioning. Encourage people in workplaces, at home, and at school, to switch off electrical equipment and lights when they are not being used.

UNIT 6 Minerals and Power Resources

Background knowledge for the unit

For more than a decade, surveys, and reports on the mineral resources of Pakistan have shown that the country is rich in various minerals, but that these have never been exploited to anything approaching their full potential. Explore the timeline of mineral deposits and power resources in the region of Pakistan:

Industrial Revolution (Late 18th - Early 19th Century)

Industrialization in Europe increased demand for minerals and energy resources. Pakistan, then a part of British India, had some mineral extraction activity, but on a smaller scale.

Pre-Partition Era (1947)

In 1947, Pakistan was formed after the partition of British India. The area received some infrastructure and resources for mineral extraction and power generation from the British colonial era.

1950s - 1960s

During the years following its independence, Pakistan made strides towards exploring and utilizing its mineral resources. This included the exploration of oil and gas reserves, which led to the discovery of substantial deposits in the Sui region of Balochistan. Additionally, the construction of the Mangla Dam on the Jhelum River provided a significant boost to the country's hydropower capacity.

1970s - 1980s

Oil and gas exploration increased, and coal mining in Sindh's Thar coalfields began with significant reserves identified.

1990s - 2000s

The government aimed to modernize power generation and distribution through private sector involvement. They also promoted the development of mineral resources like coal, natural gas, and oil, with a focus on utilizing coal for power generation in Thar.

2010s - Present

The energy industry is shifting towards renewable sources and trying to reduce reliance on fossil fuels. The Thar coalfields project and shale gas resources are gaining attention. Efforts are being made to attract foreign investment in mining and energy. Conservation and sustainable utilization of resources are important policies.

The Geological Survey of Pakistan reported that Punjab has large deposits of energy minerals (such as coal and oil), metallic minerals, and industrial minerals. Khyber Pakhtunkhwa was reported as having 'vast' mineral resources with 'huge prospects of different metallic and non-metallic minerals' as well as 'various precious and semi-precious gemstones and other minerals.'

The report described the rich potential of Balochistan, which is an important producer of Pakistan's minerals: more than 50 metallic and non-metallic minerals (of which 29 are being exploited), including metallic minerals such as chromite, copper, iron, lead, zinc, manganese, antimony, and gold; and non-metallic minerals, including barite, fluorite, calcite, magnesite, granite, coal, marble, granite, gabbro, and basalt.

Most of Pakistan's gemstones come from Khyber Pakhtunkhwa, but there are also known deposits in Balochistan, Gilgit-Baltistan, and FATA. Mining is mainly carried out by individuals or small groups of miners, rather than by large, commercial organizations. The gems are sold mainly in their raw form, but projects are underway to provide training in cutting and polishing stones. This hugely increases their value.

Reports such as this have now influenced the development of mines, such as those in the coalfields of Sindh. Coal seams have also been found in Punjab. While several countries whose coal mining industries developed much earlier have closed many of their coal mines for various reasons, including their contribution to greenhouse gases, Pakistan has only just begun to exploit its coal deposits. With this development, regulations about safety in the mining industries have been introduced.

The planned development of the coal mining industry has influenced plans for the building or improvement of roads, such as roads to the coal-powered electricity generating plant in Jhelum district. The report has influenced the plans of the Minerals Development Department of Pakistan, which has planned to introduce safety and welfare provision for mine workers, especially to protect against health problems caused by their work. The department has planned for improved water supplies for the mining regions and improved education for the children of mine workers.

Fossil fuels provide useful sources of energy, including generating electricity, but the drawbacks of burning them for energy include air pollution that can cause asthma, chronic bronchitis, and reduced lung function, as well as the greenhouse gases they add to the atmosphere, increasing global warming.

The coalfields in the Ruhr Valley in Germany developed alongside other industries. The area developed as Germany's main industrial area because of the natural resources such as coal, iron ore, and limestone, which helped the iron and steel industry to develop. Also, textile and chemical industries developed there because there were good transport links (roads, railways, and canals, and the River Rhine) and plenty of workers from the nearby towns and villages, including the cities of Essen and Dortmund. During the 1940s, iron and steel and the industries of the area were important for producing weapons and equipment for Germany during the Second World War.

Before we proceed

In this unit, the students learn what is meant by the term 'mineral'; about the appearance of many metallic and non-metallic minerals and gemstones, their uses, and how they are extracted from the Earth. They learn about mineral resources and trade around the world and in Pakistan.

The students also learn about fossil fuels and power resources around the world and in Pakistan, including coal, natural gas, and oil. They learn how fossil fuels were formed from the remains of plants and animals that lived 300 to 400 million years ago, and how they are extracted from the Earth, including the different methods of mining.

The students will also learn that alternative energy includes all energy sources that are not fossil fuels, while renewable energy refers to naturally replenished sources like solar, wind, water, and biomass. There are various renewable energy sources such as solar, wind, hydroelectric, geothermal, and biomass energy. These sources can generate electricity, heat water, and power vehicles. It's important to note that not all alternative energy sources are renewable. Students will analyse the benefits and challenges of using alternative and renewable energy resources.

Expected learning outcomes

Students should be able to:

- name and describe some metallic and nonmetallic minerals and gemstones.
- describe the mineral, gemstone, and power industries in Pakistan and the rest of the world.
- explain how fossil fuels were formed.
- describe some ways in which minerals and fossil fuels are extracted from the ground.
- identify the risks faced by miners, and how their health and safety can be protected.
- compare the advantages and disadvantages of developing the mineral and fossil fuel, alternative, and renewable energy industries.

Lesson #1	
Reference pages 75-77	
Topics	**Resources**
• What is a mineral? • Metallic minerals	• *Oxford School Atlas for Pakistan* • for each group of four: a set of small pieces of paper, each with the name of one of the following metals written on it: aluminium, chrome, lead, mercury, zinc, tin, titanium, iron; also a set of pieces of paper, each with the name of one of the following metal ores written on it: bauxite, chromite, galena, cinnabar, zincite, cassiterite, ilmenite, haematite
Introduction	**Duration: 5-10 min**
Ask what a mineral is. Students might need to be reminded of what they learned. Tell them that they are going to find out how scientists define minerals. Explain that most metals are found in the form of ores in the ground. An ore is the raw form of a metallic mineral. It is purified to produce a metal as we know it. A few metals (such as gold) occur naturally.	**Teacher's Notes**
Using the Student's Book	**Duration: 35-40 min**
Ask the students to read 'What is a mineral?' and 'Metal ores'. Check that they know what is meant by crystals. They should remember this from their work on unit 1 and they can see a picture of a haematite (iron ore) crystal on this page. They should then read the section headed 'Metallic minerals'. To help them to interpret the world map of mineral ore deposits, they should refer to a political map of the world that has all the countries named.	**Teacher's Notes**

The students should now close their Student's Books. Give each group two sets of papers—one with names of metals and the other with names of metal ores written on them, and ask them to match each metal to the ore it comes from. They should match the easiest ones first (those where the ore has a similar name to the metal) and then see which others they can remember. The answers are: bauxite/aluminium, chromite/ chrome, galena/lead, cinnabar/mercury, zincite/ zinc, cassiterite/tin, ilmenite/titanium, haematite/ iron.	
Homework	
Students can answer question B and C.	
Discussion and review	
Ask the students what they have learnt in this lesson. They could make a note of this, summarizing the lesson, for example: ✓ I learned what is meant by mineral and about the mineral ores that are mined for different metals. ✓ I learned where the world's main deposits of metallic minerals are found. ✓ I learned where there are metallic mineral resources in Pakistan and where they are mined.	

<table>
<tr><th colspan="2">Lesson #2</th></tr>
<tr><th colspan="2">Reference pages 80-81</th></tr>
<tr><th>Topics</th><th>Resources</th></tr>
<tr><td>Topics
• Non-metallic minerals</td><td>• Oxford School Atlas for Pakistan
• leaflets or information downloaded from the Internet about Khewra Salt Mines</td></tr>
<tr><td>Introduction</td><td>Duration: 5-10 min</td></tr>
<tr><td>Remind the students what is meant by ‘mineral’ and ask if they can think of any minerals that are not metals. They might know about the salt mines at Khewra, and will have heard of them during their work on human settlements. Ask them to find Khewra on a map of Pakistan, and allow a few minutes for them to read some leaflets or web downloads about the mine.
They could work in groups, sharing this reading so that different students find out different information. They should make notes to help them to write a few paragraphs to read to their group. This should not take more than about 15 to 20 minutes. It could be followed by some questions for each group to answer about Khewra and salt mining in Pakistan, for example:
• Where is Khewra? (Punjab)
• When was salt first mined there? (320 BCE)
• About how much salt is in the mines at Khewra? (220 million tonnes)
• How big are the Khewra mines? (about 110 sq km)
• What is the salt used for? (mainly in the chemical industries, but some is purified for food use)
• Which other mineral is mined at Khewra? (gypsum)
• Where are the other salt mines in Pakistan? (Warchi (near Islamabad), Kalabagh on the banks of the Indus River, and Jatta (near Koh).</td><td>Teacher’s Notes</td></tr>
</table>

Using the Student's book	**Duration: 35-40 min**
Ask the students to read pages 80-81 of the Student's Book, 'Non-metallic minerals', including the tables, and look at the pictures to find out about some of the most useful minerals and how they are used. They could then choose one of the minerals mentioned in these pages, other than salt, and use maps to find out where it is mined.	**Teacher's Notes**
Homework	
They should make notes on what they know about the mineral and what they need to find out to write a report about it. This can be continued for homework.	
Discussion and review	
Ask the students what they have learnt in this lesson. They could make a note of this, summarizing the lesson, for example: ✓ I learned about the uses of the main nonmetallic minerals mined around the world. ✓ I learned where non-metallic minerals are mined in Pakistan.	

Lesson #3	
Reference pages 83-84	
Topics	**Resources**
• Gemstones • Rare minerals in Pakistan	• *Oxford School Atlas for Pakistan* • Skills Book activity 'All in the mines'
Introduction	**Duration: 5-10 min**
Recap the last lesson by reminding the students that they learned about the main metallic and non-metallic minerals of Pakistan and the rest of the world, and that gemstones are also minerals. Gemstones are pieces of mineral crystal that can be cut, shaped, and polished, and are valued for their rarity and beauty. Ask the students to name some gemstones and list their responses. For each gemstone they mention, ask what colour it is, and whether they know where it can be found. Tell them that northern Pakistan is known to have very large deposits of high-quality gemstones, and that geologists are sure that there are more still to be identified.	**Teacher's Notes**
Using the Student's Book	**Duration: 35-40 min**
Ask the students to read the sections of page 83-84 headed 'Gemstones' to find out more about the different gemstones and where most of them are mined. Ask them to close their Student's Books before presenting a class quiz on gemstones—perhaps have the students in groups of four and ask each group a question. They could record how many they get right. Q: What colour are emeralds? A: Green Q: What colour are sapphires? A: Blue Q: Which country is the world's main supplier of opals? A: Australia Q: Which country is the world's main supplier of diamonds? A: Russia Q: Which country is the world's main supplier of sapphires? A: Madagascar Q: Myanmar is the world's main supplier of which gemstone? A: Ruby Q: Colombia is the world's main supplier of which gemstone? A: Emerald	**Teacher's Notes**

Q: What colour are garnets? A: Red/brown Q: What colour is lapis lazuli? A: Blue Q: Which city is Pakistan's main trading centre for gemstones? A: Peshawar Q: Which province does most of Pakistan's corundum come from? A: Khyber Pakhtunkhwa Q: Which province of Pakistan has mines for all the following gemstones: emerald, sapphire, ruby, topaz, tourmaline, garnet, amethyst, quartz, agate, turquoise, and lapis lazuli? A: Balochistan Remind the students that although Pakistan has great resources of gemstones, the gemstone mining industry has not been developed. Ask why. They should think and discuss with their partners where the gemstones are, consider any difficulties in mining them, and make a note of some questions that may arise out of this discussion. They can than continue reading about gemstone mining in Pakistan to find the answers. Ask if they found the answers to their questions and, if so, what answers they found. Ask how the government is trying to encourage the gemstone industry.	

Homework

Students can do question D and Skills Book activity 'All in the mines', which provides an opportunity to recap this and the previous two lessons, and to prepare for those which are to follow. Students will not yet be able to answer the questions on coal, but should read these in preparation for future lessons, when they can be answered.

Discussion and review

Ask the students what they have learnt in this lesson. They could make a note of this, summarizing the lesson, for example:

- ✓ I learned what many of the world's main gemstones look like and the main places where they are mined.
- ✓ I learned where Pakistan's gemstones are mined.
- ✓ I learned how gemstones are mined in Pakistan.
- ✓ I learned about gemstone trading.
- ✓ I learned about some of the positive and negative effects of mining on an area.

<table>
<tr><th colspan="2">Lesson #4</th></tr>
<tr><th colspan="2">Reference pages 85-86</th></tr>
<tr><th>Topics</th><th>Resources</th></tr>
<tr><td>Economic benefits of mining
Impact of mining on environment
Sustainable mining</td><td>Skills Book activity ‘Environmental cost of mining’
Skills Book activity ‘Mining in Pakistan’</td></tr>
<tr><td>Introduction</td><td>Duration: 5-10 min</td></tr>
<tr><td>Begin with a discussion on what mining is and its importance in supplying raw materials for various industries.</td><td>Teacher’s Notes</td></tr>
<tr><td>Using the Student’s Book</td><td>Duration: 35-40 min</td></tr>
<tr><td>Ask students to read pages 85-86 and mind map the economic benefits and impact of mining on the environment. Present a slideshow highlighting the economic benefits of mining, including job creation, revenue generation, and contributions to GDP. Discuss real-world examples of countries with significant mining industries and their economic growth.
Divide students into small groups and assign each group a case study of a country that has experienced economic growth due to mining. In groups, students analyze the case study and prepare a short presentation highlighting the economic benefits. Present a slideshow that explores the negative environmental impacts of mining, such as deforestation, habitat destruction, water pollution, and air pollution. Show videos and images depicting real-life examples of environmental damage caused by mining.
Engage students in a class discussion about the ethical and environmental dilemmas posed by mining activities. Define sustainable mining and explain its principles, including responsible resource extraction, reclamation, and minimizing environmental impacts. Present a case study of a mining company that has adopted sustainable practices. Highlight their efforts to minimize environmental damage and promote community well-being.
Divide students into groups and assign each group the task of designing a hypothetical mining operation that incorporates sustainable practices. Groups present their designs to the class, explaining how they address economic, environmental, and social concerns.</td><td>Teacher’s Notes</td></tr>
</table>

Lead a reflective discussion on the importance of balancing economic benefits and environmental considerations in mining operations.	
Homework	
Students can do question E and attempt Skills Book activity 'Environmental cost of mining' and 'Mining in Pakistan'.	
Discussion and review	
Ask the students what they have learnt in this lesson. They could make a note of this, summarizing the lesson, for example: ✓ I learned about the benefits of mining. ✓ I learned about the global economic dependence on mining. ✓ I learned about the environmental impact of mining. ✓ I learned about ways humans can reduce harmful effects of mining.	

Lesson #5	
Reference pages 86-90	
Topics	**Resources**
• Power resources • Fossil fuels • Coal	• *Oxford School Atlas for Pakistan* • Skills Book activity 'Coal industry of Pakistan'
Introduction	**Duration: 5-10 min**
Ask what they know about fossil fuels. Perhaps they can name some. Ask why these are called fossil fuels. If necessary, explain that this is because they are formed from organisms that were once living.	**Teacher's Notes**
Using the Student's book	**Duration: 35-40 min**
Ask the students to read pages 86-87 about fossil fuels, coal, and how coal is formed, and to look at the pictures and read the captions. They could copy the flow chart that shows how coal is formed. When they have done so, invite students to use the flow chart to explain to the class how coal is formed. Another student could describe the different types of coal, without looking at the Student's Book. Ask the students to look at the map alongside a political map of the world, to identify the countries that have important coal deposits. Point out **that in 2014 Pakistan had more coal than most of the top ten coal-producing** countries, but produces much less coal. They can read on to find out more. Ask them to read pages 87-90. Ask why coal was not very important for producing electricity in Pakistan. (Pakistan has numerous hydroelectricity plants.) Also ask why Pakistan is beginning to use more coal for producing electricity. (More coal is being discovered; the population is growing quickly and using more and more electricity. Also, hydroelectricity can also cause environmental problems, such as increased salinity in rivers caused by dams and barrages that reduce the flow of river water.) Ask what they have found out about different methods of coal-mining. They should be able to describe open-cast (surface) mining, and two methods of deep mining (longwall and room, and pillar), and to say which methods are used by most coal mines in Pakistan. **The students will notice that there were several serious accidents in mines in Pakistan in the first three months of 2016,** and the number of mine accidents has been increasing. Ask why there have	**Teacher's Notes**

been so many accidents. (The coal industry has recently begun to develop more quickly than in the past, so there are more mines and more workers. However, as in the mining of minerals, health and safety equipment and procedures have been much slower to develop.) The students can now complete any questions they have not answered of skills book activity 'All in the mines'.

The students should discuss the advantages and disadvantages of coal for Pakistan before they begin. They could discuss this with a partner at school, or at home with a friend or member of their family and make notes of the possible advantages and disadvantages. Points to consider include how the coal industry could affect employment; the development of other industries; generating electricity; the landscapes near coal mines; air quality; water quality; global warming; possible requirements for coal in the future; other energy sources; and how likely Pakistan would be to export coal. Ask them to list the advantages and disadvantages on the table provided, and then to use these ideas and information from the Student's Book and other sources to help them to write an essay about the effects on Pakistan of developing the coal industry.

2) Use this as an opportunity to structure a class discussion. Allow the students to write some notes in the table on this page about the advantages and disadvantages of coal mining for Pakistan. Then invite a student to present an opinion, giving a reason. The others should listen politely. Then invite a student volunteer to challenge the opinion respectfully, giving his/her reason. Following this, another student might wish to support one or other of the opinions. The emphasis should be on listening to other people's opinions and either supporting or challenging them respectfully, using evidence.

Homework

Students can do question F, G, and H. They can also do Skills Book activity 'Coal industry of Pakistan'.

Discussion and review

Ask the students what they have learnt in this lesson. They could make a note of this summarizing the lesson, for example:

- ✓ I learned how coal is formed as a fossil fuel and about different grades of coal.
- ✓ I learned about the world's coal reserves and coal industry.
- ✓ I learned about Pakistan's coal reserves and how its coal industry is developing.
- ✓ I learned how the coal industry developed in Germany.
- ✓ I learned how the landscape, other resources, and transport affected the development of Germany's coal industry.
- ✓ I learned how Germany's coal industry is changing, and why.

Lesson #6	
Reference pages 91-94	
Topics	**Resources**
• Crude oil • Natural gas • Alternative energy resources	• Skills Book activity 'Energy supply in Pakistan'
Introduction	**Duration: 5-10 min**
Explain that they are going to find out more about other fossil fuels: natural gas and oil. Like coal, they are formed from materials from organisms that were once living. Tell them that in many cases natural gas is found close to coal deposits, and that they can find out more about this from the next pages they read.	**Teacher's Notes**
Using the Student's book	**Duration: 35-40 min**
Ask the students to read pages 91-94 'Natural gas and oil' to find out how natural gas and oil are formed. Ask what similarities they can find between this and the way in which coal is formed. (Both are made when the remains of living things are compressed under layers of sediment and rock, but coal is formed from plants—mainly trees.) Ask them to name a natural gas and to say how it used to be wasted. (Methane near coal deposits was not used until recently, but nowadays it is collected and sent through pipelines to places where it is needed.) Ask students to explain the similarities and differences between alternative and renewable energy resources.	**Teacher's Notes**
Homework	
The students can then complete Question I and Skills Book activity 'Energy supply in Pakistan'.	
Discussion and review	
Ask the students what they have learnt in this lesson. They could make a note of this, summarizing the lesson, for example: ✓ I learned how natural gas and oil are formed. ✓ I learned about Pakistan's oil and natural gas resources, and how and where they are being developed.	

Lesson #7	
Reference pages 94-97	
Topics	**Resources**
• Renewable energy resources • Economic dependence on energy	• Skills Book activity 'Feasibility Plan' '
Introduction	**Duration: 5-10 min**
Through flow charts, explain the working of renewable energy systems and ask students to point out similarities and differences in these energy resources. Help students identify that as the world transitions to a clean energy future, these resources will become increasingly important.	**Teacher's Notes**
Using the Student's book	**Duration: 35-40 min**
Ask students to read pages 94-97. List down some of the benefits of using alternative and renewable energy resources and explore to what extent can Pakistan invest in each: • They are clean and sustainable, meaning they do not produce greenhouse gases or other pollutants. • They are domestically produced, meaning they do not rely on imported fuels. • They are often more affordable than fossil fuels in the long run. • There are also some challenges associated with using alternative and renewable energy resources, such as the need for large upfront investments and the variability of some renewable energy sources. However, these challenges are being addressed as the technology continues to develop. Overall, the use of alternative and renewable energy resources is a positive step towards a cleaner and more sustainable future. Study the role of the energy industry in shaping world economies and highlight its political role historically (World Wars to gain control of colonies with the most coal/ resources, Iraq war, etc.)	**Teacher's Notes**
Using Skills Book	**Duration: 35-40 min**
Ask students to look at the feasibility plan for coal and renewable energy resource and brainstorm how to conduct the analysis. Here are some important aspects the student should focus on to form an analysis and rationalize their choice:	**Teacher's Note**

Non-renewable energy source	Coal
Conduct a preliminary analysis that describes your aim (what do you wish to achieve from it) and limitations (such as manpower, budget, machinery, etc.).	1. Identify the Purpose and Objectives. (meet the energy demands of a particular region / reduce greenhouse gas emissions / or promote renewable energy sources) 2. Study the Geographic Location and resource availability. (consider factors such as proximity to energy sources accessibility to transmission lines, and distance from populated areas and sensitive ecosystems) 3. Evaluate Environmental Impact (consider factors like habitat disruption, air and water pollution, and the potential for land degradation) 4. Analyze Socioeconomic Factors (examine factors such as job creation, local community support, economic benefits, and potential displacement of people) 5. Study Policy and Regulatory Framework (ensure that the proposed project complies with all relevant laws and permits) 6. Consider Infrastructure and Utilities (assess the existing infrastructure, such as roads and utility connections, needed to support the construction and operation of the energy plant and how much more investment will be needed to provide if unavailable or insufficient)
What is the estimated direct and indirect cost of the project?	Ask students to compare the initial investment, operational costs, and potential revenue from energy production. Students should make guesses based on Internet research.

Conduct a market survey and make a plan that highlights the expected support and difficulties (people, organisations, vendors, etc.) from the project.	Analyse energy consumption patterns, existing energy infrastructure, and potential competitors in the market to have an idea about monetary and quantifiable energy returns from such an investment.	
Make a go-or no-go decision based on your analysis in a statement explaining your choice.	Students should articulate their choice by concisely sharing their rationale.	

Homework

Students can attempt question A and J. Students can also complete Skills Book activity 'Feasibility Plan' for renewable energy and Skills Book activity 'Vocabulary'.

Discussion and review

Ask the students what they have learnt in this lesson. They could make a note of this, summarizing the lesson, for example:

- ✓ I learned about the impact of the use of renewable energy resources.
- ✓ I learned about making feasibility plans finding possibilities and limitations of energy resources.

Answer to Assessments

A. Choose the correct answer:

I. Surface
II. Thermal
III. Uranium
IV. Biomass
V. Crude oil
VI. Afforestation
VII. IMF
VIII. Gilgit

B 1. a) gold
b) gypsum
c) salt
d) potash
e) sulphur
f) turquoise
g) emarald
h) coal
i) natural gas
j) oil

2 a) Canada, Pakistan, Russia, South Africa, the USA
b) Reko Diq in Chagai, Balochistan, as well as rivers in northern Pakistan

3 a) Shown on the map are: Chile, Democratic Republic of Congo, Uganda, the USA.

Others include Botswana, Namibia, and South Africa.

b) Nokundi and Saindak in Chagai, Balochistan

4. lead and zinc

B 1 a) Balochistan and Khyber Pakhtunkhwa

b) The students' own answers should refer to the fact that no complete survey of Pakistan's minerals was completed until very recently; also the minerals are mainly in places that are difficult to reach by road, and mining has been carried out mainly by very small businesses or individuals without access to modern methods.

2 a–c) The students should have drawn a map of Pakistan with the provinces marked and labelled, and each province's capital city marked.

d–e) The students should have marked the gemstones mentioned in this unit in the correct provinces on their map. They should have included a key for their map.

C 1 a) These are in mountainous areas.

b) It is in a mountainous area, and there has been political unrest in Khyber Pakhtunkhwa.

2 a) The gemstones are mainly located in places that are difficult to reach: high in mountains, up steep cliffs, where it is difficult to transport equipment. Only about five months of the year have suitable weather for mining, and the ground is frozen in the winter. Also, some modern equipment would not work properly at high altitudes because of low air-pressure.

b) They have to climb up ropes on steep cliffs to reach some of the gemstones. They have to use donkeys or horses to carry their equipment, or carry it themselves. They use explosives and simple equipment which can damage the stones. The air in the mines quickly becomes polluted with gas and dust, so they have to leave until it clears naturally, as they do not usually have breathing equipment.

3 a) basic safety equipment such as face masks; machinery to remove pollution from the air in mines and regulate the temperature; regulations on health and safety

b) training in cutting and polishing stones; a local centre for trading in gems

4 a) They damage many of the stones with the equipment they use. They sell their stones in their raw state, but could get higher prices for polished stones sold in a proper trading centre.

b) In some areas, particularly FATA, many gemstones deposits are still to be identified. Some gemstone mines can only be reached by climbing ropes up the cliffs. The ground is usually frozen and there are only a few months of suitable weather each year. It is too difficult to get modern mining equipment up there. Some modern equipment would not work there because of the low air pressure.

5 a–b) The students' own discussions and responses should take into account the effects on local employment and income, local roads and transport, and the effects on the environment, water, and agriculture. Examples:

Would a large mining company be good for local people?	
Reasons for large mining company jobs for many local people; training miners skills for local people; development of local trade such as shops; improved roads and transport Families could become better off and so better able to provide for their children's education.	Reasons against large mining company pollution of the air, water; and land polluted streams and rivers damage to agricultural land; damage to naturally beautiful landscapes; loss of habitats for wild animals

E 1. a) Cement: Limestone, clay, silica, iron ore

b) Fertilizer: Phosphate rock, potassium minerals

c) Chemicals: Various minerals like sulfur, borates, salt, and various metal ores for chemical processes

d) Plastic: Petroleum (not a mineral, but an important resource extracted from the Earth)

e) Detergents: Zeolite minerals (for water softening)

2. a) Answers may vary. Governments: Enforce strict regulations and laws for responsible mining practices, environmental protection, and worker safety. Implement proper land reclamation and rehabilitation plans after mining activities. Promote research and development of sustainable mining techniques that minimize environmental impacts.

b) Individuals: Reduce consumption and waste to decrease the demand for minerals and resources. Support eco-friendly products and industries that follow ethical sourcing and responsible mining practices. Advocate for sustainable mining practices and environmental protection in local communities and through social media. Conserve resources and energy to reduce the need for extensive mining operations.

F 1. a) coal b) crude oil c) natural gas

2. heat energy; water, steam; mechanical, electricity; turbines; steam, kinetic.

G. a-b) Answers will vary with each year. Refer to official websites for data.

2 a) Increase in population and urbanisation; economic growth and increased industrialization; technological advancements and greater reliance on electronic devices; changes in lifestyle and consumer behavior (e.g., more use of air conditioning, heating, and entertainment devices)

b) Insufficient energy generation capacity to meet the growing demand; inadequate maintenance and upgrades of existing power infrastructure; limited diversification of energy sources, resulting in dependency on a few sources like

thermal power; challenges in energy transmission and distribution leading to losses; limited investment in renewable energy and energy efficiency projects

H 1. a) Resources used for making electricity:

- Fossil fuels (coal, oil, natural gas): materials used, combustion process, waste products (carbon emissions, ash, etc.), environmental impact.
- Nuclear power: materials used (uranium), nuclear fission process, waste products (radioactive waste), storage and disposal methods, environmental concerns.
- Renewable sources (solar, wind, hydro, geothermal): materials used, conversion processes (solar panels, turbines, etc.), minimal waste production, lower environmental impact compared to fossil fuels.

b) In your essay about why renewable energy sources are important for the environment, you can discuss points such as:

- Reduced greenhouse gas emissions and air pollution compared to fossil fuels
- Mitigation of climate change and global warming effects
- Sustainable and inexhaustible nature of renewable sources
- Conservation of natural resources and ecosystems
- Enhanced energy security and decreased reliance on finite fossil fuel reserves
- Promotion of innovation, job creation, and economic growth in the renewable energy sector

I 1 a) a fuel formed naturally over millions of years from dead trees and other plants

b) They are formed from similar types of materials in similar conditions.

c) Longwall: Hydraulically-powered supports hold up the roof while a machine cuts coal from the coal face. When all the coal in the area has been mined, the supports are taken out section by section, and the roof is allowed to collapse. The coal face can be 100–350 metres long. Few of Pakistan's coal mines have this equipment, so miners cut the coal with pickaxes, and support the roof with wooden pit props.

Room and pillar: Miners cut 'rooms' into the coal seam and leave behind 'pillars' of coal to support the roof of the mine. The pillars of coal use up to 40% of the total coal in the seam, but sometimes they can be taken out later.

Surface mining (also called open pit or open cast): The coal is near the surface of the ground, so more of the coal deposit can be mined than in an underground mine. Surface mines can cover an area of many square kilometres and use very large pieces of equipment, such as power shovels, large trucks, bucket-wheel excavators, and conveyors. First, explosives are used to break up the soil and rock covering the coal. Next, the soil and rock are taken away. Machines or hand tools are used to drill and break up the coal. It is mined in strips and loaded on

to trucks or conveyors ready for transport. After the coal seam has been mined, the land should be restored so that it can be used for other purposes.

2 a) no

b) Some of Pakistan's coal resources have been discovered quite recently, so Pakistan's coal industry is developing later than that of many countries; also, it has not had as much investment from large businesses.

3 a) Germany's coal industry developed before that of Pakistan. Germany's coal industry has more modern equipment and safety regulations and so accidents are not so common.

b) Germany's coal industry developed mainly in a valley, whereas some of Pakistan's coalfields are in places that were difficult to reach in the eighteenth and nineteenth centuries. Also, the iron and steel industry in Germany developed close to the coal and textiles industries, with good links to the ports for export. Germany's coal industry in closing down its coal mines while Pakistan is developing new ones.

4 a) to help to reduce global warming by replacing coal with other sources of energy; it is switching to renewables such as solar power because the burning of fossil fuels releases greenhouse gases into the atmosphere.

b) China's coal industry developed later than those of the countries that are closing their mines.

c) Miners have to pass a medical examination (paid for by their employer) before they can work underground. Mine operators also have to pay for regular health checks for their workers. There are rules for how long miners can work in very high temperatures, and mines have to use machinery to control dust. Everyone has to wear head protection and ear protection and carry a filter self-rescuer (a lightweight air filter and oxygen supply). The regulations for miners are the same as for workers in all industries using dangerous materials, and so on.

J 1. a) **Fossil Fuels:**

- Abundant and well-established sources, resulting in lower initial infrastructure costs.
- Cost-effective for electricity generation and industrial processes.
- Reliable energy supply, as fossil fuel power plants can be quickly ramped up or down based on demand.
- Availability of technology and expertise for extraction and utilization.

Renewable Energy:

- Renewable sources like solar and wind have no fuel costs, resulting in lower operating expenses over time.
- Potential for reducing dependence on imported fossil fuels and energy price fluctuations.

- Minimal or no greenhouse gas emissions, leading to potential carbon credit benefits and compliance with environmental regulations.
- Job creation in the renewable energy sector and potential for local economic growth.

Nuclear Energy:

- High energy density and continuous power generation, making it suitable for base-load electricity demand.
- Minimal greenhouse gas emissions during operation.
- Reliable power supply with low fuel requirements, as nuclear fuel lasts for years.
- Potential for technological advancement and innovation in the nuclear sector.

b) **Renewable Energy:**

- Variability of energy production for sources like solar and wind, leading to intermittency and potential need for energy storage solutions.
- Land use and environmental impact associated with large-scale renewable energy installations.
- Energy storage and grid integration challenges.

Nuclear Energy:

- Generation of radioactive waste that requires safe long-term storage and disposal.
- High upfront capital costs for building nuclear power plants.
- Safety concerns due to potential for accidents, though modern designs focus on enhanced safety features.
- Public perception and opposition related to nuclear accidents.

2. Load shedding undermines a country's economic stability by impeding production, investments, and essential services, leading to reduced economic growth and development.

Answer to Skills Book

Skills Book activity 'All in the mines'

A 1
a) coal
b) salt
c) gypsum
d) gold
e) copper
f) zinc
g) vermiculite
h) ilmenite
i) sulphur
j) emerald
k) ruby
l) anthracite
m) graphite
n) lignite
o) aluminium

Skills Book activity 'Coal industry in Pakistan'

A 1. the students' own ideas

Skills Book activity 'Vocabulary'

A 1. Students should find the words given in the table.

B. Students should use their notes and refer to the internet and other reference books to write a speech about developing Pakistan's coal industry.

Skills Book activity 'Mining in Pakistan'

A 1. natural gas: 3.45
crude oil: 4.48
chromite: 25.74
limestone: -33.33
gypsum: -36.98
rock salt: -24.16
iron ore: 1.55
marble: -22.94

2. 2020-21

3. **Iron ore:** Steel production depends heavily on iron ore, which is used in construction, manufacturing, and transportation infrastructure.

Limestone: Commonly used for construction, including roads, bridges, buildings, and cement production. It also improves soil quality for agriculture.

Gypsum: Gypsum has multiple uses, including making drywall and plasterboard, improving soil structure, and being used in industrial processes such as mold production for ceramics and dental materials.

Skills Book activity 'Environmental cost of mining'

A. Answers may vary. Habitat destruction, deforestation, soil erosion, water and air pollution, and land subsidence are common impacts. They also expose workers and nearby communities to health hazards such as toxic chemicals, dust, and hazardous gases.

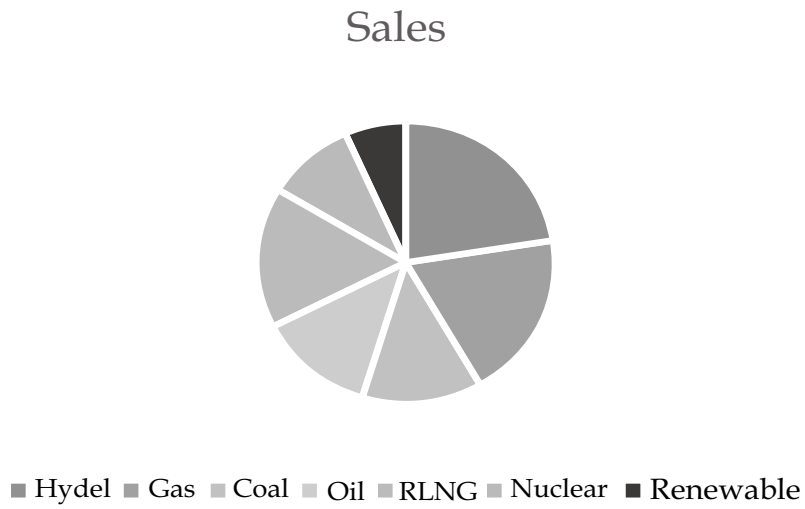
B. Answers may vary. Burning fossil fuels releases greenhouse gases, causing climate change, health problems, and depletion of resources. Renewable energy sources offer sustainable and cleaner alternatives.

C. Answers may vary.

Skills Book activity 'Energy supply in Pakistan'

A 1 Hydel provides most energy to Pakistan.

2. rugged terrain, lower population densities, security concerns, and economic factors.



B.

C. Answers may vary.

Solar: Balochistan, Sindh, Southern Punjab, and KPK have high potential for solar energy production due to abundant sunlight. Large-scale solar power projects can help meet electricity demands and reduce reliance on fossil fuels during peak hours.

Wind: Coastal regions of Sindh and Balochistan, particularly Gharo-Keti Bandar and Jhimpir are potential areas for wind energy. These areas have strong wind resources due to their proximity to the Arabian Sea. Additionally, some areas in Punjab and the northern regions of KPK have good wind potential due to mountain ranges that cause a funneling effect. Wind energy has the potential to contribute significantly to the energy mix and help reduce greenhouse gas emissions.

Geothermal: AJK, GB, and Northern KPK have geothermal potential due to tectonic activity and geothermal gradients. This can generate electricity and provide stable power.

Tidal: Coastal areas in Sindh and Balochistan have potential for tidal energy due to regular tides. Areas with significant fluctuations are ideal for tidal energy projects.

Skills Book activity 'Feasibility Plan'

Answers may vary.

Chapter 1: Plains and Rivers				
Lesson Plan no	**Subtopics**	**Reference pages**	**Learning Outcomes**	**Suggested Activities**
1.1	• What is a plain? • What are plains like?	**1-3**	• Describe the physical features of plains. • Differentiate plains from the other landforms.	• Have students create dioramas depicting different types of plains, using materials like paper, clay, and paints. They can label key features such as rivers and settlements.
1.2	• Locating plains on the world map (Time zone) • Rivers • Course of a river (till dams)	**4-6**	• Identify some major types of plains of the world. • Describe the river plain. • Explore a river system.	• Use a world map showing different time zones. Discuss how time zones relate to the rotation of the Earth and how they impact different regions. Highlight plains located in different time zones. • Create a simple classroom river model using sand, rocks, and water. Guide students in observing how rivers erode, transport sediment, and deposit it.
1.3	• Dams • Middle course of a river • Lower course of a river • Rural urban settlements on plains	**6-9**	• Describe the importance of the middle course of the river. • Discover why delta is found on the lower course of the river. • List different features of the upper, middle, and lower courses of a river.	• Provide materials like clay, cardboard, and craft sticks for students to build model dams. Discuss the purposes of dams, such as flood control and hydroelectric power generation. • Provide a map of a plain with labelled settlements. Have students mark rural and urban settlements and discuss reasons for their locations.
1.4	• River habitats • Indus dolphins • Changing plains and rivers	**10-12**	Explain how rivers are important in the biodiversity and economy of the region.	• Set up an erosion experiment using sand, water, and small objects. Demonstrate how rivers change the landscape over time through erosion and deposition. • Provide maps showing historical river courses and changes. Discuss natural and human-induced changes in river paths over time.

Chapter 2: Water Resources and Management				
Lesson Plan no	**Subtopics**	**Reference pages**	**Learning Outcomes**	**Suggested Activities**
2.1	• Sources of water • Where is water stored on the Earth? • Water cycle	**15-16**	• Identify the major sources of water on the Earth and in Pakistan.	• Provide materials for students to create 3D models depicting Earth's water storage, including oceans, ice caps, groundwater, and atmosphere. Discuss the relative amounts of water stored in each.
2.2	• Precipitation • Fog • Mist • Uses of water • Water supply in Pakistan • Indus floods	**16-19**	• Explain different types of precipitation. • Describe the process of Water Cycle in maintaining water supply of the Earth.	• Set up simple condensation experiments using a glass of cold water and observe droplet formation on the glass surface. Discuss how fog and mist are formed through similar processes. • Have students conduct surveys in their communities to gather data on water usage patterns. Analyze the results and discuss how the data can inform water conservation efforts.
2.3	• How can Pakistan solve its water problems? • Water supply • Recycled water	**20-21**	• Identify different uses of sewage waste.	• Create a simulation game where students play different roles in managing water supply for a village. Discuss the challenges and trade-offs of using recycled water from drains.
2.4	• A village water supply- from drains • Water pollution • Sustainable water management	**22-24**	Explain how rivers are important in the biodiversity and economy of the region.	• Assign students different water pollution case studies from around the world. Have them research and present the causes, impacts, and solutions implemented.

Chapter 3: Settlements and Land Use				
Lesson Plan no	**Subtopics**	**Reference pages**	**Learning Outcomes**	**Suggested Activities**
3.1	• What is a settlement?	**15-16**	• Identify the major sources of water on the Earth and in Pakistan.	• Provide materials for students to create 3D models depicting Earth's water storage, including oceans, ice caps, groundwater, and atmosphere. Discuss the relative amounts of water stored in each.
3.2	• Settlements in Pakistan • What makes a place suitable for settlement?	**16-19**	• Explain different types of precipitation. • Describe the process of Water Cycle in maintaining water supply of the Earth.	• Set up simple condensation experiments using a glass of cold water and observe droplet formation on the glass surface. Discuss how fog and mist are formed through similar processes. • Have students conduct surveys in their communities to gather data on water usage patterns. Analyze the results and discuss how the data can inform water conservation efforts.
3.3	• Functions of a settlement • The pattern of settlements	**20-21**	• Identify different uses of sewage waste.	• Create a simulation game where students play different roles in managing water supply for a village. Discuss the challenges and trade-offs of using recycled water from drains.
3.4	• Planned settlements • Mombasa: a large settlement in Kenya, Africa • Naro Moru: a small settlement in Kenya, Africa	**36-42**	• Identify the advantages and disadvantages that people of urban settlements face.	• Divide the class into two groups to debate the advantages and disadvantages of planned and unplanned settlements. Encourage students to provide reasons and evidence for their arguments. • Provide students with information about Mombasa or Naro Moru and a similar-sized settlement from another region. Have them compare and contrast the features, challenges, and opportunities of the two settlements.

3.5	• Impact of settlements on landforms • Sustainable settlements	**43-44**	• Discuss the effects of urbanization on landforms, including factors such as deforestation, construction, and altered water flow patterns. • Identify sustainable practices in planning and designing settlements, such as green spaces, efficient infrastructure, and waste management.	• Challenge students to design a sustainable settlement that minimizes environmental impact and promotes self-sufficiency. Have them consider renewable energy, waste management, and green spaces.

Chapter 4: Agriculture				
Lesson Plan no	**Subtopics**	**Reference pages**	**Learning Outcomes**	**Suggested Activities**
4.1	• What is agriculture? • Methods of farming • Organic farming in Pakistan • Smart farms	**47-49**	• Explore the broader meaning and types of agriculture. • Recognise that Pakistan is an agricultural country. • Recognise the value of agriculture in terms of Pakistan's economy. • Name the main crops of Pakistan. • Describe different methods of agriculture.	• Organise a virtual or real field trip to a local farm. Discuss the various aspects of agriculture and farming methods observed during the visit. • Divide the class into two groups: one supporting organic farming and the other discussing potential challenges. Encourage students to present evidence and engage in a structured debate. • Assign students to design a "smart farm" that incorporates technology and innovative practices for efficient resource use. Have them create posters or presentations showcasing their ideas.
4.2	• Irrigation • Arable farming • Wheat	**50-53**	• Identify methods to evaluate agricultural projects.	• Create a classroom game where students role-play as farmers planning crop rotations for a year. Discuss the benefits of crop rotation in maintaining soil fertility.
4.3	• Rice • Cotton • Sugar cane	**54-57**	• Identify methods to evaluate agricultural projects.	• Explore virtual field trips showcasing the cultivation and harvesting of specific crops. Discuss the importance of these crops in Pakistan's economy.
4.4	• Livestock farming	**57-59**	• Identify a few impacts of livestock (cattle) farming on the environment.	• Engage students in a discussion about the role of livestock farming in ensuring food security. Have them research and present case studies of how livestock farming contributes to global and local food supply.

4.5	• Forestry • Problems in agriculture • Fishing	**59-61**	• Describe those raw materials from farming and fishery help generate revenues.	• Discuss the concept of forestry and its importance in preserving ecosystems. Assign students the task of researching a specific tree species and its significance. • Introduce the fishing industry and its impact on food supply. Discuss sustainable fishing practices and potential challenges related to overfishing.
4.6	• Globalisation and agriculture • Sustainable agriculture	**61-62**	• Relate export of raw materials from farming and fishery to the global economy.	• Create a visual representation of the global food chain, highlighting the journey of various agricultural products from production to consumption.

Chapter 5: Climate Change				
Lesson Plan no	**Subtopics**	**Reference pages**	**Learning Outcomes**	**Suggested Activities**
5.1	• What is climate change? • Greenhouse effect	**65-68**	• Recall the difference between climate and weather. • Define climate change. • Explain the greenhouse effect.	• Set up a simple greenhouse effect demonstration using clear plastic containers, thermometers, and light sources. Observe and discuss how the containers trap heat, simulating the greenhouse effect.
5.2	• What is the ozone layer? • Disappearing ice	**68-70**	• Identify changes caused by the greenhouse effect. • Describe the importance of the Ozone layer.	• Divide students into groups representing different layers of the atmosphere. Have them act out the roles of molecules and discuss how the ozone layer protects Earth from harmful UV radiation.
5.3	• Causes of climate change • Impact of climate change on animals and plants	**70-76**	• Identify global warming and the greenhouse effect as the main causes of climate change in the world. • Explain the main causes of climate change in the world and some particular areas.	• To understand the concept of greenwashing, critically analyse the limitations of individual action against climate change and emphasize the need for effective governmental action.

Chapter 6: Minerals and Power Resources				
Lesson Plan no	**Subtopics**	**Reference pages**	**Learning Outcomes**	**Suggested Activities**
6.1	• What is a mineral? • Metallic minerals	**79-80**	• Name minerals found in Pakistan. • Identify industries related to minerals and power in Pakistan.	• Find objects in the classroom or at home that contain metallic and non-metallic minerals. Share your findings and discuss its characteristics.
6.2	• Non-metallic minerals	**80-81**	• Identify areas of Pakistan that are rich in mineral resources. • Name some rare minerals found in Pakistan.	• Assign groups different rare minerals found in Pakistan (e.g., pink halite, spinel, xenotime). Have each group research the mineral's properties, occurrence, and significance.
6.3	• Gemstones • Rare minerals in Pakistan	**83-84**	• Identify and name rare minerals found in Pakistan. • Discuss the significance of these rare minerals in terms of their economic value, industrial applications, and contribution to Pakistan's mineral resources.	• Assign groups different rare minerals found in Pakistan (e.g., pink halite, spinel, xenotime). Have each group research the mineral's properties, occurrence, and significance.
6.4	• Economic benefits of mining • Impact of mining on environment • Sustainable mining	**85-86**	• Identify and explain the economic benefits of mining, including job creation, revenue generation, and contribution to a country's GDP.	• Assign groups the task of researching and proposing sustainable mining practices. They should consider methods to minimize environmental impact, promote worker safety, and ensure responsible resource extraction.

6.5	• Power resources • Fossil fuels • Coal	**86-90**	• Explore the use of fossil fuels (coal, oil, and gas) to generate power in Pakistan. • Differentiate between bituminous and lignite coal. • Describe the procedures of long-wall and surface mining. • Realise the risk factors associated with coal mining.	• Divide students into groups representing fossil fuels. Have them debate the advantages and disadvantages of each energy source.
6.6	• Crude oil • Natural gas • Alternative energy resources	**91-94**	• Explore alternate sources of energy (solar, wind, and water) to generate power.	• Assign each student a different renewable energy resource (solar, wind, hydro). Have them research and create mini projects explaining how the resource works, its benefits, and potential applications.
6.7	• Renewable energy resources • Economic dependence on energy	**94-97**	• Describe the importance of alternative energy sources for the environment.	• Have students imagine a future where a specific energy resource becomes scarce. Ask them to write short stories or create visual presentations illustrating how society adapts to the changing energy landscape.

Geography Skills Checklist						
Skills overview	**Unit 1**	**Unit 2**	**Unit 3**	**Unit 4**	**Unit 5**	**Unit 6**
Use, interpret information, and complete missing details on physical maps						
Use and interpret Atlas maps						
Use and interpret climate maps						
Use and interpret ground, satellite, aerial, topographic photos						
Label and annotate maps						
Make and complete a bar chart						
Male and complete a line graph						
Make and complete a pie chart						
Use, interpret, and draw climate graphs						
Understand and use numerical data						
Use appropriate statistical measures (range, mean, etc.) in explanations and analysis						
Collect and interpret fieldwork data						
Use written and digital sources						
Write descriptively						
Make analysis (finding limitations and possibilities in policies, measures, and suggestions; supporting views with reasoning and evidence to explain choices, etc.)						
Draw conclusions						
Analyse sustainability or feasibility of options						
Spatial awareness and understanding						
Problem solving						
Interdisciplinary links						
Habitat mapping to identify ecological links						
Global perspective						
Environmental ethics, advocacy, and engagement						