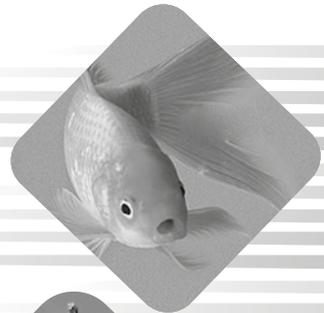


Complimentary Copy—Not For Sale

New Get Ahead

SCIENCE

Teaching Guide



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Based on Revised Pakistan National Curriculum

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Introduction to the Guide

The Teaching Guides for the *New Get Ahead Science* series provide guidelines for help of the teacher in classroom. This Teaching Guide includes:

- An introduction on how to approach *New Get Ahead Science* in class.
- Teaching strategies mentioned in the national curriculum.
- Sample lesson plans.
- Suggested answers to the exercises in the textbook.
- Suggested worksheet for assessments.
- Suggested scheme of work.

How to Approach *New Get Ahead Science*

To teach *New Get Ahead Science* in a more constructive manner, teachers are advised to make classrooms more student-centered. Students are to be given a more active role in the classroom, to be encouraged to present their thoughts and ideas confidently, and be instructed to respect differing opinions. In order to achieve this, teachers are to facilitate students so that they can take more responsibility for their learning journeys. The following summarizes the methodology with which all units of *New Get Ahead Science* are to be approached, in order to make classroom more student-centered:

- Students to be given a chance to work independently, as well as collaboratively i.e. in groups. Real-life examples to be discussed by teachers and students.
- Students to be given tasks where they share opinions with each other and with the teacher. They are to be encouraged to give reasons for their opinions.
- Teacher to role-model the ideals of respect, collaboration, and active learning in the classroom. During group discussions, all students should be encouraged to work together.
- Teacher should facilitate students only when directions are needed; most of the time, students should work on their own while reading, writing, and discussing the lessons in specific units.

Contents and Sequence of the Teaching Guide

The Teaching Guide for *New Get Ahead Science* contains suggestions for starting a lesson and provide teaching strategies for each unit. The instructional model focuses on exploring background knowledge, where students participate actively.

Recommended Schedule for an Active and Student-centered Classroom

Exploring knowledge through essential questions	5 minutes
Teaching Methodology/Activity	25 minutes
Assessment	10 minutes

The first part of each unit contains basic suggestions for taking the lesson forward in a constructive manner. The second part of the lesson contains answers to all questions present in the book. Students should be advised to come up with their own answers and teachers can use the Teachers Guide to assess students' understanding and knowledge.

Teaching Strategies as per General Science National Curriculum

Examples of effective instructional strategies include, but are not limited to, the following:

- inquiry
- questioning and discussion
- investigation and problem solving
- demonstration and laboratory work
- problem based learning
- utilizing whole class, group, and individual work
- incorporating literacy strategies (reading, writing, speaking and listening)
- using student work to inform instruction

For detailed support on teaching strategies of Science, please visit Chapter 7 pages 55 to 64 in the General Science National Curriculum 2006.

Assessment Strategies as per General Science National Curriculum

Teachers learn about student progress not only through formal tests, examinations, and projects, but also through moment-by-moment observation of students. To assess students' science knowledge, skills, and attitudes, teachers require a variety of tools and approaches, such as:

- selected response
- constructed/ created response
- performance assessment
- personal communication
- students' self-assessment

For detailed support on assessment strategies of Science, please visit Chapter 8 pages 65 to 73 in the General Science National Curriculum 2006.

Division of Syllabus into Three Terms:

1st Term	Unit 1: Human organ systems
	Unit 2: Transport in human and plants
	Unit 5: Water
	Unit 8: Transmission of heat
2nd Term	Unit 3: Reproduction in plants
	Unit 6: Structure of an atom
	Unit 9: Dispersion of light
	Unit 10: Sound waves
3rd Term	Unit 4: Environment and feeding relationship
	Unit 7: Physical and chemical changes and processes
	Unit 11: circuits and electric current

Scheme of Work

Chapter	Topic-wise allocation of periods	Learning outcomes The students should be able to:
Unit 1: Human Organ Systems	2 period	<ul style="list-style-type: none"> describe the basic structure of the body of animals describe the digestive system explain the functions of each part know the importance of balanced diet on our health explain the importance of dietary fibre for digestive system describe some digestive disorders
	2 periods	<ul style="list-style-type: none"> describe the parts of the respiratory system explain the function of each part explain how gaseous exchange takes place in the lungs differentiate between respiration and burning know the causes, effects, and treatment of respiratory diseases

Chapter	Topic-wise allocation of periods	Learning outcomes The students should be able to:
Unit 2: Transport in Human and Plants	2 period	<ul style="list-style-type: none"> • explain the system of transport of materials in human beings • describe the structure of the heart and explain its working • know about the working of the circulatory system • understand the heart disorder their causes and effects • know the transplantation of body parts • understand the disorders in the human transport system can be affected by diet
	2 periods	<ul style="list-style-type: none"> • describe the transport system in plants • explain how roots absorb water • explain how water and food are transported in plants • explain how the exchange of gases takes place in plants
Unit: 3 Reproduction in Plants	2 periods	<ul style="list-style-type: none"> • explain what is meant by growth • explain what reproduction is • describe asexual reproduction in animals and plants • define sexual reproduction
	2 periods	<ul style="list-style-type: none"> • explain the ways in which seeds and fruits are dispersed • List various factors involved in cross pollination. • understand fertilization • explain the formation of different kinds of fruits • Understand asexual reproduction in plants by different methods.
Unit 4: Environment and Feeding Relationship	2 periods	<ul style="list-style-type: none"> • know about the ecosystem and working of ecologist • explain the relationship between habitat, community, and population • describe an ecosystem and what constitutes it • describe environment and its component

Chapter	Topic-wise allocation of periods	Learning outcomes The students should be able to:
	2 periods	<ul style="list-style-type: none"> • describe the important features of a natural environment • define the term habitat • compare the different kinds of habitat • analyse the various features in a particular habitat • identify the factors that cause daily and yearly changes in a habitat • understand how things adapt to the daily and yearly changes in their habitat • Explain why the food chains always begins with a producers.
	2 period	<ul style="list-style-type: none"> • Know the relationship between producers and consumers. • describe two food chains in the environment around them • Explain a food web, and food pyramid.
Unit 5: Water	1 period	<ul style="list-style-type: none"> • explain the occurrence of water • state the chemical formula of water • explain the water cycle • Describe the stages of water cycle. • test the purity of water • Recognize the substances present in water that make the water impure.
	2 period	<ul style="list-style-type: none"> • identify the ways we use water • explain why we must save water and suggest ways of doing so • explain how water pollution is caused and assess its impact • Describe importance and uses of water for humans and other living things. • Describe composition and states of water. • Know the different ways to clean impure water.

Chapter	Topic-wise allocation of periods	Learning outcomes The students should be able to:
Unit 6: Structure of an Atom	2 periods	<ul style="list-style-type: none"> • describe the structure of an atom • differentiate between atomic number and mass number • explain the distribution of electrons in an atom • define an element • able to draw diagrams of atom
	2 periods	<ul style="list-style-type: none"> • explain what isotopes are and list the uses of radiation • Identify the position of elements in periodic table. • Know valency and make ions. • Differentiate between Cations and Anions.
	2 periods	<ul style="list-style-type: none"> • Understand isotopes and their uses in medicines and agriculture. • State the law of constant composition and give examples. • Make chemical formulae from a list of anions and cations.
Unit 7: Physical and Chemical Changes and Processes	2 periods	<ul style="list-style-type: none"> • define physical and chemical changes and differentiate between the two • explain how reversible reactions take place
	2 period	<ul style="list-style-type: none"> • explain how raw materials can be changed into useful products • explain how fertilizers work • describe the harmful effects of fertilizers
	2 periods	<ul style="list-style-type: none"> • define plastics • explain how plastics are made • describe how we use plastics • explain the composition of fats • identify the uses of fats • explain how fats can be converted into useful products

Chapter	Topic-wise allocation of periods	Learning outcomes The students should be able to:
Unit 8: Light	3 periods	<ul style="list-style-type: none"> • describe heat as a form of energy • differentiate between conductor and insulators • Explain the flow of heat from hot body to cold body. • explain how the conduction of heat takes place in solids • Analyse the conduction, convection and radiation through experiment. • Recognize the three modes of transfer of heat from the environment.
	2 periods	<ul style="list-style-type: none"> • identify the practical applications of radiation • Suggest how birds can glide in the air for hours. • Identify examples of appliances that make uses of different modes of transfer of heat. • Understand the working and principles of a vacuum flask.
Unit 9: Dispersion of Light	2 period	<ul style="list-style-type: none"> • explain how refraction occurs • Describe laws of refraction and refractive index. • Explain refraction of light and its causes. • describe refractive index • distinguish between real and apparent depth • define critical angle
	3 periods	<ul style="list-style-type: none"> • describe total internal reflection • explain how total internal reflection is useful • explain that white light is composed of seven colours • list the colour of light using a prism • Know primary colours, secondary colours. • discuss the effects of refraction with examples • explain coloured light • explain pigments and filters

Chapter	Topic-wise allocation of periods	Learning outcomes The students should be able to:
Unit 10: Sound Waves	2 periods	<ul style="list-style-type: none"> • define the terms oscillation, period, and frequency • describe waves • identify different kinds of wave • explain how frequency and pitch of a sound are related
	3 periods	<ul style="list-style-type: none"> • describe the characteristics of sound • describe the frequency ranges of some animals • explain how we make the use of sound in our daily lives
Unit 11: Circuits and Electric Current	2 periods	<ul style="list-style-type: none"> • explain the term electricity • define electric current • explain what conductors, semiconductors, and insulators are • knows a circuit • describe how series and parallel circuits are connected • explain the functions of a switch and a fuse
	3 periods	<ul style="list-style-type: none"> • explain how a current is measured • define voltage and to explain how it is measured • identify the units for measuring voltage • define resistance • identify the factors on which resistance depends • explain how resistance is measured • explain how cells and batteries are sources of electric charge • explain how electricity comes from a power station • explain the safety rules when using electricity

Human Organ Systems

Lesson plan 1

Students learning outcomes

Learn about the human digestive system.

Materials

chart showing digestive system

Keywords

tooth, saliva, salivary gland, tongue, gullet, stomach, gastric juice, acid, small intestine, pancreas, pancreatic juice, bile, liver, digestion, alimentary canal, enzyme

Overview

Students will learn about functions and organs of digestive systems of human body. They will understand the different disorders of digestive system.

Teaching methodology

Exploring knowledge through essential questions	10 min
Method/activity	25 min
Assessment	10 min

Essential questions

Before starting the lesson, ask some questions to explore background knowledge of students, e.g.

1. What do you take in breakfast?
2. What does happen to food we eat?

Method:

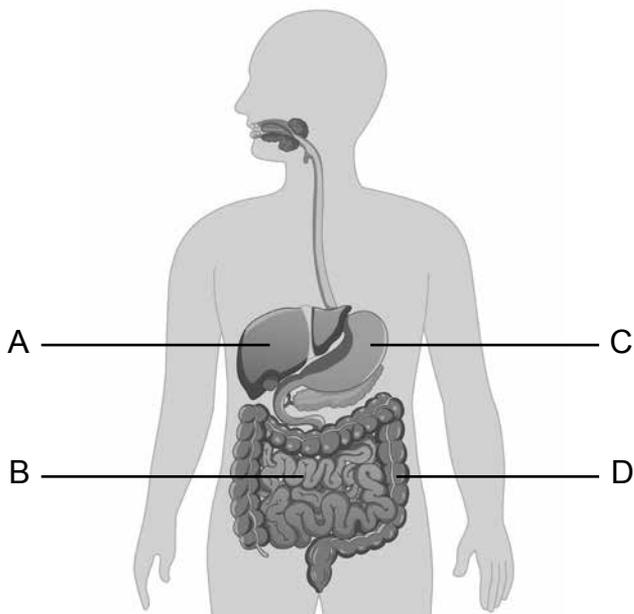
- Students may come up with the response that the food has gone to their stomach. At this phase, teacher can ask whether the food went directly to the stomach. Students may come up with several responses. During the discussion, teacher will start the explanation of several parts of the digestive system.
- Show a digestive system chart to the students and discuss different components and their functions in detail. Discuss the importance of digestion.
- The topic on disorders of digestion can be started by asking the class if they eat food sold by street hawkers. Students may come up with their responses. Here

teacher may identify the food items that are sold by street hawkers, for example; French fries, ice lollies, etc. A discussion on the disadvantages of having unhygienic food can be initiated. After which students can be informed about the diseases of digestion.

- Explain the role of digestive juices. Write the digestive process in form of a table. Explain why we feel nausea during indigestion? Explain the causes of indigestion and how acidity in the stomach can be controlled. Explain the importance of roughage. Explain the importance of fruits and vegetables in our diet. Explain the treatment that can be taken to prevent or cure stomach disorders.
- Conduct in classroom:
 - Activity 1, page 2
 - Activity 2, page 4

Assessment

1. Write down the names and functions of the organs A, B, C, and D.



2. Choose the correct answer:
 - i. Digestion begins in the:

A. stomach	B. small intestine
C. large intestine	C. mouth
 - ii. The conditions in the stomach are:

A. alkaline	B. basic
C. acidic	D. neutral

- iii. Digestion is completed in the:
- A. large intestine B.—liver
C. stomach D. small intestine
- iv. Which of the following is the correct order of parts in the digestive system, starting with the mouth?
- A. stomach, small intestine, large intestine, gullet
B. gullet, small intestine, stomach, large intestine
C. gullet, stomach, small intestine, large intestine
D. stomach, gullet, large intestine, small intestine
- v. Some digestive juice is passed into the mouth from the:
- A. salivary glands B. pancreas
C. gall bladder D. small intestine

Reinforcement/homework

Exercise questions 1, 2, 3

Lesson plan 2

Students learning outcomes

Learn the about the human respiratory system.

Materials

internal structure of the human body

Keywords

Thoracic cavity, larynx, trachea, rib, bronchi, bronchiole, alveoli, respiration

Overview

Students will learn about functions and organs of respiratory systems of human body. They will understand the different disorders of respiratory system.

Teaching methodology

Exploring knowledge through essential questions	10 min
Method/activity	25 min
Assessment	10 min

Essential questions

Before starting the lesson, ask some questions to explore background knowledge of students, e.g.

1. What do we breathe?
2. Why do we breathe?
3. Which organs are involved in respiration and breathing?

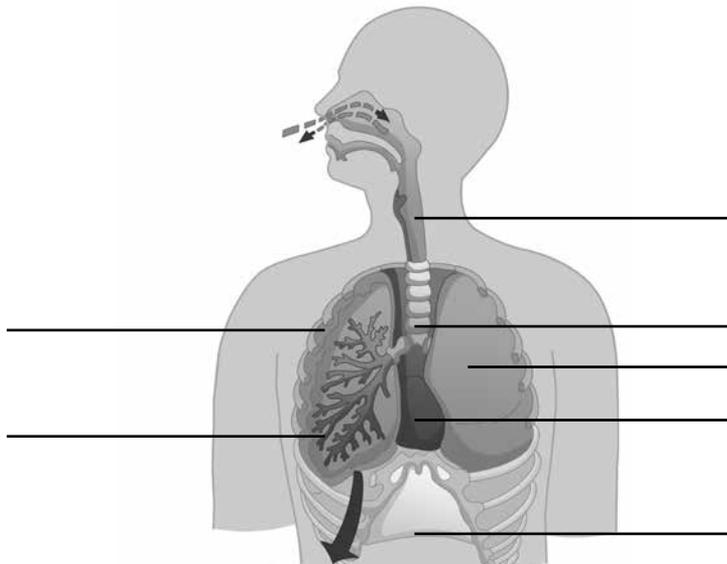
Method:

- The topic of respiration can be introduced by showing them the process of respiration in humans through a chart.
- Explain the difference between respiration and breathing. Teacher can explain about respiration and organs involved in the process in detail through pictures or the model of respiratory system.
- Later the respiratory diseases can be introduced by integrating the topic of air pollution. Furthermore, smog can be discussed, which happens in a few parts of our country due to air pollution. Explain that respiration helps the body. Explain that respiration is the process by which food is burned to release energy.
- Discuss the similarities and differences between burning and respiration. Discuss the causes and effects of respiratory diseases and how they can be prevented and treated. Warn the students about smoking. Discuss the bad effects of smoking.
- Conduct in classroom:
 - Activity 3, page 6
 - Activity 4, page 8

Assessment

1. Arrange the following sentences and write a to e to show the correct sequence of events when we breathe out.
 - a. The volume inside the chest decreases.
 - b. Air is forced out of the lungs.
 - c. The intercostal muscles relax.
 - d. The ribs move down and in.
 - e. The diaphragm relaxes.

2. Label the following diagram:



3. Write the functions of the parts of the respiratory system.

- a. larynx: _____
- b. ribcage: _____
- c. alveoli: _____
- d. diaphragm _____

Reinforcement/homework

- 1. Question 5, 6, 7 of exercise
- 2. Draw a labelled diagram of any one human system on A4 size paper.

Transport in Human and Plants

Lesson plan 1

Students learning outcomes

Learn about the transport system in humans.

Materials

a model of heart, tubes

Keywords

Blood vessel, artery, vein, capillary, cardiac muscle, chamber, atrium, ventricle, heartbeat

Overview

Students will learn about the system of transport of materials in human beings. They will learn the structure of the heart and explain its working and know about the working of the circulatory system. Students will understand the heart disorder, their causes and effects. In this topic, they will learn the transplantation of body parts and understand the disorders in the human transport system can be affected by diet.

Teaching methodology

Exploring knowledge through essential questions	10 min
Method/activity	25 min
Assessment	10 min

Essential questions

Before starting the lesson, ask some questions to explore background knowledge of students, e.g.

1. What is the function of heart?
2. What is the function of blood?
3. Count the number of times their heart beats in 15 seconds.

Method:

- Ask students to observe the vein on their wrist in order to introduce blood vessels. Show a model of the heart to explain structure and working of heart.
- Students can be asked to make a model of circulatory system by using narrow tubes in order to understand the structures and functions of arteries, veins, and capillaries.

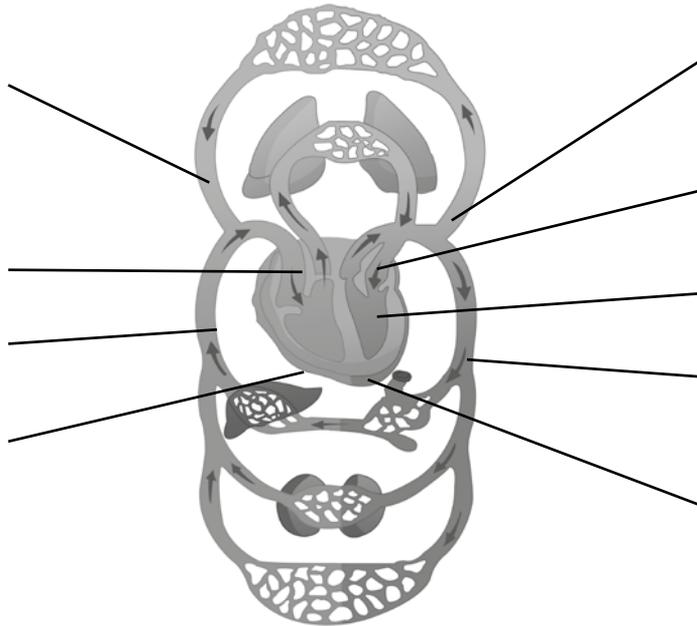
- Students can be assisted to check their pulse by keeping index and middle fingers on the inside of their wrist.
- The students can be asked to investigate the patients suffering common diseases of high blood pressure, heart attack, and diabetes in their family and inquire about their diet before and after the disorders.
- Students can be assigned to conduct research on common disorders in transport system caused by diet or other causes using library books. After the research work, the topic can be explained in detail.
- Explain about the thick blue lines that you can see on the back of your hand? Can you see very fine red lines in your eyes? Describe the structures of an artery, a vein, and a capillary and the functions that they perform. Explain the differences between them. Ask the students to feel their pulse? Explain that this is a way of feeling the heartbeat. Discuss what a heartbeat is?
- With the help of pictures and if possible a video/DVD/YouTube clip, explain a heart surgery. Explain what a graft, a pacemaker, and a heart transplant are. Discuss the ways in which heart disease can be avoided.
- Conduct in classroom:
 - Activity 1, page 15
 - Activity 2-3, page 16

Assessment

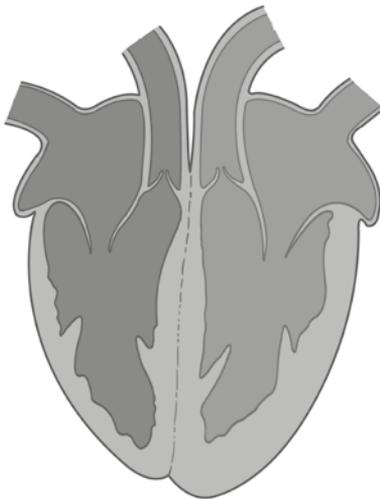
1. Complete the following table:

Blood vessels	Structure	Function
Capillaries		
Arteries		
Veins		

2. Label the following diagram of circulatory system.



3. What is the composition of blood?
4. What are the functions of different blood cells?
5. On the diagram below, label the parts of the heart. Draw arrows to show the circulation of the blood inside the heart.



Reinforcement/homework

1. Exercise questions 1-2
2. Make a model of circulatory system

Lesson plan 2

Students learning outcomes

Learn the transport system in plants.

Materials

a potted plant, slides of the sections of plant tissues, a twig from a plant, red or blue ink

Keywords

Vascular tissue, xylem vessel, phloem, sieve tube, root hair

Overview

Students will learn the transport system in plants and explain how roots absorb water. They will learn how water and food are transported in plants and explain how the exchange of gases takes place in plants.

Teaching methodology

Exploring knowledge through essential questions	10 min
Method/activity	25 min
Assessment	10 min

Essential questions

Before starting the lesson, ask some questions to explore background knowledge of students, e.g.

1. How does the transportation of oxygen take place in plants?
2. How does the transportation of carbon dioxide take place in plants?

Method:

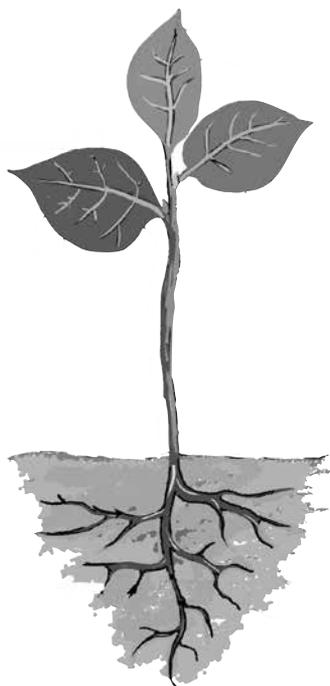
- Teacher will show a potted plant to the student. Show roots to the students and explain how roots absorb water.
- Break a twig from a plant and put it in red or blue ink for 10 minutes. Show them how the colour of petals changes to the colour of the ink.
- Teacher can relate the transport system in humans to plants. The teacher can explain the process of absorption of water in plants through roots by videos available on internet. Other topics can also be taught by using video aids.
- Explain the function of xylem and phloem. Explain that roots are the part of plant

that absorb water. Explain that xylem vessels transport water. Describe the positions and structures of xylem and phloem.

- Show students slides of sections of plant tissues. Discuss the functions of xylem and phloem. With the help of diagrams and charts explain how roots absorb water.
- Conduct in classroom:
 - Activity 4, page 21

Assessment

1. What is the function of xylem and phloem vessels?
2. What is transpiration?
3. What is the function of roots?
4. On the diagram below, draw arrows to show how water circulates inside a plant.



Reinforcement/homework

1. Exercise questions 5-8
2. Cut a twig from a plant and put in red or blue ink for 10 minutes and observe. Draw the results in students notebooks.

Reproduction in Plants

Lesson plan 1

Students learning outcomes

Learn about the parts of flower and reproduction.

Materials

picture of a flower, a flower, different types of seeds, a poster of the life cycle of a plant, a pot

Keywords

Seed, fruit, pod, capsule, disperse, hair, wing pollen grain, anther, stamen, pollination

Overview

Students will learn to explain what is meant by growth and explain the term reproduction. They will learn reproduction in plants.

Teaching methodology

Exploring knowledge through essential questions	10 min
Method/activity	25 min
Assessment	10 min

Essential questions

Before starting the lesson, ask some questions to explore background knowledge of students, e.g.

1. Why are flowers considered an important part of a plant?
2. How does a fruit form?
3. Why do flower plays an important role in reproduction?

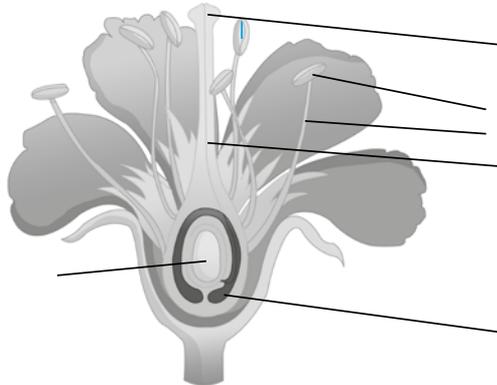
Method:

- The lesson can begin by showing the students a big picture of a flower. Identify the different parts and their functions. Bring a flower in the class and dissect it. Show different parts of the flower and discuss their functions.
- Show different types of seeds. Bring a pot in the class and sow a seed. Encourage students about plantation. The lesson can be further supplemented by showing a poster of the life cycle of a plant that ends on the formation of fruit. Show pictures of flowers and their fruits.

- Ask the students to touch the centre of the flower. Explain that the yellow powder on their fingers is pollen.
- Draw the longitudinal section of a flower on the board and label it. Cut a longitudinal section of a flower and show the students its parts with a hand lens. Ask the students to draw the outline of a flower on a sheet of paper. Take the parts of the flower apart with a pair of forceps and pin each part in its correct place on the sheet of paper and write the name of the part. Cut a cross section of the ovary of a flower and point out the attachment of the ovules inside it.
- Conduct in classroom:
 - Activity 1, page 27

Assessment

1. Label the following diagram of a flower:



2. How is the stamen adapted for wind pollination?
3. How is the stigma adapted for wind pollination?

Reinforcement/homework

1. Exercise questions 1-3
2. Collect five different types of seeds and write about their dispersal on a chart paper.

Lesson plan 2

Students learning outcomes

Students will learn about types of pollination.

Materials

different flowers, hibiscus flowers

Keywords

Self-pollination, wind pollination, fertilization, pollen tube, fruit, cone

Overview

Students will learn to explain the ways in which seeds and fruits are dispersed and list various factors involved in cross-pollination. They will understand fertilization and explain the formation of different kinds of fruits. Students will understand asexual reproduction in plants by different methods.

Teaching methodology

Exploring knowledge through essential questions	10 min
Method/activity	25 min
Assessment	10 min

Essential questions

Before starting the lesson, ask some questions to explore background knowledge of students, e.g.

1. What is the function of seed?
2. What is fruit?

Method:

- Ask students to bring different flowers or take some flowers to class and explain parts of the flower in detail, and how self and cross-pollination takes place. Draw a labelled diagram to explain self-pollination and cross-pollination.
- The teacher may arrange for hibiscus flowers to dissect, in order to show the internal male and female organs of the flower. During dissection, teacher can explain the process of self-pollination and cross-pollination.
- Teacher can use videos from internet showing the agents of pollination and may use as a resource for explanation.
- Students can be assisted to observe some examples of asexual reproduction by cutting and grafting the stems of the plants.
- Conduct in classroom:
 - Activity 2, page 32

Assessment

1. When strawberries are eaten by birds, the seeds are dropped in the faeces.
Suggest why birds are attracted to the strawberry as food.
2. Explain why the seeds can still germinate after passing through the digestive system of a bird.
3. Give two reasons why seed dispersal is necessary.

Reinforcement/homework

Exercise questions 4 and 5

Environment and Feeding Relationship

Lesson plan 1

Students learning outcomes

Learn about the environment and its factors.

Materials

a picture of a desert and a forest, an aquarium

Keywords

Food chain, consumer, producer, herbivore, carnivore, omnivore, primary consumer, secondary consumer, decomposer

Overview

The teacher will explain about the ecosystem and working of ecologist and explain the relationship between habitat, community, and population. He/She will describe an ecosystem and what constitutes it.

Teaching methodology

Exploring knowledge through essential questions	10 min
Method/activity	25 min
Assessment	10 min

Essential questions

Before starting the lesson, ask some questions to explore background knowledge of students, e.g.

1. What is environment?
2. What is an ecosystem?

Method:

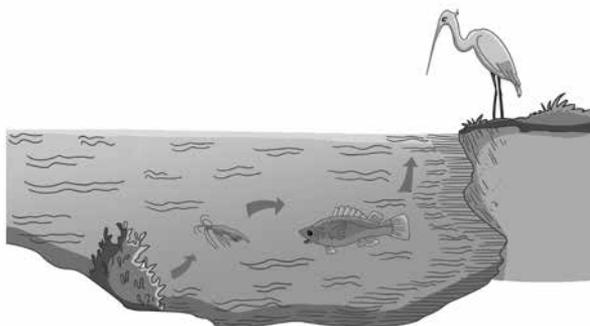
- Show pictures of desert and forest and ask students the difference in their ecosystems.
- The lesson can begin by showing the students pictures of various ecosystems and asking them to list the biotic and abiotic components.
- Teacher can show a video or pictures of types of habitats.
- Students can be taken to an aquarium to observe the ecosystem and habitat of

aquatic animals. They may also be taken to a riverside in order to investigate its habitats.

- Explain that all things that affect the way of life of a plant or animal are called its environment. Environment includes the physical conditions such as climate, soil, water, etc. and all the other organisms living in the same place. Explain that an ecosystem is a community of organisms together with the habitat in which they live. An ecosystem is made up of all the producers and consumers in a community, as well as the physical environment.
- Conduct in classroom:
 - Activity 1, page 34

Assessment

1. Look at the diagram of ecosystem of pond:



- a. Write names of two biotic factors.
 - b. Write names of two abiotic factors.
 - c. Draw a food chain.
 - d. What is the main source of energy?
2. Draw lines to connect the words with their correct meanings:

Words	Meanings
consumers	animals that can eat both plants and animals
carnivores	organisms that can make their own food
herbivores	organisms that obtain their food from another living organism
omnivores	animals that eat other animals
decomposers	organisms that rely on other organisms for their food
producers	organisms that feed on dead plants and animals
parasites	animals that eat plants

Reinforcement/homework

Exercise questions 1-2

Lesson plan 2

Students learning outcomes

Learn about organisms' adaptation in a habitat.

Materials

pictures of an aquarium and a zoo

Keywords

Adaptation, desert, water, swamp, mountain

Overview

The teacher will describe the important features of a natural environment and define the term habitat. He/she will compare the different kinds of habitat and analyse the various features in a particular habitat. Teacher will identify the factors that cause daily and yearly changes in habitat. He/she will understand how things adapt to the daily and yearly changes in their habitat and explain why the food chains always begin with producers.

Teaching methodology

Exploring knowledge through essential questions	10 min
Method/activity	25 min
Assessment	10 min

Essential questions

Before starting the lesson, ask some questions to explore background knowledge of students, e.g.

1. What is a natural environment for frogs?
2. What is a natural environment for fish?
3. What is a natural environment for squirrels?

Method:

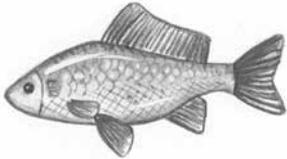
- Ask the students to list the abiotic i.e. the non-living features of deserts and forests. List out the differences between the features of plants and animals of the respective habitats.
- Teacher can ask the students to find the changes in northern areas after the massive earthquake in Pakistan. From this discussion, the teacher can explain the factors that cause changes in a habitat.

- Show the students pictures of an aquarium and a zoo. Discuss why animals are kept there.
- Explain what an artificial environment is. Discuss the natural environment of different kinds of plant and animal. Discuss the important features of a natural environment. Explain that animals and plants live in the natural conditions for which they are best suited.
- Conduct in classroom:
 - Activity 2, page 38
 - Activity 3, page 39

Assessment

1. What are the adaptations you find in the following organisms:

A



B



C



Reinforcement/homework

Question 3, 4 of exercise

Lesson plan 3

Students learning outcomes

Learn the transfer of energy in a food chain.

Materials

picture of different organisms like camel, butterfly, cactus

Keywords

Warm-blooded, cold-blooded, hibernate, pyramid

Overview

The teacher will explain the relationship between producers and consumers and describe two food chains in the environment around them. They will explain a food web and food pyramid.

Teaching methodology

Exploring knowledge through essential questions	10 min
Method/activity	25 min
Assessment	10 min

Essential questions

Before starting the lesson, ask some questions to explore background knowledge of students, e.g.

1. What is the meaning of warm-blooded?
2. What is the meaning of cold-blooded?

Method:

- Explain that animals that have a constant body temperature are called warm-blooded. Human beings, all mammals, and birds are warm-blooded. Animals whose body temperature changes with the surroundings are called cold-blooded. Amphibians, reptiles, and fish are cold-blooded. Cold-blooded animals survive low environmental temperatures by hibernating. They hide in a warm place until the temperature becomes warm.
- Teacher will show pictures of different organisms to explain the adaptation like camel, cactus, fish, polar bear etc. Further, the lesson can include an explanation of the reasons of adaptation in a particular habitat.
- Explain them that the food chains are the transfer of energy from one organism to another organism. The food chains always begin with producers.
- Teacher will illustrate the relationship between producers and consumers on the board.
- Draw a food chain on the board. Explain which organisms are the largest in numbers? Which organisms are biggest in size?
- Explain the pyramid of numbers. The position of an organism in a food chain is called its trophic level. As energy flows through a food chain, some of it is lost at every level. The number of consumers at every trophic level decreases, whereas the size of the animals increases as they consume more of the organisms from the level below them. The transfer of energy is reduced at every level, and the amount of energy passed on to the fourth level is reduced to such an extent that it cannot support another population of consumers.
- Ask the students to identify and describe two food chains in the environment around them. Explain a food web, and food pyramid with the help of diagram.

- Conduct in classroom:
 - Activity 4,5 page 44

Assessment

1. Make food chains:
 - a. eagle grass praying mantis grasshopper
 - b. snake grass frog beetle eagle
 - c. beetle grass eagle sparrow
2. Make a food web with the organisms of question 1.

Reinforcement/homework

Exercise questions 5-6

Water

Lesson plan 1

Students learning outcomes

Learn about the water cycle and purity of water.

Materials

cutting from magazines and newspapers about the lack of water in the world

Keywords

Mineral salt, distillation, Liebig condenser, chlorine, pump, storage tank

Overview

The teacher will explain the occurrence of water on the earth and state the chemical formula of water. He/she will explain the water cycle and describe the stages of water cycle. They will discuss how to test the purity of water and recognize the substances present in water that make the water impure.

Teaching methodology

Exploring knowledge through essential questions	10 min
Method/activity	25 min
Assessment	10 min

Essential questions

Before starting the lesson, ask some questions to explore background knowledge of students, e.g.

1. What do we use for drinking and washing?
2. Can you drink dirty water?
3. How do fish breathe?
4. From where do aquatic animals get oxygen?

Method:

- Show cutting from magazines and newspapers about the lack of water in different parts of the world and discuss with students the importance of water in our life.
- Discuss the causes of impure water and ask students how we can keep water clean. Explain that oxygen is slightly soluble in water and is used by fish and other water animals. Show the students a diagram of the water cycle. Explain how water is recycled in nature.

- Put some ice cubes in a beaker. Record the temperature of the ice cubes. Heat the ice until it turns into water and starts boiling. Record the temperature of the boiling water. Explain what will happen to the boiling point of water if we add some salt to it? Explain that impurities in water lower the boiling point. Describe the properties of pure water.
- Conduct in classroom:
 - Activity 1-2, page 49
 - Activity 3, page 52

Assessment

Fill in the blanks in the passage below using the words from the box. You may need to use some words more than once or not at all.

rain, snow, water, vapour, drops, evaporation, clouds, rivers, oceans, cooler, condenses

When the sun shines on the _____ and other wet surfaces, warm air rises and carries _____ with it. This process is called _____. This warm moist air rises up into the sky. As the _____ rises high up in the sky the air gets _____. The water vapour condenses making the tiny drops of water in the vapour a bit bigger. The clouds may be blown towards the land and cooled still further. Precipitation as _____, hail or _____ occurs. This falls onto the land and eventually runs into the _____. The rivers flow into the _____ and the whole cycle starts again.

Reinforcement/homework

Exercise questions 1-4

Lesson plan 2

Students learning outcomes

Learn about water pollution and its effects.

Materials

videos about ways to clean impure water

Keywords

Pure, impure, reduce, wastage, water pollution

Overview

The teacher will identify the ways we use water and explain why we must save water and suggest ways of doing so. They will explain how water pollution is caused and assess its impact. Students will learn the importance and uses of water for humans and other

living things. They will learn the composition and states of water and know the different ways to clean impure water.

Teaching methodology

Exploring knowledge through essential questions	10 min
Method/activity	25 min
Assessment	10 min

Essential questions

Before starting the lesson, ask some questions to explore background knowledge of students, e.g.

1. Do you waste water when you brush your teeth?
2. How can you reduce wastage of water?

Method:

- Teacher can search from internet and show videos about ways to clean impure water. Elicit responses from students about the uses of water in daily life with examples. Initiate a discussion on ideas to reduce wastage of water.
- Teacher will encourage the students to initiate a campaign in their areas to reduce wastage of water.
- Discuss if distilled water contains impurities? Why? How do we use water? In what other ways is water used? Discuss the domestic and commercial uses of water. Discuss water pollution. Explain that when water becomes polluted it can make animals and human beings sick. If water is filtered and then dumped into rivers and lakes, it helps to keep the water cleaner. Oil spills in the ocean kill birds, fish, and plants.
- Discuss the ways in which water pollution can be reduced and the ways in which we can reduce pollution and improve the environment.
- Conduct in classroom:
 - Activity 4-5, page 53
 - Activity 6-7, page 54

Assessment

1. Write true or false:
 - a. Water is a physical substance which is found in abundance on the Earth. _____
 - b. Three-quarters of the Earth's surface is covered with water. _____
 - c. Water is a combination of hydrogen and oxygen. _____
 - d. Rainwater is the purest form of natural water. _____

e. When water falls through the atmosphere many gases are dissolved in it.

2. List five ways in which water becomes polluted.

Reinforcement/homework

Exercise questions 5-10

Structure of an Atom

Lesson plan 1

Students learning outcomes

Learn about atoms and elements.

Materials

picture or video of an atom, periodic table

Keywords

Element, atom, electron, proton, neutron, shells

Overview

The teacher will describe the structure of an atom and differentiate between atomic number and mass number. They will explain the distribution of electrons in an atom and define an element and able to draw diagrams of atoms.

Teaching methodology

Exploring knowledge through essential questions	10 min
Method/activity	25 min
Assessment	10 min

Essential questions

Before starting the lesson, ask some questions to explore background knowledge of students, e.g.

1. What is the smallest particle of an element?
2. What is a periodic table?

Method:

- Show the picture or video of an atom and discuss structure of an atom and its sub atomic particles. Show the periodic table. Explain that atom is the smallest particle of an element.
- Describe the structure of an atom. Every atom is thought to be made up of a nucleus containing protons and neutrons. The nucleus is surrounded by a cloud of electrons. Protons carry a positive charge, electrons carry a negative charge, while the neutrons do not have any charge on them.

- Ask the students to make chart of structure of the atoms of first eighteen elements in the periodic table.
- Ask students to write the difference between atomic number and mass number on blackboard. Explain the arrangement of electrons in the various shells of an atom, using the formula $2n^2$ where 'n' is the number of the shell. E.g.
 - First shell: $2 \times 1^2 = 2$ electrons
 - Second shell: $2 \times 2^2 = 8$ electrons
 - Third shell: $2 \times 3^2 = 18$ electrons, and so on.
- Help the students to practice drawing the electronic configuration of different atoms. Explain that the distribution of electrons in the various shells of an atom is called its electronic configuration.
- Conduct in classroom:
 - Activity 1-2, page 57

Assessment

1. Write the names or symbols of the elements in the following table:

names	symbols
	Cu
carbon	
	Na
Iron	
	Au

2. Choose the correct answer:
 - i. The nucleus of an atom contains _____.
 - a. electrons and neutrons
 - b. protons and electrons
 - c. protons and neutrons
 - ii. Electrons in an atom have _____.
 - a. a positive charge
 - b. negative charge
 - c. no charge

- iii. The number of protons in an atom is called _____.
 - a. atomic number
 - b. mass number
 - c. electronic number
- iv. The number of electrons in an atom is _____ the number of protons.
 - a. greater than
 - b. equal to
 - c. less than
- v. A molecule is composed of two or more _____.
 - a. electrons
 - b. protons
 - c. atoms

Reinforcement/homework

Exercise questions 1-3

Lesson plan 2

Students learning outcomes

Learn about valency, cation and anion of different elements.

Materials

periodic table

Keywords

elements, cation, anion,

Overview

The teacher will explain isotopes, list the uses of radiation and identify the position of elements in the periodic table. They will define valency, ions and differentiate between Cations and Anions.

Teaching methodology

Exploring knowledge through essential questions	10 min
Method/activity	25 min
Assessment	10 min

Essential questions

Before starting the lesson, ask some questions to explore background knowledge of students, e.g.

1. What are atoms?
2. What is electronic configuration?

Method:

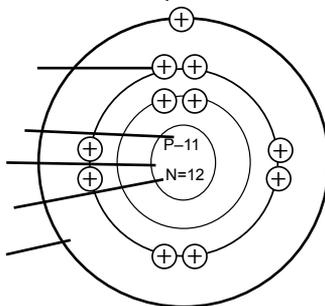
- Teacher will draw pictures on the board to explain formation of ions and its types using different examples like sodium ion and chloride ion. Explain that when atoms loss or gain electrons, ions are formed. Using diagrams on the board explain how negative and positive ions are formed. Negative ions are called anions and positive ions are called cations.
- Teacher will briefly describe isotopes and their uses in medicines and agriculture. Students will practice identifying the types and number of elements present in simple molecules and compounds. Explain what is an ion? Discuss the formation of ionic bonds with examples.
- Conduct in classroom:
 - Activity 3, page 67
 - Activity 4, page 62

Assessment

1. Write the chemical formulae or name of the following compounds:

Compound	Formulae
sodium chloride	
nitrogen oxide	
	CO ₂
magnesium chloride	
	AlCl ₃

2. Label the following diagram and identify the element:



Reinforcement/homework

Exercise questions 4-6

Lesson plan 3

Students learning outcomes

Learn formulae and equation writing.

Materials

periodic table

Keywords

Formulae, compound, valency, bond, ionic, covalent

Overview

Students will understand the term isotopes and their uses in medicines and agriculture. Students will learn the law of constant composition and give examples. They will make chemical formulae from a list of anions and cations.

Teaching methodology

Exploring knowledge through essential questions	10 min
Method/activity	25 min
Assessment	10 min

Essential questions

Before starting the lesson, ask some questions to explore background knowledge of students, e.g.

1. What is a compound?
2. What are ions?

Method:

- Students will write chemical formulae and names of compounds. Students to be asked to practice of writing chemical formulae and names of compounds.
- Teacher will demonstrate the law of constant composition with examples.
- Discuss the formation of ionic and covalent compounds, with diagrams on the board. Explain the role of valency in the joining of atoms in different ways.
- Discuss the types of bond that form compounds. Explain the methods of working out and writing the formulae of compounds.
- Conduct in classroom:
 - Activity 5, page 64

Assessment

1. Draw an atomic structure of the following:
 - a. chlorine
 - b. sodium
2. Write the valency of the following elements:
 - a. calcium
 - b. oxygen
 - c. potassium
 - d. nitrogen
3. What is the name given to the different levels of the electrons around the nucleus?

4. What are the names of particles contained in the nucleus? _____
5. What is the electrical charge on the nucleus of the atom? _____
6. What is the electrical charge on the electrons? _____

Reinforcement/homework

Exercise questions 7-8

Physical and Chemical Changes and Processes

Lesson plan 1

Students learning outcomes

Learn about physical and chemical changes.

Materials

ice, water

Keywords

physical change, melting, dissolving, chemical change, chemical reaction, reversible reaction

Overview

Teacher will define physical and chemical changes and differentiate between them. He/she will explain how reversible reactions take place.

Teaching methodology

Exploring knowledge through essential questions	10 min
Method/activity	25 min
Assessment	10 min

Essential questions

Before starting the lesson, ask some questions to explore background knowledge of students, e.g.

1. Are all reactions irreversible?
2. What change do you see when you put water in a freezer?

Method:

- By giving different examples of cooking, the teacher can explain the difference between physical and chemical changes clearly. For example, changes after making a cake, juice, frying an egg, salad, etc. Students can conduct an activity of making ice cube in a beaker to understand physical change.
- Ask students to form groups and make poster/chart about difference in physical and

chemical changes. Teacher will briefly explain the difference between physical and chemical changes with the help of reactions given in the lesson.

- Teacher will explain the topic 'Useful substances formed by chemical changes' by arranging practical demonstration in school lab if possible. Explain that there are some changes that can be reversed. A simple example is that of the ice changing to water. The water can be changed back into ice.
- Write the change on the board: ice to water, water to ice. Explain that this change can also be written with arrows in the opposite direction. This type of reaction is called a reversible reaction.
- Conduct in classroom:
 - Activity 1-2, page 69

Assessment

1. Complete the table:

Uses	Mineral/ Element
making chlorophyll for photosynthesis	nitrogen
making roots	potassium
making flowers and fruits	magnesium
making new plant tissue (protein)	phosphorus

2. Write any two differences between physical and chemical change:
3. Which one of the following are physical changes:
 - a. when pizza is baked
 - b. melting ice cream
 - c. cutting of wood
 - d. burning of paper
4. Complete the following table using the words below:
heat solids freezes shape volume cool melted
 - a. Liquids change _____ when you move them around in a container.
 - b. _____ do not change shape when you move them.
 - c. Moving a liquid from a bottle to a drinking glass does not change its _____.
 - d. When a solid turns into a liquid, we say it has _____.
 - e. To turn a solid into a liquid, _____ it.
 - f. To turn a liquid into a solid, _____ it.
 - g. When a liquid _____ it turns into a solid.

Reinforcement/homework

Exercise questions 1-3

Lesson plan 2

Students learning outcomes

Learn about fertilizers and their uses.

Materials

potted plant

Keywords

fertilizer, nitrogen, phosphorus, potassium, ammonium nitrate

Overview

The teacher will explain how raw materials can be changed into useful products and explain how fertilizers work. They will describe the harmful effects of fertilizers.

Teaching methodology

Exploring knowledge through essential questions	10 min
Method/activity	25 min
Assessment	10 min

Essential questions

Before starting the lesson, ask some questions to explore background knowledge of students, e.g.

1. What is added to improve the fertility of soil?
2. Why do we use fertilisers?

Method:

- Bring a potted plant containing fertilizer to the class and ask students if they know about the use of fertilizers. Encourage responses from them and then explain physical and chemical properties of fertilizers and their uses.
- Discuss fertilizers. Inform students about the disadvantage of fertilizers. Write the names of the different chemicals that are used to produce fertilizers. Also discuss the harmful effects of using too much fertilizer.

Assessment

1. Write the word equation for the reaction of hydrogen with the following:
 - a. Nitrogen
 - b. Oxygen

2. Write the word equation for the reaction of oxygen with the following:
 - a. Magnesium
 - b. Hydrogen
 - c. Hydrocarbon
 - d. Carbon

Reinforcement/homework

Exercise questions 4-5

Lesson plan 3

Students learning outcomes

Learn about plastics and fats.

Materials

different things made of plastic and fats, videos

Keywords

plastic, synthetic, polymer, polyethene, monomer, thermoset plastic

Overview

The teacher will define plastics and explain how plastics are made. They will describe how we use plastics. Students will learn the composition of fats and identify the uses of fats. Students will be taught how fats can be converted into useful products.

Teaching methodology

Exploring knowledge through essential questions	10 min
Method/activity	25 min
Assessment	10 min

Essential questions

Before starting the lesson, ask some questions to explore background knowledge of students, e.g.

1. What is plastic?
2. Name some objects made up of plastic?

Method:

- Ask students to name the things which are made of plastic and also how they think plastic is made. Discuss the properties of plastic by showing different things made of plastic.

- Discuss the properties of plastic. Explain that plastics are made up of many small molecules called monomers. Lots of monomers join together to make the polymers of which plastics are made. Write the names of some familiar polymers such as polyethene, polystyrene, and PVC. Discuss the uses of different kinds of plastic to make everyday items.
- Tell the class about difference between vegetable oils and fats and how they are extracted.
- Different videos can be shown or the class can be asked to research and write about the extraction of a particular vegetable oil.

Assessment

1. What is plastic and what are its types?
2. What are the harmful effects of fertilisers?
3. What are the types of fertilisers?

Reinforcement/homework

Exercise questions 6-8

Transmission of Heat

Lesson plan 1

Students learning outcomes

Learn about the transfer of heat.

Materials

ice cubes, beaker, hot water, thermometer

Keywords

vibrate, temperature, internal energy, good conductor, bad conductor, insulator

Overview

The teacher will describe heat as a form of energy and differentiate between conductor and insulators. They will explain the flow of heat from hot body to cold body and explain how the conduction of heat takes place in solids. Students will analyse the conduction, convection and radiation through experiment. They will recognize the three modes of transfer of heat from the environment.

Teaching methodology

Exploring knowledge through essential questions	10 min
Method/activity	25 min
Assessment	10 min

Essential questions

Before starting the lesson, ask some questions to explore background knowledge of students, e.g. what happens to a metal teaspoon if it is placed in a cup of hot water?

Method:

- Discuss conduction of heat through solids. Explain that the molecules at the dipped end gain energy from the hot water, start vibrating, and push the molecules in front of them. In this way a chain reaction is set up and the other end of the spoon becomes hot.
- Put some ice cubes in a beaker near a beaker of hot water. Put thermometer in both of the beaker. Observe the reading of the thermometers.
- To explain that heat transfer takes place from a body of higher to a body of lower temperature arrange a number of edible items at different temperatures on the

teachers' table. For e.g. a cup of ice cream, a glass of water with some ice cubes, a hot cup of tea, a glass of water at room temperature, and a freshly boiled potato.

- Ask a few students to check how hot or cold these items feel by touching or tasting. Later on during the lesson, after 15 to 20 minutes, the students should be asked to again check the hotness and coldness of these items. Is it the same as before? What happened to the hot items and what happened to the colder ones? The students should be able to report their observations that the hot items feel cooler but the cold items feel less cold after the passage of some time.
- Explain that heat always transfers from a region of higher temperature to a region of lower temperature.
- Conduct in classroom:
 - Activity 1-2, page 79
 - Activity 3-4, page 80

Assessment

1. Look at the following diagram and answer the questions below:



- a. Which material is used to make a sauce pan? _____
 - b. Give reason for your answer of a. _____
 - c. Which material is used to make a handle of sauce pan? _____
 - d. Give reason for your answer of b. _____
2. Write true or false:
 - a. Radiation is a particular way in which electricity travels. _____
 - b. Radiation needs a medium to be carried. _____
 - c. Radiation can travel through solids and liquids. _____
 - d. The Earth is heated by the radiation from the Moon. _____
 - e. A white surface absorbs more heat. _____
 - f. A black surface reflects more heat. _____
 - g. Good absorbers of heat radiation are bad emitters. _____

- h. Shiny silvery surfaces are the worst absorbers of radiation. _____
 - i. Dull black surfaces are the worst emitters of radiation. _____
 - j. Shiny, silvery surfaces are the best emitters of radiation. _____
3. Define the following terms:
- a. Conduction
 - b. Convection
 - c. Radiation
4. Explain the Convection in Seas and Oceans.

Reinforcement/homework

Exercise questions 1-3

Lesson plan 2

Students learning outcomes

Learn the application of transfer of heat.

Materials

a video of birds flying

Keywords

conduction, conductivity, radiation, absorb, reflect, emit, thermos flask, vacuum

Overview

The teacher will identify the practical applications of radiation and suggest how birds can glide in the air for hours. They will identify different examples of appliances that make uses of different modes of transfer of heat and understand the working and principles of a vacuum flask.

Teaching methodology

Exploring knowledge through essential questions	10 min
Method/activity	25 min
Assessment	10 min

Essential questions

Before starting the lesson, ask some questions to explore background knowledge of students, e.g.

1. Why does a new fluffy quilt seem warmer than an older flattened quilt?
2. Why do birds fluff up their feathers in winter?

Method:

- Discuss the composition of matter. Explain that particles of matter are always vibrating.
- When an object is heated, it absorbs heat energy. Its particles gain energy and they start moving faster. When this happens the temperature rises. The particles have more internal energy.
- Explain that heat is a degree of temperature. Scientifically speaking, heat is a kind of energy found in an object that has a higher temperature than its surroundings.
- Ask students about any change taking place in the glass of water at room temperature. Explain the reason why there was no change in its temperature. There will be no transfer of heat when there is no temperature difference between two bodies.
- Explain that the three modes of heat transfer (conduction, convection, and radiation) occur in the three states of matter solids, liquids or gases. However, only radiation occurs in vacuum. A number of daily life examples should be used to strengthen students' concepts.
- Explain the concept that trapped air is able to provide an insulating layer and prevent body heat from escaping. This concept helps keep us warm in our blankets and birds stay warm the same way using their feathers. Show a video of birds flying. Explain that trapped air between the hairs of animal fur keeps them warm in winter.
- Conduct in classroom:
 - Activity 5, page 83

Assessment

1. Give reason of the following statements:
 - a. A tiled floor feels cold when you walk on it with bare feet.
 - b. Heat from the Sun travels to the Earth.
 - c. Only the water at the bottom of an electric kettle is heated, but the heat travels all through the water until it boils.
 - d. The handle of a metal spoon left in hot coffee gets hot.
 - e. A grill in the top of the oven heats the food below it.
2. What are the conditions under which the transmission of heat takes place?
3. Explain the working of a Vacuum Flask with the help of a diagram.
4. Write the ways of heat transfer in the following:
 - a. Electric Kettle
 - b. Electric Heaters

- c. Our houses
 - d. From the sun
 - e. Metals
5. Complete the table below by writing the correct temperatures.

Temperature scales	Fahrenheit	Celsius	Kelvin
Human body temperature			
Boiling point of water			
Melting point of ice			

Reinforcement/homework

Exercise questions 4-6

Dispersion of Light

Lesson plan 1

Students learning outcomes

Learn the laws of refraction.

Materials

a pencil, glass of water

Keywords

Refraction, refractive index, real depth, apparent depth

Overview

The teacher will explain how refraction occurs and describe laws of refraction and refractive index. They will explain refraction of light, its causes and describe the refractive index. Students will distinguish between real and apparent depth and define critical angle.

Teaching methodology

Exploring knowledge through essential questions	10 min
Method/activity	25 min
Assessment	10 min

Essential questions

Before starting the lesson, ask some questions to explore background knowledge of students, e.g.

1. What is the speed of light?
2. Why does a pool appear shallower than it actually is?

Method:

- As a warm-up question students can be asked to write down all the phenomena they can think of which are visible to us due to the presence of light.
- Put a pencil in a glass of water to explain refraction of light. Explain that the speed of light slows down when it enters from a rarer to a denser medium and that is why the refracted ray bends towards the normal and vice versa.
- The refractive index of a transparent material depends on the density of the material. Air has the lowest refractive index and diamond the highest. The least bending of light is therefore produced in air or gases and the maximum in diamond.

- Discuss refractive index as a ratio of the speed of light to the speed of light in a medium. The greater the speed of light, the greater the change of direction.
- Explain that one of the effects of refraction is that our brains can be tricked into thinking that pools are shallower or glass blocks are thinner than they actually are. The real depth can be calculated by multiplying the apparent depth by the refractive index of the medium. The refractive index of water is about $\frac{4}{3}$, so a pool 2 metres deep appears to be only 1.5 metres deep.
- Conduct in classroom:
 - Activity 1, page 86
 - Activity 2, page 87
 - Activity 3, page 89

Assessment

1. What colour will be appeared after mixing following colours:
 - a. red + blue
 - b. yellow + red
 - c. blue + yellow
 - d. red + blue
 - e. red + blue + yellow
2. What colour will you see when:
 - a. red light falls on a red surface?
 - b. blue light falls on a red surface?
 - c. magenta light falls on a red surface?
 - d. red light falls on a cyan surface?
 - e. magenta light falls on a cyan surface?
3. What are the seven colours in white light?
4. What are the different types of Reflecting Prisms?
5. Explain the Fish Eye View.
6. What is a Critical Angle?
7. Explain the Total Internal Reflection with the help of a diagram.
8. What is a formula of Refractive index?
 - a. What is refraction?
 - b. State the Laws of Refraction.
9. Explain the working of Periscope with the help of a diagram.

Reinforcement/homework

Exercise questions 1-4

Lesson plan 2

Students learning outcomes

Learn the primary colours, secondary colours and the effects of refraction.

Materials

oil, water, a torch, primary colours sheets, prism

Keywords

colour, dispersion, spectrum, primary and secondary colour, sensors

Overview

The teacher will describe the total internal reflection and explain how total internal reflection is useful. He/she will explain that white light is composed of seven colours and list the colour of light using a prism. They will describe primary colours, secondary colours and discuss the effects of refraction with examples. Students will be taught coloured light and explain pigments and filters.

Teaching methodology

Exploring knowledge through essential questions	10 min
Method/activity	25 min
Assessment	10 min

Essential questions

Before starting the lesson, ask some questions to explore background knowledge of students, e.g.

1. What are paints, ink, and crayons made of?
2. Why do they appear coloured?

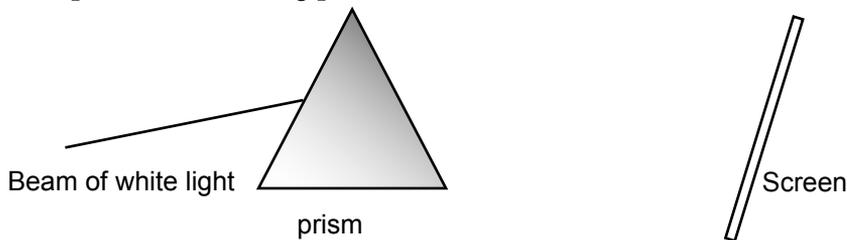
Method:

- Put some oil on water and shine light on it from a torch to show dispersion of light.
- Students can be given poster colours of the three primary colours. Then ask them to prepare different secondary colours and their shades using the primary colours. A sheet of paper divided into a number of small squares can be used to apply these colours. Once completed, these sheets of coloured squares can be displayed on the soft board.

- Explain that pigments are chemical substances which reflect some colours only. Our skin, leaves and petals of plants, all contain pigments.
- Explain by practical demonstrations the mixing of pigments to produce a wide range of colours. Show the students filters of different colours. Ask them to look through the filters and say what colours they can see. Explain that filters allow some colours to pass through, and filter out all the others. For example a green leaf looks black if we observe it through a red filter. This is because the filter has absorbed the green colour and there is no green light to reflect.
- Conduct in classroom:
 - Activity 5, page 93
 - Activity 6, page 96

Assessment

1. Complete the following picture:



2. Which of the statements about light below are true?
 - a. Light is a form of energy. _____
 - b. Light is a form of radiation. _____
 - c. Nothing else travels as fast as light. _____
 - d. Light rays reflect off objects into our eyes. _____
 - e. Light rays reflect off your eyes onto objects. _____
 - f. Light cannot travel in a vacuum. _____

Reinforcement/homework

Exercise questions 5-10

Sound Waves

Lesson plan 1

Students learning outcomes

Learn about sound waves and their effects.

Materials

Keywords

wave, amplitude, pitch, vibration

Overview

The teacher will define the terms oscillation, period, and frequency. Students will describe waves and identify different kinds of wave. They will explain how frequency and pitch of a sound are related.

Teaching methodology

Exploring knowledge through essential questions	10 min
Method/activity	25 min
Assessment	10 min

Essential questions

Before starting the lesson, ask some questions to explore background knowledge of students, e.g.

1. What kinds of sound can you hear in a busy street?
2. Which sounds do you like?

Method:

- In order to explain that sound waves are produced by vibration, a simple activity can be performed in the class. Ask your students to open their mouths and say Aaaaaaaa in a loud voice.
- Then tell them to place their thumb and two fingers on their throat while they are producing this sound. Ask them if they can feel any vibrations?
- Students should be able to feel the vibration of their vocal cords while they are producing this sound. Explain that in the same way our vocal cords produce sounds by their vibrations when we speak.

- Conduct in classroom:
 - Activity 1-3, page 99
 - Activity 4, page 100
 - Activity 5, page 101

Assessment

1. Match the columns:

Animal	Frequency range (Hz) of the sound produced
human	45-64,000 Hz
dog	20-120,000 Hz
cat	67-45,000 Hz
Dolphin	16-20,000 Hz
Elephant	20-120,000 Hz
Bat	20-20,000 Hz

2. Draw a wave showing the following:
 - a. A regular wave pattern (pleasant sound)
 - b. An irregular wave pattern (noise)
 - c. Loud sound
 - d. Soft sound
3. Define the following terms:
 - a. Velocity
 - b. Pitch
 - c. Amplitude
 - d. Wavelength
 - e. Frequency
4. Differentiate between Transverse Waves and Longitudinal Waves.
5. What are the units of the following:
 - a. Velocity
 - b. Amplitude
 - c. Wavelength
 - d. Frequency

Reinforcement/homework

Exercise question 3

Lesson plan 2

Students learning outcomes

Learn the characteristics of sound waves.

Materials

a number of same- sized glass bottles or bowls, a bob to a piece of string, rubber band

Keywords

Hertz, amplitude, oscillation, period, frequency

Overview

The teacher will describe the characteristics of sound and describe the frequency ranges of some animals. They will explain how we make the use of sound in our daily lives.

Teaching methodology

Exploring knowledge through essential questions	10 min
Method/activity	25 min
Assessment	10 min

Essential questions

Before starting the lesson, ask some questions to explore background knowledge of students, e.g.

1. What is frequency?
2. How frequency effects sound?

Method:

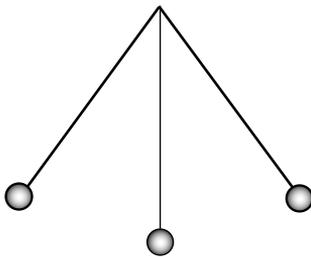
- Draw a diagram of a wave on the board. Mark the crest and the trough. Explain that wavelength is the distance between two peaks or two troughs (wave fronts). The speed of a wave tells us how far each wave front moves in one second. The speed can be calculated by the distance travelled by a wave divided by the time taken.
- A simple class demonstration can be carried out using a number of same sized glass bottles or bowls filled with different amounts of water and a wooden stick. Line up about five or six bottles or bowls carrying an increasing amount of water in each. Next, strike the bottles one by one at the edge of their mouths or the rims of the bowls one by one. Do this repeatedly and observe the sounds produced by the containers carrying from very little water to more water and the maximum amount. Does the pitch or loudness of the sounds change due to the different amount of water in the bowls? Ask the student if they can answer why this happened?
- Make a pendulum by tying a bob to a piece of string. Pull it to one side to make it

swing. Explain that the to and fro movement that it takes to complete one oscillation is called a period. Calculate the number of oscillations in one second. Explain that the number of oscillations completed in one second is called the frequency of the oscillation.

- The simplest musical instrument can be made by stretching a rubber band over an empty shoebox container or any other small open box. The students can be asked to compare the sound produced by plucking a single stretched rubber band, two rubber bands and three rubber bands. They can also compare the sounds produced by a more tightly stretched band to a less tightly stretched band.
- Conduct in classroom:
 - Activity 6-7, page 104
 - Activity 8-9, page 106

Assessment

1. What is meant by the word *vibration*?
2. Describe how a violin produces sound.
3. Bats and dolphins navigate using ultrasound. What is ultrasound?
4. Explain how ships can use ultrasound to find out the depth of water beneath them.
5. Mark the amplitude of the pendulum shown in the diagram.



Reinforcement/homework

Exercise question 3

Circuits and Electric Current

Lesson plan 1

Students learning outcomes

Learn about circuits and their components.

Materials

electrical components like cells, resistors (fixed and variable), fuse wire, switch, three pin plug, socket, ammeter, voltmeter

Keywords

circuit, series, parallel, switch, fuse, bulb

Overview

The teacher will learn to explain the term electricity and define electric current. They will explain conductors, semiconductors, and insulators. They will know a circuit and describe how series and parallel circuits are connected and explain the functions of a switch and a fuse.

Teaching methodology

Exploring knowledge through essential questions	10 min
Method/activity	25 min
Assessment	10 min

Essential questions

Before starting the lesson, ask some questions to explore background knowledge of students, e.g.

1. What is an electric current?
2. What is electricity?

Method:

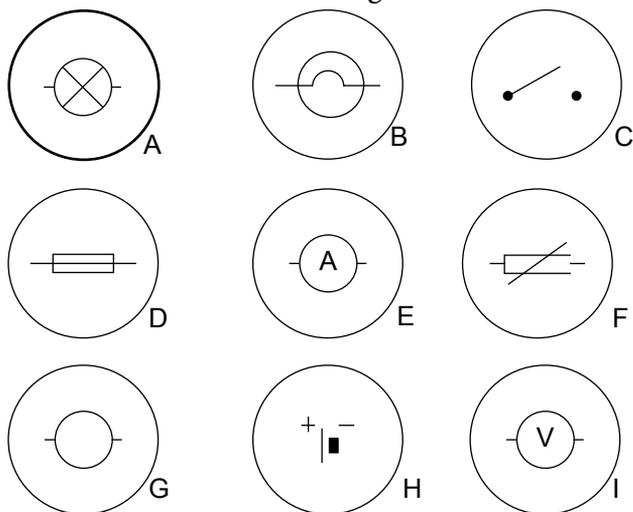
- Explain that an electric current is a flow of free electrons. Free electrons are electrons that can move from one place to another. When free electrons are forced to move in one particular direction, an electric current is produced. Explain that conductors are Materials through which electrons can flow easily, so they can carry an electric current easily. Conductors have electrons which are not tightly held so they can pass from atom to atom and cause a flow of current. Conductors

themselves do not get charged because the electrons do not remain on them. They flow through them.

- Show series and parallel circuits to the students in the class and discuss about the components of a circuit.
- Students should be shown different electrical components like cells, resistors (fixed and variable), fuse wire, switch, three pin plug, socket, ammeter, and voltmeter. They should be encouraged to make circuits independently.
- The two types of basic circuits, namely the series and parallel circuits, can be explained to the students by actually setting them up and demonstrating how they work. By progressively increasing the number of bulbs in each type of circuit, the effect produced on the brightness of the bulbs should be observed and explained.
- Conduct in classroom:
 - Activity 1, page 109
 - Activity 2, page 110
 - Activity 3, page 111
 - Activity 4-5, page 112

Assessment

1. Write names of the following:



Reinforcement/homework

Exercise questions 1-2

Lesson plan 2

Students learning outcomes

Learn about current and its uses.

Materials

a picture of electrical device

Keywords

semiconductor, insulator, electrical energy, electric current, conductor

Overview

The teacher will explain how current is measured and define voltage and to explain how it is measured. Students will identify the units for measuring voltage and define resistance. They will identify the factors on which resistance depends and explain how resistance is measured.

The teacher will explain how cells and batteries are sources of electric charge and explain how electricity comes from a power station. They will explain the safety rules when using electricity.

Teaching methodology

Exploring knowledge through essential questions	10 min
Method/activity	25 min
Assessment	10 min

Essential questions

Before starting the lesson, ask some questions to explore background knowledge of students, e.g.

1. What are conductors?
2. How do conductors allow electrons to flow through them?

Method:

- It should be explained to students that electrical devices follow the law of conservation of energy by converting electrical energy into different forms of energy like heat, sound, light, and kinetic (motion).
- A class presentation by students can be planned in which each student can share a picture of electrical device and explain the type of energy conversion it produces, for e.g. iron electrical energy is converted into heat energy.
- Teacher will discuss rules of safe use of electricity in homes with the students. They should be informed that a voltage much lower than the mains supply voltage can

be sufficient to electrocute a person. The practice and sharing of safety precautions that must be taken while using electrical devices should be encouraged at homes and schools.

- Students will give ideas about safe use of electricity.
- Conduct in classroom:
 - Activity 6-7, page 113
 - Activity 8, page 115
 - Activity 9, 10 page 116

Assessment

1. Draw the symbols for the following electrical components:
 - a. connecting wire
 - b. cell
 - c. battery
 - d. voltmeter
 - e. ammeter
 - f. two wires joined
 - g. light bulb
 - h. switch
2. Define the following terms:
 - a. Electromagnets
 - b. Current
 - c. Magnetism
 - d. Voltage
3. Draw the following:
 - a. series circuit
 - b. a parallel circuit
4. Draw an electrochemical cell.
5. Explain the term resistance.
6. Write names of any four Safety Devices.
7. What are the uses of electromagnets?
 - a. series circuit
 - b. a parallel circuit
8. Explain the Electromagnets

Reinforcement/homework

Exercise question 3

Answers to the Exercises

Unit 1

1. i. Pancreas: a gland attached to the small intestine. It produces substances called enzymes, which mix with food in small intestine to digest the food completely.
Gullet or oesophagus: a narrow tube, muscles of gullet relax and contract to push food down from the mouth to the stomach.
Stomach: a sac-like structure where food is further broken down with the help of digestive juices called gastric juices.
Liver: nutrients from the food then pass through the walls of the small intestine into the blood which carries them to the liver. Liver stores, processes, or distributes these nutrients to the body
- ii. Refer to the Students' Book.
2. Refer to the Students' Book.
- 3.

Disease	Reasons/Causes	Treatment
1. Constipation	Holding the urge to defecate too often. Large amount of water absorption by colon. Loss of water due to poor functioning of the muscle of the colon.	Patients of constipation must take more fruits, vegetables, and whole grain cereals or high fibre diets. Drinking 8 glasses of water every day and regular exercise could bring relief for the disorder.
2. Diarrhoea	Infection by bacteria, viruses or parasites. Inability to digest artificial sweeteners and lactose	The most essential and urgent treatment for diarrhoea patients is drinking lots of water or oral rehydration solution (ORS) and eating bananas.

4.

Breathing	Respiration
It is a physical process involving exchange of oxygen and carbon dioxide	It is a chemical process involving oxidation of glucose to carbon dioxide and water

Energy is not released	Energy is released
It takes place outside the cell	It takes places within the cell
Breathing is a voluntary action	Respiration is an involuntary action
between cells and the external environment	takes place in the cells

5.

Respiratory Diseases	Causes
Tuberculosis	b. Lumps of tissues are formed
Pneumonia	c. Tissue fluids accumulate in the alveoli
Bronchitis	d. The lining of bronchiole becomes swollen
Asthma	a. Irritates the muscles of bronchiole

6. i. Stomach
 ii. Blood
 iii. Bile
 iv. Teeth
 v. Digestion
7. i. F
 ii. T
 iii. T
 iv. T
 v. F

Unit 2

- Red Blood Cells (RBC), White Blood Cells (WBC), Platelets
 - Capillaries: Capillaries are extremely small and narrow blood vessels that connect arteries and veins. They receive oxygenated blood from arteries.
 - Blood with less oxygen is pumped from the Right Atrium through a valve to the Right Ventricle and through another valve into the Pulmonary Vein. The Pulmonary Vein sends it to the Lungs to pick up Oxygen. It's sent from the Lungs through Pulmonary Arteries to the Left Atrium through a valve to the Left Ventricle. The Left Ventricle sends it through a valve to the Aorta. The Aorta is a series of branches that sends oxygenated blood throughout the body.
- Refer to the Students' Book.

- High Blood Pressure: When blood flows through the arteries it pushes against the walls of the arteries. The force which acts on the walls of arteries is called blood pressure. The average blood pressure of an adult is 120/80 mm Hg. If the pressure exceeds from 120/80 mm Hg, the person is said to be hypertensive.

Heart Attack: Heart is a pumping organ. It pumps blood. The blood reaches to all parts of the body through the arteries. If arteries become blocked or narrowed, they cannot function properly. In such situation, the affected part of the heart stops working and it causes a heart attack.

Diabetes: A certain level of minerals, vitamins, oxygen and glucose must be maintained in the blood. If this level is not maintained several diseases affect the body. Similarly if the level of glucose in the blood constantly remains higher than the normal level, the condition is known as diabetes and the patient is considered diabetic.

4.

vessels	functions
 <p data-bbox="179 911 279 939">arteries</p>	Arteries are blood vessels that carry blood away from the heart to the body.
 <p data-bbox="179 1124 252 1152">veins</p>	Veins are the blood vessels that carry deoxygenated blood to the heart.
 <p data-bbox="179 1343 312 1370">capillaries</p>	Capillaries are extremely small and narrow blood vessels that connect arteries and veins. They receive oxygenated blood from arteries.

- Transplantation is the replacement of a dysfunctional organ with a healthy one. Heart transplantation replaces the unhealthy patient's heart with a healthy donor heart. An artificial heart maintains the patient's heart blood circulation.
- Xylum: Water and mineral salts moved from the roots to the leaves.
Phloem: Food substances moved from the leaves to the rest of the plant.

The Mesophyll: Just under the lower epidermis are layers of cells containing chlorophyll. Chlorophyll traps light energy which is necessary for photosynthesis.

Epidermis: The outer protective layer of the tissues is called epidermis. There are no chloroplasts in this layer. The epidermis is made of upper epidermis and lower epidermis.

Pith: It is the central part of a stem. It stores food and nutrients.

7. Transport of water and minerals from roots to leaves involves three basic steps:
 - Absorption at the roots.
 - Capillary action in the xylem vessels.
 - Evaporation at the leaf.
8. Refer to the Students' Book.

Unit 3

1. i. **Reproduction:** New plants grow out of seeds sown by farmers in their fields, and sometimes by planting a part of a plant. The process of seeds becoming plants, or a part of plants, is called reproduction.
- ii. **Sexual Reproduction in Plants:** This type of reproduction requires the participation of two parents, a male and a female. The female part of a flower has an organ called the ovary which produces eggs. The male part of a flower has an organ that produces pollen. When the egg and pollen meet, a zygote is formed. This process is called fertilization.

Asexual Reproduction: in Plants In this type of reproduction, there is only one parent. The plants that produce by asexual reproduction possess the same traits as the parent plant. Asexual reproduction in plants may be natural, artificial, or both.

- iii. Refer to the Students' Book.
- iv. **Pollination:** it is the process whereby pollen grains from the anther are transferred to the stigma of the same, or another flower.
- v.

Self-pollination	Cross-pollination
the transfer of pollen grains from the anther to the stigma of the same flower	transfer of pollen grains from the anther of one flower to the stigma of another flower

- vi. **Fertilization:** When a pollen grain reaches the stigma, it forms a tube called the pollen tube. The tube grows through the stigma and style until it reaches the ovary, where the ovules are stored. The pollen tube bursts and releases the

male reproductive cells, which combine with the ovules to create a zygote. This process is known as fertilization.

2. **By Wind:** In some plants pollination takes place by the wind. The pollen grains are light and feathery, so they can be easily carried by the wind.

By Water: Some plants grow in water. They are called aquatic plants. The plants in water release pollen grains directly into the surrounding water. Pollination by water takes place in water lily and weeds.

By Insects: The pollination which takes place in plants through insects is said to be insect pollinated. The flowers produce nectar and insects are attracted to suck the nectar. When they sit on the flowers, the pollen grains stick to their bodies. When these insects land on another flower, the pollen grains drop from their bodies and land on the sticky stigma of the flower and pollination takes place.

By Birds: Birds are also an important agent of pollination. They also feed on the nectar of flowers and help to pollinate flowers in the same way as done by the insects. Bird pollinated flowers are usually red in colour but odourless because most birds do not have a sense of smell.

3. See the above answer.
4. Formation of seeds and fruits occurs after fertilization. The stigma, style and petals wither away, while the ovary remains and begins swelling. As fruit starts to develop, the ovules turn into seeds.
5. i. ovules or eggs
ii. pollen grains
iii. soil
iv. Exchange of gas and water in a leaf takes place through the stomata.
v. seed
6. Refer to the Students' Book.

Unit 4

1. i. The relationships between all the components of an environment and their interdependence make an ecosystem.
ii. A habitat is a natural environment in which plants and animals live.
ii. food, water, shelter, air, a place to raise its young
iv. Hunting, fishing, mining, grazing, climate changes and diseases, increasing human population, and development in science and technology
v. Animals and plants that live in different habitats look different from each other. They possess features that allow them to live comfortably in their habitats.

Such features include the following examples:

- a. The leaves of rainforest trees are adapted to cope with exceptionally high rainfall.
 - b. In the high humidity of tropical rainforests, most trees have thin, smooth bark.
 - c. In tropical deltas and along ocean edges and near rivers, trees are adapted to living in wet, marshy conditions.
 - d. The skin of forest animals is coloured so that they can camouflage themselves in their environment when they are in danger.
 - e. Animals that live in forest have sharp claws to climb trees.
2. All food chains begin with green plants so we can call them producers. Green plants make their own food using water and inorganic nutrients from the soil, carbon dioxide from the air, and energy from sunlight through a process called photosynthesis.
 3. Grains pigeons cats
 4. Refer to the Students' Book.
 5. Food Webs: Many food chains interconnect to form food web. It is because most of the animals feed on more than one kind of organism.
 6. A cat does not eat mice only. It also eats little birds for e.g. chicks. Similarly chicks not only eat grains, they also eat insects and worms.

Unit 5

1. All living things need water. When you get up in the morning, you brush your teeth, take a bath, have breakfast and drink water, tea or juice. We use water for drinking, washing, bathing and watering plants. Three fourth parts of the earth are water. The human body consists of about 70 per cent water.
2. Refer to the Students' Book.
3. We receive fresh water on the Earth in the form of rain and snow. However, there exist other sources of fresh water as well, such as rivers, lakes, streams, icebergs, glaciers, ponds, and wells.
4. Place water in an environment where the temperature is 0°C it will change into ice. Ice melts when heated and turns into water. On further heating, the water evaporates into gas. This gas is known as water vapours or steam.
5. Decantation, Boiling, Filtration, Distillation
6.
 - i. 75%
 - ii. 0°C
 - iii. 100°C
 - iv. Chlorine
 - v. Distillation

7. Boiling kills the germs found in water. Ordinary tap water should be boiled for at least 20 minutes and cooled before drinking.
Filtration: fold a filter paper as shown in the figure. Make a funnel by cutting the top of a plastic bottle below the mouth. Place this funnel on the bottle. Place the filter paper on the funnel. Pour ordinary tap water through the filter paper. The impurities in the water will remain on the filter paper, and the water will be purified.
8. On heating at 100°C water boils and evaporates into gas. This gas is known as water vapours or steam. On cooling water changes into liquid again.
9.
 - i. Dumping of garbage in rivers
 - ii. Fertilisers washed down into rivers.
 - iii. Factory wastes washed down into rivers.
 - iv. Sewerage water contains soap and shampoo washed down into rivers.
 - v. Eutrophication
10. Tap water is not clean boiling kills the germs found in water. Ordinary tap water should be boiled for at least 20 minutes and cooled before drinking.
11. Rivers, lakes, streams, icebergs, glaciers, ponds, and wells.

Unit 6

1. Atomic Number: The number of protons in an atom is called the atomic number. It is shown with a symbol Z. Helium has two protons so its atomic number is 2.
Mass Number: The sum of protons and neutrons in an atom is called the mass number. It is shown with a symbol A. Helium has 2 protons and 2 neutrons so its mass number is 4
2.
 - i. F
 - ii. T
 - iii. T
 - iv. T
 - v. T
- 3.

Elements	Symbols	Electrons	Protons	Neutrons	Atomic number	Atomic mass
Helium	He	2	2	2	2	4
Beryllium	Be	4	4	5	4	9
Aluminium	Al	13	13	14	13	27

phosphorus	P	15	15	16	15	31
Chlorine	Cl	17	17	18	17	36

4.
 - i. Number of electrons
 - ii. 8
 - iii. MgO
 - iv. Proton, neutron
 - v. Na

5. Refer to the Students' Book.

6.
 - i. The number of electrons in the outermost shell of an atom is the valency of that element. Valency is the combining capacity of an element.
 - ii. An ion is an atom or group of atoms in which the number of electrons is different from the number of protons.

Cations: These are formed when an atom loses electrons and the number of protons will be more than the number of electrons and it has a positive charge.

Anions: These are formed when an atom gains electrons and the number of protons will be less than the number of electrons and a negative charge appears.

- iii. Isotopes: In an atom, the number of electron and proton are equal and specific. When atoms of the same elements have different number of neutrons, it is said to be an isotope. Isotopes have same atomic number but different mass number. Isotopes have same chemical but different physical properties.

Uses of Isotopes in Medicines

- It is used to trace different diseases.
- It is used to treat tumours and cancers.
- Images of different organs like thyroid, heart, brain and liver are studied to locate diseases.

Uses of Isotopes in Agriculture

- It can improve the yields and produce better crop.
- It improves the efficiency of crops to use isotopes to fix nitrogen and water in a crop.

- iv. This law states that a compound always contains the same elements combined in a fixed ratio. Example: a water molecule is made up of two atoms of hydrogen and one atom of oxygen no matter how and where it is formed. The ratio of H to O is always 2:1.
- v. Distribution of electrons in each shell is called electronic configuration. A specific number of electrons revolve around the nucleus as planets revolve around the Sun in the Solar System.

7. 12 Mg (2, 8, 2), 9 F (2, 7), 11 Na (2, 8, 1)
8. NaCl, CaO

Unit 7

1.

Process	Type of change	Reason
melting of ice cream	Physical change	New substance is not formed
dissolving salt in water	Physical change	New substance is not formed
cooking of food	Chemical change	New substance is formed
burning of wood	Chemical change	New substance is formed

2.
 - i. f
 - ii. t
 - iii. t
 - iv. f
 - v. f
3.
 - i. p
 - ii. c
 - iii. c
 - iv. c
 - v. p
4. Fuels are made up of hydrogen and carbon in different ratios. They are called hydrocarbons. When they burn they react with oxygen in the air and form carbon dioxide and water. This chemical change produces lots of energy.
5. This law states that mass can neither be created nor be destroyed.
6. Plastics are mainly of two types:
 - a. Thermoplastics: A plastic that becomes soft and melts on heating. It can be reshaped when warm.
 - b. Thermosets: A plastic that can't be reshaped when once it is formed.
Plastics are very strong, often brightly coloured material, which can easily be moulded into different shapes. Plastics do not rust and are very durable.
7. Fertilisers increase the fertility of the soil. Plants need nutrients for their healthy growth. The main nutrients required for plant growth are: Nitrogen, Phosphorus, and Potassium. The most common artificial fertilizer is NPK fertilizer. If a plant does not get enough of the right mineral elements, it will show a mineral deficiency. The drawings below show some mineral deficiencies in plants.

8. In this process first seeds are crushed and squeezed to extract oil. The oil is refined by adding sodium hydroxide. The impurities are used to make soap. The oil is heated with hydrogen in the presence of a catalyst. The fat is then heated to remove the unpleasant smell. Then flavouring, vitamins, and salt are added.

Unit 8

1. i. Transfer of heat through a conductor is called conduction.

Example: heating of spoon

Convection occurs when heat is transferred from one place to another by the movement of fluids itself. Example: land and sea breezes

Radiation is the transfer of heat through a vacuum. Example: sunlight reaches to the earth

- ii. Liquids and gases heat up by convection. Liquids and gases expand on heating which makes them lighter or less dense. This causes an upward movement of the warmer layers of the liquid or gas while the cooler layers of the liquid or gas move downwards to take their place.
- iii. Conduction occurs only in solids because their particles are closely packed and collide with each other when heated. Over time, the increased vibration of the particles makes its neighbouring particles vibrate faster than before. Materials which allow heat to flow through them are called conductors.
2. Teacher supervision required. Put some crystals of potassium permanganate (pink) in a beaker full of water. Heat the beaker slowly. Observe the solution as it starts to heat up. The coloured crystals first rise to the top, move sideways and then sink to the bottom. This movement of the crystals is visible as pink streaks in the water. As the water becomes hotter, the crystals start moving faster.
3. Convection in Electric Kettle: Water in electric kettles is heated by convection current.

Convection in Electric Heaters: The electric elements in an electric heater heat the air, which rise up. Cold air flows in at the bottom to replace the hot air.

Convection in Our Houses: Chimneys and ventilators are the most common examples of the use of convection. They allow hot air to rise and escape through them.

4. Radiation does not require any medium for its transfer as Heat (and light) from the Sun reaches Earth in the form of electromagnetic waves. This is how the infrared radiation from the Sun is transmitted through space and reaches the Earth.
5. Experiment: Infrared radiation is electromagnetic waves which are not visible to the human eye but can be captured by a digital camera. A heat-sensitive camera captures hot spots. This is radiation.
6. Vacuum Flask: A thermos flask consists of a double-walled glass bottle which

has a vacuum between the two walls. The inner sides of the walls are shiny. The mouth of the bottle is closed with a cork or plastic stopper. The glass bottle is fitted into a metallic or plastic container. Heat cannot enter or leave the flask through conduction and convection. The shiny surface reflects the heat waves. Anything inside the flask remains hot or cold for a longer time.

Unit 9

1.
 - i. Refraction of light takes place when light rays travel through different media having different densities.
 - ii. When the light moves from a denser medium (glass) to a less dense medium (air), the light is refracted away from the normal. Hence, the angle of refraction, r is bigger than the angle of incidence, i
 - iii. Refraction is the cause of twinkling of stars in the sky, and why a pencil in partly immersed water looks bent at an angle.
 - iv. The refractive index of a material is the ratio of the speed of light in air to the speed of light in the medium it enters.
Refractive index = Speed of light in air / speed of light in the other medium
 - v. Refraction of light occurs according to two laws of refraction:
Law 1: The incident ray, the refracted ray and the normal at the boundary of two transparent media at the point of incidence, all lie in the same plane.
Law 2: The ratio of angle of incidence and angle of refraction is light is constant for a given colour and given medium. This ratio is known as the Refractive index of that particular medium.
2. When light reflects from the outer world to the boundary of two different media such as air and water, total internal reflection occurs. As a result outer world objects such as the Moon, Sun, plants, and birds are visible to the fish underwater. However, the shape and the distance of the image of such objects are different from their real frame.
3. When a ray of light travelling from a less dense medium to a denser medium is reflected inside after striking its boundary, this is said to be the total internal reflection of the light.
Critical angle is defined as the angle of incidence that gives an angle of refraction of 90 degree.
4. Periscope: A periscope is a device which helps a person to see an object which is out of sight. The objects may be either above or below the eye level. It works on the principle of total internal reflection of the light.
Reflecting prisms: These prisms are used to invert, rotate, deviate, or displace a

beam of light. They produce a dispersion of the spectrum which is used for several purposes.

Mirage: A mirage is an optical phenomenon that creates the illusion of water, often with inverted reflections of distant objects. It is caused by the refraction of light by the alternate layers of hot and cool air in a desert or on a hot road. When the Sun is high in the sky, the sand gets heated first and then the layers of air above it

Fish eye view: Fish, and other aquatic animals and divers see a reflected view of the objects present in their surroundings. When light reflects from the outer world to the boundary of two different media such as air and water, total internal reflection occurs.

5. Refer to the Students' Book.
6. The splitting of light into its component colours is called dispersion of light. This phenomenon can be observed by using a glass prism. Light is made of seven different colours but it appears white to us. In order to see its colours a glass prism is used.
7. The primary three colour wheel is called RBG Wheel or RGB triad. These colours produce rest of the range of colours. The addition of primary colours in equal intensities results in the formation of the secondary colours. The secondary colour wheel consists of green, orange, and violet and is called VOG wheel. When mixed together red and blue make violet, blue and yellow make green, and red and yellow make orange.
8. Divide your card into seven portions using a compass. Colour each portion with a different colour. Make a small hole in the centre of the card. Place the card flat on your desk. Place the tip of the compass through the hole. Spin the card as fast as you can. The combined effect that you saw was white. Similarly the colours of the spectrum together make up white light.
9.
 - i. For home decoration both pastel and bright colours are used. The choice of the colour of wall, curtains and the furniture depends on the weather of the area.
 - ii. Traffic lights are used to control the traffic.
 - iii. Florescent yellow, green, and orange colours are used to warn about danger or cautionary actions at public places. For example; yellow stripes are used to indicate the edge of the road for safe driving. Similarly, construction sites are also edged by green or yellow stripes.
 - iv. Different coloured chalks are used to explain different topics and diagrams.
 - v. Colourful charts are used as teaching aids to highlight different concepts.
10.
 - i. Energy
 - ii. Lighter

- iii. Seven
- iv. Light
- v. White light

Unit 10

1.
 - i. A vibration is rapid to and fro movement. When we speak or shout, our vocal cords vibrate. These vibrations go out in all directions through the air as waves. When the waves reach our ears, they make our eardrums vibrate too. If this vibration is within our hearing range, we can hear the sound. Different vibrations make different sounds.
 - ii. Transverse Waves: The particles of a medium vibrate perpendicular to the direction of wave propagation in transverse waves. Light waves, water waves, magnetic waves, radio waves are examples of transverse waves.
Longitudinal Waves: The particles of a medium vibrate parallel to the direction of wave propagation in longitudinal waves. Sound waves, earthquake waves, glass vibrations, waves in a slinky spring are examples of longitudinal waves.
 - iii. Audible sound refers to sound that can be heard. The audible sounds have a range of frequencies which can be heard by animals or humans. Human beings can hear sound from as low as 20 Hz to as high as 20,000 Hz (20 KHz). Dogs can hear frequencies from 40Hz to 60,000Hz, A bat can hear frequencies from 20 Hz to 120,000 Hz.
 - iv. Sounds are used for safety and security; treatment and detection of different diseases, telecommunications and entertainment of humans in their daily life. For example, horn, Azan, bell, and traffic announcement.
2.
 - i. Frequency: The frequency is the number of waves passing through a certain point in one second.
 - ii. Wavelength: A wavelength is a measure of the distance between two identical peaks (high points) or troughs (low points) on a wave.
 - iii. Amplitude The displacement of vibration from its original position is called amplitude. The greater the amplitude, the louder is the sound.
 - iv. Pitch: Pitch is a measure of how shrill or deep the sound is.
3. Refer to the Students' Book.

Unit 11

1.
 - i. Current the rate of flow of charge across a conductor is called current.

ii.

Parallel Circuit	Series Circuit
A series circuit has only one path for the flow of electricity. If two bulbs are attached to the circuit, the current is equally divided between the two.	A circuit where all the bulbs are connected with wires which run parallel to one another is called a parallel circuit. Each bulb in the circuit receives an equal amount of electricity.

- iii. The electrical wiring in the houses and business places is an example of parallel circuit. A string of decorative lights is a good example of series circuit.
- iv. A series circuit uses a minimum amount of wire. The disadvantage of a series circuit is that all elements must be in working order for the circuit to function.
- v. Refer to the Students' Book for the answer.
- vi. A heater, hair dryer, electric iron, and electric toaster convert electrical energy into heat energy while electrical motors in a washing machine, electric drill and fan convert electrical energy into mechanical energy.
2. i. Voltage: The amount of energy supplied by the source of electrical energy to one unit charge is called the voltage of the source. It is measured in units of volts (V) using an instrument called voltmeter.
- ii. Resistance: Resistance is defined as the opposition to the flow of current. The charges collide within the conductor (wire) during their journey through the electric circuit.
- iii. The amount of energy supplied by the source of electrical energy to one unit charge is called the voltage of the source while resistance is defined as the opposition to the flow of current.
- iv. A heater, hair dryer, electric iron, and electric toaster convert electrical energy into heat energy while electrical motors in a washing machine, electric drill and fan convert electrical energy into mechanical energy.
- v. Electric shocks also called electrocution may occur due to:
- Poor or worn out insulation
 - Poor or no earthing
 - Broken switches
 - Overloading circuits
 - Faulty or loose wiring
3. i. T
- ii. F, The parallel circuit has more than one path for the current to flow

- iii. T
- iv. T
- v. T

☆ گھروں میں بجلی کا محفوظ استعمال اس سبق کا اہم حصہ ہے جس کو جامع انداز میں اور تفصیل سے بیان کیا جانا چاہیے۔ طلباء کو آگاہ کیا جانا چاہیے کہ گھروں میں فراہم کی جانے والی دو لٹیج سے بھی کہیں کم دو لٹیج کسی شخص کو ہلاک کرنے کے لیے کافی ہے۔ برقی آلات کا استعمال کرتے ہوئے جو حفاظتی تدابیر اختیار کی جانی چاہئیں، گھروں اور اسکولوں میں انہیں اپنانے کی حوصلہ افزائی کی جائے۔

باب 10

☆ یہ واضح کرنے کے لیے کلاس میں ایک سادہ سرگرمی انجام دی جاسکتی ہے کہ صوتی موجیں (sound waves) ارتعاش کی وجہ سے پیدا ہوتی ہیں۔ طلباء سے کہیے کہ اپنا منہ کھول کر زور سے ”آآآآآآآآآآ“ کی آواز نکالیں۔ پھر ان سے کہیے کہ یہ آواز نکالتے ہوئے انگوٹھا اور دو انگلیاں اپنے حلق پر رکھیں۔ پوچھیے کیا انھیں کوئی ارتعاش محسوس ہوتا ہے؟ طلباء کو یہ آواز نکالتے ہوئے اپنے آواز صوت یا وکل کورڈز (vocal chords) کا ارتعاش محسوس ہونا چاہیے۔ بیان کیجیے کہ اسی طرح سے ہمارے وکل کورڈز اپنے ارتعاش کے ذریعے اس وقت آواز پیدا کرتے ہیں جب ہم بول رہے ہوتے ہیں۔

☆ ایک ہی ساز کی شیشے کی بوتلوں یا پیالوں، جن میں پانی الگ الگ مقدار میں موجود ہو، اور لکڑی کی چھڑی کی مدد سے کلاس میں ایک سادہ سرگرمی انجام دی جاسکتی ہے۔ پانچ یا چھ بوتلوں یا پیالوں کو قطار میں اس طرح رکھ دیجیے کہ ہر آگے والی بوتل پیالے میں پچھلی بوتل پیالے سے زیادہ مقدار میں پانی ہو۔

اس کے بعد ہر بوتل کے منہ یا ہر پیالے کے کنارے پر باری باری ضرب لگائیے۔ بار بار یہ عمل دہرائیے اور پانی کی کم مقدار سے زیادہ مقدار والے کنٹینرز اور پھر سب سے زیادہ مقدار کے حامل کنٹینرز سے پیدا ہونے والی آوازوں پر غور کیجیے۔ کیا پیالوں میں پانی کی مختلف مقدار کی وجہ سے آواز کی شدت تبدیل ہوتی ہے؟ پوچھیے کہ کیوں؟

☆ سادہ ترین آلہ موسیقی (musical instrument) ماچس کی خالی ڈبیا یا کسی بھی چھوٹے مگر گھلے ہوئے باکس پر ربڑ بینڈ کھینچ کر بنایا جاسکتا ہے۔ طلباء سے کہا جاسکتا ہے کہ ایک تنے ہوئے ربڑ بینڈ، دو ربڑ بینڈز اور تین ربڑ بینڈز کو کھینچنے سے پیدا ہونے والی آوازوں کا موازنہ کریں۔

☆ طلباء ایک زیادہ شدت کے ساتھ تنے ہوئے ربڑ بینڈ اور ایک کم شدت کے ساتھ تنے ہوئے ربڑ بینڈ سے نکلنے والی آوازوں کا تقابل بھی کر سکتے ہیں۔

باب 11

☆ طلباء کے لیے دو اقسام کے بنیادی سرکٹ، یعنی سلسلے وار (series) اور متوازی (parallel) سرکٹ بیان کیے جاسکتے ہیں۔ اس کے لیے کلاس میں ان سرکٹس کا حقیقتاً انتظام کیجیے اور عملی مظاہرے کے ذریعے دکھائیے کہ یہ کیسے کام کرتے ہیں۔ سرکٹ کی ہر قسم میں بلبوں کی تعداد بڑھاتے ہوئے ان کی روشنی پر ہونے والے اثر کا مشاہدہ کیا جائے اور پھر اس کی وضاحت کی جائے۔

☆ طلباء کو مختلف برقی اجزا جیسے سیل، مزاحمتیں (Resistance)، متعین اور متغیر، فیوز واٹر، سوئچ، تھری پن پلگ، ساکٹ، ایمپٹر، اور وولٹا میٹر دکھائیے۔ اپنے طور پر سرکٹ بنانے کے سلسلے میں طلباء کی حوصلہ افزائی کی جائے۔

☆ طلباء پر یہ واضح کیا جائے کہ برقی آلات (electrical devices) برقی توانائی کو توانائی کی مختلف اشکال جیسے حرارت، آواز، روشنی اور حرکت میں بدل کر قانون بقائے توانائی (law of conservation of energy) پر عمل کرتے ہیں۔

☆ کلاس میں طلباء کی پریزنٹیشن کا بھی اہتمام کیا جاسکتا ہے جس میں ہر طالب علم ایک برقی آلہ پیش کرے اور بتائے کہ جب یہ آلہ استعمال میں ہو تو برقی توانائی یعنی بجلی کو کون سی توانائی میں تبدیل کرتا ہے۔

یہ پہلے جیسی ہی ہے؟ گرم چیزوں کے ساتھ کیا ہوا اور ٹھنڈی اشیا کے ساتھ کیا ہوا؟
☆ طلبا کو اپنے مشاہدات بیان کرنے کے قابل ہونا چاہیے کہ وقت گزرنے کے ساتھ گرم چیزیں نسبتاً کم گرم اور ٹھنڈی اشیا نسبتاً کم سرد محسوس ہو رہی ہیں۔

☆ اب اس کی وجہ بیان کیجیے، جو یہ ہے کہ حرارت ہمیشہ بلند درجہ حرارت والے علاقے سے کم درجہ حرارت والے علاقے کی طرف منتقل ہوتی ہے۔

☆ طلبا سے پوچھیے کہ کیا کمرے کے درجہ حرارت پر پانی سے بھرے گلاس میں کوئی تبدیلی رونما ہوئی۔ وجہ بیان کیجیے کہ گلاس کے درجہ حرارت میں تبدیلی کیوں نہیں آئی۔ اگر دو اجسام کے درجہ حرارت میں فرق نہ ہو تو پھر حرارت کی منتقلی عمل میں نہیں آئے گی۔

☆ طلبا کو بتایا جائے کہ انتقال حرارت کے تین طریقے ایصال (conduction)، حمل حرارت (convection) اور اشعاع حرارت (radiation) مادے کی تین حالتوں ٹھوس، مائع اور گیس (سیال) اور خلا میں وقوع پذیر ہوتے ہیں۔ طلبا کے ذہنوں میں تصورات کو راسخ کرنے کے لیے روزمرہ زندگی سے مثالیں دیتیے۔

☆ طلبا سے پوچھیے: ”نئی روئیں دار رضائی، پرانی اور سپاٹ یا روئیں سے محروم رضائی کے مقابلے میں گرم کیوں محسوس ہوتی ہے؟ سردیوں میں پرندے اپنے پروں کو کیوں پھڑپھڑاتے ہیں؟“ اس طرح کے سوالات پوچھ کر اس تصور کی تشریح کی جاسکتی ہے کہ مقید ہوا (trapped air) ایک حاجز تہہ (insulating layer) کے طور پر کام کرتی ہے جو جسم سے حرارت کے اخراج کو روک کر انسان اور پرندوں کو گرم رکھتی ہے۔ اسی طرح جانور کی کھال کے بالوں میں مقید ہوا انھیں سردیوں میں گرم رکھتی ہے۔

باب 9

☆ ذہنی طور پر تیار کرنے (warm-up) کے لیے طلبا سے کہا جاسکتا ہے کہ ان تمام مظاہر (phenomena) کے بارے میں تحریر کریں جو ان کے احاطہ خیال میں آسکتے ہیں اور جو روشنی کی موجودگی کے باعث ہمیں دکھائی دیتے ہیں۔

☆ بیان کیجیے کہ روشنی جب کسی لطیف (rarer) واسطے سے کثیف (denser) واسطے میں داخل ہوتی ہے تو اس کی رفتار دھیمی پڑ جاتی ہے، یہی وجہ ہے کہ منعطف شعاع عمود (normal) کی طرف مڑ جاتی ہے اور دوسری صورت میں اس کے برعکس ہوتا ہے۔

☆ شفاف مادے کے انعطاف نما (refractive index) کا انحصار اس مادے یا میٹیریل کی کثافت (density) پر ہوتا ہے۔ ہوا کا انعطاف نما سب سے کم اور ہیرے کا سب سے زیادہ ہوتا ہے۔ لہذا ہوا یا گیسوں میں روشنی اپنے راستے سے بہت کم انحراف (bending) کرتی ہے جب کہ ہیرے میں سے گزرتے ہوئے انحراف سب سے زیادہ ہوتا ہے۔

☆ طلبا کو تین ابتدائی رنگوں (primary colours) کے پوسٹر کلر دیے جاسکتے ہیں۔ پھر ان سے کہا جائے کہ ابتدائی رنگوں کی مدد سے مختلف ثانوی رنگ (secondary colours) اور ان کے شیڈز تیار کریں۔ ان رنگوں کا استعمال کاغذی شیٹ پر کیا جاسکتا ہے جس پر چھوٹے چھوٹے خانے بنے ہوئے ہوں۔

☆ جب کام مکمل ہو جائے تو پھر رنگین خانوں والی یہ شیٹیں سوفٹ بورڈ پر لگائی جاسکتی ہیں۔

ہم جا (isotopes) ، ادویہ سازی اور زراعت میں ان کے استعمالات کو مختصراً بیان کیجیے۔
 طلبا سادہ مالیکیولوں اور مرکبات میں موجود عناصر کی اقسام اور تعداد پہچاننے کی مشق کریں گے۔
 طلبا مرکبات کے نام اور کیمیائی فارمولے تحریر کریں گے۔
 مثالوں کی مدد سے قانون برائے مستقل تناسب (law of constant composition) کا عملی مظاہرہ کیجیے۔

باب 7

کھانا وغیرہ پکانے کی مختلف مثالیں دیتے ہوئے طبعی اور کیمیائی تغیرات (physical and chemical changes) کا درمیانی فرق واضح طور پر بیان کیجیے۔ مثال کے طور پر کیک، جوس بنانے، انڈا تلنے، سلاد وغیرہ بنانے کے بعد ہونے والی تبدیلیاں وغیرہ۔
 طلبا طبعی تبدیلی کو سمجھنے کے لیے بیکر میں برف کا ٹکڑا (ice cube) جمانے کی سرگرمی انجام دے سکتے ہیں۔
 طلبا سے کہیے کہ گروپ بنا لیں اور طبعی اور کیمیائی تبدیلیوں کے درمیان فرق کے بارے میں پوسٹر چارٹ بنائیں۔
 سبق میں Useful substances formed by chemical changes (کیمیائی تبدیلیوں کے نتیجے میں تشکیل پانے والی مفید اشیا) کے عنوان کی ذیل میں دیے گئے مختلف تعاملات (reactions) کی تشریح اگر ممکن ہو تو اسکول لیب میں عملی مظاہرے کا اہتمام کر کے کیجیے۔

طلبا سے پوچھیے کہ کیا وہ کھادوں (fertilizers) کے استعمال کے بارے میں جانتے ہیں۔ طلبا کی حوصلہ افزائی کیجیے کہ وہ جواب دیں، اور پھر کھادوں کی طبعی اور کیمیائی خصوصیات اور ان کے استعمالات بیان کیجیے۔ اس کے ساتھ ساتھ کھادوں کے نقصانات سے بھی طلبا کو آگاہ کیجیے۔

طلبا سے کہیے کہ پلاسٹک سے بنی ہوئی کچھ اشیا کے نام بیان کریں، نیز ان کے خیال میں پلاسٹک کس سے بنی ہے۔ پلاسٹک سے تیار کردہ مختلف چیزیں دکھاتے ہوئے پلاسٹک کی خصوصیات زیر بحث لائیے۔
 کلاس کو نباتاتی تیل (vegetables oils) کی مختلف اقسام کے بارے میں بتائیے اور یہ کہ یہ تیل کیسے نکالے جاتے ہیں۔ طلبا کو مختلف ویڈیوز دکھائی جاسکتی ہیں یا پھر انہیں کسی مخصوص نباتاتی تیل پر تحقیق کر کے اس کی تلخیص (extraction) کے بارے میں لکھنے کی ہدایت کیجیے۔

باب 8

☆ اس تصور کو بیان کرنے کے لیے کہ انتقال حرارت (heat transfer) بلند درجہ حرارت والے جسم سے کم درجہ حرارت کے حامل جسم کی طرف ہوتا ہے، کلاس میں ایک دل چسپ مگر سادہ عملی مظاہرہ کیا جاسکتا ہے۔ مختلف کھانے پینے کی اشیا کا انتظام کیجیے جن کا درجہ حرارت مختلف ہو، مثال کے طور پر ایک کپ آئس کریم، پانی کا گلاس جس میں برف کے چند ٹکڑے موجود ہوں، گرم چائے کا کپ، کمرے کے درجہ حرارت کا حامل پانی کا گلاس، اور تازہ اُبلتا ہوا آلو اپنی میز پر رکھ لیجیے۔ چند طلبا سے کہیے کہ وہ چھو کر یا پچھ کر دیکھیں کہ یہ چیزیں کتنی ٹھنڈی یا گرم محسوس ہوتی ہیں۔
 ☆ سبق کی تدریس جاری رکھیں، پھر 15 سے 20 منٹ بعد طلبا سے کہیے کہ وہ ان چیزوں کی ٹھنڈک اور گراماٹھ کا اندازہ کریں۔ کیا

انٹرنیٹ پر دستیاب ویڈیوز سے بھی مدد لے جاسکتی ہے جن میں زیرگی کے عامل (agents) دکھائے گئے ہوں، ان ویڈیوز کو تشریح کے لیے ایک ذریعے کے طور پر بھی استعمال کیا جاسکتا ہے۔
 طلباء پودوں کے تنوں کو کاٹ کر یا قلم لگا کر غیر جنسی تولید کی چند مثالوں کا مشاہدہ کریں۔ اساتذہ اس عمل میں ان کی مدد کر سکتے ہیں۔

باب 4

سبق کے آغاز میں طلباء کو مختلف ماحولیاتی نظاموں کی تصاویر دکھا کر انہیں حیاتی (biotic) اور غیر حیاتی (abiotic) اجزا کی فہرست بنانے کی ہدایت کی جاسکتی ہے۔

مساکن کی اقسام کی تصاویر یا ویڈیو دکھائی جاسکتی ہے۔

آبی جانوروں کے ماحولیاتی نظام اور مسکن کا مشاہدہ کرانے کے لیے طلباء کو مچھلی گھر (aquarium) لے جایا جاسکتا ہے۔ انہیں دریا کے کنارے بھی لے جایا جاسکتا ہے تاکہ وہاں کے مساکن پر تحقیق کر سکیں رکھوج لگاسکیں۔

طلباء سے کہیے کہ صحراؤں اور جنگلات کے غیر حیاتی (abiotic) خواص کی فہرست بنائیں اور ان مساکن (habitats) کے پودوں اور جانوروں کی خصوصیات کے مابین فرق تلاش کریں۔

طلباء کو ہدایت کی جاسکتی ہے کہ وہ پاکستان کے شمالی علاقوں میں آنے والے شدید زلزلے کے بعد وہاں رونما ہونے والی تبدیلیاں تلاش کریں۔

اس گفتگو کو آگے بڑھاتے ہوئے مسکن میں تبدیلی کا سبب بننے والے عوامل بیان کیے جاسکتے ہیں۔

اس کے علاوہ سبق میں کسی مخصوص مسکن میں مطابق پذیری (adaptation) کے اسباب کی تشریح بھی شامل کی جاسکتی ہے۔

باب 5

طلباء سے کہیے وہ بتائیں کہ ہماری زندگی میں پانی کی کیا اہمیت ہے۔

ناخالص یا آلودہ پانی کے اسباب پر بحث کیجیے نیز یہ کہ طلباء کے خیال میں ہم پانی کو کیسے صاف و شفاف رکھ سکتے ہیں۔

آلودہ پانی کو صاف کرنے کے طریقوں کے بارے میں انٹرنیٹ سے ویڈیوز تلاش کر کے دکھائی جاسکتی ہیں۔

طلباء سے کہیے کہ روزمرہ زندگی میں پانی کے استعمالات کو مثالوں کے ساتھ بیان کریں۔

پانی کے ضیاع (wastage) کو محدود کرنے کے آئیڈیاز پر بحث کا آغاز کیجیے۔

باب 6

ایٹم اور ایٹم کے ذیلی ذرات (sub atomic particles) کے بارے میں طلباء کے علم میں اضافہ کیجیے۔

طلباء سے کہیے کہ دوری جدول (periodic table) کے ابتدائی اٹھارہ عناصر کی ایٹمی ساخت کی اشکال پر مشتمل چارٹ بنائیں۔

طلباء سے کہیے کہ بلیک بورڈ پر ایٹمی نمبر اور کمیتی نمبر (mass number) کے درمیان فرق تحریر کریں۔

آیون (ions) اور اس کی اقسام کی تشکیل کا واضح تصور بیان کیجیے۔

☆ دل کا فعل یا کام کیا ہوتا ہے؟

☆ خون کا کیا فعل یا کام ہوتا ہے؟

خون کی نالیاں یا رگیں متعارف کرانے کے لیے طلبا سے کہیے کہ اپنی کلائی پر نظر آنے والی رگ کا مشاہدہ کریں۔
دل کے نمونے یا ماڈل کی مدد سے دل کی ساخت بیان کیجیے جو اسکول کی لیبارٹری میں سے آسانی دستیاب ہو سکتا ہے۔ اسی دل کے
ماڈل کی مدد سے دل کے افعال بیان کیے جاسکتے ہیں۔

طلبا سے کہا جاسکتا ہے کہ شریانوں (arteries)، وریڈوں (veins) اور کیپیلریز (capillaries) کی ساخت اور افعال کو سمجھنے
کے لیے پتی ٹیوبوں کی مدد سے نظام دوران خون (circulatory system) کا ماڈل بنائیں۔

کلائی کے زیریں حصے پر انگشت شہادت (index finger) اور درمیانی انگلی رکھ کر نبض دیکھنے میں طلبا کی مدد کی جاسکتی ہے۔
طلبا کو یہ تفویض (assign) کیا جاسکتا ہے کہ غذا اور دیگر وجوہات کے باعث دوران خون کے نظام میں ہونے والے عام امراض
پر تحقیق کریں۔ تحقیقی کام کے بعد یہ موضوع تفصیل سے بیان کیا جاسکتا ہے۔

طلبا سے کہا جاسکتا ہے کہ اپنے خاندان میں بلند فشار خون (high blood pressure)، دل کے دورے (heart attack)،
اور ذیابیطس (disbetes) میں مبتلا مریضوں پر تحقیقات کریں اور ان سے دریافت کیجیے کہ بیماری میں مبتلا ہونے سے پہلے اور بعد
میں ان کی خوراک کیا تھی۔

انسان کے نظام دوران خون کا تعلق پودوں سے جوڑا جاسکتا ہے۔ انٹرنیٹ پر دستیاب ویڈیوز کی مدد سے پودوں میں جڑوں کے
ذریعے پانی کے جذب ہونے کے عمل کو بیان کیا جاسکتا ہے۔ (ویڈیوز کی مدد سے دوسرے اسباق / موضوعات بھی پڑھائے
جاسکتے ہیں۔)

باب 3

طلبا کو پھول کی ایک بڑی تصویر دکھا کر سبق کا آغاز کیا جاسکتا ہے اور اس کے بعد مندرجہ ذیل سوالات پوچھے جائیں گے:

☆ پھولوں کو پودے کا اہم حصہ کیوں سمجھا جاتا ہے؟

☆ پھل کیسے بنتا ہے؟

☆ تولیدی عمل (reproduction) میں پھول کیوں اہم کردار ادا کرتے ہیں؟

سبق کو جاری رکھنے کے لیے طلبا کو پودے کے دور حیات (life cycle) پر مبنی پوسٹر دکھایا جاسکتا ہے جو پھل کی تشکیل پر ختم ہوتا ہو۔
طلبا سے کہیے کہ مختلف قسم کے پھول لے کر آئیں یا اساتذہ خود کلاس میں کچھ پھول لے آئیں اور پھول کے حصوں کو تفصیل
سے بیان کیجیے، نیز یہ بھی واضح کیجیے کہ خود زیرگی (self-pollination) اور باز زیرگی (cross pollination) کیسے وقوع پذیر
ہوتی ہے۔

ٹپچر hibiscus نسل کے پھولوں کا انتظام کر کے، انھیں بیچ میں سے کاٹ کر ان کے اندرونی نر اور مادہ اعضا (male and
female organs) دکھاسکتی ہیں۔ کاٹنے کے عمل کے دوران خود زیرگی (self-pollination) اور باز زیرگی (cross
pollination) کی تشریح کی جاسکتی ہے۔

باب 1

☆ سبق کا آغاز طلبا سے یہ پوچھ کر کیجیے کہ ناشتے میں انھوں نے کیا کھایا تھا، اور جو غذا انھوں نے کھائی تھی اس کے ساتھ کیا ہوا۔ طلبا یہ جواب دے سکتے ہیں کہ غذا ان کے معدوں میں چلی گئی تھی۔ اس موقع پر طلبا سے پوچھا جاسکتا ہے کہ کیا غذا براہ راست ان کے معدوں میں چلی گئی تھی۔ طلبا مختلف جوابات دے سکتے ہیں۔ اسی گفتگو کے دوران، نظام انہضام (digestive system) کے مختلف حصوں کے بارے میں بیان کرنا شروع کیجیے۔

☆ ہاضمے کی خرابیوں کا موضوع طلبا سے یہ پوچھتے ہوئے شروع کیا جاسکتا ہے کہ کیا وہ پھیری والوں (street hawkers) سے خرید کر کوئی غذا کھاتے ہیں۔ طلبا اپنے جوابات دے سکتے ہیں۔ یہاں ان غذائی اشیاء کا تذکرہ کیا جاسکتا ہے جو پھیری والے یا خانچہ فروش بیچتے ہیں۔ مثال کے طور پر، فرنیج، فراز، قلفی وغیرہ۔ غیر محفوظ یا مضر صحت (unhygienic) غذا کھانے کے نقصانات پر بحث شروع کی جاسکتی ہے۔ اس کے بعد طلبا کو ہاضمے کی بیماریوں کے متعلق آگاہ کیا جاسکتا ہے۔

☆ عمل تنفس (respiration) کا موضوع طلبا کو سانس لینے کے عمل سے متعلق انسانی جسم کی اندرونی ساخت کا چارٹ دکھاتے ہوئے متعارف کرایا جاسکتا ہے۔ طلبا سے مندرجہ ذیل سوالات پوچھے جاسکتے ہیں:

☆ ہم کس میں سانس لیتے ہیں؟

☆ ہم سانس کیوں لیتے ہیں؟

☆ عمل تنفس (respiration) اور سانس لینے (breathing) میں کیا فرق ہے؟

☆ عمل تنفس (respiration) اور سانس لینے (breathing) میں کون سے اعضا شامل ہوتے ہیں؟

مندرجہ بالا سوالات دونوں عمل (processes) کے درمیان فرق کرنے میں معاون ہوں گے، مزید وضاحت اس بحث کے بعد کی جاسکتی ہے۔

تصاویر کے ذریعے یا پھر نظام تنفس کے ماڈل یا نمونے کی مدد سے تفصیلی طور پر عمل تنفس اور متعلقہ اعضا کے بارے میں بیان کیا جاسکتا ہے۔

بعد ازاں فضائی آلودگی کا موضوع شامل کرتے ہوئے سانس کے امراض کا تعارف کروایا جاسکتا ہے۔ اس کے علاوہ دُھواں ملی دُھند یا اسموگ (smog) کو بھی زیر بحث لایا جاسکتا ہے، جو ہمارے ملک کے چند علاقوں میں فضائی آلودگی کی وجہ سے ہوتی ہے۔

باب 2

سبق کا آغاز طلبا میں تجسس پیدا کرنے کے لیے مندرجہ ذیل سوالات کرتے ہوئے کیا جاسکتا ہے:

☆ انسانی خلیوں میں آکسیجن اور کاربن ڈائی آکسائیڈ کا انتقال (transportation) کیسے ہوتا ہے؟

قومی نصاب برائے جنرل سائنس کے مطابق جانچ (Assessment) کی حکمت عملیاں استاد طالب علم کی تعلیمی کارکردگی سے نہ صرف روایتی ٹیسٹ، امتحانات اور عملی کام (پروجیکٹ) کے ذریعے واقف ہوتے ہیں بلکہ طلبا کا لمحہ بہ لمحہ مشاہدہ بھی اس میں معاون ہوتا ہے۔ سائنس کے بارے میں طلبا کی معلومات، سائنسی مہارتوں، اور رویوں کو جانچنے کے لیے اساتذہ کو مختلف النوع اوزار (tools) اور طریقہ ہائے کار کی ضرورت ہوتی ہے۔ مثلاً:

☆ مخصوص رد عمل

☆ تعمیر/تخلیقی رد عمل

☆ کارکردگی کی جانچ

☆ ذاتی ابلاغ (personal communication)

☆ طلبا کی خود تشخیصی (self-assessment)

سائنس کی تشخیصی حکمت عملیوں پر مفصل ہدایات کے لیے قومی نصاب برائے جنرل سائنس 2006 کا باب 8، صفحہ 65 تا 73 ملاحظہ کیجئے۔

رہنمائے اساتذہ کے مشتملات اور ترتیب

رہنمائے اساتذہ برائے نیوگیٹ ایڈ سائنس میں سبق کا آغاز کرنے کے لیے تجاویز شامل ہیں نیز ہر باب کے لیے تدریسی حکمت عملیاں بھی فراہم کی گئی ہیں۔ ہدایاتی ماڈل کا مرکز و محور سابقہ یا پہلے سے موجود معلومات کو کھگانا ہے جس میں طلبا کی سرگرم شرکت کی حوصلہ افزائی کی جاتی ہے۔

ایک فعال اور طالب علم محور کمرہ جماعت کے لیے سفارش کردہ ترتیب کار (شیڈول)

5 منٹ	سابقہ / پہلے سے موجود معلومات کو کھگانا بذریعہ بنیادی سوالات
25 منٹ	آموزش (learning) بذریعہ بحث / سرگرمی
10 منٹ	نتیجہ / حاصل بذریعہ جانچ

ہر باب کا ابتدائی حصہ تعمیری انداز میں سبق کو آگے بڑھانے کے لیے بنیادی تجاویز پر مشتمل ہے۔ دوسرے حصے میں کتاب میں موجود تمام سوالات کے جوابات دیے گئے ہیں۔ طلبا کی حوصلہ افزائی کی جائے کہ وہ اپنے ذہن سے کام لیتے ہوئے جوابات دیں اور پھر استاد ان جوابات کی بنیاد پر طلبا کی تفہیم اور معلومات کی جانچ کر سکتے ہیں۔

قومی نصاب برائے جنرل سائنس کے مطابق تدریسی حکمت عملیاں

موثر ہدایاتی تدریسی حکمت عملیوں میں مندرجہ ذیل شامل ہیں (تاہم حکمت عملیاں انھی تک محدود نہیں ہیں):

- تحقیق و تفتیش (انکوائری)
- سوالات اور گفتگو
- تحقیق اور مسئلے کا حل
- عملی مظاہرہ اور تجربہ گاہی کام (لیبارٹری ورک)
- مسائل پر مبنی آموزش (problem based learning)
- پوری جماعت، گروپ، اور انفرادی کام سے استفادہ
- خواندگی کی حکمت عملیوں (پڑھنا، لکھنا، بولنا اور سننا) کی شمولیت
- طالب علم کے کام کی بنیاد پر ہدایات کی فراہمی

سائنس کی تدریسی حکمت عملیوں پر مفصل ہدایات کے لیے قومی نصاب برائے جنرل سائنس 2006 کا باب 7، صفحہ 55 تا 64 ملاحظہ کیجیے۔

نیوگیٹ اہیڈ سائنس سیریز کے لیے تیار کردہ رہنمائے اساتذہ کمرہ جماعت میں استاد کی معاونت کے لیے ہدایات فراہم کرتی ہیں۔
اس رہنمائے اساتذہ میں شامل ہے:

- کمرہ جماعت میں نیوگیٹ اہیڈ سائنس کی مؤثر تدریس کا طریقہ
- قومی نصاب میں مذکور تدریسی حکمت عملیاں
- سبق کی تدریس کی منصوبہ بندی کے نمونے
- نصابی کتاب میں دی گئی مشقوں کے مجوزہ جوابات
- جانچ (assessments) کے لیے مجوزہ ورک شیٹ
- کام کی مجوزہ اسکیم

نیوگیٹ اہیڈ سائنس کی تدریس کیسے کی جائے

نیوگیٹ اہیڈ سائنس کی مزید تعمیری انداز میں تدریس کے لیے اساتذہ کو مشورہ دیا جاتا ہے کہ طالب علم کو کمرہ جماعت کا محور بنائے۔ طلبا کو کمرہ جماعت میں زیادہ فعال کردار دیا جائے، اُن کی حوصلہ افزائی کی جائے تاکہ وہ اپنے خیالات اور تصورات کو اعتماد کے ساتھ پیش کریں، نیز انہیں مختلف آرا کا احترام کرنا بھی سکھایا جائے۔ یہ تمام مقاصد حاصل کرنے کی غرض سے اساتذہ کے لیے ضروری ہے کہ طلبا کی معاونت کرتے ہوئے انہیں آسانیاں فراہم کیجئے تاکہ وہ زیادہ ذمے داری کے ساتھ اپنا سفرِ آموزش (learning journeys) طے کر سکیں۔ مندرجہ ذیل سطور میں ان تدریسی طریقوں کا خلاصہ کیا گیا ہے جن سے کام لیتے ہوئے کمرہ جماعت کو زیادہ سے زیادہ طالب علم محور بنانے کے لیے نیوگیٹ اہیڈ سائنس کے تمام ابواب پڑھائے جائیں گے:

- طلبا کو انفرادی اور اجتماعی، یعنی گروپ میں، کام کرنے کا موقع فراہم کیا جائے۔ اساتذہ اور طلبا حقیقی زندگی سے مثالیں زیر بحث لائیں۔
- طلبا کو ایسے کام ر ذمے داریاں تفویض کی جائیں جنہیں انجام دیتے ہوئے وہ آپس میں، اور استاد کے ساتھ تبادلہ خیال کر سکیں۔ طلبا کی حوصلہ افزائی کی جائے کہ وہ اپنی رائے یا خیالات کے پس پردہ وجوہ بیان کریں۔
- استاد کے لیے ضروری ہے کہ وہ کمرہ جماعت میں خود کو عزت و احترام، شرکت اور فعال آموزش (active learning) کے آئیڈیل کے طور پر پیش کریں۔ گروپ کے مباحثوں کے دوران مل جل کر کام کرنے کے لیے طلبا کی حوصلہ افزائی کی جائے۔
- استاد کو طلبا کی معاونت اس وقت کرنی چاہیے جب انہیں رہنمائی کی ضرورت ہو؛ پڑھتے، لکھتے اور مخصوص ابواب میں اسباق پر بحث کرتے ہوئے بیشتر وقت طلبا اپنے طور پر کام کریں گے۔