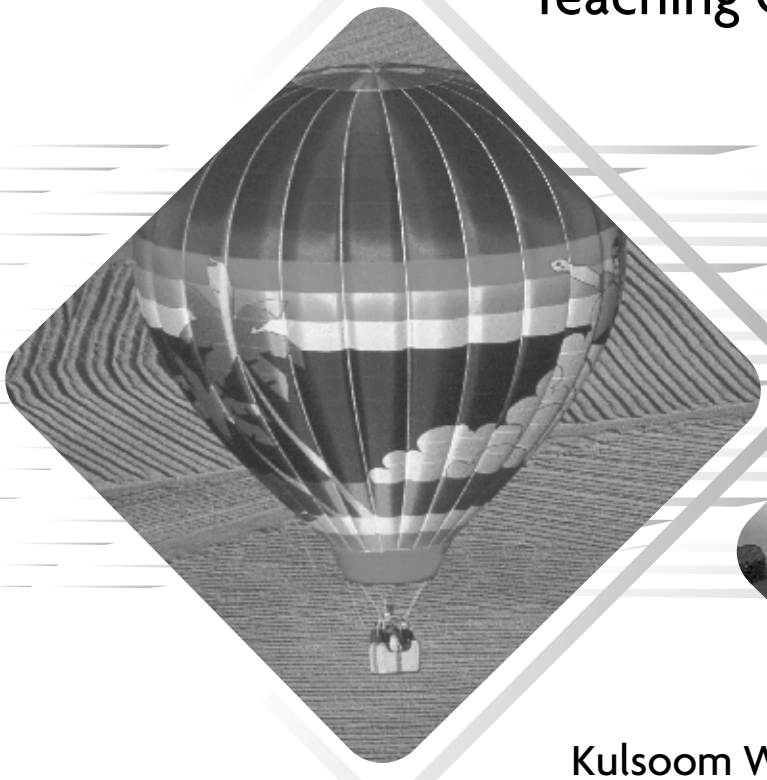
8

New Get Ahead

SCIENCE

Teaching Guide



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Based on Revised Pakistan National Curriculum

OXFORD
UNIVERSITY PRESS

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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 system
Unit 4: Environmental pollution
Unit 7: Forces
Unit 8: Measurement of physical quantities

2nd Term Unit 2: Heredity of organisms
Unit 5: Chemical reactions
Unit 9: Sources and effects of heat energy
Unit 10: Lenses

3rd Term Unit 3: Biotechnology
Unit 6: Acids, alkalis and salts
Unit 11: Electricity in action
Unit 12: Exploring space

Scheme of Work

Chapter	**Topic-wise allocation of periods**	**Learning outcomes** The students should be able to:
Unit1: Human Organ System	2 period	• define sensitivity • explain that all living things are sensitive • explain how animals are sensitive
	2 periods	• define coordination and explain how coordination is brought about in higher animals • describe the endocrine system and explain the functions of the hormones • describe the nervous system and explain how it works • describe and explain a reflex action and its importance • define excretion
	2 periods	• describe the structure of the excretory system • describe the structure and function of a nephron • name some diseases of the kidneys and discuss their treatment

Chapter	Topic-wise allocation of periods	Learning outcomes The students should be able to:
Unit 2: Heredity of Organisms	2 period	• describe the structure of chromosomes and genes • explain the kinds of cell division • know the behaviour of chromosomes during cell division
	2 periods	• define heredity • describe patterns of inheritance • identify some genetic diseases
Unit 3: Biotechnology	2 periods	• define the term biotechnology • explain the importance of biotechnology • describe some uses of biotechnology in everyday life
	2 periods	• define genetic engineering • describe the steps involved in genetic engineering • describe the uses of biotechnological product
Unit 4: Environmental Pollution	2 periods	• define pollution • describe how human activities are damaging natural resources and the environment • explain how animal life is being threatened • explain the importance of plants for the environment
	2 periods	• explain how land and water pollution is harmful for us • explain how air may be polluted • explain the harmful effects of air pollution • define conservation • explain the importance of conservation • suggest ways to conserve our natural resources and preserve life on Earth

Chapter	Topic-wise allocation of periods	Learning outcomes The students should be able to:
Unit 5: Chemical Reactions	1 period	• describe a physical and chemical change • compare the physical and chemical change • discuss the different types of chemical reaction
	2 period	• explain what a chemical equation is • explain the method for writing a chemical equation
	2 period	• state the law of conservation of mass • explain how to balance equations
Unit 6: Acids, Alkalis, and Salts	2 periods	• define an acid and describe its properties • list some uses of acids • define an alkali and explain its properties • list some uses of alkalis
	2 periods	• define salts and explain the properties of salts • list some uses of salts
	2 periods	• describe the ways in which salts can be prepared • describe different indicators • know the use of indicator
Unit 7: Force	2 periods	• define force and pressure • know the formula for calculating pressure explain the relation between force and pressure
	3 period	• list examples of where we experience pressure in our everyday life • explain how liquids exert pressure • explain that a fluid exerts pressure equally in all directions • explain how hydraulic machines work
Unit 8: Measurement of Physical Quantities	3 periods	• explain what is meant by mass, volume, and time • explain the difference between mass and weight
	2 periods	• use of S.I unit in daily life • use the correct instruments for measuring mass, volume, and time • record measurements of mass, volume, and time

Chapter	Topic-wise allocation of periods	Learning outcomes The students should be able to:
Unit 9: Sources and Effects of Heat Energy	2 period	• explain the effect of heat on solids • explain the effect of heat on liquids • explain the effect of heat on gases • describe the effects of expansion and contraction in everyday life • identify useful applications of expansion
	3 periods	• explain why evaporation causes cooling • describe how the volume of a liquid changes when it solidifies • explain the different scales of temperatures • use the formulae to convert different temperature readings from one scale to another
Unit 10: Lenses	2 periods	• identify a lens • describe the different types of lens • state the rules of refraction of rays by a lens • describe the formation of images by a convex and a concave lens
	3 periods	• describe the use of lenses in optical instruments • describe the structure of the human eye • compare the eye to a camera • list some defects of vision • know the correction of poor eye-sight

Chapter	Topic-wise allocation of periods	Learning outcomes The students should be able to:
Unit11: Electricity in Action	2 periods	• Know the different sources of electricity • Explain the term electromagnetism • describe a dynamo • explain how electricity and magnetism are related
	3 periods	• understand different types of cell • describe the motor effect • explain how the motor effect is used to make electric motors • define alternating current • explain how an alternating current and a direct current can be produced • identify electrical appliances which use alternating current or direct current
	3 periods	• describe the process of electricity generation at a power station • explain the problems of electricity generation • explain how electricity is distributed
Unit 12: Exploring Space	2 periods	• define telecommunication • describe the various means of telecommunication • explain the kind of technology we use in everyday life • describe the uses of a television, a laser light, a computer, nuclear reactor • describe artificial satellites • list the functions of artificial satellites • describe a rocket
	3 periods	• explain how a rocket is launched into space • describe an astronaut and the clothes he wears • explain how astronauts survive in space • discuss the benefits and problems of space exploration

Human Organ System

Lesson plan 1

Students learning outcomes

Learn about sensitivity in animals.

Materials

scissors, perfume, fruit, soft material, activity cards, chart of human nervous system, colour pencils

Keywords

Neuron, motor nerve cell, sensory nerve cell, nervous system, peripheral nervous system, central nervous system

Overview

Students will learn how all living things are sensitive. They will learn how animals are sensitive.

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 tells the body what to do?
2. What protects the brain?
3. What are our 5 senses?

Method:

- First show students a simple machine (scissors) to show how its parts work together. Then talk about how the organs in your body work together in groups called system. The brain contains nerves that send messages all over the body through other nerves.
- The brain is part of the central nervous system along with the spinal cord. The spinal cord is a bundle of nerves that relay messages from the brain to different parts of the body.

- Students can be asked to make a table of voluntary and involuntary actions and list down all the activities they have done throughout the day in the table.
- Have students line up. Have one student be the brain. Pass activity cards down the line, when the 'brain' is tapped on the shoulder, have the student with the card do the activity.
- Conduct an activity by making 5 groups and one by one ask each group to close their eyes and identify different stimuli, e.g. smelling a perfume, tasting a fruit, touching something soft, or identifying something without looking. This activity will help reiterate the 5 senses and sense organs.
- Display a large chart of human nervous system and explain the role of nerves and cells. Ensure students understand the difference between central nervous system (CNS) and peripheral nervous system (PNS). Ask students to prepare a presentation on the functions of brain. They should explain the role of each part of the brain mentioned in textbook.
- With the help of charts and diagrams on the board, explain the structure of the nervous system. Explain the structure of the brain and the functions of each part. The brain is the main organ which controls all the parts of the body and helps them to work together. Explain what the nervous system is made of? Draw a neuron and explain how neurons are linked together to make up the nervous system. Draw a reflex arc on the board and explain the path of a stimulus to the brain or spinal cord and the response produced.
- Draw the structure of neuron on the board to explain the structure of nerves.
- Conduct in classroom:
  - Activity 1, page 5

Assessment

1. Which two parts make up the central nervous system?
2. Match each word on the left with its correct meaning on the right.

Organ	Functions
behaviour	a bundle of nerve fibres surrounded by a protective, fatty sheath
sensory nerve	the ability to be aware of the surroundings by sight, hearing, etc.
sense organ	a special cell or organ that receives stimuli from outside the body or from other nerve cells inside the body
stimulus	a nerve that carries stimuli from receptor cells or sense organs
nerve	a nerve that carries messages (impulses) from the brain to muscles and other parts of the body

sense	a pattern of actions carried out by an animal
receptor	an action as a result of a nerve impulse, e.g. moving a muscle
motor nerve	one of the organs that allows an animal to detect its surroundings
response	anything that causes a living organism to do something

Reinforcement/homework

Exercise questions 1-4

Lesson plan 2

Students learning outcomes

Learn the coordination of organ systems in higher animals.

Materials

a big chart of urinary system, internal structure of a kidney, sheep's kidney

Keywords

Kidney, ureter, bladder, urethra, cortex, nephron, Bowman's capsule, glomerulus, urea, renal artery, renal vein, urinary tubule, urine, excretion

Overview

Students will learn how coordination is brought about in higher animals. They will learn about the endocrine system and the functions of the hormones. Students will also learn how the nervous system works. They will discover what is reflex action and its importance.

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. Which one is the main organ of excretion?
2. Why is it important to remove waste from the body?

Method:

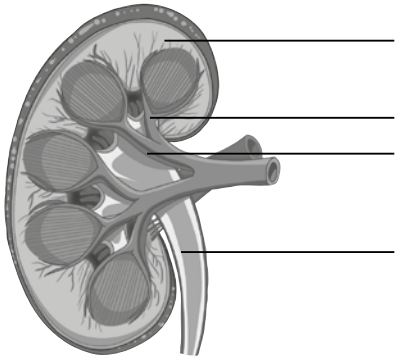
- In this lesson, students will review the functions of the human body's excretory

system, including the four major organs of the urinary system. They should be able to explain the relationship between the circulatory system and urinary system.

- Show a big chart of urinary system and show internal structure of a kidney. Show a sheep's kidney to understand the structure.
- Explain to the students that their body needs water to survive. If we go more than a couple of days without water, we would be very thirsty and our cells would not be able to keep functioning. But not all water is drinkable. Before you fill up your glass, the water must be filtered to remove impurities that could hurt you. Our body has a similar filtering system called the excretory system. The excretory system filters the blood to remove wastes that could be harmful to the body.
- There are four main parts that make up the excretory system: the kidneys, ureters, bladder, and urethra.
- Conduct in classroom:
  - Activity 2, page 8

Assessment

1. Label the following diagram:



2. What is the function of kidneys?
3. Match the part of the brain to its function:

Part	Function
medulla oblongata	the largest part of the brain which is concerned with receiving stimuli and the coordination of responses
cerebellum	controls many of the involuntary movements of the body, such as respiration, heartbeat, and digestion
cerebrum	serves as a pathway for the nerve fibres; also controls certain reflexes

Reinforcement/homework

Exercise questions 5-7

Lesson plan 3

Students learning outcomes

Learn the excretory system in animals.

Materials

dialysis chart, big chart of urinary system, internal structure of a kidney, sheep's kidney

Keywords

Kidney, ureter, bladder, urethra, cortex, nephron, Bowman's capsule, glomerulus, urea, renal artery, renal vein, urinary tubule, urine, excretion

Overview

Students will study the process of excretion, the excretory system, and the structure and function of a nephron. They will learn about the diseases of the kidneys and discuss their treatment.

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 kidney?
2. How does the body get rid of waste products?

Method:

- Ask students to make a chart of the human excretory system. Some students can be asked to deliver a presentation on the Excretory System.
- Search internet for suitable videos about kidney malfunctions and show to students, or students may be asked to research about these malfunctions and prepare a report.
- Explain that stones form in the kidneys and may be found anywhere in the urinary system. Often, stones form when the urine becomes concentrated, allowing minerals to crystallize and stick together. They can vary in size, from small stones that can

flow through your urinary system, to larger stones that cannot. Some stones cause great pain, while others cause very little pain.

- Urinary tract infections (UTIs) are bacterial infections of any part of the urinary tract. When bacteria get into the bladder or kidney and produce more bacteria in the urine, they cause a UTI. If the kidneys are unable to filter wastes from the blood, the wastes build up in the body. Kidney failure can be caused by an accident that injures the kidneys, the loss of a lot of blood, or by some drugs and poisons.
- Teacher will explain the working of the kidneys. Explain the role of the kidneys in helping to maintain a balance of salt and water in the body.
- Show a fresh specimen of a cow's kidney in the class. Describe its shape and colour. Make a longitudinal section and show them the inner structure through a hand lens.
- Explain, with help of charts and diagrams on the board, how kidneys help to filter out poisonous waste substances from the body. Discuss kidney diseases and their causes and effects. Explain how a kidney disease can be treated. Also, discuss dialysis and kidney transplants; show a dialysis chart.

Assessment

Choose the correct answer:

i. In which of the following is urine stored before it is passed out of the body?
   a. bladder b. kidney c. urethra d. ureter

ii. In which part of the kidney does the filtration of dissolved salts occur?
   a. pelvis b. medulla c. cortex d. ureter

iii. The disease which results in glucose being excreted by the kidneys into the urine is called:
   a. anaemia b pneumonia c. bronchitis d. diabetes

iv. The name of the part of the excretory system which carries urine from the kidney to the bladder is:
   a. ureter b. urethra c. aorta d. sphincter muscle

Reinforcement/homework

Exercise questions 8-11

Heredity of Organisms

Lesson plan 1

Students learning outcomes

Learn the cell division and function of chromosomes.

Materials

chart showing mitosis and meiosis

Keywords

Mitosis, meiosis, homologous, haploid number, chromosome, DNA,

Overview

Students will learn the structure of chromosomes and genes and explain the kinds of cell division. They will study the behaviour of chromosomes during cell division.

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. Whom do you resemble in your family?
2. Do you know why?

Method:

- Students can be asked to make a family tree and try to find out about their characteristics.
- Explain in what way do we resemble each other? In what way do we resemble our parents? Explain that many of our features, for example, hair and eye colour, are controlled by a pair of genes which are transferred to us from our parents. The passing on of characteristics from one generation to the next is called heredity. The study of heredity is called genetics.
- Explain why identical twins raised apart would be ideal subjects for an experiment. Make sure students understand that identical twins have exactly the same genetic

makeup, so any inherited traits, including all physical traits, would be exactly the same. However, if raised separately, the twins would grow up with different environmental influences.

- Divide the class into groups, and assign each group to come up with a design for an experiment that would cast light on the nature-nurture controversy. All experimental designs should involve a pair of twins raised apart from each other.
- Ask the pupils to roll their tongues. Some can but some cannot. Explain the concept of traits after this activity. Students can be asked to prepare a presentation on genetic disorders.
- Students find the most and least common combination of traits in the class by marking their traits for tongue rolling, earlobe attachment, etc. Students then organize the leaves on a large "tree of traits." Students distinguish between inherited and learned traits by creating a "family tree of traits" using handprints.
- Discuss the patterns of inheritance using the examples given in the text. Explain that genes in a pair may be exactly alike or they may be different.
- Explain that each chromosome is made up of a long chain of genes, and that a gene is an instruction for the production of one protein (or occasionally more) which is vital to the development of the cell. For example, one gene may 'instruct' the cell to make the pigment present in the iris of brown eyes, or to make the protease enzyme in the stomach. The chemical which forms genes is called DNA (short for deoxyribonucleic acid).
- Complete the lesson by showing how these instructions are passed from cell to cell when a single cell divides again and again to form a whole organism consisting of thousands or millions of cells. This type of division, which the students need to have explained to them in detail with the aid of clear diagrams, is called mitosis. It is important to point out that it does not take place only in a zygote but also occurs in all living, growing tissues.
- Conduct in classroom:
  - Activity 1, page 14

Assessment

Choose the correct answer:

i. Differences in characteristics within a species are called _____.

a. features b. heredity

c. identity d. variations

ii. _____ is the study of inherited characteristics.

a. Mutation b. Evolution

c. Heredity d. Meiosis

iii. Each chromosome makes an exact copy of itself by a process called _____.

a. replication
b. variation
c. mitosis
d. division

Reinforcement/homework

Exercise questions 1-3

Lesson plan 2

Students learning outcomes

Learn the patterns of inheritance and genetic diseases.

Materials

model of DNA

Keywords

Heredity, variation, gene

Overview

Students will learn about heredity and the patterns of inheritance. They will be able to identify some genetic diseases.

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 nucleus of a cell made up of?
2. Where have the millions of different living things come from?

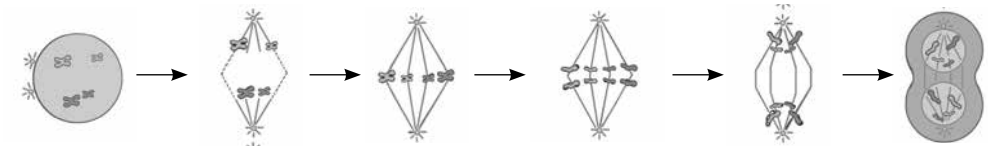
Method:

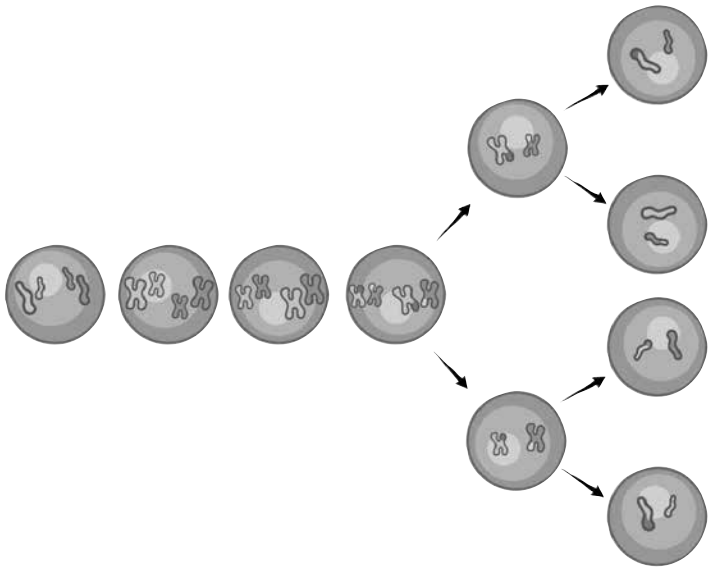
- Draw structure of cell on board and explain the composition of nucleus. Explain with help of diagrams, the structure of chromosomes and genes. Discuss cell division and the behaviour of chromosomes during cell division.
- Show the students slides of the two kinds of cell division.

- Hair colour can be any shade from blond to black. Some people have very fine hair, others much coarser hair. These are not clear-cut variations and are thus more difficult to measure.
- It is simpler to look at the hair of each individual and note whether it is straight, wavy, or curly. You do, however, have to make sure that the curls are natural ones!
- Explain mitosis and meiosis with the help of a chart and ask students to list down the difference between mitosis and meiosis.
- Explain that a human male cell has 23 chromosomes with genes from the father. A human female cell has 23 chromosomes with genes from the mother. Discuss the patterns of inheritance from the examples given in the text.
- Encourage the students to note down how they resemble and how they differ from their family members.
- Conduct in classroom:
  - Activity 2, page 20

Assessment

1. Name the kind of cell division that is taking place in the following diagrams:





2. Differences between members of the same species are called variations. These variations can be inherited or environmental.
   a) Look at the three characteristic features below. For each one say if the characteristic feature is inherited, environmental, or a mixture of the two.
      i. Intelligence _____
      ii. Weight _____
      iii. Blood group _____
      iv. Eye colour _____
      v. Hair colour _____
   b) Characteristic features are inherited when genes are passed from parents to their children. What structure in every living cell contains the genes?

Reinforcement/homework

Exercise questions 4-6

UNIT 3

Biotechnology

Lesson plan 1

Students learning outcomes

Learn the importance of biotechnology.

Materials

packet of enzymatic detergents, bread, antibiotics

Keywords

continuous variation, heredity, variation, gene

Overview

Students will learn the term biotechnology and discover the importance of biotechnology. They will be able to describe some uses of biotechnology in everyday life.

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 all these people have in common?
2. In what ways do we resemble each other?

Method:

- Ask students what they have heard about genetically altered foods. Summarize their thoughts on the chalkboard, explain the term biotechnology that using modern technology to change or modify the biological structure of living organisms or to create new organisms for specific uses.
- Biotechnology is the use of biological processes, organisms, or arrangements, to manufacture products which increase the quality of human life. Explain in detail what biotechnology is. Then ask the students to prepare a chart about the uses of biotechnology. Discuss genetic engineering and explain transfer of genes into bacteria.

- Ask students to visit a local supermarket, read the food labels, see if they can find any foods that have been genetically altered, and if any were found, what did the label say? What does it mean if the label says "Naturally Grown," "Made only from Natural Products," or "Organically Grown?"
- Biotechnology is the combination of knowledge of a biologist and skills of a technologist to provide food, medicines, and new materials for industry. It can also help to clear up much of the waste that pollutes our environment. Explain that a biotechnologist may use the entire cells, or parts of cells, such as DNA, to control chemical reactions. Microorganisms can be grown in vast quantities before being 'harvested' for food. They are also a source of important molecules such as antibodies used in medicines.
- Discuss the use of biotechnology in various fields. It has helped farmers through the development of new kinds of plants and healthier and more productive animals to get more milk and meat. Better and more nutritious food is being developed from fast growing algae and fungi. Alternative sources of fuel such as biogas are being produced in the countries where there is more. Useful medicines such as vaccines and antibiotics are being produced from bacteria and fungi. Bacteria are also being used to pump oil from the ground.
- With the help of charts and diagrams, explain the process of genetic engineering. Explain that certain enzymes are called chemical scissors which are used to cut a portion of the DNA, (carrying a useful gene) from a bacterial cell. This portion of DNA can be then inserted into the DNA of another bacterial cell.

Assessment

1. What is DNA?
2. Draw a diagram of a small piece of the DNA molecule.
3. Briefly explain how DNA carries the genetic code.

Reinforcement/homework

Exercise questions 1-2

Lesson plan 2

Students learning outcomes

Learn about the genetic engineering and biotechnological products.

Materials

model of DNA, chart of making biofuel

Keywords

Variation, biotechnology, fermentation, microbe

Overview

Students will define genetic engineering and describe the steps involved in genetic engineering. They will describe the uses of biotechnological product.

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. Other than milk, what is your favourite dairy product?
2. Do you know how your favourite dairy product is made?

Method:

- Display pictures of biotechnological products and explain the well-known biotechnological products. Explain that microbes grow quickly when given the right temperature and food supply. It is therefore, easier to grow microbes in large quantities than to develop ways of growing plant and animal cells on their own. Also, microbe cells are relatively simple. This makes it easier for scientists to genetically engineer new microbes for specific jobs.
- Describe the process of genetic engineering with the help of diagrams and charts. Discuss the ways that biotechnology has helped man in the fields of food, fuel, and health. Also discuss the use of biotechnology in industry and in mining.
- With the help of charts and diagrams, explain the process of genetic engineering. Explain that enzymes called chemical scissors are used to cut a portion of the DNA, (carrying a useful gene) of a bacterial cell, which is then inserted into the DNA of another bacterial cell. The gene located on the cut portion instructs the microbial cell to produce the required material, which it does in great quantities, because microbes grow and reproduce at a rapid rate.

Assessment

List five uses of modern biotechnology.

Reinforcement/homework

Exercise questions 3-5

Environmental Pollution

Lesson plan 1

Students learning outcomes

Learn about the different types of pollution.

Materials

a chart of ozone depletion, a poster to show air pollution

Keywords

Pollution, pollutant, intensive farming, nutrient, fertilizer, fertile, chemical waste, sewage, oil spill

Overview

Students will learn about pollution and how human activities are damaging natural resources and the environment. They will discover how animal life is being threatened and the importance of plants for 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.

1. What causes air pollution?
2. Have you visited the northern areas of Pakistan?
3. Why do you like to visit such places?

Method:

- Explain that air becomes polluted when too much fuel is burnt improperly in factories, furnaces, and car engines.
- Bring a chart in the class to show ozone layer around the Earth and greenhouse gases. Discuss about global warming and acid rain. Discuss the greenhouse effect and the depletion of the ozone layer due to air pollution and show pictures.
- Show aerosol and markers with a sign CFC free.

- The amount of carbon dioxide in our atmosphere has risen by over 10%. This large increase is thought to explain why the temperature of the northern hemisphere appears to be rising. This phenomenon is called global warming. Discuss the harmful effects of global warming. Discuss the harmful effects of nuclear radiation.
- Discuss the places are attractive because they are clean and free of pollution. Students can be shown pictures of a number of different diseases caused by pollution. Explain the kinds of pollution, i.e. air, water, land, noise pollution, etc. Land becomes polluted when it is covered with litter or when farmers spray pesticides. Insecticides spoil our air and water. They also contaminate food chains.
- Show the students pictures of rubbish and litter in the streets. Explain that rubbish is solid waste. If solid waste is not disposed of, it looks ugly and becomes smelly. If it is burnt, it often pollutes the air. If left in the open air, it attracts insects and rats. If it is buried, dangerous chemicals may drain from it and contaminate underground water.
- Conduct in classroom:
  - Activity 1, page 34

Assessment

Choose the correct answer:

i. Why does deforestation make global warming worse?
   a. Trees absorb moisture from the soil.
   b. Trees take carbon dioxide from the air.
   c. Trees make the landscape look attractive.
   d. There will be a shortage of timber.

ii. Which of the following will NOT result from global warming?
   a. rising sea levels
   b. more droughts
   c. more damaging storms
   d. a larger ozone 'hole'

iii. Which one of the following pollutants can spread germs that cause diseases?
   a. farm chemicals
   b. leaking oil from oil tankers
   c. untreated human sewage
   d. chemical waste from factories

iv. Which of these elements may occur in fossil fuels?

a. sulphur b. nitrogen

c. helium d. calcium

v. Which of these compounds helps to cause the greenhouse effect?

a. water b. sulphur dioxide

d. CFCs e. carbon dioxide

Reinforcement/homework

Exercise questions 1-4

Lesson plan 2

Students learning outcomes

Learn the ways to control pollution.

Materials

five clean transparent jars or beakers, some water, vinegar, washing powder, engine oil, washing liquid, two slides, some cooking oil, two shoeboxes

Keywords

acid rain, ozone, global warming, conservation, natural resource, wildlife, extinct, endangered species, recycle, reuse, reduce, contamination

Overview

The teacher will explain how land and water pollution is harmful for us and how air may be polluted. She/he will explain the harmful effects of air pollution and define conservation and its importance. Students will be encourage to suggest ways to conserve our natural resources and preserve life on Earth.

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 causes air pollution?
2. How many kinds of pollution are there?

Method:

- Discuss water pollution and its causes.
- Encourage the students to make posters about pollution and its effects.
- Teacher will discuss about the importance of natural resources and their conservation. Students will be asked what they can do to clean the environment like participating in cleaning of schools, streets and cities. Students should be encouraged to participate in such activities.
- Discuss the importance of air for all living things. We all need air to survive. If the air we breathe in is polluted, it can cause illness. Explain that air becomes polluted when too much fuel is burnt improperly in factories, furnaces, and car engines.
- Discuss the greenhouse effect and the depletion of the ozone layer due to air pollution. The amount of carbon dioxide in our atmosphere has risen by over 10%. This large increase is thought to explain why the temperature of the northern hemisphere appears to be rising. This phenomenon is called global warming.
- Discuss the harmful effects of global warming. Discuss the harmful effects of nuclear radiation.
- Conduct in classroom:
  - Activity 2-3, page 35
  - Activity 4, page 36

Assessment

Answer the following questions.

i. Give one effect of acid rain.
ii. Name the main gas associated with global warming.
iii. How is that gas formed?
iv. Describe one possible effect of global warming.
v. Where would you find a catalytic converter?
vi. What does a catalytic converter do?
vii. Suggest two things humans can do to help reduce this global warming.
viii. Suggest two ways in which cutting down large areas of forest can be harmful to the Earth's atmosphere and climate.

Reinforcement/homework

Exercise questions 5-8

Chemical Reactions

Lesson plan 1

Students learning outcomes

Learn the differences between chemical and physical changes. Learn the importance of chemical reactions.

Materials

atomic modelling kit, a match box

Keywords

Physical change, chemical change, chemical reaction, synthesis

Overview

The teacher will describe a physical and chemical change. She/he will compare the physical and chemical change. She/he will discuss the different types of chemical reaction.

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 burning?
2. What happens when iron rusts, or when toast burns?

Method:

- As a starter activity bring a matchbox in the class, burn it and ask the students which type of change it is. Teacher will ask the students about different examples of physical and chemical changes.
- After writing a chemical equation on the board, explain the law of conservation of mass and the balancing of chemical equation. This can be explained with the help of different examples from textbook.

- Explain that new chemical compounds are made and it may be impossible to reverse the process. These are chemical changes, also known as chemical reactions. Discuss what happens when a chemical change takes place. Discuss the different types of chemical reaction with examples.
- Write the reactions on the board and explain how the substances have reacted to form new compounds.
- Conduct in classroom:
  - Activity 1, page 42

Assessment

Complete the following equations.

i. Nitrogen + Hydrogen → _____

ii. Sodium + Chlorine → _____

iii. Calcium + Chlorine → _____

iv. Copper + Oxygen → _____

Reinforcement/homework

Exercise questions 1-2

Lesson plan 2

Students learning outcomes

Learn to write balance chemical equations. Learn the law of conservation of mass.

Materials

periodic table, atomic modelling kit

Keywords

balanced equation, Law of conservation of matter

Overview

The teacher will state the law of conservation of mass and explain how to balance equations using this law.

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. Write the equations on the board and ask students to count the number of atoms of the reactants and products on both sides of the arrow in the given equation?
2. Are they equal?

Method:

- Now write the equation: $C + O \rightarrow CO_2$ Ask the students to count the number of the atoms of the products and reactants. Ask: Are they equal on both sides?
- Explain the importance of balancing equations and the law of conservation of matter, with more examples. Help the students to practice balancing equations.
- Write on the board a chemical equation $Fe + S \rightarrow FeS$ Ask the students to count the number of atoms of the reactants and products on both sides of the arrow.
- Conduct in classroom:
  - Activity 2, page 46

Assessment

1. Complete and balance the following equations:
   i. $H_2 + O_2$ → _____
   ii. $CuO + C$ → _____
   iii. $HCl + Mg$ → _____
   iv. $C + O_2$ → _____
   v. $Fe + S$ → _____
2. What are exothermic and endothermic reactions?

Reinforcement/homework

Exercise questions 5-7

Lesson plan 3

Students learning outcomes

Learn about types of chemical reactions and energy changes in chemical reactions.

Materials

periodic table, atomic modelling kit

Keywords

chemical equation, chemical reaction, reactant, product, arrow, state symbol, balancing

Overview

Students will be taught to write a chemical equation and the methods for writing a chemical equation.

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 change?
2. What change is observed when we burn a piece of paper?

Method:

- Use a funnel to put a spoonful of baking soda into a balloon. Set the balloon aside. Wipe the funnel clean with a tissue paper. Use the funnel to fill the bottle with water until it is 1/2 full. Stretch the opening of the balloon around the opening of the bottle. Be careful not to spill any baking soda into the water. Observe the change. What will happen when the baking soda mixes with water? What happens to the balloon?
- Teacher will show different cards on which different type of equation's examples will be written. Concepts will be explained with the help of these cards. Students can note down these equations in their notebooks.
- For example:

  To show addition reaction by making a card of equation: $A + B \rightarrow AB$

  To show decomposition reaction make a card of equation: $AB \rightarrow A + B$

  To show combustion reaction make a card of: $A + BC \rightarrow AC + B$

  To show neutralization reaction make a card of: $AB + CD \rightarrow AD + CB$
- Explain exothermic and endothermic reactions with examples. When iron and sulphur are mixed and heated together, a new substance, iron oxide, is formed. Although you have to heat the iron and sulphur to start this reaction, it gives out heat once it gets going.
- A reaction which gives out heat is called exothermic. Fireworks are an example of exothermic reactions. Chemical substances are mixed in just the right amounts to

produce light and sound energy as well as heat energy. Some reactions take in heat while they are taking place.

Assessment

1. Combustion is useful because _____
2. Neutralization is useful because _____
3. Write true or false:
   a. There is a loss of mass when the reactants turn into products. _____
   b. A word equation shows what is happening in a reaction._____
   c. Chemical reactions involve temporary changes. _____
   d. Reactions always either take in or give out energy. _____
   e. Usually the temperature in a reaction goes up. _____
   f. There are often visible changes in a reaction. _____

Reinforcement/homework

Exercise questions 3-4

UNIT 6

Acids, Alkalis, and Salts

Lesson plan 1

Students learning outcomes

Learn about acids and alkalis.

Materials

lemon, mango, bitter gourd, pickles, cakes, soft drinks, soaps, litmus paper

Keywords

litmus, corrosive, sour, hydrogen ion, pH paper, strong acid, weak acid

Overview

The teacher will define an acid and describe its properties and uses. She/he will define an alkali and explain its properties and uses.

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 does lemon or orange taste like?
2. What does shampoo or soap taste like?

Method:

- Bring different items like lemon, orange, baking powder and salt and tell the students about the taste and other properties. Discuss the different uses of acid, alkalis, and salt by showing pictures like vinegar, drain unblocks and fertilizers. Ask students to list down different acids, alkalis and salts also list down their differences.
- Explain that acids are sour. The acids that we use in our food are weak acids. Discuss the physical properties of acids. Put a piece of paper in a beaker containing some sulphuric acid. Explain that acids like sulphuric acid are very strong. They are corrosive. Dip a litmus paper in some dilute hydrochloric acid. Explain that acids turn litmus paper red. Dip pH paper in an acid Explain that acids have a low pH

value. Set up an electrolytic cell with dilute hydrochloric acid solution. Explain that a current is flowing through the cell. This shows that acids are good conductors of electricity. Demonstrate the chemical properties of acids by performing the tests. Discuss the uses of acids.

- Conduct in classroom:
  - Activity 1–2, page 49

Assessment

The table below shows the pH of five different chemicals.

chemicals	pH
A	5.8
B	6.9
C	7.0
D	7.3
E	7.6
F	9.7

a) Which chemical is the strongest acid?
b) Which chemical is the weakest alkali?
c) Which chemical is neutral?
d) What colour will A turn Universal Indicator?
e) What colour will the F turn Universal Indicator?
f) What colour will the C turn Universal Indicator?

Reinforcement/homework

Exercise questions 1-3

Lesson plan 2

Students learning outcomes

Learn about indicators and their uses.

Materials

weak alkali, strong alkali, litmus paper, pH paper

Keywords

weak alkali, strong alkali, salt, hydroxyl ion, corrosive, neutralize

Overview

Students will define salts, properties of salts and uses.

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 acids?
2. What are alkalis?

Method:

- Demonstration can be conducted in lab using different indicators and acid, alkalis and salt by the teacher to show colour change. They can then be individually asked to test different solution of cola, salt, soap, vinegar and baking powder.
- Discuss the uses of neutralization reaction in class.
- Explain that alkalis have a bitter taste. Saliva is a weak alkali therefore it has no taste. Pour some sodium hydroxide into a test tube and put a blob of fat in it. Hold your thumb over the top and shake the test tube vigorously. Ask: What has happened to the fat? Explain that strong alkalis can dissolve fats. Dip a litmus paper and a pH paper in an alkali. Explain that alkalis turn litmus paper red and pH paper purple. Alkalis have a high pH value.
- Set up an electrolytic cell with dilute sodium hydroxide solution. Show the students the flow of the current through the alkali. Explain that alkalis are good conductors of electricity. Discuss the neutralization reaction between an acid and an alkali. Explain how indigestion, tooth decay, and insect bites can be treated by neutralization reactions.

Assessment

What is the pH of the following?

i) lemon juice _____

ii) washroom cleaner _____

iii) distilled water _____

iv) hair shampoo _____

Reinforcement/homework

Exercise questions 4-6

Lesson plan 3

Students learning outcomes

Learn the term salt and its uses.

Materials

red cabbage, boiling water, lemon juice, vinegar, washing soda, baking soda solution, tomatoes.

Keywords

indicator, litmus, Universal Indicator, pH paper, salt, crystal, fertilizer

Overview

The teacher will describe the ways in which salts can be prepared and describe different indicators and their uses.

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 salt?
2. In what form do we see salts?

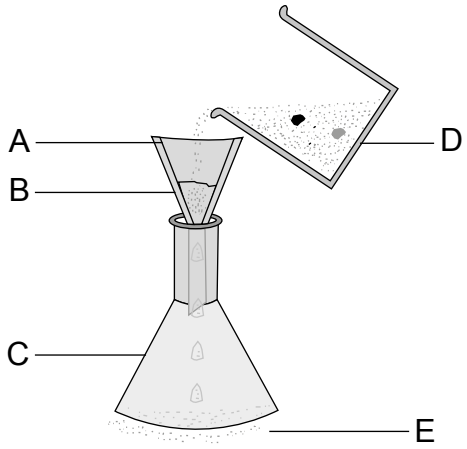
Method:

- Explain that salts are solids that we see in the form of crystals. Discuss the properties of salts. Set up an electrolytic cell with a solution of sodium chloride (common salt). Explain that salt solutions are good conductors of electricity. Most salts occur naturally, but some salts are prepared in the laboratory, or in factories.
- Explain the reactions by which salts can be prepared.
- Explain the uses of salts.
- Discuss the various indicators that are used to find out whether a solution is acidic, alkaline, or neutral.

- Conduct in classroom:
  - Activity 3-4, page 55
  - Activity 5, page 58
  - Activity 6, page 59

Assessment

1. When an acid reacts with an alkali, a certain type of compound is formed. Complete the word equation for this type of reaction:
   acid + alkali →
2. The name of the reaction between an acid and an alkali is:
   i) combustion ii) neutralization iii) oxidation iv) reduction
3. Now complete these examples of this type of reaction:
   i. hydrochloric acid + sodium hydroxide →
   ii. sulphuric acid + potassium hydroxide→
4. Label the following diagram:



Reinforcement/homework

Exercise questions 7-8

Lesson plan 1

Students learning outcomes

Learn about the force and pressure and its importance.

Materials

a rope, magnet, pins, balloon, bat, ball, toy car

Keywords

newton, square metre, pascal, pressure, force, area

Overview

The teacher will define force and pressure. They will state the formula for calculating pressure and explain the relation between force and pressure.

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 causes more damage to a wooden floor, shoes with flat soles or high heels?
2. Can anyone define pressure?

Method:

- Describe force and then guide students towards the actual definition.
- Make a cloud on the blackboard using students' responses about what forces can do.
- Explain that high heels can ruin carpets and punch holes in wooden floors. This is not just because of the strong downward force, but because this force is concentrated on such a small area that it produces strong pressure. Explain that scientists use the word pressure to describe how concentrated a force is.
- Explain the method of calculating pressure and the unit that pressure is measured in. Explain we calculate the force on an area if we know the pressure?

- Explain how force can be calculated by rearranging the pressure equation. Discuss the pressure of objects on different surfaces, and explain the applications of pressure.
- Explain different situation in daily life where forces are used so that students understand the forces operating in a range of situations. Ask the students to give ideas about the forces that are operating in each situation in turn and help them understand what is actually happening.
- Bring a toy and try to demonstrate a type of force that can be applied to push, pull, or create and change in the direction of an object. Explain start, stop, speed up, slow down, and change direction.
- Conduct in classroom:
  - Activity 1, page 62
  - Activity 2, page 63
  - Activity 3, page 64

Assessment

1. Choose the correct answer:
   i. Which of the following will create the greatest pressure on a surface?
      a. snowshoes b. drawing pin
      c. skis d. the feet of a camel
   ii. The unit for force is the:
      a. kilogram b. metre c. joule d. newton
   iii. The force of gravity pulling on an object is called its:
      a. height b. mass
      c. weight d. temperature
   iv. What units do we use to measure pressure?
      a. newtons b. metres
      c. pascals d. newton metres
   v. What pressure is created when a force of 64 N is applied over an area of 4 m^2?
      a. 256 Pa b. 16 Pa
      c. 16 m2 d. 256 m^2
2. Ali stands on the bathroom scales. The scales read 50 kg.
   a. What is Ali's mass? _____
   b. What is Ali's weight? _____

3. When Ali stands, the area of his feet in contact with the ground is 200cm^2.
   a. What pressure does Ali exert on the ground? _____

b. When Ali stands on one foot, what effect does this have on the pressure he exerts on the ground? _____

Reinforcement/homework

Exercise questions 1-3

Lesson plan 2

Students learning outcomes

Learn about pressure in our everyday life.

Materials

empty juice box, balloons, candle

Keywords

transmit, hydraulic machine, density, depth, weight, atmosphere, atmospheric pressure, compressed, fluid pressure, aerosol

Overview

The teacher will list the examples of where we experience pressure in our everyday life and explain how liquids exert pressure. She/he will explain that a fluid exerts pressure equally in all directions and explain how hydraulic machines work.

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 liquids exert pressure?
2. Why does a swimmer feel pressure in his ears?
3. If he goes deeper into the water, how will it affect the pressure?
4. What is blood pressure?

Method:

- Teacher can use magnets to show opposite poles of magnet attract and similar poles repel each other. Discuss with the students about the push or pull forces acting on an object.

- Teacher will drag heavy and light objects in front of the students like chair, table and let the students estimate the force required to lift several objects in the classroom.
- Students will be asked to blow a balloon to explain the gas pressure.
- Demonstrated to explain behaviour of gases under pressure. For e.g. the concept of behaviour of gases at high temperature.
- Teacher will demonstrate the hydraulics system with the help of a chart of hydraulic brake system. Teacher will bring a perfume bottle or any other spray bottle in the class to show the working of aerosol spray.
- Explain that liquids have two special features: they cannot be squashed, and if a liquid in a container is put under pressure, the pressure is transmitted equally to all parts of the liquid.
- Discuss hydraulic machines which use liquid pressure to transmit forces from one place to another. Most hydraulic machines are force magnifiers: they give out more force than is put in. This happens because the output piston is larger than the input piston.
- Explain that gravity is a force that pulls any liquid in a container downwards. A liquid under pressure pushes on every surface it touches. The pressure of a liquid increases with depth. The width or the shape of the container does not affect the pressure. Explain that pressure is affected by the density of the liquid. Explain the formula for calculating the pressure of liquids.
- Explain that the Earth's atmosphere contains billions of tons of air. At sea level, the atmospheric pressure is equivalent to a force of about 100,000 newtons pushing on every square metre. Explain that in a gas the particles are continuously moving, so at any given time many of them are colliding with the sides of the container. They bounce off without losing any energy, and in doing so, each one exerts a small outward force on the wall. Because billions of particles are doing this each second, the force appears as constant pressure. Discuss the applications of atmospheric pressure and liquid pressure.
- Show an aerosol spray and explain the construction and working of an aerosol.
- Conduct in classroom:
  - Activity 4-6, page 62

Assessment

1. Write down the formula for calculating pressure.
2. Why is it an advantage for a camel to have big feet when it walks across desert sand?
3. Calculate the pressure exerted on the ground by each foot of a camel if it weighs 7000 N and each foot has an area of 600 cm^2.

4. Calculate the pressure exerted on the ground by each foot of a horse if it weighs 5000 N and each foot has an area of 125 cm^2.
5. Which animal would make the deepest footprints in sand, the horse or the camel?
6. Name a unit of pressure.

Reinforcement/homework

Exercise questions 4-6

UNIT 8

Measurement of Physical Quantities

Lesson plan 1

Students learning outcomes

Learn the S. I. units of different quantities.

Materials

pencil box, science book, a metre scale, a measuring tape

Keywords

matter, S.I units, MKS system, metre, kilogram, second

Overview

The teacher will explain what is meant by mass, volume, and time. She/he will explain the difference between mass and weight.

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 have any idea of how long a metre is?
2. How long?
3. How big?

Method:

- Begin the lesson by explaining what measuring something means. Explain that long ago people had only inexact ideas about distance and time. For example, half an hour's walk may mean very different distances for different people. Scientists make many kinds of measurements in the laboratory. It is only by making careful and accurate measurements that scientific work can be carried out. Since 1960, scientists have used SI units for all measurements. SI stands for System International, or the International System of Units.

- Bring different instruments to class or take the students to school lab to explain their uses as given in textbook.
- Discuss in class how they think scientific investigations take place. Explain the safety measures to be taken in a lab. Show the students a metre rule. Bring a piece of cloth in the class and ask them to measure it using hand spans to get a rough idea of how long a metre is?
- Conduct in classroom:
  - Activity 1-2, page 74

Assessment

1. What is meant by the term *SI unit*?
2. Why is it important to have SI units?
3. What are the SI units of:
   i) time
   ii) distance
4. Fill in the blanks to complete the statements:
   a. km is the symbol for _____.
   b. To measure the volume of a liquid we use the unit_____.
   c. A balance is used to measure _____.
   d. A measuring cylinder is used to measure _____.
   e. A metre rule is used to measure _____.

Reinforcement/homework

Exercise questions 1-2

Lesson plan 2

Students learning outcomes

Learn the use of different S. I. units.

Materials

measuring cylinders, scale, stopwatch, weighing balance

Keywords

meniscus, time, hour, minute, second, clock

Overview

The teacher will discuss the use of S.I unit in daily life and demonstrate the correct instruments for measuring mass, volume, and time. Students will record measurements of mass, volume, and time.

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 mass?
2. What is weight?
3. What is the difference between the two?
4. What is volume?
5. How can we measure the volume of a body?

Method:

- Ask the students to measure their copies or pencils and write measurement in their notebooks. Explain conversion of units.
- Ask students to make a chart of different lab instruments and their uses.
- Explain the difference between mass and weight. Weight is a force and is measured in Newton. Mass is the quantity of matter in a body. The mass of a body does not change, no matter where it is, but the weight can vary from place to place.
- The unit for measuring mass is the kilogram (kg). 1 kg = 1000 g
- The smaller units of mass are the gram and milligram.
- We often work with these smaller units in the laboratory.
- The instrument used to measure mass is called a balance.
- Discuss the different types of balance.
- Discuss the formula for finding the volume of regular solids: length x breadth x height.
- The volume of liquids is measured in litres (l). 1 litre = 1000 millilitres (ml)
- The instruments used for measuring the volume of liquids are: measuring cylinder, measuring flask, burette, pipette, etc.
- Bring four measuring cylinders in the class. Fill it with water and ask the students to measure the volumes. For reading the volume of a liquid accurately we have to read the bottom level of the meniscus. The eye must be level with it. To ensure that the liquid is level the cylinder must be upright when the reading is taken.

- Explain that in the past, sundials were used to tell the time. A sundial is the simplest clock. The sun casts a shadow on the face of the sundial. The movement of the shadow follows the apparent movement of the Sun. The position of the shadow on the scale gives the time.
- Show a clock and ask the students what do we measure with a clock?
- Ask three students to run from one to another corner of the class and note the time using stop watch.
- Explain the students to think what the world would be without clocks, watches, or calendars. Explain that stopwatches, watches, and clocks are used to measure time. A stopwatch has knobs or buttons to start, stop, and reset the digits. It has a large second's hand.
- One full round of the hand measures 60 seconds.
- Electronic stopwatches can measure time intervals accurate to 0.01 second. They have digital display of time, which makes taking readings easier.
- Conduct in classroom:
  - Activity 3, page 75

Assessment

Choose the instrument you would use to measure each of the following distances:

30 cm ruler measuring tape metre ruler car milometer

i) The distance between Karachi and Quetta _____

ii) The length of one of the school corridors _____

iii) The size of your textbook _____

iv) The size of your table _____

Reinforcement/homework

Exercise questions 3-5

UNIT 9

Sources and Effects of Heat Energy

Lesson plan 1

Students learning outcomes

Learn the effect of heat on solid and liquids.

Materials

a candle and a torch, beaker, water, bits of paper or sawdust, burner or spirit lamp, a matchbox, a glass

Keywords

expansion, contraction

Overview

The teacher will explain the effect of heat on solids and explain the effect of heat on liquids. She/he will explain the effect of heat on gases and describe the effects of expansion and contraction in everyday life. She/he will identify the useful applications of expansion.

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 do we measure temperature of a body?
2. Why do gases diffuse faster at high temperature?

Method:

- Bring a candle and a torch to show the different sources of heat. Ask the students to rub hands to produce heat. If you heat ice, it melts, but it does not become hotter.
- Discuss the three states of matter and the behaviour of particles on heating. Explain that solids, liquids, and gases are made up of tiny particles which can attract each other. The particles are constantly moving.
- In a solid the particles attract each other strongly. Therefore the particles stay close together. They move by vibrating.

- In a liquid, the particles attract each other less strongly. The particles can move about as they vibrate. Liquids can flow.
- In a gas the particles attract each other very little. The particles move about very fast and quickly fill the container.
- As solids, liquids, and gases get hotter, the particles move faster. When the particles of a solid are heated, they begin to break the attraction they have between them. The solid may become a liquid. When a liquid is heated, the particles may break all the attractions between them. The liquid will then become a gas.
- A hot substance has more energy than a cold substance. Heat transfer is the flow of energy from a hot place to a colder one. The temperature stays at 0 degrees Celsius until all the ice has melted. The heat absorbed when a solid melts is called the latent heat of fusion: *fusion* means to melt, and *latent* means hidden.
- The effect of heat seems to be hidden because the temperature does not rise. In fact, the heat absorbed by the solid is used to pull the molecules apart, so that they are free to move around as a liquid.
- Every time that you put the kettle on to boil, heat energy is absorbed by the water. The temperature rises to 100 degrees Celsius, but no further. If you leave the kettle on the stove, the extra energy just turns more and more of the water into steam, but the temperature remains the same.
- The heat energy absorbed when a liquid changes into gas is called the latent heat of vaporization. The energy is needed to pull the molecules apart so that they can move around freely as a gas. Perform the experiment of relegation and discuss the effects of pressure on the melting point of a solid, such as ice. To explain expansion and contraction demonstrate. Freeze-thaw weathering will be explained with the help of cards showing steps of ice wedging.
- Conduct in classroom:
  - Activity 1 page 79
  - Activity 2, 3 page 80
  - Activity 4, 5, 6 page 81

Assessment

Write true or false:

i. The particles in a solid are packed close together.
ii. The particles in a gas are far apart.
iii. Liquids are easy to compress.
iv. Gases have a low density.
v. Gases are difficult to compress.
vi. Liquids and gases can flow.
vii. The particles in a solid vibrate.

Reinforcement/homework

Exercise questions 1-2

Lesson plan 2

Students learning outcomes

Learn the conversion of temperature reading from one scale to another.

Materials

A metallic bottle top, an ice cube, a tripod stand, a candle.

Keywords

expand, temperature, thermometer, vibrate

Overview

The teacher will explain why evaporation causes cooling and describe how the volume of a liquid changes when it solidifies. She/he will explain the different scales of temperatures and use the formulae to convert different temperature readings from one scale to another.

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 difference between heat and temperature?
2. What will you see when a solid/ ice is heated?

Method

- Show different clippings of magazines or pictures from internet to show the effects and applications of expansion and contraction of solids. For e.g., show a picture of railway tracks or hanging wires from poles.
- Two strips of different coloured paper will be used to show a bimetallic strip and teacher will explain its use.
- Different types of thermometers will be brought to the class by the teacher and their differences will be explained. Demonstrate recording the freezing and boiling point

of water using different thermometers. Teacher will ask the students to practice conversion of different scales using formulae.

- Explain that expansion and contraction in a gas occurs in the same way as in solids and liquids. The difference in the expansion of gases is that the amount of expansion is much larger than that in a solid or a liquid. Discuss the ways in which the expansion of gases is useful.
- Conduct in classroom:
  - Activity 7–8, page 82
  - Activity 9, page 84

Assessment

1. What happens to the size of objects as they get hotter?
2. What happens to the size of objects as they get colder?
3. As the railway lines get hotter, what happens to the gaps in the track?
4. What would happen in hot weather if there were no gaps in the track?
5. In countries where there is very hot and very cold weather, should the gaps between the lengths of track be wider or narrower?

Reinforcement/homework

Exercise questions 3-5

UNIT 10

Lenses

Lesson plan 1

Students learning outcomes

Learn about different types of lenses.

Materials

different types of lens, microscope, magnifying glass

Keywords

Classification, variety, groups, vertebrates, invertebrates, kingdom, feature

Overview

The teacher will identify a lens and describe the different types of lens. She/he will state the rules of refraction of rays by a lens and describe the formation of images by a convex and a concave lens.

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.

Show the students a magnifying glass. Tell them to read the words on the page of their books.

1. Why do the words look big?
2. Why do we use lens?

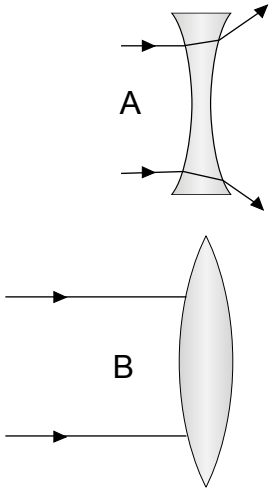
Method:

- The structure of human eye will be shown on a chart to the students and different parts and their functions will be discussed. A camera will be shown to the students and students will discuss the points of difference. An optician may be invited to the class to discuss about the defects of vision and importance of protection of eye or teacher will show a chart about the defects of vision. Teacher will show a leaf or onion cells through a microscope to the students.

- With the help of diagrams explain the paths of rays when they pass through a lens. Explain the formation of images of an object placed at various distances from the lens. Describe the kinds of images that will be formed. Explain the difference between real and virtual images. Help the students practice drawing refraction of rays through lenses.
- Describe a lens. With the help of real lenses and diagrams on the board, explain the types of lenses, and how light refracts when it passes through lenses. Hold a magnifying glass near a window. Focus a sharp image of the Sun on a sheet of paper. Explain that a clear image of an object is formed at a point where all the rays coming from the object come to a point (converge). This point is called the principal focus, and the distance between the image and the lens is called the focal length of the lens. Show the students how to calculate the focal length of a lens using an optical bench.
- Teacher will bring a magnifying glass and draw a ray diagram to show the formation of a virtual image and real image. Teacher will give ideas about to differentiate that a real image is an image which can be projected but virtual image cannot be measured. Teacher will explain the image produced by a lens on the brain considering that the light is travelling to the eye in a straight line. Teacher will keep a burning candle at different distances from a converging lens to demonstrate the formation of images, and students will observe the nature of the image formed on the screen.
- Conduct in classroom:
  - Activity 1, page 88

Assessment

1. Complete the diagram:



2. What type of lens is A?
3. What type of lens is B?

Reinforcement/homework

Exercise questions 1-2

Lesson plan 2

Students learning outcomes

Learn the uses of lenses in optical instruments.

Materials

spectacles, binoculars, camera, magnifying glass, camera

Keywords

eye, lens, iris, retina, light-sensitive cell, virtual image, optic nerve

Overview

The teacher will describe the use of lenses in optical instruments and describe the structure of the human eye. She/he will compare the eye to a camera and list some defects of vision.

Students will know the correction of poor eye-sight.

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. Can you see distant objects without your glasses?
2. Does anyone in your family wear glasses?
3. Can you see in the dark?

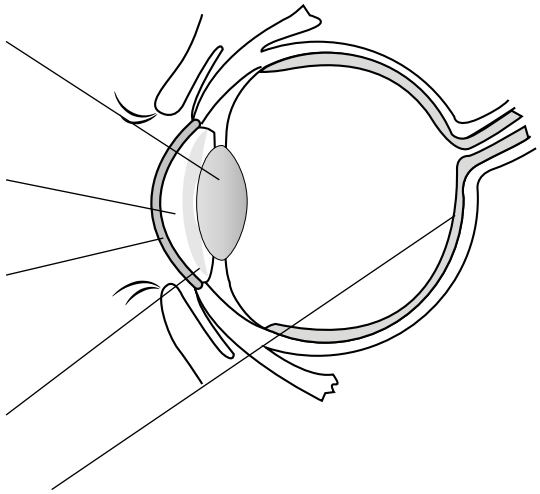
Method:

- Hold a lens above the writing on this page. Look through the lens from the top and move the lens up and down until the writing is clear. Teacher will show converging lenses and show the image formation of a distant object for example a bird or a building seen through a lens bringing parallel rays from a distance to focus through a cylindrical lens. Students will be invited to draw a ray diagram to scale to show the formation of a real image.

- Draw the longitudinal section of the human eye, and describe its parts. Draw a section of a camera and explain the similarities and differences between the eye and the camera. Identify some students in the class who wear glasses Discuss the use of spectacles and the defects of vision. Explain, with diagrams on the board, how corrective lenses can be used to help improve poor vision. Discuss the role of the iris and the pupil of the eye in adjusting to light and dark. Also explain the role of rods and cones in helping the eyes to get used to seeing in the dark. Discuss night vision.
- Show the students a microscope and explain its construction. Put a microscope slide under the objective lens and ask the students to observe the image. Explain that the combination of lenses in optical instruments helps us to see clear images of objects. Draw a section of the telescope and explain how images of distant objects can be seen through it. Explain that the image is upside down or inverted, but it does not matter when we are observing heavenly bodies.

Assessment

1. Label the following diagram:



2. Why is it important for the cornea of the eye to be transparent?
3. Name the two kinds of sensitive cell which are found in the retina.
4. The size of the pupil can be varied by the iris. What is the purpose of this?
5. Which part of the eye that sends impulses to the brain

Reinforcement/homework

Exercise questions 3-5

UNIT 11

Electricity in Action

Lesson plan 1

Students learning outcomes

Learn about the electricity and magnetism.

Materials

copper wire, glass rod, magnet, galvanometer, an iron wire, a candle, ice-cold water.

Keywords

Compass, magnetic field, electromagnetism, solenoid, generator, dynamo

Overview

The teacher will describe the different sources of electricity and explain the term electromagnetism. She/he will describe a dynamo and explain how electricity and magnetism 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. How is electricity generated at a power station?
2. How does it reach us?

Method:

- Students should be explained that the large-scale production of power in power stations basically uses two types of energy sources, the renewable and non-renewable type. Renewable sources are those which can be replaced easily like wind, water, solar, tidal, geothermal. Non-renewable sources are those which cannot be replaced in a short period of time once they are used up. These include all types of fossil fuels coal, oil, gas as well as nuclear fuel.
- Make a list of all the suggestions on the board. Wind a loop of wire on a nail. Remove the nail and attach the ends of the coil to a battery. Bring a magnetic

needle close to it. The needle will be deflected showing that there is a magnetic field around the coil. Explain that this type of coil is called an electromagnet or solenoid. If the number of turns of the coil is increased or if the current is increased, the electromagnet can be made stronger. Explain that when an electric current flows in a wire in a magnetic field, a force is produced which makes the wire move. This force is called the motor effect. The motor effect is used by scientists and engineers to build electric motors.

- Wind a loop of wire around a nail to make a coil. Remove the nail and attach the ends of the coil to a battery. Bring a magnetic needle close to the coil; the needle will be deflected showing that there is a magnetic field around the coil. Explain that this type of coil is called an electromagnet or a solenoid. If the number of turns of the coil is increased, or if the current is increased, the electromagnet will be stronger. Putting a piece of iron inside the coil makes the field even stronger. One end of the coil behaves like the North Pole and the other, the south pole of a magnet. Switching off the current destroys the magnetism. Explain if you had to build a stronger electromagnet, what would you do? How many turns of wire would you wind round it? What size of current would you use? Set up the circuit of the motor. Explain that when an electric current flows in a wire in a magnetic field, a force is produced which makes the wire move.
- Conduct in classroom:
  - Activity 1, page 97
  - Activity 2, page 98

Assessment

1. Name two unwanted forms of energy that result from wind turbines.
2. Explain why wind is a renewable energy source.
3. What are two advantages of wind turbines?
4. What are two disadvantages of wind turbines?

Reinforcement/homework

Exercise questions 1-2

Lesson plan 2

Students learning outcomes

Discover the uses of electrical appliances.

Materials

A zinc plate, a copper plate, two electric wires, diluted sulphuric acid (H2 SO4), a beaker, a bulb.

Keywords

Power station, energy source, wind turbine, hydroelectric power plant, solar energy, and transformer, Alternating current, direct current

Overview

The teacher will understand different types of cell and describe the motor effect and explain how the motor effect is used to make electric motors. She/he will define alternating current and explain how an alternating current and a direct current can be produced. She/he will identify electrical appliances which use alternating current or direct current.

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 transformers?
2. What is their role in transmitting electricity?

Method:

- Explain the method of electricity generation at a power station. When electricity is generated it has to be transmitted around the country using thick copper or aluminium cables which are hung on pylons or buried underground. Explain that these metals are very good conductors of electricity. The cables are thick to give low resistance.
- Explain that very high voltages are used when electrical energy has to be transmitted over long distances. Also, different uses require different voltages. Explain that it is the network which carries electrical energy around the country. It uses step-up and step-down transformers to increase or decrease the voltage.
- The small-scale electricity production is done through chemical means in dry cells and batteries and using mechanical means in domestic generators and dynamos. The difference between an alternating current and a direct current is also a very important concept which needs to be clearly understood. The students should be asked to sort the different devices in their surroundings that work using AC and DC as a warm up activity for this topic.

- Tell the students that they have just found out that electricity can be used to make magnets; the opposite is also true; magnets can be used to produce or generate electricity. It is quite easy to generate electricity in the laboratory. All you need is a U-shaped magnet and a loop of wire. Move the wire up and down between the poles of the magnet. To show that a current is flowing you have to connect a meter to the wire. It will give a tiny reading, but only while the wire is moving. To generate useful electricity you will need a long wire wound into a coil. Mount the coil on an axle. Place the coil between the poles of a magnet. Spin the coil steadily. This is the arrangement in a model generator. It uses the moving energy from a steam engine or a water turbine to spin the coil. When it is working, this generator can supply a steady current big enough to light a torch bulb. A power generator is much more complicated and much more powerful. It can generate enough electricity to supply a whole town.
- Spinning a coil between the poles of a fixed magnet is not the only way to generate electricity. Spinning a magnet inside a fixed coil generates electricity as well. The bicycle dynamo uses a spinning magnet. You have to supply energy to spin it. With a bicycle dynamo and a lamp you can change chemical energy in your food into light energy! Discuss some output components and their uses.
- When an electric current flows in a wire in a magnetic field, a force is produced. The force can make the wire move. This is sometimes called the motor effect. The motor effect has been used by engineers to build electrical motors which are so commonly used in small motors which move the tape in cassette players, to the powerful motors used to move heavy machines and trains, etc.
- A current can be produced when a wire is moved through a magnetic field. This is called the Dynamo effect. It is just the opposite of the motor effect.
- A current can also be generated or induced by moving a magnet towards or away from a coil of wire. The current is only induced when the magnet is moving.
- The size of the current can be increased by:
  a. moving the magnet faster
  b. using a stronger magnet
  c. using more turns of wire in the coil
- Conduct in classroom:
  - Activity 3, page 100

Assessment

1. Match the problems of electricity generation with the sources:

Problems	Power generation sources
Are relatively expensive and do not work at night or in bad weather.	hydroelectric power plants
Do not need reservoirs to store water, and do not create pollution, but their construction costs are high.	using fossil fuels
Use a reservoir to store water, due to which lots of land is submerged; dams which are built to store water, displace people and destroy wild life; dam bursts can be disastrous.	solar panels
They are not renewable. They took millions of years to make, and at some point in time will run out. They can cause serious environmental problems.	wind turbines

Reinforcement/homework

Exercise questions 3-5

Lesson plan 3

Students learning outcomes

Learn the process of electricity generation at a power station.

Materials

A used cell, knife, chart showing power stations

Keywords

classification, variety, groups, vertebrates, invertebrates, kingdom, feature

Overview

The teacher will describe the process of electricity generation at a power station and discuss the problems of electricity generation. She/he will explain how electricity is distributed

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. Where does electricity in our homes come from?
2. What do we use in a torch to light the bulb?
3. How does an electric clock work?

Method:

- The students can be asked to write an assignment on the advantages and disadvantages of using different sources of energy for the production of power on a large scale.
- Electronic systems all have the three basic components the input output and the processor unit. Different output devices like computer, watches, clocks, calculators, mobile phones are being used most commonly today in our daily life.
- In power stations fuel such as coal, gas, oil, or energy from a nuclear reactor is used to heat water and turn it into steam. The steam then turns turbines connected to a.c. generators.
- These are called alternators. They work on the same principle as the bicycle dynamo. The voltage is produced by a magnet spinning inside fixed coils of wire. The power station uses a spinning electromagnet. By changing the current in the electromagnet the output from the alternator can be accurately controlled without slowing the turbines. The current for the electromagnet comes from a small d.c. generator which is also driven by the turbines.
- Output components and their uses:
    a. Calculators: these devices use electronic circuits to solve mathematical problems quickly and accurately.
    b. Digital clocks: these devices use electronic timing circuits. These timers can be used in other devices.
    c. Central heating control units: these devices use programmable electronic circuits to allow easy control and are more reliable than mechanical switches.
    d. Computers: these devices are used for solving mathematical problems, business purposes and games.

e. Electronic organs: these devices use electronic circuits to produce musical notes and rhythms.

f. Satellite communications: these devices are used for international communications, military purposes, and satellite television.

- Conduct in classroom:
  - Activity 4, page 100

Assessment

1. Write the terms for these descriptions:
   i. the force produced when an electric current flows in a wire in a magnetic field
   ii. the current generated by a magnet moving near a coil of wire
   iii. the current produced when a wire is moved through a magnetic field
   iv. a device which uses electronic circuits to solve mathematical problems quickly and accurately
   v. a device that uses electronic timing circuits
2. The resistance of a piece of wire depends on several factors.
   i) Does the resistance of a piece of copper wire increase, decrease, or stay the same when its length increases?
      a. increase b. decrease
      c. stay the same
   ii) Does the resistance of a piece of copper wire increase, decrease, or stay the same when its diameter increases?
      a. increase b. decrease
      c. stay the same

Reinforcement/homework

Exercise questions 6-7

Exploring Space

Lesson plan 1

Students learning outcomes

Learn about telecommunication and space.

Materials

pictures of solar system and astronauts

Keywords

Artificial satellite, aerial, radio telescope, space station, space shuttle

Overview

The teacher will define telecommunication and describe the various means of telecommunication. She/he will explain the kind of technology we use in everyday life and describe the uses of a television, a laser light, a computer, a nuclear reactor. The teacher will describe artificial satellites and list the functions of artificial satellites. She/he will be able to describe a rocket.

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 solar system?
2. What is a satellite?
3. What is the natural satellite of the Earth?

Method:

- Explain how do we receive radio and television programs from other countries? Explain that artificial satellites are sent in space. They orbit the Earth. They carry aerials and machines which are used to send and receive signals.
- From where do artificial satellites get their supply of energy? Explain that satellites have solar panels that capture Sun energy, which is converted into electrical energy.

Discuss the various types of spacecraft and machines that are being used to explore space.

- Explain how do we receive telephone calls from far off countries? How do programs relay from a television station reach our television sets? Explain the transmission of sound and light waves in the form of electric signals to our TV sets, and how they are converted back into sound and light waves.
- Ask the students to observe the screen of a TV set with a magnifying glass. Explain that the coloured dots that they see on the screen are due to the coating of phosphor at the back of the screen. Phosphor glows when electrons are shot at it. Explain about is laser light. Explain that laser light is a concentrated beam of light which can travel long distances. It can also travel in glass tubes called optical fibres. Optical fibres are being used instead of telephone cables. Explain working of a computer.
- Show the students the parts of a computer.
- Explain how a computer works.

Assessment

1. What are artificial satellites?
2. What are they used for?

Reinforcement/homework

List some uses of Robotic Spacecraft in:

a. Our daily life.

b. Space exploration.

Lesson plan 2

Students learning outcomes

Learn about space exploration and its importance.

Materials

binoculars, pictures of spacecraft

Keywords

space travel, rockets fuel, oxidizer, combustion chamber, astronaut, cosmonaut, space walking, life support system, mission control

Overview

The teacher will explain how a rocket is launched into space and describe an astronaut and the clothes he wears. She/he will explain how astronauts survive in space and discuss the benefits and problems of space exploration.

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.

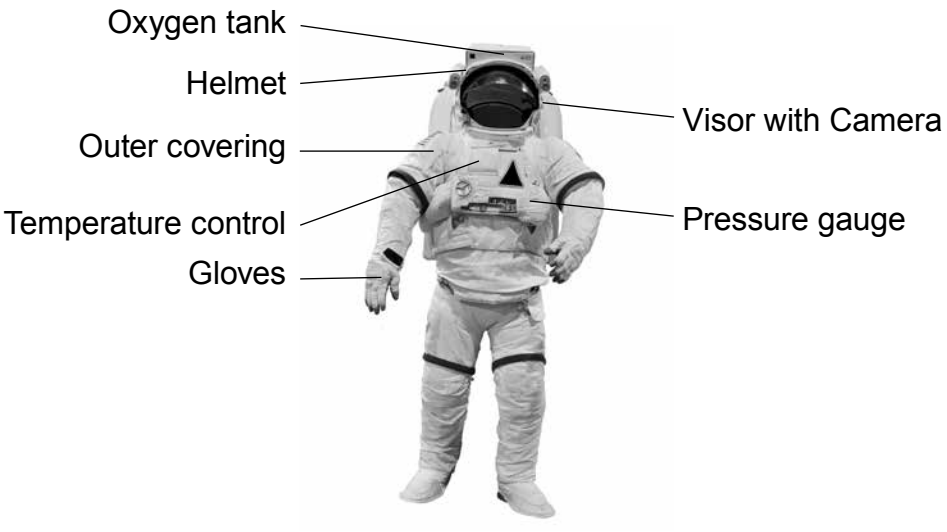
1. Can an aeroplane travel into space?
2. Why an aeroplane cannot travel into space?
3. What is a rocket?
4. How does a rocket travel in space?

Method:

- Ask students what they know about the solar system. Ask them the names of the planets and try to develop their interest in discussing the topic. Discuss the history of space exploration, if possible show pictures of first human who travelled in space.
- Explain different tools and telescopes used in space exploration. Start with a brief history of the telescope and the fact that the Italian scientist Galileo Galilei first developed a telescope in about the year 1600.
- Show a picture of an astronaut and discuss how astronauts look after themselves in space. Explain that only rockets can go into space because they carry their own supply of liquid fuel. They travel at a very fast speed to overcome the Earth's gravity, and they orbit the Earth at the same velocity.
- Show the students pictures of spacecraft and astronauts. Explain that a spacecraft has its own life-support system, which provides food, air, and water to the astronauts.
- Ask: How do astronauts survive in space? Explain that the spacesuit that an astronaut wears keeps their pressure and temperature constant. Discuss the benefits generated by space technology, and the problems that have resulted from space exploration.
- Ask students to research about different space shuttles.
- Give different situations to students and ask them what they think astronauts might have done in such situations.

Assessment

1. Look carefully at these pictures of an astronaut in his space suit. Then answer the questions below.



   a. Which part of the space suit protects an astronaut's face from flying dust and pieces of rock?
   b. How does the astronaut keep cool inside the space suit?
   c. How does the astronaut breathe in space?
   d. Why do you think there are lights attached to the astronaut's helmet?
   e. Why do you think an astronaut wears a camera that sends pictures to the spacecraft and Mission Control?

Reinforcement/homework

Exercise questions 1-5

Answers to the exercise questions

Unit 1

1. The central nervous system consists of the brain and the spinal cord. The central nervous system is a system which receives information from the brain and coordinates and influences the activity of all parts of the bodies.

   Cerebrum is made up of delicate layers of tissues. It is the principal part of the brain and occupies most of the upper part of the brain.

   Cerebellum is made up of deep layers. It is smaller than the cerebrum and is located at the back, mostly underneath the cerebrum.

   Medulla oblongata is located at the base of the brain, it connects the brain and spinal cord.

   The Spinal Cord is a long tube which starts from the brain and passes down through the vertebral column. A network of nerves emerges from the spinal cord.
2. Humans perform different functions and tasks every day. All this is possible because of the amazing and complex nervous system of our body. Information about our surroundings is collected by receptor cells present in the sense organs.
3. Refer to the Students' Book.
4.

Name	structure	functions
Cerebrum	It is made up of delicate layers of tissues. It is the principal part of the brain and occupies most of the upper part of the brain.	Its sensory areas receive impulses from the sensory organs, motor areas control muscle coordination and movement, and associated areas control thoughts, ideas, memory and conversation
Cerebellum	It is made up of deep layers. It is smaller than the cerebrum and is located at the back, mostly underneath the cerebrum.	Controls muscular activity and balance; coordinates between the brain and the spinal cord.

Medulla oblongata	It is located at the base of the brain, it connects the brain and spinal cord.	Controls all involuntary functions like digestion, heartbeat, etc.
The Spinal Cord	It is a long tube which starts from the brain and passes down through the vertebral column. A network of nerves emerges from the spinal cord.	These nerves connect all the parts of the body with the spinal cord, which is, in turn, connected to the brain.

5. Nerves. These are made up of cable-like bundles of nerve cells called neurons. Nerve cells receive and send messages between the body and the brain.

   Sensory neurons: They send impulses from sensory receptors to inform the CNS of a stimulus. Sensory neurons have long dendrites and short axons.

   Motor neurons: They send impulses from the CNS to the muscle, organ or gland they command to take action. Motor neurons have short dendrites and long axons.

6. The automatic responses of our body are called reflex actions. There are many actions which you do without consciously thinking about them. In general, the spinal cord sends these messages. Sometimes, the subconscious part of the brain takes part in making these decisions.

7. A voluntary action is an action which is in our control. We initiate it by your own conscious to perform actions like running, walking. The brain sends impulses from it to the muscles or glands through the spinal cord.

   An involuntary action is an action which is not in our control. The spinal cord sends these messages. Sometimes, the subconscious part of the brain takes part in making these decisions.

8. The removal of urine is accomplished by the urinary tract, this is called excretion. The excretory system removes metabolic wastes from the body. In humans, this includes the removal of liquid nitrogenous waste in the form of urine, and the solid wastes especially from the breakdown of food.

9. Kidney not only functions as the excretory organ but also regulates water and salt balance in the body. Kidney makes sure that the concentration of the blood stays more or less constant. It is important because changes in the amount of water in the blood and tissue fluid can have adverse effects on body cells. If there is more water in the blood, then the water may move into the cells by osmosis causing them to swell up or perhaps even to burst. If the blood is too concentrated (with less water) water will move out of the cells causing them to shrink. In both cases cell's metabolic activities are disturbed.

10. Refer to the Students' Book.

11. Renal Stones: A kidney stone is a solid mass that forms from the crystals of calcium, magnesium, and uric acid, which separate from the urine and get deposited on the kidney walls.

    Kidney Infection: a person's kidneys may stop working properly due to kidney infection. This might be due to an infection in the kidneys. Complete failure of the kidneys allows urea and other waste products to accumulate up in the blood.

    Diabetes: refer to the Students' Book.

12. Kidney Dialysis: A patient whose kidneys are near to failure, is connected to a dialysis machine. The dialysis machine takes over the role of the kidneys and removes waste substances from the blood.

    Kidney Transplant: kidney machines are not a permanent remedy, a better and long term solution for kidney failure is a kidney transplant.

13. Refer to the Students' Book.

14. i. nervous system
    ii. cerebrum
    iii. central nervous system
    iv. kidneys
    v. nephrons

15. i. true
    ii. false
    iii. true
    iv. false
    v. false

Unit 2

1.

Mitosis	Meiosis
Cell divide once	Cell divide twice
Parent cell produces two daughter cells	Parent cell produces four daughter cells
Daughter cells have the same number of chromosomes as the parent cell	Daughter cells have half number of chromosomes as the parent cells
Controls growth in living things	Controls genetic factors from parents to offspring

2. Refer to the Students' Book.

    Chromosomes are thread like structures in the nucleus which are made up of DNA (deoxyribonucleic acid).

The DNA consists of multiple tiny units known as genes. These contain all the information of an organism which are inherited from their parent cells, and a set of instructions for growth and development.

3. Heredity is the transfer of characteristics or traits from one generation to another or from parents to their offspring.

   Characteristics: long or short hair, black or brown eyes, short or tall body

4. Earlobe attached or detached, black or brown or coloured eyes.
5. Genetic Disorder:
   a. In haemophilia, the ability to control blood clotting is weakened.
   b. In muscular dystrophy, the muscles becomes weak and it becomes difficult for the person to move.
   c. Sickle cell anaemia is a genetic blood disorder in which the shape of the red blood cells is distorted.
   d. In Tay-sachs disease, blindness and muscle degeneration occur before death.
   e. In down syndrome, the offspring suffers physical and mental retardation
6. Refer to the Students' Book.
7. i. Mitosis
   ii. Thread, DNA
   iii. Meiosis
   iv. Heredity
8. i. False
   ii. True
   iii. True
   iv. True
   v. false

Unit 3

1. Biotechnology is the use of living organism to make, or improve the quality of products for industrial and other purposes.
2. Bactria grow and a multiply quickly and they do not have a true nucleus instead it has one double strand of DNA in a ring shape. Bacteria are used by biotechnologists to introduce a new gene into an organism. Due to the simple structure of the bacteria makes it easy for scientists to change their genes, and then introduce them into an organism. See diagram in the Students' Book for reference.
3. Fertilizers, soaps, detergents, and bioplastics.

4. Genetic modification can be used to produce crops that contain higher amounts of vitamins to improve their nutritional quality. Biotechnology is also used to alter the content of many oil crops, either to increase the amount of oil or to alter the types of oils they produce. Biotechnology could also be used to upgrade plants.
5. Healthcare: Genetically engineered plants and animals are used to produce medicines. Diabetes is a disorder in which the body's blood glucose levels remain too low or too high. It can be treated by injecting insulin. Nowadays, most insulin is made by using genetically modified bacteria. Insulin is formed from the DNA of E. coli bacteria for this purpose.

   Biofuels: A biofuel is a fuel made from animal or food waste, wood and alcohol. Vegetable oil or alcohol are used in cars, sometimes mixed with petrol. It is called gasohol. Methane, a natural gas is produced by fermentation. It is called biofuel.

   Livestock: Biotechnology is used to increase the breeding in health of animals which help animals to produce more meat. Genetically engineered species of cattle give large quantities of milk. Hens lay more and larger eggs.

   Food and Drink: Cheese and bread are biotechnological products. Yeast is used in baking bread. Which makes bread dough rise. This also improves its flavour and quality.
6. i. biotechnology
   ii. genetic engineering
   iii. Bacteria
   iv. GMOs
   v. Genetic Engineering
7. i. True
   ii. False
   iii. False
   iv. False
   v. True

Unit 4

1. i. Pollutants are unwanted substances harmful for plants and animals.
   ii. Air pollution: When the air is contaminated with harmful pollutants such as dust particles and gaseous chemicals we say that the air is polluted.

   Land pollution: When the land is contaminated with harmful pollutants such as garbage, chemicals and fertilisers, we say that the air is polluted.

   Water pollution: When the water is contaminated with harmful pollutants such as chemicals, garbage and other contamination we say that the air is polluted.

iii. It is the cutting down of trees in the forest to convert it to a non-forest use. Examples of deforestation include conversion of forests to farms, or to use for residential, commercial or industrial purposes.

Due to deforestation, the greenhouse gases in the atmosphere have increased, adding to global warming.

In the absence of trees, the soil is directly exposed to the Sun, making it dry.

The flow of water is disrupted and leads to floods in some areas and droughts in others.

iv. The three ways are:

- Plant a tree.
- Go paperless.
- Recycle and buy recycled products.

v. Carbon dioxide, methane, water vapours which are called greenhouse gases.

vi. Global warming can cause lots of destruction and damage to life on Earth. It can also cause changes in weather. Glaciers are melting much faster which cause flooding in some areas.

2.

Problems	**Causes**	**Effects**	**Prevention**
Acid rain	Toxic gases	destroy forests, kill aquatic animals, and corrode the stone work of historical buildings	Use lead-free petrol in cars. • Keep vehicles in good condition so that they do not emit large amounts of smoke and gases in the air.
Global warming	greenhouse gases	Glaciers are melting much faster which cause flooding in some areas.	• Go paperless. • Recycle and buy recycled products.

Ozone depletion	chlorofluorocarbon (CFC)	Ozone layer is becoming thinner. Ultraviolet rays cause skin cancer, eye and lung diseases	Use lead-free petrol in cars. • Keep vehicles in good condition so that they do not emit large amounts of smoke and gases in the air.
Greenhouse effect	greenhouse gases	Global warming. Glaciers are melting much faster which cause flooding in some areas.	Use lead-free petrol in cars. • Keep vehicles in good condition so that they do not emit large amounts of smoke and gases in the air.

3. Gases such as carbon dioxide, sulphur dioxide and oxides of nitrogen are released into the air in large quantities by factories and motor vehicles. These gases dissolve in rainwater and form acid rain. Acid rain can destroy forests, kill aquatic animals, and corrode the stone work of historical buildings.
4. There are two types of natural resources:
   a. Renewable Resources: Renewable resources are water, air and plants. These are produced again.
   b. Non–renewable Resources: These are the resources which are difficult to produce again. Like fossil fuel, and minerals. We use fuel like, oil, gas or coal and due to an increase in human population, these uses are increasing day by day.
5. The following steps should be taken by each one of us:
   - Plant more trees.
   - Reuse, recycle, and reduce
   - Turn off electrical appliances when not in use.
   - Use public transport.
   - Use more renewable energy resources.
6. Refer to the Students' Book.
7. Refer to the Students' Book.

Unit 5

1. i. When elements are chemically combined and a new substance is formed, this process is called a chemical reaction. In a chemical reaction atoms are rearranged.

   ii. A subscript is a number which shows how many atoms of an element are in a molecule. A coefficient shows how many molecules there are of a particular chemical taking part in a chemical reaction.

   iii. According to the law of conservation of mass "mass can neither be created nor it is destroyed but it can be changed from one type to another type of substance in a chemical reaction."

   Total mass of the reactant = Total mass of the product

   iv.

   a. The reactions in which heat is absorbed are called endothermic reactions. Endothermic reactions take in energy from the surroundings.

   b. Exothermic reactions transfer energy to the surroundings. The energy is usually transferred as heat energy, causing the reaction mixture and its surroundings to become hotter.

   v . Refer to the Students' Book.

2. i. Addition reaction

   ii. Displacement reaction

   iii. Double displacement reaction

   iv. Displacement reaction

3. i. magnesium + oxygen → magnesium oxide

   ii. sodium hydroxide + hydrochloric acid → sodium chloride+ hydrogen

   iii. silver nitrate + sodium chloride → sodium nitrate + silver chloride

   iv. calcium oxide + water → calcium hydroxide

4. i. $N_2 + 2O_2 \rightarrow 2NO_2$

   ii. $Mg + 2HCl \rightarrow MgCl_2 + H_2$

   iii. $2H_2 + O_2 \rightarrow 2H_2O$

   iv. $Mg + FeSO_4 \rightarrow MgSO_4 + Fe$

5. i. $H_2 + Cl_2 \rightarrow 2HCl$

   ii. $2Na + Cl_2 \rightarrow 2NaCl$

   iii. $2K + 2H_2O \rightarrow 2KOH + H_2$

   iv. $2Li + O_2 \rightarrow 2Li_2O$

Unit 6

1. i. They are sour in taste. They change the colour of the indicators. For instance, they turn the blue litmus paper red.
   ii. They are bitter in taste and have a soapy touch. They change red litmus paper blue.
   iii. Most of them are soluble in water. They melt and boil at very high temperatures.
2. i. 2,6,7,8,13
   ii. Salt solution is neutral. Acidic solution and alkaline solution can be coloured or colourless
3. Properties of acid: They are sour in taste. They change the colour of the indicators. For instance they turn the blue litmus paper red.

   Properties of alkalis: They are bitter in taste and have a soapy touch. They change red litmus paper blue.

   Properties of salts: Most of them are soluble in water. They melt and boil at very high temperatures.
4. i. True
   ii. False
   iii. True
   iv. False
   v. False
   vi. True
5. i. Lemons, oranges, vinegar
   ii. Watermelon, Apples, Tomatoes
   iii. Sour
   iv. Acid because it has sour taste
   v. Dark green
   vi. Neutralization reaction
6.

Litmus	**Soft drink**	**Nitric acid**	**Sodium hydroxide**	**Salt solution**
Red	Red	Red	Blue	No change
Blue	Red	Red	Blue	No change

7.

Solution	Colour of universal indicator	pH	Type of solution
Soft drink	orange	4	acidic
Soap solution	Dark green	8	alkaline
Milk	yellow	6	acidic
Water	Light green	7	neutral
Drain cleaner	Dark blue	13	alkaline

8. i. Acid+ alkali→salt+ water
   ii. acid+ metal →salt+ hydrogen
   iii. $Ca(OH)_2(aq) + 2NH_4Cl(aq) \rightarrow CaCl_2 + 2H_2O(l) + 2NH_3(s)$
   iv. $2HNO_3(aq) + CaCO_3 \rightarrow Ca(NO_3)_2(aq) + CO_2(g) + H_2O(l)$
   v. Hydrochloric acid + sodium hydroxide→sodium chloride+ water
9. Stomach contains hydrochloric acid. Refer to the Students' Book.

Unit 7

1. i. Force is a type of energy. Force can make an object move. Push and pull, stretch and throw are different forces.
   ii. An object thrown in the air always return to the ground due to gravity.
   iii. The pressure of the air is called atmospheric pressure. Atmospheric pressure is the highest near the sea level. At high altitudes air particles become less therefore, pressure is decreased.

   Air pressure is measured with an instrument called barometer.
   iv. There are two kinds of barometers:
      a. Mercury barometer: The mercury barometer is heavy because it is full of mercury.
      b. Aneroid barometer: The aneroid barometer is light and has no mercury in it. It is easier and more convenient to use. It consists of a flexible metallic box. When air pressure is exerted on the box, the needle on the dial moves to indicate the reading.
   v. The pressure in the aerosol is higher than the atmospheric pressure. When the plunger of the aerosol spray is pressed the gas moves upward in spray form.
   vi. At high temperature particles of gases collide more and pressure is increased.

2. i. $200N/4m^2=50N/m^2$
   ii. 1000Pa
3. i. A container with 500 particles.
   ii. A balloon with 1000 particles
   iii. A container with 500 particles at 100°C
4. i. False, the force which attracts objects to the Earth is called gravity.
   ii. False ,we say work has been done when force is applied in one direction
   iii. False, the pressure in the aerosol is higher than the atmospheric pressure.
   iv. False, the higher the source of water, the greater is the pressure.
   v. True
5. i. Less
   ii. Pressure
   iii. Newton, N
   iv. Square meter, m^2
6. i. Camel walks easily on sand because camel has less pressure because of flat feet.
   ii. Hikers face difficulty in breathing at high altitudes because oxygen is less.
   iii. More force is required to push a heavy object because mass is more.
7. Refer to the Students' Book.

Unit 8

1. a. 40 ml b. 65 ml c. 124 ml d. 72ml
2. Teacher supervision required.
3. system international unit, S.I unit
4.

Physical quantity	**S.I Unit**	**Symbol**
Time	second	s
Length	meter	m
Mass	kilogram	kg
Volume	litre	l

5. a. In order to observe the reading on the scale, your eye must be in correct position i.e. vertically above the reading. If the eye is not in the correct position then the error occurred is called Parallax error.
   b. When liquid is poured into a measuring cylinder, the liquid forms a curved surface on the top. This curved surface is known as a meniscus. Most liquids

curve downwards. To observe the reading on graduating cylinder accurately, the position of the eye must be at the same level as the meniscus. The meniscus of the mercury curves upward.

c. The prefixes are used to express smaller and bigger physical quantities. It is more convenient to express smaller quantities in small units.

6. a. A meter rule is one meter long graduated wooden stick. The meter rule is calibrated in centimetres and millimetres. It can measure the least value up to 0.1 cm or 0.01mm. To measure long distances like length and breadth of a park or field we use measuring tapes. Measuring tapes measure length in centimetres and meters.

   b. It is a long narrow cylinder made up of glass or plastic. It is calibrated in ml. It comes in different sizes 10ml, 25ml, 50ml and 100 ml. A measuring cylinder is used to measure a volume of liquids. The least count of measuring cylinder is 0.5 ml.

7. a. Conical Flask: It is used to heat, store and mix liquids.

   b. Volumetric Flask: It is used to contain a precise volume of liquid at a particular temperature. It is also used for preparing a standard solution with precise dilution.

   c. Round bottom Flask: It is used to boil the liquids. Its narrow neck prevents splash exposures.

8. When liquid is poured into a measuring cylinder, the liquid forms a curved surface on the top. This curved surface is known as a meniscus. Most liquids curve downwards. To observe the reading on graduating cylinder accurately, the position of the eye must be at the same level as the meniscus. The meniscus of the mercury curves upward.

Unit 9

1. i. Refer to the Students' Book.

   ii. Sources of Heat

      a. The Sun: The main source of heat energy is the Sun.

      b. Fire: Fire is produced by lightning and burning of fuels such as petroleum, natural gas and coal.

      c. Electricity: Electricity can be converted into heat energy.

      d. Friction: The heat produced by rubbing hands is due to friction. Sun

   iii. Heat is a form of energy. It is the energy that flows from a hot body to a cold body while temperature is the degree of hotness or coldness.

iv. Refer to the Students' Book.

v. Refer to the Students' Book.

vi. Objects expand when heated because particles move apart. Objects contract when cooled because particles come close to each other.

2. Materials expand on heating specially metals.

   Materials: A metal ring, a metal ball which cannot pass through the ring.

   Method: Heat the ring and try to pass the ball through the ring. Ball will pass through the ring because ring is expanded.

3. a. Convert 70°C into K 70°C +273=343K

   b. Convert 250°C into °F (250 °Cx9/5)+32=482°F

   c. 30 K into °F 30K-273=-243°C (-243 x9/5)+32=-405.4°F

   d. 200 K into °C 200K-273=-73K

   e. 150 °F into K 5/9 x (150°F – 32) = 20°C 20°C +273=293K

4. Temperature is the degree of hotness or coldness. It is measured with a thermometer.

5. Teacher supervision required.

6. Bonding two metals with dissimilar thermal expansion coefficients can produce useful devices for detecting and measuring temperature changes.

7.

A	B
Contraction	Takes place when objects cool because particles come close to each other
Bimetallic strip	It is made when two different metals are joined together
Temperature	Is the measure of hotness or coldness of an object
Heat energy	Flows from a hot body to a cold body

Unit 10

1. i. Centre of Curvature and Principal Axis: The line, P1 P2 joining C1 and C2 is called the principal axis.

   ii. Pole: The point where the principal axis meets the surface is called a pole.

   iii. Principal Axis: Centre of curvature is also called principal axis. The line, P1 P2 joining C1 and C2 is called the principal axis.

   iv. Refer to the Students' Book.

2. Refer to the Students' Book.

3. i. Concave lens: It is thinner in the middle and diverges (disperses) the light rays. It is also called a diverging lens. It causes a beam of parallel rays to diverge after refraction.

   Convex lens: It is thicker in the middle and converges (concentrates) the light rays. It is also called converging lens. A convex lens bends light rays inward, which results in the object being perceived as larger or closer.

   Refer to the Students' Book for the diagrams.

   ii. Refer to the Students' Book.

   iii.

Human eye	**Camera**
Actual shape of the lens changed naturally to focus.	The lens is moved closer or farther to focus an image by a button.
The retina in a human eye is not uniformly sensitive.	A film in a camera is uniformly sensitive to light.
Image is made on a retina.	Image is formed on a film.
In a dark location the eye has more sensitivity than a camera.	In a bright light camera cannot properly capture the image which becomes blurred.

   iv. Uses of Lenses
   - A camera uses a lens to focus an image on photographic film.
   - The magnifying lenses can enlarge the images.
   - Lenses are used in spectacles and binoculars.
   - Telescope is an optical device in which lens is used.
   - The lenses are used in microscopes so that minute organisms can be seen.
   - Lenses are used in the projector.

   v. Refer to the Students' Book.

4. i. Convex lens

   ii. Convex lens

   iii. Long-Sightedness: (Hyperopia)

   iv. Short-Sightedness: (Myopia)

5. Refer to the Students' Book.
6. Refer to the Students' Book.
7. See above for answer.

8. a. Concave lens: It is thinner in the middle and diverges (disperses) the light rays. It is also called a diverging lens. It causes a beam of parallel rays to diverge after refraction.
   b. Convex lens: It is thicker in the middle and converges (concentrates) the light rays. It is also called converging lens. A convex lens bends light rays inward, which results in the object being perceived as larger or closer.
9. Refer to the Students' Book.
10. Refer to the Students' Book.
11. Refer to the Students' Book.

Unit 11

1. i. Electricity can be produced by moving a magnet around a copper coil. A stronger current can be produced by increasing the rounds of coil or the speed with which the magnet is moved.
   ii. Coal, gas or petrol is burnt in power stations. The steam produced as a result of burning, is used to move the turbines which generate electricity.
   iii. Our main source of energy is the Sun. Many countries produce electricity using heat and light from the Sun. This is an easy, cheap and pollution-free method of producing electricity. Light energy from the Sun is collected, and converted into electricity with the help of solar cells.
   iv. Batteries and cells are the safest means of producing electricity through a chemical reaction.
   v. Nuclear energy is obtained by splitting the nucleus of an atom into parts. This process is called nuclear fission. Very high amount of heat is liberated during this process. This heat is used to produce steam which moves the turbines connected to electrical generators. This is how electricity is produced.
2. Refer to the Students' Book.
3.

Direct current (DC)	**Alternating current (AC)**
Is an electric current which flows only in one direction.	Is an electric current which periodically reverses direction.
Some sources of DC power are dry cells, batteries, thermocouples, solar cells and dynamos.	It is the form of electrical energy that is used when we plug kitchen appliances, televisions

4. Answer depends on the students.
5. i. Tarbela, Mangla and Warsak.
   ii. Solar

iii. Fission
iv. Karachi
v. Parallel

6. Dynamos: One simple example of a generator is the bicycle dynamo. The dynamo has a wheel that touches the back tyre. As the bicycle moves, the wheel turns the magnet inside a coil. This induces enough electricity to run the bicycle's lights. The faster the bicycle moves, the greater the induced current and the brighter the lights. Refer to the Students' Book for the diagram.
7. Problems of Generating Electricity:
   a. Thermal power stations waste more energy than they produce. Most energy is lost as heat energy during cooling the water and waste gases. In a typical coal burning power station only about 35% of the energy in its fuel is converted into electrical energy.
   b. Production of carbon dioxide and acid rain due to the burning of fossil fuels.
   c. Hot water from power stations when dumped into rivers or the sea cause an increase in the temperatures of water causing harm to the living organisms in it.
   d. Nuclear fuel if not disposed of carefully can also be extremely harmful to the ecosystems.
8. Any electronic system can be considered to consist of three parts:
   a. Input sensor
   b. Maintaining processor
   c. Output transducer
9.
   a. AC can be changed to DC by an adopter that you use to power your battery. DC can be stored in batteries but AC cannot be stored.
   b. A converter is a device that changes alternating current to direct current or vice versa.
   c. A rectifier changing alternating current to direct current. Rectifier is use to recharge the batteries of mobile phones, iPods, digital cameras and other small devices.
   d. A power inverter does the opposite, changes the flow of the charge from direct current to alternating current.

Unit 12

1. i. Neil Armstrong
   ii. 1608 , Galileo
   iii. Robotic space crafts

iv. America, Russia, Japan and Europe

v. football field

2.

Year	Event
1957	the inception of space age
1958	the first U.S. satellite that went into space
1969	the exploration of the Moon
1990	five astronauts deployed a telescope into the Earth's orbit
2000	the first piece of space station was launched into the Earth's orbit

3. i. Spectroscope: is a machine or a vehicle designed to fly into space. The spacecraft is sent into space for different purposes including Earth observation, communication, planetary exploration, navigation and transportations of cargo and humans.

   ii. Artificial satellite: When a robotic spacecraft is orbiting around any other object, it is called artificial satellite.

   iii. Reflecting telescope: The light is analysed by breaking into its components, this technique is called spectroscopy. The scientist observed that every element responsible for a certain pattern or spectrum. This helps them to study the elements that make up the stars. A spectroscope is equipped with a camera to record velocities and to accurately measure the wavelengths of the spectral line.

4. Refer to the Students' Book.

5. The spacecraft: is a machine or a vehicle designed to fly into space. The spacecraft is sent into space for different purposes including Earth observation, communication, planetary exploration, navigation and transportations of cargo and humans

   The space shuttle: is a transport used to carry an astronaut into the space, and come back to the Earth and be re-launched into the space again. Each time the shuttle is launched, it is called a mission.

6. An international space station is made and used by collaboration of different countries.

7. The images which were captured by telescopes on the Earth were not clear. The images were distorted by the Earth's atmosphere. To overcome this problem, in the 1940s an astronomer Lyman Spitzer was the first to propose the observatory above the position of the Earth. The images received from this observatory would be a lot sharper because it would be able to detect light from the stars, galaxies and other objects in space before the light got absorbed by the atmosphere. On April 25 1990,

five astronauts deployed a telescope into the Earth's orbit roughly 380 miles (600 Km) above the Earth's surface. This telescope is named as Hubble Telescope.

8. The spacecraft is a machine or a vehicle designed to fly into space. The spacecraft is sent into space for different purposes including Earth observation, communication, planetary exploration, navigation and transportations of cargo and humans. There are two types of spacecraft
   a. Robotic Spacecraft: is less risky as it does not have any human. They are used to support scientific research. They collect data and can travel in most dangerous areas. Some robotic spacecraft are programmed and some can be controlled from the Earth. Voyager 1 and Voyager 2 are the example of robotic spacecraft, which was used to collect data from Mars and Jupiter. When a robotic spacecraft is orbiting around any other object, it is a called artificial satellite.
   b. Manned Spacecraft: is designed to take a human crew into space. These spacecraft are designed more sophisticatedly. It has everything that is required for human survival. It has a built-in washroom, thermal control system, oxygen, food and water
9. Astronauts survive in space by:
   a. Keeping Healthy.
   b. Maintaining personal hygiene.
   c. Eating nutritious meals
   d. Getting enough sleep.

Notes

Notes

انسان کی تصویر دکھایئے۔

خلائی تحقیق (space exploration) میں استعمال ہونے والے مختلف آلات (tools) اور خردبینوں (telescopes) کے بارے میں بیان کیجیے۔

طلبا سے کہیے کہ مختلف خلائی شٹلز (space shuttles) کے بارے میں تحقیق کریں۔

بحث کیجیے کہ خلاباز یا خلانورد (astronauts) خلا میں اپنی دیکھ بھال کیسے کرتے ہیں۔ طلبا کو مختلف حالات یا صورت ہائے احوال (situations) دیجیے اور پوچھیے کہ ان کے خیال میں ان حالات میں خلابازوں نے کیا کیا ہوگا۔

کلاس میں مدعو کیا جاسکتا ہے، یا پھر ٹیچر بینائی کی خرابیوں سے متعلق چارٹ دکھائیں۔
خردبین (microscope) کے ذریعے طلبا کو ایک پتّے یا پیاز کے خلیے (cells) دکھایئے۔

باب 11

ہر تصوّر کو سرگرمیوں اور روزمرّہ زندگی سے لی گئی مثالوں کی مدد سے تفصیلی طور پر بیان کرتے ہوئے یہ سبق پڑھایا جائے۔
طلبا پر واضح کیا جائے کہ بجلی گھروں (power stations) میں بجلی کی بڑے پیمانے پر پیداوار (large-scale production) میں بنیادی طور پر توانائی کے دو قسم کے ذرائع یا مآخذ (sources) استعمال ہوتے ہیں، قابل تجدید (renewable) اور ناقابل تجدید (non-renewable)۔ قابل تجدید (renewable) مآخذ یا ذرائع وہ ہیں جنھیں آسانی سے بدلا یا بحال (replace) کیا جا سکتا ہو جیسے ہوا، پانی، شمسی توانائی (solar)، مدوجزری توانائی (tidal) اور جیوتھرمل (geo thermal) ناقابل تجدید ذرائع وہ ہیں جنھیں ایک بار استعمال کر لینے کے بعد مختصر وقت میں بدلا یا بحال نہ کیا جاسکتا ہو۔ ان میں تمام اقسام کے رکازی ایندھن (fossil fuels) کوئلہ، تیل، گیس اور ایٹمی ایندھن (nuclear fuel) شامل ہیں۔
چھوٹے پیمانے (small-scale) پر بجلی کی پیداوار خشک سیل (dry cells) اور بیٹریوں (batteries) میں کیمیائی طریقے اور گھریلو جنریٹروں (domestic generators) اور ڈائنمو (dynamo) میں میکانیکی (mechanical) طریقوں کے استعمال سے کی جاتی ہے۔
آلٹرنیٹ کرنٹ (اے سی) (alternating current) اور ڈائریکٹ کرنٹ (ڈی سی) (direct current) میں فرق ایک بہت اہم تصوّر ہے جسے واضح طور پر سمجھنے کی ضرورت ہوتی ہے۔اس موضوع کے لیے ذہنی طور پر تیار کرنے کی سرگرمی (warm up activity) کے طور پر طلبا سے کہیے کہ وہ اپنے اطراف ان آلات (devices) کی نشان دہی کریں جو اے سی اور ڈی سی کرنٹ سے چلتے ہیں۔
طلبا سے کہا جاسکتا ہے کہ بڑے پیمانے پر بجلی کی پیداوار کے لیے توانائی کے مختلف ذرائع کے استعمال کے فوائد (advantages) اور نقصانات (disadvantages) پر ایک اسائنمنٹ تحریر کریں۔ طلبا سے کہا جاسکتا ہے کہ توانائی کے ماخذ یا ذریعے (source) پر تفصیلی تحقیق کریں اور پھر کلاس میں پریزنٹیشن دیں۔
تمام الیکٹرانی نظاموں (Electronic systems) میں تین بنیادی جزو، ان پُٹ (input)، آؤٹ پُٹ (output) اور پروسیسر یونٹ (processor unit) ہوتے ہیں۔ مختلف آؤٹ پُٹ ڈیوائسز جیسے کمپیوٹر، گھڑیاں، کلاک، کیلکولیٹر، موبائل فون وغیرہ ہماری روزمرّہ زندگی میں عام استعمال ہو رہے ہیں۔

باب 12

طلبا سے پوچھیے کہ نظام شمسی (solar system) کے بارے میں وہ کیا جانتے ہیں۔ سیاروں (planets) کے نام پوچھیے اور سبق پر اظہار خیال کرنے کے سلسلے میں طلبا میں دل چسپی اُبھارنے کی کوشش کیجیے۔
خلا کو کھوجنے یا خلائی تحقیق (space exploration) کی تاریخ پر بحث کیجیے، اگر ممکن ہو تو خلا کا سفر کرنے والے سب سے پہلے

موسم میں جمنے_ پگھلنے (freeze-thaw) کے عمل یا کیفیت کو ice wedging کے مراحل کو ظاہر کرتے کارڈز کی مدد سے بیان کیا جائے گا۔

طلبا کو ٹھوس کے پھیلنے اور سکڑنے کے اثرات اور اطلاق (effects and applications) سے آگاہ کرنے کے لیے انھیں جرائد (magazines) کے مختلف تراشے (clippings) یا انٹرنیٹ سے لی گئی تصاویر دکھایئے۔ (ریل کی پٹریوں، کھمبوں سے لٹکتی تاروں، جار کو کھولنے کی تصاویر دکھایئے)۔

دو دھاتی پٹی (bimetallic strip) دکھانے کے لیے مختلف رنگ کی دو کاغذی پٹیاں استعمال کی جائیں گی اور ٹیچر اس (دو دھاتی پٹی) کا استعمال بیان کریں گی۔

کلاس میں مختلف اقسام کے تھرمامیٹر لے کر آیئے اور ان کے درمیان فرق بیان کیجیے۔

مختلف تھرمامیٹرز کی مدد سے پانی کا نقطۂ انجماد اور نقطۂ کھولاؤ (freezing and boiling point) ریکارڈ کرنے کا عملی مظاہرہ کیجیے۔

طلبا کو ہدایت کیجیے کہ فارمولوں کی مدد سے مختلف پیمانوں (scales) کی ایک سے دوسرے میں تبدیلی کی مشق کریں۔

باب 10

اس صفحے پر چھپی ہوئی تحریر کے اوپر ایک عدسہ پکڑے رہیے۔ عدسے کے اوپر سے دیکھتے ہوئے اسے نیچے اور اوپر حرکت دیجیے حتیٰ کہ تحریر بالکل واضح ہوجائے۔

محدّب عدسہ (magnifying glass) دکھایئے، اور کسی دور فاصلے پر موجود جسم مثلاً پرندہ یا عمارت کی عدسے کے ذریعے بنتی شبیہ اس طرح دکھایئے کہ طویل فاصلے سے آتی ہوئی متوازی شعاعوں کو (cylindrical lens) کے ذریعے فوکس (focus) کیجیے۔

طلبا سے کہا جائے گا کہ حقیقی شبیہ (real images) کی تشکیل ظاہر کرنے کے لیے رے ڈایاگرام (ray diagram) بنائیں۔

ایک محدّب عدسہ لے کر آیئے اور حقیقی اور مجازی شبیہ (virtual and real image) کو ظاہر کرنے کے لیے ray diagram بنایئے۔

دونوں قسم کی شبیہوں میں فرق کرنے کے لیے بیان کیجیے کہ ''حقیقی شبیہ'' وہ شبیہ ہے جسے project کیا جاسکتا ہو جب کہ ''مجازی شبیہ'' کی پیمائش نہیں کی جاسکتی۔

یہ تصوّر کرتے ہوئے دماغ میں عدسے کے ذریعے بننے والی شبیہ کو بیان کیجیے کہ روشنی آنکھ تک خط مستقیم (straight line) میں سفر کرتی ہے۔

شبیہوں کے بننے کے عمل کا مظاہرہ کرنے کے لیے جلتی ہوئی موم بتی ایک محدّب عدسے (converging lens) سے مختلف فاصلوں پر رکھیے اور طلبا مشاہدہ کر کے بتائیں کہ پردے (screen) پر کس قسم کی شبیہ بنتی ہے۔

طلبا کو ایک چارٹ پر انسانی آنکھ کی ساخت دکھائی جائے گی اور اس کے مختلف حصوں اور افعال کو زیر بحث لایا جائے گا۔

طلبا کو ایک کیمرا دکھایا جائے گا اور طلبا اس کی امتیازی خصوصیات (points of difference) پر بحث کریں گے۔

بصارت کی خرابیوں (defects of vision) اور آنکھ کی حفاظت کی اہمیت پر گفتگو کرنے کے لیے ماہر امراضِ چشم (optician) کو

خیالات بیان کریں، اور پھر یہ سمجھنے میں ان کی مدد کیجیے کہ دراصل ہو کیا رہا ہے۔
طلبا کے ساتھ ایک جسم یا شے پر عمل کرنے والی دھکیل (push) یا کھنچاؤ (pull) کی قوت پر تبادلۂ خیال کیجیے۔ مقناطیس کا استعمال کرتے ہوئے دکھایئے کہ مقناطیس کے مخالف قطبین (poles) ایک دوسرے کی طرف کشش رکھتے ہیں اور مشابہ (similar) قطبین ایک دوسرے کو دور دھکیلتے ہیں۔
طلبا کے سامنے وزنی اور ہلکی چیزیں جیسے کرسی، میز کھسکایئے اور پھر طلبا سے کہیے کہ وہ اندازہ کریں کہ کمرۂ جماعت میں رکھی ہوئی مختلف اشیا کو اٹھانے کے لیے کتنی قوت درکار ہوگی۔
گیس کے دباؤ کو بیان کرنے کے لیے طلبا سے کہا جائے گا کہ غبارہ پھلائیں۔
دباؤ کے زیر اثر گیسوں کے طرز عمل (behavious) کو بیان کرنے کے لیے سرگرمی 6 انجام دی جائے گی۔
سرگرمی 7 کے عملی مظاہرے سے بلند درجۂ حرارت پر گیسوں کے طرز عمل کا تصوّر واضح ہوجائے گا۔
ہائیڈرولک بریک سسٹم کے چارٹ کی مدد سے ہائیڈرولکس سسٹم کی تشریح کیجیے۔
ایروسول اسپرے کے انداز کار (working) کو ظاہر کرنے کے لیے کلاس میں پرفیوم کی بوتل یا کوئی بھی اسپرے بوتل لے کر آیئے۔

باب 8

کلاس میں زیر بحث لایئے کہ طلبا کے خیال میں سائنسی تحقیقات کس طرح کی جاتی ہیں۔ لیب میں اختیار کیے جانے والے حفاظتی اقدامات کو بیان کیجیے۔
کلاس میں مختلف آلات لے کر آیئے یا طلبا کو اسکول لیب میں لے جایئے اور ان آلات کے استعمالات کی وضاحت کیجیے جیسا کہ نصابی کتاب میں دیا گیا ہے۔
طلبا سے کہیے کہ اپنی کاپیوں یا پنسلوں کو ناپیں اور پھر پیمائش اپنی نوٹ بکس میں درج کریں۔
نصابی کتاب میں دی گئی سرگرمی 1 اور 2 انجام دیجیے۔
اکائیوں (units) کی تبدیلی کو بیان کیجیے اور طلبا سے کہیے کہ سرگرمی 3 انجام دیں۔
طلبا سے کہیے کہ تجربہ گاہ (lab) میں استعمال ہونے والے مختلف آلات اور ان کے استعمالات پر مشتمل چارٹ بنائیں۔

باب 9

حرارت کے مختلف مآخذ یا ذرائع (sources) دکھانے کے لیے ایک موم بتی اور ٹارچ لے کر آیئے۔ طلبا سے کہیے کہ حرارت پیدا کرنے کے لیے اپنے ہاتھوں کو رگڑیں۔
پھیلاؤ (expansion) اور سکڑاؤ (contraction) کو بیان کرنے کے لیے سرگرمی 5 انجام دیجیے۔
مائعات کے پھیلاؤ کا عملی مظاہرہ سرگرمی 6 کے ذریعے کیا جائے گا۔
گیس کے پھیلاؤ کا عملی مظاہرہ سرگرمی 7 کے ذریعے کیا جائے گا۔

مثال کے طور پر جمعی تعامل (addition reaction) کو ظاہر کرنے کے لے مندرجہ ذیل مساوات کا کارڈ بنایئے:

$A + B \rightarrow AB$

تحلیلی تعامل (decomposition reaction) کو ظاہر کرنے کے لیے مندرجہ ذیل مساوات کا کارڈ بنایئے:

$AB \rightarrow A + B$

احتراقی تعامل (combustion reaction) ظاہر کرنے کے لیے کارڈ بنایئے:

$A + BC \rightarrow AC + B$

تعدیلی تعامل (neutralization reaction) کو ظاہر کرنے کے لیے کارڈ بنایئے:

$AB + CD \rightarrow AD + CB$

پانی کو گرم کرکے اس میں نمک حل کرنے کا مظاہرہ کیجیے۔ گرم پانی میں تھرمامیٹر ڈالیے۔ تھرمامیٹر پر بڑھتا ہوا درجۂ حرارت ظاہر ہوگا۔

آئیڈیاز دیجیے اور توانائی اور کیمیائی تعاملات (chemical reactions) کی اہمیت پر تبادلۂ خیال کیجیے۔

باب 6

مختلف اشیا جیسے لیموں، نارنگی، خمیری سفوف (baking powder) اور نمک لے کر آیئے اور طلبا کو ان کے ذائقے اور دیگر خصوصیات کے بارے میں بتایئے۔

طلبا کو سرکے (vinegar) ، بند نالیاں کھولنے والے کیمیکلز (drain unblockers) اور کھادوں (fertilizers) کی تصویریں دکھاتے ہوئے تیزاب، الکلی، اور نمک کے مختلف استعمالات پر بحث کیجیے۔

طلبا سے کہیے کہ مختلف تیزابوں، الکلی اور نمک کے ناموں کی فہرست بنائیں اور ان کے مابین فرق بھی تحریر کریں۔

لیب میں مختلف انڈیکیٹرز، تیزاب، الکلیوں اور نمک کا استعمال کرتے ہوئے رنگت میں تبدیلی کا عمل دکھایا جا سکتا ہے۔

☆ پھر طلبا سے انفرادی طور پر کہا جاسکتا ہے کہ وہ کولا، نمک، صابن، سرکہ اور بیکنگ پاؤڈر کے مختلف محلول چکھیں، یا پھر نصابی کتاب سے سرگرمی 4 بھی انجام دی جاسکتی ہے۔

☆ کلاس میں تعدیلی تعامل (neutralization reaction) پر بحث کیجیے۔

باب 7

سبق کا آغاز طلبا سے قوت (force) کی تعریف دریافت کرتے ہوئے کیجیے، اور پھر قوت کی اصل تعریف کی جانب ان کی رہنمائی کیجیے۔ طلبا سے کہا جاسکتا ہے وہ تجویز کریں کہ قوتیں (forces) کیا کرسکتی ہیں، اور پھر بلیک بورڈ پر طلبا کے جوابات پر مشتمل کلاؤڈ (clous) بنایئے۔

روزمرّہ زندگی سے مختلف صورت ہائے احوال (situations) بیان کیجیے جہاں قوتوں کا استعمال کیا جاتا ہو تاکہ طلبا مختلف صورت حال ر ماحول میں کارفرما قوتوں کو سمجھ سکیں۔ طلبا سے کہیے ہر صورت حال یا سچویشن میں مصروف عمل قوتوں کے بارے میں اپنے

باب 3

تفصیل سے بیان کیجیے کہ بایوٹیکنالوجی کیا ہوتی ہے۔ پھر طلبا سے کہیے کہ بایوٹیکنالوجی کے استعمالات پر چارٹ تیار کریں۔

جینیاتی انجینئرنگ (genetic engineering) پر بحث کیجیے اور پھر ٹیکسٹ باکس میں دیے گئے تصویری خاکے کی مدد سے بیکٹیریا میں جین کی منتقلی کو بیان کیجیے۔

بایوٹیکنالوجی سے بنی مصنوعات (biotechnological products) کی تصاویر دکھایئے اور ان کے بارے میں بیان کیجیے یا پھر طلبا سے کہیے وہ بایوٹیکنالوجی سے بنی جن مصنوعات کے بارے میں جانتے ہیں ان کے ناموں کی فہرست بنائیں۔

طلبا کو بایوٹیکنالوجی کی اہمیت کے بارے میں تحریر کرنے کی ہدایت کر دیجیے۔

باب 4

طلبا سے پوچھیے کہ کیا وہ کبھی پاکستان کے شمالی علاقوں میں گئے ہیں۔ آپ ان سے پوچھ سکتی ہیں کہ انھیں ایسی جگہوں پر جانا کیوں اچھا لگتا ہے۔ بحث کیجیے کہ یہ جگہیں اور مقامات دل کش اور پُرکشش ہیں کیوں کہ یہ صاف ستھرے اور آلودگی (pollution) سے پاک ہیں۔

طلبا کو آلودگی سے پھیلنے والی مختلف بیماریوں (کے اثرات) کی تصاویر دکھائی جاسکتی ہیں۔

زمین کے اطراف اوزون کی تہہ اور گرین ہاؤس گیسوں کو دکھانے کے لیے کلاس میں ایک چارٹ لے کر آیئے۔ عالمی حدت یا گلوبل وارمنگ (global warming) اور تیزابی بارش (acid rain) پر گفتگو کیجیے۔

طلبا کی حوصلہ افزائی کیجیے کہ آلودگی اور اس کے اثرات کے بارے میں پوسٹر بنائیں۔

قدرتی وسائل (natural resources) اور ان کے تحفظ (conservation) کی اہمیت پر طلبا سے بحث کیجیے۔

طلبا سے پوچھا جائے گا کہ ماحول کو صاف ستھرا بنانے کے لیے وہ کیا کر سکتے ہیں، جیسے اسکولوں، سڑکوں اور شہروں کی صفائی ستھرائی میں شریک ہونا۔ ایسی سرگرمیوں میں شرکت کے لیے طلبا کی حوصلہ افزائی کی جائے۔

باب 5

ابتدائی یا افتتاحی سرگرمی کے طور پر کلاس میں ماچس کی ڈبیا (matchbox) لے کر آیئے، اسے جلایئے اور طلبا سے پوچھیے کہ یہ تبدیلی کس قسم کی ہے۔

طلبا سے طبعی اور کیمیائی تبدیلیوں (physical and chemical changes) کی مختلف مثالیں بیان کرنے کا کہیے۔

بورڈ پر ایک کیمیائی مساوات (chemical equation) درج کرنے کے بعد قانون بقائے مادّہ یا بقائے کمیت (law of conservation of mass) کو بیان کیجیے اور کیمیائی مساوات متوازن کرنے کی وضاحت کیجیے۔ انھیں بیان کرنے کے لیے نصابی کتاب میں دی گئی مختلف مثالوں سے مدد لی جاسکتی ہے۔

طلبا کو مختلف کارڈز دکھایئے گی جن پر مساواتوں کی مختلف مثالیں درج ہوں گی۔ ان کارڈز کی مدد سے تصورات کو بیان کیا جائے گا۔ طلبا اپنی نوٹ بُکس میں ان مساواتوں کو درج کر سکتے ہیں۔

نوٹس برائے اساتذہ

باب 1

طلبا کے 5 گروپ بنا کر ایک سرگرمی کا اہتمام کیجیے۔ ہر گروپ کے طلبا سے کہیے کہ وہ اپنی آنکھیں بند کرلیں اور تحریک دینے والے مختلف افعال (stimuli) انجام دیں، مثلاً خوشبو سونگھنا، پھل کو چکھنا، کسی نرم شے کو چُھونا، اور دیکھے بغیر کسی کی شناخت کرنا وغیرہ۔ یہ سرگرمی 5 حسوں اور حسی اعضا کا اعادہ کرنے یا دہرانے (reiterate) میں معاون ہوگی۔

انسانی اعصابی نظام کا بڑا چارٹ دکھایئے اور عصبیوں (nerves) اور خلیوں (cells) کے کردار کو بیان کیجیے۔ اس بات کو یقینی بنایئے کہ طلبا مرکزی اعصابی نظام (central nervous system) (CNS) اور محیطی عصبی نظام (peripheral nervous system) (PNS) کے درمیان فرق کو سمجھ جائیں۔

طلبا کو ہدایت کر دیجیے کہ دماغ کے افعال پر ایک پریزنٹیشن تیار کریں۔ وہ نصابی کتاب میں مذکور دماغ کے ہر حصے کا کردار واضح کریں۔

نصابی کتاب میں دی گئی سرگرمی 1 اعصاب کی ساخت کو بیان کرنے کے لیے کلاس میں بآسانی انجام دی جاسکتی ہے۔

طلبا سے کہا جاسکتا ہے کہ رضا کارانہ اور غیر رضا کارانہ (voluntary and involuntary) افعال کا جدول (table) بنائیں اور دن بھر میں انھوں نے جو سرگرمیاں انجام دی ہیں یا جو کام کیے ہیں اس جدول میں انھیں درج کردیں۔

اگر وسائل موجود ہوں تو گردے کے حصوں کی تشریح کے لیے اسکول لیب میں سرگرمی 2 انجام دیجیے۔

طلبا سے کہیے کہ انسان کے نظام اخراج (excretory system) کا چارٹ بنائیں۔ کچھ طلبا کو نظام اخراج پر پریزنٹیشن دینے کی ہدایت کی جاسکتی ہے۔

گردے کی خرابیوں کے بارے میں انٹرنیٹ سے موزوں ویڈیوز تلاش کیجیے اور طلبا کو دکھایئے یا طلبا سے کہا جاسکتا ہے کہ وہ ان خرابیوں پر تحقیق (research) کرنے کے بعد ایک رپورٹ تیار کریں۔

باب 2

بنی نوع انسان (human beings) میں تغیّرات کو بیان کرنے کے لیے کلاس میں سرگرمی 1 انجام دی جاسکتی ہے۔

طلبا سے کہا جاسکتا ہے کہ وہ اپنا شجرۂ نسب (family tree) بنائیں اور اپنی خصوصیات کے بارے میں جاننے کی کوشش کریں۔

اشکال کی مدد سے بالواسطہ تقسیم یا مائی ٹوسس (mitosis) اور تخفیفی انقسام یا می اوسس (meiosis) کی وضاحت کیجیے اور طلبا سے کہیے کہ مائی ٹوسس اور می اوسس کے درمیان فرق تحریر کریں۔

طلبا سے کہیے کہ اپنی زبانوں کے دونوں کناروں کو موڑ کر گولائی بنائیں۔ کچھ طلبا یہ کر پائیں گے اور کچھ نہیں۔ یہ سرگرمی مکمل ہونے کے بعد خصلت (traits) کا تصوّر بیان کریں۔

طلبا سے کہیے کہ کلاس میں سرگرمی 2 انجام دیں۔

طلبا کو جینیاتی بگاڑ یا خرابیوں (genetic disorders) پر پریزنٹیشن تیار کرنے کی ہدایت کی جاسکتی 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 ردعمل
- ☆ تعمیری/تخلیقی ردعمل
- ☆ کارکردگی کی جانچ
- ☆ ذاتی ابلاغ (personal communication)
- ☆ طلبا کی خود تشخیصی (self-assessment)

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

رہنمائے اساتذہ کے مشتملات اور ترتیب

رہنمائے اساتذہ برائے نیو گیٹ اہیڈ 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 ومحور سابقہ یا پہلے سے موجود معلومات کو کھنگالنا ہے جس میں طلبا کی سرگرم شرکت کی حوصلہ افزائی کی جاتی ہے۔

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

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

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

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

- تحقیق وتفتیش (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 مفصّل ہدایات کے لیے قومی نصاب برائے جنرل سائنس 2006 کا باب 7، صفحہ 55 تا 64 ملاحظہ کیجیے۔

تعارف

نیو گیٹ اہیڈ سائنس سیریز کے لیے تیار کردہ رہنمائے اساتذہ کمرۂ جماعت میں استاد کی معاونت کے لیے ہدایات فراہم کرتی ہیں۔ اِس رہنمائے اساتذہ میں شامل ہے:

- کمرۂ جماعت میں نیو گیٹ 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

نیو گیٹ اہیڈ سائنس کی تدریس کیسے کی جائے

نیو گیٹ اہیڈ سائنس کی مزید تعمیری انداز میں تدریس کے لیے اساتذہ کو مشورہ دیا جاتا ہے کہ طالب علم کو کمرۂ جماعت کا محور بنائیے۔ طلبا کو کمرۂ 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 انھیں 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 انھیں آسانیاں فراہم کیجیے تاکہ وہ زیادہ ذمے داری کے ساتھ اپنا سفرِ آموزش (learning journeys) طے کرسکیں۔ مندرجہ ذیل سطور میں ان تدریسی طریقوں کا خلاصہ کیا گیا ہے جن سے کام لیتے ہوئے کمرۂ جماعت کو زیادہ سے زیادہ طالب علم محور بنانے کے لیے نیو گیٹ 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 / ذمے داریاں تفویض کی جائیں جنھیں انجام دیتے ہوئے وہ آپس میں، اور استاد کے ساتھ تبادلۂ خیال کرسکیں۔ 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 کمرۂ 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 انھیں رہنمائی کی ضرورت ہو؛ پڑھتے، لکھتے اور مخصوص ابواب میں اسباق پر بحث کرتے ہوئے بیشتر وقت طلبا اپنے طور پر کام کریں گے۔