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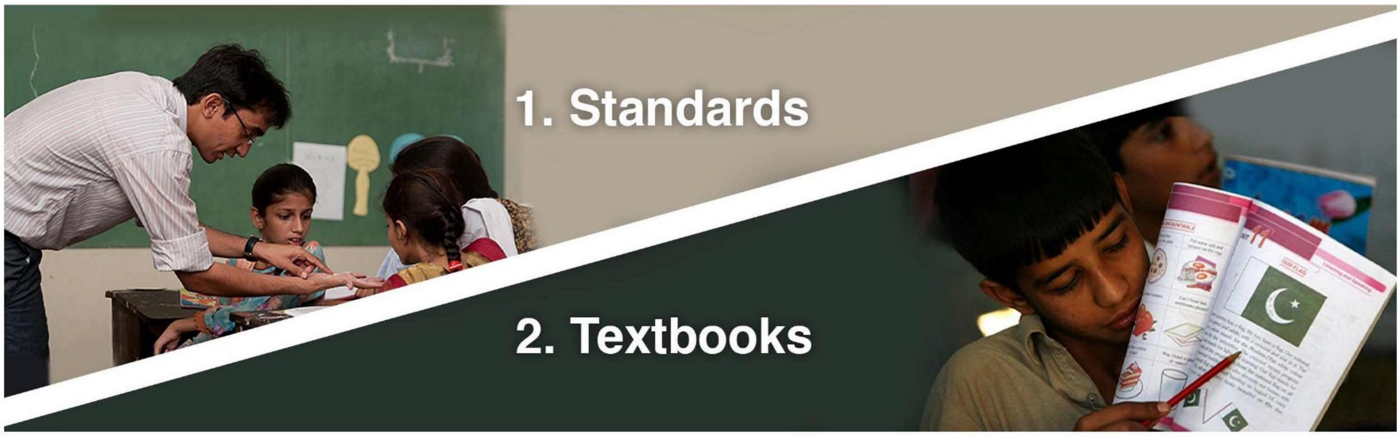
GENERAL SCIENCE (VI-VIII)

2022

FOUR PARTS OF A CURRICULUM:



DIRECTORATE OF CURRICULUM & TEACHER EDUCATION

KHYBER PAKHTUNKHWA ABBOTTABAD

بسم الله الرحمن الرحيم

GENERAL SCIENCE (VI-VIII)

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Science

GRADES 6 - 8

INTRODUCTION

Children are curious and inquisitive by nature. They seek meaning, connection, and understanding, as they interact with the world around them. Pakistani children may live across different geographies, speak different languages, experience different climates, and have access to different resources; however, their innate natural curiosity is a common denominator amongst them. This curiosity is evident when we see a Pakistani child play with a paper plane, roll a rubber tyre, speak into a drain pipe or milk their cow. Little do they know that they are making their first important discoveries about the forces of aerodynamics, friction, and velocity, the reflection of sound, and the profound interdependence between living organisms in their ecosystem, As they expand the wingspan of their paper plane or redirect their tyre to an incline on the road, they are little scientists sans lab coats, engaging in their earliest experiments. The vision of the Single National Curriculum for Science is to nurture this curiosity and help learners meaningfully understand, experience and relate to their world – both natural and human-designed – and the universe.

A scientifically literate workforce is a critical need of Pakistan. Climate change, the global public health crises, social unrest, technology integration and increased automation of work, and mismatch in the demand and supply of skills in the domestic labour market all place unique demands on the 5 year old today, who will likely enter the workforce in the period of 2035-2039. To withstand an uncertain future both rife with challenges and rich with opportunities, requires a scientifically literate person who can think critically, and ideate and design thoughtfully to solve problems and evolve new solutions critical to Pakistan's sustainability as an economy and a nation. To this end, this curriculum has been designed as a structured road map of formal scientific study, with the intent to enable and inspire the next generation of scientists, thinkers, innovators, researchers, teachers, and decision makers.

The Science curriculum document has been designed with the belief that scientific literacy is fundamental to understanding the world around us. It provides guidance for structured learning of Science in schools, and entails a systematic study of the living, physical, material, and technological components of our environment. It aims to provide learners with the skills and vocabulary to process and understand the world in which they live, clarify ideas, ask questions and apply their knowledge and skills in problem solving and decision making such that they can purposely improve the quality of their own lives and those around them. As they graduate from the K-VIII education stream, the curriculum's goal is to equip them with (1) a broad base of scientific knowledge across various domains and disciplines, and (2) develop in them the scientific thinking and learning skills and attitudes that will be beneficial and transferable to their academic, and professional pursuits in future.

This document has been designed to provide teachers, science educators and curriculum designers a summary of key science content and skills that should be taught in each grade in the learner's K-VIII journey. The curriculum is based on a student-centred approach that recognizes how students learn, how scientific learning experiences should be designed, and how learning can be assessed. Students learn science through concrete learning experiences, related to a particular context or situation. The process of learning involves ascertaining what the student already knows, and linking it with new knowledge, making learning relevant to the learner's life and context. The curriculum introduces age appropriate scientific ideas and concepts and these concepts and ideas are progressively extended, in a spiral manner, throughout the primary and middle years.

The Science curriculum features learning outcomes that are further disaggregated into knowledge and skills to emphasize the afore-cited two goals of the curriculum. It also features recommended learning activities and experiences that will aid in acquisition of new knowledge and development of important scientific skills. Moreover, formative and summative assessments have been suggested which will enable teachers and assessment designers to measure student progress vis-à-vis the stated curriculum benchmarks and aspired outcomes.

We hope that through structured study of science guided by this document, students will:

- Develop a critical sense of wonder and curiosity about the world around them;
- Develop a broad base of knowledge about various systems, processes and interactions in the fields of Life Sciences, Earth and Space Sciences, and Physical Sciences;
- Become scientific thinkers and problem solvers, who understand the principles of scientific inquiry and are able to apply them to investigate and understand complex problems and generate new insights, information and solutions;
- Build a deeper, more meaningful connection with nature and the world they live in, and understand, with a sense of responsibility, the role they can play in making it better;
- Become change agents, who are able to apply science and technology to make decisions and take actions to address social, economic, ethical, and environmental issues, and,
- Feel inspired and motivated to pursue careers in science, regardless of their gender, and recognize that a wide variety of careers and entrepreneurship opportunities related to science, technology, and the environment are accessible to them.

GRADES 6-8

STRANDS, CROSS-CUTTING CONCEPTS, and BENCHMARKS

1. STRAND/DOMAIN: LIFE SCIENCES

Students will develop the necessary scientific knowledge skills, values and attitudes forming a basis for their career in various fields of Life Sciences, integrated economy, advanced scientific and technological innovations. A conscious effort has been made to transit from the theoretical to a more advanced and technological application of Life Sciences.

This strand begins and builds from basic to more complex understandings of a system, both at the level of the cell and at the ecosystem level. The concepts of basic science skills, life processes of plants & animals' inheritance, the health and healthy lifestyle, causes and prevention of diseases have also been added. The other major topics developed in this strand include the type of relationships among organisms in a food chain and food web, human impact on the environment and environmental conservation.

Benchmark **By the end of Grade VIII**	**1.** Explain the interdependence of non-living and living components in an ecosystem. **2.** Describe the energy flow and nutrient cycles in an ecosystem. **3.** Communicate solutions that will reduce the impact of humans on land, water, air and/or other living things in the local environment. **4.** Research and describe the structure and function of specialized plant and animal cells including cell division. **5.** Describe how the genetic information stored in DNA, received from parents, determines our physical characteristics. **6.** Describe the structure of DNA and its modification and application in biotechnology in various fields. **7.** Explain the root and shoot system of plants emphasizing the process of photosynthesis, respiration and transpiration. **8.** Compare and contrast the artificial and natural reproduction in plants and investigate ways in which artificial propagation of plants can lead to food production and food security. **9.** Explore and explain the structure and function of major human organ systems and relate them to the basic biological processes required to sustain life. **10.** Explain how the brain controls and coordinates with other organ system(s). **11.** Describe the causes and prevention of infectious diseases and how the natural immune system responds. **12.** Understand the constituents of a balanced diet and analyze the consequences of dietary deficiencies which lead to different disorders. **13.** Compare and contrast the transport system of animals and plants.

2. STRAND/ DOMAIN: PHYSICAL SCIENCES

This strand focuses on students' understanding of what force, motion, and energy are and how these concepts are connected. Major topics developed in this strand include simple machines, motion, energy forms and their transformations, electricity and magnetism. It also focuses on the description of properties of matter, and basic structure of matter. The major topics developed in this strand include concepts related to the basic particle model of matter, physical and chemical changes in metals bonds and chemical reactions.

Students will increase their understanding of the classification of elements in the periodic table. In all grades, students will develop the ability to use appropriate vocabulary related to the physical world to communicate clearly about scientific and technological concepts.

Benchmark **By the end of Grade VIII**	**1.** Analyze the interaction between matter and energy and use the particle model of matter to account for the different states of matter and how they can convert from one state to another **2.** Use evidence to construct an explanation on how energy is transferred, transformed, and conserved. **3.** Practically investigate the nature and constituents of mixtures by applying separation techniques. **4.** Compare elements using the systematic organization of the periodic table, construct formulas and account for the various kinds of chemical bonds in nature. **5.** Distinguish between physical and chemical reactions, types of chemical reactions and acids, alkalis and salts. **6.** Compare types and properties of waves and explain how they interact with matter. **7.** Account for and conduct experiments to investigate the reflective, refractive and absorptive properties of light **8.** Describe the relationships between: electricity and magnetism, static and current electricity, and series and parallel electrical circuits. **9.** Investigate and describe types of forces, including contact forces and forces acting at a distance, such as electrical, magnetic, and gravitational. **10.** Measure and record data from experiments to produce speed-time graphs and interpret them to accurately describe motion. **11.** Account for and evaluate through investigation the relationships between pressure, force and area.

3. STRAND/ DOMAIN: EARTH AND SPACE SCIENCE

In the Earth and space sciences strand, students recognize the relationship between earth, solar system, and the universe. Students are naturally interested in everything around them and mostly focused on understanding the existence level of renewable and nonrenewable energy resources. This curiosity leads them to observe, collect, and record information about the Earth and about objects visible in the universe.

Under this strand, student's attention shifts from the properties of particular objects towards an understanding of the life of the star family with the understanding of formation of galaxies regarding the relevant terms neutron star, black hole and constellation. Students grapple with the importance and methods of obtaining direct and indirect evidence to support critical thinking. By studying the Earth regarding general processes for rock cycle and effect on Earth surface with understanding of relative terms like glaciations, the movement of tectonic plates and volcanic eruptions, etc.

Benchmark **By the end of Grade VIII**	**1.** Identify the Sun as a star and source of light and heat. **2.** Describe the physical features of planets and dwarf planets. **3.** Explain how gravity is the force that keeps objects in the solar system in regular and predictable motion and describe the resulting phenomena. **4.** Describe how black holes can be formed during the life cycle of stars ***5.*** Account for how space exploration is an active area of scientific and technological research and development.

4. CROSS-CUTTING ELEMENTS

Within this scope of content, students will be acquiring skills, attitudes and behaviors as well as creating links between science and their daily life activities. Skills, attitudes and STEAM (Science, Technology, Engineering, Arts and Mathematics) are cross-cutting elements which are interlinked with chapter contents and are reflected in students' learning outcomes. These elements are briefly discussed below:

4.1 Thinking and Working Scientifically

- Identify whether a given hypothesis is testable.
- Make predictions of likely outcomes for a scientific enquiry.
- Plan a range of scientific investigations e.g. observe and classify
- Know the meaning of hazard symbols, and consider them when planning practical work.
- Decide what equipment is required to carry out an investigation.
- Take precise measurements, explaining why accuracy and precision are important.
- Collect and record observations and/or measurements.
- Describe trends and patterns in results.
- Make conclusions from results informed by reasoning.
- Suggest improvements while doing experiments.

4.2 Science in Context

This refers to the students' need for developing the attitudes or 'habits of mind' that are considered essential for a meaningful study of science and its relationship to society.

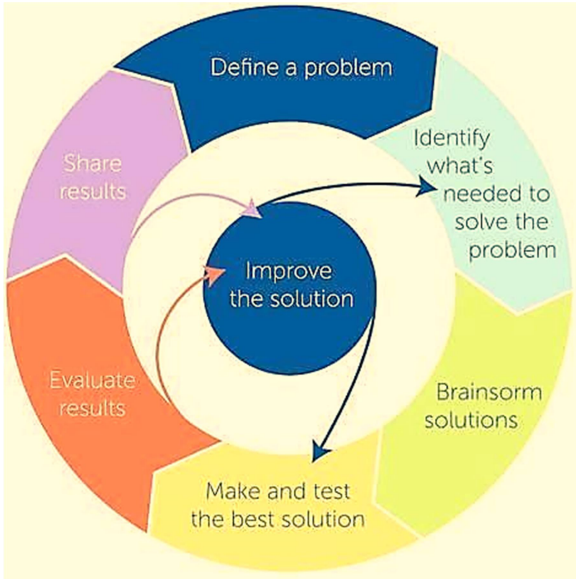
Scientific attitudes have been incorporated into the students' learning outcomes so as to enable them in making informed decisions and demonstrating responsible behaviors.

1. Describe how science is applied across societies and industries.
2. Evaluate issues which involve and/or require scientific understanding.
3. Describe how people develop and use scientific understanding.
4. Discuss how the uses of science can have a global environmental impact.

4.3 STEAM Models, Investigations and Perspectives

STEAM is an interdisciplinary and applied approach on the idea of educating students in four specific disciplines of Science, Technology, Engineering, the Arts and Mathematics. STEAM integrates these disciplines into a cohesive learning paradigm based on real life applications. STEAM planning involves a blend of five disciplines to help students' experience meaningful and deep learning. Through interdisciplinary authentic projects **s**tudents develop an understanding of the nature of science and technology, the relationship between science and technology, and the social and environmental context of science and technology.

By the end of Grade VIII	1. Describe the strengths and limitations of a model. 2. Use symbols and formulae to represent scientific ideas. 3. Use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions to challenges/ inquiry questions. 4. Apply mathematical concepts (for example; percentages and ratios) to analyze data and present the data collected in the form of graphs, charts and tables.



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SNC - General Science (Grades 4-8)
Progression Grid

The following progression grid incorporates specifications from the General Science Curriculum of Pakistan 2020 and globally recognized curricula. Science for grades 4-8 is organized in the following domains:

A. **Life Science**
B. **Physical Science**
C. **Earth and Space Science**

Thinking and Working Scientifically **Overarching SLOs that will be addressed during the course of teaching different scientific concepts.**	
By the end of Grade 5 students should be able to:	**By the end of Grade 8 students should be able to:**

Scientific Enquiry: • Ask questions • Know the five main types of scientific enquiry (observe over time, identify and classify, compare and contrast, fair test, research-by finding information). • Use equipment to carry out scientific investigations. • Take measurements and record them. • Enlist and practice safety procedures while carrying out practical activities. • Make a conclusion from results informed by reasoning.	**Scientific Enquiry:** • Identify whether a given hypothesis is testable. • Make predictions of likely outcomes for a scientific enquiry. • Plan a range of scientific investigations e.g. observe and classify etc. • Know the meaning of hazard symbols, and consider them when planning practical work. • Decide what equipment is required to carry out an investigation . • Take precise measurements, explaining why accuracy and precision are important. • Collect and record observations and/or measurements • Describe trends and patterns in results. • Make conclusions by interpreting results informed by reasoning. • **Suggest improvements while doing experiments.**
Engineering Design Process - STEM/ STEAM **Models and Representations** • Use models to show scientific ideas and what happens in science. • Use a variety of technologies following the design process to identify and solve problems, to interpret data and present the data collected in the form of graphs and charts.	**Engineering Design Process - STEM/ STEAM** **Models and Representations** • Describe the strengths and limitations of a model. • Use symbols and formulae to represent scientific ideas. • Use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions to challenges/ enquiry questions. • Apply mathematical concepts (e.g., percentages and ratios) to analyze data and present the data collected in the form of graphs, charts and tables.

Science in Context:	**Science in Context:**
● Describe how science is used in their local area. ● Identify people who use science, including professionally, in their area and describe how they use science. ● Discuss how the use of science and technology can have positive and negative environmental effects locally and globally.	● Describe how science is applied across societies and industries, and in research. ● **Discuss** issues which involve and/or require scientific understanding. ● Describe how people develop and use scientific understanding. ● Discuss how the uses of science can have a global environmental impact.

Domain A: Life Science

Grade 4	Grade 5	Grade 6	Grade 7	Grade 8
Life processes **Plant structure and function** **Animal structure and function** **Ecosystem - adaptations**	**Structure and function- human body system** **Microorganisms and diseases** **Ecosystem**	**Cellular Organization** **Re-production in plants** **Balanced diet** **Human digestive system**	**Plant systems** **Human respiratory and circulatory system** **Immunity and Diseases**	**Ecology** **Human Nervous system** **Variations, Heredity& Cell division** **Biotechnology**
Organisms - Characteristics and Life Processes of Living Things				
Benchmark I **By the end of Grade 5, students should be able to:** • Describe the life processes of animals and plants.		**Benchmark I** **By the end of Grade 8, students should be able to:** • Research and describe the structure and function of specialized plant and animal cells, including cell division. • Describe how the genetic information stored in DNA, received from parents, determine our physical characteristics.		

[SLO: S-04-A-01] Understand that living things grow, take in nutrients, breathe, reproduce eliminate waste and die.				

[SLO: S-04-A-02] Discuss that living things need energy to grow, live and be healthy, and plants get their energy from light (photosynthesis) while animals get their energy from eating plants and other animals.				
[SLO: S-04-A-03] Explore the requirements of plants for life and growth (air, light, water, nutrients from soil, and room to grow).				

		[SLO: S-06-A-01] Recognize cells as the basic unit of life that are organized into tissues, organs, systems and organisms. [SLO: S-06-A-02] Arrange and rank different levels of cellular organizations – cells to tissues, organs and organisms. [SLO: S-06-A-03] Relate the structures of some common cells (nerve, muscle, epithelium and blood cells) to their functions.		

				[SLO: S-08-A-01] Describe variation and adaptation in living organisms. [SLO: S-08-A-02] Explain and illustrate the differences between variation and adaptation. [SLO: S-08-A-03] Identify sources of variation from environmental and genetic factors. [SLO: S-08-A-04] Explain how different adaptations affects the chances of survivals of different species of organism.

		[SLO: S-06-A-04] Identify the structures present in an animal cell and plant cell as seen under a simple microscope and relate them to their functions (only cell membrane, cytoplasm, nucleus, cell wall, chloroplast, mitochondria and vacuole). [SLO: S-06-A-05] Describe the similarities and differences between the structures of plant and animal cells. Sketch the animal and plant cells and label key organelles in each. [SLO: S-06-A-06] Compare and contrast an animal cell and plant cell by preparing slides using onion peels and cheek cells.		[SLO: S-08-A-05] Recognize Genetics as the study of Heredity and describe heredity as the transfer of genetic information that specifies structure, characteristics, and functions, from parents to offspring. [SLO: S-08-A-06] Differentiate between the concept of genes and chromosomes and relate them to how genetic characteristics are inherited.

				[SLO: S-08-A-07] Describe the composition and structure of DNA. [SLO: S-08-A-08] Design a model of DNA to demonstrate its structure, functions, and various components.
				[SLO: S-08-A-09] Describe cell division and its types – mitosis and meiosis and relate them to the passage of genetic information through reproduction. [SLO: S-08-A-10] Explain the process of mitosis and meiosis and identify their key phases.

2. Organisms - Structure and Functions (Plants) - How plants use their body structures to survive?

Benchmark II: **By the end of Grade 5, students will be expected to:**	**Benchmark II:** **By the end of Grade 8, students will be expected to:**
• Explain how plants use their body structures to survive, identify the parts of plant transport system, and describe their functions. • Describe the parts of the flower and their functions.	• Explain the root and shoot system of plants emphasizing the process of photosynthesis, respiration, and transpiration. • Compare and contrast the artificial and natural reproduction in plants and investigate ways in which artificial propagation of plants can lead to food production and food security.

[SLO: S-04-A-04] Classify the plants into two major groups (flowering, non-flowering), and give examples of each group. [SLO: S-04-A-05] Describe the functions of different parts of flowering plants: Roots, stem/ trunk, leaves and flowers.		[SLO: S-06-A-07] Describe the different types of reproduction of plants. [SLO: S-06-A-08] Compare and contrast types of reproduction (sexual and asexual) in plants. [SLO: S-06-A-09] Distinguish between artificial and natural asexual reproduction in plants. (Budding, grafting, Bulbs, Tuber, Runners, cutting, and layering.) [SLO: S-06-A-10] Inquire how artificial propagation can lead to better quality yield in agriculture.		

[SLO: S-04-A-06] Investigate the way in which water is transported within plants. [SLO: S-04-A-07] Identify the parts of the plant transport system and describe their functions (stem, -leaf, -root). ***Note:*** ***- Recall of the relative positions of water and food carrying tubes is not required.*** ***- The use of specific terms ('xylem' and 'phloem') is not required.***			[SLO: S-07-A-01] Explain the root and shoot system in plants. Label different parts of leaf, stem and root (external and internal structure).	
			[SLO: S-07-A-02] Predict the role of xylem and phloem in transport of water and food in plants by observing the cross section of the stem.	

[SLO: S-04-A-08] Identify the parts of a flower and describe their functions (limited to petals, sepals, anthers, filaments, stamens, stigma, style, carpel, and ovary).			[SLO: S-07-A-03] Define the process of photosynthesis and derive word equation for it. [SLO: S-07-A-04] Know that plants require minerals to maintain healthy growth and life processes (limited to magnesium to make chlorophyll and nitrates to make protein). [SLO: S-07-A-05] Explain that the structure of leaves is adapted to the process of photosynthesis.	
[SLO: S-04-A-09] Explore the role of flowers in the life cycle of flowering plants, including pollination, fruit and seed formation and seed dispersal.				

[SLO: S-04-A-10] Describe seed germination and know that seeds require water and an appropriate temperature to germinate. [SLO: S-04-A-11] Identify stages in the life cycles of common flowering plants.				
[SLO: S-04-A-12] Relate that why plants are vital to sustaining life on Earth.				
[SLO: S-04-A-13] Identify various professions associated with this unit of science. E.g., botanists, farmers, gardeners, florists, etc.			[SLO: S-07-A-06] Describe the process of respiration and write word equation for it. Compare and contrast the processes of photosynthesis and respiration.	

			[SLO: S-07-A-07] Investigate the phenomena of transpiration and its importance in a plant (wind, temperature, light, humidity affecting rate of transpiration in plants).	
			[SLO: S-07-A-08] Explore natural raise of water based on the principle of transpiration.	

3. Organisms - Structure and Functions (Animals)	
Benchmark III: **By the end of Grade 5, students will be able to:** ● Explain how organ systems work together to help human bodies get what they need and carry out life processes. ● Describe that animals receive different types of information through their senses, and respond by processing it in their brains.	**Benchmark III:** **By the end of Grade 8, students will be able to:** ● Compare and contrast the transport system of animals and plants. ● Explore and explain the structure and function of major human organ systems, and relate them to the basic biological processes required to sustain life. ● Explain how the brain controls and coordinates with other organ system(s).

[SLO: S-04-A-14] Distinguish between major groups of animals with backbones (vertebrates: Fish, amphibians, reptiles, birds and mammals) and without backbones (invertebrates: Insects, snails, earthworm, jellyfish and corals) on the basis of their characteristics. [SLO: S-04-A-15] Identify that some animals (spider, crab, beetles) have an exoskeleton.	[SLO: S-05-A-01] Identify that the human body has a number of systems, each with its own function. [SLO: S-05-A-02] Recognize the integration of the different systems (Respiratory, and Circulatory) in carrying out life processes. ***Note: Detailed knowledge of the respiratory system (e.g., alveoli) and circulatory system (e.g., heart chambers and valves) is not required.***		[SLO: S-07-A-09] Differentiate between the processes of respiration and breathing. [SLO: S-07-A-10] Differentiate between aerobic and anaerobic respiration. [SLO: S-07-A-11] Trace the path of air in and out of the body and how the oxygen it contains is used during the process of respiration. [SLO: S-07-A-12] Sketch and label the human circulatory system.	[SLO: S-08-A-11] Identify the organs, functions and processes of the Human Nervous System. [SLO: S-08-A-12] Sketch and label a diagram of the Human Nervous System. [SLO: S-08-A-13] Explain how the brain works as a control station of the human body. [SLO: S-08-A-14] Identify the three major parts of the brain – fore brain, mid brain and hind brain, and describe their various functions. [SLO: S-08-A-15] Describe the structure of the cerebrum, its division into two hemispheres (left and right) and the role of each hemisphere in the control of the body. [SLO: S-08-A-16] Map the various steps in the transmission of messages through the body and to the brain via a reflex arch.

[SLO: S-04-A-16] Describe some of the important functions of the skeleton.	[SLO: S-05-A-03] Use a model to describe how we receive different types of information through our senses, process the information in our brain and respond to the information in different ways.		[SLO: S-07-A-13] Hypothesize how exercises of varying intensity (from rest to high-intensity interval training) would impact their pulse rate, test their hypothesis, calculate their pulse rate and record their findings. [SLO: S-07-A-14] Describe the role and function of major organs in the human respiratory system including trachea, lungs and alveoli (air sacs). [SLO: S-07-A-15] Explain that living organisms have a complex transport system for transfer of various solids, liquids, and gases across the body.	

[SLO: S-04-A-17] Describe the Human Digestive System including the simple functions of the organs involved (mouth, esophagus, stomach, small and large intestine).	[SLO: S-05-A-04] Describe the Human Respiratory System in terms of oxygen from the air moving into the blood in the lungs and know that many vertebrates have a similar respiratory system.	[SLO: S-06-A-11] State the importance of digestion in the human body and describe physical and chemical digestion. [SLO: S-06-A-12] Sequence the main regions of Alimentary Canal, its associated organs and describe the functions of different parts of the Alimentary Canal. [SLO: S-06-A-13] Briefly describe the role of enzymes in digestion.	[SLO: S-07-A-16] Describe the structure and function of the human heart. [SLO: S-07-A-17] Explain how blood circulates in the human body through a network of vessels (arteries, veins and capillaries), and transports gases, nutrients, wastes and heat. [SLO: S-07-A-18] Compare and contrast arteries, veins and capillaries. [SLO: S-07-A-19] Describe the composition of blood and the functions of red blood cells, white blood cells, platelets and plasma.	

[SLO: S-04-A-18] Recognize that humans have different types of teeth (molar, premolar, incisors, canine) and know their functions in digestion of food. [SLO: S-04-A-19] Investigate the causes and prevention of tooth decay and gum diseases.	[SLO: S-05-A-05] Identify by name the main parts of the Human Circulatory System, and describe briefly the functions of the heart, blood vessels and blood.			[SLO: S-08-A-20] Describe the structure of the cerebrum, its division into two hemispheres (left and right) and the role of each hemisphere in the control of the body.
[SLO: S-04-A-20] Identify that many vertebrates have a digestive system similar to humans.	[SLO: S-05-A-06] Identify that many animals have a circulatory system similar to humans.	[SLO: S-06-A-14] Conclude that blood transports the products of digestion to other parts of the body and the undigested products get egested/defecated.		[SLO: S-08-A-21] Explain and represent how messages flow through the body from and to the brain, and how the brain collaborates with the sensory organs to regulate this process. [SLO: S-08-A-22] Predict what would happen if a nerve connection broke.

				[SLO: S-08-A-23] Match various body functions with the relevant part of the brain that controls or regulates them (for instance, associating breathing with the brain stem).

4. Human health and disease	
Benchmark IV: **By the end of Grade 5, students will be expected to:** ● Describe some of the causes of infectious diseases and suggest measures that can control the spread of the diseases. ● Recognize the advantages and disadvantages of microorganisms.	**Benchmark IV:** **By the end of Grade 8, students will be expected to:** ● Describe the causes and prevention of infectious diseases and how the natural immune system responds. ● Understand the constituents of balanced diet and analyze the consequences dietary deficiencies which lead to different disorders.

[SLO: S-04-A-21] Recognize the items of the first aid box.	[SLO: S-05-A-07] Use a first aid box to dress a wound.	[SLO: S-06-A-15] Identify the constituents of a balanced diet for humans as including protein, carbohydrates, fats and oils, water, minerals (limited to calcium and iron) and vitamins (limited to A, C and D), and describe the functions of these nutrients. [SLO: S-06-A-16] Identify the essential nutrients, their chemical composition, and food sources. [SLO: S-06-A-17] Identify and describe essential nutrients' deficiency disorders. [SLO: S-06-A-18] Recognize that a healthy diet contains a balance of foodstuffs. [SLO: S-06-A-19] Correlate diet and fitness.		

	[SLO: S-05-A-08] Define and describe main groups of microorganisms (bacteria, virus and fungi) and give examples of each. [SLO: S-05-A-09] Recognize some common diseases of each group (bacteria, virus and fungi) caused by microorganisms. [SLO: S-05-A-10] Recognize that microorganisms get transmitted into humans and spread infectious diseases. [SLO: S-05-A-11] Differentiate between contagious and non-contagious diseases. [SLO: S-05-A-12] Relate the transmission of common communicable diseases to human contact [SLO: S-05-A-13] Explain some methods of preventing thetransmission of contagious diseases COVID-19 & Polio.		[SLO: S-07-A-20] Explain the various lines of defenses that the body has against pathogens. [SLO: S-07-A-21] Describe the three types of immunity in humans – innate, adaptive, and passive. [SLO: S-07-A-22] Identify the various types of pathogens that cause infectious diseases. [SLO: S-07-A-23] Describe the parts of the immunity system and how they function to produce an immune response. [SLO: S-07-A-24] Illustrate how adaptive immunity develops over time. [SLO: S-07-A-25] Visualize the ways to add additional layers of defense (such as wearing masks, using sanitizers, etc.). [SLO: S-07-A-26] Propose some common strategies for strengthening their immune system.	

		[SLO: S-06-A-20] Briefly describe some major digestive disorders.	[SLO: S-07-A-27] Explain how infectious diseases such as hepatitis, covid-19, typhoid, and dengue are caused /contracted, how they are tested and diagnosed, and how they can be prevented. [SLO: S-07-A-28] Suggest ways in which communities of people can safeguard against the spread of infectious diseases.	
	[SLO: S-05-A-14] Recognize the advantages of microorganisms. [SLO: S-05-A-15] Investigate the role of microorganisms in producing or breaking down/decomposing materials.		[SLO:S07-A-29] Describe the role of vaccines in immunity and explore some strategies on how vaccines can be created.	

5. Ecosystems - Conditions for life on Earth/ Biodiversity and Interdependence

Benchmark V: **By the end of Grade 5, students will be expected to:** • Explore the interaction of living things in an ecosystem. • Use diagrams to explain how energy flows in an ecosystem. • Identify the causes and effects of environmental pollution and suggest measures to reduce it.	**Benchmark V:** **By the end of Grade 8, students will be expected to:** • Explain the interdependence of non-living and living components in an ecosystem. • Describe the energy flow and nutrient cycles in an ecosystem. • Communicate solutions that will reduce the impact of humans on land, water, air and/or other living things in the local environment.

[SLO: S-04-A-22] Recognize that ecosystems (e.g., forests, ponds, rivers, grasslands and deserts) consist of habitats that provide living things with what they need.	[SLO: S-05-A-16] Describe food chains as being made of producers and consumers, and classify consumers as herbivores, omnivores, carnivores, predators, and/or prey.			SLO: S-08-A-24] Describe the role of living things in cycling oxygen and carbon through an ecosystem, citing the processes of respiration, photosynthesis, and combustion. [SLO: S-08-A-25] Relate how oxygen and carbon cycles are complementary processes that bring balance and symmetry to life on Earth. [SLO: S-08-A-26] Describe global warming and explain how threats to the carbon-oxygen balance such as overpopulation, reliance on fossil fuels, and deforestation are contributing to global warming and climate change. [SLO: S-08-A-27] Describe how energy flows from producers to consumers, and how only part of the energy flows from one level of the pyramid to the next.

[SLO: S-04-A-23] Recognize and explain that living things respond to environmental condition	[SLO: S-05-A-17] Describe a food web and its relation to a food chain.			[SLO: S-08-A-28] Draw a food web diagram to illustrate the food relationships between organisms. [SLO: S-08-A-29] Describe and illustrate through examples key ecological relationships between organisms, including competition, predation and symbiosis. [SLO: S-08-A-30] Predict how changes in an ecosystem (e.g., changes in the water supply, the introduction of a new population, hunting, migration) can affect available resources, and thus the balance among populations.

[SLO: S-04-A-24] Describe how plants and animals adapt to environments that are hot, cold, wet and/or dry and describe common physical adaptations of plants (e.g., a thick stem, a waxy coating helps it survive with less water) and animals e.g., colours of animals help in camouflage. [SLO: S-04-A-25] Associate behaviors of animals with the environments in which they live,, and describe how these behaviors help them to survive (e.g., migration and hibernation).	[SLO: S-05-A-18] Explain how human activities add toxic substances to an ecosystem.			[SLO: S-08-A-31] Hypothesize what would happen in the ecosystem if the population of one of the participants in different ecological relationships is affected. [SLO: S-08-A-32] Explain ways in which human behavior (e.g., replanting forests, reducing air and water pollution, protecting endangered species) can have positive effects on the local environment.

[SLO: S-04-A-26] Explore how human actions such as urbanization and population growth can affect a habitat. [SLO: S-04-A-27] Explain that when a habitat changes, organisms living in it are affected as well.	[SLO: S-05-A-19] Identify that some substances in our environment can be toxic and these substances can move through the food webs/ chains and can be harmful for living things. [SLO: S-05-A-20] Explore the main causes of water, air and land pollution in the local and wider community.			

	SLO: S-05-A-21] Explain the effects of water, air and land pollution. (Unclean/Toxic water, smoke, smog, excess CO/other gases, open garbage dumps, industrial waste, etc.) on the environment and life. [SLO: S-05-A-22] Discuss the effects of burning fossil fuels and releasing greenhouse gases in air. [SLO: S-05-A-23] Differentiate between biodegradable and non-biodegradable materials and their impact on the environment.			

6. Biotechnology	
	Benchmark VI: **By the end of Grade 8, students will be expected to:** ● Describe the structure of DNA, its modification and application, in biotechnology in various fields.

				[SLO: S-08-A-33] Define biotechnology as the use of living cells and organisms in products and processes that can improve the quality of life. [SLO: S-08-A-34] Illustrate how biotechnology is a discipline/field that has the potential to transform how we live. [SLO: S-08-A-35] Discuss the applications of biotechnology in the Pakistani context and their effects on the people and the environment of Pakistan over time. Illustrative examples: bread-making, making of yogurt and cheese, vaccines for immunization, insulin production, dyes, etc.

				[SLO: S-08-A-36] Relate the use of biotechnology in food sciences in producing foods with higher nutritional value and improved taste and quality (how fermentation has been improved by genetically modified organisms or the introduction of certain genes to raise iron content in rice, can be taken as examples).

Domain B: Physical Science

Grade 4	Grade 5	Grade 6	Grade 7	Grade 8
• Matter and its characteristics • Forms of Energy and Energy transfer • Force and Simple machines • Technology in Everyday Life	• Physical and Chemical changes of Matter • Light and Sound • Electricity and Magnetism • Technology in Everyday Life	• Matter as Particles • Elements and compounds • Mixtures • Energy • Electricity • Magnetism • Technology in Everyday Life	• Structure of an Atom • Physical and Chemical Changes • Chemical Bonds • Solutions • Force and Motion • Waves and energy • Heat and Temperature • Technology in Everyday Life	• Periodic Table • Chemical Reactions and Bonds • Acids, Bases and Salts • Force and Pressure • Reflection & Refraction of Light • Electricity & Magnetism • Technology in Everyday Life
Benchmark VII: **By the end of Grade 5, students will be able to:** • Investigate matter and explore its chemical and physical properties through daily life examples. • Recognize the importance of science and technology to solve everyday problems. • Integrate scientific concepts/ STEAM in daily life to improve the quality of their own life and lives of others. • Understand how scientific concepts/ STEAM affect their life and society • Compare the properties of different states of matter and identify the conditions that cause matter to change states.		**Benchmark VII**: **By the end of Grade 8, students will be able to:** • Recognize the importance of science and technology to solve everyday problems. • Integrate scientific concepts/ STEAM in daily life to improve the quality of their own life and lives of others. • Understand how scientific concepts/ STEAM affect their life and society. • Analyze the complexity of matter and energy, particle model of matter, different states of matter and its conversion from one state to another. • Investigate mixtures and apply the separating techniques. • Compare the systematic organization of elements in the periodic table, constructing formula and forming chemical bonds. • Distinguish between physical and chemical reactions, types of chemical reactions and acids, alkalis and salts.		

[SLO: S-04-B-01] Design models of sphere, cube, prism, cylinder and cone with clay or play dough/ environment friendly materials.	[SLO: S-05-B-01] Design a model of a footbridge using the given specifications (e.g can sustain a given weight). [SLO: S-05-B-02] Design a model of a bookshelf using the given specifications (e.g can sustain a given weight, space, materials).			
	[SLO: S-05-B-03] Prepare LED light strings working with 2 volt battery.			
[SLO: S-04-B-02] Identify and describe three states of matter (i.e., a solid has a definite shape and volume, a liquid has a definite volume but not a definite shape, and a gas has neither a definite shape nor a definite volume).				

		[SLO: S-06-B-01] Describe the structure of matter in terms of particles (i.e., atoms and molecules).	[SLO: S-07-B-01] Describe and draw the structure of an atom in terms of electrons, protons and neutrons.	
			[SLO: S-07-B-02] Describe how an atom is electrically neutral	
			[SLO: S-07-B-03] Differentiate between atomic number and mass number.	
			[SLO: S-07-B-04] Determine the atomic number and mass number of elements on the basis of the number of protons, electrons and neutrons.	
			[SLO: S-07-B-05] Show the arrangement of electrons in K, L and M shells of elements And draw the atomic structure of the first eighteen elements of the Periodic Table.	[SLO: S-08-B-01] Recognize Periodic Table as a way of classifying the elements in groups and periods.

			[SLO: S-07-B-06] Draw atomic structures of elements in the Periodic Table.	
		[SLO: S-06-B-02] Describe molecules as a combination of atoms (e.g., H_2O, O_2 & CO_2).	[SLO: S-07-B-07] Explain that the Periodic Table is a way to organize elements in a systematic order.	
		[SLO: S-06-B-03] Recognize the names and symbols for some common elements (first 10 elements of the Periodic Table) and recognize their physical properties.	[SLO: S-07-B-08] Recognize periods and groups in the Periodic Table.	[SLO: S-08-B-02] Identify the names and location of the first 18 elements only.
			[SLO: S-07-B-09] Define valency and explain the formation of ions.	

		[SLO: S-06-B-04] Differentiate that some elements are made of atoms and some elements exist as molecules and have different properties to a single atom of the element.		
		[SLO: S-06-B-05] Explain that compounds are formed by different types of elements joining together chemically forming a new substance.	[SLO: S-07-B-10] Write chemical formulae on the basis of valency of the constituent elements. such as H_2O, NaCl, NH_3, CO_2, etc.	
		[SLO: S-06-B-06] Illustrate the formation of a compound with the help of a word equation.		
		[SLO: S-06-B-07] Distinguish between elements and compounds.		

		[SLO: S-06-B-08] Explore the common elements and compounds in our daily life (Carbon, Nitrogen, Hydrogen, Aluminium, Water, Common salt, Sugar).		
[SLO: S-04-B-03] Compare and sort the materials on physical properties (mass, volume, density, states of matter, conduction of heat and electricity).	[SLO: S-05-B-04] Observe the changes in materials that do not result in new materials (dissolving, crushing).			
[SLO: S-04-B -04] Properties of metals (appearance, texture, color, density, conduction of heat and electricity using daily life examples).		[SLO: S-06-B-09] Categorize elements into metals and non-metals of first 10 elements based on their physical properties.		[SLO: S-08-B-03] Identify properties of metals and non-metals. [SLO: S-08-B-04] Relate the properties to the uses of metals.
		[SLO: S-06-B-10] Explain the Particle Theory of Matter.		

	[SLO: S-05-B-05] Matter can be changed from one state to another by heating or cooling.	[SLO: S-06-B-11] Use particle model of matter to investigate the movement and arrangement of particles in three states.		
		[SLO: S-06-B-12] Explain why gases and liquids take the shape of their containers but solids do not, in terms of the Particle Theory of Matter.		
		[SLO: S-06-B-13] Discuss, using the particle theory of matter, why liquids and gases can flow easily but solids cannot.		

		[SLO: S-06-B-14] Interpret the evidence for the existence of the particles in matter by observing daily life examples (adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water). [SLO: S-06-B-15] Apply the particle theory of matter to explain diffusion.		
			[SLO: S-07-B-11] Differentiate between physical and chemical changes while considering daily life examples.	[SLO: S-08-B-05] Identify chemical reactions and give examples.
			[SLO: S-07-B-12] Recognize that oxygen is needed in combustion, rusting and tarnishing.	[SLO: S-08-B-06] Define the Law of Conservation of Mass and demonstrate the law with an experiment.
			[SLO: S-07-B-13] Explore methods of preventing rusting.	[SLO: S-08-B-07] Write and balance chemical equations.

			[SLO: S-07-B-14] Relate uses of materials to their chemical properties (e.g., tendency to rust, flammability).	[SLO: S-08-B-08] Distinguish between different types of reactions (combination, decomposition, displacement, double displacement, combustion).
			[SLO: S-07-B-15] Evaluate Impact of combustion reaction on environment.	[SLO: S-08-B-09] Distinguish between endothermic and exothermic reactions. [SLO: S-08-B-10] Recognize the importance of exothermic and endothermic reactions in daily life.
			[SLO: S-07-B-16] Relate uses of materials to their physical properties (e.g., melting point, boiling point, solubility, thermal conductivity).	[SLO: S-08-B-11] Design a car that is powered solely by a chemical reaction and can travel.(STEAM)

	[SLO: S-05-B-06] Identify observable changes in materials that make new materials with different properties (e.g., decaying, such as food spoiling, burning, rusting).		[SLO: S-07-B-17] Distinguish between physical and chemical properties of matter. [SLO: S-07-B-18] Physically demonstrate the process of solution formation (using water as universal solvent). [SLO: S-07-B-19] Distinguish among solute, solvent and solution; saturated and unsaturated solution.	

			[SLO: S-07-B-20] Recognize that a chemical bond results from the attraction between atoms and that the atoms' electrons are involved in this bonding.	[SLO: S-08-B-12] Discuss formation of ionic bonds as a result of electrostatic forces between atoms (e. g., NaCl). [SLO: S-08-B-13] Discuss types and formation of covalent bond as a result of mutual sharing of electrons between atoms (e. g., H_2, O_2, N_2). [SLO: S-08-B-14] Name certain ionic and covalent compounds.
				[SLO: S-08-B-15] Draw cross and dot structures showing formation of ionic compounds and covalent compounds.

[SLO: S-04-B-05] Investigate the conditions that cause matter to change states (heating or cooling), and explain the processes associated with it (i.e., melting, freezing, and boiling).		[SLO: S-06-B-16] Explain the changes in states: Melting, freezing, evaporation, condensation, and sublimation, using the particle model of matter.		
	[SLO: S-05-B-07] Compare physical and chemical changes.			
		[SLO: S-06-B-17] Demonstrate that mixtures are formed when two or more substances mix with each other physically without the formation of a new substance.		
		[SLO: S-06-B-18] Identify different types of mixtures.		
		[SLO: S-06-B-19] Describe the difference between elements, compounds, and mixtures.		

		[SLO: S-06-B-20] Differentiate between pure substances and mixtures on the basis of their formation and composition.		
		[SLO: S-06-B-21] Describe alloys as mixtures of metals and some other elements.		
		[SLO: S-06-B-22] Identify and explain examples of common mixtures from daily life.		
		[SLO: S-06-B-23] Justify why air is considered as a mixture of gases.		
		[SLO: S-06-B-24] Demonstrate ways of separating different mixtures.		
		[SLO: S-06-B-25] Demonstrate the process of solution formation (using water as universal solvent)	[SLO: S-07-B-21] Define solubility.	

			[SLO: S-07-B-22] Recognize that the amount of solute which dissolves in a given solvent has an upper limit at a given temperature	
			[SLO: S-07-B-23] Identify the factors which affect the solubility of a solute in a solvent and recognize the importance of these factors in homes and industries.	
			[SLO: S-07-B-24] Explain what is meant by a concentrated and dilute solution.	
			[SLO: S-07-B-25] Identify ways of accelerating the process of dissolving materials in a given amount of water and provide reasoning (i.e., increasing the temperature, stirring, and breaking the solid into smaller pieces increases the process of dissolving).	

			[SLO: S-07-B-26] Explore the effectiveness of various cleaning solutions in cleaning tarnished and oxidized coins. (STEAM)	
			[SLO: S-07-B-27] Make a rock candy with sugar using crystal seeding technique. (STEAM).	
				[SLO: S-08-B-16] Classify acids, bases, and salts and give examples of each.
				[SLO: S-08-B-17] Identify the physical properties of acids, bases, and salts.
				[SLO: S-08-B-18] Define pH and its ranges with reference to indicators.
				[SLO: S-08-B-19] Interpret the pH scale and identify acids, bases, and salts.
				[SLO: S-08-B-20] Describe neutralization reaction with real life examples.

				[SLO: S-08-B-21] Observe and write the uses of acids, bases, and salts in daily life. .

Benchmark VIII: **By the end of Grade 5, students will be expected to:** ● Demonstrate the effects of heat on the states of matter. ● Describe the forms of energy, simple energy transformation and the uses of energy. ● Investigate and describe the flow of electric current in an electric circuit and relationship between electricity and magnetism. ● Demonstrate the characteristics of light and sound with the physical phenomena.		**Benchmark VIII:** **By the end of Grade 8, students will be expected to:** ● Use evidence to construct an explanation on how energy is transferred, transformed, and conserved. ● Compare types and properties of waves and explain how they interact with matter. ● Investigate that light can be reflected, refracted, and/or absorbed. ● Describe the relationships between: electricity and magnetism, static and current electricity, and series and parallel electrical circuits.		
[SLO: S-04-B-06] Recognize the basic forms of energy (light, sound, heat, electrical, and magnetic) as the ability to cause motion or create change.		[SLO: S-06-B-26] Recognize energy as a physical quantity.		
		[SLO: S-06-B-27] Relate potential energy and kinetic energy.		

		[SLO: S-06-B-28] Demonstrate an energy transfer such as a bouncing ball by energy transfer diagram, e.g. gravitational potential energy → kinetic → elastic potential energy + thermal + sound → kinetic → gravitational potential energy, etc.		,
		[SLO: S-06-B-29] State the Law of Conservation of Energy and explain how the law applies to different situations.		
		[SLO: S-06-B-30] Compare the Renewable Energy Sources (wind, water, Sun and plants) and Non-Renewable Sources of energy (coal, natural gas, crude oil).		
		[SLO: S-06-B-31] Identify the advantages of using renewable energy resources.		

		[SLO: S-06-B-32] Assemble and demonstrate a solar panel to operate a small fan. (STEAM) [SLO: S-06-B-33] Design and make a solar water heater. (STEAM)		

[SLO: S-04-B-07] Describe the properties of light (travels in a straight line, travels very fast and in all directions).				[SLO: S-08-B-22] Identify basic properties of light (i.e., speed, transmission through different media, absorption, reflection and dispersion). [SLO: S-08-B-23] Describe and show how an image is formed by the plane mirror. [SLO: S-08-B-24] State the Laws of Reflection. [SLO: S-08-B-25] Describe different optical instruments which use curved mirrors. [SLO: S-08-B-26] Relate the apparent color of objects to reflected or absorbed light. [SLO: S-08-B-27] Explain that light is refracted at the boundary between air and any transparent material. [SLO: S-08-B-28] Distinguish between reflection and refraction of light with daily life examples.

[SLO: S-04-B-08] Relate familiar physical phenomena (shadow, reflection, rainbow) to the behavior of light.				[SLO: S-08-B-31] Investigate that light is made up of many colours. Relate the apparent color of objects to reflected or absorbed light. [SLO: S-08-B-32] Identify spherical mirror Describe the characteristics of image(s) formed by concave mirrors and convex mirrors. [SLO: S-08-B-33] Describe use of different optical instruments in which plane and spherical mirrors are used.
	[SLO: S-05-B-08] Identify natural, artificial light sources.			
	[SLO: S-05-B-09] Sort out luminous and non-luminous objects.			

	[SLO: S-05-B-10] Identify transparent, translucent and opaque objects.			
[SLO: S-04-B-09] Demonstrate the production of sound.	[SLO: S-05-B-11] Demonstrate that sound can travel through different states of matter with different speed.			
[SLO: S-04-B-10] Relate familiar physical phenomena (vibrating objects) to the behavior of sound.	[SLO: S-05-B-12] Describe the structure and discuss the mechanism of the conduction of sound waves.			
[SLO: S-04-B-11] Identify the different sounds on the basis of softness and loudness.	[SLO: S-05-B-13] Describe the intensity of sound.			
	[SLO: S-05-B-14] List the harmful effects of noise on human health. [SLO: S-05-B-15] State the role of humans in reducing noise pollution.			

[SLO: S-04-B-12] Understand temperature as the degree of hotness or coldness of an object or place.				
[SLO: S-04-B-13] Demonstrate that the warmer objects have higher temperature than cooler objects.			[SLO: S-07-B-28] Describe the expansion of the three states of matter on heating, and contraction on cooling, in terms of particles. [SLO: S-07-B-29] Predict the effects of heat gain and heat loss.	
[SLO: S-04-B-14] Demonstrate changes occur when hotter objects are brought closer to the cooler objects.			[SLO: S-07-B-30] Compare all three scales of temperature (including inter-conversion of temperature scales).	
[SLO: S-04-B-15] Describe the ways to measure the temperature and its units.			[SLO: S-07-B-31] Define the terms heat and temperature on the basis of Kinetic Molecular Theory.	

[SLO: S-04-B-16] Use various instruments (room thermometers, anemometer, clinical thermometer, etc.) and measure and record temperature using different scales.			[SLO: S-07-B-32] Explain why metals are good thermal conductors and fluids are poor conductors of heat using the particle model.	
			[SLO: S-07-B-33] Construct the concept of heat conduction, convection and radiation by applying particle theory including daily life examples.	
			[SLO: S-07-B-34] Identify the effects of thermal expansion and contraction with their applications in daily life.	
			[SLO: S-07-B-35] Explain the practical methods of thermal insulation used for constructing buildings.	

[SLO: S-04-B-17] Recognize that electrical energy in a circuit can be transformed into other forms of energy (light, heat, sound).		[SLO: S-06-B-34] Explain the phenomena of static electricity in everyday life.		
[SLO: S-04-B-18] Demonstrate that simple electrical systems (e.g., a flashlight) require a complete (unbroken) electrical pathway.	[SLO: S-05-B-16] Describe flow of electric current in an electric circuit.	[SLO: S-06-B-35] Recognize electric current as a flow of charges.		
		[SLO: S-06-B-36] Describe a simple circuit as a path for flow of charges.		
		[SLO: S-06-B-37] Differentiate between open and closed circuits.		
	[SLO: S-05-B-17] Draw circuit diagram with symbols.	[SLO: S-06-B-38] Draw and interpret simple circuit diagrams (using symbols).		

		[SLO: S-06-B-39] Describe the characteristics of series and parallel circuits. [SLO: S-06-B-40] Draw and construct a series and parallel circuits.		
		[SLO: S-06-B-41] Identify the use of series and parallel electric circuits in daily life.		
		[SLO: S-06-B-42] Investigate the factors that affect the brightness of bulbs or speed of electric motors • Number of batteries • Number of Bulbs • Type of wire • Length of wire • Thickness of wire		
		[SLO: S-06-B-43] Assemble and operate a trip wire security alarm system using simple items. (STEAM)		
				[SLO: S-08-B-34] Define resistance and its SI unit.

				[SLO: S-08-B-35] Define voltage & current state their SI units
				[SLO: S-08-B-36] Formulate that resistance is the ratio of voltage to current.
				[SLO: S-08-B-37] Define electric power and state its unit.
				[SLO: S-08-B-38] Recognize the electric power of various electrical appliances.
				[SLO: S-08-B-39] Recognize the terms earth wire, fuse, circuit breaker.
				[SLO: S-08-B-40] Analyze the danger of overloading and short circuit and identify the importance of earth wire, fuses and circuit breakers.

			[SLO: S-07-B-36] Define a wave. [SLO: S-07-B-37] Compare the types of waves (mechanical and electromagnetic) with daily life examples. [SLO: S-07-B-38] Distinguish between Longitudinal and Transverse waves. [SLO: S-07-B-39] Identify; 1. water wave and Sound wave as mechanical wave; 2. light wave as electromagnetic wave.	

			[SLO: S-07-B-40] Define the terms: Wavelength, frequency, and time period of wave. [SLO: S-07-B-41] Define and relate: 1. Pitch and frequency. 2. Amplitude and frequency. [SLO: S-07-B-42] Explain the factors affecting pitch and loudness of sound.	[SLO: S-08-B-41] List precautionary measures to ensure the safe use of electricity. [SLO: S-08-B-42] Investigate the Factors that affect the strength of an electromagnet. [SLO: S-08-B-43] Describe the properties that are unique to electromagnets (i.e. the strength varies with current, number of coils and type of matter in the core; the magnetic attraction can be turned on and off; and the poles can switch.

			[SLO: S-07-B-43] Compare and interpret waveforms in terms of pitch and loudness. [SLO: S-07-B-44] Construct the inverse relation between time period and frequency [SLO: S-07-B-45] Relate common phenomenon (e.g., echo, hearing thunder after seeing lightning) to the properties of sound.	[SLO: S-08-B-44] Describe briefly the working principles of electromagnetic devices such as speakers and doorbell.

Benchmark IX: **By the end of Grade 5, students will be expected to:** ● Investigate different types of forces and their effects. ● Demonstrate the understanding that simple machines help make motion and work easier. ● Apply scientific skills to solve problems and suggest solutions.		**Benchmark IX:** **By the end of Grade 8, students will be expected to:** ● Investigate and describe types of forces, including contact forces and forces acting at a distance, such as electrical, magnetic, and gravitational. ● Measure and record data from experiments to produce speed-time graphs and interpret them to accurately describe motion. ● Evaluate through investigation the relationship between pressure, force and area.		
			[SLO: S-07-B-46] Describe the effect of force on changing the speed and direction of motion with time.	

			[SLO: S-07-B-47] Define and state the SI unit of force.	
			[SLO: S-07-B-48] Formulate the relationship between speed, distance and time.	
			[SLO: S-07-B-49] State SI (System International) unit of speed.	
			[SLO: S-07-B-50] Calculate average speed.	
			[SLO: S-07-B-51] Interpret a distance-time graph.	
[SLO: S-04-B-19] Describe different types of force (friction, resistance, muscular forces, applied, gravitational, magnetic, electric). [SLO: S-04-B-20] Investigate that friction can either be detrimental or useful under different circumstances (ways to reduce friction).				

[SLO: S-04-B-21] List uses of different types of force in our daily life.				
[SLO: S-04-B-22] Explore how force can move or stop objects, change direction, shape, & speed.			[SLO: S-07-B-52] Give examples of contact forces and non-contact forces.	
[SLO: S-04-B-23] Describe that an object may have multiple forces acting on it, even when at rest. [SLO: S-04-B-24] Compare the effects of force of different strengths in the same or opposite directions acting on an object.				

[SLO: S-04-B-25] Recognize that simple machines, (e.g., levers, pulleys, gears, ramps) help make motion easier (e.g., make lifting things easier, reduce the amount of force required, change the distance, change the direction of the force). [SLO: S-04-B-26] Design hammer, wheels, rollers and gears using clay or playdough/ cardboard/ environment friendly material				
			[SLO: S-07-B-53] Demonstrate that forces always work in action and reaction pairs (equal in magnitude, opposite in direction).	[SLO: S-08-B-45] Recognize that several forces may act on an object and that they may or may not balance each other.
				[SLO: S-08-B-46] Examine the effect of an unbalanced force on an object.

				[SLO: S-08-B-47] Differentiate between floating and sinking objects in terms of density.
				[SLO: S-08-B-48] Define ‘pressure’ with examples and its unit
				[SLO: S-08-B-49] Relate pressure with force and area.
				[SLO: S-08-B-50] Investigate effects related to pressure (e.g., water pressure increasing with depth, a balloon expanding when inflated, etc.)
				[SLO: S-08-B-51] Examine the effect of force in the presence of air pressure.
				[SLO: S-08-B-52] Make a hydraulic elevator. (STEAM) [SLO: S-08-B-53] Build a two stage rocket model. (STEAM)

	[SLO: S-05-B-18] Demonstrate magnets have two poles (opposites attract and like poles repel).	[SLO: S-06-B-44] Explain that electric current has a magnetic field around it using a magnetic compass. [SLO: S-06-B-45] Recognize that a freely-moving magnet comes to rest pointing in a North-South direction.		[SLO: S-08-B-54] Investigate the factors that affect the strength of an electromagnet.
	[SLO: S-05-B-19] Recognize the difference between a magnet and a magnetic material.	[SLO: S-06-B-46] Describe how to magnetize a magnetic material. Describe how to de-magnetize a magnet.		[SLO: S-08-B-55] Describe the properties that are unique to electromagnets (i.e., the strength varies with current, number of coils, and type of metal in the core; the magnetic attraction can be turned on and off; and the poles can switch).

	[SLO: S-05-B-20] Relate properties of magnets (i.e., two opposite poles, attraction/repulsion, and strength of the magnetic force varies with distance) to uses in everyday life (e.g., a directional compass).	[SLO: S-06-B-47] Construct an electromagnet and identify its applications in daily life		[SLO: S-08-B-56] Describe briefly the working principles of electromagnetic devices such as speaker, doorbell.
		[SLO: S-06-B-48] Compare different types of magnets (permanent, temporary and electromagnets).		
	[SLO: S-05-B-21] Construct a magnetic compass. (STEM/STEAM)	[SLO: S-06-B-49] Recognize that there is a space around a magnet where effect of magnetic force can be observed.		
		[SLO: S-06-B-50] Draw magnetic field of a bar magnet using iron filings.		

		[SLO: S-06-B-51] Recognize Earth's magnetic field which attracts a freely pivoted magnet to line up with it.		
Technology in Everyday Life	**Technology in Everyday Life**	**Technology in Everyday Life**	**Technology in Everyday Life**	**Technology in everyday life**

[SLO: S-04-B-27] Use scientific instruments/ apparatus in everyday life (e.g. thermometer, blood pressure apparatus, digital balance, stop watch, calculator, available digital devices). [SLO: S-04-B-28] Use a plumb line to install a flagpole vertically.	[SLO: S-05-B-22] Use scientific instruments /apparatus in everyday life (Use spirit level/water level to level different objects i.e. table, picture, frame etc.). [SLO: S-05-B-23] Practice safety measures for earthquake and fire drill.	[SLO: S-06-B-52] Grow seasonal plants and vegetables in earthen pots and demonstrate the effect of use of fertilizers on the growth of plants. [SLO: S-06-B-53] Prepare yogurt and cheese from milk to demonstrate the beneficial microorganisms. [SLO: S-06-B-54] Design a solar oven to convert solar energy into heat energy. [SLO: S-06-B-55] Assemble a circuit to demonstrate the working of an electric bell.	[SLO: S-07-B-54] Design a model to demonstrate drip & sprinkler irrigation system for conservation of water. [SLO: S-07-B-55] Use different techniques of preserving foods like orange juice, apple jam and pickles. [SLO: S-07-B-56] Make a simple Stethoscope. [SLO: S-07-B-57] Make a sanitizer using suitable substances.	[SLO: S-08-B-57] Make bioplastic from milk and vinegar as an application of biotechnology. [SLO: S-08-B-58] Make toothpaste, soap and detergent as an application of acids and bases in daily life. [SLO: S-08-B-59] Assemble a concave mirror type solar cooker to convert solar energy into heat energy [SLO: S-08-B-60] Assemble and operate a simple wind turbine to produce electricity. [SLO: S-08-B-61] Demonstrate the working of UPS and use it to operate a fan or energy saver bulb.

Domain C: Earth and Space Science

Grade 4	Grade 5	Grade 6	Grade 7	Grade 8
Earth and its Resources **Earth in the Solar System**	**Structure of the Earth** **Soil** **Space and Satellites**	**Solar System**	**Earth & Space**	**Our Universe**
Benchmark X: **By grade V, students will be expected to:** ● Describe the structure of the Earth and recognize that Earth's surface is made up of land, water, and is surrounded by air. ● Identify the Earth's resources that we use in our everyday life and how to conserve them. ● Describes the composition and characteristics of soil types, providing examples of their uses.		**Benchmark X**: **By grade VIII, students will be expected to:**		
[SLO: S-04-C-01] Define natural resources	[SLO: S-05-C-01] Describe the structure of the Earth (i.e., crust, mantle, and core) and the physical characteristics of these distinct parts.			
	[SLO: S-05-C-02] Describe common features of volcanoes and know they are found at breaks in the Earth's crust.			

[SLO: S-04-C-02] Recognize that the Earth's surface is made up of land and water and is surrounded by a layer of air called the atmosphere which is a mixture of different gases (nitrogen, carbon dioxide, and oxygen, etc.).	[SLO: S-05-C-03] Understand that the Earth's crust moves and when parts move suddenly this is called an earthquake.			
[SLO: S-04-C-03] Describe the sources of water on earth.				
[SLO: S-04-C-04] Apply knowledge of changes of state of water to common weather events (e.g., cloud formation, dew formation, the evaporation of puddles, snow, and rain) and understand the Water Cycle.				
[SLO: S-04-C-05] Recognize that most water on Earth is not pure and has dissolved substances in it.	[SLO: S-05-C-04] Identify similarities and differences among the different types of soil and classify them based on their clay, sand, and organic content.			
	[SLO: S-05-C-05] Investigate the composition and characteristics of different soils.			

	[SLO: S-05-C-06] Comprehend that soil composition can change, which can support, or hinder, plant growth.			
	[SLO: S-05-C-07] Identify various causes of soil pollution.			
	[SLO: S-05-C-08] Identify professions related to Earth Science i.e., paleontologists, seismologists, geologists.			

Benchmark XI: **By the end of Grade 5, students will be expected to:** ● Demonstrate the understanding of movement of the Earth, Sun, Moon, Solar System and its relationship. ● Demonstrate how the relationship of the Earth, Sun, and Moon, causes eclipses and moon phases. ● Explore and investigate the importance of space exploration and the uses of various satellites. ● Describes how the Earth spins around its axis in 24 hours resulting in day and night.	**Benchmark X:** **By the end of Grade 8, students will be expected to:** ● Describe the physical features of celestial bodies. ● Explain how gravity is the force that keeps objects in the Solar System in regular and predictable motion and describe the resulting phenomena. ● Describe the formation of black hole in the life of a star ● Recognize space exploration as an active area of scientific and technological research and development.

[SLO: S-04-C-06] Describe the Solar System with the Sun at the center and the planets revolving around the Sun.			[SLO: S-07-C-01] Recognize that the force of gravity keeps planets and moons in their orbits. [SLO: S-07-C-02] Differentiate between mass and weight, using examples of weightlessness experienced by astronauts on the surface of the Moon.	
	[SLO: S-05-C-09] Know that a satellite is an object in space that orbits a larger object and a moon is a natural satellite that orbits a planet.			
		[SLO: S-06-C-01] Differentiate between the characteristics of different planets.		
[SLO: S-04-C-07] Understand that planetary systems can contain stars, planets, asteroids, and comets.		[SLO: S-06-C-02] Identify the characteristics of asteroids, meteorites and comets.		[SLO: S-08-C-01] Explore the terms star, galaxy, Milky Way and the black holes
				[SLO: S-08-C-02] Compare the types of galaxies.

				[SLO: S-08-C-03] Relate the life of a star with the formation of black hole, neutron star. Pulsar White Dwarf, Red Giant.
				[SLO: S-08-C-04] Discuss the birth and eventual death of our sun.
			[SLO: S-07-C-03] Recognize that tides are caused by the gravitational pull of the Moon	
				[SLO: S-08-C-05] Show how information is collected from space by using telescopes (e.g., Hubble Space Telescope) and space probes (e.g., Galileo).
[SLO: S-04-C-08] Recognize that the Earth has a Moon that revolves around it, and from the Earth the Moon looks different at different times of the month (Phases of the Moon).	[SLO: S-05-C-10] Describe the natural satellites of the planets of the Solar System.	[SLO: S-06-C-03] Describe the uses of various satellites in space i.e., geostationary, weather, communication and Global Positioning System (GPS).		

[SLO: S-04-C-09] Investigate and describe how day and night are related to Earth's daily rotation about its axis, and provide evidence of this rotation from the changing appearance of shadows during the day.			[SLO: S-07-C-04] Describe the effects of the Earth's annual revolution around the Sun, given the tilt of its axis (e.g., different seasons, different constellations visible at different times of the year).	
[SLO: S-04-C-10] Illustrate and explain how Solar and Lunar Eclipses occur				
	[SLO: S-05-C-11] Define artificial satellites and explain their importance in exploring the Earth and Space.	[SLO: S-06-C-04] Investigate how artificial satellites have improved our knowledge about space and are used for space research		
	[SLO: S-05-C-12] Recognize the role of NASA (National Aeronautics and Space Administration); explore the contribution of SUPARCO in space exploration.			
			[SLO: S-07-C-05] Describe how seasons in Earth's Northern and Southern Hemispheres are related to Earth's annual movement around the Sun.	

		[SLO: S-06-C-05] Differentiate between planets and dwarf planets.		
	[SLO: S-05-C-13] Predict and comprehend how astronauts explore space, how do astronauts survive and research in space.			
		[SLO: S-06-C-06] Inquire into the sighting of Halley's Comet; describe what they would feel if they saw it.		
	[SLO: S-05-C-14] Identify using secondary sources the key milestones in space technology in the past 10 years.			[SLO: S-08-C-06] Describe advancements in space technology and analyze the benefits generated by the technology of space exploration.
	[SLO: S-05-C-15] Identify professions related to the Earth Science i.e., Astronauts, Physicists, Space Scientists, etc.			

DRAFT

SNC - Science - Grade 6-8

Curriculum Guidelines Grade 6

Below what follows are Curriculum Unit Planners (not lesson plans) to help educators visualize how they could design learning experiences that implement the Curriculum in letter and spirit.

Note: The Units mentioned below are not numbered because they are meant to be flexibility incorporated into the Scheme of Studies of the school. Educators may teach these sample Units in any sequence they find to be suitable.

SNC Grade 6

Thinking and Working Scientifically The following skills will be addressed during the course of teaching different scientific concepts under different units. These are to be integrated with the content SLOs in Life Science, Physical Science and Earth Science domains/ strands.

Students should be able to:

Scientific Enquiry:

- Identify whether a given hypothesis is testable.
- Make predictions of likely outcomes for a scientific enquiry.
- Plan a range of scientific investigations e.g. observe and classify etc.
- Know the meaning of hazard symbols, and consider them when planning practical work.
- Decide what equipment is required to carry out an investigation .
- Take precise measurements, explaining why accuracy and precision are important.
- Collect and record observations and/or measurements
- Describe trends and patterns in results.
- Make conclusions by interpreting results informed by reasoning.
- Suggest improvements while doing experiments.

Engineering Design Process - STEM/ STEAM

Models and Representations

- Describe the strengths and limitations of a model.
- Use symbols and formulae to represent scientific ideas.
- Use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions to challenges/ enquiry questions.
- Apply mathematical concepts (e.g., percentages and ratios) to analyze data and present the data collected in the form of graphs, charts and tables.

Science in Context:

- Describe how science is applied across societies and industries, and in research.
- Discuss issues which involve and/or require scientific understanding.
- Describe how people develop and use scientific understanding.
- Discuss how the uses of science can have a global environmental impact.

DOMAIN: Life Sciences

Grade 6

* The additional/advanced SLOs are written in Italics.

Unit : Cellular Organization

Student Learning Outcomes:

Students will be able to:

- Recognize cells as the basic unit of life that are organized into tissues, organs, systems and organisms.
- Arrange and rank different levels of cellular organizations – cells to tissues, organs and organisms.
- Relate the structures of some common cells (nerve, muscle, epithelium and blood cells) to their functions.
- Identify the structures present in an animal cell and plant cell as seen under a simple microscope and relate them to their functions (only cell membrane, cytoplasm, nucleus, cell wall, chloroplast, mitochondria and vacuole).
- Describe the similarities and differences between the structures of plant and animal cells.
- Sketch the animal and plant cells and label key organelles in each.
- Compare and contrast an animal cell and plant cell by preparing slides using onion peels and cheek cells.

Knowledge:	**Skills:**
● Cells are the basic unit of life that are organized into tissues, organs, systems and organisms. ● Structures of some common cells (nerve, muscle, epithelium and blood cells) to their functions. ● Identify the structures present in an animal cell and plant cell as seen under a simple microscope and relate them to their functions. ● similarities and differences between the structures of plant and animal cells **Key Vocabulary** Cells, tissues, organs, organisms, organelles, cell wall, cell membrane, nucleus, cytoplasm, mitochondria, chloroplast, vacuole, nerve cells, muscle cells, epithelial cells, blood cells, microscope.	Students will be able to: ● Arrange and rank different levels of cellular organizations – cells to tissues, organs and organisms. ● Sketch the animal and plant cells and label key organelles in each. ● Compare and contrast an animal cell and plant cell by preparing slides using onion peels and cheek cells.

Assessments:

Formative Assessments

KWL charts for assessing prior knowledge of students

Discussion questions to address misconceptions

Recording measurements and observations

Oral and written responses

Sequencing picture cards

Entry and Exit tickets

Class Tests including short question answers, labelling diagrams etc.

Self and peer assessments

Marked Quizzes

Presentations

Projects with criteria/ rubrics

Summative Assessments

Are commonly referred to as assessment of learning, in which the focus is on determining what the student has learned at the end of a unit of instruction or at the end of a grade level.

End of unit tests

Projects/ performance assessments

Mid Year-End of Year Exams

Learning Activities

Activity 1

Explain cellular organization through a chart.

Activity 2

Observing the Cellular Tissue Structure of an Onion Cell through a Microscope

Materials:

1. A thin onion membrane,
2. Microscopic glass slides,
3. Microscopic cover slips,
4. A needle,
5. Blotting paper,
6. Dropper,
7. Iodine Solution,
8. Water,
9. Microscope

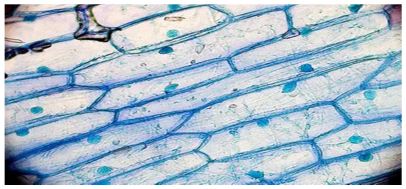
Procedure:

1. Add a drop of water at the centre of the microscopic slide.
2. Having pulled off a thin membrane from the onion layer, lay it at the centre of the microscopic slide (the drop of water will help flatten the membrane).
3. Add a drop of iodine solution on the onion membrane (or methylene blue).
4. Gently lay a microscopic cover slip on the membrane and press it down gently using a needle to remove air bubbles.
5. Touch a blotting paper on one side of the slide to drain excess iodine/water solution.
6. Place the slide on the microscope stage under low power to observe.
7. Adjust focus for clarity to observe.

Observations

- Large, rectangular interlocking cells,
- Clearly visible distinct cell walls surrounding the cells,

- Dark stained nucleus,
- Large vacuoles at the centre,
- Small granules may be observed inside the cells (within the cytoplasm)



onion-cells

Activity 3

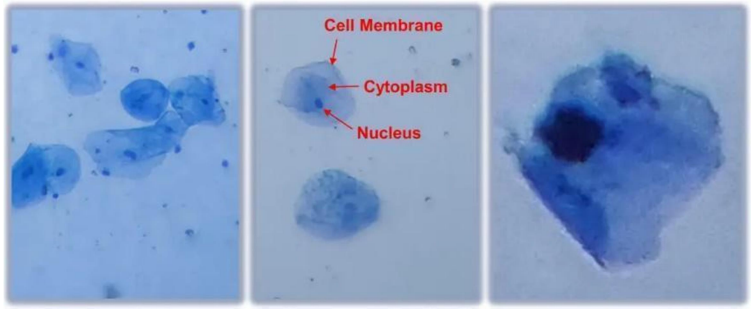
Human Cheek Cell Experiment

Materials

1. Glass microscope slides
2. Plastic coverslips
3. Paper towels or tissue
4. Methylene Blue solution (0.5% to 1% (mix approximately 1 part stock solution with 4 parts of water))
5. Plastic pipette or dropper
6. Sterile, individually packed cotton swabs

Methods

1. Take a clean cotton swab and gently scrape the inside of your mouth.
2. Smear the cotton swab on the centre of the microscope slide for 2 to 3 seconds.
3. Add a drop of methylene blue solution and place a coverslip on top. Concentrated methylene blue is toxic if ingested. Wear gloves and do NOT allow children to handle methylene blue solution or have access to the bottle of solution.
4. Remove any excess solution by allowing a paper towel to touch one side of the coverslip.
5. Place the slide on the microscope, with 4 x or 10 x objective in position and find a cell. View at higher magnification.
6. The cells seen are squamous epithelial cells from the outer epithelial layer of the mouth. The small blue dots are bacteria from our teeth and mouth.



Micro cosmos Cheek cells

Activity 4

1. Ask students to make charts of animal and plant cells and compare them.

References:

- *onion-cells-microscope*. (n.d.). Retrieved from microscopemaster: https://www.microscopemaster.com/onion-cells-microscope.html#gallery[pagegallery]/0/
- (n.d.). Retrieved from microcosmos.foldscope: https://microcosmos.foldscope.com/?p=98800

DOMAIN: Life Sciences

*** The additional/advanced SLOs are written in Italics.**

Unit : Reproduction in Plants

Student Learning Outcomes:

Students will be able to:

- Describe the different types of reproduction of plants.
- Compare and contrast types of reproduction (sexual and asexual) in plants.
- Distinguish between artificial and natural asexual reproduction in plants (budding, grafting, bulbs, tuber, runners, cutting, and layering).
- Inquire how artificial propagation can lead to better quality yield in agriculture.

Knowledge:	**Skills:**
● Types of reproduction (sexual and asexual) in plants. ● Artificial propagation can lead to better quality yield in agriculture. ● Various professions associated with this unit of science. For e.g. botanists, farmers, gardeners, florists **Key Vocabulary:** reproduction, asexual reproduction, sexual reproduction, natural propagation, artificial propagation, cross pollination, fertilization, budding, layering, grafting	Students will be able to: ● Distinguish between artificial and natural asexual reproduction in plants (budding, grafting, bulbs, tuber, runners, cutting, and layering). ● Practice using the techniques of grafting, budding, layering, cutting of plants for growing plants. ● Follow safety measures.

Assessments

Formative Assessments

KWL charts for assessing prior knowledge of students

Discussion questions to address misconceptions

Recording measurements and observations

Oral and written responses

Sequencing picture cards

Entry and Exit tickets

Class Tests including short question answers, labelling diagrams etc.

Self and peer assessments

Marked Quizzes

Presentations

Projects with criteria/ rubrics

Summative Assessments are commonly referred to as assessment of learning, in which the focus is on determining what the student has learned at the end of a unit of instruction or at the end of a grade level.

End of unit tests

Projects/ performance assessments

Mid Year-End of Year Exams

Learning Activities

Activity 1

As your students to work in groups to create charts on the five stages of the life cycle of plants:
seed, germination, growth, reproduction, pollination, and seed spreading.

Activity 2

1. Ask your students to work in groups to dissect flowers and record their observations, working from the outermost whorl to the innermost whorl.
2. In particular, ask them to create and label cross-section diagrams of the dissected flowers, including an explanation of how each part of the flower labelled affects flower reproduction.

Activity 3

1. Ask your students to work in pairs to brainstorm ways that plants are pollinated.
2. When they have finished discussing, have them share their ideas with the class.
3. Discuss, using their ideas as a guide, how the structure of plants contribute to pollination.
4. Ask your students to consider the role of outside sources (insects, other animals, wind etc.) in pollination.
5. Then, on the basis of their observations and the class discussion, ask them to develop their own hypotheses about how flower pollination occurs.
6. Have them write their hypothesis on their observation sheets and tell them to be prepared to share and defend their hypothesis with the class.
7. Time permitting, have a class discussion on various student ideas about how flowers are pollinated.
8. After discussing their hypotheses, have students research how their plant is pollinated.

Activity 4

Guide the student as they conduct seed germination experiments over the span of several weeks.

Activity 5

Bring plants to class that can be grown from parts other than seeds, for example onions, potatoes, ginger, etc.

DOMAIN: Life Sciences

Grade 6

*** The additional/advanced SLOs are written in Italics.**

Unit: Human Digestive System
Student Learning Outcomes **Students will be able to:** ● State the importance of digestion in the human body and describe physical and chemical digestion. ● Sequence the main regions of the Alimentary Canal, its associated organs, and describe the functions of different parts of the Alimentary Canal. ● Briefly describe the role of enzymes in digestion. ● Conclude that blood transports the products of digestion to other parts of the body and the undigested products get egested/defecated.

Knowledge	**Skills**
● Importance of digestion in the human body and describe physical and chemical digestion. ● The main regions of the Alimentary Canal, its associated organs, and describe the functions of different parts of the Alimentary Canal. ● Role of enzymes in digestion. ● Major digestive disorders. ● Blood transports the products of digestion to other parts of the body and the undigested products get egested/ defecated. **Key Vocabulary** digestive system, alimentary canal, physical digestion, chemical digestion, biological catalyst, organs, enzyme, amylase, egested, defecated, feces	Students will be able to: ● Develop a model to show the functions of different parts of the alimentary canal. ● Develop questions to initiate scientific inquiry. ● Investigate the effect of the enzyme amylase on starch solution. ● Make predictions using scientific knowledge and understanding. ● Test predictions with reference to evidence gained. ● Use a range of equipment correctly. ● Compare results with predictions.

Assessments

Formative Assessments

KWL charts for assessing prior knowledge of students

Discussion questions

Oral and written responses

Exit tickets

Class Tests including short question answers, labelling diagrams etc.

Marked Quizzes

Observation of student interaction with lab equipment / apparatus and adherence to usage and safety guidelines

Summative Assessments

Journal to see the connections between different topics about plants

Lab reports prepared by students

Model and presentation of the Alimentary Canal by students

Midterm or Final Exam

Learning Activities

Activity 1

Model of the Alimentary Canal

1. Make a set of recycled materials available to students such as cardboard cut-outs (rectangular), cardboard rolls, tape, scissors, paint etc.
2. Guide the students in making a model of the alimentary canal that shows how each organ is positioned and connected to the next and indicates the pathway of food in the process of digestion from the mouth to the rectum.

Activity 2

Pass the Parcel Role Play

1. Sort students into groups of 7 to 8, where one learner plays the human eating a certain food, while the other 7 play one of the following organs: mouth, pharynx, esophagus, stomach, small intestine, large intestine and rectum.
2. Use a small bowl of shredded paper to indicate the masticated food passed from the mouth and traveling through the alimentary canal.
3. Each learner should act the part of their organ and talk about how they are processing the food onward. Depending on the food item selected by the human, they can be encouraged to speak to the challenge of processing the chosen food.

Activity 3

Jigsaw for Digestive Disorders

1. Sort students into groups of six, where each group becomes the expert of a specific digestive disorder. Depending on the number of students in the class, the number of digestive disorders or number of students in the expert groups can be varied. Recommended digestive disorders are: Diarrhoea, Constipation, Gastroenteritis and Ulcers. Others that may be considered are: Celiac Disorder and GERD.
2. The teacher should prepare a one pager on each disorder, which addresses their causes, symptoms and remedies / prevention strategies.
3. Once the expert group has discussed their disorder and explored answers to the guiding questions, they are then

reorganized into Jigsaw groups where each member represents a different expert group. These experts then brief the rest of their group members on the digestive disorder they have learnt about.

Activity 5: Food Pathways

1. For independent practice, give students worksheets of an unlabeled diagram of the digestive system and have them label organs, and chart the path of food through the various organs through arrows and descriptors of the various processes happening at each step of the process including physical and chemical digestion at various stages, absorption of nutrients, egestion and excretion.

DOMAIN: Life Sciences

Grade 6

*** The additional/advanced SLOs are written in Italics.**

Unit: Balanced Diet
Student Learning Outcomes: **Students will be able to:** 1. Identify the constituents of a balanced diet for humans as including protein, carbohydrates, fats and oils, water, minerals (limited to calcium and iron) and vitamins (limited to A, C and D), and describe the functions of these nutrients. 2. Identify the essential nutrients, their chemical composition and food sources. 3. Identify and describe essential nutrients' deficiency disorders. 4. Recognize that a healthy diet contains a balance of foodstuffs. 5. Correlate diet and fitness. 6. Briefly describe some major digestive disorders.

Knowledge:	**Skills** Students will be able to:

● A healthy diet contains a balance of foodstuffs.
● correlate diet and fitness
● constituents of a balanced diet for humans as including protein, carbohydrates, fats and oils, water, minerals (limited to calcium and iron) and vitamins (limited to A, C and D), and describe the functions of these nutrients.
● Essential nutrients, their chemical composition and food sources.
● Describe essential nutrients' deficiency disorders.
 	
Key Vocabulary
 	
healthy diet, balanced diet, food stuff, nutrients, essential nutrients, proteins, carbohydrates, fats, minerals, vitamins, fiber, deficiency disorders, chemical composition, food source, food habit, calcium, iron, budget,
	● Classify food into food groups.
	● Consult the key recommendations of Pakistan's healthy food guidelines 2019.
	● Deconstruct a meal into food groups and serving sizes.
	● Use available sources of information to know the functions of all the components of a balanced diet e.g.,
	● protein is used for growth and repair
	● fats store energy;
	● carbohydrates (sugar and starch) are an energy source;
	● Present findings in tables and charts citing the source;
	● Create/ design healthy meal menus within a budget;
	● Research the symptoms that they would have, if there is a deficiency of any component;
	  ● vitamin A
	  ● vitamin C
	  ● vitamin D
	  ● iron
	  ● calcium
	  ● fiber
	  ● water
	● Learn how to cook a healthy meal;
	● Learn how to adapt a recipe to make it healthier;
	● Think critically about their own food choices;
	● Identify social aspects that influence healthy and unhealthy food habits.

Assessments

Formative Assessments

KWL charts for assessing prior knowledge of students

Discussions with specific questions / prompts

Oral and written responses

Exit tickets

Class Tests including short question answers, labelling diagrams etc.

Marked Quizzes

Observation of student interaction with lab equipment / apparatus and adherence to usage and safety guidelines

Summative Assessments

Student logs of their eating habits and nutritional plans.

Midterm or Final Exam

Learning Activities

Activity 1: Barrier Game: Mapping Nutrients with their Sources

1. In this activity, students work in pairs and sit back-to-back with each other. Learner 1 has a set of food items that they need to explain to learner 2. They cannot explicitly name the food item but can talk about its smell, shape, taste, color etc.
2. Learner 2 will have a worksheet that will only have the names of nutrients (Carbohydrates, Proteins, Fats, Water, Iron, Calcium and Vitamins (A, C and D).
3. Learner 2 has to guess both the food item Learner 1 is relaying to them and then align them with the nutrients they provide in their worksheet.

Activity 2: My Food Journal

1. Independent Practice: students will prepare a journal of their daily meals, and log all the food they have eaten.
2. After completing one week, they will reflect on their nutritional consumption and identify which nutrients they may not be consuming sufficiently.
3. They will then prepare a plan for the next week with some changes and monitor their nutritional consumption in week 2.
4. Since there are many differences in the quality and quantity of food consumed by students, particularly in classrooms where students come from varying degrees of socioeconomic advantage / disadvantage, parental investment and care etc., this should be guided as an individual reflective activity with no report outs to the larger class.

Activity 3: Jigsaw for Diseases related to Nutritional Deficiencies

1. Sort students into groups of six, where each group becomes the expert of a specific disease caused by a nutritional deficiency.
2. Depending on the number of students in the class, the number of diseases / disorders or number of students in the expert

groups can be varied.

3. Recommended diseases are: Malnutrition (Protein-Energy Malnutrition), Anemia, Goiter and Scurvy. Others that may be considered are: Osteoporosis and Night Blindness. The teacher should prepare a one pager on each disorder, which addresses their causes, symptoms and remedies / prevention strategies.
4. Once the expert group has discussed their disease and explored answers to the guiding questions, they are then reorganized into Jigsaw groups where each member represents a different expert group. These experts then brief the rest of their group members on the nutritional disease they have learnt about.

Activity: Fit for a Queen / King

1. Organize a role play activity in which the whole class participates.
2. One learner can be selected as the King or Queen of the class, while 5-6 students can assume various roles as advisors such as the Royal's fitness instructor, their mother, their doctor etc. Everyone else is vying to become the Royal's new personal chef.
3. Each candidate must pitch an ideal meal to the King, and talk about its nutritional benefits along with its taste and other features.
4. The royal after consulting their advisors will hire their new chef.

DOMAIN: Physical Sciences

Grade 6

*** The additional/advanced SLOs are written in Italics.**

Unit: Matter as Particles
Student Learning Outcomes: **Students will be able to:** ● Explain the Particle Theory of Matter. ● Use a particle model of matter to investigate the movement and arrangement of particles in three states. ● Explain why gases and liquids take the shape of their containers but solids do not, in terms of the particle theory of matter. ● Discuss, using the particle theory of matter, why liquids and gases can flow easily but solids cannot. ● Interpret the evidence for the existence of the particles in matter by observing daily life examples (adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water). ● Apply the particle theory of matter to explain diffusion. ● Explain the changes in states: melting, freezing, evaporation, condensation and sublimation using the particle model of matter.

Knowledge:	**Skills:**
● The Particle Theory of Matter. ● Gases and liquids take the shape of their containers but solids do not, in terms of the particle theory of matter. ● Liquids and gases flow easily. ● The particle theory of matter, why liquids and gases can flow easily but solids cannot. ● Particle Theory of Matter to explain diffusion. ● Explain the changes in state: melting, freezing, evaporation, condensation and sublimation using the particle model of matter. **Key Vocabulary** freezing, melting, evaporation, solidification, condensation, sublimation, diffusion, particles, atoms.	Students will be able to: ● Create models to describe gases, liquids and solids. ● Explore the idea that matter is made of particles that are too small to be seen by observing materials. ● Use a particle model of matter to investigate the movement and arrangement of particles in three states. ● Explain why liquids and gases flow easily. ● Interpret the evidence for the existence of the particles in matter by observing daily life examples (adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water). ● Investigate the factors which affect the rate of evaporation and communicate findings. ● Choose equipment to carry out scientific investigations (burner, beaker, tripod stand etc) to measure the temperature during the heating or cooling of a substance and communicate findings. ● Use models to explain expansion and contraction of matter during these processes. ● Use the particle model to identify changes in melting, freezing, evaporation, condensation and sublimation. ● Make observations about phenomena related to diffusion around them. ● Make predictions of likely outcomes for a scientific inquiry. ● Interpret results using scientific knowledge and understanding.

Assessments

Formative Assessments

- Brainstorming/mind maps/graphic organizers
- Model making (use of wooden/skewer sticks and play dough to make molecules of different compounds)
- Students' responses on exploring simulation activities on web resources
- Activity sheets
- Booklet making (individual or in groups)
- Students' responses during discussion on watching YouTube videos
- Students' responses on demonstration of chemical reactions for making compounds
- Exit tickets (Write one sentence what you have learned today)
- Project

Summative Assessments

- Class tests
- Marked Quiz
- End of unit tests
- Term wise examination

Learning Activities

1. Students should create a mind map showing what they understand by the terms ‘solids’, ‘liquids’ and ‘gases’.
2. Introducing the term ‘particle theory’; ask students: What do you think of when I say particle? Are solids, liquids and gases all made of particles? Are particles everywhere? Ask students to present their understanding of particles in relation to solids, liquids and gases. They can do a poster, a drama activity, or a stand-up talk – key focus is their understanding. When looking at explanations, unpick any misconceptions students may hold.
3. Demonstrate the movement and spacing of particles in solids, liquids and gases using a simulation/web.
4. Use of air freshener to demonstrate the process of diffusion. Students can be asked to come up with examples from daily life.
5. Illustrate that diffusion occurs in liquids and gases (show mixing of ink in water, Opening the Soda/Cold Drinks bottle and the CO_2 diffuses in the air, dipping the tea bags in hot water will diffuse the tea in hot water). Relate it with air pollution (small dust particles or smoke diffuse into the air and cause air pollution).
6. Discuss with students about Brownian motion and how Robert Brown discovered the movement of pollen in water.7. Demonstrate the Brownian motion by using the movement of a pollen on the surface of water using a microscope.
7. Demonstrate changes in states of matter (condensation by putting a saucer on a hot cup of water, evaporation by boiling water and showing steam, melting by putting the ice on a teacher’s table etc.
8. Use photographs/slideshow/flash cards to show examples of changes in state of water. (Clouds and snow, windows with frost, water boiling in a pot etc.) Followed by asking students to identify each process/state.
9. Discuss how wet washing hung on a line outside, dries – and the factors that might affect how quickly it dries. Devise classroom tests for testing the variables affecting drying washing, e.g. one ‘control’ cloth lying on the bench and others, a) on the radiator/heater, b) hanging near the window, c) hanging near the door, d) hanging near a fan, etc.

DOMAIN: Physical Sciences

Grade 6

*** The additional/advanced SLOs are written in Italics.**

Unit: Elements and Compounds
Student Learning Outcomes: **Students will be able to:** ● Describe the structure of matter in terms of particles (i.e., atoms and molecules). ● Describe molecules as a combination of atoms (e.g., H_2O, O_2, & CO_2). ● Differentiate that some elements are made of atoms and some elements exist as molecules and have different properties to a single atom of the element. ● Recognize the names and symbols for some common elements (first 10 elements of the Periodic Table) and recognize their physical properties. ● Explain that compounds are formed by different types of elements joining together chemically forming a new substance. ● Illustrate the formation of a compound with the help of a word equation. ● Distinguish between elements and compounds. ● Explore the common elements and compounds in our daily life-(Carbon, Nitrogen, Hydrogen, Aluminum, Water, Common Salt and Sugar). ● Categories elements into metals and non-metals based on their physical properties.

Knowledge:	**Skills:**
● Structure of matter in terms of particles (i.e., atoms and molecules). ● Molecule as a combination of atoms (e.g., H_2O, O_2 & CO_2). ● Compounds are formed by different types of elements joining together chemically forming a new substance. ● Elements and compounds. ● Names and symbols for some common elements (first 18 elements of periodic table). ● Elements as metals and non-metals based on their physical properties. ● role of common elements and compounds in our daily life-(Carbon, Nitrogen, Hydrogen, Aluminum, Water, Common Salt, Sugar) ● Some elements are made of atoms and some elements exist as molecules and have different properties to a single atom of the element. *(Advanced SLO)* *Describe an atom as an electrically neutral entity.* **Key Vocabulary** atom, subatomic particle, electrons, nucleus, proton, neutron, atomic number, molecule, element, compound, homo atomic molecules and heteroatomic molecules, metals, non-metals, melting point, boiling point, good/poor conductors, ductile, malleable, chemical symbols, chemical formula,	Students will be able to: ● Differentiate between atoms and molecules by making models using play dough/ flour. ● Explore the elements present around us. ● Compare and contrast properties of elements and relate them with their uses. ● Explore the common elements and compounds in our daily life (Carbon, Nitrogen, Hydrogen, Aluminum, Water, Common Salt and Sugar). ● Develop models of atoms and molecules. ● Make a simple poster presenting common elements, their names, and symbols ● Make predictions of likely outcomes for a scientific inquiry. ● Interpret results using scientific knowledge and understanding. ● Draw a conclusion from their findings.

Assessments

Formative Assessments

- Brainstorming/mind maps/graphic organizers
- Model making (use of wooden/skewer sticks and play dough to make molecules of different compounds)
- students' responses on exploring simulation activities on web resources
- Activity sheets
- Booklet making (individual or in groups)
- students' responses during discussion on watching YouTube videos
- students' responses on demonstration of chemical reactions for making compounds
- Exit tickets (Write one sentence what you have learned today)
- Projects

Summative Assessments

- Class tests
- Marked Quiz
- End of unit tests
- Term wise examination

Learning Activities

1. Molecules of water can be made by using wooden toothpicks and play dough (different colours can be used to represent a specific element). Make equal size small balls of play dough. According to the chemical formula of a compound, different students can be assigned different compounds like H_2O, O_2 & CO_2.
2. Students can be asked to play an interactive simulation game 'how to build a molecule'
3. Demonstrate the formation of simple compounds, like burning sugar. Show simple combinations of elements, e.g., burning magnesium or steel wool in air/oxygen. Alternatively, YouTube videos can be shown. Discuss that magnesium combined with oxygen to give magnesium oxide. Students can also heat the mixture of iron filings and sulphur to form a compound iron sulphide.
4. Make a booklet of commonly found elements and compounds and mention their uses.
5. An activity sheet can be used where students can compare and contrast the properties of elements and compounds.

DOMAIN: Physical Sciences

Grade 6

*** The additional/advanced SLOs are written in Italics.**

Learning Activities

(Note: All experiments where light source is used are suggested to be done in a comparatively darker room)

1. A torch or any other light source can be used to show students the incident ray and reflected ray from a surface.
2. students in groups can be asked to measure the angle of incident ray and reflected ray by using a protractor after tracing the path of both rays on a piece of paper.
3. Use of illustrations/flashcards/secondary resources (YouTube videos, simulations) to show how we see the apparent colour of the objects when light is reflected or absorbed light.
4. Project work can be assigned in groups to plan how to use the Law of Reflection to build a working periscope.
5. Students can be asked to explore the speed of light through different mediums. They can make a booklet of different materials and search from the internet about the speed of light, through each of them and conclude their findings.
6. First-hand experience can be given to students about the use of plane mirrors in microscopes and ask them how the law of reflection works here.

DOMAIN: Physical Sciences Grade 6

*** The additional/advanced SLOs are written in Italics.**

Unit: Mixtures
Student Learning Outcomes: **Students will be able to:** ● Demonstrate that mixtures are formed when two or more substances mix physically with each other without the formation of a new substance. ● Identify different types of mixtures. ● Describe the difference between elements, compounds and mixtures. ● Differentiate between pure substances and mixtures on the basis of their formation and composition. ● Describe alloys as mixtures of metals and some other elements. ● Identify and explain examples of common mixtures from daily life. ● Justify why air is considered as a mixture of gases. ● Demonstrate ways of separating different mixtures. ● Demonstrate the process of solution formation (using water as universal solvent)

Knowledge:	**Skills:**
● mixture is an impure substance ● Mixtures are formed when two or more substances mix with each other without the formation of a new substance. ● Different types of mixtures. ● Difference between compounds and mixtures. ● Pure substances and mixtures on the basis of their formation and composition. ● alloys as mixtures of metals and some other element ● examples of common mixtures from daily life	Students will be able to: ● Make mixtures by using different substances and identify the method to separate their contents. ● Conduct an investigation to determine whether the physical mixing of two or more substances results in new substances. ● Compare and contrast different types of mixtures. ● Explore the common mixtures from everyday life. ● Draw some particle diagrams of pure substances/mixtures. ● Show an awareness of applications of the various separation techniques in everyday life and industries.

• Demonstrate the use of different techniques such as filtration, Decantation, evaporation, crystallization, distillation and chromatography for separating mixtures. **Key Vocabulary** homogenous, heterogeneous, evaporation, filtration, distillation, chromatogram, chromatography, solvent, solute, soluble, insoluble, mixture, alloy	• Demonstrate basic principles involved in some separation techniques such as filtration, evaporation and distillation. • Analyze common examples of a mixture. • Justify why air is considered as a mixture of gases • Relate the properties of constituents are used to separate them from a mixture. • Choose equipment to carry out scientific investigations (burner, beaker, tripod stand etc.); • Interpret results using scientific knowledge and understanding; • Draw a conclusion from their findings. • Make a slow sand filter (STEAM project).

Assessments

Formative

Assessments

- KWL charts
- Identification of mixtures through pictures/slideshow
- Students' oral, verbal and written responses
- Exit tickets
- Projects

Summative Assessments

- Class tests
- Marked Quiz
- End of unit tests
- Term wise examination

Learning Activities

1. Display the words or show images of salad dressing, soil and sand. Ask the students if they can think of what these things have in common.

Discuss what mixture is and demonstrate the formation of a few mixtures (salt and water, talcum powder and water, sand and salt, sand and iron filings). Encourage them to give five examples of mixtures from everyday life.

Students in groups can be given water, sugar, salt, rice grains and corn to make two homogenous and two heterogeneous mixtures and present it to the class.

Demonstrate the methods to separate the constituent of mixtures (evaporation, distillation, condensation, sieving, chromatography).

Plan and carry out the preparation of clean dry samples of one or both constituents from a mixture e.g. sand and sugar, sand and salt.

DOMAIN: Physical
Sciences Grade 6

*** The additional/advanced SLOs are written in Italics.**

Unit: Energy
Student Learning Outcomes: **Students will be able to:** ● Recognize energy as a physical quantity. ● State the Law of Conservation of Energy, and explain how the law applies to different situations. Relate potential energy and kinetic energy. ● Demonstrate an energy transfer such as a bouncing ball by energy transfer diagram e.g., gravitational potential energy → kinetic → elastic potential energy + thermal + sound → kinetic → gravitational potential energy etc. ● Compare the renewable energy sources (wind, water, sun and plants) and non-renewable sources of energy (coal, natural gas, crude oil). ● Identify the advantages of using renewable energy sources. ● Assemble and demonstrate a solar panel to operate a small fan. (STEAM) ● Design and make a solar water heater. (STEAM)

Knowledge	**Skills:**
● Energy as a physical quantity. ● Potential energy and kinetic energy can be converted from one to the other. ● Law of Conservation of Energy, and explain how the law applies to different situations. ● Renewable energy sources (wind, water, sun and plants), and non-renewable sources of energy (coal, natural gas, crude oil). ● Advantages of using renewable energy resources. **Key Vocabulary:** energy, potential energy, mechanical energy, renewable, non-renewable, conservation, solar, wind, water, tidal, chemical stores of energy, fuel, energy supplies, joules, chemical energy, elastic energy, potential energy, mass, kinetic energy, light energy, sound energy, friction, principle of conservation of energy, speed, fossil fuel.	Students will be able to: ● Demonstrate an energy transfer such as a bouncing ball by energy transfer diagram, e.g., gravitational potential energy → kinetic → elastic potential energy + thermal + sound → kinetic → gravitational potential energy, etc. ● Examine the various types of renewable energy resources in terms of the sources harvested from; their availability in a given region; dependability. ● Relate the use of energy resources to effects on the environment; advantages and disadvantages. ● Name different renewable energy sources in Pakistan ● Investigate energy conversion from one form to another, and communicate findings. ● Explain how potential energy and kinetic energy can be converted from one to the other. ● Identify different forms of energy with examples from our daily life. ● Make a report on the harmful effects of fossil fuels. ● Assemble and demonstrate a solar panel to operate a small fan (STEAM).

	• Design and make a self - running energy generator (STEAM). • Make a solar powered desalinator. (STEAM).

Assessments
Formative Assessments

- Quiz
- Group task
- Students' oral, verbal and written responses
- Graphic organiser

Summative Assessments

- Class tests
- Marked Quizzes
- End of unit tests
- Term wise examination
- Projects

Learning Activities

1. Distribute paper to each learner to write one sentence that uses the word energy. Give them suggestions such as, “I have lots of energy today,” and “I use energy from oil to heat my house.” Then Distribute poster size paper, have small groups write their sentences on the paper. Encourage groups to add to the list. Display all of the lists so that students can see all of the ideas. Ask students to classify the types of energy listed in the sentences.
2. Show students a poster to identify the forms of energy they could see and also tell where they could see energy transformation.
3. Ask students what they already know about energy, types of energy, energy transfers and the conservation of energy. students make a mind map or poster to record their current understanding.
4. Make a pendulum in the classroom with a ball and thread to demonstrate conservation of energy to students.
5. Make a roller coaster and investigate energy conversion in the roller coaster ride.
6. Make a pinwheel fan and describe it as an example of a renewable energy resource.

Enlist how many energy resources are misused in our daily lives and brainstorm actionable steps they would take as responsible citizens, (citizenship goals/values). Make a solar heater using cardboard and aluminum foil.
Suggested Links for STEM/ STEAM Projects: https://www.teachengineering.org/activities/view/cub_desal_lesson01_activity2 https://www.teachengineering.org/activities/vie

DOMAIN: Physical Sciences

Grade 6

*** The additional/advanced SLOs are written in Italics.**

Standard: Electricity
Student Learning Outcomes: **Students will be able to:** ● Explain the phenomena of static electricity in everyday life. ● Recognize electric current as a flow of charges. ● Describe a simple circuit as a path for flow of charges. ● Differentiate between open and closed circuits. ● Draw and interpret simple circuit diagrams (using symbols). ● Describe the characteristics of series and parallel circuits. ● Draw and construct series and parallel circuits. ● Identify the use of series and parallel electric circuits in daily life. ● Investigate the factors that affect the brightness of bulbs or speed of electric motors: number of batteries, number of bulbs, type of wire, length of wire, thickness of wire. ● Assemble and operate a trip wire security alarm system using simple items. (STEAM)

Knowledge:	**Skills:**
● electric current as a flow of charges ● A simple circuit as a path for flow of charges. ● open and closed circuits ● Symbols of circuit components. ● Characteristics of series and parallel circuits. ● Series and parallel circuit. ● Use of series and parallel electric circuits in daily life. ● phenomena of static electricity in everyday life ● the factors that affect the brightness of bulbs or speed of motors: Number of batteries Number of Bulbs Type of wire Length of wire Thickness of wire **Key Vocabulary** electricity, current, charge, parallel circuit, series circuit, component, wire, bulb, battery, switch, motor	Students will be able to: ● Draw and interpret simple circuit diagrams (using symbols). ● Construct simple circuits. ● Compare and contrast open and closed circuits. ● Predict how the current through the battery with the switch closed compares to the current through the battery with the switch open. ● Construct and compare series and parallel circuits. ● Justify the use of series and parallel electric circuits in daily life. ● Compare the flow of current through different bulbs in a circuit. ● Make predictions about the effect of some variables on the current in a circuit. ● Investigate the factors that affect the brightness of bulbs or speed of motors (number of batteries, number of bulbs, type, length and thickness of wire). ● Make predictions of likely outcomes for a scientific inquiry. ● Interpret results using scientific knowledge and understanding. ● Draw conclusions from their findings (i.e. the current is the same at each place in a series circuit). ● Assemble and operate a trip wire security alarm system using simple items (STEAM).

Assessments

Formative Assessments

- Mind maps
- Role play (students forming a circle to present electric circuit)
- Activity sheet (how circuits work and mention the role of each component of a circuit)
- By students' verbal and written responses
- Discussions and think pair and share (Why would the fairy lights not work if one of the bulbs is removed from the string?)
- Project work (construction of circuits)
- Exit tickets (What are the factors that affect the brightness of the bulb)

Summative Assessments

- Class tests
- Marked Quizzes
- End of unit tests
- Term wise examination
- Projects

Learning Activities

1. Complete a mind map showing what they understand about circuits and their components.
2. Ask students to stand in a large circle around the room. Nominate one learner as the cell and give them a container full of ping pong balls. Tell the class that the ping pong balls represent parcels of energy. Nominate two or three other students to be light bulbs; the rest of the students are parts of the connecting wire. The battery starts to pass out the ping pong balls and they are passed around the circle. The light bulbs pass on some as received but throw some others randomly into room. (risk assessing your choice of 'bulbs' and where they are standing). The balls keep going round and round the circuit until eventually all the ping pong balls will have been thrown out into the room and the battery has nothing left to pass on. Ask the class to look around for the parcels of energy and see that they are still there – they have not disappeared, they have just spread out. That is how an electrical circuit transfers energy. Now nominate two or three students to be insulators – they have to stand with their hands behind their backs, make sure they are between the battery and the first of the bulbs. They cannot pass on the energy so it never gets to the bulb so the bulbs cannot light.
3. Demonstrate how to set up the circuits and encourage students to construct a simple circuit and not down their findings about on and closed circuit on an activity sheet.
4. Show students a set of fairy lights (the sort where they all go out if one bulb goes out). Turn on the lights and then disconnect one bulb, so that all of the lights go out. Ask students to explain what has happened by using their knowledge of electrical circuits. Pose this question as a think/pair/share activity where students have one minute to think for themselves, two minutes to discuss with a partner and then five minutes to share their ideas with another pair.
5. Encourage students to explore series and parallel circuits in their classrooms. Have students construct a series and parallel circuits in groups and present it to the class. (Teacher can ask questions during their presentation:
    - In which kind of circuit are the components all connected one after the other? (Series)
    - In which kind of circuit can you switch off or disconnect one component without breaking the whole circuit? (Parallel)
6. Encourage students to battle energy vampires by creating reminders to unplug appliances for their schools and homes. They can design some reminder cards and hang them around the room near energy vampires.
7. Plan and conduct an investigation to study factors that affect the brightness of bulbs or speed of motors (number of batteries, number of Bulbs, type, length and thickness of wire) and make circuit diagrams, accordingly.
8. Make a paper circuit card using LED, aluminum foil and battery. (STEAM)

DOMAIN: Physical Sciences

Grade 6

*** The additional/advanced SLOs are written in Italics.**

Unit: Magnetism
Student Learning Outcomes: Students will be able to: 1. Explain that electric current has magnetic field around it using a magnetic compass. 2. Describe how to magnetize a magnetic material. Describe how to demagnetize a magnet. 3. Construct an electromagnet and identify its applications in daily life. 4. Compare different types of magnets (permanent, temporary and electromagnets). 5. Recognize that there is a space around a magnet where the effect of magnetic force can be observed. 6. Draw the magnetic field of a bar magnet using iron filings. 7. Recognize Earth's magnetic field which attracts a freely-pivoted magnet to line up with it. 8. Recognize that a freely-moving magnet comes to rest pointing in a north-south direction.

Knowledge:	**Skills:**
● Properties of permanent magnets (i.e, two opposite poles, attraction/repulsion, and strength of the magnetic force varies with distance) and make connections to uses in everyday life (e.g., a directional compass). ● a magnetic field is a space around a magnet where the effect of magnetic force can be observed ● Magnetic field of a bar magnet using iron filings. ● how the Earth's magnetic field can be investigated through the attraction that a freely-pivoted magnet experiences and then aligns up in the north-south direction ● How to magnetise a magnetic material. ● an electromagnet ● Factors that affect the strength of an electromagnet. ● Working principles of electromagnetic devices such as speakers, doorbells.	Students will be able to: ● Compare magnets, non-magnets and magnetic materials. ● Predict the motion of magnets, based on knowledge that they repel and attract. ● Make a magnet by the 'stroke' method and the electrical method. ● Plot magnetic field of a bar magnet using iron filings. ● Compare and contrast permanent magnets and electromagnets ● Relate properties of permanent magnets to everyday use. ● Design a method for measuring magnetic strength. ● Relate the electromagnets used in industries and households. ● Make a toy car that uses magnetic force to move. ● Identify important variables; choose which variables to change, control and measure. ● Present results as appropriate in tables and graphs. ● Describe briefly the working principles of electromagnetic devices such as a speaker, a doorbell.
Key Vocabulary stroke method, compass needle, permanent magnet, poles, magnetic force, compass, attraction, repulsion, bar magnet, magnetic field, iron fillings, electromagnet, current, coil, electromagnetic devices, telephone, speaker, electric motor and electric generator	***Additional SLO*** ● *Describe the properties that are unique to electromagnets (i.e., the strength varies with current, number of coils, and type of metal in the core; the magnetic attraction can be turned on and off; the poles can switch).*

Assessments

Formative Assessments

- KWL charts
- Students' responses in discussion, assessing web resources and doing scientific inquiry
- Projects
- Students' responses in plotting of a magnetic field and making of temporary magnets
- Exit tickets (what have you learned today?)
- Written tasks/worksheets

Summative Assessments

- Class tests
- Marked Quiz
- End of unit tests
- Term wise examination
- Marked projects

Learning Activities

1. Revise prior learning on magnets by showing students some examples of effects caused by magnets (e.g. a video). Assess whether students can correctly use the term ‘magnet’, ‘magnetic’, ‘attract’ and ‘repel’. Attraction and repulsion can be seen very easily if magnets are suspended. This is also an opportunity to check which pole points to the north of the Earth.
2. Students can be asked to magnetize a nail by stroking it with a permanent magnet. They demonstrate that it is magnetic by using it to pick up paper clips (or similar). Use an animation so students can visualize the domains becoming arranged in the nail. What would happen if you stroked the magnet in different directions? If there is time, students investigate whether their predictions are correct.
3. Show students an example of magnets exerting a force at a distance. In pairs, students discuss what they think is happening. They share their ideas and feedback to the class.
4. Use a simulation to demonstrate how a magnetic field can be mapped. Start by showing the simulation without the field. Demonstrate that the compass experiences a force that is in different directions depending on where it is in the field.
5. Demonstrate that the field has different strengths in different places;

    - the field is stronger near the poles (shown by the field lines being closer together);
    - the field is weaker further away from the poles (shown by the field lines being further apart).

6. Show students how to use a plotting compass to detect the field around a bar magnet. Ask the students to, in pairs, draw the fields around the bar magnets. Compare results.
7. Use the simulation again with the magnetic field visible. Ask students to compare the shape of this field with the one they have drawn. Ask students to identify where the magnetic field is strongest. Ask them to predict which part of a bar magnet, iron filings would be most attracted to. Demonstrate placing a bar magnet beneath a piece of card. Sprinkle iron filings on the top. These will produce patterns. The filings will be concentrated around the poles.
8. Students make their own electromagnet using a low voltage applied to an insulated copper wire wrapped around an iron

nail. They test this with a compass to detect magnetism. Is the shape of the field the same as with a permanent magnet? Is magnetism permanent? Does the magnetism 'disappear' when the current stops? Does the magnetism 'disappear' when the nail is removed but current kept on?

9. **Scientific inquiry Activity**: Students use their electromagnet to pick up small items like paper clips. By using the 'number of paper clips picked up' as their dependent variable, they design an investigation to find out:
    - How does the number of coils of copper wire affect the strength of the electromagnet?
    - How does the current in the wire affect the strength of the electromagnet?

    This is an opportunity for students to demonstrate a wide range of scientific inquiry skills by planning, doing, interpreting and evaluating their own investigation.
10. Student's summaries their learning by making a table that compares and contrasts permanent magnets and electromagnets.
11. Students research the uses of magnets and electromagnets, for example in: medical contexts, route finding, security, sorting steel from other materials for recycling.

Unit: Technology in Everyday Life

Students will be able to:

- Grow seasonal plants and vegetables in earthen pots and demonstrate the effect of use of fertilizers on the growth of plants
- Prepare yogurt and cheese from milk to demonstrate beneficial microorganisms.
- Design a solar oven to convert solar energy into heat energy.
- Assemble a circuit to demonstrate the working of an electric bell.

Knowledge	**Skills**
● Seasonal plants and vegetables ● Conditions for growth ● Organic fertilizers/ manure ● Chemical fertilizers ● Pesticides ● Use of microorganisms in food industry ● Solar oven and use of concave mirrors/ shiny surface ● Working of electromagnets	Planning and planting seasonal vegetables and plants. Practice using the available scientific instruments/ apparatus and follow safety measures Preparing their own brands of yogurt and cheese and marketing it. Plan and design a solar oven and explain its working.

Assessment

Formative Assessments

- KWL charts
- Students' responses in discussion, assessing web resources and doing scientific inquiry
- Projects
- Exit tickets (what have you learned today?)
- Written tasks/worksheets

Summative Assessments

- Class tests
- Marked Quiz
- End of unit tests
- Term wise examination
- Projects

Learner activities

The following links may be used for conducting the unit activities.

Grow seasonal plants and vegetables in earthen pots

https://www.youtube.com/watch?v=1R6fPlcN6GA&t=21s

Preparing of cheese

https://www.youtube.com/watch?v=utyzDUrd2Bw

Preparing of yogurt

https://www.youtube.com/watch?v=tyZ5mv8kyik

Plan and design a solar oven

https://www.sciencebuddies.org/stem-activities/solar-oven

https://www.youtube.com/watch?v=kBmy-AeIzp0

A circuit to demonstrate the working of an electric bell

https://www.youtube.com/watch?v=Bps3KzCSVOE

DOMAIN*:* Earth and Space Sciences

Grade 6

*** The additional/advanced SLOs are written in Italics.**

Unit: Solar System
Student Learning Outcomes: **Students will be able to:** ● Describe the characteristics of different planets ● Identify the characteristics of asteroids, meteorites and comets ● describe the uses of various satellites in space i.e. geostationary, weather, communication and Global Positioning System (GPS) ● Investigate how artificial satellites have improved our knowledge about space and are used for space research. ● differentiate between planets and dwarf planets ● Inquire into the sighting of Halley's Comet; describe what they would feel if they saw it.

Knowledge:	**Skills:**
● uses of various satellites in space i.e. geostationary, weather, communication and Global Positioning System (GPS) ● structure of the Sun ● characteristics of asteroids, meteorites and comets ● characteristics of different planets in our solar system ● planets and dwarf planets ● significance of Halley's Comet across the world in terms of its visibility with the naked eye. **Key Vocabulary** geostationary, asteroid, meteor, comet, orbit, dwarf planet, weather, solar system, communication, Global Positioning system (GPS), artificial satellites, core, light year, milky way, Radiative Zone, Convection Zone, Photosphere, Chromosphere, Granulation, Prominence.	Students will be able to: ● Differentiate between the characteristics of different planets. ● Observe images of different planets to analyze the characteristics of each planet. ● Construct models of all the planets. ● Investigate how artificial satellites have improved our knowledge about space and are used for space research. ● Investigate how the satellite knows where we are. ● Differentiate between planets and dwarf planets on the basis of their characteristics. ● Investigate Pluto is a dwarf planet. ● Differentiate between asteroids, meteorites and comets.

Assessments

Formative Assessments

- KWL chart
- Exit slips
- One-minute summary on satellites
- Ask students to create a visualization or doodle map of what they learnt
- Presentations

Summative Assessments

- Creative portfolio on planets
- End of term or midterm exam
- Podcast or oral presentation- a five-to-ten-minute speech about the core concepts of the unit.

Learning Activities

Activity 1- Creating a Model of the Solar System

1. Ask students to create a model of the solar system.
2. They will use different colored balloons/play dough to model each planet and present their models to the class.

Activity 2- Characteristics of Planets

1. Divide students into groups and assign each group one planet.
2. Ask students to prepare a one-page advertisement on chart paper to persuade someone to visit their planet.
3. They should describe the characteristics of the planet and how the planet is different from other planets in their presentations.

Activity 3- Differentiate between Asteroids, Meteorites and Comets

1. Place three boxes labelled asteroids, meteorites and comets.
2. Write down the characteristics of asteroids, meteorites and comets on paper strips and ask students to put them in the correct bucket.

Activity 4- Learn how an Artificial Satellite works

1. Divide students into groups and provide them with construction material to build an artificial satellite.
2. Then make larger teams and have each team prepare a signal ball on paper.
3. Divide students into satellites, space rocks and signal rocks. Students must pass their signal ball from the starting satellite to the final satellite.

Activity 5- Role play

1. Ask students to prepare a short play on their favourite topic from the unit and present it to class.
2. Ask students to tell how they would feel if they saw the planet, comet, or space rock in real life.

Suggested Links:

- https://laney.edu/cheli-fossum/wp-content/uploads/sites/210/2012/01/10-Enzymes.pdf
- https://phet.colorado.edu/sims/html/build-a-molecule/latest/build-a-molecule_en.html
- https://littlebinsforlittlehands
- https://www.sciencekiddo.com/paper-circuit-cards/
- https://phet.colorado.edu/en/simulation/legacy/magnet-and-compass
- https://phet.colorado.edu/en/simulation/legacy/magnet-and-compass

SNC - SCIENCE Grade 7

Thinking and Working Scientifically **The following skills will be addressed during the course of teaching different scientific concepts under different units.** **These are to be integrated with the content SLOs in Life Science, Physical Science and Earth Science domains/ strands.**
Students should be able to:
Scientific Inquiry: • Identify whether a given hypothesis is testable. • Make predictions of likely outcomes for a scientific inquiry. • Plan a range of scientific investigations e.g. observe and classify etc. • Know the meaning of hazard symbols, and consider them when planning practical work. • Decide what equipment is required to carry out an investigation . • Take precise measurements, explaining why accuracy and precision are important. • Collect and record observations and/or measurements • Describe trends and patterns in results. • Make conclusions by interpreting results informed by reasoning. • Suggest improvements while doing experiments.

Curriculum Guidelines

Engineering Design Process - STEM/ STEAM
Models and Representations

- Describe the strengths and limitations of a model.
- Use symbols and formulae to represent scientific ideas.
- Use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions to challenges/ enquiry questions.
- Apply mathematical concepts (e.g., percentages and ratios) to analyze data and present the data collected in the form of graphs, charts and tables.

Science in Context:

- Describe how science is applied across societies and industries, and in research.
- **Discuss** issues which involve and/or require scientific understanding.
- Describe how people develop and use scientific understanding.
- Discuss how the uses of science can have a global environmental impact.

DOMAIN: Life Sciences

Grade 7

* The additional/advanced SLOs are written in Italics.

Unit: Plant Systems

Student Learning Outcomes:

Students will be able to:

- Explain the root and shoot system in plants. Label different parts of leaf, stem and root (external and internal structure).
- Predict the role of xylem and phloem in transport of water and food in plants by observing the cross section of the stem.
- Define the process of photosynthesis and derive word equations for it.
- Know that plants require minerals to maintain healthy growth and life processes (limited to magnesium to make chlorophyll and nitrates to make protein).
- Explain that the structure of leaves is adapted to the process of photosynthesis.
- Describe the process of respiration and write word equations for it.
- Compare and contrast the processes of photosynthesis and respiration.
- Investigate the phenomena of transpiration and its importance in a plant,(wind, temperature, light, and humidity affect the rate of transpiration in plants).
- Explore and apply natural raise of water based on the principle of transpiration.

Knowledge:	**Skills:**
• the structure and function of the following plant organs; roots, stem and leaves, and how they come together to constitute the root and shoot systems of the plant. • three types of plant tissue and describe their function. • living organisms have a complex transport system for transfer of water, nutrients and other matter across the body. • plants require minerals to maintain healthy growth and life processes (limited to magnesium to make chlorophyll and nitrates to make protein). • two transport systems in plants – xylem and phloem, and explain how they work together to help the plant survive and grow. • process of photosynthesis and respiration in plants. • leaves adapted to the process of photosynthesis • plants have evolved in their structure and features to survive in their ecological context (for instance, vascular plants in deserts, some flora in the Antarctica or vascular plants in the Himalayas). **Key Vocabulary** organs, cells, tissues, vascular tissue, ground tissue, epidermis, xylem, phloem, vascular bundle stem, roots, leaves, root hair, stomata, cuticle, cortex, humidity, chlorophyll, *palisade mesophyll, spongy mesophyll*, oxygen, carbon dioxide, sugar molecule, photosynthesis, respiration, chemical energy, heat energy, light energy, transpiration, translocation, magnesium, nitrates	Students will be able to: • Sketch and label the different parts of leaf, stem and root – both external and internal structure. • Map, sequentially, the series of steps taken in the transport of water, minerals, chemicals and nutrients in xylem and phloem. • Design a model to demonstrate the function of xylem and phloem. • Derive an equation to show how plants convert light energy into chemical energy during photosynthesis. • Demonstrate how plants break down food to produce energy during respiration through an equation. • Compare and contrast the processes of respiration and photosynthesis. • Imagine what would happen if plants were unable to use carbon dioxide during photosynthesis. • Hypothesize and investigate how various environmental factors such as light intensity, wind, temperature and humidity affects the rate of water uptake by a plant.

Assessments

Formative Assessments

- KWL charts for assessing prior knowledge of students
- Discussion questions
- Oral and written responses
- Exit tickets
- Class Tests including short question answers, labelling diagrams etc.
- Marked Quizzes

Summative Assessments

- Journal to see the connections between different topics about plants
- Final Project/ Presentations
- Midterm or Final Exam

Learning Activities

Activity 1: Visualizing Movement of Water through the Xylem

Take cabbage or celery leaves (their ends should be intact) and place them in clear containers filled with water. Add a few drops of food colouring in the water and let the leaves sit for 8 hours or overnight. Observe how the veins of the leaves are coloured, starting from the bottom to the top. Discuss xylem's role in water transportation in plants through this demonstration.

Activity 2: Xylem and Phloem Model

Using a paper cup, a toilet paper tube, a set of thin white straws and a set of thick, coloured straws, arrange a model of the inside of a plant. The paper cup can represent the outer bark of the plant. Within the paper cup, arrange the toilet paper tube so that it is in the centre. Outside the toilet paper tube, arrange the thick, coloured straws to represent phloem, and the thin white straws should be placed inside the tube to represent xylem.

Activity 3: Sticky Note Revision

Draw a table with two columns on a chart, and label one column as 'Xylem' and the other as 'Phloem'. Write down different features and functions of xylem and phloem separately on sticky notes, so that one sticky note has only one feature/ function of either xylem or phloem written on them. Have the students come up to the chart one-by-one. Each learner should correctly identify the feature/ function written on the sticky note and paste it in the relevant column.

Activity 4: Paint The Process

Divide students into groups and ask each group to paint the diagrams of xylem and phloem and detail each step of the transport process alongside the diagrams.

Activity 5: Plant Food

Prepare 'plant food' using old banana peels. Bury the peels in a hole a few inches below the surface next to plants like rose bushes or other plants that require high levels of potassium. Discuss the importance of food in plants and humans and discuss how food will be transported in plants.

Suggested Links:

https://www.pinterest.com/pin/260716265898074573/]

https://www.plt.org/educator-tips/diy-model-to-explain-inner-tree-parts]

DOMAIN: Life Sciences

Grade 7

*** The additional/advanced SLOs are written in Italics.**

Unit: Human Respiratory and Circulatory System
Student Learning Outcomes: Students will be able to: ● Explain that living organisms have a complex transport system for transfer of various solids, liquids and gases across the body. ● Differentiate between the processes of respiration and breathing. ● Differentiate between aerobic and anaerobic respiration. ● Trace the path of air in and out of the body and how oxygen it contains is used during the process of respiration. ● Hypothesise how exercises of varying intensity (from rest to high-intensity interval training) would impact their pulses rate, test their hypothesis, calculate their pulse rate and record their findings. ● Describe the role and function of major organs in the human respiratory system including trachea, lungs and alveoli (air sacs). ● Describe the structure and function of the human heart. ● Sketch and label the human circulatory system. ● Explain how blood circulates in the human body through a network of vessels (arteries, veins and capillaries), and transports gases, nutrients, wastes and heat. ● Compare and contrast arteries, veins and capillaries. ● Describe the composition of blood and the functions of red blood cells, white blood cells, platelets and plasma.

Knowledge:	**Skills:**
● processes of breathing and respiration and illustrate how air moves in and out of our body ● living organisms have a complex transport system for transfer of various matter across the body ● role and function of major organs in the human respiratory system including trachea, lungs and alveoli (air sacs) ● structure and function of the human heart ● blood circulates in the human body through a network of vessels (arteries, veins and capillaries), and transports gases, nutrients, wastes and heat ● composition of blood and the functions of red blood cells, white blood cells, platelets and plasma *Advanced SLOs* • *Identify practises that help keep the respiratory system healthy.* • *Describe respiratory illnesses (asthma, emphysema and pneumonia) and how they affect lungs.* **Key Vocabulary**	Students will be able to: ● Compare and draw connections between the transport systems in plants and humans. ● Differentiate between the processes of respiration and breathing. ● Differentiate between aerobic and anaerobic respiration. ● Sketch and label the human circulatory system. ● Sketch and label the human respiratory system. ● Compare and contrast arteries, veins and capillaries. ● Trace the path of air in and out of the body and how it converts during the process of respiration. ● Design a model of a lung to demonstrate how air moves in and out of the lungs. ● Use storytelling to illustrate how various practises – both harmful (e.g., smoking) and helpful (regular swimming etc.,) impact the respiratory system. ● Hypothesise how exercises of varying intensity (from rest to high-intensity interval training) would impact their pulse rate, test their hypothesis, calculate their pulse rate and record their findings. *Advanced SLOs* ● *Trace the path of air in and out of the body and how the oxygen it contains is used during the process of respiration.* ● *Hypothesise how exercises of varying intensity (from rest to high-intensity interval training) would impact their pulse rate, test their hypothesis, calculate their pulse rate and record their*

breathing, respiration, *nasal cavity, pharynx,* larynx, trachea, lungs, diaphragm, chest wall, ribcage, alveoli, chest cavity, contraction, relaxation, inhalation, exhalation, heart, atrium, ventricle, valve, oxygenated blood, deoxygenated blood, red blood cells, white blood cells, platelets, plasma, hemoglobin	*findings.* • *Explore the natural balance in the processes of inhalation and exhalation, in respiration and in photosynthesis and synthesize why, in their opinion, balance is beneficial and how it aids life and survival on Earth.* • *Explore careers in science such as Sleep Therapists, Respiratory Therapists, Pulmonologists etc.*

Assessments

Formative Assessments

- KWL charts for assessing prior knowledge of students
- Think- pair- share activities to compare the processes of respiratory and circulatory systems
- Discussion questions
- Oral and written responses
- Exit tickets
- Class Tests including short question answers, labeling diagrams etc.
- Marked Quizzes

Summative Assessments

- Journal to see the differences between transport in humans and transport in plants
- Final Project/ Presentations
- Midterm or Final Exam

Learning Activities

Activity 1: Model of Lungs

1. Create a model of lungs using a plastic bottle, two balloons, scissors, and tape.
2. Measure an inch or two from the bottom of the plastic bottle and cut the bottom off carefully.
3. Take one balloon and put it inside the bottle. Then fold the bottom of the balloon around the rim of the bottle so the balloon hangs from the top.
4. Wrap tape around the top to tighten the balloon in place.
5. Tie a knot at the end of the remaining balloon and cut the large part of the balloon in half horizontally.
6. Using the balloon half with the knot, stretch the open end over the bottom of the bottle. Use tape to secure if necessary.
7. Gently pull down on the balloon from the knot. This should cause air to flow into the balloons within the lung model.
8. Release the balloon with the knot and watch as the air is expelled from the lung model.

Activity 2: Storytelling Activities

1. Divide students in groups and ask each group to create two stories each: one that demonstrates the negative effects on lungs (through smoking, pollution etc.) and one that demonstrates the positive effects on lungs (through exercising, swimming, taking precautionary measures such as masks etc.).

Activity 3: Model of Heart

1. Make a working model to demonstrate how the heart pumps blood. Using two bottle caps, four juice-box straws, three plastic bottles and water mixed with red food colouring, design a model.
2. Make two straw-sized holes in one bottle cap, whereas in the second bottle cap, one hole should be straw-sized and one hole should be smaller. Take two straws, stretch, and bend them to create a 90-degree angle. Slide one straw into the other straw, then tape up the joint. Repeat with the second set of straws.
3. Place the three bottles on the table. Fill the first two with red-coloured water to about 80% full. Leave the third one empty. On the first bottle place the cap with one straw hole and one small hole. On the middle bottle place the cap with two straw holes.
4. Leave the third bottle without a cap. Place the straws in the bottles so that the middle bottle is connected with the other two bottles with the straws.
5. Squeeze the middle bottle to see how “blood” moves from one part of the body into the other.

Activity 4: Measuring the Pulse

1. Teach students how they can measure their heart rate by placing the index and third fingers on their neck to the side of their windpipe.
2. To check the pulse at the wrist, place two fingers between the bone and the tendon over the radial artery — which is located on the thumb side of the wrist.
3. Ask students to count the heartbeats up to 15 at least and note the time.
4. Ask students to engage in some activity, such as running around the ground, doing jumping jacks etc. and ask them to recheck their pulse.
5. Compare the differences by calculating the pulse rate before and after exercise.

Activity 5: Capillaries, Veins and Arteries

1. Make a yarn model to understand the size and roles of capillaries, veins, and arteries.
2. Take thick yarn in blue and red color to represent veins and arteries respectively.
3. Thinner white colored yarn can be used to represent the capillaries.

Activity 6: Who Does What?

1. Divide students in groups and ask each student to research the people who work in relation to the respiratory and circulatory systems (pulmonologists, cardiologists, respiratory therapists etc.).
2. Ask the groups to prepare a short presentation to present their findings.

Suggested Links:

https://ctsciencecenter.org/blog/science-at-play-make-your-own-lung-model/]

https://www.steampoweredfamily.com/activities/heart-model-heart-stem/]

https://www.steampoweredfamily.com/activities/heart-model-heart-stem/]

DOMAIN: Life Sciences

Grade 7

*** The additional/advanced SLOs are written in Italics.**

Unit: Immunity and Diseases
Student Learning Outcomes: **Students will be able to:** ● Describe the three types of immunity in humans – innate, adaptive, and passive. ● Illustrate how adaptive immunity develops over time. ● Identify the various types of pathogens that cause infectious diseases. ● Explain the various lines of defences that the body has against pathogens. ● Describe the parts of the immunity system and how they function to produce an immune response. ● Visualise the ways to add additional layers of defence (such as wearing masks, using sanitizers, etc.). ● Propose some common strategies for strengthening their immune system. ● Explain how infectious diseases such as hepatitis, covid-19, typhoid, and dengue are caused /contracted, how they are tested and diagnosed, and how they can be prevented. ● Suggest ways in which communities of people can safeguard against the spread of infectious diseases. ● Describe the role of vaccines in immunity, and explore some strategies on how vaccines can be created.

Knowledge:	**Skills:**
  ● three types of immunity in humans – innate, adaptive, and passive. ● various types of pathogens that cause infectious diseases. ● various defences that the body has against pathogens. ● the parts of the immunity system and how they function to produce an immune response. ● adaptive immunity develops over time. ● how infectious diseases such as hepatitis, Covid-19, typhoid and dengue are caused / contracted, how they are tested and diagnosed, and how they can be prevented. . **Key Vocabulary** Pulmonary artery, pulmonary vein, capillaries, innate immunity, adaptive immunity, passive immunity, pathogens, immune system, *leukocytes, lymphocytes, phagocytes, neutrophils, eosinophil, T-cells, B-cells*, natural killer cells, virus, bacteria, antibodies, daily infection rate (*/ R^o*), infectious diseases, non-infectious diseases, vaccine	Students will be able to: ● Differentiate between infectious and non-infectious diseases. ● Differentiate between specific and nonspecific immune responses. ● Visualise and map the various lines of defence the human body has against pathogens and ideate how they can add additional layers of defence (such as wearing masks, using sanitizers, etc.). ● Estimate how quickly a disease is likely to spread using the base number of infected population and the daily infection rate. ● Relate the cause and effect in the contraction of an infection. ● Predict how quickly diseases are likely to spread based on how they are transmitted (air, skin-skin contact, bodily fluids like blood, contact with animals etc.). ● Ideate and write ways in which communities of people can safeguard against the spread of infectious diseases. ● Propose some common strategies for strengthening their immune system. (Advanced SLOs) ● *Explore what happens to an astronaut's immune system when they are in space.* ● *Explore careers in science such as immunologists, public health statisticians, etc.* ● *Apply their knowledge of the various cells to determine which should be deployed to fight*

	against various pathogens. • *Read and interpret basic blood reports to determine the state of infection.*

Assessments

Formative Assessments

- KWL charts for assessing prior knowledge of students
- Think- pair- share activities to compare the types of immunity
- Discussion questions
- Oral and written responses
- Exit tickets
- Class Tests including short question answers, labelling diagrams etc.
- Marked Quizzes

Summative Assessments

- Journal to keep their health log, along with reflections on measures that they specifically took to protect themselves and others during flu season.
- Final Project/ Presentations
- Midterm or Final Exam

Learning Activities

Activity 1: Pathogen Recognition

Fill a container with sand. In the sand, place medium-sized pieces of paper, dry pasta, pom-poms (spongy soft small coloured balls) etc. use two differently sized tweezers, a small tweezers and a large one, for this activity. Ask students to come one by one and use the small tweezers to try and pick up any of the different things in the sand (paper, pasta etc.) with their eyes closed. After that, repeat the activity but with the bigger tweezers and with the students' eyes open. Compare the difficulty and ease of picking up the materials before and after with the reaction of the human body to pathogens before and after developing antibodies.

Activity 2: Immunity Enhancer

Ask students to research and bring possible things that can help to enhance the immunity of the human body. These things can be used externally (masks, sanitizers) and internally (medicines, supplements). Discuss the functions of each thing with the whole class.

Activity 3: Do it Yourself (DIY) Immunity Builders

Make cloth masks and face shields with students. Ask them to keep a logbook of all the healthy food they take to build their immunity.

Activity 4: Charting the Infection

Divide students in groups and ask them to make two charts, one that represents the spread of an unmitigated infection and the other that represents how infections can be curbed using vaccines etc. Each group should prepare for a different disease.

Activity 5: Skit Preparation

Divide students in groups and ask them to prepare a skit that demonstrates how a sick person should be taken care of in case of different diseases. Each group should prepare for at least one disease.

Suggested Links:

https://www.immunology.org/sites/default/files/Pathogen%20buster%21%20.pdf]

OMAIN: Physical Sciences

Grade 7

*** The additional/advanced SLOs are written in Italics.**

Unit: Structure of an Atom
Student Learning Outcomes: **Students will be able to:** ● Describe and draw the structure of an atom in terms of electrons, protons and neutrons. ● Describe how an atom is electrically neutral. ● Differentiate between atomic number and mass number. ● Determine the atomic number and mass number of elements on the basis of the number of protons, electrons and neutrons. ● Show the arrangement of electrons in K, L and M shells of elements. ● Draw the atomic structure of the first eighteen elements of the periodic table. ● Draw atomic structure of elements in the periodic table. ● Explain that the Periodic Table is a way to organise elements in a systematic order. ● Recognize periods and groups in the Periodic Table

Knowledge:	**Skills:**
• structure of an atom in terms of electrons, protons and neutrons • an atom as an electrically neutral entity • atomic number and mass number • the atomic number and mass number of elements on the basis of number of protons, electrons and neutrons • the arrangement of electrons in K, L and M shells of elements. • atomic structure of elements in the periodic table. **Key Vocabulary** Atom (divisible entity), molecule, symbol, atomic number, mass number, electrons, protons, neutrons, nucleus, orbit/ shell, neutral, elements, periodic table, groups, periods, metals, non-metals, transition elements, valence shell, valence number, compound, formulae, octet rule, duplet rule	Students will be able to: • Make a model of the structure of an atom using available materials. • Draw atomic structures of first 18 elements. • Draw atomic structure of elements in the periodic table. • Make chemical formulae. • Compare and contrast atomic structure of different elements. • Make a 3-D atomic structure model of few elements. • Make a chronological timeline for atomic structures proposed by different scientists by doing research on the internet.

Assessments

Formative Assessments

- Brainstorming/mind maps/graphic organisers
- Model making (use of play dough to make atomic structure)
- Students' responses on exploring simulation activities on web resources
- Activity sheets
- Biography/Scrapbook making (individual or in groups)
- Students' responses during discussions and questions answer sessions
- Plenary (two stars and a wish)
- Projects

Summative Assessments

- Class tests
- Marked Quiz
- End of unit tests
- Term wise examination
- Marked projects

Learning Activities

1. Structure of an atom can be explained by using 3-D models of any atom followed by students making the 3-D models of different atoms in groups.
2. A large sized periodic table can be displayed in front of the students to study groups, periods, atomic and mass numbers.
3. Draw the atomic structure of your own choice by dragging the number of protons, neutrons and electrons. You keep on dragging the protons and neutrons into the nucleus and it automatically gives you another element.
4. Activity/Lab sheets can be given to students to fill up the shells of the atom after calculating the number of electrons from given atomic numbers followed by peer assessment and discussion.
5. Students can be asked to research some factual information on a particular atom and make its biography. (Project)(STEAM)
6. A scrapbook can be made by students, about five different atoms (writing information about atomic number, protons, neutrons, electrons, charges, atomic masses, etc.). (Project) (STEAM)

Suggested Links:

https://phet.colorado.edu/sims/html/build-an-atom/latest/build-an-atom_en.html

DOMAIN: Physical Sciences

Grade 7

The additional/advanced SLOs are written in Italics.

Unit: Physical and Chemical Changes
Student Learning Outcomes: **Students will be able to:** ● Differentiate between physical and chemical changes while considering daily life examples. ● Recognize that oxygen is needed in combustion, rusting and tarnishing. ● Explore methods of preventing rusting. ● Relate uses of materials to their chemical properties (e.g., tendency to rust, flammability). ● Evaluate impact of combustion reaction on environment. ● Relate uses of materials to their physical properties (e.g., melting point, boiling point, solubility, thermal conductivity). ● Distinguish between physical and chemical properties of matter.

Knowledge:	**Skills:**
Students will: • physical and chemical changes while considering daily life examples • reversible and non-reversible chemical changes. (formation of ammonia) • oxygen is needed in combustion, rusting and tarnishing • Impact of combustion reaction on environment • methods of preventing rusting • physical and chemical properties of matter. • Indicators of physical and chemical change. • uses of materials to their physical properties (e.g., melting point, boiling point, solubility, thermal conductivity). • uses of materials to their chemical properties (e.g., tendency to rust, flammability). **Key Vocabulary** rust, reversible reaction, non-reversible reaction, chemical change, physical change, melting point, boiling point, solubility, thermal conductivity, tendency to rust, flammability, reactant, products, combustion, burning, rusting, tarnishing, iron oxide, galvanising	Students will be able to: • Compare and contrast physical and chemical changes • Apply physical and chemical changes to everyday situations. • Evaluate Impact of combustion reaction on environment. • Differentiate between burning and combustion. • Explore methods of preventing rusting. • Relate the uses of materials to everyday life, based on their physical and chemical properties. • Plan and conduct simple experiments to analyse physical and chemical changes. • Sort and classify data and information using drawings, pictographs and tables. • Communicate observations and ideas using oral or written language, drawing or role-play. • Draw conclusions from their findings.

Assessments

Formative Assessments

- Brainstorming (recall of previous knowledge about physical and chemical changes)
- By students' verbal and written responses during experiments/investigations
- Group work
- Making of a booklet
- Poster making
- Quick quiz

Summative Assessments

- Class tests
- Marked Quiz
- End of unit tests
- Term wise examination
- Projects

Learning Activities

1. Students' prior knowledge can be assessed by asking questions about chemical and physical changes around us.
2. The teacher may then use a presentation to review physical and chemical properties and the criteria for each.
3. Demonstrate a few of the chemical processes (burning, rusting and combustion) and encourage students to identify how they are different from physical processes. Students can be asked to make predictions and note down the observations for each of the process.
4. Make a list/booklet of chemical and physical changes of different materials.
5. Students work in groups to investigate the use of chemical changes and their application in everyday life by exploring the recycling process. Each group will choose one material (plastic, glass or paper) and research the origin, process, and end product.
6. Make a poster highlighting the impact of combustion on the environment.
7. A quick quiz can be taken.

Unit: Chemicals Bonds

Student Learning Outcomes:

Students will be able to:

- Define valency and explain the formation of ions.
- Write chemical formulae on the basis of valency of the constituent elements such as H_2O NaCl, NH_3, CO_2, etc.
- Recognize that a chemical bond results from the attraction between atoms and that the atoms' electrons are involved in this bonding.
- Discuss formation of ionic bonds as a result of electrostatic forces between atoms (e. g., NaCl).
- Discuss types and formation of covalent bonds as a result of mutual sharing of electrons between atoms (e. g., H_2, O_2, N_2).
- Name certain ionic and covalent compounds.
- Draw cross and dot structures showing formation of ionic compounds and covalent compounds.

Knowledge:	**Skills:**
• Valency and the formation of ions • Chemical formulae on the basis of constituent elements (H_2O, CO_2, NH_3, NaCl) • a chemical bond results from the attraction between atoms in a compound and that the atoms' electrons are involved in this bonding • formation of ionic bonds as a result of electrostatic forces between atoms. (e. g., NaCl) • types and formation of covalent bonds as a result of mutual sharing of electrons between atoms. (e. g., H_2, O_2, N_2) • ionic and covalent compounds • cross and dot structures showing formation of ionic compounds and covalent compounds **Key Vocabulary** chemical bonds, ionic bonds, covalent bonds, electrostatic forces, single covalent bond, double covalent bond, triple covalent bond, mutual sharing	Students will be able to: • Draw cross and dot structures showing formation of ionic compounds and covalent compounds. • Explore the formation of ionic and covalent bonds through simulations. • Illustrate the formation of ionic and covalent bonds in a booklet. • Make 3-d models of ionic and covalent bonds by using straws, skewer sticks, ping pong balls, etc. • Relate the formation of chemical bonds with valency. • Compare ionic and covalent bonding.

Assessments

Formative Assessments

- Brainstorming
- Graphic organizers
- Think pair and share followed by discussion
- Model making (making of chemical bonds)
- Students' responses on exploring simulation activities on web resources

Summative Assessments

- Class tests
- Marked Quiz
- End of unit tests
- Term wise examination
- Projects

Learning Activities

1. Brainstorm with students about their prior knowledge of atomic structure and make a mind map on board based on their responses.
2. Think pair and share; how do valence electrons relate to chemical bonds?
3. Use of illustrations/flashcards/secondary resources (YouTube videos, simulations) to show the types of chemical bonds and how they are formed.
4. Students can be asked to illustrate the formation of ionic and covalent bonds in a booklet.
5. Make 3-d models of ionic and covalent bonds by using straws, skewer sticks, ping pong balls etc. (in groups/pairs/individual)

DOMAIN: Physical Sciences

***The additional/advanced SLOs are written in Italics.**

Unit: Solutions

Student Learning Outcomes:

Students will be able to:

- Demonstrate the process of solution formation (using water as universal solvent).
- Distinguish among solute, solvent and solution; saturated and unsaturated solution.
- Define solubility.
- Recognize that the amount of solute which dissolves in a given solvent has an upper limit at a given temperature.
- Identify the factors which affect the solubility of a solute in a solvent and recognize the importance of these factors in homes and industries.
- Explain what is meant by a concentrated and dilute solution.
- Identify ways of accelerating the process of dissolving materials in a given amount of water and provide reasoning (i.e., increasing the temperature, stirring, and breaking the solid into smaller pieces increases the process of dissolving).
- Explore the effectiveness of various cleaning solutions in cleaning tarnished and oxidised coins. (STEAM)
- Make a rock candy with sugar using crystal seeding technique. (STEAM)

Knowledge:

- the process of solution formation (using water as universal solvent).
- solute, solvent and solution; saturated and unsaturated solution.
- solubility
- concentrated and dilute solution
- the amount of solute which dissolves in a given solvent has an upper limit at a given temperature

Skills:

Students will be able to:

- Make and examine the differences in types of solutions (dilute, concentrated, saturated, super saturated) using water as solvent.
- Make accurate measurements while making solutions.
- Differentiate between dissolving and solubility.
- Explore how the solubility of gases is different from solids.

• the factors which affect the solubility of a solute in a solvent and recognize the importance of these factors in homes and industries. • ways of accelerating the process of dissolving materials in a given amount of water and provide reasoning. (i.e., increasing the temperature, stirring, and breaking the solid into smaller pieces increases the process of dissolving). **Key Vocabulary** solute, solvent, solution, solubility, concentrated, saturated, dilute, dissolving, soluble, insoluble, super saturated solution,	• Investigate the factors that affect solubility of substances. • Interpret the solubility of different substances in water through a solubility curve. • Choose equipment to carry out scientific investigations (stirrer, beaker, burner, mortar, etc.). • Apply the understanding of solubility and dissolving to a real life situation. • Make predictions of likely outcomes for a scientific inquiry. • Interpret results using scientific knowledge and understanding. • Draw a conclusion from their findings (factors affecting dissolving, solubility). • Show findings of investigations by using drawings, pictographs, tables and graphs. • Explore the effectiveness of various cleaning solutions in cleaning tarnished and oxidised coins. (STEAM) • Make a rock candy with sugar using crystal seeding technique. (STEAM)
Assessments **Formative Assessments** • KWL charts • Identification of solutions and making solutions of different concentrations • Students' oral, verbal and written responses • Exit tickets • Projects	

Summative Assessments

- End of unit tests
- Term wise exams
- Projects

Learner activities

- Demonstrate to students the preparation of different types of solutions and mixtures followed by discussion about differences present among them.
- A mind map can be made on board based on students' responses.
- A list of different solutions can be displayed in front of students to identify solute and solvent in each type of solution.
- Students in groups would investigate types of solutions and factors that affect solubility. They would make predictions, investigations and conclude results followed by a presentation in front of the class.
- Solubility curves of different solutes can be given to students to evaluate the trends in solutes and solvents.
- Make a report on the types of solutions used in homes, medicines and industries.

DOMAIN: Physical
Sciences Grade 7

*** The additional/advanced SLOs are written in Italics.**

I8Unit: Heat and Temperature
Student Learning Outcomes: **Students will be able to:** • Describe the expansion of the three states of matter on heating, and contraction on cooling, in terms of particles. • Predict the effects of heat gain and heat loss. • Compare all three scales of temperature (including interconversion of temperature scales). • Define the termp0s heat and temperature on the basis of kinetic molecular theory. • Explain why metals are good thermal conductors and fluids are poor conductors of heat using the particle model. • Construct the concept of heat conduction, convection and radiation by applying particle theory including daily life examples. • Identify the effects of thermal expansion and contraction with their applications in daily life. • Explain the practical methods of thermal insulation used for constructing buildings.

Knowledge:	**Skills:**
• heat and temperature with reference to kinetic molecular theory • three scales of temperature (including inter-conversion of temperature scales) • metals are good thermal conductors and fluids are poor conductors of heat in terms of particle model • the expansion of the three states of matter on heating and contraction on cooling in terms of particles • heat conduction, convection and radiation with reference to the particle theory including daily life examples • effects of heat gain and heat loss • effects of thermal expansion and contraction with their applications in daily life • thermal insulation used for constructing buildings **Key Vocabulary** conduction, convection, radiation, kinetic energy, convection current, thermometer, expansion, contraction, thermal, insulator, conductor, temperature, heat gain, heat loss, poor absorber/ reflector, bi metallic strip ,infrared waves, radiator/ absorber, emitter	Students will be able to: • Compare different scales to measure temperature. • Measure temperature using a thermometer with and make interconversion of temperature scales. • Differentiate conductors and insulators. • Infer that generally, solids, liquids, and gases expand when heat energy is absorbed and contract when heat energy is given out. • Relate some effects and applications of expansion and contraction in everyday life. • Predict the effects of heat gain and heat loss. • Sketch a building with methods of thermal insulation. • Illustrate the transfer of heat energy from warmer objects to cooler ones using examples of conduction, radiation and convection and the effects that may result. • Investigate the movement of heat between objects by conduction, convection, and radiation. • Compare and contrast three modes of heat transfer • show an awareness of the various proposed causes (man-made and natural) of climate change (e.g., global warming). • Carry out practical work safely.

	• Interpret results using scientific knowledge and understanding in the form of drawings, tables and pictographs. • Draw a conclusion from their findings.

Assessments

Formative Assessments

- Brainstorming/mind maps/graphic organisers
- Students' responses on exploring simulation activities on web resources
- Activity sheets
- Booklet making (individual or in groups)
- Students' responses during discussion on watching YouTube videos
- Students' responses on demonstration of heat transfer investigations
- Exit tickets (Write one sentence what you have learned today)
- Projects (make a thermometer and model house with insulation)
- Quizlet exercise – matching term with its definition
- Kahoot quiz – choosing the correct answer about heat transfer in everyday life.
- Teacher asks students for everyday examples of heat transfer

Summative Assessments

- Class tests
- Marked Quiz
- End of unit tests
- Term wise examination
- Projects

Learning Activities

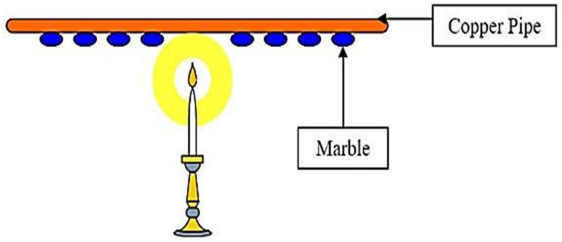
1. Make a simple thermometer using Methylated Spirit.
2. In groups students will receive a bowl of hot water and three spoons (1 metal, 1 wooden and 1 plastic spoon). They will write a prediction as to which spoon will get warm first and which spoon will get warm last. After the students have made all their predictions, they will put all three of the spoons into the hot water. They will record

what happens. After the completion of the task, they will answer the following questions:

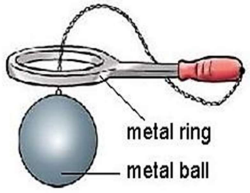
- Why did the metal spoon heat up the fastest?
- What was the difference between the metal spoon and the wooden and plastic spoons that made them heat up at different rates? Do you think that all types of metals would heat up at the same rate as the metal spoon did? Why or, why not?

3. Show students the mode of heat transfer through convection by heating a container of cold water with few drops of potassium permanganate in it. Encourage students to see the convection currents in water and relate it to other real-life examples.
4. Demonstrate conduction of heat through an investigation. Marbles will be attached to a copper pipe with wax. The pipe will be held over a candle or a Bunsen burner. As the heat from the candle is conducted along the copper pipe the marbles will fall off the pipe.
   As the marbles are falling off the pipe, students can be asked what they think is happening. Why are the marbles falling off in a

   sequence?



5. Demonstrate expansion of solids as described in the diagram. Before heating, the metal ball is able to go through the ring. Ask students to predict what happens when we heat the metal ball to high temperature.



6. Use flash cards/ web resources to differentiate between different types of heat transfer and movement of particles on expansion or contraction of materials.
7. Make a model of a house with a heat insulation mechanism
8. Make a presentation to show the effects of thermal expansion and contraction on materials around us.

Suggested Links:

- https://www.sciencebuddies.org/stem-activities/homemade-thermometer?from=Blog#materials
- Images from SNC zero draft 2020 6-8

9.-

DOMAIN: Physical

Sciences Grade 7

*** The additional/advanced SLOs are written in Italics.**

Unit: Force and Motion
Student Learning Outcomes: **Students will be able to:** ● Describe the effect of force on changing the speed and direction of motion with time. ● Define and state the SI unit of force. ● Formulate the relationship between speed, distance and time. ● State the SI unit of speed. ● Calculate average speed. ● Interpret a distance-time graph. ● Give examples of contact forces and non-contact forces

Knowledge:

- relationship between speed, distance and time
- SI unit of speed
- average speed
- distance-time graph
- uniform and non-uniform motion
- the effect of force on changing the speed and direction of motion with time
- the SI unit of force
- examples of contact forces and non-contact forces

Key Vocabulary

force, push, pull, stretch, turn, force arrow, interact, balance, direction, magnitude, upward, downward, attract, repel, force metre, newton metre, Newton (N), weight, gravity, mass, matter, contact force, non-contact force, gravitational force, friction, air resistance, balanced forces, unbalanced forces, streamline, SI (System International) force.

Skills

Students will be able to:

- Measure force, using newton as the SI unit.
- Calculate average speed using formula.
- Make connections between speed, distance, and time.
- Construct a science experiment about force and motion.
- Demonstrate that forces always work in action and reaction pairs (equal in magnitude, opposite in direction).
- Predict and reflect on the results.
- Conduct a controlled experiment that allows the collection of distance/time data.
- Plot distance and time graph.
- Apply an understanding of the effects of force in real life.
- Plan activities like tug of war, football match etc., to illustrate the effects of force.
- Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.
- Investigate that forces act in equal and opposite directions.
- Analyse contact and non-contact forces with the help of available secondary resources.

Assessments

Formative Assessments

- Students' responses while completing graphic organizers
- Plotting speed-time and distance- time graphs from the readings recorded in an experiment
- Students' oral, verbal and written responses during discussions and investigations
- Two stars and a wish
- Project (make a balloon car)

Summative Assessments

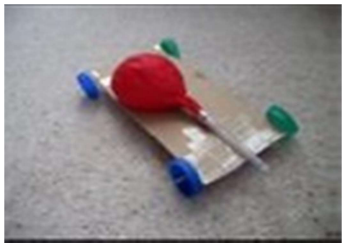
- Class tests
- Marked Quiz
- End of unit tests
- Term wise examination
- Projects

Learner Activities

Learning Activities

- Students brainstorm forces present around us by asking questions or using graphic organizers to assess their prior knowledge.
- Students can be asked to use a measuring tape to measure out 10m. They will time how long it takes to walk, run, hop, and crawl the 10 m. and record their results in the table. They can be further asked to calculate their speed by using the results.
- Explain to students that they are going to investigate how far they can move in 10 seconds. Remind students of the importance of collecting results in an organized way. Ask students to design a table they could use for their results. If necessary, remind students of how to draw a table and show an example.
- Take students to a space where they can move reasonably long distances (e.g. outdoors in the school or in a hall). Students can try different activities such as running, walking, skipping and hopping for 10 seconds. If skateboards or bicycles are available, then they can also be tested for 10 seconds. For each activity, students need to measure the distance they have moved and record the results in their tables. They then calculate the mean distance they travelled in 10 seconds for each activity. Elicit that speed = 'distance'/'time'

- Students return to the classroom and discuss their results:
    - Was it a fair test? How accurate were the measurements?
    - Were there any anomalous results? How could the investigation be improved?
- Students process and analyse the data they collected. They would calculate average speed for each activity and draw bar charts to compare different activities.
- Students can view a short graphical explanation of speed and distance. Demonstrate how to draw a distance/time graph from the provided data.
- Use of flash cards to let students indicate different forces and their direction on an object.
- Make a balloon car and give the concept of action and reaction.



Balloon car

DOMAIN: Physical Sciences

Grade 7

Unit: Waves and Energy

Student Learning Outcomes
 	
Students will be able to:
 	
● define a wave.
● compare the types of waves (mechanical and electromagnetic) with daily life examples
● distinguish between longitudinal and transverse waves.
● identify:
  ○ water wave and sound wave as mechanical wave
  ○ light wave as electromagnetic wave
● define the terms: wavelength, frequency and time period of wave.
● define and relate: 1. pitch and frequency; 2. amplitude and frequency
● explain the factors affecting pitch and loudness of sound.
● compare and interpret waveforms in terms of pitch and loudness
● construct the inverse relation between time period and frequency
● relate common phenomenon (e.g. echo, hearing thunder after seeing lightning) to the properties of sound

Knowledge

- waves and types of waves (mechanical and electromagnetic) with daily life examples
- longitudinal and transverse waves
- water wave and sound wave as mechanical wave
- light wave as electromagnetic wave
- wavelength, frequency and time period of wave relate:
  - ❖ pitch and frequency
  - ❖ amplitude and frequency
- factors affecting pitch and loudness of sound
- waveforms in terms of pitch and loudness
- inverse relation between time period and frequency
- common phenomenon (e.g. echo, hearing thunder after seeing lightning) and the properties of sound

Key Vocabulary

Longitudinal wave, transverse wave, mechanical wave, electromagnetic wave, echo, wavelength, vibrate, vibration, hertz, Oscilloscope, amplitude, wave forms, vacuum, hertz, frequency, low frequency, high frequency, medium, crests and troughs, mean/rest position, displacement, high pitch, low pitch, loudness, loud sound, soft sound

Skills:

Students will be able to*:*

- distinguish between types of waves
- compare and contrast types of waves with connection to real life situations
- relate different examples of waves to their types
- use of graphs and charts to present patterns in data
- relate the scientific terms while making wave patterns
- compare and interpret waveforms in terms of pitch and loudness
- construct the inverse relation between time period and frequency
- relate common phenomenon (e.g. echo, hearing thunder after seeing lightning) to the properties of sound
- make a wave model
- investigate to which characteristics of the human voice - pitch (frequency) and amplitude- people of all ages respond positively and negatively
- investigate the behaviour of longitudinal and transverse waves
- illustrate ways that the energy of waves is transferred by interaction with matter (including transverse and longitudinal/compressional waves)

Assessments

Formative Assessments

- students' oral, verbal and written responses
- Evaluating students' prior knowledge through brainstorming
- KWL
- students' responses in making of different models/projects to apply the knowledge of about types of waves
- Exit cards (What have you learned today?)

Summative Assessments

- Class tests
- Marked Quiz
- End of unit tests
- Term wise examination
- Projects

Learning Activities

1. KWL charts- (What I know? What I want to know? What have I learnt?)
2. Demonstrate that sounds are due to vibrations, using one or more demonstrations. For each demonstration students should observe the vibrations and explain that these are responsible for the sound.

    - Suspend a table tennis ball from nylon thread. Vibrate a tuning fork (or a bell) and touch the table tennis ball.
    - Demonstrate how sounds are made on any string instrument. Identify the vibration of the strings.
    - Students use their fingers to feel the vibrations at their lips and neck while they are talking (pressing gently on the voice box). Place polystyrene balls on a speaker. Play low and high sounds through the speaker and observe what happened?
    - Show high-speed footage of different ways that sound can be made.
    - Use a slinky (loose spring) to demonstrate the longitudinal and transverse waves.
3. Make a phone with a cup and a thread to demonstrate the concept of sound waves.
4. Make a drum by using empty jars, plastic bags and rubber to demonstrate the concept of pitch, frequency, amplitude.
5. Make drums of different sizes to explain the factors affecting pitch and loudness of sound.
6. Demonstrate the different pitch sounds produced by different strings of the guitar.
7. Use a presentation and visual graphics to make students understand different types of waves.

Domain: Physical Science

Grade 7

<table>
<tr><td colspan="2">Unit: Technology in Everyday Life- STEM/ STEAM Challenges

Students will be able to:

● design a model to demonstrate drip and sprinkler irrigation system for conservation of water
● use different techniques of preserving foods like orange juice, apple jam and pickles.
● make a simple stethoscope.
● make a sanitizer using suitable substances</td></tr>
<tr><td>Knowledge:

● steps involved in the engineering design process
● irrigation systems
● Importance of conservation of water
● techniques for preservation of food
● stethoscope and its use
● hand sanitizer and its purpose

Key vocabulary: design, engineers, irrigation system, stethoscope, preservation, sanitizer</td><td>Skills:

● use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions to challenges/ inquiry questions
● use secondary sources of information to study the designs of drip and sprinkler irrigation use in Pakistan
● apply the process people follow to design new things (make a plan, make drawings of the design, choose the best available material, construct working models and test your design)
● describe the strengths and limitations of your model
● use primary and secondary sources to find out how food is preserved</td></tr>
</table>

	• practice different techniques of food preservation • design a working model of a stethoscope and explain how it works • describe strengths and limitations of your model

Assessment

Assessments

Formative Assessments

- KWL chart
- Concept maps to represent understanding of a topic
- Think-pair-share exercise
- Quizzes
- Jigsaw groups- Groups work on different topics and then restructure groups to share knowledge.

Summative Assessments

- Journal to see connection between different topics/concepts
- Final project
    - Midterm or final exam.

- **Learner activities**

- Discuss with students the similarities and differences in the steps that engineers and scientists take in finding solutions to a

problem.

- Encourage students to develop a list of questions that they may ask an expert in the field.
- Encourage students to plan their projects considering details like: What materials to use? What would be the size of the model etc.?
- Discuss with students how engineers test and improve their designs and record and share what they have done.
- Let students design, construct and test their models and evaluate to find the strengths and areas for improvement.

The following links may be used for help.

- Design a model to demonstrate sprinkler irrigation system for conservation of water

- Build a Water Sprinkler Toy
  https://www.sciencebuddies.org/stem-activities/water-sprinkler-toy
  https://www.youtube.com/watch?v=KCLbBQBMeEw

- Design a model to demonstrate drip
  https://www.youtube.com/watch?v=kyWjDAGyeDw
- Make a simple stethoscope
  https://www.youtube.com/watch?v=s3u-WmQQgfY
- Make a sanitizer using suitable substances
  https://www.youtube.com/watch?v=e4jI2G1yrWI
  Techniques for preservation of food
  https://www.youtube.com/watch?v=2cOOsGhj3NE
  Importance of conservation of water
  https://www.youtube.com/watch?v=nTcFXJT0Fsc

Unit: Earth and Space

Student learning outcomes

Students will be able to:

- Recognize that the force of gravity keeps planets and moons in their orbits.
- Differentiate between mass and weight, using examples of weightlessness experienced by astronauts on the surface of the Moon.
- Recognize that tides are caused by the gravitational pull of the Moon.
- Describe the effects of the Earth's annual revolution around the Sun, given the tilt of its axis (e.g., different seasons, different constellations visible at different times of the year).
- Describe how seasons in Earth's Northern and Southern hemispheres are related to Earth's annual movement around the Sun.

Knowledge:

- the force of gravity keeps planets and moons in their orbits
- Differentiate between mass and weight; using examples of weightlessness experienced by astronauts on the surface of the moon.
- tides are caused by the gravitational pull of the moon.
- the effects of the Earth's annual revolution around the Sun, given the tilt of its axis (e.g., different seasons, different constellations visible at different times of the year).
- Seasons in Earth's Northern and Southern hemispheres are related to Earth's annual movement around the Sun.

Key Vocabulary

Skills:

Students will be able to:

- analyse why the planets in our Solar System orbit the Sun instead of flying off into space
- analyse how some countries have opposite seasons than Pakistan and where they are located
- interpret results using scientific knowledge and understanding

(Advanced SLOs)

- *Conduct an experiment with a balloon and a length of string to understand how the force of gravity between*

force of gravity, orbit, tides, annual revolution, axis, constellations, northern hemisphere, and southern hemisphere, rotation, season revolution, weightlessness, Astronauts.	*two objects can balance to form an orbit.*

Assessments

Formative Assessments

- KWL chart
- Concept maps to represent understanding of a topic
- Think-pair-share exercise
- Quizzes
- Jigsaw groups- Groups work on different topics and then restructure groups to share knowledge.

Summative Assessments

- Journal to see connection between different topics/concepts
- Final project
- Midterm or final exam.

Learning Activities

Activity 1- Visualising Planet Orbits

Take students to an open space and assign each student a star (Sun, planet, etc.) from space. Ask students to pretend to be that

star and orbit the sun accordingly. Follow this activity with a classroom discussion on the Solar System orbit.

Activity 2- The Great Gravity Escape

Use balloons and a length of string to understand how the force of gravity between two objects and the velocity of a spacecraft can balance to form an orbit.

Activity 3- Viewing Constellations

Download a constellation application on your mobile phone and use it to view the different constellations. If a mobile application is not available, then make a constellation viewer using a toilet paper tube. Ask students to draw what they see.

Activity 4- What causes Seasons?

Poke/pass a pencil through a foam ball to make the Earth. Light a bulb and instruct students to move the ball so that the pencil tip tilts away from the lamp. Ask students questions such as, where on the ball does the light shine most brightly? What would the weather be on this side of the ball? When you move the ball around the lamp, what differences do you see in how the light changes on the ball?

Activity 5- Engagement Poll to Review Unit

Ask questions related to the unit and ask students to write the letter of the correct answer on sticky notes. Make a graph with the answers.

SNC - SCIENCE Grade 8

Curriculum Guidelines

Thinking and Working Scientifically

The following skills will be addressed during the course of teaching different scientific concepts under different units. These are to be integrated with the content SLOs in Life Science, Physical Science and Earth Science domains/ strands.

Students should be able to:

Scientific Enquiry:

- Identify whether a given hypothesis is testable.
- Make predictions of likely outcomes for a scientific enquiry.
- Plan a range of scientific investigations e.g. observe and classify etc.
- Know the meaning of hazard symbols, and consider them when planning practical work.
- Decide what equipment is required to carry out an investigation .
- Take precise measurements, explaining why accuracy and precision are important.
- Collect and record observations and/or measurements
- Describe trends and patterns in results.
- Make conclusions by interpreting results informed by reasoning.
- Suggest improvements while doing experiments.

Engineering Design Process - STEM/ STEAM

Models and Representations

- Describe the strengths and limitations of a model.
- Use symbols and formulae to represent scientific ideas.
- Use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions to challenges/ enquiry questions.
- Apply mathematical concepts (e.g., percentages and ratios) to analyse data and present the data collected in the form of graphs, charts and tables.

Science in Context:

- Describe how science is applied across societies and industries, and in research.
- **Discuss** issues which involve and/or require scientific understanding.
- Describe how people develop and use scientific understanding.
- Discuss how the uses of science can have a global environmental impact.

DOMAIN: Life Sciences

Grade 8

Note: All advanced SLOs are written in Italics. Schools, teachers and textbook publishers have the discretion to follow these SLOs to

give an enriched learning experience to their students.

Unit: Ecology

Student Learning Outcome

Student will be able to:

- describe the role of living things in cycling oxygen and carbon through an ecosystem, citing the processes of respiration, photosynthesis and combustion
- relate how oxygen and carbon cycles are complementary processes that bring balance and symmetry to life on earth
- describe global warming and explain how threats to the carbon-oxygen balance such as overpopulation, reliance on fossil fuels, and deforestation are contributing to global warming and climate change
- describe how energy flows from producers to consumers, and how only part of the energy flows from one level of the pyramid to the next
- draw a food web diagram to illustrate the food relationships between organisms
- describe and illustrate through examples key ecological relationships between organisms, including competition, predation and symbiosis
- predict how changes in an ecosystem (e.g., changes in the water supply, the introduction of a new population, hunting, migration) can affect available resources, and thus the balance among populations
- hypothesise what would happen in the ecosystem if the population of one of the participants in different ecological relationships is affected
- explain ways in which human behaviour (e.g., replanting forests, reducing air and water pollution, protecting endangered species) can have positive effects on the local environment

Knowledge:	**Skills:**

● energy flow from producers to consumers
● energy pyramid and energy flow from one level to the next
● oxygen cycle, carbon cycle
● global warming and its threats to the carbon-oxygen balance
● human activities that affect ecosystems negatively
  ○ deforestations
  ○ overpopulation
  ○ reliance on fossil fuels
  ○ emission of greenhouse gases
  ○ use of brick kilns with old techniques
● ecological relationships, competition, predation, symbiosis and parasitism.
● human behaviour (e.g., replanting forests, reducing air and water pollution, protecting endangered species) can have positive effects on the local environment.
 	
Advanced SLOs
 	
· *describe and illustrate through examples key ecological relationships between organisms, including mutualism, commensalism and parasitism*
	Students will be able to:
	● classify or sort various organisms on an energy pyramid, and using a criteria or key for classification
	● contextualise the food web to include organisms that are visible in their immediate ecology and depict food relationships between them
	● investigate individual or communal practises in their context that are contributing to global warming
	● ideate ways they can collectively reduce their reliance on fossil fuels, and plan an individual and communal plan of action to mitigate global warming (E.g. communal interventions could be reforestation, pooling of fuel-dependent resources, switching to renewable energy like solar panels; individuals could be recycling and reusing materials and resources, reducing energy consumption at home etc.)
	● predict how changes in an ecosystem (e.g., changes in the water supply, the introduction of a new population, hunting, migration) can affect available resources, and thus the balance among populations
	● hypothesise what would happen in the ecosystem if the population of one of the participants in different ecological relationships is affected
	● portray how changes in the ecosystem can affect available resources that various segments of the human population are competing for, leading to widening inequality and gaps in the quality of life of various populations

Key Vocabulary producers, consumers, decomposers, autotrophs, herbivores, carnivores, omnivores, energy pyramids, food webs, respiration, photosynthesis, combustion, fossil fuels, global warming, climate change, competition, predation, symbiosis, , replantation, waste management, recycling. ***Advanced Vocabulary****: mutualism, commensalism, parasitism*	***Advanced SLOs*** ● *reflect on the natural balance between carbon and oxygen through mindful breathing* ● *prepare and perform a role play on how competition, predation and symbiosis can be reflected in relationships between humans* ● *explore careers in science including climate change analysts, activists, policymakers and lawmakers; energy engineers, sustainability leaders in organisations, sustainability auditors*

Assessments

Formative Assessments

- KWL charts for assessing prior knowledge of students
- Think- pair- share activities to discuss the importance of stable ecosystems
- Peer Quizzes
- Discussion questions
- Oral and written responses
- Exit tickets
- Class Tests including short question answers, labelling diagrams etc.
- Marked Quizzes

Summative Assessments

- End-of-Unit Tests
- Final Project/ Presentations
- Midterm or Final Exam

Learning Activities

Activity 1: Model of Ecosystems

Provide students with resources to build models of different ecosystems such as forest, pond, desert, urban housing society etc.

Activity 2: Human Impact on Ecosystems

Divide students in pairs and assign them an ecosystem each (forest, mountain range etc.). Ask them to research and observe the human impact on ecosystem, and to assess whether it is positive or negative. Recommend using real-life, recent examples which can be found in different newspapers or on online forums.

Activity 3: Chain of Events

Conduct an activity where the students design and decorate pieces of chart papers to understand the chain of events that occur in oxygen and carbon cycles.

Activity 4: Environmental Pledge + Logbook

Explain the importance of environmental conservation to the students and advise them to pledge to take helpful steps to conserve the environment. students should keep a logbook for the rest of the year where they can enter any step they have taken to help the environment, from planting a tree or turning off a tap to researching methods of recycling or donating to a foundation working for the environment.

Activity 5: Group Research

Explain to students the negative effects of destabilizing ecosystems. Divide them in groups and ask each group to research a certain environmental disaster (tsunami, floods, volcanic eruptions) or ecological disaster (forest fires, oil leaks in the oceans, nuclear bombing), and provide ideas to counter these disasters.

DOMAIN: Life Sciences

Grade 8

Unit: Human Nervous System
Student Learning Outcome **Student will be able to:** ● Identify organs, functions and processes of the human nervous system ● sketch and label a diagram of the human nervous system ● explain how the brain works as the control station of a human body ● identify the three major parts of the brain – forebrain, midbrain and hindbrain, and describe their various functions ● describe the structure of the cerebrum, its division into two hemispheres (left and right) and the role of each hemisphere in the control of the body ● Explain and represent how messages flow through the body from and to the brain, and how the brain collaborates with the sensory organs to regulate this process ● map the various steps in the transmission of messages through the body and to the brain via a reflex arch. ● describe the role and function of neurons in transmitting messages through the body ● Predict what would happen if a nerve connection broke. ● match various body functions with the relevant part of the brain that controls or regulates them (For instance, associating breathing with the brain stem).

Knowledge:	**Skills:**
● human nervous system, nerves, neurons and types of neurons ● brain as a control station of the human body ● the organs, functions and processes of the human nervous system ● identify the three major parts of the brain – forebrain, midbrain and hindbrain, and define their various functions ● practises for maintenance of brain health ● neurological conditions and their impact on functions of the human body ● structure of the cerebrum, its division into two hemispheres (left and right)	Students will be able to: ● predict what would happen if a nerve connection broke ● sketch and label a diagram of the human nervous system ● create a plan of activities and exercises they can do to maintain a healthy brain ● match various body functions with the relevant part of the brain that controls or regulates them (for instance, associating breathing with the brain stem)
Advanced SLOs ● *describe neurodiversity as a form of natural human variation, and recognize the diverse ways people function in society* ● *recognize common neurological conditions and describe how they impact the development and function of the human body* ● *differentiate between sympathetic and*	***Advanced SLOs*** ● *research and narrate with empathy and understanding how neurodiverse and neurotypical individuals experience the world similarly or differently* ● *associate various body responses to the sympathetic or parasympathetic nervous systems* ● *brainstorm basic strategies for managing stress* ● *explore various careers in science such as cognitive neuroscientists, brain surgeons, neurologists, neuropsychologists, survivalists*

parasympathetic nervous system ● *differentiate between fight and flight responses* ● *identify the four lobes in each cerebral hemisphere, and relate their specific functions to them* **Key Vocabulary** central nervous system, peripheral nervous system, brain, spinal cord, neurons, motor neurons, sensory neurons, signal, cerebrum, cerebellum, brainstem, sensory organs, sensory pathways ***Advanced vocabulary****: sympathetic nervous system, parasympathetic nervous system, adrenaline, hypothalamus, fight and flight responses*	

Assessments

- KWL charts for assessing prior knowledge of students
- Peer Quizzes
- Discussion questions
- Oral and written responses
- Exit tickets
- Class Tests including short question answers, labelling diagrams etc.
- Marked Quizzes

Summative Assessments

- End-of-Unit Tests
- Final Project/ Presentations

  Midterm or Final Exam

Learning Activities

Activity 1: Model of Nervous System

Create a model of a neuron by using clay, playdough, Styrofoam, recyclables, or anything else you can get your hands on. Students can use pictures from their books to get an idea of where the components of a neuron should go and what shape they should be. Use different colours to indicate different structures. Make a neural circuit with a few of the neurons.

Activity 2: Neuron Chain Tag

Take the students out on the ground and explain the process of a neuron chain (how signals travel from brain to other parts of the body). Start with just one player who is "it." This player is the first neuron and tries to tag another player. A tagged player must hold the hand of the first player and together they must chase the other players. As more and more players are tagged, they are added to the chain of neurons. The game ends when all the players are part of the chain.

Activity 3: Brain Break Book

Ask the students to design and keep a personal brain break book where they add in breathing exercises and meditating activities which they can use to practice good mental health.

Activity 4: Thinking Cap

Using crafts paper, students should make a thinking cap that covers the entirety of their heads. The cap should be labelled according to the different parts of the brain (temporal lobe, frontal lobe etc.) so that the students can remember exactly where the parts of the brain are located.

Activity 5: Understanding the Complexity of the Brain

Ask the students to draw 10 dots on one side of a piece of paper and 10 dots on the other side of the paper. Assume these dots represent neurons and assume that each neuron makes connections with the 10 dots on the other side of the paper. Then connect each dot on one side with the 10 dots on the other side. Students can use different coloured pencils for each line that they draw to understand just how complex the system of neuron transmission is.

References: https://faculty.washington.edu/chudler/experi.html

DOMAIN: Life Sciences

Grade 8

Unit: Variation Heredity and Cell Division

Student Learning Outcome

Student will be able to:

- describe variation and adaptation in living organisms
- explain and illustrate the differences between variation and adaptation
- identify sources of variation from environmental and genetic factors
- explain how different adaptations affect the chances of survival of different species of organisms
- recognize Genetics as the study of Heredity and describe heredity as the transfer of genetic information that specifies structure, characteristics and function, from parents to offspring.
- differentiate between the concept of genes and chromosomes and relate them to how genetic characteristics are inherited
- describe the composition and structure of DNA
- design a model of DNA to demonstrate its structure, functions and various components
- describe cell division and its types – mitosis and meiosis and relate them to the passage of genetic information through reproduction
- describe cell division and its types - meiosis and relate them to the passage of genetic information through reproduction.
- explain the process of mitosis and meiosis and identify their key phases

Knowledge:

- genetics and heredity
- genes, alleles and chromosomes and how genetic characteristics are inherited
- nucleic acid stores and express genetic information
- specific traits and characteristics of organisms are determined by their DNA, genes and the specific proteins their cells produce
- dominant and recessive genes, traits are inherited
- mutations – natural or induced - can alter a gene, create new mutations, introduce new variations and affect survivability
- cell division and its types – mitosis and meiosis, and passage of genetic information through reproduction
- mitosis and meiosis, and their key phases

Key Vocabulary

heredity, genetics, genes, chromosomes, deoxyribonucleic acids DNA, inherited traits, instincts, learned behaviours, variation, adaptation, cell division, mitosis, meiosis, stimuli

Skills:

Students will be able to:

- reflect on their physical traits such as eye colour, skin colour, hair colour and texture, height etc. and associate them with traits they see in their parents
- differentiate between phenotype and genotype
- predict the physical traits of offspring organisms when given descriptors of parents' traits and characteristics
- design a model of DNA to demonstrate its structure, functions and various components
- illustrate the differences between inherited traits & instincts and learned behaviours
- relate the concept of mutation to students' understanding of variation and adaptation
- identify and narrate experiences where they used their instincts to respond to a certain situation or stimuli
- synthesise how heredity and cell division interact to reproduce genetic traits and characteristics across populations
- explore careers in science such as geneticists, genealogists, family health historians etc.

Advanced SLOs

- evaluate with specific examples and case studies, if human behaviour is learned or acquired
- analyse why variation of traits, characteristics and learned behaviours is beneficial for a species
- *predict results involving monohybrid inheritance using genetic diagram*

Assessments

Formative Assessments

- KWL charts for assessing prior knowledge of students
- Peer Quizzes
- Discussion questions
- Oral and written responses
- Exit tickets
- Class Tests including short question answers, labelling diagrams etc.
- Marked Quizzes

Summative Assessments

- End-of-Unit Tests
- Final Project/ Presentations
- Midterm or Final Exam

Learning Activities

Activity 1: Play-Dough Model of DNA

Students should design a model of DNA using Play-Dough and label its different parts.

Activity 2: Inventory of Traits

Explain the necessity of variations among members in a species. Divide the students into groups and ask each group to create an "inventory" of traits, where members of each group discuss their traits (attached earlobe, similar hair colour/ texture, rolling tongue etc.). Students should note the similarities and differences among their group members.

Activity 3: Risk Continuum

Explain the risk of hereditary diseases. Ask the students to research possible hereditary diseases (diabetes, high blood pressure, eye diseases etc.) and to observe whether their family history might have a record of such diseases. Students should also look at the precautionary and preventive measures taken to stop the risk of hereditary diseases.

Activity 4: Visual Representation of Mitosis

Conduct an activity using different coloured yarns to represent the process of mitosis.

Activity 5: Punnett Square Experiments

Ask the students to check the accuracy of the Punnett Square by using alleles. Alleles can be in the form of two different colours to denote dominant and recessive alleles, or in the form of capital letters and small letters to denote dominant and recessive alleles respectively.

References: https://learn.genetics.utah.edu/content/basics/activities/pdfs/InventoryOfTraits.pdf

DOMAIN: Life Sciences

Grade 8

Unit: Biotechnology

Student Learning Outcome

Student will be able to:

- define biotechnology as the use of living cells and organisms in products and processes that can improve the quality of life
- illustrate how biotechnology is a discipline/ field that has the potential to transform how we live
- discuss the applications of biotechnology in the Pakistani context and their effects on the people and the environment of Pakistan over time. Illustrative examples: bread-making, making of yogurt and cheese, vaccines for immunisation, insulin production, dyes, etc.
- relate the use of biotechnology in food sciences in producing foods with higher nutritional value and improved taste and quality [How fermentation has been improved by genetically modified organisms or the introduction of certain genes to raise iron content in rice, can be taken as examples]

Knowledge:

- biotechnology and its uses
- biotechnology as the use of living cells and organisms in products and processes that can improve the quality of life
- biotechnology and its relation with different disciplines
- applications of biotechnology in the Pakistani context and their effects on the people and the environment of Pakistan over time (Illustrative examples: Bread-making, making of yogurt and cheese, vaccines for immunisation, insulin and interferon production etc.
- possible career paths in biotechnology, including microbiologists, bio-technicians, biotechnology law and policy makers, product designers etc.

Key Vocabulary

biotechnology, genetic modification, nucleic acid, Deoxyribonucleic Acid (DNA), traits, characteristics, genes, genetic information

Skills:

Students will be able to:

- narrate the useful or harmful effects of biotechnology on living organisms or their ecology, in the form of a story
- analyse the specific uses of biotechnology in the agriculture sector – transgenic crop plants, pest control strategies, mass propagation etc
- illustrate how biotechnology is a discipline/ field that has the potential to transform how we live
- assess the use of biotechnology in food sciences in producing foods with higher nutritional value and improved taste and quality [how fermentation has been improved by genetically modified organisms or the introduction of certain genes to raise iron content in rice, can be taken as examples]
- discuss specific examples of the applications of biotechnology by identifying real problems, presenting the biotechnological intervention, the intended outcome of the intervention, and its short- and long-term effects on humans, other living organisms and the environment
- evaluate the use of biotechnology in public health, including the use of vaccines, gene therapy, insulin production, and stem cell-research and the ethical ramifications of these applications
- discuss how bioremediation and bioreactors can be used to improve waste management in Pakistan
- articulate why ethical standards are particularly important in regulating commercial or experimental use of biotechnology

Assessments

Formative Assessments

- KWL charts for assessing prior knowledge of students
- Think-pair-share activities
- Peer Quizzes
- Discussion questions
- Oral and written responses
- Exit tickets
- Class Tests including short question answers, labelling diagrams etc.
- Marked Quizzes

Summative Assessments

- End-of-Unit Tests
- Final Project/ Presentations

  Midterm or Final Exam

Learning Activities

Activity 1: Storytelling

Divide students into groups and ask each group to come up with two stories each, where one story narrates the positive impact of biotechnology, and the other story narrates the negative impact of biotechnology.

Activity 2: Types of Biotechnology

Students can research and prepare presentations on different types of biotechnology (medical, industrial etc.)

Activity 3: Biotechnology and Fiction

Ask students to draw links between biotechnology and different characters they may have encountered in stories, films, or cartoons (for example Spider-Man). Explain to students how fiction uses biotechnology to create superhuman with genetically altered DNA. Students should be able to understand how and why fictional traits come forth because of biotechnology and should be able to differentiate between fact and fiction.

Activity 4: Food and Biotechnology

Show videos of fermentation process as carried out using biotechnology, to students. After the video, divide them into pairs so they can discuss the effects of how food can be produced in bulk and be tastier because of biotechnology.

Activity 5: Environment and Biotechnology

Explain the processes of biotechnology and how it impacts the environment (plants, animals, soil etc.). Ask the students to think and share the ways in which biotechnology is contributing positively to the environment and how biotechnology is tampering with environmental processes and ecosystems.

DOMAIN: Physical Sciences

Grade 8

Unit: The Periodic Table

Student Learning Outcomes

Students will be able to:

- recognize periodic table as a way of classifying the elements in groups and periods
- Identify the names and location of the first 18 elements only
- Identify the properties of metals and non-metals
- Relate the properties to the uses of metals

Knowledge:	**Skills:**
periodic table as a way of classifying the elements in groups and periods ● the arrangements of elements in the periodic table in terms of periodicity and trends (atomic radii, metallic and non-metallic,) in groups and periods; ● the names and location of first 18 elements in periods and groups ● properties of metals, nonmetals and metalloids **Key Vocabulary** Periodic table, periodicity, groups, periods, halogens, alkali metals, alkaline earth metals, noble gases, transition elements, metals, non-metals, atomic radius, atomic reactivity.	Students will be able to: ● relate the names, symbols and uses of elements in the periodic table ● locate different periods, groups, and blocks within the periodic table to become familiar with the structure and purpose of the periodic table ● list common names for groups of elements in order to find the group and location of specific elements ● locate the areas of the periodic table where metals, non-metals, and metalloids can be found, ● link the location of the element to the number of valence electrons and atomic number in order to explain why elements in the same group have similar properties ● predict the trends of atomic radius , metallic and non-metalic nature of elements ● investigate the properties of particular elements ● classify an element as a metal, non-metal, or metalloid based on its physical and chemical properties ● make a presentation on chronological time presenting how the current periodic table was developed over time based on many discoveries, models and revisions ● build a 3-D model of periodic table using empty egg carton or any other resource Advanced SLOs ● *recognize the arrangements of elements in the periodic table in terms of periodicity and trends (atomic radii, metallic and non-metallic, melting and boiling points) in groups and periods* ● *relate reactivity of elements to their atomic sizes*

Assessments

Formative Assessments

- Discussion about pasting flash cards on the empty template of periodic table
- students' oral, verbal and written responses
- Evaluating students understanding about Periodic Table of Elements by using missing information worksheets
- Exit cards

Summative Assessments

- Class tests
- Marked Quiz
- End of unit tests
- Term wise examination
- Projects

DOMAIN: Physical Sciences

Grade 8

Unit: Chemical Reactions

Student Learning Outcomes

Students will be able to:

- identify chemical reactions and give examples
- define the law of conservation of mass and demonstrate the law with an experiment
- write and balance chemical equations
- distinguish between different types of reactions (combination, decomposition, displacement, double displacement, combustion)
- distinguish between endothermic and exothermic reactions
- recognize the importance of exothermic and endothermic reactions in daily life

Knowledge ● chemical reactions ● the law of conservation of mass ● balanced chemical equations ● different types of reactions. (combination, displacement, double displacement, combustion, decomposition ● endothermic and exothermic reaction ● the importance of exothermic and endothermic reactions in daily life **Key Vocabulary** chemical reactions, synthesis /combination reaction, decomposition reaction, single displacement or replacement reaction, chemical equation, reactants, products, balanced equation , conservation of mass, exothermic reaction, endothermic reaction	**Skills:** Students will be able to: ● conduct simple chemical reactions ● construct balanced equations of chemical reactions ● compare and contrast types of chemical reactions ● demonstrate law of conservation of mass in an experiment ● relate the different types of chemical reactions to real life situations. ● make predictions of likely outcomes for a scientific enquiry ● interpret results using scientific knowledge and understanding ● make conclusions from their findings ● choose equipment to carry out scientific investigations ● carry out practical work safely

Assessments

Formative Assessments

- students' oral, verbal and written responses
- Evaluating students understanding about chemical reactions through balancing the chemical equations worksheets
- Exit cards (What have you learned today?)
- Projects
- Quiz on Kahoot and Quizzes

Summative Assessments

- Class tests
- Marked Quiz
- End of unit tests
- Term wise examination
- Projects

Learning Activities

1. students could produce a spider diagram showing different everyday chemical reactions.
2. Have your students make a storyboard showing other students how to balance chemical equations.
3. Get your students to create a T-Chart storyboard comparing different chemical reactions.
4. students can be given worksheets to complete and balance the chemical reactions.
5. Design a car that is powered solely by a chemical reaction and can travel (STEAM)

DOMAIN: Physical Sciences

Grade 8

Unit: Acids, Bases and Salts

Student Learning Outcomes

Students will be able to:

- classify acids, bases, and salts and give examples of each
- identify the physical and chemical properties of acids, bases and salts
- define pH and its ranges with reference to indicators
- interpret the pH scale and identify acids, bases and salts
- describe neutralisation reactions with real life examples
- observe and write the uses of acid, bases and salts in daily life

Knowledge: ● acid, base and salt and examples of each ● physical and chemical properties of acids, base and salts ● pH and its ranges with reference to indicators ● neutralisation reactions with real life examples ● uses of acids, bases and salts in daily life **Key Vocabulary** Methyl blue, Phenolphthalein, Litmus, neutralisation, pH, indicator, carbonates, carbon dioxide, metals, dilute, concentrated, hydrogen, soapy, sour, bitter, conductor, corrosive, phenolphthalein, acidic, alkaline	**Skills:** Students will be able to: ● distinguish between acids, bases and salts ● sort everyday solutions as acidic and basic ● classify solutions as acidic, basic and neutral based on pH value and indicator used ● investigate the effect of a variety of acids and bases on different indicators ● explore different types of indicators (methyl blue, phenolphthalein, litmus etc.) in laboratory ● interpret readings from pH scale ● relate the use of acids, bases and salts in real life ● list down the acids and bases used in the household ● compare and contrast acids and bases by making a Venn diagram ● investigate neutralisation reactions and make its connection to industry and agriculture ● plan and conduct simple experiments to analyse properties of acids, bases and salts ● sort and classify data and information using tables and graphs ● make conclusion from their findings ● choose equipments to carry out scientific investigations ● carry out practical work safely

Assessments

Formative Assessments

- students' oral, verbal and written responses
- Evaluating students' prior knowledge through questions and discussion
- Presentation on uses of acids in groups or individually
- students' responses in drawing and annotating a suitable colour chart with numbers that correspond to acids, base and neutral solutions.
- Investigations on properties of acids and bases
- Exit cards (What have you learned today?)
- Projects

Summative Assessments

- Class tests
- Marked Quiz
- End of unit tests
- Term wise examination
- Projects

Learning Activities

1. Start by reviewing students' previous knowledge of acids.

    - What is an acid?
    - Can you name any acid?

2. Students can be provided a display of acids (flash cards / original acid samples) to compare different acids (vinegar, lemon juice, canned drink)

   Laboratory acids- with hazard labels.

3. Use a pH chart to demonstrate how the colour of universal indicators changes in solutions of different pH.
4. Students in groups or pairs can be asked to find the pH of given solutions and identify them as acids and bases.
5. Students draw and annotate a suitable colour chart. Make sure they know the number(s) that correspond to acids, base and neutral solutions.
6. **Using indicators:** This activity uses turmeric, a common spice in curry, as an indicator for acidity and basicity. Turmeric is yellow in acid and neutral

   substance but turns bright red with bases. Students can use their indicator to test household chemicals and determine which are basic. (This activity requires adult supervision since it uses isopropyl alcohol, also known as rubbing alcohol).

   Material: Take ¼ teaspoon turmeric powder, ¼ cup of isopropyl alcohol, one small jar with a tight-fitting lid, one dropper and five small bowls or cups with household Chemicals to test (soap, vinegar, baking soda, etc.)

7. Ask students to make a presentation on the uses of acids, bases and the importance of neutralisation in everyday life.

DOMAIN: Physical Sciences

Grade 8

Unit: Reflection and Refraction of Light

Student Learning Outcomes:

Students will be able to:

- identify basic properties of light (i.e. speed, transmission through different media, absorption, reflection and dispersion)
- Describe and show how an image is formed by the plane mirror.
- state the Laws of Reflection
- describe different optical instruments which use curved mirror
- relate the apparent colour of objects to reflected or absorbed light
- explain that light is refracted at the boundary between air and any transparent material
- distinguish between reflection and refraction of light with daily life examples
- Investigate that light is made up of many colours.
- identify spherical mirrors
- describe the characteristics of an image(s) formed by concave and convex mirror
- describe use of different optical instruments in which plane and spherical mirrors are used.

Knowledge:

- a ray of light
- behaviour of light
- Laws of Reflection
- a simple ray diagram; path of light in reflection from a plane mirror
- different optical instruments using plane mirrors (microscope, telescope, binocular)
- working of a periscope
- basic properties of light (i.e. speed, transmission through different media, absorption, reflection and dispersion)
- relation of apparent colours of objects with reflected or absorbed light
- refraction of light at the boundary between air and any transparent material
- reflection and refraction of light with daily life examples
- the dispersion of light through a glass prism
- dispersion in everyday life

Key vocabulary:

refraction, reflection, transparent,, medium,, mirror image, rare-view mirror, optical instruments, diminished, magnified, refraction, refracted ray, emergent ray, object, image, dispersion, rainbow spectrum

Skills:

Students will be able to:

- draw ray diagrams to show passing of light from one medium to another.
- Predict the effect of transparent media of varying densities on the angle of refraction of light.
- Illustrate the characteristics of image formed in a plane mirror.
- Compare refraction with reflection of light
- Investigate how light refracts differently through different materials.
- Apply understanding of refraction to everyday situations.
- Apply understanding of dispersion to real life situations;
    - o make and discuss observations;
    - o interpret results using scientific knowledge and understanding;
    - o draw conclusions from their findings.
- Compare and contrast images formed by a plane mirror, concave mirror and convex mirror.

	• Apply understanding of images formed by different mirrors to real life situations.
	  • use tools and apparatus safely.
	  • carry out practical work safely
	
	(Advanced SLO)
	• *Interpret a simple ray diagram to identify the path of light in reflection from a plane mirror.*
	• *Make a periscope using plane mirror strips (STEAM)*

Assessments

Formative Assessments

- Students' oral, verbal and written responses
- Evaluating students' prior knowledge through brainstorming
- Students' responses in making of different models/projects to apply the knowledge of about refraction and reflection
- Exit cards (What have you learned today?)

Summative Assessments

- Class tests
- Marked Quiz
- End of unit tests
- Term wise examination
- projects

Learning Activities

Show the effect of refraction using one or more of these demonstrations.

<u>The bending pencil.</u>

Fill three identical glasses with different amounts of water. Then put a pencil in each glass of water and students make careful observations, drawing what they see. The pencils can be moved from one side of the glass to another.

<u>The disappearing coin trick.</u>

Put a coin into the bottom of an empty glass. Slowly add water and watch the apparent position of the coin as the water level rises.

Investigating the law of refraction

Scientific inquiry Activity

- Demonstrate how to accurately record the path of a ray of light as it enters and exits a rectangular block. This can be done with optical pins. Show how to find the normal line for the point of entry and exit. Then show how to use a protractor to measure the angle of incidence and the angle of refraction at the entry and exit point.
- Students, in groups, draw the path of the light as it enters and exits a block. They should do this for several angles of incidence. It may help to darken the room.
- They measure the angle of incidence and the angle of refraction for a ray of light as it enters and leaves a block.
- They should record their results in a table and draw a graph of their results.
- Alternatively, a simulation can be used to investigate refraction. Again, results should be recorded in a table and a graph drawn.

Extension Activity

1. An application of refraction: Spear fishing.
2. Use a ray diagram to show the refraction of light. Ask: What would happen if the fisherman speared the place where the fish appears to be? Does the fisherman need to stab above or below the image of the fish?
3. Create Newton's disc.
4. Show students the types of mirrors and through a video demonstration the type of image formed. They can be asked to make a list of places where they have seen concave and convex mirrors.

DOMAIN: Physical Sciences

Grade 8

Unit: Force and Pressure

Student Learning Outcome

Students will be able to:

- recognize that several forces may act on an object and that they may or may not balance each other
- examine the effect of an unbalanced force on an object
- differentiate between floating and sinking objects in terms of density
- define ‘pressure’ with examples and its unit
- relate pressure with force and area
- investigate effects related to pressure (e.g. water pressure increasing with depth, a balloon expanding when inflated etc.)
- examine the effect of force in the presence of air pressure
- Make a hydraulic elevator. (STEAM)
- Build a two stage rocket model. (STEAM)

Knowledge: ● recognize that several forces may act on an object which may or may not balance each other ● study the effect of an unbalanced force on an object ● differentiate between floating and sinking objects in terms of density ● define 'pressure' with examples and its units ● relate pressure with force and area ● investigate effects related to pressure (e.g. water pressure increases with depth, a balloon expanding when inflated etc.) ● differentiate between mass and weight ● study the effect of force in the presence of air pressure **Key Vocabulary** pressure, density, pressure, balanced, unbalanced, weight, Newton, Pascal, mass, weight.	**Skills:** Students will be able to: ● relate and apply their knowledge about force and its effects in real life situations ● differentiate between balanced and unbalanced forces ● examine the effect of an unbalanced force on an object ● explore more interesting facts about the nature of force ● conduct an experiment to distinguish between floating and sinking objects in terms of density ● investigate effects related to pressure. (e.g. water pressure increasing with depth, a balloon expanding when inflated etc.) ● examine the effect of force in the presence of air pressure ● predict and reflect on the results ● solve numerical problems related to pressure and area, density, mass and weight ● plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on an object ● develop scientific skills such as observation, hypothesising, articulation of scientific understanding with evidence ● show curiosity about the destructive power of forces in nature (e.g., earthquakes, tsunamis, volcanic eruptions, tropical cyclones) ● Make a hydraulic elevator. (STEAM) ● Build a two stage rocket. (STEAM)

Assessments

Formative Assessments

- Brainstorming about prior knowledge
- students' oral, verbal and written responses
- Evaluating students understanding through quizzes
- Exit cards (what have you learned today)

Summative Assessments

- Class tests
- Marked Quiz
- End of unit tests
- Term wise examination
- Projects

Learning Activities

1. Start the lesson by simply asking which is easier, walking in air or swimming in water.
2. Floating Egg Demonstration

   Ask students to predict what will happen when an egg is placed in equal volumes of salt and fresh water. Add water to two beakers or cups. Mix five to six teaspoons of salt into one beaker to create a salt water solution. Place an egg into the fresh water and salt water beakers. Students will observe that the egg sinks in the fresh water and floats in the salt water solution. Ask students why the egg sinks in fresh water and floats in salt water.

3. Explore the relationship among force, area, and pressure by using a large rectangular wooden block, coins or washers, and a small container of

   and or flour to model different pressures by changing just one variable (for example, laying a block in the sand on its smallest side will create a slightly deeper impression than laying it on one of its larger sides).

4. Use of secondary resources/ presentation/ simulations to study
5. Make a hydraulic elevator (STEAM)
6. Build a two-stage rocket (STEAM)

Suggested links:

Hydraulic Elevator- STEM Engineering Project

https://www.teachengineering.org/populartopics/designprocess

https://www.teachengineering.org/curricularunits/view/cub_rockets_curricularunit

DOMAIN: Physical Sciences

Grade 8

Unit: Electricity and Magnetism

Student Learning Objective

Students will be able to:

- define voltage and current, state their SI unit
- define resistance and its SI unit
- formulate that resistance is the ratio of voltage to current
- define electric power and state its unit
- recognize the electric power of various electrical appliances
- estimate the cost of using electrical appliances (electricity bill) in daily life
- recognize the terms earth wire, fuse, circuit breaker
- analyse the danger of overloading and short circuit and identify the importance of earth wire, fuses and circuit breakers
- list precautionary measures to ensure the safe use of electricity
- investigate the factors that affect the strength of an electromagnet
- describe the properties that are unique to electromagnets (i.e. the strength varies with current, number of coils and type of metal in the core; the magnetic attraction can be turned on and off; and the poles can switch
- describe briefly the working principles of electromagnetic devices such as speaker and doorbell

Knowledge:

- voltage and SI unit of voltage
- resistance and its SI unit
- resistance is the ratio of voltage to current
- electric power and its unit
- the electric power of various household electrical appliances
- estimate the cost of using daily life electrical appliances (electricity bill)
- the danger of overloading and short circuit and the importance of earth wire, fuses and circuit breakers
- precautionary measures to ensure the safe use of electricity

Advanced SLOs

- *Describe the properties that are unique to electromagnets (i.e., the strength varies with current, number of coils, and type of metal in the core; the magnetic attraction can be turned on and off; the poles can switch).*

Key Vocabulary

earth wire, fuse, circuit breaker, switch, wire, rheostat, ampere, electric power, battery, static electricity, attraction, repulsion, electric charge, coulomb-metre, positive electric charge, negative

Skills:

Students will be able to:

- draw and interpret circuit diagrams
- investigate the effect of varying resistance on the current in the circuit using fixed or variable resistors (note: formula V=IR is not required)
- investigate how series or parallel arrangement of fixed resistors affects the current as an output of the system
- analyse the danger of overloading and short circuit; explore the importance of earth wires, circuit breakers and fuses
- ensure the safe use of electricity
- Investigate the strength of an electromagnet
- design and construct electromagnets with different strengths

electric charge, neutral, friction, conductors, insulators, circuit, circuit symbols, circuit diagrams, closed and open circuit, electric current, ammeter, ampere (symbol A) series circuit, parallel circuit, voltage, resistance, volts, voltmeter, resistor, variable resistor, positive, negative terminals, electromagnets	

Assessments

Formative Assessments

- Brainstorming about prior knowledge
- students' oral, verbal and written responses
- Evaluating students understanding through quizzes
- Exit cards (what have you learned today

Summative Assessments

- Class tests
- Marked Quiz
- End of unit tests
- Term wise examination
- Projects

Learning Activities

- Brainstorming to access students' prior knowledge about circuit components and types of circuits.
- Students will demonstrate the use of ammeter and voltmeter in series and parallel circuits and record their observations on activity sheets.
- Students will use rheostat to investigate the effect of resistors in the circuit.
- Students will be asked to search from the internet the electric power required by different electrical appliances and relate it with the electricity bill.
- Students can estimate the cost of using daily life electrical appliances (electricity bill) and suggest ways to reduce electricity bills and conserve energy.
- Ask students to make an awareness brochure to highlight the danger of overloading and short circuit and identify the importance of earth wire, fuses and circuit breakers.
- Revise prior learning on magnets by showing students some examples of effects caused by magnets (e.g. a video). Assess whether students can correctly use the term 'magnet', 'magnetic', 'attract' and 'repel'. Attraction and repulsion can be seen very easily if magnets are suspended. This is also an opportunity to check which pole points to the north of the Earth.

- Students can be asked to magnetise a nail by stroking it with a permanent magnet. They demonstrate that it is magnetic by using it to pick up paper clips (or similar). Use an animation so students can visualise the domains becoming arranged in the nail. What would happen if you stroked the magnet in different directions? If there is time, students investigate whether their predictions are correct.
- Show students an example of magnets exerting a force at a distance. In pairs, students discuss what they think is happening. They share their ideas and feedback to the class.
- Use a simulation to demonstrate how a magnetic field can be mapped. Start by showing the simulation without the field. Demonstrate that the compass experiences a force that is in different directions depending on where it is in the field.
- Demonstrate that the field has different strengths in different places; the field is stronger near the poles (shown by the field lines being closer together); the field is weaker further away from the poles (shown by the field lines being further apart).

- Show students how to use a plotting compass to detect the field around a bar magnet. Ask the students to, in pairs, draw the fields around the bar magnets. Compare results.

- Use the simulation again with the magnetic field visible. Ask students to compare the shape of this field with the one they have drawn. Ask students to identify where the magnetic field is strongest. Ask them to predict which part of a bar magnet, iron filings would be most attracted to. Demonstrate placing a bar magnet beneath a piece of card. Sprinkle iron filings on the top. These will produce patterns. The filings will be concentrated around the poles.

- Students make their own electromagnet using a low voltage applied to an insulated copper wire wrapped around an iron nail.

Suggested links: https://www.sci-ed-ga.org/the-electric-bill-project

DOMAIN*:* Physical Science

Grade 8

Unit: Technology in Everyday Life	
Student Learning outcomes: **Students will be able to:** ● make bioplastic from milk and vinegar as an application of biotechnology ● make toothpaste, soap and detergent as an application of acids, bases in daily life ● assemble a concave mirror type solar cooker to convert solar energy into heat energy ● assemble and operate a simple wind turbine to produce electricity ● demonstrate the working of UPS and use it to operate a fan or energy saver bulb ● Design a Car that is powered solely by a chemical reaction and can travel.	
Knowledge ● bioplastic ● processes involved in making toothpaste, soap and detergent ● acids and bases in everyday life ● concave mirror and how they work ● function of a wind turbine ● function of UPS and safety measures ● energy savers Key vocabulary; Bio plastic ,biotechnology, acid, base, safety measures	**Skills** ● use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions to challenges/ inquiry questions ● use secondary sources of information to study the process of making the given products. ● apply the process people follow to design new things (make a plan, make drawings of the design, choose the best available material, construct working models and test your design) ● describe the strengths and limitations of your model ● Follow safety measures while handling electrical appliances ● Design the model of wind turbine using reusable material.

	• Design a car that is powered solely by Chemical reaction.

Assessments

Formative Assessments

- KWL Chart
- Venn Diagram to compare and contrast
- Exit slips
- Silent poll
- Discussion and written questions

Summative Assessments

- Midterm or final exam
- End of unit test

Learning Activities. The following links may be used for conducting the unit activities.

Make bio plastic from milk

https://www.sciencebuddies.org/stem-activities/milk-into-plastic

Building a Simple Solar Oven

https://www.sciencebuddies.org/science-fair-projects/project-ideas/Energy_p018/energy-power/build-a-simple-solar-oven

https://www.youtube.com/watch?v=7IX7YJtHwTk

A Simple Wind Turbine to Produce Electricity

https://www.youtube.com/watch?v=DILJJwsFl3w

Working of UPS and use it to operate a fan

https://www.youtube.com/watch?v=bj5KpFR_LPU

Processes involved in making toothpaste

https://www.slideshare.net/nueldavidwest/making-and-testing-toothpaste-activity

Design a Car that is powered solely by a chemical reactions and can travel.

https://www.youtube.com/watch?v=bT4CjZjVwEo

DOMAIN*:* Earth and Space Sciences

Grade 8

Unit: Our Universe

Student Learning Objectives:

Students will be able to:

- explore and understand the terms star, galaxy, milky way and the black holes
- compare the types of galaxies
- relate the life of a star with the formation of black hole, neutron star. pulsar white dwarf, red giant
- discuss the birth and eventual death of our Sun
- show how information is collected from space by using telescopes (e.g. Hubble space telescope) and space probes (e.g., Galileo)
- describe advancements in space technology and analyse the benefits generated by the technology of space exploration

Knowledge:

- explore and recognize the terms star, galaxy milky way and the black hole
- explain the birth and death of our Sun
- relate the life of a star with the formation of black hole, neutron star, pulsar white dwarf, red giant
- show how information is collected from space by using telescopes (e.g. Hubble space telescope) and space probes (e.g., Galileo)
- describe advancements in space technology and analyse the benefits generated by the technology of space exploration

Key Vocabulary

star, Galaxy, Milky way, Black hole, Neutron star, Pulsar white dwarf, red giant, Telescope, Hubble Space Telescope, Space Probes, Galileo.

Skills:

Students will be able to:

- ask questions to begin scientific enquiry
- articulate in their own words how the universe began and explain the big bang theory in story form
- compare the types of galaxy
- evaluate the evidence that supports scientific theories of the origin of the universe
- imagine what would happen if the Sun dies
- use a telescope to view stars and planets
- find out about the latest advancements in space technology and present it in the classroom
- interpret results using scientific knowledge and understanding
- make conclusion from their findings

Advanced SLOs

- *describe the big bang theory and explain how the universe began*
- *evaluate the evidence that support scientific theories of the origin of the universe*

Assessments

Formative Assessments

- KWL Chart
- Venn Diagram to compare and contrast
- Exit slips
- Silent poll
- Discussion and written questions

Summative Assessments

- Midterm or final exam
- End of unit tests

Learning Activities

Activity 1- Theory Development of the Big Bang

Divide students into groups and provide each group with the required materials to demonstrate the big bang theory as a story.

Activity 2- What if the sun dies?

Ask students to prepare a short play on what would happen if they woke up one day and found out the sun had died. Ask them to show what the earth would be like if there was no sun in their plays and the impact it would have on the environment.

Activity 3- Using a telescope to view the stars and planets.

If possible, arrange for a telescope and take turns to look at the sky through the telescope. Ask students to describe what they see. Otherwise, build a telescope in class using cardstock/chart paper and ask students to use that to look at the sky. Ask students to draw what the sky looks like through the telescope.

Activity 4- Research on space advancement

Ask students to use the computer lab, if available or find articles in newspapers or magazines regarding space advancement. Ask students to come to the front of the class and summarise what they read in the article.

Activity 5- Scientific Inquiry Graphic Organizer

Divide students into pairs and ask them to choose a scientific theory about the origin of the universe. Ask students to draw a main circle with the name of the theory written in it. Ask students to draw smaller connecting circles around the main circle evaluating the evidence of this theory, asking questions to interpret the theory, and draw conclusions from their findings.

SCIENCE

Guidelines for Textbook Authors (Grades 6-8)

GUIDELINES FOR THE TEXTBOOK AUTHORS

A textbook is an important teaching and learning tool and a standard source of information for the formal study of a subject. Writing a textbook is an extremely important and technical task in the sense that it requires the translation of curriculum learning outcomes at the proper cognitive level of the learners. The textbook authors are required to understand the curriculum in letter and spirit. In this regard, the following key points are of fundamental importance:

- Complete understanding of the content of the curriculum
- Background knowledge of the development of the Single National Curriculum (SNC)
- Understanding of the CPA (Concrete-Pictorial-Abstract) approach
- Realization of the thoughts of the ones who developed the curriculum
- Realization of the responsibility as a Textbook Author

Keeping the above key points in mind, the textbook authors are recommended to follow the following, but not limited to these, guidelines:

- The first and foremost responsibility of a textbook author is to translate the spirit of the curriculum into content and activities/exercises of the textbook. Therefore, the textbook author needs to go through the curriculum by time and again in order to have an in-depth understanding.
- Prepare a mind map of themes and learning outcomes, that is, unit/chapter-wise distribution/ presentation of the scheme of the SLOs.
- It is necessary for the authors to remember, all the time, that the learning approach adopted in the development of this curriculum is the CPA approach. Therefore, it is required for the authors to introduce each and every concept following the CPA approach. Ignorance in this regard might result in a great deviation from our goals.
- The textbook should be written in such a manner that it should carry a thorough continuation among the contents presented in a different unit/chapter.
- Retain and limit the textual material to the learning outcomes details. Consider the time allocated to the subject in the scheme of studies. This will help to decide the length, width, and depth of chapters/topics and concepts.
- Select accurate, authentic, and up-to-date text, and real-life examples.
- Make the scientific concepts interesting and easy to understand for the children through relevant activities, information boxes, and pictures etc.
- The material must help to enhance the knowledge of learners, develop inquiry skills, and engage them in higher-order thinking.
- The content should be interactive and appealing for further learning of the

learners.

- The content should help the child make connections between the different concepts.
- The material should help learners to understand the world in which they live and grow as lifelong learners.
- The material must be relevant and error-free.
- The material must be free from gender, ethnic, regional, and all sorts of biasedness.
- Use attractive and engaging text, tables, graphs etc. along with clear and appropriate illustrations which must be properly labeled and captioned.
- The textbook should have a variety of practical and thought-provoking activities to develop long-lasting learning of the learners.
- Exercises should include clues to encourage learners to think, develop skills, and use the information for a variety of purposes.
- If a particular topic involves various types of concepts/problems or techniques, each type should be given importance individually.
- Authors should consider introducing questions (involving a gradually increasing level of difficulty i.e., from low to moderate, and then to higher-order)
- The textbook must contain a Table of Contents, index and a Glossary.
- The textbook must be contextually relevant and applicable in the normal classroom environment.
- The figures, illustrations, and pictures should be from the local/Pakistani environment.
- Include an appropriately developed assessment after in each unit/chapter.
- Last but not the least, the textbook should contain material that could make the learners to think beyond the textbook.

Guidelines for Writing a Unit/Chapter

In order to make the learning interesting and exciting and to provide a strong foundation for higher-order learning, each unit/chapter in the science textbook must have the following, but not limited to these, features:

- A unit/chapter should start as a continuation of the previous unit/chapter or even a previous section. It is necessary for the authors to start with the facts (either from the existing knowledge of the learners or from daily-life situations) that highlight the need for the contents of that unit/chapter.

- ***Unit/Chapter opener to introduce the unit/chapter with title, full page-colored photographs, and students Learning Outcomes (SLOs).***
- ***SLOs*** at the beginning of each unit/chapter clearly describes the objectives and the tasks that are to be achieved in the unit/chapter.
- Keywords, terms and definitions **to be highlighted in the text.**
- ***Headings and subheadings with specific colors to show different levels of activities.***
- ***Science tidbits*** to provide snippets of interesting and useful knowledge.
- Attractive and colorful illustrations to **captivate learners.**
- Questions like ***"Do You Know?"*** to recall, think, and apply what they have learned as well as to reinforce the learning of key concepts and principles.
- ***Relevant everyday experiences and contexts are used.***

- ***Hands-on activities to encourage the learners to make their own inquiries.***
- ***Skills and processes to infuse values, ethics and attitude.***
- ***Reading check*** to strengthen scientific investigations and relating science contents.
- Authors are encouraged to introduce the activities to be done in groups to make the students interact and share their scientific concepts with each other. This will indirectly refine their scientific concepts and will contribute to leading them towards collaborative studies.
- ***Awareness beyond the classroom*** to widen the horizon of the learners by providing interesting information and introducing, more advanced relevant concepts according to grade level in an understandable way.
- ***Key Points*** to provide a summary of the concepts and principles studied in a unit/chapter should be included at the end of that unit/chapter.
- ***Review Questions*** at the end of each unit/chapter to:
    - recall and integrate previous learning
    - engage and develop their creativity
    - move from lower higher-order thinking
    - develop process skills
    - develop multiple intelligences
- ***Think-Tank/Investigate*** to include open-ended questions to provoke learners' thinking, creativity and investigation skills.
- **Addresses of relevant websites and online learning centers/resources** should be mentioned at the end of each unit/chapter so that the learners and teachers can get up-to-date information about the concepts. The material should reflect the role of technology to promote learning with understanding. Beware that the referred websites or centers should not include material contrary to our religious, moral, ethical, cultural, and social values.
- Teacher Guide should include tips to teachers at relevant places in unit/chapters to explain different concepts and to use a variety of tools/materials, and activities.

SNC - SCIENCE 4-8

Safety Rules

All science teachers are expected to teach students that safety is an important part of science. These rules provide behavior, hygiene, and safety information to avoid accidents and injuries that may occur during science activities and experiments. A list of rules given below are intended to help educators to provide a safe science environment for their students.

- The safety equipment (e.g., fire extinguishers) may be located in the hallway near the entrance.
- Students should know emergency exit routes.
- Use equipment only for its designated purpose.
- Never consume and/or store food or beverages or apply cosmetics in areas where hazardous chemicals are used or stored.
- Long hair and loose clothing must be pulled back and secured from entanglement or potential capture.
- Safety glasses or goggles should be worn in any area where chemicals are used or stored.
- Determine the potential hazards and appropriate safety precautions before beginning any work.
- A first aid box must be present (the kit should be checked periodically, ensuring that any items which have been used are replaced. Such items as band-aid tend to be used quickly and may need frequent replenishment).

Safety while studying plants:

- Before planning out of class activities and field trips, teachers need to find out whether any student has an allergy to plants/ pollen and take measures, accordingly.
- All gardening tools used should be made of plastic (especially made for children).
- Never allow students to place seeds or plants used in science activities in their mouth.
- Paper bags should be used for collecting plants/ leaves.
- Always make students wash their hands after working with plants.

Safety while studying animals:

- Be responsible for animals in the classroom receiving proper care: e.g., light, climate control and food.
- Before bringing any pet or any other animal to class, teachers need to find out whether any student has an allergy to any particular animal (including birds and turtles) and take measures, accordingly.
- Provide proper direction for handling of animals – minimally and gently (demonstrate appropriate technique of handling animals).

- Always make students wash hands with soap and water after handling or working with animals.

Safety while using tools:

- Tools, especially made for young children, should be provided to the students such as children's mechano, and plastic screw drivers.
- Take precautionary measures when using sharp tools and objects like screws, wires, scissors, and screwdrivers.
- Select batteries carefully, batteries with any sign of corrosion should be disposed of carefully.

Reference: Retrieved from general-laboratory-safety-rules.html/general-laboratory-safety-rules.html: https:https://ehs.okstate.edu/general-laboratory-safety-rules.html/general-laboratory-safety-rules.html

DRAFT

GENERAL SCIENCE - TEACHING AND LEARNING

Teachers are encouraged to use and review a variety of teaching methods and learning activities that are predominantly based on a variety of approaches to engage and motivate learners to learn.

1. The 21st CENTURY LEARNING SKILLS– 4 Cs

The concept of globalization has introduced rapid changes in social structures, communities, and society. Teachers are required to not only to cater the individual needs of students but also to prepare them to cope with increasingly changing global society. The 21st century learning skills are vital skills required to prepare the learner for the global society and can be practiced naturally in science lessons across all age groups. These skills encompass a comprehensive set of behavioral learning, knowledge, and attitudes that can be attained by all stakeholders including students, teachers, school leadership and policy leaders. These skills are elaborated below:

CRITICAL THINKING	In science lessons critical thinking can be developed through focused learning activities. These skills can be developed by engaging students in scientific enquiry including: a. Identifying a problem and asking questions about that problem. b. Selecting information to respond to the problem and evaluating it. c. Drawing conclusions from the evidence. Reference: https://www.cambridge.org/us/education/blog/2018/10/18/teaching-critical-thinking-science-key-students-future-success/
CREATIVE THINKING	Creative thinking is the ability to look at things in a different way and discover the new solutions of problems. This ability enables the students to use imagination to develop new ideas and create something new.
COMMUNICATING	Communicating is the clear exchange of information and ideas between student-student and student-teachers. Science lesson planning should have opportunities for students to interact and communicate with each other a number of times so that any misconceptions regarding scientific concepts can be addressed.
COLLABORATING	The classroom of global citizens is being driven by the idea of fostering a collaborative culture to encourage students to work together to solve problems. The 21st century classrooms are designed with flexibility of seating so that students rearrange seats to re-group, other ways for collaboration could be through online groups, video conferencing, Google meet, Google hangouts etc.

References:

- SNC General Science 2020
- https://www.cambridge.org/us/education/blog/2018/10/18/teaching-critical-thinking-science-key-students-future-success/

2. ACTIVE LEARNING

Active Learning is an important feature of the science curriculum. Teachers are encouraged to use and review a variety of teaching methods and learning activities that are predominantly based on active teaching approaches to engage and motivate learners to learn.

Active learning describes a classroom approach which acknowledges that learners are active in the learning process, building knowledge and understanding in response to learning opportunities provided by their teacher. In practice, active learning refers to activities that are introduced in the classroom. This contrasts with a model of instructions whereby knowledge is imparted or transmitted from the teacher to the learner. Active learning means that learners take increasing responsibility for their learning, and that teachers are enablers and activators of learning.

Active learning is based on a theory of learning called constructivism, which emphasizes the fact that learners construct or build their own understanding. Learners replace or adapt their existing knowledge and understanding (based on their prior knowledge) with deeper and more skilled levels of understanding. Skilled teaching is active, providing learning environments, opportunities, interactions, tasks and instructions that foster deep learning.

Another aspect of constructivism is the theory of social constructivism, which says that learning happens primarily through social interaction with others, such as a teacher or a learner's peers. One prominent social constructivist, Lev Vygotsky (1896–1934), described the zone of proximal development (ZPD). This is the area where learning activities should be focused, lying between what the learners could achieve independently and what the learner can achieve with the teacher's expert guidance. By scaffolding tasks, providing guidance and support that challenges the learner based on their current ability, and providing rich feedback through assessment for learning, the teacher actively helps learners develop deeper levels of understanding.

Active learning is an active, dynamic process in which connections (between different facts, ideas and processes) are constantly changing. Such connections are encouraged through dialogue between teachers and learners, and between learners and their peers.

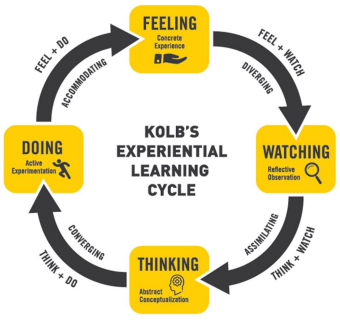
Theoretical frameworks underpinning Active learning

Active learning is a concept used as a general term to combine various learning theories into a pedagogic approach. It has been a common theme evident in the work of many educators, such as Dewy, Piaget and Vygotsky.

It is difficult to provide an internationally accepted definition of all of the terms associated with active learning, however below there are some generally accepted terms and their descriptions:

<table>
<tr><th colspan="2">Terms associated with active learning</th></tr>
<tr><th>Collaborative learning</th><th>Cooperative learning</th></tr>
<tr><td>In this approach, learners work in groups of two or more towards a common goal. It focuses on assessing the contribution of individuals within the group and of the performance of the group as a whole.

In collaborative learning situations, learners are not simply understanding the information, but are working together to create something new.</td><td>This approach is similar to collaborative learning, though it is a more structured form of group work where learners pursue common goals while being assessed individually.</td></tr>
<tr><th>Problem-based learning</th><th>Experiential learning</th></tr>
<tr><td>In this approach, relevant problems are introduced and used to provide the context and motivation for the learning that follows. It is usually collaborative and cooperative and involves significant amounts of self-directed learning on the part of the learners.</td><td>In this approach, learning involves learning from experience. Learners are encouraged to predict, discover, create and relate to and interact with things around them. Reflection is the key practice during all the phases of the experiential learning cycle.

Reference:
https://www.uwindsor.ca/cces/1281/about</td></tr>
</table>

Active Learning strategies

There is a varied range of methods which teachers can integrate into their daily teaching and learning activities in order to foster an active approach:

Paired/group discussion	**Designing questions leading to investigations**	**Model making/ prototypes to represent a scientific concept**
Debates	**Role play**	**Collaborative Group work**
Concept cartoons	**Concept maps/ mind maps**	**KWL charts**
Choice boards/ playlists	**Use of graphic organizers**	**T-charts for mapping cause and effect**
Scientific enquiry research using secondary sources	**Game based learning**	**Experimentation following scientific process**
Compare and contrast	**Planning fair tests**	**Making documentaries or videos**

Below are some features of active learning in the classroom.

A range of teaching and learning approaches are used.
Learners should experience a wide range of learning and teaching approaches. Tasks are challenging, creative and investigative. Learners engage confidently in activities and are prepared to take risks.
Learning is made relevant and meaningful to pupils.
Explanations of new topics should make appropriate links with previous learning and be relevant to the context of the learner. Learners are encouraged to explain key ideas and concepts in their own words. Curriculum topics are linked to real-life situations and are made meaningful.
Learning outcomes are understood.
Teachers' questions focus on key learning aims and outcomes and they invite learners to think about them. Learners understand and can describe these aims and success criteria.
Active participation of learners in activities.
Tasks and activities involve learners in learning through thinking and doing, rather than by rote such as conducting interviews, going for field trips and group studies. Learning can be applied in new situations. Learners can work well independently and as part of a group.
Class discussions are interactive.

Class discussions are interactive and involve an appropriate range of learners within the class. All learners understand that their individual responses will be valued. Learners as well as teachers ask each other questions. Those who are not involved in discussion participate actively by listening, thinking and reflecting. Learning should not be limited to textbooks rather than out of book questions should be encouraged.
Learners lead their own learning.
Teachers adopt approaches which ensure learners are leaders in their own learning. Learners have independent learning skills and can reflect on their own learning. They draw their own informed conclusions. They know what they are trying to achieve and seek help at appropriate times. Learners have choices in their learning. Cramming at any stage should be discouraged. Understanding of the lesson and its concepts should be encouraged.
Use of technology
Computers and related technology help to engage and challenge students. It is a very important resource for learning the concepts and processes of science through simulations, graphics, pod casting, data manipulation, and model building through various websites and soft-wares available.
Values and attitudes in classroom
Science teaching also highlights areas which support and cater to the development, reinforcement, and extension of attitudes that also support scientific inquiry such as open- mindedness and respect for evidence, initiative and perseverance, and creativity and inventiveness.
Home assignments
It extends the opportunity for learners to think scientifically so that they contribute in personal growth self-discipline and learning responsibility. It reinforces the ideas and skill processes so that the learner feels confident in their ability to work without help and reflect their understanding.

Teacher's Role in an active learning environment

In an active classroom environment, the role of a teacher is often that of a facilitator that promotes learner centered approach. It should enable learners to build knowledge through talking, reading and writing, with use of dialogue, discussion and group work important in fostering whole-class understanding. Teachers will set their teaching in real-world contexts, and they will find out learners' starting point of understanding before they plan how to enable them to learn. Because of this, a learner-centered approach will focus on differentiation, and will use strategies associated with assessment for learning, including:

- effective questioning
- sharing of assessment criteria
- provision of feedback
- provision of peer assessment and self-assessment

- using assessment information to adapt their teaching

Teacher-centered classroom	**Learner-centered classroom**
Product-centered learning	**Process-centered learning**
Teacher as a transmitter of knowledge	**Teacher as an organizer of knowledge**
Teacher as a 'doer' for learners	**Teacher as an 'enabler'**
Subject-specific focus	**Teacher as an 'enabler'**

Student's role in an active learning environment

The active class room environment engages students to become inquirers and independent learners.

Being passive recipients of knowledge	**Active and participatory learners**
Answering questions	**Asking questions**
Being 'spoon-fed'	**Taking responsibility for their own learning**
Competing with other learners	**Collaborating with other learners**
Learners of individual subjects	**Connecting their learning**

3. THE FLIPPED CLASSROOM

The flipped classroom approach is a pedagogical model which aims to shift the focus from passive to active learning. As defined by Bergmann and Sams in 2007 "Flipped learning is the pedagogical approach in which direct instructions shifts from group learning space to individual learning space, and the resulting group space is transformed into a dynamic learning environment, where the educator guides students as they apply concepts and engage creatively with the subject matter."

The flipped classroom encourages:

- **independent learning** as learners take more responsibility for their own learning and explore core content (individually or in groups, at home or at school) and then

apply knowledge and skills to a range of activities in their classroom using higher-order thinking.

- **learner-centered learning** as teachers can guide student learning in the classroom, correcting misunderstandings and providing timely **feedback** using a variety of pedagogical strategies.
- **Flexible environment and learning modes** as students have a flexible learning space beyond their classroom.
- **Learner centered classroom culture** as a greater focus on concept exploration in-depth, meaning-making and demonstration of knowledge while in the classroom, naturally shifting away from didactic teaching.

Technological advancements have also enabled teachers to experiment more with this model, enabling learners to access materials (for example, instructional videos and audio recordings) beyond the classroom.

4. PROBLEM-BASED LEARNING

Problem-based learning is the type of classroom organization that supports a constructivist approach to teaching and learning. Guided by teachers acting as cognitive coaches, learners develop critical thinking, problem solving, and collaborative skills as they identify problems, formulate hypotheses, conduct data searches, perform experiments, formulate solutions and determine the "best fit" of solutions to the conditions of the problem. Problem-based learning will enable learners to embrace complexity, find relevance and enjoyment in their learning, and enhance their capacity for creative and responsible real-world problem solving. Teachers assume the role of cognitive coach rather than knowledge-holder and disseminator and learners are the active problem-solvers, decision-makers, and meaning-makers rather than passive listeners. To design a problem- based learning experience for the learners various sequential steps are required such as:

- Identify a problem suitable for the age group of learners.
- Identify the problem from the context of the learners' world so that it presents real/authentic opportunities.
- Organize the subject matter around the problem, not the discipline.
- Give learners the responsibility for making choices around the learning experiences and collaboratively follow the Engineering Design Process (EDP) to reach solutions.

5. STEM/ STEAM

The science curriculum has been designed on STEAM framework which enables more creative, innovative thinkers to identify and address the needs of the society and the environment and it also validates the arts in education.

The key component of the STEAM approach is teaching science content with behavioral objectives at increasing levels of cognitive challenge (Bloom's taxonomy) and following the Engineering Design Process (EDP) that leads to technological solutions. STEM/ STEAM is an

interdisciplinary approach well aligned with the problems in our daily lives making it an exceptional way of learning and finding solutions.

The following illustration represents the recommended steps of the Engineering Design process.

Figure 1: (stem-and-ngss, 2015)

Reference: stem-and-ngss. (2015). Retrieved from nextgenerationscience. weebly: http://.weebly.com/stem-and-ngss.html

5.1 Essential elements of high quality STEM Curricula

Promoting engineering design, the process of identifying a problem, innovative solution and evaluation	Grade-appropriate content and encompassing of hands-on, minds-on, and collaborative approaches to learning.	. Use appropriate technologies such as modelling, simulation, and distance learning to enhance STEAM education learning experiences and investigations.
Provide students with interdisciplinary, multicultural, and multi-perspective viewpoints with a global perspective.	Integration of technology, engineering, science, and mathematics in the classroom	Integrate STEAM core content knowledge through strategies such as project-based learning.

When designing STEM/ STEAM challenges subject teachers need to work together involving students in exploratory learning where teacher-talk is at a minimum and students driven interaction and discovery is the focus. There are different ways of implementing STEM/ STEAM in schools.

One way to plan STEM/STEAM learning experiences is collaborative lesson planning by Mathematics, Science and Arts teachers so that desired concepts/lessons are taught across all relevant classrooms (science and mathematics) in parallel. Several STEM/ STEAM opportunities have been designed in the curriculum for teachers' reference.

Project based learning approach is being widely used around the world to implement STEM/STEAM. Some of the advantages of following the STEM/ STEAM approach are as follows:

1. **PBL helps students bridge thinking across disciplines**

Great PBL focuses learning around real world problems, providing a clear connection between what is learned in school and how it is relevant beyond the classroom. The authentic nature of these problems and issues means they are both complex and messy, requiring students to draw on knowledge across disciplines and expertise in many areas.

2. **PBL promotes deeper connections to content**

The goal of project-based learning isn't to cover; it's to uncover. Project-based learning is an inquiry approach that requires time for students to make connections between the problems they are facing, to think about what they already know, and to develop lines of inquiry for new content they "need to know." This specific context and need to know helps them not only identify and avoid misconceptions, but connect facts and information as they apply knowledge to solve, evaluate, and reflect on specific situations.

3. **PBL fosters the inquiry skills necessary for success in STEM**

The open-ended nature of a project-based approach, one that isn't looking for a correct answer, fosters both the analytical and creative thinking necessary for innovation. Great questions for project-based learning don't lead to students jumping into answers; they lead to even more questions.

For example, a project-based approach to learning might ask students to consider: "How do we make cafeteria lunch healthier?" In response, students may ask, "Do you mean healthier for students or do you mean healthier for the planet?" Even if students only focused on healthier for students, they need ask:

- What is the calorie and vitamin content of existing meals?
- Which lunches are favorites?
- How much of any lunch do students eat?
- What types of food get thrown away?

Teachers can support their questioning skills with graphic organizers, like KWL charts and 5 Whys organizers.

As a result of their questioning, students work may focus on finding ways to make existing lunch options healthier or their work may focus on developing new options entirely. The real world problems and challenges used in a project-based approach, don't provide the content and ask for an expected response, they require intensive questioning as well as the analytical thinking and creative problem solving needed for success in STEM.

4. PBL fosters reflection and metacognition

"We don't learn from experience, we learn from reflecting on experience."
John Dewey

The process of project-based learning is recursive and requires extensive reflection for successful solution development. As student work to develop ideas and implement them, they are constantly asking questions like:

- What do we know? What do we need to know?
- What do we think will happen? Why?
- What really happened? Where did our thinking going wrong?
- What worked? What didn't work?
- What really happened? Where did our thinking going wrong?
- What worked? What didn't work?

The reflective nature of the project-based process helps students make connections between content they are learning and how it impacts their thinking and problem solving. How well they can find and utilize that knowledge helps them better understand not only what they are learning but how they are learning.

Taking a project-based approach to STEM learning can help students form deeper connections to content, connect ideas across disciplines, and build the questioning, thinking, and metacognitive skills necessary for success in today's rapidly-changing world.

Reference: https://creativeeducator.tech4learning.com/2018/articles/taking-a-project-based-approach-to-STEM-learning

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