SINGLE NATIONAL CURRICULUM

GENERAL SCIENCE
GRADE IV-V 2020

ONE NATION, ONE CURRICULUM

NATIONAL CURRICULUM COUNCIL,
MINISTRY OF FEDERAL EDUCATION AND PROFESSIONAL TRAINING, ISLAMABAD
GOVERNMENT OF PAKISTAN

بسم اللہ الرحمن الرحیم

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PREFACE

It is a well-established fact that educational curriculum plays a key role in nation building. Having a uniform curriculum across the country is a long-standing aspiration of all segments of the society and the present government has declared it as its priority. Development of the Single National Curriculum for Pre 1-5 is the fulfillment of the dream of 'One Nation, One Curriculum'.

The decades old educational apartheid amongst the different streams of education in the country has not only kept the different educational institutions, educational quality, teachers and students divided, but has also perpetuated inequity in opportunities of social and economic progress amongst the population. These systems or streams of education in the country are creating disparities and different mindsets.

In our beloved country, different systems of education cater to the educational needs of children in the different classes of society. These include public sector schools, low cost private schools and the well-endowed state of the art private schools. Alongside, across the length and breadth of the country there are madrassahs which cater to the educational needs of approximately three million children. These different educational institutes follow completely different curricula, and resultantly we have graduates with completely different thinking and approach to life and livelihoods. These are precisely the differences that become stumbling blocks for nations aspiring to become great. A single national curriculum is therefore, an important step in the journey to building a strong nation.

Development of the Single National Curriculum for grade Pre 1-5 has been completed under a broad-based consultative process with the engagement of experts from all provinces and areas. To achieve this goal, the experts of provincial and area curriculum authorities, textbook boards, faculty from renowned universities, research organizations, teacher training institutes and assessment experts and representatives of minorities participated in the consultative process. For the first time ever, distinguished experts from the Ittehad Tanzeemat Ul Madaras Pakistan (ITMP) participated in the development of the curriculum for grade Pre1-5 under an all-inclusive consultative year-long process amassing extensive inputs of more than four hundred experts.

The key considerations in the development of SNC include: teachings from the Quran and Sunnah; vision of Quaid-e-Azam Muhammad Ali Jinnah and Allama Iqbal; the Constitution of Pakistan, national policies; international commitments, including Sustainable Development Goals (SDGs); latest trends in education; societal values; inclusive education; human rights and child protcetion; hygiene and sanitation; environment and climate change; global citizenship; life skills based and civic education; respect for religious and cultural diversity; move away from rote learning; activities and project based learning; 21st century skills; use of information and communication technology; and the ever evolving challenges and trends of the new era.

At the onset of the development of SNC, it was crucial to analyze and build upon its predecessor national curriculum 2006 of Pakistan. In this regard, comparative studies of the 2006 curriculum were conducted vis-à-vis the curricula of Singapore and Cambridge

education. In parallel, standards for learners of Pakistan were compared with those of Singapore, Malaysia and United Kingdom. Based on the findings and recommendations of these research activities, standards for the SNC were agreed upon. In order to ensure the inclusion of international trends in the SNC, a series of national level workshops and conferences were organized on the topics of Critical Thinking, Sustainable Development Goals (SDGs) and Life Skills Based Education (LSBE).

The 2006 national curriculum was revised in the light of recommendations derived from the above-mentioned researches and conferences, under the careful supervision of experts. The draft of the SNC pre 1-5, hence prepared was shared with the provinces and areas for their review and feedback. For the first time in the history of curriculum development of Pakistan, experts from Gilgit-Baltistan and Federal Government Educational Institutes (Cantts & Garrisons) participated in the consultative workshops. Moreover, the draft curriculum was also shared with the Cambridge University UK and Institute for Educational Development, Karachi for expert inputs and value addition. The draft curriculum was then updated in the light of feedback received. As a next step a national conference was organized in which experts from all over the country participated to conduct yet another thorough review of the updated curriculum draft. In an historic moment, at the conclusion of the national conference, experts from different schools of thought reached consensus and signed off on the Single National Curriculum for grade Pre 1-5.

In addition to being aligned to modern international trends, the SNC has our national and cultural values at its core. This curriculum endeavors to build a nation that takes pride in its religious and national beliefs and values and at the same time inculcates respect for religious and cultural diversity in the society and the world at large. It envisions the development of exemplary attitudes and behaviors in individuals who are capable of dealing with the challenges of the 21st century.

To enable implementation of the SNC in its true spirit, model textbooks, teacher training modules and an assessment framework are being developed, which will ensure delivery of education that is qualitatively superior and relevant to the children's lives.

It is of foremost import to thank all provinces and areas, public and private institutions and experts, university faculty and researchers, experts from ITMP and representatives of minorities for their relentless efforts and invaluable recommendations which enabled the development of the SNC grade Pre 1-5.

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01 INTRODUCTION

Science is a systematic study of structure and behaviour of natural and physical world through observations and experiments. Teaching the scientific method to students is teaching them how to observe, think, learn, solve problems and make informed decisions. These skills are integral to every aspect of a student's education and life, from school to career. Therefore, the importance of science in our institutions and daily life cannot be ignored.

The General Science curriculum focuses on various issues pertaining to the current state of science education in the country, including General Science curriculum, textbooks, teaching, assessment, and schools' infrastructure. The existing General Science curriculum was reviewed in the light of ground realities and study of best practices from around the world including a number of documents, foreign curricula, standards for science teachings, STEM and TIMSS content requirements.

The purpose was to develop a curriculum that will serve as a foundation document for the promotion of school science education in Pakistan that is in line with the required standards of education in the 21st century as well as to introduce international programs like **Science, Technology, Engineering and Mathematics** (STEM) and **Trends in International Mathematics and Science Study** (TIMSS) at each level of schooling.

The **Trends in International Mathematics and Science Study** (TIMSS) provides reliable and timely data on the Mathematics and Science achievement of Pakistani students compared to that of students in other countries. In 2019, Pakistan also became part of the TIMSS study whereby 30,000 students of Grade 4 participated. TIMSS is sponsored by the International Association for the Evaluation of Educational Achievement (IEA) and managed in the United States by the National Centre for Education Statistics (NCES).

1.1 GOALS

The overall purpose of science education in Pakistan is to develop scientific literacy. The accomplishment of this goal within the school context can take place only if certain opportunities are presented. The following goals have been determined for science education in Pakistan:

- Encourage students to develop a critical sense of wonder and curiosity about scientific and technological endeavours through inquiry;
- Enable students to use science and technology to acquire new knowledge and to create opportunities to solve problems, so that they may improve the quality of their own lives and lives of others;
- Prepare students to critically address social, economic, ethical, and environmental issues related to science and technology;
- Develop in students, of varying aptitudes and interests, the knowledge of a wide variety of careers related to science, technology, and the environment.

Although inquiry and the scientific method are integral to science education and practice, every decision we make is based on these processes. Natural human curiosity and necessity lead to questions based on observations, constructing a hypothesis, testing it with evidence and evaluating the result and making future decisions based on that result. Problem-solving and critical thinking are two of the most important skills students learn in school. They are essential for making good decisions that lead to achievement and success during and after school. The new curriculum is designed to develop these higher order thinking skills in students to prepare them for the future.

Science is not seen as merely objective and value free, but is recognized as an integral part of daily life and human experience and is therefore relevant to everyone. Advancements in science and technology are playing an increasingly significant role in everyday life. Therefore, science education will be a key enabler in developing scientific literacy and building a strong future for Pakistan's young generation by;

- Addressing the fundamental social, cultural and economic needs of students that affect their lifestyle.
- Providing the confidence to address highly competitive and rapid technological innovation.
- Sensitizing them with a growing knowledge which has a profound impact on people's lives.
- Providing them with an understanding of global interdependence and their role in contributing towards building a sustainable future.

Science, technology and society are responsive to each other. While science may act as a catalyst for change, it is also influenced by technological advances and social and economic pressures. The application of science affects our environment and our lives.

CHAPTER

02 STRANDS, STANDARDS AND BENCHMARKS

CHAPTER

02 STRANDS, STANDARDS AND BENCHMARKS

2.1 STRAND-1: LIFE SCIENCES

The Life Sciences strand focuses on the life processes of plants and animals and the specific needs of each. 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. The major topics developed in the strand include basic needs and life processes of organisms, their physical characteristics and orderly changes in life cycles. The concept of kingdoms of living things and a general classification of organisms is also presented. The other major topics developed in this strand include the types of relationships among organisms in a food chain and their non-living environment.

The Life Sciences strand includes the relationship of knowledge and skills to develop scientific attitudes towards science and technology. It also emphasizes on the impact of changes on the environment and the need for sustainable development.

In all grades, students will develop the ability to use appropriate vocabulary and scientific terminology related to the life sciences to communicate clearly.

Note: All standards in this document are developed up to Grade 8 level while the benchmarks are designed up to grade 5.

Standard – 1	Students will understand, explain and differentiate between the structure, characteristics and basic needs of living things, the processes of life, and will also investigate the diversity of life and how living things interact with each other and their environment.
Benchmarks **By the end of Grade V, students will be expected to:**	1. Describe Ecosystem and how energy is transferred through living things in the form of food. 2. Compare and contrast the characteristics and life processes of plants and animals. 3. Understand the use of microorganisms in production of various food items. 4. Identify the effects of microorganisms in causing common diseases. 5. Compare and contrast the life cycles and reproduction, in plants and animals. 6. Identify the causes and effects of environmental pollution and suggest measures to reduce pollution. 7. Distinguish between the various food components to understand the concept of balanced diet and its impact on human health.

2.2 STRAND 2: 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, types of motion, energy forms and their transformations, electricity and magnetism. It also focuses on the description, physical properties, and basic structure of matter. The major topics developed in this strand include concepts related to the basic description of objects, states of matter, phase changes, and the classification of matter.

Students will increase their understanding of the characteristics of objects and materials they encounter daily. Students gain an understanding about matter and energy, including their forms, the changes they undergo, and their interactions.

In all grades, students will develop the ability to use appropriate vocabulary related to physical world to communicate clearly about scientific and technological concepts.

Standard – 2	Students will describe and explain common properties, forms, and interactions of energy and matter, their transformations and applications in chemical, physical, and biological systems.
Benchmarks **By the end of Grade V, students will be expected to:**	1. Compare the properties of different states of matter and identify the conditions that cause matter to change states 2. Differentiate between mixture and solution. 3. Analyze dilute and concentrated solutions through some daily life examples. 4. Identify various properties of metals. 5. Demonstrate the effect of heat on the states of matter. 6. Describe the forms of energy, simple energy transformations and the uses of energy. 7. Define force and demonstrate the effect of gravity on the objects. 8. Recognize that frictional force works against the direction of motion. 9. Demonstrate the use of simple machines to make work easier. 10. Investigate and describe flow of electric current in an electrical circuit. 11. Describe the relationship between electricity and magnetism in an electromagnetic device. 12. Demonstrate that light travels in straight line. 13. Investigate how sound travels in different media.

2.3 STRAND-3: EARTH AND SPACE SCIENCES

In Earth and Space Sciences, students recognize the relationship between the Earth, our solar system, and the universe. They know that the moon, sun and other stars appear to move relative to the Earth and that these movements correspond to the pattern of day and night, and the seasons. Students are naturally interested in everything around them. This curiosity leads them to observe, collect, and record information about the Earth and about objects visible in the sky.

In Grades IV-V, students study the regularities of interrelated systems of the natural world. In doing so, they develop understanding of basic laws, theories, and models that explain the world. By studying the Earth, students can make informed decisions about issues affecting the planet on which they live. They recognize that new technologies and observations change our explanations about how things in the natural world behave.

Standard – 3	Students will be knowledgeable of the composition, structure, processes and interactions among the Earth's systems; they will compare and contrast our planet and sun to other planets and star systems; and explain how we learn about universe.

Benchmarks **By the end of Grade V, students will be expected to:**	1. Identify the Earth's resources that we use in everyday life. 2. Describe the effect of geographic location on weather and climates. 3. Demonstrate the rotation of the Earth and revolution of Earth around the sun. 4. Investigate and describe soil components. 5. Describe the structure of Earth and movement of earth, sun, moon, solar system and its relationship. 6. Demonstrate how the relationship of the Earth, moon and sun causes eclipses and moon phases. 7. Describe the importance of space exploration and the uses of various satellites.

2.4 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 STEM (Science, Technology, Engineering 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:

2.4.1 SKILLS

In everyday life, we find ourselves wondering about nature, gathering information, devising and evaluating possible explanations for how things work around us, and discussing ideas with others. These are human activities that reflect in many ways how scientists think and work.

Scientific inquiry is a way of learning about the natural world and the environment we live in. It involves the use of all senses to develop the skills of observing, labelling, comparing, describing and sorting, and to wonder about the differences and changes in everyday world. Students will be encouraged to communicate their findings in a variety of ways, including labelled drawings, pictorial graphs, oral and written forms. As their investigative skills develop, they will learn to predict, redesign their investigation, find solutions to their problems, collect data, analyze and interpret data and tell whether the result is as expected or not, hence moving from deductive to inductive teaching. Students should be encouraged to reflect on their investigations, identify difficulties and suggest improvements.

It is therefore, intended that students will develop necessary skills, as they are encouraged to think scientifically rather than simply memorizing and/or studying scientific facts. Also it is expected from teachers that they will engage students in scientific inquiry to develop such skills.

Standard – 4	Students will develop the skills required for science and technology inquiry, solving problems, communicating scientific ideas and results, working collaboratively, and making informed decisions.

Benchmarks **By the end of Grade V, students will be expected to:**	1. Develop solution to problems through reasoning and identifying the nature, similarities and differences of the objects. 2. Work with others, share and communicate ideas. 3. Apply safety rules and measures to protect themselves from hazardous conditions and efficiently use the equipment, tools and chemicals. 4. Critically think about scientific concepts. 5. Suggest solutions of various scientific problems.

2.4.2 ATTITUDES

This strand 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 the society. These include: a commitment to the pursuit of knowledge and achievement of potential, resulting in a disposition towards striving to understand the world and how best one can make a positive contribution towards it; respect and concern for others and their rights, resulting in sensitivity to and concern for the well-being of others. By applying scientific concepts to natural and cultural environment students will demonstrate commitment to regenerative and sustainable resource use.

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

Standard – 5	Students will display a sense of curiosity and wonder about the natural world; they will be encouraged to develop attitudes that support the responsible acquisition and application of scientific and technological knowledge for the mutual benefit of self, society, and the environment.

Benchmarks **By the end of Grade V, students will be expected to:**	1. Develop interest and curiosity about objects and events within the immediate environment. 2. Take ownership in learning. 3. Be open-minded in self-review, peer review and teacher review by practicing honesty and integrity in the classroom. 4. Be sensitive to the needs of other people and organisms in environment. 5. Show concern for their own safety and that of others in carrying out scientific activities.

2.4.3 SCIENCE, TECHNOLOGY, ENGINEERING AND MATHEMATICS (STEM)

STEM is a curriculum based on the idea of educating students in four specific disciplines of Science, Technology, Engineering and Mathematics in an interdisciplinary and applied approach rather than teach these four disciplines as separate subjects. STEM integrates these disciplines into a cohesive learning paradigm based on real life applications. Here you will find a complete blend and essence of the four disciplines to help students find meaningful learning in their classroom scenarios.

Standard – 6	Students will 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.

Benchmarks **By the end of Grade V, students will be expected to:**	1. Recognize the importance of science and technology to solve everyday problems. 2. Integrate scientific concepts (STEM) in daily life to improve the quality of their own life and lives of others. 3. Understand how scientific concepts (STEM) affect their lives and society.

CHAPTER

PROGRESSION GRID: GRADE IV AND GRADE V

CHAPTER

03 PROGRESSION GRID: GRADE IV AND GRADE V

Grade-IV	Grade-V
CHARACTERISTICS AND LIFE PROCESSES OF ORGANISMS	**CLASSIFICATION OF LIVING THINGS**
Characteristics of major groups of living things	
• Compare and contrast characteristics that distinguish major groups of living things (plant and animals) • Classify animals in terms of vertebrates and invertebrates with examples and analyze the differences and similarities in vertebrates and invertebrates. • Classify plants in terms of flowering and non-flowering with examples and analyze the differences and similarities in flowering and non-flowering plants. • Recognize and appreciate diversity in life (both plants and animals) and identify ways to protect diversity.	• Describe classification of living organisms and its importance. • Classify the plants into two major groups (dicots and monocots) and give examples of each group. • Compare and contrast the structure of a dicot and a monocot plant (with respect to their seeds, leaves and flowers). • Differentiate between vertebrates and invertebrates based on their characteristics. • Classify vertebrates into, fish, amphibians, reptiles, birds and mammals on the basis of their characteristics. • Classify invertebrates into five groups (sponges, worms, insects, snails, and starfish) on the basis of their characteristics. • Analyse some of the factors caused by Human which are affecting Biodiversity • Suggest and write some measures for conservation of endangered species.
Functions of major structures in living things	**MICROORGANISMS**
• Identify major parts/organs in animals (teeth, bones, lungs, heart, stomach muscles, brain) • Relate the parts/organs of body of animals to their functions (e.g., teeth break down food, bones support the body, lungs take in air, the heart circulates blood, the stomach helps to digest food, muscles move the body).	• Define and describe microorganisms. • Identify the main groups of microorganisms and give examples for each. • Recognize some common diseases of each group caused by microorganisms. • Highlight the role of microorganisms in decomposition and discuss its harmful and beneficial effects.

Grade-IV	Grade-V
Functions of major structures in living things	**MICROORGANISMS**
• Identify parts of a plant body (leaves, stem, flowers, seeds, roots). • Relate the structures of plants to their functions (i.e., roots absorb water and nutrients and anchor the plant, leaves make food, the stem transports water and food, flowers produce seeds, and seeds produce new plants).	• Recognize that microorganisms get transmitted into humans and spread infectious diseases. • Discuss and deduce advantages and disadvantages (any 3) of microorganisms by using some daily life examples. • Suggest preventive measure to protect him/herself from these infections.
	FLOWERS AND SEEDS
	• Examine and Describe structure of a flower • Define pollination and describe its types with examples. • Define reproduction and differentiate between sexual and asexual reproduction in plants. • Describe the structure of a seed and demonstrate its germination. • Compare and contrast the structure and function of chick pea and Maize seed. • Illustrate the conditions necessary for seed germination.
	ENVIRONMENTAL POLLUTION
	• Define pollution and its types. • Explain the main causes of water, air and land pollution. • Explain the effects of water, air and land pollution (unclean/toxic water, smoke, smog, excess CO2/other gases, open garbage dumps, industrial waste etc.) on the environment and life. • Discuss and explain the effects of burning fossil fuels and releasing greenhouse gases in air. • Differentiate between biodegradable and non-biodegradable materials. • Explain the impact of non-biodegradable materials on the environment. • Investigate possibilities and suggest ways to reduce non-biodegradable materials.

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

Grade-IV	Grade-V
HUMAN HEALTH	
Symptoms, transmission, and prevention of communicable diseases	
• Observe and recognize some common symptoms of illness (e.g., fever, coughing and influenza). • Differentiate between contagious diseases (hepatitis, T.B, influenza and non-contagious (polio, cancer) • Relate the transmission of common communicable diseases (e.g., touching, sneezing, and coughing) to human contact. • Explain some methods of preventing common diseases and their transmission (e.g., vaccination, washing hands, wearing mask).	
Ways of maintaining good health	
• Describe the importance of maintaining good health. • Recognize everyday behaviours that promote good health (e.g., a balanced diet, drinking clean water, exercising regularly, brushing teeth, getting enough sleep) • Define balanced diet and explain its components. • Identify common food sources included in a balanced diet (e.g., fruits, vegetables, grains, milk and meat group). • Understand the value of clean drinking water and inquire about the factors that generally make it unclean. • Explore a few ways that can help make water clean and suitable for drinking (water filtration and boiling).	

Grade-IV	Grade-V
MATTER AND ITS CHARACTERISTICS	**PHYSICAL AND CHEMICAL CHANGES OF MATTER**
States of matter and its characteristics	*Physical changes observed in everyday life*
• Describe matter and its states. • Describe characteristics of each state of matter with examples.	• Identify observable changes in materials that do not result in new materials with different properties (e.g., dissolving, crushing aluminium can). • Recognize that matter can be changed from one state to another by heating or cooling (candle wax). • Describe and demonstrate the states of water (i.e., melting, freezing, boiling, evaporation, and condensation). • Identify ways of accelerating the process of dissolving materials in 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). • Distinguish between strong and weak concentrations of simple solutions.
Physical properties as a basis of classifying matter	*Chemical changes observed in everyday life*
• Compare and sort objects and materials on the basis of physical properties (e.g., mass, volume, states of matter, ability to conduct heat or electricity, ability to float or sink in water). • Explore the properties of metals (i.e. appearance, texture, color, density). • Identify properties of metal (conducting heat and electricity) and relate these properties to use of metals (i.e. a copper electrical wire, an iron cooking pot).	• Identify observable changes in materials that make new materials with different properties (e.g., decaying, burning, rusting). • Differentiate between physical and chemical changes with examples.

Grade-IV	Grade-V
FORMS OF ENERGY AND ENERGY TRANSFER	**LIGHT AND SOUND**
Common sources and uses of energy	
• Identify sources of energy (e.g., the Sun, flowing water, wind, coal, oil, gas). • Recognize that energy is needed to do work, (e.g. for moving objects), heating and lighting. • Describe and demonstrate the transformation of energy. • Understand the importance of energy conservation. • Recognize the role and responsibility of humans to conserve energy resources.	• Identify natural and artificial sources of light. • Justify that light emerges from a source and travels in a straight line. • Investigate luminous and non-luminous objects in daily life. • Identify and differentiate between transparent, opaque and translucent objects in their surroundings. • Investigate that light travels in a straight line. • Explain the formation of shadows. • Predict the location, size and shape of a shadow from a light source relative to the position of objects. • Demonstrate that shiny surfaces reflect light better than dull surfaces. • Describe and demonstrate how sound is produced by a vibrating body. • Identify variety of materials through which sound can travel. • Identify that speed of sound differs in solids, liquids and gaseous medium. • Define and describe the intensity of sound with examples. • Define noise and its harmful effects on human health. • Appreciate the role of human beings in reducing noise pollution.
Light and sound in everyday life	
• Relate familiar physical phenomena (i.e., shadows, reflections, and rainbows) to the behaviour of light. • Relate familiar physical phenomena (i.e., vibrating objects, echoes) to the production and behaviour of sound.	
Heat transfer	
• Recognize that warmer objects have a higher temperature than cooler objects. • Investigate the changes that occur when a hot object is brought in contact with a cold object. • Identify ways to measure temperature and understand its unit.	

Grade-IV	Grade-V
Electricity and simple electric circuits	**ELECTRICITY AND MAGNETISM**
• Describe and demonstrate that electrical energy in a circuit can be transformed into other forms of energy (e.g., heat, light, sound). • Explain and provide reasoning that a simple electric circuit requires a complete electrical pathway.	• Explain the phenomenon of static electricity in everyday life. • Describe charges and their properties. • Differentiate between conductors and insulators in daily life. • Describe flow of electric current in an electric circuit. • Describe and design an electric circuit and explain its components. • Recognize that magnets can be used to attract some metallic objects • Describe and demonstrate that magnets have two poles and like poles repel and opposite poles attract. • Identify earth as huge magnet and demonstrate it with experiment. • Describe the working of a magnetic compass. • Explain different types of magnets (permanent, temporary magnet and electro-magnet).
FORCES AND MOTION	
Familiar forces and the motion of objects	
• Describe force and motion with examples from daily life • Identify gravity as a force that draws objects to Earth. • Investigate that frictional force works against the direction of motion. • Provide reasoning with evidence that friction can be either detrimental or useful under different circumstances.	
Simple machines	
• 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, or change the direction of the force).	

Grade-IV	Grade-V
THE EARTH AND ITS RESOURCES	**STRUCTURE OF EARTH**
Physical characteristics of Earth - Earth's resources	
• Recognize that earth's surface is made up of land and water and is surrounded by air. • Recognize that water in rivers and streams flows from mountains to oceans or lakes. • Identify some of Earth's natural resources that are used in everyday life (e.g., water, wind, soil, forests, oil, natural gas, minerals). • Recognize that some remains (fossils) of animals and plants that lived on Earth a long time ago are found in rocks, soil and under the sea. • Differentiate between renewable and non-renewable resources • Investigate the impact of human activities on Earth's natural resources • Suggest the ways to conserve the natural resources.	• Describe the structure of the Earth (i.e., crust, mantle, and core) and the physical characteristics of these distinct parts. • Describe the sources of water on Earth. • Identify similarities and differences among the different types of soil. • Investigate the composition and characteristics of different soils.
EARTH'S WEATHER AND CLIMATES	
• Understand the difference between weather and climate. • Relate weather (i.e., daily variations in temperature, humidity, precipitation in the form of rain or snow, clouds, and wind) changes with changing geographical location. • Recognize that average temperature and precipitation can change seasons and location.	

Grade-IV	Grade-V
EARTH IN THE SOLAR SYSTEM	**SPACE AND SATELLITES**
Objects in the Solar System and their movements	
• Describe and demonstrate the Solar System with planets revolving around the sun. • Identify the sun as a source of heat and light for the Solar System • Recognize that the earth has a moon that revolves around it, and from earth the moon looks different at different times of the month.	• Define the term 'space' and emphasize the need to explore it • Recognize the role of NASA (National Aeronautics and Space Administration) in space exploration. • Define the term 'satellite' and describe its importance. • Describe the natural satellites of the planets of the solar system. • Define artificial satellites and explain their importance in exploring the Earth and space. • Recognize the key milestones in space technology. • Describe the uses of various satellites in space i.e. geostationary, weather, communication and Global Positioning System (GPS).
Earth's motion and related patterns observed on Earth	
• Investigate and explain how day and night are related to Earth's daily rotation about its axis, and provide evidence of this rotation from the changing appearance of shadows during the day. • Describe how seasons in Earth's Northern and Southern hemispheres are related to Earth's annual movement around the Sun.	
Solar and Lunar eclipses	
• Illustrate and explain how solar and lunar eclipses occur.	

Grade-IV	Grade-V
TECHNOLOGY IN EVERYDAY LIFE	**TECHNOLOGY IN EVERYDAY LIFE**
Basic Craft making (out of paper, cardboard, reeds, packing material etc.)	*Technical model making (out of clay, paper, reed board, reeds, packing material)*
• Practice techniques of folding, cutting, tearing and pasting papers, cardboard to make objects and patterns • Design paper bags, envelopes, cards and face mask.	• Enlist and practice safety procedures while carrying out the activities • Make a model of foot bridge and bookshelf • Use spirit level/water level to level different objects (table, picture, frame etc.) • Use a plumb line to install a flag pole vertically.
Basic technical model making (out of clay)	*Making Technical Devices*
• Design models of sphere, cube, prism, cylinder and cone with clay or play dough.	• Prepare LED light strings working with 12 volt battery • Make a musical instrument from easily available resources • Make moveable wagon, bus, trolley etc.
Technical activities	*First aid and disaster management*
• Design hammer, wheels, rollers and gears using clay or play dough • Operate tablets/mobile phones for use of calculator, alarm clock and calendar • Operate mobile phones for taking snap shots	• Use first aid box to dress a wound. • Practice Shifting a person to hospital • Practice earth quake, fire and flood drill
Elementary first aid	
• Recognize the items of first aid box. • Use digital and clinical thermometer externally to measure body temperature. • Check blood pressure by digital blood pressure monitor	

CHAPTER

04 LEARNING CONTENTS AND THE STUDENT'S LEARNING OUTCOMES

CHAPTER

04 LEARNING CONTENTS AND THE STUDENT'S LEARNING OUTCOMES

4.1 GRADE IV

Contents	Students' Learning Outcomes	Suggested Activities	Suggested links
Chapter 1 **Characteristics and life processes of organisms** 1. Characteristics of major groups of living things	*All the students should be able to:* • Compare and contrast characteristics that distinguish major groups of living things(plants and animals) • Classify animals in terms of vertebrates and invertebrates with examples and analyze the differences and similarities in vertebrates and invertebrates. • Classify plants in terms of flowering and non-flowering with examples and analyze the differences and similarities in flowering and non-flowering plants. • Recognize and appreciate diversity in life (both plants and animals) and identify ways to protect diversity.	• Construct a scrap book collecting plants/animals' pictures and classifying them as well. Which of them can you find in Pakistan? • Observe animals and plants from your surrounding area and study their characteristics and behaviors. (Where did you see them, where do they live, what do they eat?) • Use small pots to plant few seeds, provide water and sunlight, observe their growth and record changes.	Animals with Backbone and without Backbone: **https://www.youtube.com/watch?v=anOfA-R8qb8** Flowering & Nonflowering Plants: **https://study.com/academy/lesson/flowering-nonflowering-plants-lesson-for-kids.html**
2. Functions of major structures in living things	• Identify major parts/organs in animals (teeth, bones, lungs, heart, stomach muscles, brain). • Relate the parts/organs of body of animals to their functions (e.g., teeth break down food, bones support the body, lungs take in air, the heart circulates blood, the stomach helps to digest food, muscles move the body).	• Cut out the pictures of different organs. Paste and label them onto the Human outline diagram and write functions of each organ.	Body Organs: Teeth **https://www.youtube.com/watch?v=1gQ29tgXlJI** Lungs: **https://www.youtube.com/watch?v=C-k4N78UJkw**

Note: In case of student with disabilities, activities will be adapted according to the requirements of the child.

Contents	Students' Learning Outcomes	Suggested Activities	Suggested links
	• Identify parts of a plant (leaves, stem, flowers, seeds, roots). • Relate the structures of plants to their functions (i.e., roots absorb water and nutrients and anchor the plant, leaves make food, the stem transports water and food, flowers produce seeds, and seeds produce new plants).	• Take two similar plants, and place one in regular water and the other in colored (ink) water for a few days. Observe any changes. Cut the stems and discuss the differences. • Imagine that you woke up one morning and found all the plants withered. Write a story about what happens after that. • Explore what makes humans different from plants with respect to movement and obtaining food.	Parts of a Plant: **https://www.youtube.com/watch?v=X6TLFZUC9gI**

Contents	Students' Learning Outcomes	Suggested Activities	Suggested links
Chapter 2 **Ecosystems** 1. Diversity of the conditions for life on Earth	*All the students should be able to:* • Recognize what is an ecosystem (e.g., forests, ponds, rivers, grasslands and deserts). • Explain biotic (plants, animals and humans) and abiotic factors (light, temperature, soil and water) and their linkages.	• Distribute animal and plant pictures (or name cards) among students and place different chart sheets representing different ecosystems. Take turns placing the animals/plants on the different ecosystem charts.	

Contents	Students' Learning Outcomes	Suggested Activities	Suggested links
	• Analyse the way these biotic and abiotic constituents create a balance to sustain any ecosystem. • Recognize the interactions between animals and plants and the importance of maintaining balance within an ecosystem.	• Using the materials used in the above activity, select the picture with a balanced ecosystem and remove one of its biotic or abiotic components. Now ask students to discuss in groups about the impact it will have on an ecosystem. Once the students have discussed, ask them to present their findings as a group (by selecting one group presenter) • Celebrate earth day/ tree plantation day/green day/cleanliness day/ water day etc.	
2. Relationships in simple food chains	• Describe a few food chains and analyse their structure to understand its function. • Describe the roles of living things at each link in a simple food chain (e.g., plants produce their own food; some animals eat plants, while other animals eat the animals that eat plants). • Identify and describe common predators and their prey.	• Construct a model or create a chart by pasting pictures of animals and plants in a simple food chain using common plants and animals from familiar ecosystems, such as a forest or a desert. Using these models/charts allow students to observe and discuss the food chain so that they can understand how a food chain works. • Show some time lapse video showing the concept of prey, predator or survival of the fittest.	Food chain: **https://www.youtube.com/watch?v=hLq2datPo5M**

Contents	Students' Learning Outcomes	Suggested Activities	Suggested links
3. Competition in an ecosystem	• Recognize and explain that some living things in an ecosystem compete with each other for food and space. • Recognize the value of a balanced ecosystem. • Interpret that human actions such as urbanization, pollution and deforestation affect food chains in an ecosystem. • Identify various actions and roles that humans can play in preserving various ecosystems.		

Contents	Students' Learning Outcomes	Suggested Activities	Suggested links
Chapter 3 **Human Health** 1. Symptoms, transmission, and prevention of communicable diseases	*All the students should be able to:* • Observe and recognize some common symptoms of illness (e.g., fever, coughing and influenza). • Differentiate between contagious diseases (hepatitis, T.B, influenza, and polio) and non-contagious (cancer, and diabetes) • Relate the transmission of common communicable diseases (e.g., touching, sneezing, and coughing) to human contact. • Explain some methods of preventing common diseases and their transmission (e.g., vaccination, washing hands, wearing mask).	• Ask the students to keep a 'health' journal over a week and list one new thing they do every day to keep themselves healthy (wash hands, eat well, get enough sleep). • Design a menu for a school lunch and give reasons to explain why each food was chosen. • Create a diet plan for the student's own well-being. • Plan and conduct an interview with a Physician to discuss healthy life style. • Visit your kitchen/School canteen and identify hazards which may cause diseases.	Coughing: **https://www.youtube.com/watch?v=sBj6kLHvm-U** Wash Your Hands: **https://www.youtube.com/watch?v=NoxdS4eXy18**

Contents	Students' Learning Outcomes	Suggested Activities	Suggested links
2. Ways of maintaining good health	• Describe the importance of maintaining good health. • Recognize everyday behaviours that promote good health (e.g., a balanced diet, drinking clean water, exercising regularly, brushing teeth, getting enough sleep) • Define balanced diet and explain its components. • Identify common food sources included in a balanced diet (e.g., fruits, vegetables, grains, milk and meat group). • Understand the value of clean drinking water and inquire about the factors that generally make it unclean. • Explore a few ways that can help make water clean and suitable for drinking (water filtration and boiling).		Balanced Diet: **https://www.youtube.com/watch?v=YimuIdEZSNY**

Contents	Students' Learning Outcomes	Suggested Activities	Suggested links
Chapter 4 **Matter and its characteristics** 1. States of matter and its characteristics	*All the students should be able to:* • Describe matter and its states (solid, liquid, gas). • Describe characteristics of each state of matter with examples.	• Demonstrate changes in state of matter on heating and cooling in an experiment. • Classify the materials (wood , red syrup, saw dust, stone, balloon, plasticine, aluminum foil, cotton, oil) and write the reason why has it been categorized.	States of Matter: **https://www.youtube.com/watch?v=wclY8F-UoTE** States of matter: **https://www.youtube.com/watch?v=Nzs_Oc_dzps**
2. Physical properties as a basis of classifying matter	• Compare and sort objects and materials on the basis of physical properties (e.g., mass, volume, states of matter, ability to conduct heat or electricity, ability to float or sink in water).		

Contents	Students' Learning Outcomes	Suggested Activities	Suggested links
	• Explore the properties of metals (i.e. appearance, texture, color, density). • Identify properties of metal (conducting heat and electricity) and relate these properties to use of metals (i.e. a copper electrical wire, an iron cooking pot).		

Contents	Students' Learning Outcomes	Suggested Activities	Suggested links
Chapter 5 **Forms of energy and energy transfer** 1. Common sources and uses of energy	• Identify sources of energy (e.g., the Sun, flowing water, wind, coal, oil, gas). • Recognize that energy is needed to do work,(e.g. for moving objects), heating and lighting. • Describe and demonstrate the transformation of energy. • Understand the importance of energy conservation. • Recognize the role and responsibility of humans to conserve energy resources.	• Design an activity to show transmission of energy. Make a paper windmill/ pinwheel. Demonstrate that blowing air into the pinwheel generates motion and is a 'transmission' of energy. • Observe different electrical objects in the classroom and discuss what form of energy they produce from electricity.	Different sources of energy: **https://www.youtube.com/watch?v=wMOpMka6PJI** Energy to do work: **https://www.youtube.com/watch?v=vAThuCmwp9I**
2. Light and sound in everyday life	• Relate familiar physical phenomena (i.e., shadows, reflections, and rainbows) to the behaviour of light. • Relate familiar physical phenomena (i.e., vibrating objects, echoes) to the production and behaviour of sound.	• Use a prism, mirror and magnifying glass to investigate how light behaves. • Design a musical instrument using easily available materials.	

Contents	Students' Learning Outcomes	Suggested Activities	Suggested links
		• Use string/paper cups to create a simple telephone. And use rubber bands with a small box to create a simple music instrument.	Light Shadow & Reflection: **https://www.youtube.com/watch?v=zH0jxo1q3Ww**
3. Heat transfer	• Recognize that warmer objects have a higher temperature than cooler objects. • Investigate the changes that occur when a hot object is brought in contact with a cold object. • Identify ways to measure temperature and understand its unit.	• Take a steel spatula and place in hot water. Heat will transfer from the tip of the spatula to the handle.	Heat Energy: **https://www.youtube.com/watch?v=xGKg3TSO4v8**
4. Electricity and simple electric circuits	• Describe and demonstrate that electrical energy in a circuit can be transformed into other forms of energy (e.g., heat, light, sound). • Explain and provide reasoning that a simple electric circuit requires a complete electrical pathway.	• Construct a simple electric circuit by using wire, bulb and battery.	Simple electric circuit: **https://www.youtube.com/watch?v=CXr9gFaeHgg**

Contents	Students' Learning Outcomes	Suggested Activities	Suggested links
Chapter 6 **Forces and Motion** 1. Familiar forces and the motion of objects	*All the students should be able to:* • Describe force and motion with examples from daily life • Identify gravity as a force that draws objects to Earth. • Investigate that friction force works against the direction of motion. • Provide reasoning with evidence that friction can be either detrimental or useful under different circumstances.	• Design a hover-craft using the concept of friction. (With the help of balloon and CD/paper plate).	What is Friction: **https://www.youtube.com/watch?v=C7NPD9W0kro**

Contents	Students' Learning Outcomes	Suggested Activities	Suggested links
		• Design rubber band wheel car and try it on different surfaces. Use talcum powder on the same surfaces to demonstrate the effect of friction.	
2. Simple machines	• 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, or change the direction of the force).	• Make simple levers to lift objects (such as books) in the classroom.	Simple machines: **https://www.youtube.com/watch?v=fvOmaf2GfCY**

Contents	Students' Learning Outcomes	Suggested Activities	Suggested links
Chapter 7 **Earth and its resources** 1. Physical characteristics of Earth	• Recognize that earth's surface is made up of land and water in and is surrounded by air. • Recognize that water in rivers and streams flows from mountains to oceans or lakes.		
2. Earth's resources	• Identify some of Earth's natural resources that are used in everyday life (e.g., water, wind, soil, forests, oil, natural gas, minerals). • Recognize that some remains (fossils) of animals and plants that lived on Earth a long time ago are found in rocks, soil and under the sea. • Differentiate between renewable and non-renewable resources • Investigate the impact of human activities on Earth's natural resources • Suggest the ways to conserve the natural resources.	• Ask students to identify a simple everyday object they use or are familiar with (furniture, shoes, books, clothes etc). Discuss the various resources used in making it. Which of these are non-renewable? What would happen if we run out of these resources? • Help students create their own fossils using 'plaster of paris', paper cups and a small toy or object that can fit inside the cup.	Earth's Resources - Air, Water, Land: **https://www.youtube.com/watch?v=071lUxclTBw** What are fossils: **https://www.youtube.com/watch?v=agl48Q6xMmA**

Contents	Students' Learning Outcomes	Suggested Activities	Suggested links
Chapter 8 **Earth's Weather and Climates** 1. Weather and climate	*All the students should be able to:* • Understand the difference between weather and climate. • Relate that weather (i.e., daily variations in temperature, humidity, precipitation in the form of rain or snow, clouds, and wind) changes with changing geographical location. • Recognize that average temperature and precipitation can change seasons and location.	 • Measure the temperature every day **for a week** and observe other weather conditions such as rain, sun, cloud-cover, hail storm and make a weather chart. Sample given above(Robotics)	Changes in Weather: **https://www.youtube.com/watch?v=ML36o23u9uA** The Science of Clouds: **https://www.youtube.com/watch?v=dnL5LPil77M**

Contents	Students' Learning Outcomes	Suggested Activities	Suggested links
Chapter 9 **Earth in the Solar System** 1. Objects in the Solar System and their movements	*All the students should be able to:* • Describe and demonstrate the Solar System with the sun at the centre and the planets revolving around the sun. • Identify the sun as a source of heat and light for the Solar System • Recognize that the earth has a moon that revolves around it, and from earth the moon looks different at different times of the month.	• Using clay or plasticine or any such material and prepare models of Solar system and Phases of moon. • Study the web link and prepare working model of solar system and related concepts.	The Solar System Planets: **https://www.youtube.com/watch?v=ASQkz4XaphU**
2. Earth's motion and related patterns observed on Earth	• Investigate and describe how day and night are related to Earth's daily rotation about its axis, and provide evidence of this rotation from the changing appearance of shadows during the day. • Describe how seasons in Earth's Northern and Southern hemispheres are related to Earth's annual movement around the Sun.		Earth's Revolution & Rotation: **https://www.youtube.com/watch?v=EXasopxAFoM**

Contents	Students' Learning Outcomes	Suggested Activities	Suggested links
3. Solar and Lunar eclipses	• Illustrate and explain how solar and lunar eclipses occur.	• Design models of solar and lunar eclipses.	Eclipses: **https://www.youtube.com/watch?v=cK7zieTA5Sk**

Contents	Students' Learning Outcomes	Suggested Activities	Suggested links
Chapter 10 **Technology in everyday life** 1. Basic craft making	• Practice techniques of folding, cutting, tearing and pasting papers, cardboard to make objects and patterns • Design paper bags, envelopes, cards and face mask.	• Practice making things out of paper at home	
2. Basic technical model making	• Design models of sphere, cube, prism, cylinder and cone with clay or play dough. • Design hammer, wheels, rollers and gears using clay or play dough	• Make clay toys at home and school. Use water soluble paints to colour the toys.	
3. Technical activities	• Operate tablets/mobile phones for use of calculator, alarm clock and calendar • Operate mobile phones for taking snap shots	• Use of mobile phone can be given as a homework.	
4. Elementary first aid	• Recognize the items of first aid box. • Use digital and clinical thermometer externally to measure body temperature. • Check blood pressure by digital blood pressure monitor		

4.2 GRADE V

LEARNING CONTENTS AND THE STUDENT'S LEARNING OUTCOMES

Contents	Students' Learning Outcomes	Suggested Activities	Suggested links
Chapter 1 Classification of living things 1. Five Kingdom systems (Monera, Protista, Fungi, Plants, Animals)	*All the students should be able to:* • Describe classification of living organisms and its importance.		Classification of Living things: **https://www.youtube.com/watch?v=oMFqEp4Sf40**
2. Classification and Characteristics of Plants	• Classify the plants into two major groups (dicots and monocots) and give examples of each group.	• Compile a scrap book with a collection of 5 dried and preserved flowering and 5 non flowering plants.	
3. Classification and characteristics of Flowering Plants (monocot and dicot)	• Compare and contrast the structure of a dicot and a monocot plant (with respect to their seeds, leaves and flowers).		
4. Classification and Characteristics of Animals (vertebrates and invertebrates) 5. Biodiversity (Deforestation & Hunting)	• Differentiate between vertebrates and invertebrates based on their characteristics. • Classify vertebrates into, fish, amphibians, reptiles, birds and mammals on the basis of their characteristics. • Classify invertebrates into five groups (sponges, worms, insects, snails, and starfish) on the basis of their characteristics. • Analyse some of the factors caused by Human which are affecting Biodiversity • Suggest and write some measures for conservation of endangered species.	• Compile an album of vertebrates and invertebrate and write information about their characteristics. • Explore biodiversity and factors causing loss of biodiversity in your locality. • Identify factors responsible for extinction of endangering of species • Give examples of extinct or endangered species? Which category of living organisms are the most at risk?	Vertebrate animals: Mammals, fish, birds, amphibians and reptiles: **https://www.youtube.com/watch?v=HQdiSMUZEDA**

Note: In case of student with disabilities, activities will be adapted according to the requirements of the child.

Contents	Students' Learning Outcomes	Suggested Activities	Suggested links
Chapter 2 Microorganisms 1. Viruses, Bacteria and Fungi	*All the students should be able to:* • Define and describe microorganisms. • Identify the main groups of microorganisms and give examples for each.		Microorganism: Definition, Types & Classification: **https://study.com/academy/lesson/microorganism-definition-types-classification.html**
2. Role of microorganisms as decomposers	• Highlight the role of microorganisms in decomposition and discuss its harmful and beneficial effects.		
3. Advantages and disadvantages of microorganisms	• Recognize some common diseases of each group caused by microorganisms. • Recognize that microorganisms get transmitted into humans and spread infectious diseases. • Discuss and deduce advantages and disadvantages (any 3) of microorganisms by using some daily life examples. • Suggest preventive measures to protect themselves from these infections	• Discuss what food students typically have at home and the importance of 'good' microorganisms in producing these foods (yoghurt, cheese, bread etc.). • Plan and prepare yogurt or other biotechnological products. • Brainstorm several common diseases with students. Which of these are caused by viruses, bacteria, fungi – how can we keep ourselves safe?	How do germs spread (and why do they make us sick): **https://www.youtube.com/watch?v=yxonJTWhBJQ**

Contents	Students' Learning Outcomes	Suggested Activities	Suggested links
Chapter 3 Flowers and seeds 1. Structure of a flower	• Examine and Describe the structure of a flower	• Dissect the flower and observe various parts of a flower	Microorganism: Definition, Types & Classification: **https://study.com/academy/lesson/microorganism-definition-types-classification.html**

Contents	Students' Learning Outcomes	Suggested Activities	Suggested links
2. Pollination and its types	• Define pollination and describe its types with examples.		Pollination: **https://www.youtube.com/watch?v=CUPzbTuJlgc**
3. Types of reproduction in plants	• Define reproduction and differentiate between sexual and asexual reproduction in plants.		
4. Structure and germination of seed (monocot/dicot)	• Describe the structure of a seed and demonstrate its germination. • Compare and contrast the structure and function of a chick pea and Maize seed.	• Design an experiment to monitor the changes that occur in the seed during its germination. Also suggest reasons for the changes as well as the factors imperative for germination. • Compile a scrap book of the leaves of dicot and monocot plants. Also describe other characteristics that make it different from each other.	What is Germination of Seed: **https://www.youtube.com/watch?v=ro8Z9qIlWjM**
5. Conditions necessary for seed germination	• Illustrate the conditions necessary for seed germination.		

Contents	Students' Learning Outcomes	Suggested Activities	Suggested links
Chapter 4 Environmental pollution 1. Pollution and its types	• Define pollution and its types.	• Plan and conduct a campaign to bring awareness to a problem of environmental pollution in your surroundings.	Water pollution: How Water Gets Dirty: **https://www.youtube.com/watch?v=Om42Lppkd9w**
2. Causes of pollution	• Explain the main causes of water, air and land pollution.	• Plan and conduct a campaign in your school or neighbourhood regarding our responsibility to save our immediate environment	

Contents	Students' Learning Outcomes	Suggested Activities	Suggested links
3. Effects of Pollution on life (Smoke, smog, Sewage Water, Solid Wastes, Industrial Wastes)	• Explain the effects of water, air and land pollution (unclean/toxic water, smoke, smog, excess CO2/other gases, open garbage dumps, industrial waste etc.) on the environment and life.	• Design a model to explain the greenhouse effect.	
4. Preventive measures to reduce Pollution	• Explain the effects of burning fossil fuels and releasing greenhouse gases in the air.		
5. Biodegradable and non-biodegradable materials	• Differentiate between biodegradable and non-biodegradable materials. • Explain the impact of non-biodegradable materials on the environment. • Investigate possibilities and suggest ways to reduce non-biodegradable materials.	• Students to bring biodegradable and non-biodegradable material and discuss what makes them different.	Biodegradable and Non-Biodegradable: **https://www.youtube.com/watch?v=aTflLRf7WS4&app=desktop**

Contents	Students' Learning Outcomes	Suggested Activities	Suggested links
Chapter 5 **Physical and chemical changes of matter** 1. Physical changes observed in everyday life	• Identify observable changes in materials that do not result in new materials with different properties (e.g., dissolving, crushing aluminium can). • Recognize that matter can be changed from one state to another by heating or cooling (candle wax). • Describe and demonstrate the states of water (i.e., melting, freezing, boiling, evaporation, and condensation).	• Demonstrate chemical change by burning a paper. • Demonstrate physical change by melting a candle. • Ask students to observe various objects on the school premises that display signs of wear and tear. Discuss whether these changes are chemical or physical – what caused these changes.	Changing States of Matter: **https://study.com/academy/lesson/changing-states-of-matter-lesson-for-kids.html**

Contents	Students' Learning Outcomes	Suggested Activities	Suggested links
	• Identify ways of accelerating the process of dissolving materials in 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). • Distinguish between strong and weak concentrations of simple solutions.		Concentration of Solutions: **https://study.com/academy/lesson/concentration-of-solutions-definition-levels.html**
2. Chemical changes observed in everyday life	• Identify observable changes in materials that make new materials with different properties (e.g., decaying, burning, rusting). • Differentiate between physical and chemical changes with examples.	• Take baking soda and vinegar in separate bowls. Then combine the two together in a large bowl. (Be sure students stand away from the bowl). Explain that when baking soda and vinegar are combined, they go through a chemical change. Bubbles form because a gas is released, which is a byproduct of the chemical change. Ask students to draw the process.	Rusting of Iron: **https://www.youtube.com/watch?v=qd2B9yCKzc0**

Contents	Students' Learning Outcomes	Suggested Activities	Suggested links
Chapter 6 **Light and sound** **A. Light** 1. Sources of light	• Identify natural and artificial sources of light. • Justify that light emerges from a source and travels in a straight line.		
2. Luminous and non-Luminous objects	• Investigate luminous and non-luminous objects in daily life.		

Contents	Students' Learning Outcomes	Suggested Activities	Suggested links
3. Transparent, opaque and translucent objects	• Identify and differentiate between transparent, opaque and translucent objects in their surroundings.	• Perform the following activity to investigate the difference between transparent, opaque and translucent object: • Look around your house for one object made out of wood (opaque), clear glass, (transparent), and frosted glass (translucent). Shine a flashlight beam through each item and observe what happens to the light. Draw a diagram of what you observe. • Once you understand the difference between opaque, transparent, and translucent go on a scavenger hunt of your house! You can take your flashlight with you and test the items as you find them. • Compile a list of your findings.	
4. Light travels in straight lines	• Investigate that light travels in a straight line.		How Does Light Travel: **https://www.youtube.com/watch?v=fm_GAlrBuQ**
5. Formation of shadows	• Explain the formation of shadows. • Predict the location, size and shape of a shadow from a light source relative to the position of objects.		Shadow: **https://www.youtube.com/watch?v=lOIGOT88Aqc** Formation of Shadow: **https://www.youtube.com/watch?v=DavnmxgVwaw**

Contents	Students' Learning Outcomes	Suggested Activities	Suggested links
6. Reflection of light.	• Demonstrate that shiny surfaces reflect light better than dull surfaces.		
B. Sound 1. Production of sound	• Describe and demonstrate how sound is produced by a vibrating body.		
2. Propagation of sound	• Identify variety of materials through which sound can travel.		How Does Sound Travel: **https://study.com/academy/lesson/how-does-sound-travel-lesson-for-kids.html**
3. Intensity of sound (high, low)	• Identify that speed of sound differs in solids, liquids and gaseous medium. • Define and describe the intensity of sound with examples.		
4. Noise and its effects on human health.	• Define noise and its harmful effects on human health.	• Ask students to maintain a journal by identifying sources of noise pollution in their daily lives. Discuss the various sources? How can we reduce noises?	
5. Controlling noise pollution	• Appreciate the role of human beings in reducing noise pollution.	• Design symbols and signs for controlling noise pollution around your school.	

Contents	Students' Learning Outcomes	Suggested Activities	Suggested links
Chapter 7 **Electricity and Magnetism** 1. Static electricity	• Explain the phenomenon of static electricity in everyday life.	• Use a dry comb and small pieces of paper to demonstrate static electricity.	Static Electricity: **https://study.com/academy/lesson/static-electricity-lesson-for-kids-definition-facts.html**
2. Charges and their properties	• Describe charges and their properties.		

Contents	Students' Learning Outcomes	Suggested Activities	Suggested links
3. Conductors and insulators	• Differentiate between conductors and insulators from daily life.	• Investigate insulators and conductors from daily life.	
4. Electric current	• Describe the flow of electric current in an electric circuit.		
5. Electrical circuits and its components 6. Fuse and its uses	• Describe and design an electric circuit and explain its components.	• Design an electrical circuit and observe the working of its components.	Electrical Circuits: **https://www.youtube.com/watch?v=js7Q-r7G9ug**
7. Magnet and magnetism	• Recognize that magnets can be used to attract some metallic objects • Describe and demonstrate that magnets have two poles and that like poles repel and opposite poles attract.	• Make a list of magnetic and non-magnetic materials from everyday life. • Plan, design and make a model/ toy based on magnetism.	
8. Properties of magnets	• Identify earth as a huge magnet and demonstrate it with an experiment.	• Design an experiment by using two magnets to investigate that each magnet has north and south poles and same poles attract while opposite poles repel each other.	
9. Types of magnets	• Describe the working of magnetic compass. • Explain different types of magnets (permanent, temporary magnet and electro-magnet).	• Make an electromagnet. • Design an electromagnet with the help of a cell, iron nail and wire and show its working.	How Compass works: **https://www.youtube.com/watch?v=MqCiY7MAT2U**

Contents	Students' Learning Outcomes	Suggested Activities	Suggested links
Chapter 8 **Structure of Earth** **A. Earth** 1. Structure of Earth	• Describe the structure of the Earth (i.e., crust, mantle, and core) and the physical characteristics of these distinct parts. • Describe the sources of water on Earth.	• Design a model to elaborate the structure of the Earth.	Structure of The Earth: **https://www.youtube.com/watch?v=eXiVGEEPQ6c**
B. Soil 1. Types of soil	• Identify similarities and differences among the different types of soil.	• Investigate types of soil. • Investigate and compare absorption of water by different soils.	
2. Composition and characteristics of Soil	• Investigate the composition and characteristics of different soils.	• Make a clay model of the layers of earth, its characteristics and reasons for different layers of soil.	

Contents	Students' Learning Outcomes	Suggested Activities	Suggested links
Chapter 9 **Space and Satellites** 1. Space	• Define the term space and emphasize the need to explore it • Recognize the role of NASA (National Aeronautic and Space Administration) in space exploration.		Space: **https://www.youtube.com/watch?v=n4mr7rcAxmM** NASA Facts: **https://study.com/academy/lesson/nasa-facts-lesson-for-kids.html**
2. Satellites	• Define the term satellite and describe its importance.	• Make a satellite model with a cardboard. Guide the students through the following website link: https://www.youtube.com/watch?v=S_rEKUruxqQ	
3. Natural and artificial satellites	• Describe the natural satellites of the planets of the solar system.		

Contents	Students' Learning Outcomes	Suggested Activities	Suggested links
	• Define artificial satellites and explain their importance in exploring the Earth and space. • Recognize the key milestones in space technology.		
4. Types of artificial satellites and their uses	• Describe the uses of various satellites in space i.e. geostationary, weather, communication and global positioning system (GPS).		Different Kinds of Artificial Satellites: **https://www.youtube.com/watch?v=aVQXkl1tzok**

Contents	Students' Learning Outcomes	Suggested Activities	Suggested links
Chapter 10 **Technology in everyday life** 1. Technical model making	• Enlist and practice safety procedures while carrying out the activities • Make a model of foot bridge and bookshelf • Use spirit level/water level to compare the level of different objects (table, picture, frame etc.) • Use a plumb line to install a flag pole vertically.	• Take help from different YouTube videos to see how to make foot bridge and book shelves and other things mentioned	
2. Making technical devices	• Prepare LED light strings working with 12volt battery • Make a musical instrument from easily available resources. • Make moveable van, bus and trolly.		
3. First aid and disaster management	• Use first aid box to dress a wound. • Practice Shifting a person to hospital • Practice earth quake, fire and flood drill.		

CHAPTER

05 TEACHING AND LEARNING

CHAPTER

05 TEACHING AND LEARNING

The purpose of the General Science Curriculum is to make students develop two things, scientific literacy and positive attitudes about using science as a way of obtaining knowledge. Students will be expected to learn how to practice science, how to communicate the results of science inquiries to others, and how to use their knowledge of science concepts and principles to reason about science and to solve problems in real life situations. The vision of science education, calls for a shift in the focus of teaching and learning context. This can only be accomplished by providing students with opportunities to explore the context of science and its applications, and to develop an understanding of the interconnections between science, technology, society and environment.

5.1 PROMOTING SCIENTIFIC LITERACY IN TEACHING AND LEARNING PROCESS

Being scientifically literate requires that a person has essential understanding of key science ideas, along with a fluency in the language and terms used to describe them. The General Science Curriculum will give special attention to the age-appropriate critical thinking, or inquiry skills that are presented as Students' Learning Outcomes for each of the content standards. Students and teachers have opportunities for in-depth explorations that build understanding of the way in which scientific knowledge is created, validated and communicated. This will assist students not only to understand science principles but also develop a lifelong desire to know more. Hence the aim is also to equip students to be able to learn independently rather than the teacher, the sole source of giving knowledge. Teacher is therefore, not a sage on the stage rather a guide on the side. Hence, it is also important for teachers to understand that students are not empty vessels but much more capable and adept to achieve higher standards of learning. Hattie (2009) believes that the student achievement is much higher if the teachers' expectations are higher as well.

5.2 WHAT IS ACTIVE LEARNING?

Active Learning is an important feature of the science curriculum. Teachers should be 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. Leaners with diverse background, abilities and preferred learning styles.

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.

5.3 TERMS ASSOCIATED WITH 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, Vygotsky, etc.

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 definitions outlined:

Terms associated with active learning	
Collaborative learning	**Cooperative learning**
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.	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.
Problem-based learning	**Experiential learning**
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.	In this approach, learning involves learning from experience. Learners are encouraged to predict, discover, create and relate to and interact with things around them. This form of learning is unstructured and involves minimal guidance from the teacher.

5.4 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	**Questioning techniques**	**Whole-class instruction**
Debates	**Role play**	**Group work & presentations**

5.5 ACTIVE LEARNING IN THE CLASSROOM

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 assignment
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.

5.6 SHIFTING ROLE OF A TEACHER

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'**

5.7 SHIFTING ROLE OF A LEARNER

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**

More examples of active learning

5.7.1 THE FLIPPED CLASSROOM

The flipped classroom approach is a pedagogical model which aims to shift the focus from passive to active learning. There are varying definitions of the term 'flipped classroom', and it can depend on variables such as class size, resources, support, etc. The flipped classroom can encourage:

- learners to 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 using higher-order thinking.
- learner-centered learning, collaboration and significant learning opportunities can be gained through facilitating active learning, engaging learners, guiding learning, correcting misunderstandings and providing timely feedback using a variety of pedagogical strategies.
- a greater focus on concept exploration, meaning-making and demonstration or application of knowledge while in the classroom, with less focus on 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.

5.7.2 PROBLEM-BASED LEARNING

Problem-based learning (PBL) 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 will assume the role of cognitive coach rather than knowledge-holder and disseminator and learners will be 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 learners.
- Connect the problem with 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 defining their learning experience and planning to present among peers.

CHAPTER

06 ASSESSMENT AND EVALUATION

CHAPTER

06 ASSESSMENT AND EVALUATION

6.1 ASSESSMENT

Assessment is a systematic process that measures the outcomes of students' learning in terms of knowledge acquired, understanding developed, and skills gained. It determines their progression through their learning experiences and enables them to demonstrate that they have achieved the intended learning outcomes. Assessment usually collects information on demographic and other background factors to allow comparison to be made between the achievement of the subgroup in the population. This information when related statistical analysis to student achievement, can answer questions that are central to the role of National Assessment, such as, the following:

- What factors are associated with low achievement?
- Is the system serving any particular group?
- All gaps between groups in performance leads to remedial action.

In this way, we can relate outcomes to inputs that are provided and processes being used. Recommended activities for conducting assessment:

- Describe in detail the content and cognitive skills of achievement and the background variable to be assessed.
- Entrust test development to personals who are familiar with both curriculum standard and learning level of student.
- Use assessment instrument adequately to assess the knowledge and skills about which information is required and what will provide information on sub-domains of knowledge or skills (for example, problem solving rather than just overall score).
- Develop clear and unambiguous test and questionnaire items, and present them in a clear and attractive manner.

Assessment provides all stakeholders with information as to how well students, schools and programs are succeeding, and it identifies areas that need improvement. Thus, the focus of assessment shifts from judgment to continuous improvement.

6.2 EVALUATION

Evaluation is the process of analyzing, reflecting upon, and summarizing assessment information, and making judgments or decisions based upon the information gathered. Evaluation is effective when it is integrated into the teaching-learning process and carried out regularly and comprehensively through the use of a variety of assessment techniques. Assessment and evaluation are essential components of teaching and learning in science. Without effective assessment and evaluation, it is not possible to know whether students have learned, whether teaching has been effective, or how best to address students' learning needs.

- The mode of instruction and mode of assessment should be in synergy (specially in case of children from diverse language background and children with disabilities).
- In case of student with disabilities assessment will be adapted according to the requirements of the child.

6.3 ASSESSING STUDENT LEARNING IN SCIENCE

The General Science Curriculum emphasizes having a classroom environment in which students will be encouraged to learn scientific processes and knowledge within meaningful contexts. It is important that assessment strategies reflect this emphasis and are consistent in approach. An assessment program, which provides regular feedback, and is part of the learning process, is important to both student and teacher. Feedback tells students if they demonstrate understanding of scientific concepts and if their actions display expected performance levels for inquiry, decision making, and problem solving. Regular feedback inspires confidence in learning science and in becoming scientifically literate.

Therefore the assessment of students' learning must be aligned with curriculum outcomes. The General Science Curriculum provides suggestions for developing student learning across the four general curriculum outcome areas: knowledge; skills; attitudes; and science, technology, society and environment. These outcomes describe a balance of inquiry problem solving, and decision making, within a suggested social-environmental context, for a given set of scientific knowledge.

6.4 OBJECTIVES OF ASSESSMENT

The assessment objectives are classified into the following three major performance expectations:

6.4.1 UNDERSTANDING SCIENCE PRINCIPLES

Students should be able to:

- Describe knowledge and understanding of scientific phenomena, facts, and principles.
- Develop relationships among science principles.
- Use scientific vocabulary, terminology and conventions.

6.4.2 CONDUCTING SCIENTIFIC INQUIRY

Students should be able to:

- Follow and carry out instructions accurately and safely.
- Locate, select, organize and present relevant information from a variety of sources.
- Identify patterns, report trends and draw inferences.
- Make predictions and hypotheses and deduce relationships.
- Identify the problem, plan and carry out an investigation to solve the problem.
- Conduct scientific investigation using appropriate tools and technologies.
- Apply and communicate information through science process skills.

6.4.3 APPLYING SCIENCE PRINCIPLES

Students should be able to:

- Apply science principles to both familiar and unfamiliar situations/problems.
- Shows understanding of connections between science and technology and the world outside the school as well as their implications.
- Propose solutions to problems with respect to science & technology and its relation with society and environment.

6.5 INCORPORATING ASSESSMENT INTO THE LEARNING PROCESS

Assessment of students' learning must be part of every teaching and learning experience. Students should learn to evaluate their own learning. Traditional student testing programs, which rely on final, one-time evaluations, provide data that is of limited use to students as they construct knowledge. Meaningful assessment, like meaningful learning, must be authentic and connected to real-life problems.

A constructivist approach to learning and teaching has profound implications for the way learning is measured. Traditional classroom practice relies heavily on paper-and-pencil tests to measure students' learning and ability to apply knowledge. Learning is a process of connecting prior understanding with new learning. Consequently, an assessment strategy that measures the acquisition of facts and elements cannot serve a constructivist model.

Linking assessment to instruction - embedding it in the process of learning - is vital for an effective implementation of the "Inquiry based and Outcome focused" Science Curriculum.

To allow students to construct learning in the classroom through authentic experiences, assessment must be:

1. Valid, leading to attainment of multi-dimensional science learning;
2. Open-ended, allowing for discussion and revision of new understanding;
3. Tolerant of divergent thinking and promote the notion of no "one right answer";
4. Presented in alternative modes, not just paper-and-pencil responses to limiting questions;
5. Designed to promote analysis, comparison, generalization, prediction, and modification;
6. Capable of promoting collaboration and team effort in demonstration of competence; and
7. Ongoing and cumulative, showing development over time.

6.6 TYPES OF ASSESSMENT

Assessment serves many important purposes. Some of them are given below:

I. Diagnostic (to plan instruction to fit the student's prior knowledge)
II. Formative (to improve performance and adapt instruction)
III. Summative (to report on final performance)

6.7 PURPOSE OF ASSESSMENT

6.7.1 TO GUIDE INSTRUCTION

Assessments should provide continuous data about student learning so teachers can identify student needs and plan appropriate instructional strategies by obtaining feedback on their own practice, finding out the gaps between teaching (what was taught) and learning (what has been learned).

6.7.2 TO INFORM PROGRESS OF STUDENTS

The purpose of assessment is to provide information and feedback on students' progress to the students and their parents.

6.7.3 TO PROVIDE INFORMATION ON THE EFFECTIVENESS OF CURRICULUM

The purpose of assessment is to provide information on the effectiveness of science curriculum to all stakeholders in order to improve curricula, teaching standards and students' learning environment. Teachers, students, and parents need feedback on student progress. School administrators, educational planners, and the community need information to determine the overall effectiveness of the science program.

6.8 CLASSROOM ASSESSMENT

The primary purpose of classroom assessment is not only to evaluate and classify students' performance but also to inform of teaching methods and learning environment, and to monitor student progress in achieving year-end learning outcomes. Therefore, classroom assessment is used for various purposes:

1. Assessment ***as*** Learning
2. Assessment ***for*** Learning
3. Assessment ***of*** Learning

Each of the purpose requires a different role for teachers and different planning (for details refer Appendix A.). Traditionally, the focus of classroom assessment has been on assessment of learning (summative assessment). Assessment for learning has been used only for diagnostic processes and for feedback. In order to enhance science learning of all students, the role of assessment as learning must provide an opportunity to students whereby they become critical and analysts of their own learning.

6.8.1 CLASSROOM ASSESSMENT STRATEGIES

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

- **Selected Response**
  Multiple-choice, matching, completion tests, etc.
- **Self-constructed Response Questions**
  Fill-in-the-blank phrase(s), essay (restricted and extended response), reports, procedures, explanations, short answer sentence(s), paragraph(s), label a

diagram, and graph/table, etc.

- **Performance based Assessment**
  Presentation, illustrations, science lab, demonstration, process skills, enactment, project, debate, model, exhibition, table, graph, portfolios, etc.
- **Personal Communication Assessment**
  Oral questioning, observation, interview, conference, process description, checklists, etc.

6.9 STUDENTS' SELF-ASSESSMENT

Students recognize the relationship between content achievement, skill proficiency, and assessment opportunities by setting their sights on their own demonstration. They can do self-assessment if they are provided with the knowledge-related checklists as well as checklists specific to applications and attitudes. Students assume the role of a researcher and use critical thinking skills as they find facts and make inferences to reach more conclusions about their learning. They are not receiving information passively and then simply giving it back to the teacher after memorizing it.Assessment should allow students to monitor their progress in various scientific skills: initiating and planning; performing and recording; analyzing and interpreting; communication and teamwork. The curriculum calls for students to be actively involved in their learning, using the tools of science and of information processing during classroom/ laboratory activities.

6.10 QUALITY IN ASSESSMENT

Assessment of science learning must change as science instruction moves from a focus on facts to a focus on in-depth understanding of major concepts and processes of science. Whereas the Quality Assessment will have the following major objectives:

- Measurement of what students should know and are able to do according to the Learning Outcomes of science;
- Objective verification of the application of scientific principles to familiar and unfamiliar situations; and
- Alignment with the Learning Outcomes and the Teaching/Learning Strategies.

Therefore, assessment and evaluation of the students' learning of science according to predetermined Standards and Benchmarks will ensure the quality of their academic achievements.

6.11 LARGE-SCALE NATIONAL ASSESSMENT

Large-scale national assessments are conducted by National Educational Assessment System (NEAS), a subordinate office of the Ministry of Federal Education and Professional Training, in collaboration with Provincial and Areas Assessment bodies. The objective of these assessments is to evaluate the overall capability and quality of the education system, and to focus on providing evidence-based findings to policy makers for effective interventions in education system.

In 2019 NEAS supported Pakistan’s first-time participation in the international level academic assessment of Trends in International Mathematics and Science Study (TIMSS) for grade 4 with an aim to become internationally competitive and recognize its comparative position within the world community. NEAS was the main coordinator for the nationwide conduct of the TIMSS 2019 test with an aim to establish an international

baseline for Pakistan.

The TIMSS assessment is designed to provide valid and reliable data by assessing achievement in Mathematics and Science at the 4th, 8th and 12th grades on a regular four-year interval with an aim to diagnose the issues within the education system and improve teaching and learning in mathematics and science. TIMSS also addresses background factors through targeted questionnaires for teachers, parents and head teachers.

6.12 TIMSS SCIENCE ASSESSMENT FOR 2019

The table shows the target percentages of each of the three strands in the TIMSS 2019 Science assessment for Grade Four.

Strand	Percentage
Life Science	45%
Physical Science	35%
Earth and Space Sciences	20%

In the curriculum each of these strands includes several chapters, and each chapter in turn includes one or more key topics. Each topic is further described by specific SLOs that represent the students' expected knowledge, abilities, and skills to be developed and assessed within each topic. Each SLO can be assessed by drawing upon any of the three cognitive domains (knowing, applying, and reasoning).

Cognitive Domain	Percentage
Knowing	40%
Applying	40%
Reasoning	20%

These cognitive domains are assessed through MCQs (Multiple Choice Questions) and CRQs (Constructed Response Questions). TIMSS sample questions are available on link given below **(https://nces.ed.gov/timss/pdf/TIMSS2011_G4_Science.pdf).**

6.13 CONSTRUCTION OF TEST ITEMS

Written test items (selected response and creative response) should adhere to the following criteria:

1. Items should be clearly written.
2. Each test items should be written on the understanding level of learners.
3. Test items should cover what learners have had opportunities to learn.

Too frequently, these test items measure students' gains in recall of factual information. There are other relevant facts for students to acquire. These are higher levels of thinking or cognition that students should also develop.

These test items should measure students' achievement in:

- Understanding basic science concepts and acquired learning;
- Evaluating contents in terms of criteria or standards;
- Problem-solving skills;
- Analytical and creative thinking;
- Positive attitudes developed toward science and scientific methods of thinking;
- Ability to work together with others;
- Relevant concepts and generalizations developed; and
- The ability to manipulate and utilize science equipment.

Results from achievement tests may be utilized, along with other data-gathering techniques, to appraise students' progress in the science curriculum.

6.14 REPORTING

Reporting on student learning should focus on the extent to which students have achieved the curriculum outcomes. Reporting involves communicating the summary and interpretation of information about students' learning to various audiences who require it. Teachers have a special responsibility to explain accurately what progress students have made in their learning and to respond to parents' and students' inquiries about learning.

Narrative reports on progress and achievement can provide information on students' learning that letter or number grades alone cannot. Such reports might, for example, suggest ways in which students can improve their learning and identify ways in which teachers and parents/ guardians/ caregivers can best provide support.

Effective communication with parents/ guardians/ caregivers regarding their children's progress is essential in fostering successful home-school partnerships. The report card is one means of reporting individual student progress. Other means include the use of conferences, notes, and phone calls etc.

6.14.1 GUIDING PRINCIPLES FOR REPORTING

In order to provide accurate, useful information about the achievement and instructional needs of students, certain guiding principles for the development and use of assessment must be followed. For example:

- Assessment strategies should be appropriate and compatible with the purpose and context of the assessment.
- Students should be provided with sufficient opportunity to demonstrate the knowledge, skills, attitudes, or behaviours being assessed.
- Procedures for judging or scoring student performance should be appropriate for the assessment strategy used and be consistently applied and monitored.
- Procedures for summarizing and interpreting assessment results should yield accurate and informative representations of a student's performance in relation to the curriculum outcomes for the reporting period.
- Assessment reports should be clear, accurate, and of practical value to the audience for whom they are intended.

6.15 ATTITUDES AND VALUES

Attitudes and values cannot be assessed directly. They are embedded in what students do and say. Teaching methods and learning activities that encourage students to recognize the value and relevance of what they are learning go a long way towards motivating

students to work and to learn effectively.

Activities that involve students in investigating issues related to science and technology outside the school environment provide them opportunities to develop the attitudes and values so as to make informed and responsible decisions.

A SUMMARY OF ASSESSING SCIENCE LEARNING IS PRESENTED AS FOLLOWS:

What?	When?	How?	Recording
Science Knowledge and Understanding:			
• Biological science • Earth and space Science • Physical Science	• Ongoing during and after Science lessons • On completion of units • On completion of projects or practical investigations	• Observation • Student work samples • Oral reports • Talking with students • Diagnostic tasks • Student designed tests • Self-assessment • Modelling • Teacher-constructed tests	• Anecdotal records • Annotated class lists • Knowledge-related checklists • Science journals • Cumulative checklists • Photographs, videos
Application of Scientific Knowledge:			
• Explaining • Predicting • Analyzing	• Ongoing during and after Science lessons • On completion of units • During class discussions	• Concept mapping • Open-ended Questions • Problem-solving Activities • Debates • Teacher-constructed tests	

What?	When?	How?	Recording
Skills, Processes and Procedures:			
• Observation • Posing questions or hypothesizing • Identifying and controlling variables • Planning investigations • Classifying • Using equipment correctly • Justifying measurement procedures • Collecting and recording data • Drawings • Presenting data • Analyzing data • Drawing conclusions	• During and after practical sessions • When planning and carrying out investigations • During and after excursions	• Observation • Practical tests • Fieldwork • Practical investigations • Surveys and interviews • Practical reports	• Annotated class lists specific to processes identified • Anecdotal records • Portfolio of students practical reports • Photographs, video, audio recordings

Scientific Attitudes and Acting Responsibly:			
• Flexibility • Curiosity • Respect for evidence • Critical reflection	• Ongoing, during and after Science lessons • During individual and group projects	• Science journals • Questionnaires • Talking informally with students • Practical reports • Library research tasks, including using the internet and authoring Tools	• Anecdotal records detailing attitudes • Portfolio of student practical report • Checklist specific to attitudes Listed

What?	When?	How?	Recording
Scientific Communication:			
• Appropriate language and vocabulary	• During ongoing discussions • Following completion of project reports • During individual or group presentations	• Oral presentations • Practical reports • Drawing • Research project Reports • Role-plays, performances • Peer-assessment • Creative writing • Using authoring tools for accessing presenting and communicating information	• Video, audio recordings • Anecdotal records • Portfolio of students' practical and research reports

CHAPTER

07 GUIDELINES TO THE TEXTBOOK AUTHORS

CHAPTER

07 GUIDELINES TO THE TEXTBOOK AUTHORS

A textbook is an important teaching and learning resource and one of the most extensively used resources in our classrooms. The textbooks provides the basic science information for the acquisition of knowledge. 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 students. Textbook authors need to consider, among others, the following guidelines:

- Introduction to textbook explaining the structure and format of the book, organization of concepts in connection with the curriculum objectives, and directions to use the textbook must be stated in the beginning of the textbook.
- The textbook must have accurate, authentic, and up-to-date material.
- The language structure should be written in such a way as if talking to the audience.
- The material must be sufficient to give students the knowledge they need to understand, the concepts, develop the inquiry skills and engage in higher order thinking.
- The material should help students understand the world in which they live, and prepare for lifelong learning.
- The material must be error free so it can be trusted.
- The material must be unbiased.
- The book must be attractive and engaging along with illustrations, tables, graphs etc.
- The illustrations should be clearly, accurately, appropriately and neatly drawn. These must be properly labelled and captioned.
- The textbook should have variety of practical and thinking activities to engage students in learning.
- Exercises should be included to encourage students to think, develop skills, and use information for a variety of purposes.
- The textbook must contain Table of contents and Glossary.
- The textbook must be contextually relevant and feasible to use in normal classroom environment.
- The figures, illustrations and pictures should be from local/ Pakistani environment.
- Should give students material to think beyond the textbook too.

7.1 GUIDELINES FOR WRITING A CHAPTER

To make the learning of science interesting and exciting and to provide a strong foundation for higher learning, each chapter in the science textbooks must have, among others, the following features:

- ***Chapter opener*** *to introduce the chapter with title, full page coloured photographs, trigger questions and SLOs.*

- ***Specific Learning Outcomes*** at the beginning of each chapter clearly describing the objectives and tasks to be achieved in the chapter.
- **Key words, terms and definitions to be highlighted in the text.**
- ***Headings and subheadings*** *with color coding to show different levels.*
- ***Science tidbits*** to provide snippets of interesting and useful knowledge.
- **Attractive and colourful illustrations to captivate students. The figures to be drawn by students should be given as line diagram.**
- ***Do You Know?*** Questions to recall, think and apply what they have learnt as well as to reinforce the learning of key concepts and principles.
- ***Everyday experiences*** *and context which students can relate to be used throughout the book.*
- ***Hands on activities*** *to encourage students to make their own inquiries.*
- ***Link to real life.***
- ***Skills and processes*** *to infuse values, ethics and attitudes.*
- **IT related activities** to encourage students to use internet resources.
- ***Mini-exercise*** to provide questions involving scientific investigations and relating science contents with the technology, society and environment.
- ***Awareness beyond the classroom*** to widen the horizon of the students by providing interesting information and introducing related, more advanced concepts according to grade level in an understandable way.
- ***Key Points*** to provide a summary of the concepts and principles in the chapter.
- ***Review Questions*** at the end of each chapter to:
    - Recall and integrate previous learning
    - Engage students and develop their creativity
    - Move from lower to higher order thinking
    - Develop process skills
    - Develop multiple intelligences
- ***Think-Tank/Investigate*** to include open-ended questions to provoke students' thinking, creatively and investigation skills.

7.2 CRITERIA FOR ANALYSIS OF TEXTBOOKS

Following criteria must be considered for selecting learning material for the textbook. Answers to most of these questions, if in the affirmative, will indicate a good quality textbook.

1. Is the book in line with the goals of the curriculum?
2. Is the content accurate and up to date?
3. Are the contents relevant to the needs, age and level of understanding of the students?
4. Are science process skills developed through text, activities and assessment?
5. Do the illustrations (pictures, drawings, graphs, etc.) help to understand the contents better?
6. Do the end-of-the chapter exercises encourage students?
    a. To think;
    b. To develop their skills; and
    c. To be creative.
7. Are learning activities flexible to suit the needs of diverse learners and children with disabilities?
8. Do learning activities include student participation in real life issues and promote scientific inquiry or investigation?
9. Are a variety of assessment strategies suggested? (e.g., multiple choice,

CRQs, project work, exhibitions, open-ended and divergent responses, think tank etc.)

10. Do the text, questions and suggested activities stimulate interest that would lead to further study?
11. Is the book free from biases?
    a) Religion b) nationality c) gender d) occupation e) social class f) abilities
12. Is a teacher's guide included?
13. Is it attractive and appealing to children?
14. Is the language readable, understandable, and easy to follow? Appropriate for the children who will use it?
15. Is there an introduction and key points/summary?
16. Does it have
    a. An introduction; (How to use the book)
    b. Table of contents; and
    c. Glossary;
17. Are the following adequate?
    a. Paper quality (80gm, white)
    b. Picture quality (Resolution and colours)
    c. Page size (23x36/8)
    d. Line spacing (1.25)
    e. Titles and sub-titles (28-32, 18-22)
    f. Font size (14 Ariel)

7.3 TEACHERS' GUIDE

Teachers' guides provide detailed explanation of key concepts. Textbooks usually come with a teacher's guide aimed at informing teachers of how the textbook is written and how best to use it to facilitate student learning. It is a way to teach a particular topic, provide further activities, web links, examples, answers to think- tank questions and text

APPENDICES:

A. PLANNING CLASSROOM ASSESSMENT

	Assessment as Learning	***Assessment for Learning***	***Assessment of Learning***
Why Assess?	• To guide and provide opportunities for each student to monitor and critically reflect on his or her learning, and identify next steps	• To enable teachers to determine next steps in advancing student learning	• To certify or inform parents or others of student's proficiency in relation to curriculum learning outcomes
Assess What?	• Each student's thinking about his or her learning, what strategies he or she uses to support or challenge that learning, and the mechanisms he or she uses to adjust learning	• Each student's to be progress and learning needs in relation to the curricular outcomes	• The extent to which students can apply the key concepts, knowledge, skills, and attitudes related to the curricular outcomes
What Methods?	• A range of methods in different modes that elicit students' learning	• A range of methods in different modes that make students' skills and understanding visible	• A range of methods in different modes that assess both product and process
Ensuring Quality	• Accuracy and consistency of student's self-reflection, self-monitoring, and self adjustment • Engagement of the students in considering and challenging their thinking • Students record their own learning	• Accuracy and consistency of observations and interpretations of student learning • Clear, detailed learning expectations • Accurate, detailed notes for descriptive feedback to each student	• Accuracy, consistency, and fairness of judgments based on high-quality information • Clear, detailed learning expectations • Fair and accurate summative reporting
Using the Information	• Provide each student with accurate descriptive feedback that will help to develop independent learning habits • Have each student focus on the task and learning (not only on getting the right answer)	• Provide each student with accurate descriptive feedback to further his or her learning • Differentiate instruction by continually checking where each student is in relation to the curricular outcomes	• Indicate each student's level of learning • Provide the foundation for discussions on placement or promotion

	Assessment as Learning	*Assessment for Learning*	*Assessment of Learning*
	• Provide each student with idea for adjusting, rethinking, and articulate learning • Provide the conditions for the teacher and student to discuss alternatives • Students report about their learning	• Provide parents or guardians with descriptive feedback about student learning and ideas for support	• Report fair, accurate, and detailed information that can be used to decide the next steps in a student's learning

B. DEVELOPING SCIENCE SKILLS AND PROCESSES

The development of science skills and processes allows students to solve problems, think critically, make decisions, find answers, and satisfy their curiosity. The following skills and processes are central to the presentation of all content and the delivery of instruction and assessment activities in classrooms.

Science Skills and Processes	
Observing	Observing involves obtaining information about objects, situations, or events using as many senses as possible. Observations may be qualitative or quantitative in nature. Observing provides both a basis for new inferences or hypotheses and a tool for testing existing inferences and hypotheses.
Measuring	Observations are quantified using non-standard and then standard units. Length, area, volume, mass, time intervals, and force are among the measurements used. Appropriate measurement instruments and units within the metric system are selected.
Classifying	Classifying involves grouping objects, concepts, or events on the basis of observable properties to show similarities, differences, and inter-relationships.
Inferring	Inferring means suggesting more about a set of conditions than is observed. Inferences are based on observed data and past experience. Inferences may evolve from both direct and indirect evidence and are modified on the basis of new evidence.
Predicting	A forecast is made about future events on the basis of ordered data. Predictions on the basis of ordered data, extrapolation beyond observed patterns of events, and tests of predictions can be made.

Science Skills and Processes	
Communicating	Communicating is the process of organizing and processing data that occurs between the observation stage and the interpretation or generalization stage. It usually involves organizing "rough" data in a more compact and meaningful way (ordering, rearranging, comparing), depicting the data pictorially or graphically, and processing it mathematically (finding slopes, tangents) to facilitate interpretations.
Hypothesizing	Hypothesizing is an "educated guess" made about an expected relationship between two variables in an attempt to explain a cause-and-effect relationship. Hypotheses are based on observations or inferences about a set of events. A hypothesis should be testable.
Designing Experiments	Experimenting is a cause-and-effect test between two variables. All processes may be involved. This can begin with setting a problem to be solved, identifying the variables to be controlled, making operational definitions, devising the test to be carried out, and following the prescribed procedure.
Controlling Variables	Controlling variables involves the process of deciding which variables or factors will influence the outcome of an experiment, situation, or event, and deliberately controlling all recognized variables in a systematic manner.
Interpreting Data	Interpreting is the process by which sense is made of the observations in the form of inferences, generalizations, or explanations. It is usually a direct response to the problem under investigation and therefore includes judgments about the interpretation to fit with proposed hypotheses, and the limitation of the new knowledge.
Formulating Models	This process involves the use of physical or mental models to describe the behaviour of something that is unfamiliar. Constant vigilance is necessary to ascertain the validity of the model or analogy to the phenomenon modelled. Models often need revision to accommodate new facts.

C. DEVELOPING CRITICAL AND CREATIVE THINKING SKILLS (CITED FROM MALAYSIA CURRICULUM)

The development of critical and creative thinking skills allows students to solve problems, think critically, make decisions, find answers, and satisfy their curiosity. The following skills and processes are central to the presentation of all content and the delivery of instruction and assessment activities in classrooms.

CRITICAL THINKING SKILL

A brief description of each **critical thinking** skill is as follows:

- **Attributing:** Identifying criteria such as characteristics, features, qualities and elements of a concept or an object.
- **Comparing and Contrasting:** Finding similarities and differences based on criteria such as characteristics, features, qualities and elements of a concept or event.
- **Grouping and Classifying:** Separating and grouping objects or phenomena into categories based on certain criteria such as common characteristics or features.
- **Sequencing:** Arranging objects and information in order based on the quality or quantity of common characteristics or features such as size, time, shape or number.
- **Prioritising:** Arranging objects and information in order based on their importance or priority.
- **Analysing:** Examining information in detail by breaking it down into smaller parts to find implicit meaning and relationships.
- **Detecting Bias:** Identifying views or opinions that have the tendency to support or oppose something in an unfair or misleading way.
- **Evaluating:** Making judgments on the quality or value of something based on valid reasons or evidence.
- **Making Conclusions:** Making a statement about the outcome of an investigation that is based on a hypothesis.

CREATIVE THINKING SKILLS

A brief description of each **creative thinking** skill is as follows:

- **Generating Ideas:** Producing or giving ideas in a discussion.
- **Relating:** Making connections in a certain situation to determine a structure or pattern of relationship.
- **Making Inferences:** Using past experiences or previously collected data to draw conclusions and make explanations of events.
- **Predicting:** Stating the outcome of a future event based on prior knowledge gained through experiences or collected data.
- **Making Generalisations:** Making a general conclusion about a group based on observations made on, or some information from, samples of the group.
- **Visualising:** Recalling or forming mental images about a particular idea, concept, situation or vision.
- **Synthesising:** Combining separate elements or parts to form a general picture in various forms such as writing, drawing or artifact.
- **Making Hypotheses:** Making a general statement on the relationship between manipulated variables and responding variables in order to explain a certain thing or happening. This statement is thought to be true and can be tested to determine its validity.
- **Making Analogies:** Understanding a certain abstract or complex concept by relating it to a simpler or concrete concept with similar characteristics.
- **Inventing:** Producing something new or adapting something already in existence to overcome problems in a systematic manner.

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