Zero Draft

Single National Curriculum

General Science

Grade VI – VIII, 2020

ONE NATION, ONE CURRICULUM

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

CURRICULUM

GENERAL SCIENCE

GRADE VI -VIII

2020

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Introduction

Chapter 01

Introduction

The General Science Curriculum for Grade VI-VIII is based on the belief that science education enhances students' ability to explore and question the nature of phenomena in the world around them. This curriculum reflects the investigative and inquiry-based research by the student. Therefore, it is aligned with the International Standards. STEAM (Science, Technology, Engineering, Arts and Mathematics) is the integrated approach in the General Science Curriculum. The goal of STEAM approach is to develop better skills. These skills prepare students for the 21st Century workforce.

Learning progression at all grade levels shows a purposeful sequencing of teaching and learning expectations. The curriculum is student-cantered with an approach to develop higher order thinking. An attempt has also been made to develop the connections between all disciplines of sciences.

- Engage students in the process of science such as predicting and formulating hypothesis, higher level skills such as critical thinking and evaluating
- Promote creativity, collaboration, communication, use of internet and laboratory equipment
- Provide students the opportunities to construct their own ideas in science which can be investigated

By giving more importance to scientific process and experimentations, we believe that our curriculum enables the students to develop ownership of their own learning. As a result, they develop curiosity and finally start searching to enhance their learning and solving problems. Thus scientific skills, attitudes and understanding of the significance of research in science is developed in the students. This is achieved by hands-on and minds-on activities. The curriculum encourages the students to move from 'what' is happening in a certain problem and move to 'why' it is happening. This approach deepens their understanding about the problem and leads towards a scientific approach.

One vital aspect of the curriculum is that it develops the scientific thinking; therefore, the children are always in search of finding out. They do not learn the discoveries made by other people; they are encouraged to make their own discoveries. It becomes evident when a young

child asks questions, plans an investigation, compiles the data and starts searching for the answer.

A unique feature of the curriculum is the introduction of separate chapters about 'technology'. We have got firm belief that this is going to help the students enhance their technical understanding about different aspects that could serve as problem-solving tool in real life. They become better at dealing with everyday challenges that arise through various possible circumstances and at the same time may develop a certain level of confidence when applying to certain industries.

The curriculum incorporates the Hybrid model in which students are split into two groups having face to face instruction either even or odd days. On days when the students do not have in-person instruction, they will be learning remotely. Alternatives to this would be to have different groups of kids alternating in-person instruction weekly or even daily.

This Single National Curriculum (SNC) aims to introduce a reform in education. It brings the public and the private sector on the same platform to promote quality education with a unified approach. With this unification, textbook development, similar instructional approach, collaborative teacher training, effective assessment methodology, proper monitoring and supervision the National Vision can be achieved.

1.1 Goals:

The science curriculum aims to develop and promote scientific literacy in Pakistan. Scientific literacy and critical thinking are the key components of science education aiming to prepare students to think and to function as responsible citizens both within Pakistan and the World increasingly affected by science and technology. This can be achieved through the kinds of tasks our students are engaged in, the way the activities take place and the way in which they participate. The achievement of this goal depends on certain opportunities.

The following goals have been determined for science education in Pakistan:

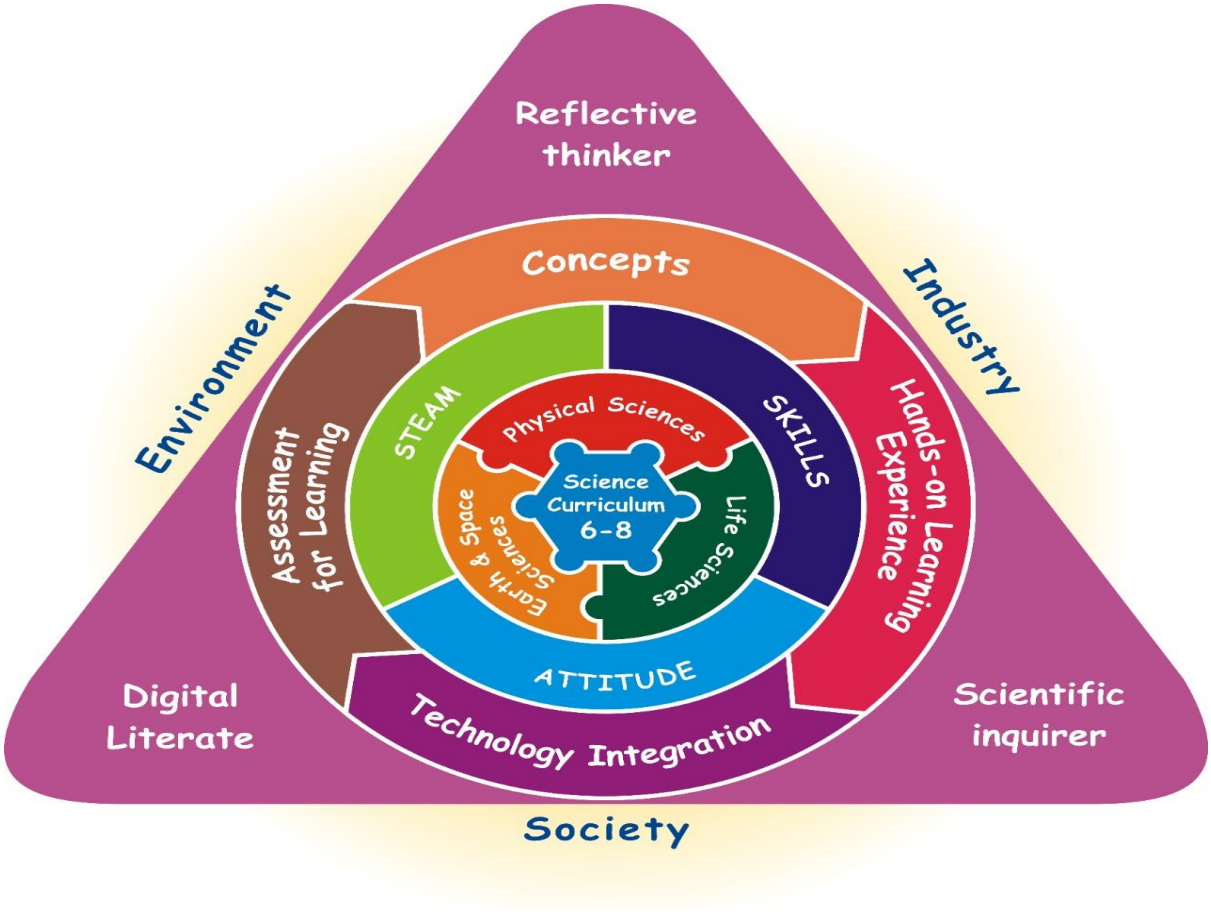
- Encourage to develop critical thinking and become confident analytical thinker
- Enable students to use science and technology to acquire new knowledge and to create opportunities to solve problems, so that they may improve quality of their own lives and lives of others
- Prepare students to critically address social, economic, ethical and environmental issues related to science and technology

- Develop in students, of varying aptitudes and interests, and the knowledge of wide variety of careers related to science, technology and the environment

The science curriculum provides opportunities to connect with industrial and agricultural domains and encourages building a more productive and ecologically sustainable environment. The learners will begin to understand and appreciate how science presents them with opportunities for responsible decision making in the local, national and international community.

1.2 Science Curriculum Frame Work:

This curriculum shields the three broad strands of Life sciences, Physical sciences, Earth and Space Sciences. It is an integrated learning progression and connects to Mathematics, the natural language of science and technology.



CHAPTER 02

Strands, Standards and Benchmarks

CHAPTER 02

Strands, Standards and Benchmarks

2.1 STRAND-1: LIFE SCIENCES

Life Sciences strand includes a rapidly advancing science incorporating a vast knowledge of living organisms which is applied for technological advancements for the sustainable development. Students will develop the necessary scientific knowledge skills, values and attitudes forming a basis for their career in various fields of life sciences, integrated economy, advanced scientific and technological innovations. A conscious effort has been made to transit from the theoretical to a more advanced and technological application of life sciences.

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

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.
Benchmark **By the end of Grade VIII**	• Apply scientific approach using basic science skills to explore the materials and events in everyday life. • Familiarize with SI units and the basic scientific apparatus used in the laboratory. • Recognize cell as the basic unit of life and levels of cellular organization. • Identify the essential nutrients of a balanced diet and describe the human digestive system. • Justify reproduction as the basic process for continuation of life with emphasis on plant reproduction and life cycle of frog and bird. • Explain the root and shoot system of plants

	emphasizing the process of photosynthesis, respiration and transpiration. • Describe respiratory and circulatory systems and their importance to life. • Describe the causes and prevention of major human diseases and importance of natural immune system and adopting healthy life style to keep our body healthy. • Describe cell division, heredity, variation and inheritance. • Describe the structure of DNA and its modification and application in biotechnology in various fields. • Explain the introduction and interdependence of non-living and living components in an ecosystem. • Describe the energy flow in ecosystem and environmental conservation.

2.2. STRAND-2: PHYSICAL SCIENCES

Physical Sciences focus on students' understanding of matter in terms of its particle nature and properties, motion, force and waves along with its interrelated connections. This strand progresses from basic to more complex understanding. The major topics include the concepts such as, structure of atom, chemical bonding, periodic table, physical & chemical changes, electricity, properties of light, renewable and non-renewable resources of energy.

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 increase their understanding of the characteristics of objects and materials they experience in daily life. Students develop an understanding of the nature of matter, its complexity and its conversion into different states, explain common properties, forms and interactions of energy and matter, their transformations and applications in chemical, physical, and biological systems.

Benchmark **By the end of Grade VIII**	• Analyse the complexity of matter and energy, particle model of matter, different states of matter and its conversion from one state to another • Investigate mixtures and apply the separating techniques • Compare the systematic organization of elements in the periodic table, constructing formula and forming chemical bonds • Distinguish between physical and chemical reactions, types of chemical reactions and acids, bases and salts • Evaluate natural processes and human activities that affect global environmental change and suggest and evaluate possible solutions to problems. • Explain how energy is transferred, transformed, and conserved. • Describe and compare types and properties of waves and explain how they interact with matter. • Explain that light can be reflected, refracted, and/or absorbed. • Describe the relationships between: electricity and magnetism, static and current electricity, and series and parallel electrical circuits. • Investigate and describe types of forces, including contact forces and forces acting at a distance, such as electrical, magnetic, and gravitational

2.3. Strand-3: Earth and Space Science

In Earth and space sciences Strand, students recognize the relationship between earth, solar system, and the universe. 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.

Under this strand, student's attention shifts from the properties of particular objects towards an understanding of the Sun as a source of energy, relate the life of a star with the formation of black hole. Students grapple with the importance and methods of obtaining direct and indirect evidence to support critical thinking. Students study the regularities of the interrelated systems of the natural world. In doing so, they develop understandings of the Big Bang Theory of the origin of the universe. By studying the Earth from both historical and current time frame, students can make informed decisions about issues affecting the planet on which they live.

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.
Benchmark **By the end of Grade VIII**	• Identify sun as a star and source of light and heat. • Describe the physical features of planets and dwarf planets. • Explain how gravity is the force that keeps objects in the solar system in regular and predictable motion and describe the resulting phenomena. • Explain the big bang theory of the origin of the universe. • Describe the formation of black hole in the life of a star • Recognize space exploration as an active area of scientific and technological research and development.

2.4 CROSS-CUTTING ELEMENTS

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

2.4.1 Skills

This curriculum focuses on 21st century skills that develop the hands-on activities along with laboratory based science environment. By hands-on we mean to teach the scientific concept from concrete to abstract as well as from easier understanding to complex by using scientific and inquiry method to understand the real life problem. Through this process learners will be able to enhance communication, critical thinking and problem solving, interpersonal and self-directional skills.

As their 21st century skills develop, our learners will be able to connect to the newly emerging discoveries as well as technology and they will participate in the worldwide competitions. This exposure will motivate learners to explore and make new discoveries

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.
Benchmark **By the end of Grade VIII**	• Use the scientific process for investigation • Application of available tools, techniques and

	measurement units for gathering data and presenting in an organized way/form. • Connect students to technical world through the main domains i.e. Learning, Literacy and Life Skills (3Ls).

2.4.2 Attitudes

Attitude refers to a mental state acquired through experiences. This strand is essential for a lifelong, productive study of science and its relationship to the society. This strand develops curiosity, creativity, objectivity, integrity, open-mindedness, perseverance and responsibility in the students. It helps them to identify the significant understanding from the data acquired for a unit of inquiry and make them able to generate open ended questions worthy of sustainable research and valid explanations.

This strand builds up a potential in the students to make accurate decisions, understand their positive role in the society, demonstrate responsible behaviours and show commitment to exploration. It inculcates values, respect and concerns for natural and cultural environment making the student more responsible towards society and his environment.

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.
Benchmark **By the end of Grade VIII**	• Develop the pattern of posing questions and investigating phenomena through instruments of science. • Acquire scientific knowledge by applying concepts, theories, principles, and laws from life, physical, and space sciences • Demonstrate thinking as a tool to encourage mutual exchange between Science and humanities pioneering new ways of working across disciplines. • Signify the ability to solve problems and make personal decisions about issues affecting the individual, society, and the environment. • Promote social and civic responsibility and the respect for nature and culture

2.4.3. Science, Technology, Engineering, ART and Mathematics (STEAM)

STEAM is an interdisciplinary approach in curriculum that examines the relationship between the Arts and STEM content. STEAM is a developing educational model of how the transitional academic subjects of science, technology, engineering, arts and mathematics can be structured into a framework by which to plan integrative curricula. The aim of STEAM inclusion in science is make students capable of thinking across spectrums and making connections between multiple disciplines. STEAM is defined as "Science and Technology, interpreted through Engineering and The Arts, all based in a language of Mathematics".

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.
Benchmark **By the end of Grade VIII**	● Recognize the importance of science, technology, Engineering and Mathematics to solve everyday problems. ● Integrate the scientific concepts in daily life to improve the quality of their own lives and lives of others. ● Undertake personal actions to care for the immediate environment and contribute to responsible group decisions.

CHAPTER 03

PROGRESSION GRID GRADE VI-VIII

CHAPTER 03

PROGRESSION GRID: GRADE VI-VIII

Grade VI	Grade VII	Grade VIII
Chapter 1 **Introducing Science** • Define science pertaining to daily life. • Investigate the impact of science on daily life • Develop scientific skills and attitude in study and practice of science. • Enlist basic physical quantities and their SI Units. • Measure physical quantities (time, volume, mass and length, temperature) using SI units. • Identify and recognize common apparatus used in science laboratory. • Choose different types of laboratory apparatus according to their use. • Identify and label the parts as well as functions of a simple microscope. • Predict some common laboratory hazard warning symbols. • Identify and observe the laboratory safety rules. • Construct safety rules to be observed in science laboratories. • Discuss the benefits, abuses and limitations of science and technology. • Applying scientific approach to make simple microscope using available resources.		

Chapter 2 **Cells, tissues, Organs and organ System** • Recognize cell as the basic unit of life. • Relate the structures of some common cells (nerve, muscle, epithelium and blood cells) to their functions. • Identify the structures present in an animal cell and plant cell as seen under a simple microscope. • Compare and contrast an animal cell and plant cell by preparing Slides using onion peels/cheek cells (temporary mount using single staining method). • Arrange and rank different levels of cellular organizations – cells to tissues, organs and organisms • Relate the function and location of human organs (lungs, stomach, brain, kidney, heart, eye, ear, tongue, nose, skin).	**Chapter 1** **Plant Systems** • Explain the root and shoot system in plants. • Label different parts of leaf, stem and root (external and internal structure). • Predict the role of xylem and phloem in transport of water and food in plants by observing the cross section of stem. • Define the process of photosynthesis and derive word equation for it. • Explain that the structure of leaves is adapted to the process of photosynthesis. • Describe process of respiration and write word equation for it. • Compare and contrast the processes of photosynthesis and respiration. • Investigate the phenomena of transpiration and its importance in a plant (wind, temperature, light, humidity affecting rate of transpiration in plants). • Exploring and applying natural raise of water based on the principle of transpiration.	**Chapter 1** **Inheritance and Cell Division** • Describe cell division and its types. • Identify the phases of mitosis and explain its significance. • Identify the phases of meiosis and explain its significance.(only introduction of 4-stages) • Differentiate between Mitosis and meiosis. • Predict heredity and recognize its importance in transferring of characteristics from parents to off springs. • Differentiate between genes, alleles and chromosomes. • Compare the terms diploid, haploid and homologous, non-homologous chromosomes. • Define terms phenotype, genotype, dominant, recessive, homozygous and heterozygous. • Predict results involving monohybrid inheritance using genetic diagram • Explain co-dominance and how sex is determined in humans. • Describe multiple alleles, using human ABO blood group inheritance as an example. • Relate variation and competition. • Speculate artificial selection in producing economically important animals and plants.

Chapter3 Food and digestion	Chapter2 Human Organ Systems	Chapter2 Biotechnology
• Identify the seven essential nutrients and recognize their importance in human body. • Identify the essential nutrients, their chemical composition and food sources. • Identify and describe essential nutrients' deficiency disorders. • Recognize that a healthy diet contains a balance of foodstuffs • Correlate diet and fitness. • Compare the structure and functions of different types of teeth • Justify the importance of tooth care • Investigate the causes and prevention of tooth decay and gum diseases. • State the importance of digestion in human body and describe physical and chemical digestion. • Sequence the main regions of alimentary canal, its associated organs and describe the functions of different parts of alimentary canal • Briefly describe role of enzymes in digestion • Conclude that blood transports the products of digestion to other parts of body and the undigested products get egested/defecated. • Briefly describe some major digestive disorders	• Illustrate the process of breathing. • Distinguish breathing from respiration. • Describe the process of respiration. • Identify the major organs of human respiratory system and their functions. • Describe the role of alveoli in gas exchange. • Differentiate between aerobic and anaerobic respiration. • Discuss the importance of respiration. • Recognize how smoking and drugs affect the respiratory system. • Describe circulatory system. • Describe the structure and function of human heart. • Label basic components of the circulatory system including heart and state role and importance of each component. • Differentiate between arteries, capillaries and veins. List the components of blood as red blood cells, white blood cells, platelets and plasma and state their function.	• Define Biotechnology • Describe composition and structure of DNA. • Simulate how DNA is made and copied. • Relate DNA, genes and chromosomes. • Describe how genes are introduced into bacterium. • Illustrate the application of genetic engineering in the production of human insulin. • Investigate some biotechnological products used in daily life. • Investigate the genetic modification in different foods can increase the amounts of essential nutrients. • List general applications of biotechnology in various fields. • Predict how biotechnology allows meeting the nutritional needs of growing populations. • Debate on various issues arising from genetic engineering. • Genetic engineering (DNA extraction and comparison).

Chapter4 **Growth and Development** • Justify reproduction as basis of the continuation of life. • Identify the different types of reproduction in plants. • Compare types of (sexual and asexual) reproduction in plants. • Distinguish between artificial and natural asexual reproduction in plants • Simulate natural and artificial propagation in agriculture (runners, tubers, bulbs, budding, grafting, cutting, and layering). • Appraise the stages of life cycles in frog and bird.	**Chapter3** **Healthy Life style** • Explore and state certain habits that are the part of the healthy life style. • Differentiate between types of immunity. • Recognize the role of human immune system against infections. • Explore the ways to improve the immune system. • Differentiate between infectious and non-infectious diseases • Describe causes and prevention of the following diseases; • Infectious diseases: 1. Hepatitis 2. Covid-19 3. Typhoid 4. Dengue • Non-infectious diseases: 1. Diabetes 2. Cardiovascular disease (Hyper tension and heart attack) • Identify the role of hand washing in disease prevention	
		Chapter 3 **Ecology** • Define ecosystem. • Distinguish between population and community. • Identify habitat and the abiotic factors effecting the habitat . • Describe the biotic environment (competition, predation, mutualism, commensalism

		symbiosis). • Explain how a pyramid of numbers describes the number of producers, herbivores and carnivores in a habitat. • Simulate different nutrients cycle in an ecosystem (carbon, nitrogen) • Explore carbon sinks are and outline the role of oceans and forests as carbon sinks • Explain Human impact on the environment (pollution, deforestation, Greenhouse effect, ozone depletion, global warming and acid rain). • Recognise that some human activities have long–term negative consequences on the ecosystem. (such as eucalyptus plantation, Chinese mulberry conocarpus) • Collaborate with different communities to discuss the effects of individual and collaborative efforts in improving the environment. • Elaborate the role of microorganisms in sewage treatment.
VI	**VII**	**VIII**
Chapter 5: **Elements and Compounds:** • Describe the structure of matter in terms of particles (i.e., atoms and molecules). • Describe an atom as an electrically neutral entity • Describe molecules as	**Chapter 4** **Structure of an Atom** • Describe and draw the structure of an atom in terms of electrons, protons and neutrons. • Differentiate between atomic number and mass number.	**Chapter 4** **Periodic Table** • Define Periodic table as a way of classifying the elements. • Recognize the

combination of atoms (e.g., H_2O, O_2 & CO_2). • Explain that compounds are formed by different types of elements joining together chemically forming a new substance. • Distinguish between elements and compounds. • Recognize the names and symbols for some common elements (first 18 elements of periodic table). • Categorize elements into metals and non-metals based on their physical properties. • Explore the common elements and compounds in our daily life.	• Determine the atomic number and mass number of elements on the basis of number of protons, electrons and neutrons. • Calculate the number of electrons in a given orbit using the $2n^2$ formula. • Draw atomic structures of elements in the periodic table. • Explain that Periodic Table is a way to organize elements in a systematic order. • Recognize periods and groups in the periodic table. • Define Valency and explain the formation of ions. • Make chemical formulae of compounds	arrangements of elements in periodic table in terms of periodicity. • Identify the names and location of elements in periods and groups. • Explain Periodicity of elements in periodic table. • Define atomic radius and reactivity of elements. • Relate reactivity of elements to their atomic sizes. • Identify properties of metals and non-metals.
	Chapter 5 **Chemical Bonds** • Discuss formation of ionic bond as a result of electrostatic forces between atoms (e. g, NaCl) • Discuss types and formation of covalent bond as a result of mutual sharing of electrons between atoms (e. g, H_2, O_2, N_2) • Name certain ionic and covalent compounds • Draw cross and dot structures showing formation of ionic compounds and covalent compounds	**Chapter 5** **Chemical Reactions** • Identify chemical reaction and give examples. • Define the law of conservation of mass and demonstrate the law with an experiment. • Write and balance chemical equations. • Distinguish between different types of reactions • Identify and practice single displacement reactions using the reactivity series • Distinguish between endothermic and exothermic reactions • Recognize the importance of exothermic and endothermic reactions in daily life.

Chapter 6 **Matter as Particles** • Explain the particle theory of matter. • Investigate the movement and arrangement of particles in three states of matter • Compare the physical properties of matter in different states • Describe an experiment that demonstrate Brownian motion • Explain the changes in states: melting, freezing, evaporation, condensation and sublimation using the particle model of matter • Describe and demonstrate the process of diffusion	**Chapter 6** **Physical and Chemical Changes** • Differentiate between physical and chemical changes while considering daily life examples • Distinguish between reversible and non-reversible chemical changes. • Recognize that oxygen is needed in combustion, rusting and tarnishing • Evaluate Impact of combustion reaction on environment • Explore methods of preventing rusting.	
Chapter 7 **Mixture:** • Differentiate between mixture and compound • Identify different types of mixtures • Describe alloys as mixtures of metals and some other elements. • Demonstrate that mixtures are formed when two or more substances mix with each other without the formation of a new substance. • Identify and explain examples of common mixtures from daily life. • Justify why air is considered as a mixture of gases. • Demonstrate ways of separating different mixtures. • Demonstrate the process of solution formation (using water as universal solvent).		**Chapter 6** **Acids, Alkalis and Salts** • Classify acid, base and salts and give example of each. • Identify the physical and chemical properties of acids, base and salts. • Define pH and its Ranges with reference to indicators • Interpret the pH scale and identify acids, base and salts. • Describe neutralization reaction with real life examples. • Observe and write the uses of acid, base and salts in daily life. .

	Chapter 7 **Heat & Temperature** • Define the terms heat and temperature on the basis of kinetic molecular theory. • Compare all three scales of temperature (including inter-conversion of temperature scales) • Construct the concept of heat conduction, convection and radiation by applying particle theory including daily life examples. • Predict the effects of heat gain and heat loss. • Identify the effects of thermal expansion and contraction with their applications in daily life. • State and explain the practical methods of thermal insulation used for constructing buildings.	
Chapter 8 **Energy** • Recognize energy as physical quantity. • Identify its different forms (Potential energy, kinetic energy, chemical energy, light energy, electrical energy, sound energy, and thermal energy) • State the law of conservation of energy and explain how the law applies to different situations • Recognise that energy can change its form when it is transferred from one object to another. .	**Chapter 8** **Wave & Types** • Define a wave • Compare the types of waves (mechanical and electromagnetic) with daily life examples • Distinguish between Longitudinal and transverse waves. • Identify; *1. water wave and Sound wave as mechanical wave* *2. Light wave as electromagnetic wave* • Define the terms;	

• Compare the Renewable Energy Sources *(wind, water, Sun and plants)*and Non-Renewable Sources of energy *(coal, natural gas, crude oil)* • Identify the advantages of using renewable energy resources.	wavelength, frequency and time period of wave. • Relate : 1. pitch and frequency 2. Amplitude and frequency • Explain the factors affecting pitch and loudness of sound. • Compare and interpret wave forms in terms of pitch and loudness • Construct the inverse relation between time period and frequency.	
Chapter 9 **Reflection of light** • Describe a ray of light. • Describe the difference between real and virtual images. • State the laws of reflection. • Describe and show how an image is formed by the plane mirror. • Describe the characteristics of image formed by plane mirror. • Describe different optical instruments using plane mirrors. • Make a periscope using plane mirror strips.	**Chapter 9** **Light** • Recognize the types of curved mirrors (concave and convex mirrors). • Describe and show how an image is formed by concave mirror. • Describe the characteristics of image formed by concave mirror. • Describe and show how an image is formed by convex mirror. • Describe the characteristics of image formed by convex mirror. • Describe different optical instruments using curved mirrors.	**Chapter 7** **Refraction of light** • Recognize that light is refracted at the boundary between air and any transparent material. • Analyse the values of refractive index of different materials • Distinguish between reflection and refraction of light with daily life examples. • Define lens. • Recognize the difference between convex lens • Analyse image formation by convex lens and concave lens • Analyse image formation by concave lens • Describe the application of refraction in daily life. • Utilize Lenses in daily life (Applications) • Describe and show the

		dispersion of light through a glass prism. • Give examples of dispersion from daily life.
	Chapter 10 **Force and Motion** • Formulate the relationship between speed, distance and time. • State SI unit of speed • Identify uniform and non-uniform motion • Describe the effect of force on changing the speed and direction of motion with time. • Define and state the SI unit of force • Give example of contact forces and non-contact forces • Demonstrate that forces always work in action and reaction pairs (equal in magnitude, opposite in direction.	**Chapter 8** **Effect of Force** • Recognise that several forces may act on an object which may or may not balance each other. • Examine the effect of an unbalanced force on an object. • Relate the utilization of pulleys and gears in daily life. • Differentiate between floating and sinking objects in terms of density • Define 'pressure' with examples • Relate pressure with force and area • Investigate effects related to pressure (e.g. water pressure increasing with depth, a balloon expanding when inflated etc.) • Differentiate between mass and weight • Examine the effect of force in the presence of air resistance.
Chapter 10 **Electricity** • Recognize electric current as a flow of charges. • Describe a simple circuit as a path for flow of charges. • Differentiate between open and close circuit. • Draw and interpret simple circuit diagram (using symbols). • Describe the characteristics	**Chapter 11** **Magnetism** • Relate properties of permanent magnets (i.e., two opposite poles, attraction/repulsion, and strength of the magnetic force varies with distance) to uses in everyday life (e.g., a directional compass). • Recognize that there is a space around a magnet	**Chapter 9** **Electricity** • Define voltage and state SI unit of voltage. • Define resistance and its SI unit • Formulate that resistance is the ratio of voltage to current. • Analyze current variation by introducing different resistance

of series and parallel circuits. • Draw and construct series and parallel circuit. • Identify the use of series and parallel electric circuits in daily life.	where effect of magnetic force can be observed • Draw magnetic field of a bar magnet using iron filings • Describe the properties that are unique to electromagnets (i.e., the strength varies with current, number of coils, and type of metal in the core; the magnetic attraction can be turned on and off; and the poles can switch) • Recognize that electric current has magnetic field around it using a magnetic compass. • Describe briefly the working principles of electromagnetic devices such as telephone, speaker, electric motor and electric generator	• Define electric power and state its unit • Recognize the electric power of various electric appliances. • Estimate the cost of using daily life electrical appliances (electricity bill) • Recognize the terms earth wire, fuse, circuit breaker • Analyze the danger of overloading and short circuit and identify the importance of earth wire, fuses and circuit breakers. • List precautionary measures to ensure the safe use of electricity.
Chapter 11 **Solar System** • Recognize the structure of Sun. • Differentiate between planets and dwarf planets. • Describe the characteristics of asteroids, meteorites and comets.	**Chapter 12** **Investigating Space** • Recognize that the force of gravity keeps planets and moons in their orbits. • Recognize that tides are caused by the gravitational pull of the Moon • Describe the effects of the Earth's annual revolution around the Sun, given the tilt of its axis (e.g., different seasons, different constellations visible at different times of the	**Chapter 10** **Investigating Space** • Explain the Big bang theory of the origin of the Universe. • Compare the types of galaxies. • Relate the life of a star with the formation of black hole, neutron star. Pulsar white dwarf, red giant • Show how information is collected from space by using telescopes (e.g. Hubble space telescope) and space probes (e.g., Galileo). • Describe advancements in space technology • Explore the contribution

	year).	of SUPARCO .
Chapter 12 **Technology** • Make a slow sand filter • Devise a way to propagate the cuttings hydroponically. • Explore the effectiveness of various cleaning solutions in cleaning tarnished and oxidized coins. • Make Rock Candy with sugar using crystal seeding technique. • Assemble and demonstrate of Solar panel to operate a small fan • Assemble and operate trip wire security alarm system using simple items.	**Chapter 13** **Technology** • Make a simple Stethoscope • Construct a working two-chamber microbial fuel cell • Make bio plastic from milk and vinegar. • Design a car that is powered solely by a chemical reaction and can travel 25 feet • Design and make a Solar water heater. • Make a Self-Running Energy Generator	**Chapter 11** **Technology** • Make a centrifuge using a salad spinner, adhesive putty, and rubber bands. • Make a Plant Tissue Culture Incubator. • Separate water into hydrogen and oxygen using electrolysis. • Make a solar powered desalinator • Make a hydraulic elevator. • Build a two-stage rocket

Chapter 04

Learning Contents and the Student's Learning Outcomes

Chapter 04

Learning Contents and the Student's Learning Outcomes

4.1. Grade – VI

Learning Contents and Students' Learning Outcomes

(Knowledge, Skills, Attitudes and STEAM)

Contents	Students' Learning Outcomes	Suggested activities	Suggested links / resources
Science around us • What is science? • Role of science in daily life • Scientific method • Basic practical skills (measurement and recording)	• Define science pertaining to daily life. • Investigate the impact of science on daily life. • Develop scientific skills and attitude in study and practice of science. • Enlist basic physical quantities and their SI Units. • Measure physical quantities (time, volume, mass and length, temperature) using SI units.	• Arrange a visit to the science lab, observe and enlist the common apparatus / equipment. • Record readings using different scales (weight, temperature and length). • Study and identify different parts of microscope with their uses.	https://www.reference.com/science/importance-science-everyday-life-ae2e09b890e8c82a https://www.youtube.com/watch?v=MEIXRLcC6RA https://www.acs.org/content/acs/en/chemical-safety/basics/glassware-and-equipment.html https://teacherworksheets.co.uk/sheets/laboratory-apparatus https://lessonworksheets.com/concept/laboratory-and-apparatus

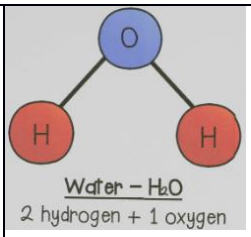
• Laboratory apparatus • Laboratory safety	• Identify and recognize common apparatus used in science laboratory. • Choose different types of laboratory apparatus according to their use. • Identify and label the parts as well as functions of a simple microscope. • Predict some common laboratory hazard warning symbols. • Identify and observe the laboratory safety rules. • Construct safety rules to be observed in science laboratories. • Discuss the benefits, abuses and limitations of science and technology	• Make a chart for lab safety rules • Make a chart showing lab warning symbols	
Technology content	• Applying scientific approach to make simple microscope using available resources.	• Make microscope from smart phone.	https://www.instructables.com/id/DIY-Microscope-Using-Smartphone/
Vocabulary: science, investigation, logical reasoning, problem solving, observation, hypothesis, test, experimentation, `control group, experimental group, variables, result, conclusion, theory, law, , physical quantities, length, mass, time, temperature, meter, kilogram, second, Kelvin, meter rod, physical balance, stopwatch, thermometer, microscope, stage, eyepiece, mirror, arm, slide, cover slip, gloves, hazardous, flammable, toxic, chemical, lab-coat, safety glasses, dangerous, radiation, fumes, fire extinguisher, test tube, tripod stand, beaker, wire gauze, spirit lamp, Bunsen burner, glass rod, dropper.			

Chapter 2 Cellular organization • Cell and the structure of a basic cell • Plant cell and animal cell • Tissues ,organs, organ systems	• Recognize cell as the basic unit of life.(Understand) • Relate the structures of some common cells (nerve, muscle, epithelium and blood cells) to their functions. • Identify the structures present in an animal cell and plant cell as seen under a simple microscope. • Compare and contrast an animal cell and plant cell by preparing Slides using onion peels/cheek cells (temporary mount using single staining method). • Arrange and rank different levels of cellular organizations – cells to tissues, organs and organisms. • Relate the function and location of human organs (lungs, stomach, brain, kidney, heart, eye, ear, tongue, nose, skin).	• Make a slide using onion peels/cheek cells. • Observe the variety of microscopic organisms found in pond water. • Make a 3D model of plant and animal cell  • Dissection of a chicken leg to observe a number of tissue types, including muscle and bone. • Make a chart enlisting the disorders of various parts of body and ways to keep them healthy.(Citizenship Goals / Values)	https://www.onlinemathlearning.com/animal-plant-cells.html http://www.cpalms.org/Public/PreviewResourceLesson/Preview/75372 http://www.discoveryeducation.com/teachers/free-lesson-plans/introduction-to-bacteria.cfm https://www.youtube.com/watch?v=ckZP3QYFTvY https://www.youtube.com/watch?v=Hbpe3FhsQp8 https://www.youtube.com/watch?v=8IlzKri08kk
Vocabulary: cytoplasm, cell membrane, cell wall, nucleus organelles, chromosomes, mitochondria, vacuole, ribosome, nucleus, chlorophyll, chloroplast, tissues, organs, organ system, organism, digestive system, circulatory system, excretory system nervous system, sense organs, respiratory system, respire, waste product			

Chapter 3 **Food and digestion** • Nutrients in food • Balanced Diet • Structure, type and different functions of teeth and tooth care • Digestion • Digestive system	• Identify the seven essential nutrients and recognize their importance in human body. • Identify the essential nutrients, their chemical composition and food sources. • Identify and describe essential nutrients' deficiency disorders. • Recognize that a healthy diet contains a balance of foodstuffs. • Correlate diet and fitness. • Compare the structure and functions of different types of teeth. • Justify the importance of tooth care. • Investigate the causes and prevention of tooth decay and gum diseases. • State the importance of digestion in human body and describe physical and chemical digestion. • Sequence the main regions of alimentary canal, its associated organs and describe the functions of different	• Make a chart enlisting the importance of mineral intake. • Make and maintain a fitness chart. (Citizenship Goals / Values) • Make a model of different types of teeth with plaster of Paris. • Plan a balanced diet for different age groups and for different situations. • Arrange a poster competition (within class) on "ways to take care of your teeth" • Perform a dental health activity with eggshells and soda showing how fizzy drinks affect teeth. • Make a very simple digestion model using one leg of a pair of	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5977042/ https://www.unicef.org/pakistan/nutrition-0 http://www.pnds.org/2016-newsletter/ https://www.sdpi.org/publications/files/Food%20Legislation%20Report-Pakistan.pdf www.nih.org.pk/Nutrition.asp http://www.scientificanimations.com/digestive-system-animation/(Animations) https://www.thoughtco.com/egg-in-soda-dental-health-activity-2086863 https://www.cartoonstock.com/directory/d/digestive_system.asp (concept cartoons) https://www.youtube.com/watch?v=TkzMN0BK0Bo https://www.youtube.com/watch?v=inEPlZZ_SfA https://www.youtube.com/watch?v=bFczvJp0bpU https://www.science-sparks.com/digestive-system-model/.

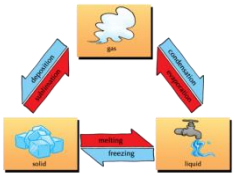
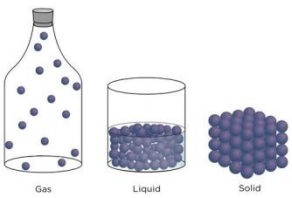
• Digestive disorders	parts of alimentary canal. • Briefly describe role of enzymes in digestion . • Conclude that blood transports the products of digestion to other parts of body and the undigested products get egested/defecated. • Briefly describe some major digestive disorders	tights as the small intestine. 	
Vocabulary: nutrients, proteins, carbohydrates, cellulose, starch, sugar, fat, vitamins, minerals, fibre, water, energy, balanced diet, food groups, malnutrition, dairy foods, decay, digestion, digestive system, alimentary canal,ingestion,mouth,mechanical digestion, chemical digestion, Calcium,rickets,Iodine deficiency.Goiter, Iron deficiency anemia,.Zinc ,Vitamin C.Scurvy.enzymes ,egestion, swallow, salivary glands, oesophagus, stomach, liver, gallbladder, pancreas, small intestine, large intestine, appendix, rectum, anus,absorption, large molecules, teeth, incisors, canines, premolars, molars, biting, tearing, rolling, mixing, crushing, grinding, crown, root, enamel, calcium, dentine, gum, pulp cavity, blood vessels, nerves, fibres, jawbone, bacteria, fluoride, peristalsis, anti-peristalsis, voluntary, involuntary muscles			
Chapter 4 Growth and development • Reproduction and growth • Vegetative propagation	• Justify reproduction as basis of the continuation of life. • Identify the different types of reproduction in plants. • Compare types of (sexual and asexual) reproduction in plants. • Distinguish between artificial and natural asexual reproduction in	• Create a kitchen garden to discover the different types of plant propagation (runner, tuber, bulbs, budding, grafting, cutting and layering)	https://www.youtube.com/watch?v=idCPXlNpwvY https://www.youtube.com/watch?v=O1S8WzwLPlM https://www.desktopclass.com/biology/artificial-vegetative-propagation-lesson-16-1-3.html https://lessonworksheets.com/concept/vegetative-propagation https://www.youtube.com/watch?v=F3ElGMVU6SY https://www.youtube.com/watch?v=O1S8WzwLPlM https://sciencetrends.com/life-cycle-frog-tadpole-

• Life Cycles of animals	plants. • Simulate natural and artificial propagation in agriculture (runners, tubers, bulbs, budding, grafting, cutting, and layering). • Appraise the stages of life cycles in frog and bird.	• Study stages of life cycle of frog or bird in lab • Make a frog life cycle from eatables. 	adult-frog/ https://www.twinkl.com/teaching-wiki/life-cycle-of-a-frog https://superstarworksheets.com/science-worksheets/life-cycle-of-a-frog-worksheets/ https://www.softschools.com/science/frog/ https://teachbesideme.com/edible-frog-life-cycle-snack/#:~:text=This%20first%20step%20for%20this,just%20did%20this%20to%20taste.
Vocabulary: growth, development, reproduction, sexual, asexual, artificial, propagation, natural, agriculture, runners, tubers, bulbs, budding, grafting, cutting, layering, lifecycle, metamorphosis, stages, adult, fertilization, tadpoles, gills, breathe, egg, chick, adult bird.			
Chapter 5: Elements and Compounds: • Atoms and Molecules • Elements and Compounds	• Describe the structure of matter in terms of particles (i.e., atoms and molecules). • Describe an atom as an electrically neutral entity. • Describe molecules as combination of atoms (e.g., H_2O, O_2 &CO_2). • Explain that compounds are formed by different types of elements joining together chemically forming a new substance • Distinguish between elements and	Activity-1: Molecule of water can be prepared by using the following material: 1. Wooden toothpicks 2. Play dough (different colour can be used to represent a specific element) 3. Make equal size small balls of play dough 4. According to the chemical formula of a compound given by the teacher make the model of that compound. (practice this with H_2O, O_2 and CO_2)	(Describe the difference between elements, compounds and mixtures) https://www.youtube.com/watch?v=wMP4QbrMPLE **Interactive (1,2,3,4,5:**(this link addresses many aspects of this chapter and seems to be suitable)https://1941.stem.org.uk/offharness/frameset.htm https://www.teachengineering.org/activities/view/uoh_sep_mixtures_activity1 https://phet.colorado.edu/sims/html/build-an-

• Some common Elements and their Symbols • Classification of Elements into metals, non-metals • Uses of some common Elements and compounds	compounds. • Recognize the names and symbols for some common elements (first 18 elements of periodic table). (Understand) • Categorize elements into metals and non-metals based on their physical properties. • Explore the common elements and compounds in our daily life.	 Following link is about "how to build an tom". It is an 'interactive activity' and students should play this game: https://phet.colorado.edu/en/simulation/build-an-atom Activity-2: Mechanical engineers focus on understanding the nature and properties of varying materials so that they can create product. They take advantage of the varying strengths and abilities of different materials to make composites with significantly different physical or chemical properties. Understanding the properties of a given material, element, component, or composite is a critical part of the engineering design process. 	atom/latest/build-an-atom_en.html https://www.youtube.com/watch?v=Zg6KeXsDVwY

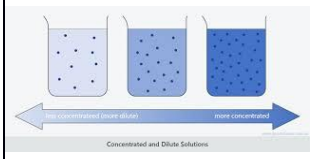
Vocabulary:

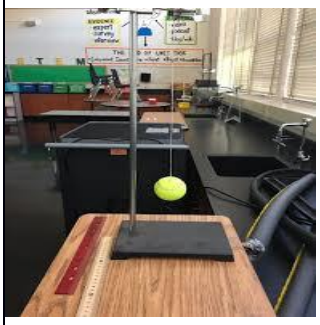
Atom, sub-atomic particle, electrons, nucleus, proton, neutron, atomic number, molecule, element, compound, , metals, non-metals, melting point, boiling point, good/poor conductors, ductile, malleable, chemical symbols, chemical formula, chemical bonding.

Chapter 6 **Matter as Particles** • Particle theory • Particles model for three states of matter • Physical properties of matter (volume, shape, density and compressibility) • Brownian motion • Diffusion	• Recognize that matter can exist in three physical states (solid, liquid and gas). • Differentiate three states of matter. • Identify the changes in physical states of matter (melting, freezing, evaporation, condensation and sublimation) using the particle model of matter. • Describe the Brownian motion of particles and how this explains the diffusion of gases.	 Activity: Heating ice cube and showing conversion of three states of matter 1. Learners observe an ice cube and discuss the arrangement of particles in it. 2. Then they melt it (this could be done even by keeping it in hands for a short while). Preferably, the ice cube should be kept in a china dish. The melting and the particles in this is discussed by the learners. 3. The china dish is heated. The water starts evaporating. These particles can be collected on an inverted spoon and shown to the learners (as a proof of evaporation) Here, the state of particles can be discussed.  	(Arrangement and movement of molecules in three states of matter) https://www.youtube.com/watch?v=v12xG80KcZw https://www.youtube.com/watch?v=MrTxRn9MNWM (This video shows us the different ways that particles behave in the solid, liquid and gaseous states) **Brownian Motion:** https://www.siyavula.com/read/science/grade-8/particle-model-of-matter/06-particle-model-of-matter?id=toc-id-4

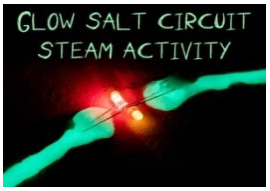
		• Demonstrate Brownian motion using ink and water. 	

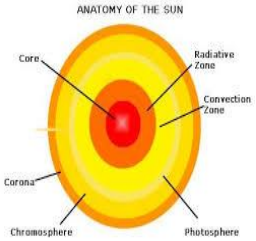
Vocabulary words:
volume, shape, density and compressibility, Particle theory, Particles model, Physical properties, Brownian motion , Diffusion ,states of matter, kinetic energy, collision, flow, intermolecular spaces, melting, freezing, evaporation, condensation and sublimation .

Chapter 7 **Mixtures:** • Mixture, and its uses • Air as a mixture of gases • Separating Mixtures (Filtration, Evaporation, Sublimation and Distillation, chromatography) • Solution and its types • Particle Model of Solution • Dilute and Concentrated Solutions • Solubility and Effects of	• Describe mixtures as two or more elements and or compounds that are not chemically combined. • Classify substances as elements, compounds and mixtures. • Identify common materials as mixtures. • Justify why air is considered as a mixture of gases. • Investigate different ways to separate mixtures. • Demonstrate the process of making a solution. • Distinguish between solute, solvent and solution. • Distinguish between a dilute and concentrated solution. • Explore the effect of	Activity: Formation of solution. Formation of dilute and concentrated solutions. Showing separating techniques Activity:  1. Take 250 ml water in a beaker 2. Add a few crystals of $CuSO_4$/ NaCl to the water in beaker. 3. Add a little more of $CuSO_4$ /NaCl to water. 4. Keep on adding $CuSO_4$ / NaClto water till the time comes when it becomes dark blue. Learners to compare the colour of water	https://www.howtosmile.org/resource/smile-000-000-001-297 https://www.youtube.com/watch?v=RJyW0A57XK0 https://www.youtube.com/watch?v=msSclkLW4Lk https://www.youtube.com/watch?v=XC1RxloV0Mo https://www.youtube.com/watch?v=ByJ6lzD2Vbg

Temperature on Solubility	temperature on solubility.	after all these additions. They link this with the solubility of $CuSO_4$ / NaCl dilute and concentration of the solution.	
Technology Connection: Sanitizer	Make a sanitizer.	Make a sanitizer using iso-propyl alcohol, glycerine and water	https://www.webmd.com/lung/how-to-make-hand-sanitizer
Vocabulary: compounds, mixtures, solution, alloys, dissolving, chromatography, solute, solvent, dilute,concentrated, saturated, unsaturated, super saturated, filtration, filtrate, soluble, insoluble, solubility, distillation, evaporation,residue,			
Chapter 8 **Energy** • Forms of energy	• Recognize energy as physical quantity. • Identify its different forms (Potential energy, kinetic energy, chemical energy, light energy, electrical energy, sound energy, and thermal energy).	• Make a pendulum in the classroom with a ball and thread to demonstrate conservation of energy to students. 	• https://www.youtube • https://www.youtube • https://www.youtube • https://www.youtube https://study.com/academ https://www.youtube.com
• Conservation of energy principle	• State the law of conservation of energy and explain how the law applies to different situations.	• Make a roller coaster and Investigate energy conversion in a roller coaster ride.	https://www.youtube.com
• Energy conversion	• Recognise that energy can change its form when it is transferred from one object to another.		• https://www.teach • https://study.com
• Renewable and non-renewable energy resources	• Compare the Renewable Energy Sources *(wind, water, Sun and plants)*and	• Make a pin wheel fan	

• Conservation of energy resources	Non-Renewable Sources of energy *(coal, natural gas, crude oil)* • Identify the advantages of using renewable energy resources.	and describe it as an example of renewable energy resource.  • Enlist how many energy resources are misused in our daily lives. (Citizenship Goals / Values)	
Technology connection	• Make a solar oven.	• Make a solar oven using card board and aluminium foil 	https://littlebinsforlittleha
Vocabulary: Energy, chemical stores of energy, fuel, energy supplies, joules, chemical energy, elastic energy, potential energy, m energy, kinetic energy, light energy, sound energy, friction, principle of conservation of energy, speed, fossil fuel, re			
Chapter 9 **Light** • Reflection • Laws of reflection	• Describe a ray of light. • Describe the difference between real and virtual images. • State the laws of reflection.	• Make a Light Patterns Box using card board and empty tin cans to observe reflections. 	• https://www.youtube.com/watch?v=skGmQC87Bvgandt=100s • https://www.youtube.com/watch?v=Xf_VZ8GxU1Yandt=29s • https://phet.colorado.edu/en/simulations/filter?sort=alphaandview=grid • https://yenka.com/ • https://www.youtu

• Image formation by plane mirror • Physical description of optical instrument (Plane mirrors only)	• Describe and show how an image is formed by the plane mirror. • Describe the characteristics of image formed by plane mirror. • Describe different optical instruments using plane mirrors.	• Observe the incident and reflected ray by using a plane mirror, torch and comb. 	be.com/watch?v=bjlYKvQo-kI https://www.youtube.com/watch?v=EZIWPXTHIUs
Technology connection	Make a periscope using plane mirror strips.	Make a periscope using plane mirror strips.	https://www.education.com/science-fair/article/physics_building-periscope/
Vocabulary: ray of light, light, white light, light source, straight line, luminous, non-luminous, eyes, Sun, transmit, transparent, opaque, translucent, shadow, image, bouncing, path of light, reflect, reflection, law of reflection, incident ray, reflected ray, normal, plane surface, plane mirror, concave mirror, convex mirror			
Chapter 10 **Electricity** Electric current • Electric circuit	• Recognize electric current as a flow of charges. • Describe a simple circuit as a path for flow of charges. • Differentiate	• Make a glow salt circuit using table salt, LED bulbs and battery. 	https://www.steampoweredfamily.com/activities/glow-salt-circuit-steam-activity-for-kids/?utm_medium=social&utm_source=pinterest&utm_campaign=tailwind_tribes&utm_content=tribes&utm_term=462940472_16142008_30223

• Types of electric circuit • Use of series and parallel electric circuits in daily life	between open and close circuit. • Draw and interpret simple circuit diagram (using symbols). • Describe the characteristics of series and parallel circuits. • Draw and construct series and parallel circuit • Identify the use of series and parallel electric circuits in daily life.	• Make a paper circuit card using LED, aluminium foil and battery.  • **Unplug Me Activity** Students will battle energy vampires by creating reminders to unplug appliances for their schools and homes. They can design original reminder cards and hang them around the room near energy vampires. (Citizenship Goals / Values)	https://www.sciencekiddo.com/paper-circuit-cards/
Vocabulary words: current, circuit, series circuit, parallel circuit			
Chapter 11 **Solar System** • Sun • Planets and Dwarf planets • Asteroids, Meteorite	• Recognize the structure of Sun. • Differentiate between planets and dwarf planets. • Describe the characteristics of asteroids,	• Use different colours of clay to design the structure of sun. 	• https://youtu.be/2HoTK_Gqi2Q • https://youtu.be/libKVRa01L8 • https://youtu.be/EFO_bsg1sw8 • https://youtu.be/n6dbT9StGCE

and Comets	meteorites and comets.	• Make a constellations projector using flash light and pin hole constellation cards  • Install and use astronomy apps such as sky map and identify the planets in the night . 	• https://youtu.be/OGiEkHZZrIs • https://www.greenkidcrafts.com/diy-constellation-projector/
Vocabulary words: sun,star,planets,dwarf planet, Asteroids, Meteorite , Comets			
Chapter 12 **Technology**			
• Slow Sand filter	• Make a slow sand filter alarm system	• Make a slow sand filter using gravel, sand and perforated pipes.	• https://www.youtube.com/watch?v=S55MvJYXXz4
• Vegetative propagation	• Devise a way to propagate the cuttings hydroponically.	• Grow plants (rose,mint or grapes) from cuttings in water	• https://www.youtube.com/watch?v=0oeyesNl0Zo
• Sugar Crystals	• Make Rock Candy with sugar.	• Make Rock Candy with sugar using crystal seeding technique.	• https://www.youtube.com/watch?v=HvKJz4M585c
• Cleaning solutions	• Explore the effectiveness of various	• Use common household items to make old oxidized	• https://www.gallykids.com/cleaning-coins-experiment

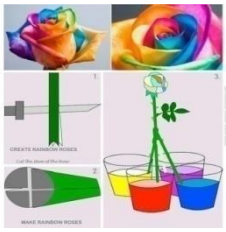
	cleaning solutions in cleaning tarnished and oxidized coins.	coins clean and shiny again	
• Solar Panel	• Assemble and demonstration of Solar panel to operate a small fan	• Assemble mini solar panel and operate a small fan.	• https://www.youtube.com/watch?v=34WrXWrXWnw
• Security alarm system	• Assemble and operate trip wire security	• Assemble and operate trip wire security alarm system.	• https://laughingsquid.com/how-to-make-a-simple-trip-wire-alarm-using-a-clothespin-a-led-light-buzzer-and-batteries/

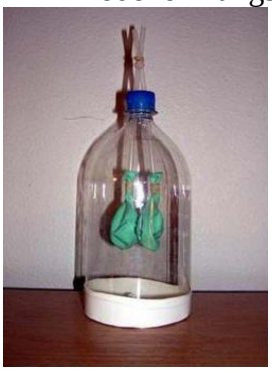
4.2 Grade – VII

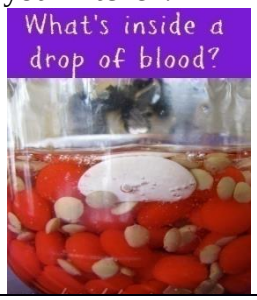
Learning Contents and Students' Learning Outcomes

(Knowledge, Skills, Attitudes and STEAM)

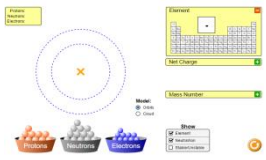
Contents	Students' Learning Outcomes	Suggested activities	Suggested links/resources
Chapter 1 **Plant Systems** • Root and shoot system • Structure of leaf ,stem and root	• Explain the root and shoot system in plants. • Label different parts of leaf, stem and root (external and internal structure).	• Observe slides of cross section of leave, root and stem. • Make and demonstrate Plant stem cross sectional model using different coloured straws 	• https://www.youtube.com/watch?v=JFb-CWlz7kE • https://www.youtube.com/watch?v=jtuX7H05tmQ&list=RDCMUCS3wWlfGUijnRIf745lRl2A&start_radio=1&t=11 • https://www.youtube.com/watch?v=Kv_0udatlh8 • https://www.youtube.com/watch?v=QXdujo4PZ7c • https://www.youtube.com/watch?v=CmBDVIUB19g • https://www.youtu

• Transport • Photosynthesis • Respiration • Transpiration	• Predict the role of xylem and phloem in transport of water and food in plants by observing the cross section of stem. • Define the process of photosynthesis and derive word equation for it. • Explain that the structure of leaves is adapted to the process of photosynthesis. •Describe process of respiration and write word equation for it. • Compare the processes of photosynthesis and respiration. •Investigate the phenomena of transpiration and its importance in a plant (wind, temperature, light, humidity affecting rate of transpiration in plants).	• make a rainbow flower using colored water  • Demonstrate photosynthetic floatation (oxygen produced during photosynthesis make leaves float)  • Observing respiration in plant using water in glass bowl  • Demonstration of capillary action and water transport in plants using filter paper.	be.com/watch?time_continue=44&v=KdIEiGwsgjY&feature=emb_logo • https://www.youtube.com/watch?v=pFaBpVoQD4E • https://www.youtube.com/watch?v=pwymX2LxnQs • https://quizizz.com/admin/quiz/5c744845915b66001b61c9d0/photosynthesis-7th-grade • https://quizizz.com/admin/quiz/5838708de6107cb673e7ad20/unit-7-grade-8 • https://www.youtube.com/watch?v=vuA21m0Z2HQ • https://www.youtube.com/watch?v=CEYr0hyxEzw https://www.youtube.com/watch?v=-wIs2KKvMg4 https://www.exploratorium.edu/snacks/photosynthetic-floatation https://aspb.org/wp-content/uploads/2016/05/5_PLANTS-RESPIRE-TOO-Respiration-and-energy.pdf https://gosciencegirls.com/respiration-in-plants/ https://www.science-sparks.com/transport-in-plants/

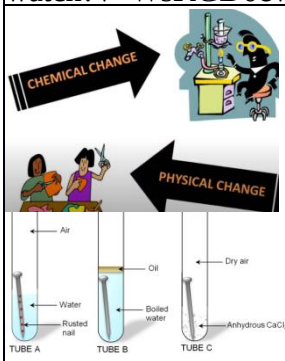
• **Technology connection**	•Exploring and applying natural raise of water based on the principle of transpiration	 • Make a natural water pump using available resources. (technology)	https://www.youtube.com/watch?v=q9pJX_J9QOE
Vocabulary: root, shoot, flower, leaf, photosynthesis, carbon dioxide, oxygen, chlorophyll, chloroplast, glucose, veins, transverse/ cross section, cuticle, epidermis, upper epidermis, lower epidermis, stomata, guard cells, palisade mesophyll, spongy mesophyll, root hairs, xylem vessels, transpiration, respiration, xylem, phloem,translocation vascular bundle			
Chapter 2 **Human Organ Systems** • Respiratory system	• Illustrate the process of breathing. • Distinguish breathing from respiration. • Describe the process of respiration. • Identify the major organs of human respiratory system and their functions. • Describe the role of alveoli in gas exchange. . • Differentiate between aerobic and anaerobic respiration. • Discuss the importance of respiration.	• Make a working Model of Lungs  • Count Pulse before exercise and after exercise. • Persuasive poster for raising awareness regarding harmful effect of smoking.	• https://www.visiblebody.com/learn/respiratory • https://www.youtube.com/watch?v=A8xGmKLm6RY • https://www.youtube.com/watch?v=a_D1UVP7eSY • https://www.youtube.com/watch?v=p4zOXOM6wgE • https://www.youtube.com/watch?v=mZvzl8KH6iI • https://www.youtube.com/watch?v=PlNEabFZ5Qk • https://quizlet.com/213950574/kahoot-questions-circulatory-system-flash-cards/ • https://www.bbc.co.uk/bitesize
• Smoking and health	• Recognize how smoking and drugs affect the respiratory system.		• https://www.youtube.com/watch?v=_qmNCJxpsr0&t=33s • https://www.youtube.com/watch?v=_8IaqzNh3D0

• Circulatory system • Blood	• Describe circulatory system. • Describe the structure and function of human heart. • Label basic components of the circulatory system including heart and state role and importance of each component. • Differentiate between arteries, capillaries and veins. • List the components of blood as red blood cells, white blood cells, platelets and plasma and state their function.	• Dissect an animal's heart. • Make a model showing the right ventricle "receiving" oxygen-poor blood from the right atrium through the tricuspid valve and pumping it to the body through the pulmonary valve.  • Make a microscopic model of blood with ingredients found in your kitchen. 	• https://www.kiwico.com/diy/Science-Projects-for-Kids/3/project/Pumping-Heart/2883 https://creeksidelearning.com/more-kitchen-science-whats-inside-a-drop-of-blood/
Vocabulary: , respiration, respiratory system, lungs, larynx/voice box, trachea/windpipe, bronchus (pl. bronchi), diaphragm, gas exchange, air sacs, alveoli, chemical reaction, glucose, aerobic respiration, anaerobic respiration, energy, drug, addictive, nicotine, cancer, carbon mono oxide, tar, passive smoker, blood, blood vessels, artery (pl. arteries), veins, capillaries (sing. capillary), pulse, heart, heartbeat, pump, circulatory system, circulation, oxygenated, deoxygenated, diffuse, , ventricle, atrium/atria, pulmonary artery, pulmonary vein, aorta, vena cava, valve, contract, relax, haemoglobin, oxyhaemoglobin, plasma, red blood cells, white blood cells, platelets, antibodies, elastic wall, closed circuit.			
Chapter 3 **Healthy lifestyle** • Diseases and its types	• Explore and state certain habits that are the part of the healthy	• Create sneeze zone area by laying a tape next to some pieces of paper (newspaper or old	https://www.yourgenome.org/sites/default/files/downloads/activities/sneeze-zone/sneezezone-instructions.pdf

	life style.	cardboard.	https://www.youtube.com/watch?v=fSEFXl2XQpc
• Immunity and its types	• Differentiate between types of immunity. • Recognize the role of human immune system against infections.		https://www.youtube.com/watch?v=24IYt5Z3eC4 https://www.youtube.com/watch?v=_Ypw3s0pNNU
• Preventive measures against diseases	• Explore the ways to improve the immune system. • Differentiate between infectious and non-infectious diseases . • Describe causes and prevention of the following diseases; • Infectious diseases: 5. Hepatitis 6. Covid-19 7. Typhoid 8. Dengue • Non-infectious diseases: 3. Diabetes 4. Cardiovascular disease (Hyper tension and heart attack) • Identify the role of hand washing in disease prevention. (Citizenship Goals / Values)	• Identify areas around the school where healthy habits are promoted or where more support for good health is needed. (Citizenship Goals / Values) • Investigate how memory cells in the immune system help the human body fight off illness  • Perform Black paint and glove hand wash activity.  • Create a Diet and nutrition app (Technology)	https://www.sciencebuddies.org/science-fair-projects/project-ideas/HumBio_p036/human-biology-health/immune-system-memory?from=Pinterest#procedure https://www.youtube.com/watch?v=A6olQabXWLs https://www.youtube.com/watch?v=A6olQabXWLs https://www.youtube.com/watch?v=xRmwUjW7Nwo https://www.youtube.com/watch?v=Ky-gNIlejwM https://www.youtube.com/watch?v=GIJK3dwCWCw https://www.youtube.com/watch?v=Cvu1ApHkhYM https://www.youtube.com/watch?v=aq-F4rNuj3Y https://www.youtube.com/watch?v=BtN-goy9VOY https://www.youtube.com/watch?v=8919Zm8Gi4U https://www.youtube.com

			/watch?v=ee75YGaVtX0 https://www.youtube.com/watch?v=5DGwOJXSxqg https://www.youtube.com/watch?v=RN81h85V6D4 https://www.youtube.com/watch?v=X_GEBGWIYYQ https://www.youtube.com/watch?v=Uvb-8bAfyQw
Human Health vocabulary: Immune system, active immunity, passive immunity, Innate immunity, acquired immunity, pathogen, viruses, bacteria, infectious disease, non-infectious disease, vaccine, immunisation, antiseptic, disinfect, antibiotics, antibodies, healthy food, probiotics,balanced diet, exercise, prevention, vaccination, cardiovascular diseases, diabetes, typhoid, Covid-19, hepatitis			
Chapter 4 **Atomic structure** (1-20 elements only) • Structure of Atom • Atomic Number and Mass Number • Distribution of Electrons in shells (K &L only) using $2n^2$ Formula • Valency and Ions	• Identify an atom as electrically neutral entity made up of neutrons, protons and electrons. • Draw the atomic structure of first 20 elements. • Differentiate between atomic number and mass number. • Determine the atomic number and mass number of elements. • Calculate the number of electrons in a given orbit using the $2n^2$ formula. • Recognize that an ion is formed when an atom gains or losses an electron.(.	Activity-2: Draw a general sketch of Periodic Table. Activity-1 Draw the atomic structure of your own choice by dragging the number of *protons*, neutrons and electrons. You keep on dragging the protons and neutrons into the nucleus and it automatically gives you the symbol of the element. 	https://www.youtube.com/watch?v=Zg6KeXsDVwY https://www.youtube.com/watch?v=lVSF2lP4oBA https://www.youtube.com/watch?v=2ugSvI-F__I https://www.youtube.com/watch?v=EIAaGHK5pjA https://phet.colorado.edu/sims/html/build-an-atom/latest/build-an-atom_en.html

• Chemical Formulae	• Write the chemical formula on the basis of valency.		
Vocabulary : Atom , Molecule, symbol, atomic number, mass number, electron , protons , neutrons, nucleus, orbit/shell, neutral, elements, periodic table, groups, periods, metals, non-metals, transition elements , valance shell , valence number,ions, cations, anions, compound , formulae ,			
Chapter 5 **Chemical Bonding** • Formation of Chemical Bond • Types of Chemical Bonds (Ionic Bonds, Covalent Bonds)	• Describe the ways in which chemical bonds are formed. • Demonstrate and explain the formation of an ionic bond as a result of electrostatic forces. • Draw electronic dot and cross structure of an ionic compound (for example NaCl) . • Discuss types and formation of covalent bond as a result of mutual sharing of electrons between atoms (e. g, H_2, O_2, N_2) . • List ionic and covalent compounds.	Activity: (note for the Author: 3D Models should show the usage of recycled material)	https://www.youtube.com/watch?v=bka20Q9TN6M https://www.youtube.com/watch?v=2vD-LuqTzLY https://www.youtube.com/watch?v=Qf07-8Jhhpc https://www.youtube.com/watch?v=h24UmH38_LI https://www.youtube.com/watch?v=zhqrZLpftH4 https://www.youtube.com/watch?v=LkAykOv1foc https://www.youtube.com/watch?v=VSc491HLzDo
Vocabulary : chemical bonds, ionic bonds, covalent bonds, electrostatic forces, single covalent bond, double covalent bond, triple covalent bond, mutual sharing .			
Chapter 6 **Physical and Chemical Changes**	• Identify physical	Activity: To identify physical and	• https://www.youtube.com/watch?v=s2ObEtQKePI

• Physical Changes • Chemical changes. • Reversible and Non-Reversible changes • Chemical reactions • Indications of chemical changes • Useful and undesirable chemical changes • Combustion and its impact	and chemical changes, and understand the difference between them. • Investigate chemical reaction as a process leading to newly formed products (rusting and burning). • Distinguish between reversible and irreversible changes. • Explore methods of Preventing rusting • Explain that burning requires oxygen. • Evaluate impact of combustion reaction on environment.	chemical changes. Hands-on activity to show reversible and non-reversible changes Conditions to show rusting of nail https://www.youtube.com/watch?v=WsKGD0evbAc  Activity: 1. Take three test tubes A, B and C and place one clean iron nail in each of them. 2. In the test tube A pour some water and close its mouth with the help of a cork. 3. In the test tube B pour boiled water which does not contain dissolved air. Also pour some oil in test tube B to form a layer over boiled water. The layer of oil will prevent the entry of air in water. 4. In the test tube C put some	• https://www.youtube.com/watch?v=x49BtB5dOwg • https://www.youtube.com/watch?v=KwQZOARVJRw https://www.youtube.com/watch?v=Lak04nkLxhY https://www.youtube.com/watch?v=jQoE_9x37mQ https://www.youtube.com/watch?v=zEjEqnMBdEM&vl=en https://www.youtube.com/watch?v=T4pSuflO9fk

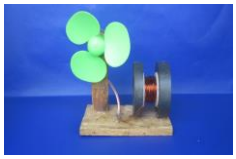
		anhydrous calcium chloride and cork it. Anhydrous calcium chloride is drying agent. So, it is added into test tube C to absorb all the moisture present in the air of test tube. Keep these test tubes undisturbed for some days. Record your observation and discuss this irreversible change (rusting).	
Technology :	**Making of writing ink from primary dyes**	Make writing ink from primary dyes.	https://www.thoughtco.com/easy-ink-recipes-3975972
Vocabulary : Physical change , chemical change, reversible , irreversible reaction, chemical reaction, reactant, products, , combustion ,burning, , rusting , , tarnishing , iron oxide, galvanizing,			
Chapter 7 **Heat and Temperature** • Heat • Temperature • Transfer of heat (conduction, convection and radiation)	• Define the terms heat and temperature on the basis of kinetic molecular theory. • Compare all three scales of temperature (including inter-conversion of temperature scales) . • Construct the concept of heat conduction, convection and radiation by applying particle theory including daily life examples.	• Make a simple thermometer using alcohol. 	• https://www.youtube.com/watch?v=g2v222rnEtY • https://www.sciencebuddies.org/stem-activities/homemade-thermometer?from=Blog#materials • https://www.sciencebuddies.org/stem-activities/solar-updraft-tower?from=Blog • https://www.youtube.com/watch?v=IqV5L66EP2E • https://www.youtub

• Thermal expansion • Good and bad emitters / absorbers of heat radiation. • Thermal insulation	• Predict the effects of heat gain and heat loss. • Identify the effects of thermal expansion and contraction with their applications in daily life. • State and explain the practical methods of thermal insulation used for constructing buildings		e.com/watch?v=O4Rxb-3jIqQ • https://www.youtube.com/watch?v=OnAA3Z-x4MQ • https://www.youtube.com/watch?v=Vx0yAS2u8gI
Technology Connection	• Build a Solar Updraft Tower	• Build a Solar Updraft Tower 	https://www.sciencebuddies.org/stem-activities/solar-updraft-tower#instructions http://almostunschoolers.blogspot.com/2015/04/simple-solar-thermal-projects-for-kids.html
Vocabulary: conduction, convection, convection current, radiation, expansion, contraction, thermal, insulator, conductor, temperature, heat gain, heat loss, poor absorber/ reflector, bi metallic strip ,infrared waves, radiator/ absorber, emitter			
Chapter 8 **Wave and Types**		• Use slinky (lose	

• Types of waves	• Define a wave • Compare the types of waves (mechanical and electromagnetic) with daily life examples • Distinguish between Longitudinal and transverse waves.	spring) to demonstrate the longitudinal and transverse waves. 	https://www.howtorunahomedaycare.com/articles/make-a-simple-drum-for-preschool-fun/
• Energy transformation through wave a) Water waves b) Sound waves c) Light waves	• Identify; *3. water wave and Sound wave as mechanical wave* *4. Light wave as electromagnetic wave*	• Make a phone with cup and thread to demonstrate the concept of sound waves 	http://www.discoveryeducation.com/teachers/free-lesson-plans/the-phenomenon-of-sound-waves.cfm http://scienceprojectideasforkids.com/2010/sound-pitch-loudness/
• Wavelength, frequency and time period	• Define the terms; wavelength, frequency and time period of wave. • Relate : 3. pitch and frequency 4. Amplitude and frequency • Explain the factors affecting pitch and loudness of sound. • Compare and interpret wave forms in terms of pitch and loudness • Construct the inverse relation between time period and frequency.	• Make a drum by using empty jars, plastic bags and rubber to demonstrate the concept of pitch, frequency, amplitude.  • Make drums of different sizes to explain the factors affecting pitch and loudness of sound.	http://www.bbc.co.uk/schools/gcsebitesize/science/aqa_pre_2011/radiation/anintroductiontowavesrev2.shtml http://gradestack.com/CBSE-Class-8th-Complete/Sound/Amplitude-Time-Period-/14794-2855-2731-study-wtw https://www.pbslearningmedia.org/resource/phy03.sci.phys.howmove.lp_sound/sound-vibrations/#.WRvcdDclHIV https://www.scholastic.com/teachers/articles/teaching-content/science-sound/ http://www.physicsclassroom.com/class/sound/Lesson-2/Pitch-and-

			Frequency
Vocabulary : wavelength, vibrate, vibration, hertz, Oscilloscope, amplitude, wave forms, vacuum, hertz, frequency, low frequency, high frequency, Medium, crests and troughs, mean/rest position ,displacement, , high pitch, low pitch, loudness, loud sound, soft sound			
Chapter-9 **Light** • Image formation by curved mirror(concave mirror and convex mirror) • Physical description of optical instrument (Curved Mirrors only)	• Recognize the types of curved mirrors (concave and convex mirrors). • Describe and show how an image is formed by a concave mirror. • Describe the characteristics of image formed by concave mirror. • Describe and show how an image is formed by a convex mirror. • Describe the characteristics of image formed by convex mirror. • Describe different optical instruments using curved mirrors.		
Vocabulary: curved mirrors, concave mirror, convex mirror, image formation optical instruments.			
Chapter 10 **Force and Motion** Position ,Speed and acceleration	• Formulate the relationship between speed,	Make a balloon car and give the concept of action	• https://www.youtube.com/watch?v=IJWEtCRWGvI • https://www.youtube.com/watch?v=7_Uo7RufH4c

	distance and time. • State SI unit of speed • Identify uniform and non-uniform motion • Describe the effect of force on changing the speed and direction of motion with time.	and reaction 	• https://www.youtube.com/watch?v=n2gQs1mcZHA • https://www.youtube.com/watch?v=n2gQs1mcZHA • https://www.youtube.com/watch?v=8Q1tw_QWy-8 • https://www.youtube.com/watch?v=L_TXu8ih668
Force and its units	• Define and state the SI unit of force		
Contact forces and non-contact forces	• Give example of contact forces and non-contact forces		
Action and reaction	• Demonstrate that forces always work in action and reaction pairs (equal in magnitude, opposite in direction.		
• **Vocabulary:** force, push, pull, stretch, turn, force arrow, interact, balance, direction, magnitude, upward, downward, attract, repel, force meter, newton meter, Newton (N), weight, gravity, mass, matter, contact force, non-contact force, gravitational force, friction, air resistance, balanced forces, unbalanced forces, streamline, SI (System International)density, volume, pressure, area, force, atmospheric pressure			
Chapter11 **Magnetism** Permanent Magnets	• Relate the strength of the magnetic field of a permanent magnet with distance. • Recognize that there is a space around a magnet where effect	• Spin the fidget spinner using two bar magnets (understand the concept of opposite	https://www.youtube.com/watch?v=BSdS-DfOWbNs

Electromagnets Electromagnetic Devices	of magnetic force can be observed • Draw magnetic field of a bar magnet using iron filings • Describe the properties that are unique to electromagnets (i.e., the strength varies with current, number of coils, and type of metal in the core; the magnetic attraction can be turned on and off; and the poles can switch) • Recognize that electric current has magnetic field around it using a magnetic compass. • Describe briefly the working principles of electromagnetic devices such as telephone, speaker, electric motor and electric generator	poles of magnet)  • Draw magnetic field of a straight current carrying conductor using iron filings • Make a fan with help of magnet, dry cell and conductor  • Make a coil that rotates when is attached with dry cell.	https://www.youtube.com/watch?v=2L0ZHxcoWhM https://www.youtube.com/watch?v=2L0ZHxcoWhM
Technology Connection	Make a simple motor by using wire, dry cell and magnet.	Make a simple motor by using wire, dry cell and magnet.	https://www.instructables.com/Easy-DIY-Homopolar-Motor/
Vocabulary words: Permanent Magnet,poles,magnetic force,compass,attraction,repulsion,bar magnet,magnetic field,iron fillings,electro magnet,current, coil,electromagnetic devices,telephone, speaker, electric motor and electric generator			
Chapter12 Investigating Space Force of gravity in solar system Gravitational pull of	Recognize that the force of gravity keeps planets and moons in their orbits. Recognize that tides are caused by the gravitational	Demonstrate the concept of gravity using paperclips and magnets. 	https://www.youtube.com/watch?v=MTY1Kje0yLg https://buggyandbuddy.com/gravity/

Moon Earth's annual revolution	pull of the Moon Describe the effects of the Earth's annual revolution around the Sun, given the tilt of its axis (e.g., different seasons, different constellations visible at different times of the year).	Demonstrate the gravitational fields of planets on a flexible surface using marbles and play dough.	http://einstein.stanford.edu/Media/Einsteins_Universe_Anima-Flash.html https://www.lpi.usra.edu/education/explore/solar_system/activities/bigKid/planetPull/ https://spaceplace.nasa.gov/what-is-gravity/en/
Vocabulary: gravity,planets,moon,orbits,tide,gravitational pull, annual revolution of earth, tilt ,axis of earth,seasons,constellations			
Chapter 13 **Technology**			
• Stethoscope	• Make a simple Stethoscope	• Make a simple Stethoscope using balloon funnel and plastic tubing.	https://www.sciencebuddies.org/science-fair-projects/project-ideas/HumBio_p033/human-biology-health/make-your-own-stethoscope#procedure
• Microbial Fuel Cell	• Construct a working two-chamber microbial fuel cell	• Construct a working two-chamber microbial fuel cell.	https://www.instructables.com/id/DIY-Microbial-Fuel-Cell-easy/
• Bioplastics	• Make bio plastic from milk and vinegar.	• Make bio plastic from milk and vinegar.	https://www.steampoweredfamily.com/activities/make-plastic-from-milk/
• Gas Production (plastic bottle chemistry)	• Design a car that is powered solely by a chemical reaction and can travel 25 feet	• Design a car that is powered solely by a chemical reaction of acetic acid to sodium bicarbonate that can travel 25 feet.	• https://engineering.oregonstate.edu/momentum/k12/march04/index.html
• Solar water heater.	• Design and make a Solar water heater.	• Design and make a Solar water heater.	https://www.instructables.com/Kids-Solar-Water-Heater/

• Energy Generator	• Make a Self-Running Energy Generator	• Make a Self-Running Energy Generator by using Magnet With Light Bulb 220V.	https://www.youtube.com/watch?v=dVE6ofG9d9c

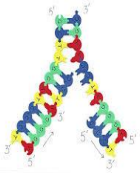
4.3 Grade – VIII

Learning Contents and Students' Learning Outcomes

(Knowledge, Skills, Attitudes and STEM)

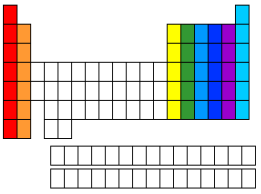
Contents	Students' Learning Outcomes	Suggested Activities	Suggested links / resources
Chapter 1 **Inheritance and Cell Division** • Cell division • Heredity	• Describe cell division and its types. • Identify the phases of mitosis and explain its significance. • Identify the phases of meiosis and explain its significance.(only introduction of 4-stages). • Differentiate between Mitosis and meiosis. • Predict heredity and recognize its importance in transferring of characteristics from	• Set up the Engineering Cell Division Lab  • Make a slide of cell division in onion • Make a giant cell- Human cell division model • Observe what traits you share with other members of your family.	**video-real cell division footage** **video-cell division and cell cycle** **Identifying stages of mitosis under a microscope and on a micrograph** **observing cell division in onion** **Cell Cycle/Mitosis Manipulatives Group Activity and Worksheet** **interactive simulation stages of mitosis**

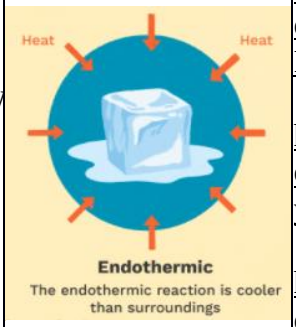
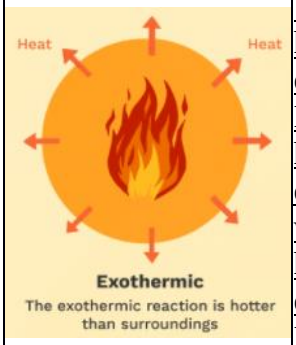
	parents to off springs. • Differentiate between genes, alleles and chromosomes. • Compare the terms diploid, haploid and homologous, non-homologous chromosomes. • Define terms phenotype,genotype, dominant, recessive, homozygous and heterozygous.		**https://padlet.com/dashboard**
• Variation and Inheritance	• Predict results involving monohybrid inheritance using genetic diagram • Explain co-dominance and how sex is determined in humans • Describe multiple alleles, using human ABO blood group inheritance as an example. • Relate variation and competition. • Speculate artificial selection in producing economically important animals and plants.		
Vocabulary: cell division,chromatin, chromosome, daughter cell, deoxyribonucleic acid, diploid, eukaryotic, eukaryote, centromere, prokaryote, gamete, meiosis, DNA, haploid, daughter cell, centromere, hereditary traits, geneticists, monohybrid inheritance, progeny, first filial generation, cross pollination, hybrid, dominant, recessive, segregate, law of segregation, gene locus, homologous			

chromosome, homozygous, heterozygous, homozygous dominant, homozygous recessive, breeding, test cross, co-dominance, genotype, phenotype, autosomes, multiple allele, replication, albinism, sickle cell anemia, Down's syndrome, natural selection, evolution, artificial selection, inbreeding,			
Chapter 2 **Biotechnology** • Biotechnology • DNA Replication • Introduction of Gene into Bacterium • Genetic Modifications (Microorganism Resistance improved Nutrition and quality of food) • Biotechnology Product saving lives (Insulin, Vaccines) • General applications (Agriculture, Environment, Health, food production and preservation)	• Define Biotechnology. • Describe composition and structure of DNA. • Simulate how DNA is made and copied. • Relate DNA, genes and chromosomes. • Describe how genes are introduced into bacterium. • Illustrate the application of genetic engineering in the production of human insulin. • Investigate some biotechnological products used in daily life • Investigate the genetic modification in different foods can increase the amounts of essential nutrients. • List general applications of biotechnology in various fields.	• Extract DNA using detergent and salt. • Design an experiment to find the temperature at which yeast works best to ferment Sugar. • Make Yogurt at home • Design and carry out an experiment to see if yeast is present on the surface of fruit. • Make a model of DNA replication  • Make a report which includes cloning techniques and any possible risks involved. Suggest bio safety to reduce such risks • Make a list of any five medicines which are being produced using	https://www.biologyjunction.com/extracting_dna.htm http://www.math.unl.edu/~jump/Center1/Labs/What%20Affects%20Yeast%20Growth.pdf https://www.wikihow.com/Make-Yogurt

Technology content	• Predict how biotechnology allows meeting the nutritional needs of growing populations. • Debate on various issues arising from genetic engineering • Genetic engineering (DNA extraction and comparison).	biotechnology. • Extract and compare DNA of strawberry and banana.	http://www.pbs.org/wgbh/nova/teachers/activities/pdf/3214_01_nsn_01.pdf
Vocabulary: Biotechnology, Replication, bacterium, vector, genes, vaccines, genetic modification, microorganism manipulation, antibiotic, genetic testing, gene therapy, cloning, insulin, diabetes, interferon, DNA, genome, gene transfer, fermentation, interferon, nucleotides, donor, recipient, plasmid,			
Chapter 3 **Ecology** • Ecosystem • Interaction among living things (Population and community) • Interaction of living with non-living • Energy flow in ecosystem	• Define ecosystem. • Distinguish between population and community. • Identify habitat and the abiotic factors effecting the habitat. • Describe the biotic environment (competition, predation, mutualism, commensalism symbiosis). • Explain how a pyramid of numbers describes the number of producers, herbivores and carnivores in a habitat.	• Construct a food web for a habitat in your country • Observe different habitats and write a report on the interdependence of different populations of flora and fauna. • Compare two habitats for their differences and similarities. • Research on the causes of global warming and how it affects humans. Finding out some of the steps we can take to reduce the emission of gases which cause global warming. (Citizenship Goals / Values) • Visit natural habitats to see the	biodiversity Human impact on the environment Negative impact of human activities corona virus link to destruction of wild life and ecosystem graph-human population growth-Pakistan Mangroves- custodian of the coast

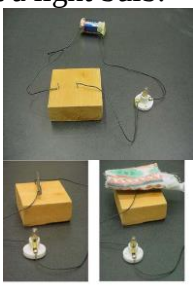
• Human impact on the environment • Environmental conservation (cycles of matter)	• Simulate different nutrients cycle in an ecosystem (carbon, nitrogen) . • Explore carbon sinks are and outline the role of oceans and forests as carbon sinks. • Explain Human impact on the environment (pollution, deforestation, Greenhouse effect, ozone depletion, global warming and acid rain). • Elaborate the role of microorganisms in sewage treatment. • Recognise that some human activities have long–term negative consequences on the ecosystem. (such as eucalyptus plantation, Chinese mulberry conocarpus)	impact of human activities on the environment. • Outline the role of microorganisms in sewage treatment • Activity on How does acid rain effect bean seedling • Design an experiment to discover the best conditions needed for the decay of plant material in a compost heap • construct a food chain from pyramid of numbers • Visit to wild life park/lakes to see the impact of human activities on the environment. • Enlist human activities have long–term negative consequences on the ecosystem. (such as eucalyptus plantation, Chinese mulberry conocarpus) *(Citizenship Goals / Values)*	
Technology content	• Identify rain harvesting as tool for water conservation by developing a rain water catcher.	• Make a rain water catcher(technology)	https://www.youtube.com/watch?v=xCPHMTXvYOs

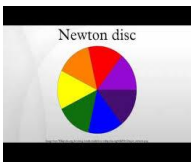
Vocabulary: flora, fauna, ecology, organism, habitat, environment, community, biodiversity, population, community, environment, biotic environment, abiotic environment, factors, physical factors, air, water, minerals, light, temperature, pH, producer, prey, predator, shedding leaves, hibernating, nocturnal, migration, aestivation, acidity/alkalinity, competition, compete, herbivore, carnivore, omnivore, scavenger, camouflage, mimicry, symbiosis, mutualism, lichen, parasitism, ecosystem, pollution, pollutants, haze, acid rain, carbon dioxide, greenhouse effect, greenhouse gas, global warming, climate change, habitat, extinct, water pollution, untreated wastewater, litter, fertilisers, land pollution, over-hunting, exploitation, over-exploitation, deforestation, soil erosion, conserving, conservation, 3Rs, reduce, reuse, recycle, environmental friendly, harness, renewable energy, reforestation, sustainable development			
Chapter 4 **Periodic table** • The Periodic Table • Arrangement of elements in periodic table. • Periods and groups and their names • Trends in groups and periods • Prediction of elements	• Define Periodic table as a way of classifying the elements. • Recognize the arrangements of elements in periodic table in terms of periodicity. • Identify the names and location of elements in periods and groups. • Explain Periodicity of elements in periodic table. • Define atomic radius and reactivity of elements. • Relate reactivity of elements to their atomic sizes. • Identify properties of metals	**Scavenger hunt activity**  Identify and place elements in the periodic table template based on the clues provided.	

as metals and non-metals based on their properties	and non-metals.		
Vocabulary : Periodic table,periodicity,groups,periods,halogens,alkali metals, alkaline earth metals,noble gases,transition elements, metals ,non metals,atomic radius,atomic reactivity.			
Chapter 5 **Chemical Reactions** • Chemical Reactions. • Chemical Equations and Balancing • Law of Conservation of Mass • Types of Chemical Reactions (Synthesis, Decomposition, neutralization and Displacement reaction) • Reactivity series • Energy Changes in Chemical Reactions (Exothermic and Endothermic)	• Identify chemical reactions and give examples. • Write a chemical equation and balance it. . • State the law of conservation of mass and demonstrate the law with an experiment. • Differentiate between types of reactions. • Identify and demonstrate the single displacement reactions using the reactivity series. • Distinguish between endothermic and exothermic reactions • Recognize the importance of exothermic and endothermic reactions in daily life.	Activity: 1. Adding CaO in water (this is an example of exothermic reaction) 2.melting ice cubes (is an example of endothermic reaction)  	https://www.youtube.com/watch?v=WWJQpuv9ElE https://www.youtube.com/watch?v=M96tUDiZ5DQ https://www.youtube.com/watch?v=92XUa76AZ6c https://www.youtube.com/watch?v=i2x4foEuRcI https://www.youtube.com/watch?v=4jISjQvdyhs https://www.youtube.com/watch?v=JrUhHybVJdA https://www.youtube.com/watch?v=2S6e11NBwiw https://www.youtube.com/watch?v=MhlWTZwDHM8 https://www.youtube.com/watch?v=1ocQhkHw_MM https://www.youtube.com/watch?v=eJXL0IrbtqE

Technology connection	Electroplate your coins with copper.	Use house hold materials to electroplate your coins with copper.	
Vocabulary : Chemical reactions, synthesis /combination reaction, decomposition reaction , single displacement or replacement reaction, , neutralization reaction , neutral compound , chemical equation , reactants , products , balanced equation , conservation of mass , exothermic reaction, endothermic reaction.			
Chapter 6 **Acids, Bases and Salts** • Introduction to Acids, Bases and Salts • Properties of Acids, Bases and Salts • pH and its Ranges with reference to indicators • pH scale • Neutralization • Uses of Acids, Bases and Salts	• Classify acid, base and salts and give example of each. • Identify the physical and chemical properties of acids, base and salts. • Define pH and its Ranges with reference to indicators • Interpret the pH scale and identify acids, base and salts. • Describe neutralization reaction with real life examples. • Observe and write the uses of acid, base and salts in daily life. .	Activity: 1. Using pH paper to find out the pH value of different material and matching it with the pH scale. 2.Titration to demonstrate neutralization. 3.Dissolving the egg shell by putting it into vinegar Activity: This activity uses turmeric, a common spice in curry, as an indicator for acidity and basicity. Turmeric is yellow in acid and neutral substances, but turns bright red with bases. Learners can use their indicator to test household chemicals and determine which are basic. (This activity requires adult supervision since it uses isopropyl alcohol, also known as rubbing alcohol). Material: 1. Take ¼ teaspoon turmeric powder	https://www.youtube.com/watch?v=i2x4foEuRcI&vl=enhttps://www.youtube.com/watch?v=jGOKug-dA0g https://www.youtube.com/watch?v=obUrWoTNFag https://www.youtube.com/watch?v=RnyB2qbQtHk https://www.youtube.com/watch?v=WnAKhtnJjz0 https://www.youtube.com/watch?v=B3A-UzEN7lwhttps://www.youtube.com/watch?v=zvLDD0MeusIhttps://www.youtube.com/watch?v=zvLDD0MeusI https://www.youtube.com/watch?v=zYGnq7-_L9w https://www.youtube.com/watch?v=4Zq13W-0lU4 https://www.youtube.com/watch?v=dpjWqLDq2FQ https://www.youtube.com/watch?v=RmnT9jwX4gQ https://www.youtube.com/watch?v=-

		2. Take ¼ cup of isopropyl alcohol (rubbing alcohol) 3. One small jar with a tight-fitting lid 4. One dropper 5. Five small bowls or cups with household Chemicals to test (soap, vinegar, ba king soda, etc.)	1nJv0k8zQU https://www.youtube.com/watch?v=XD5GZYjtGek https://www.youtube.com/watch?v=zOcduvKFh3U https://www.youtube.com/watch?v=ckbsHM2igT0
Technology connection	Making of pickle and preserving / preserving juices .	Make pickle and preserve juices.	
Vocabulary: Acids, alkalis, , pH value, pH scale, Neutral, neutralization , corrosive , titration , indicators , litmus paper, phenolphthalein, Acidic , alkaline			
Chapter 7 **Effect of Force** • Simple machines (pulleys, gears) • Buoyancy • Pressure	• Recognise that several forces may act on an object which may or may not balance each other. • Examine the effect of an unbalanced force on an object. • Relate the utilization of pulleys and gears in daily life. • Differentiate between floating and sinking objects in terms of density • Define 'pressure' with examples • Relate pressure with force and area • Investigate effects related to pressure (e.g.	• Make a Pulley. • Make a candy gear  • Explore the relationship among force, area, and pressure by using a large rectangular wooden block, coins or washers, and a small container of sand or flour to model different pressures by changing just one variable (for example, laying a block in the sand on	https://sciencing.com/make-pulley-children-5896241.html https://www.sciencebuddies.org/stem-activities/candy-gears#summary https://www.youtube.com/watch?v=xUCYFof8QyA https://www.youtube.com/watch?v=GXwg1imZr10 https://www.youtube.com/watch?v=aazuuZdrpUo https://www.bbc.co.uk/bitesize/guides/z2wy6yc/revision/3

• Air resistance	water pressure increasing with depth, a balloon expanding when inflated etc.) • Differentiate between mass and weight • Examine the effect of force in the presence of air resistance.	its smallest side will create a slightly deeper impression than laying it on one of its larger sides).	
VOCABULARY: speed, distance, time, average speed, speed check, Light Gates, speed camera, metre, kilometre, second, hour, minute, constant speed, changing speed, distance time graph, instantaneous speed			
Chapter 8 **Electricity** • Potential difference • Resistance • Electric power • Household electrical appliances • Potential hazards in using electricity	• Define voltage and state SI unit of voltage. • Define resistance and its SI unit • Formulate that resistance is the ratio of voltage to current. • Analyse current variation by introducing different resistance • Define electric power and state its unit. • Recognize the electric power of various electric appliances. • Estimate the cost of using daily life electrical appliances (electricity bill) • Recognize the terms earth wire, fuse, circuit breaker	• Make a flashlight using two plastic bottles, ice cream sticks, one LED, wires, glue and two batteries.  • Construct a simple switch and determine what objects and what types of materials can be used to close a switch in a circuit and light a light bulb. 	https://www.youtube.com/watch?v=FBu0Vy4cuN4 https://www.youtube.com/watch?v=CIv6vu9d73c https://www.youtube.com/watch?v=oB1v-wh7EGU https://www.youtube.com/watch?v=nzmoGca5rXc https://www.youtube.com/watch?v=BLIYsRwKrkE https://www.youtube.com/watch?v=PafSqL1riS4 https://www.teachengineering.org/activities/view/cub_electricity_lesson04_activity2 https://www.stem.org.uk/sites/default/files/pages/downloads/BEST_PMA_Big%20idea%20notes_Electricity%20and%20mag

• Safety precautions	• Analyze the danger of overloading and short circuit and identify the importance of earth wire, fuses and circuit breakers. • List precautionary measures to ensure the safe use of electricity. (Citizenship Goals /Values)		netism.pdf https://www.youtube.com/watch?v=fUpcV4NnnuE https://www.youtube.com/watch?v=HsgiZCAwyh8 https://www.youtube.com/watch?v=BHksDnZFvo https://www.youtube.com/watch?v=ExM_pvn4ek4 https://www.youtube.com/watch?v=xVeKAHWge3I
Vocabulary: static electricity, attraction, repulsion, electric charge, coulomb-meter, positive electric charge, negative electric charge, neutral, friction, conductors, insulators, circuit, circuit symbols, circuit diagrams, closed and open circuit, electric current, ammeter, ampere (symbol A) series circuit, parallel circuit, voltage, resistance, volts, voltmeter, resistor, variable resistor, positive, negative terminals			
Chapter 9 **Refraction of light** •Refraction •Effects of refraction in daily life e.g. apparent depth, Mirage etc. •Laws of refraction (Theoretical sketch only) •Refractive index •Physical description of optical instrument (Lenses only)	•Recognize that light is refracted at the boundary between air and any transparent material. •Analyse the values of refractive index of different materials. •Distinguish between reflection and refraction of light with daily life examples. •Define lens. •Recognize the difference between convex lens	Place a jar or glass about 6 inches in front of the page with colour bars or arrows and observe Refraction.  • Create Newton's disc.  • Make a magnifying glass using plastic	https://www.youtube.com/watch?v=SeaWCamCHWQ https://www.youtube.com/watch?v=SeaWCamCHWQ https://www.youtube.com/watch?v=4H6bOMeeFmY https://www.youtube.com/watch?v=cf_aUBbyuts https://www.youtube.com/watch?v=nQFhWfmKjms https://www.wikihow.com/Make-a-Newton-

• Image formed by convex lens • Image formed by concave lens • Dispersion	• Analyse image formation by convex lens and concave lens • Analyse image formation by concave lens • Describe the application of refraction in daily life. • Utilize Lenses in daily life . • Describe and show the dispersion of light through a glass prism. • Give examples of dispersion from daily life.	bottle and water. 	Disc https://www.science-sparks.com/make-your-own-magnifying-glass/
Vocabulary: non-luminous, spectrum, refraction, reflection, transparent, translucent, opaque, reflected, transmitted, absorbed, Newton's disc, medium, media, sunlight, upright, laterally inverted, retina, cornea, mirror image, rare-view mirror, kaleidoscope, eyepiece, telescope, microscope, periscope, optical instruments, naked eye, diminished, magnified, refraction, refracted ray, emergent ray, object, image, dispersion, rainbow spectrum, component colours, coloured filters, primary colours, secondary colours, prism			
Chapter 10 **Astronomy** • Big bang theory • Galaxies • The life of stars (Birth and Death) • Black hole • Information from space (Telescopes, Space probes)	• Describe the Big bang theory of the origin of the Universe. • Compare the types of galaxies. • Relate the life of a star with the formation of black hole, neutron star. Pulsar white dwarf, red giant • Show how information is collected from space by using telescopes (e.g. Hubble space telescope) and space probes (e.g., Galileo). • Describe advancements in space technology • Explore the contribution of SUPARCO	• Take virtual tours at nasa.gov • Explore spacex and its mission to mars  • Create a story about the life cycle of a star using the image  "Star-forming region" by ESO	• https://youtu.be/wNDGgL73ihY • https://youtu.be/4xIQGbYur9Q • https://youtu.be/LS-VPyLaJFM • https://youtu.be/PM9CQDlQI0A • https://youtu.be/dzBhB1h9B8I • https://www.spacetelescope.org/science/ • https://www.nationalgeographic.org/media/space-probes/
Vocabulary: Black hole, pulsar, white dwarf, red giant, planetary nebulae, stellar nebula, galaxy, Milky way, Andromeda, neutron star, SUPARCO			
Chapter 11 **Technology**	Make a centrifuge using a	• Make a centrifuge	https://www.sciencebu

Centrifuge	salad spinner, adhesive putty, and rubber bands.	using a salad spinner, adhesive putty, and rubber bands.	ddies.org/science-fair-projects/project-ideas/BioChem_p041/biotechnology-techniques/snow-globe-science-with-a-centrifuge#procedure
Plant Tissue Culture Incubator	Make a Plant Tissue Culture Incubator.	• Make a Plant Tissue Culture Incubator using a 30 Watt LED worklight and insulator box.	https://www.instructables.com/id/DIY-Plant-Tissue-Culture-Incubator/
Electrolysis .	Separate water into hydrogen and oxygen	• Separate water into hydrogen and oxygen using electrolysis	http://www.navigatingbyjoy.com/2014/09/18/chemistry-kids-separate-water-hydrogen-oxygen-using-electrolysis/
Solar-Powered Water Desalination	Make a solar powered desalinator.	• Make a solar powered desalinator using plastic containers, funnels and straws	https://www.sciencebuddies.org/science-fair-projects/project-ideas/EnvEng_p022/environmental-engineering/solar-powered-water-desalination#summary
Hydraulic Elevator	Make a hydraulic elevator.	• Make a hydraulic elevator using syringes and plastic tubing.	https://teachbesideme.com/stem-project-build-a-hydraulic-elevator/
Rocket	Build a two-stage rocket.	• Build a two-stage rocket with balloons.	https://www.scientificamerican.com/article/build-a-2-stage-balloon-rocket/

CHAPTER 05

TEACHING AND LEARNING

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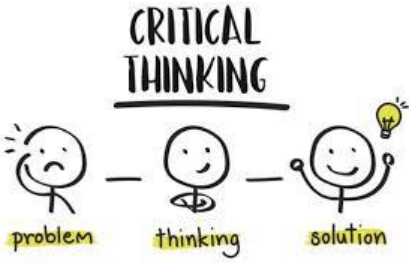
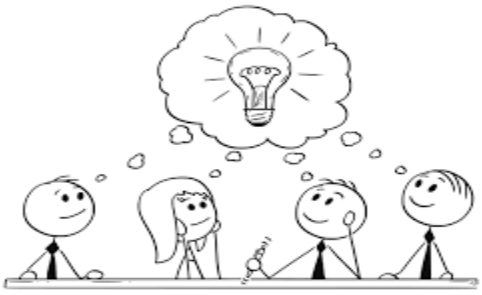
The overarching objective of science curriculum is to enable the students to carry out investigations and evaluate evidence to draw conclusions to develop skills of scientific inquiry. “Science curriculum emphasizes activities in which the students can identify, recognize or observe scientific issues, explain or interpret data or scientific phenomena, and draw conclusions based on the evidence” (Lavonen & Laaksonen, 2009, p. 924). Quality teaching is essential for quality learning, which provide necessary life skills to face global challenges, Effective instruction promotes excellence and student learning outcomes through best practices of STEAM and STEM.

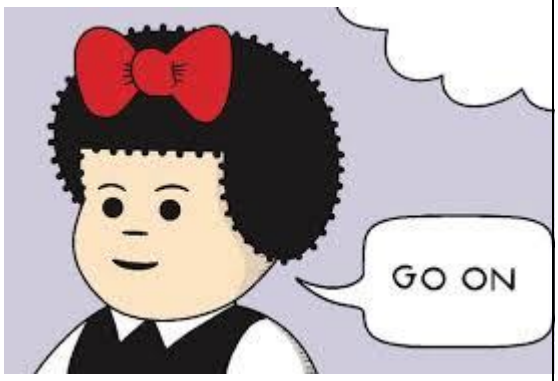
5.1. The 21st Century Learning Skills

The concept of globalization has introduced rapid changes in social structures, communities, and society. Teachers of today required to teach not only to cater the individual needs of leaner but also to prepare them to cope with increasingly changing global society. The 21st century learning skills are often called the 4 C's. A successful leaner of any stage comes down to four C’s i.e. critical thinking, collaboration, creativity, and communication. These are the four vital skills required to prepare the learner for global society. The term 21st century skills suggests to a comprehensive set of behavioural learning, knowledge, and attitude by teachers, professors, school reformers, policy leaders, stakeholders required important to accomplishment in today’s global society. The 21st century skills can be applied in all academic subject areas, educational, career and resilience throughout a student’s life.

5.2. Teaching Learning Strategies

Critical thinking 	These skills are beyond the memorization and support to conceptual understanding of the content taught with focused and careful analysis. These critical thinking skills also help students to develop themselves in their academics as well as career path.
Creative Thinking 	Creative thinking is the ability to look at things in a different way and discover the new solutions of problems. This ability enables the individuals to use of imagination to develop new ideas and create something new. Teaching involving creative thinking sharpens the learner's mind.
Communicating 	Communicating is the clear exchange of information, ideas and making sure that students are clear about all that which teachers were sharing in the in the classroom. Teachers and students can streamline communication between them. The analysis of student's progress provides the idea on how successfully teachers communicated.
Collaborating. 	Working together on some project or activity is collaboration. The classroom of global citizens is being driven by the idea of fostering a collaborative culture to encourage students to work together to solve problems. The 21st century classrooms are designed with flexibility of seating so that the students can push or pull to work together and become more energized to use that knowledge constructively. At remote post ion this could be through online groups, video

	conferencing, google meet, google hangouts etc
Elicitation 	In this technique, instead of the teacher providing answers to students all the time, the students are encouraged to contribute what they already know, to the lesson. This strategy enables them to build on their foundation of knowledge.
Brainstorming 	Brainstorming is a great educational tool to facilitate cooperative learning. Brainstorming in the classroom expedites active student participation, assists with generating ideas and sharing information or knowledge among students. It is an interactive method for learning and retaining information in the classroom. All ideas and thoughts are considered and given equal preference.
Discussions 	Discussions provide excellent opportunities to enhance student motivation. They create opportunities for students to practice and improve a number of skills, including the ability to use fluent expressions and defend positions, consider different points of view, and evaluate evidence.
Case Study 	A case study is a research methodology and an experimental inquiry that investigates a phenomenon within its real-life contest.

Mind Mapping 	It is a great tool to engage students and encourage creativity. Students will retain information better and it will also comfort teachers that students remember and fully comprehend new information and knowledge. A Mind Map can develop into several ideas which can branch out into new Mind Maps from each node.
Comic Strip 	Is a digital storytelling tool which consists of a series of cartoon drawings that narrate a story. Students create a narrative storyline and illustrate it with relevant graphics.
Simulation 	A simulation is the re-creation of a real-world process in a controlled environment. It uses something called modelling to figure out the result of the simulation. Science, comes up with lots of rules and laws to describe the world, and those models together allow us to create simulations. For example, we might study the way air molecules move when there is a heat source nearby and create a model to describe it. Then we can put dozens of molecules together and do a simulation.
Collaboration and cooperation 	In collaboration students team together to explore a significant question or create a meaningful project. In cooperative learning, students work together in small groups on a structured activity. They are individually accountable for their work, and the work of the group as a whole is also assessed.

Demonstration/exposition 	In demonstration/Exposition method, the teaching and learning process moves in a systematic way. Demonstration often occurs when students have a hard time connecting theories to actual practice or when students are unable to understand applications of theories.
Investigation /hand on 	Science is a practical subject hence, practical activities are to be carried out that may provide opportunities to the learners to promote their skills of evaluation, analysis and synthesis. Investigative practical work poses questions which students must answer after applying science skills and techniques. These methods provide opportunities of exploration, research and experimentation.
Field Trip 	Field trips are out of school activities which provide the learners with real life experiences and observations. It can be an interesting way for learners to explore new things and immerse themselves in authentic situations away from pressures of schoolwork and routine.
Model making 	Is a very effective technique where students engage in interactive activities. Model making activities enable students to learn graphing, visualization and computational skills.

Research 	Research method is an amalgamation of inquiry and reasoning 'to solve a problem, thus leading towards a discovery of truth, illuminate a situation or add to our knowledge' (Mutch, 2005, pp. 14) 'by the discovery of non-trivial facts and insights' (Howard & Sharp, 1983, as cited in Bell, 2005, pp. 2)
Problem based learning 	It is a student-centered approach in which students learn about a subject by working in groups to solve problems.
Games 	Fish bowl, hot seat, bingo, puzzles, quiz ,Jeopardy charades etc.

5.3. Teaching Strategies That Can Keep Students Engaged.

1. Discover new things together – It's much more fun for both parties when students and teachers learn new things together.
2. Make it interactive – If you want your students to be interested in what you are teaching them, you must make it interactive.
3. Incorporate mystery into your lessons – Learning is the most fun when it's surprising. Don't just tell them information; cloak it in to mystery.

4. Be crazy, but show you care – Let loose; laugh; make fun of yourself. Don't worry about sacrificing your authority.
5. Participate in projects – I had a creative science professor at my school who would bring his own material to class for the students to workshop. It was great fun for all of us, and enjoyable for him as well.
6. Avoid "going through the motions" – Make an effort to be fresh, try new things, take risks, make mistakes, and enjoy the moment.
7. Share your passion with students – Show students how you have fun. Passion is contagious. If you're having a good time, chances are your students will too.
8. Laugh at your students' jokes – It's one of the best ways to ensure teachers and students have fun: enjoy one another.
9. Replace lectures with conversations – Why should teaching be so passive? Forget the sage on the stage and engage your students in a casual conversation like you would a good friend.
10. Enjoy yourself – We pay a lot of attention to those people, who enjoy themselves.

Additionally,

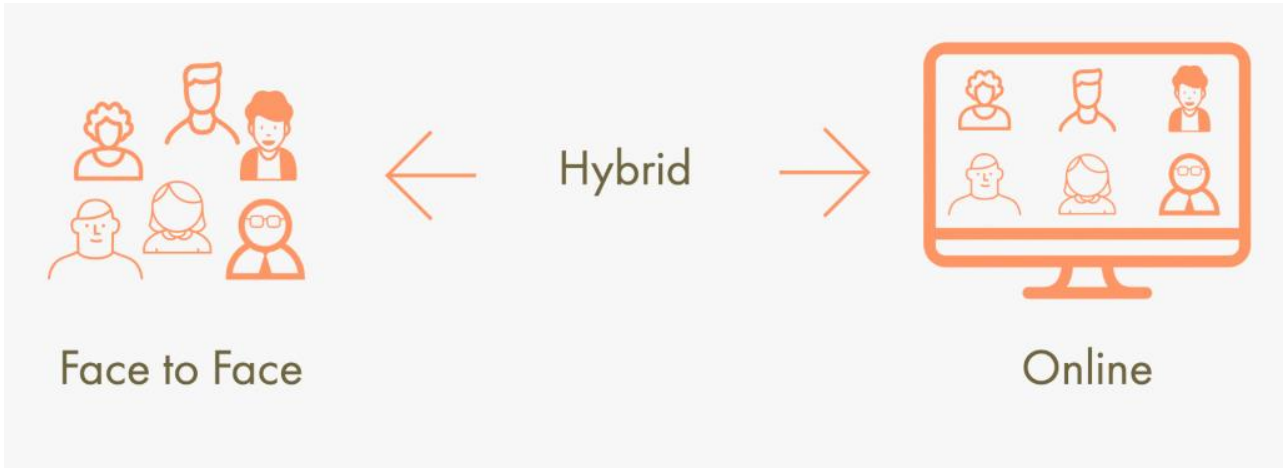
1. Relate your content with their lives – When you create a real-world connection to what students are learning, it will give them a greater understanding of why they need to learn it.
2. Use technology in the classroom – In this world today, technology is what students live and breathe every day. If you want to make your class the most interesting class that everyone loves to go to, then you must incorporate technology.

Allowing the students creative freedom in their learning is essential. Learning off set phrases is useful up until a point. After that, they need to be able to understand why a particular word is said in a particular way, and how they can manipulate it to suit the current situations.

Overall, talk less and involve with students more. The more you make your class interactive and the more that you utilize technology, the more your students will enjoy what they are learning.

5.4 The New Normal Teaching (Hybrid Teaching Model)

The hybrid teaching model is the suggested ideal option as New Normal Model of Teaching. This model can influence and summarizes teaching and learning. It describes the processes not only from teacher but also from the learner's perspective. This model and its competencies to address the challenges associated with teaching -learning process, particularly in execution and restructuring of examination. In this model some students attend class in-person, while others can join the class virtually from home. The class in this model may include e-learning elements, like online exercises and pre-recorded video instruction, to support the in-person classroom component.



This learning model comes in many different forms, depending on the content and instructor's expectations for the course. The above example highlights one way to combine virtual and in-person learning. This model also compatible during swear weather situations like (Fog, heavy rains snow falls etc.)

The New Normal Hybrid Model					
Cohort A	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
	Teacher Facilitated Remote Learning	**Remote Structured Learning**	**In Person Learning**	**Remote Structured Learning**	**In Person Learning**
Cohort B		**In Person Learning**	**Remote Structured Learning**	**In Person Learning**	**Remote Structured Learning**
	A limited number of students based on individual differences/needs will attend school in-person more frequently.				

5.4.1. Online teaching.

The most important component of Hybrid Model is remote teaching through online classroom. Which is the most emerging mode of 21st century teaching? Online teaching is the latest trend of distance learning in which teacher and students work online through internet and computer. There are several software applications designed to conduct quality online teaching, i.e. Google classroom, Edmodo, Microsoft office 360, and customized learning management systems (LMS). A learning management system is a software application for teaching-learning, the administration, documentation, tracking, reporting, automation, and delivery of educational courses, and for training programs. The learning management system concept developed with the increasing popularity of online teaching and e-learning.

5.4.2. SOP's for Virtual Classroom / Online Teaching

Online teaching should be conducted through virtual learning management system. For setting up of virtual/ online classroom vice principals or head of the departments are responsible to provide complete soft data of student to concerned teacher.

1. For Virtual classroom, starting every week students will be exposed to slightly more challenging assignments and classes to master grade-level skills in order to be ready for the 21st century job market skills along with their character building and personality development. Students will be assigned to complete higher order thinking projects, analytic essays, presentations, and assessments.
2. All teacher must mark their attendance virtually by 9 am the latest (attendance will open at 8:30) and must remain approachable by either phone, email or video call throughout the workday. All teachers must check their official email periodically throughout the day for regular updates from the office of the School.
3. Student grades will be posted Grades page on google classroom and report cards will be sent at the end of the marking period to prepare their portfolio. We ask our parents and students to follow the guidelines listed below:
4. Students are expected to pause, rewind, and re-watch the pre-recorded video lessons/ ppt with or without voice notes in their online classroom as needed and take notes to understand the key concepts.
5. Take at least two live sessions during the week to answer your questions and join discussions followed by posting your assignments in google classroom. This live session could be through google hang out/Zoom/Google meet.
6. Your participation in pre-recorded video lessons, live sessions, and assignments is required and will be reflected in your annual assessment.
7. Graded assignments and teacher lessons will be posted 3-4 times a week on Google Classrooms. Students will earn credit as part of their semester assessment requirements upon completion of the compulsory/elective courses.
8. **WhatsApp GROUPS** cannot be used for teaching purposes however it can be used or general announcements.

9. It is mandatory for science faculty to use Science journal for weekly experiments in virtual settings parallel to science Labs in normal social settings. No end of the term experiments is allowed.
10. For Individual virtual meetings with students and parents, teachers are expected to contact through their official email only. Please avoid sharing your personal cell number. Make announcements in your classroom by copy and paste the following sentence, **"Please email me to schedule a conference call appointment, Email replies can be expected within 48 hours."**
11. School is responsible to build the capacity and provide training to all faculty about the use of virtual/ online teaching.
12. Always come with real names, Students should always come and join the class /online session with real name. Students Always need to turn on their cameras, if no camera then you have to leave the class.

Timetable

Hours/Days	Monday	Tuesday	Wednesday	Thursday	Friday

5.4.3. Benefits of Hybrid Learning

The in-person classroom teaching and online learning, both have their advantages and limitations. The purpose of hybrid learning is to create a singular learning experience by combining both structures without any weakness.

1. **Flexibility**

Many schools transition to hybrid learning for flexibility. It provides a great flexibility of learning in terms of teaching methods, schedule, students engagement with their teachers, peers, and teaching material as well. It offers the quality learning remotely from home to those students, who are not able to attend the in-person class.

2. **Synchronous communication.**

The in-person academic discussions are the characteristic of classroom model This aspect of hybrid learning also offers the opportunity of real-time engagement between peers. The hybrid model offers the best used for synchronous group work, presentations followed by Q&A , and even deep-rooted discussions, which helps the learners to develop online and in person academic relationships with freedom of independent study and individual academic growth.

3. **Efficient use of resources.**

The online availability of learning materials made this mode more useful and effective. While planning syllabus and scheduling for hybrid model teachers must be clear that which portion would take place online and what specific part needs to go for in person classroom. What resources would be required for each lesson and plan, accordingly, ensure the optimum utilization of resources.

4. **Digital Citizenship**

The word Digital citizenship refers to the safe and accountable use of digital devices connected with internet. Since today's students are connected and engage in society through internet and digital devices so they are called digital citizens. Hence the safer use of the digital technology and internet is crucial to teach today's students of global society. This hybrid model of teaching also helps in creating the concept of digital citizens among the students.

5.4.4. The New Normal Class Structure

Our step-by-step guide for how to create and run a successful Hybrid Learning classroom.

1. First, gather your course materials.
2. Give yourself good time to plan your materials and activities.
3. The focus that you are planning for a hybrid class not the traditional one.

4. Set your semester goals.
5. Map it out.
6. Multiple check for the assignments in correct format, medium of each assignment, what is going for online and what is best for in-person.
7. Create and source content (Online Book bank etc).
8. Determine which course objectives are best served as in-person activities.
9. Determine the online portion of your course.
10. Providing immediate feedback to students
11. Peer discussion and give your hybrid learning plan a trial run.
12. Providing frequent feedback/ Comments to students

Some Clarification

What do you plan to accomplish with your hybrid class? By setting long and short-term goals for yourself and your class, you can explain the key expectations to your students. Determine these goals and their corresponding assessment, and work backward to structure the rest of your course. This backtracking from the end of the semester to your very first session will ensure that all your assignments and materials serve your course directly.

Map it out.

Now that you have determined the goals of your course, and how your students will be assessed, you'll need to map out how they'll navigate your class. Create a chart, table, timeline, or another visual tool to outline your course modules, and their respective activities and resources, in chronological order. By mapping your course visually, it will be easier for you to spot any course holes or underdeveloped activities.

Determine which course objectives are best served as in-person activities.

Now you have determined what your course will look like, it's time to factor in the hybrid element. Your face-to-face class time should be reserved for activities that require activities such as:

1. Synchronous group and organize brainstorming sessions.
2. Communicating class expectations and outlining individual responsibilities
3. Establishing a collaborative, trust-based learning environment
4. Call and response presentations.

5.4.5. Hybrid Teaching Tips

To ensure your new hybrid course runs smoothly, here are some teaching tips just for you:

1. Stop What's app teaching.
2. Don't be afraid to redesign to accommodate yourself for any weaknesses.
3. Connect yourself to a trusted IT person/organization or colleague.
4. Use in person teaching where you get stuck.
5. Provide mobile learning options for the online portion of your course.
6. Be open to feedback, and really learn from your student's experiences.
7. Don't overload students with lengthy online assignments. Limit your assignment by number of sentences.
8. Written critical analysis and thoughtful discourse.
9. Embrace your hybrid community. If you find yourself stuck or frustrated, turn to other hybrid class instructors that you respect: their experience and wisdom are priceless.

Some More

1. Remember that synchronous, face-to-face time can happen in-person, or virtually. If some students are in the classroom, while others are learning from home, you can use **video conferencing/ Zoom/ google hangouts/google meet tools** to connect with one another.
2. You'll notice that one main element of your hybrid course not mentioned in the face-to-face section is the deliverance of information. While in-person time is reserved for synchronous and group discussions, the majority of personal assignments will be done virtually. Additionally, the other activities that make up the online portion of your hybrid class can include.
3. Once you mapped out the modules in your course, you would need to create and source the content that will be used by your students. This is the time for you to create assignments, find all reading materials, source your video content, and finalize your syllabus.

4. If your school has experience with hybrid classes, adapting archived resources and tailoring them to fit your class structure is a great place to start. Additionally, resources can be found on flagship education websites and managing discussion forums.

5.5. The 21st Century Teaching Approach (STEAM)

The 21st century world is increasingly changing and has generated the concepts of internationalization and globalization throughout the social system. This SNC has integrated the 21st century teaching pedagogies i.e. forward thinking, change management, ownership, collaborative teaching, life skills, cooperative learning and integration of technology which are entirely different from traditional chalk and talk method. Since the technological advancements has integrated technology in all aspects of social life, it has also changed the pedagogical approach to teaching and learning. The science curriculum has been designed on STEAM framework which provides solution to the need for more creative, innovative thinkers in the workforce and it's a solution for the need to validate the arts in education.

The key component of STEAM approach is teaching content with behavioral objectives using technology instead of teaching science disciplines as independent subjects. It is an interdisciplinary approach and STEAM well aligned with the problem of daily lives making it an exceptional way of learning. The subjects do not work on their own, instead they are woven together in practical and seamless way.

The STEAM

STEAM is defined as science, technology, engineering, and the arts through mathematics. It is educational to learning science using technology with the focus of Arts and Mathematics. It means adding Arts to STEM as generated the idea of STEAM. This is the integration of creative thinking and applied arts in real situations. This A is more concerned with artistic touch and aesthetics. the application of creativity and arts is a natural part of STEM. It

becomes particularly interesting for elementary grades. Both the STEM and STEAM are operationalized with same principles and practices. It is all about the integration of Science, Technology, Engineering, Arts and Math.

1. STEAM is a guided approach to exploratory learning where teacher-talk is at a minimum and students drive interaction and discovery. Implementation, though collaborative lesson planning of teachers about lessons, units and that concept/lesson/unit of science must be addressed across all relevant classrooms (science and mathematics) in parallel.

2. It may or may not be a team teaching, but it is team planning. Once the team members feel confident in their knowledge, they will become coaches for their colleagues. They must share their lesson with each other. The content could be tough in in different classrooms but during the same academic week.

3. At the same time, school administrators need to provide teachers with proper support – both time and resources. Administrators should create opportunities for teachers to co-

plan curriculum and encourage frequent check-ins, perhaps even daily, to ensure consistent implementation. In addition, school leaders can play a vital role in community partnerships, e.g., museums, to expand their STEAM network.

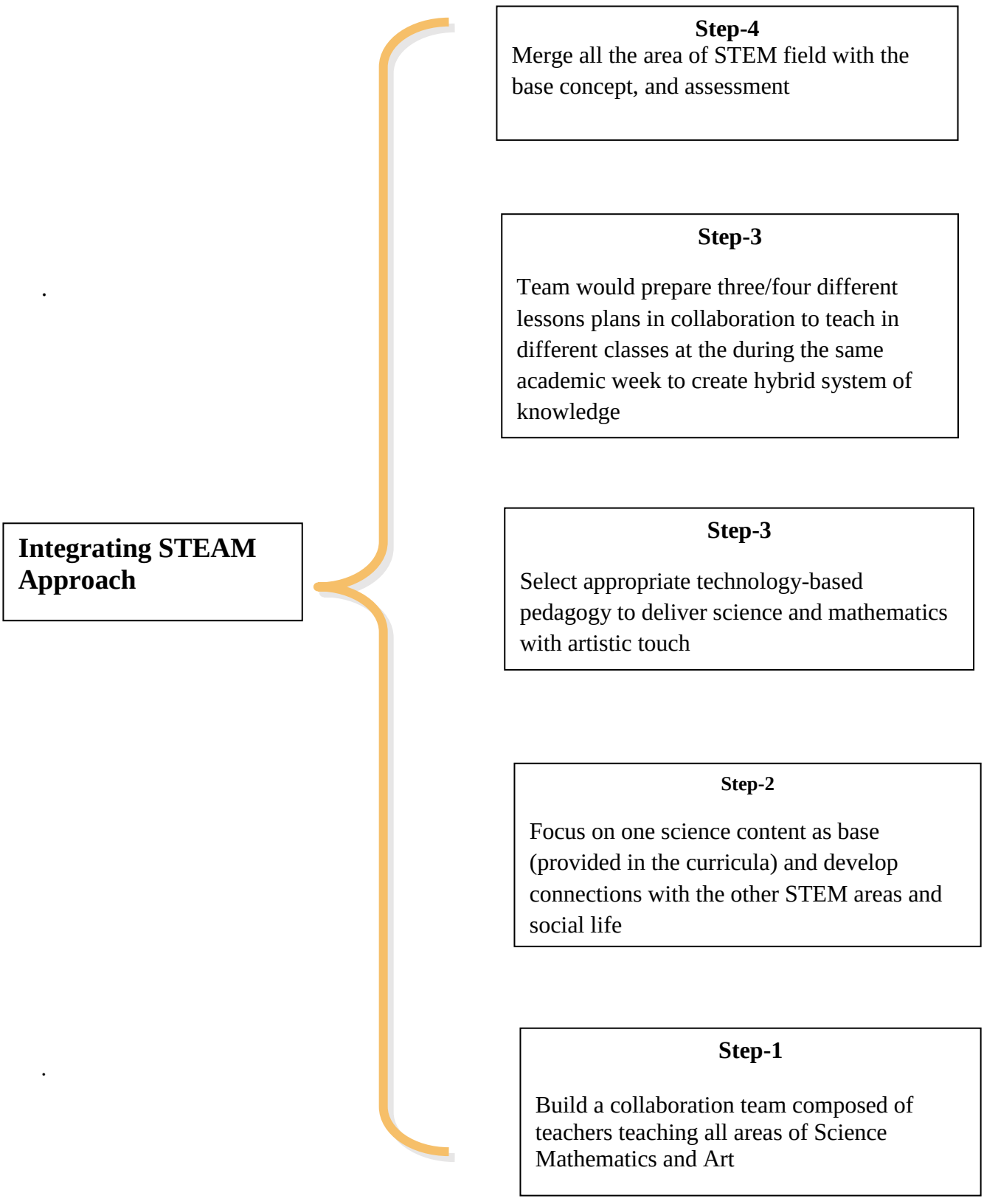
5.5.1. Guidelines to Implement STEAM Approach

STEAM Education is an approach to educating students in four specific disciplines that are science, technology, engineering, and mathematics. It is an interdisciplinary teaching-learning approach for preparing the new generation for the 21st century with the 4Cs framework, i.e., communication, collaboration, creativity, and critical thinking. This integrated approach involves an interconnectivity of disciplines with a strong collaborative connection to life skills. The STEAM classroom connects students to real-world challenges, blending dynamic digital content with get-in-there, hands-on activities to accelerate student comprehension and application. In a STEM classroom, the student must be familiar with the instrumentation and application of science concepts and theories. The essential elements of high-quality curricula of STEM education programs are:

1. Integration of technology, engineering, science, and mathematics in the classroom.
2. STEAM approach is vital to promote engineering design, problem-solving, the process of identifying a problem, innovative solution, evaluation, and a practical understanding of the world.
3. Grade-appropriate content and encompassing of hands-on, minds-on, and collaborative approaches to learning.
4. Provide students with interdisciplinary, multicultural, and multi-perspective viewpoints with a global perspective.
5. Use appropriate technologies such as modelling, simulation, and distance learning to enhance STEAM education learning experiences and investigations.

6. Integrate STEAM core content knowledge through strategies such as project-based learning.

5.5.2 .The STEAM Integration Framework for Heard Teachers/ Head of the Departments



5.6. Sample Lesson Plan

Grade: VIII

Title: Pressure (Chapter 8: Effect of Force)

Dates: xxxx-xxx-xxxx

Standard – 4 (SNC)

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

Target Benchmarks

- Apply scientific approach using basic science skills to explore the materials and events in everyday life.
- Use the scientific process for investigation.
- Application of available tools, techniques and measurement units for gathering data and presenting in an organized way/form.
- Connect students to technical world through the main domains i.e. Learning, Literacy and Life Skills (3Ls).

Specific Objectives

This STEAM lesson would be taught with the specific objectives as under.

1. It would help to connect the middle school classroom with the society and the social life.
2. Help the middle school students for understanding scientific, specific social science issues, with mathematical alternatives.
3. Help the student understand and apply the scientific perspective and reason accurately and objectively about technology, and engineering matters.
4. Promote a lasting student interest in science, technology, engineering, Arts and mathematics for high school.

Resources:

Marker board, eraser markers, paper, Group Activity handouts, Computer Projector, Online PowerPoint Presentations, websites, class computer; school computer lab

Warm-up:

Essential Question of the day,

1. Review previous days lesson key points.
2. What is pressure?
3. Are you previously familiar with this word?
4. Share your answer with the class,
5. Class discussion (If timelines allows)

Essential Queries (Addressed by Teacher):

- Explain the importance of knowing about pressure (What and Why)
- Collect, organize, and record appropriate data.
- Develop reasonable conclusions based on data collected.
- Evaluate whether conclusions are reasonable by reviewing the process and checking against other available information.
- Use data as evidence to support scientific arguments and claims in written or oral presentations (Record blood pressure reading by using BP apparatus (if possible), Atmospheric pressure data from internet.)
- Participate in group discussions of scientific investigation and current scientific issues.
- Organize and consolidate their mathematical thinking through communication.
- Communicate their mathematical thinking coherently and clearly to peers, teachers, and others.
- Use the language of mathematics to express mathematical ideas precisely.
- Recognize and use connections among mathematical ideas.

- Understand how mathematical ideas interconnect and build on one another to produce a coherent whole.
- Recognize and apply concept of pressure in contexts outside of physical sciences and mathematics such as blood pressure.
- Create and use representations to organize, record, and communicate mathematical ideas.
- Select, apply, and translate mathematical figures to explain the concept (Blood pressure, Atmospheric pressure etc.)
- Use representations to model and interpret physical, social, and mathematical phenomena.

Lesson:

Class Activity.

1. Short content-based information through lecture of presentation (ppt), not more than 20 minutes. of presentation by teacher on Pressure (What, ????)
2. Students will learn about the pressure in terms of physical sciences. Teacher would present the surface level about atmospheric pressure, blood pressure, pressure in clod drink bottles or any other daily local observation around the student.
3. Teacher would allot them small research projects (Atmospheric pressure of last three months for some specific areas), Comparison between the different readings of atmospheric pressure.
4. Students will use the research process to answer the following question. This research report would be prepared through library and internet research with the safer use of internet resources with the concept of global citizenship.
    a. What is the meaning of miasmatical figures and pressure measuring units?
    b. What are the similarities of atmospheric pressure reading of different areas?
    c. Why or why not?
5. Students will complete a worksheet using frequency distribution.

Homework:

Students will then write a short research report (not more than half page) and then do an Oral report in class about their research findings targeting the above-mentioned question.

5.7. Academic Time Allocation

- Total No of teaching periods/classes during an academic year =180
- Duration of teaching period = 40 minutes
- Total teaching hours during one academic year =40*180= 7200 minutes, 120 hours
- Keeping in view the sub themes, SLOs and suggested activities, each chapter has been allocated estimated teaching periods. School administration/ class teacher may adjust the teaching periods according to their own requirements

Grade- VI		
Sr No.	**Chapter**	**Estimated teaching periods allocated**
01	Science around us	15
02	Cellular organization	12
03	Food and digestion	22
04	Growth and development	13
05	Elements and Compounds	22
06	Matter as Particles	15
07	Mixtures:	14
08	Energy	13
09	Light	13
10	Electricity	14
11	Solar System	12
12	Technology	15
		180
Grade- VII		
Sr No.	**Chapter**	**Estimated teaching periods allocated**
01	Plant Systems	18
02	Human Organ Systems	17
03	Healthy lifestyle	13
04	Atomic structure	14

05	Chemical Bonding	12
06	Physical and Chemical Changes	15
07	Heat and Temperature	16
08	Wave and Types	15
09	Force and Motion	14
10	Light	12
11	Magnetism	15
12	Investigating Space	09
13	Technology	10
Total		180
Grade- VIII		
Sr No.	**Chapter**	**Estimated teaching periods allocated**
01	Inheritance and Cell Division	20
02	Biotechnology	20
03	Ecology	20
04	Periodic table	16
05	Chemical Reactions	16
06	Acids, Bases and Salts	17
07	Effect of Force	15
08	Electricity	15
09	Refraction of light	15
10	Astronomy	13
11	Technology	14
Total		180

CHAPTER 06

ASSESSMENT

CHAPTER 06

ASSESSMENT

Assessment is a continuous process of evaluating, measuring and documenting the academic readiness, learning progress, skill attainment and educational needs of learners. It refers to assess the expected behavioral changes in all (cognitive, affective and psychomotor domains).

Science is not only product but it is also a process, therefore assessment is not merely measuring the scientific knowledge but also evaluating the scientific skills and imbibed desirable scientific interests, attitudes and feelings of appreciations. This appropriate way for assessment, serves as diagnostic, prognostic and remedial testing instead of declaring students merely as pass, fail or categorize them into grades.

6.1. Science Assessment Purpose

Assessments are designed to serve the following purposes in science teaching

1. To diagnose the strengthen level of the learners, according to their interests and attitudes.
2. To analyze the success or failure of teaching strategies.
3. To investigate about the weaknesses and strengths of students' knowledge.
4. To determine the manipulation level including experimental skills learners.
5. To pin point the dissecting, mathematical, drawing, collecting, mounting and preserving skills of science students

6.2. Classification of Science Assessment

There are several aspects, for assessing learners

1. Time
2. Item difficulty
3. Comparison
4. Purpose

6.2.1. Time based

Assessment has following types on the basis of time

1. **Diagnostic Assessment**

   The assessment conducted to diagnose the learner's existing or previous knowledge of relevant topic, including positive and negative potentials prior to instruction is called diagnostic assessment. Its purpose is to analyze the learning needs of learner so that instruction can be planned in accordance.

2. **Formative assessment**

   This is the type of assessment that is designed after instruction and it's purpose is not only to monitor learning progress of learners but also getting feedback about teacher's instruction and to fill the deficient loops of instruction.

3. **Summative assessment**

   The assessment that is conducted in the last of instruction to certify and evaluate the learner is called summative assessment. It is broader in scope as compared to former one.

6.2.2.Item based

On the basis of assessment items there are following two types of assessment

1. **Objective Type**

Objective type items are used in assessment to maximize objectivity. In such assessment's response options are structured such that

1. Examinee has only a limited set of options.
2. Examiner has limited option of subjective contents for administration of assessment and interpretation of results.

2. **Subjective Type**

Subjective type items are used in assessment to investigate the high order learning outcomes. Such assessments are designed to explore the

1. Application, Analysis, Synthesis skills of examinees.
2. Diversity of responses of examinees.
3. Divergent and convergent thinking patterns of learners.

3. Performance Type

Performance based items are used to determine the

1. Manipulative and experimental skills of science learners
2. Dissecting, mathematical, drawing, collecting, mounting and preserving skills of science students

6.2.3. Comparison based

1. **Norm referenced assessment**

In Norm referenced assessment student's performance is compared against the average norm.

2. Criterion referenced assessment

In Criterion referenced assessment student's performance is compared against the pre-determined criteria/learning standards or benchmarks.

3. Impassive assessment

In Impassive assessment student's current performance is compared against the previous performance of his own, so that learner's progression and retrogression can be analyzed.

6.2.4. Purpose based

Assessment has following types on the basis of purpose it served: -

1. Maximum performance

In maximum performance assessment the purpose is to check the maximum capabilities of examiners. Hence learners are pre-informed about assessment and it's pattern so that they can fully prepare themselves for it.

2. Typical performance

Typical performance assessment's purpose is to check the routine performance of learner, so surprise tests are conducted.

6.3.TIMSS :(Trends in International Mathematics and Science study)

TIMSS is a project of International Association for the Evaluation of Educational Achievement (IEA) that conducts comprehensive Standardized assessments of mathematics and science for students in year 5 to 8, supported with extensive data about country, school and classroom learning environments. First Assessment was conducted in 1995, TIMSS reports every four years.

6.3.1.TIMSS 2019

In 2019 first time the TIMSS will be a digitally based assessment administered on supplied tablets. A subset of students will take paper and pencil TIMSS.

6.3.2.TIMSS 2019 Science Framework

At each grade, the science assessment framework for TIMSS 2019 is organized around two dimensions:

- Content dimension, specifying the subject matter to be assessed
- Cognitive dimension, specifying the thinking processes to be assessed

Target Percentages of the TIMSS 2019 Science Assessment Devoted to Content and Cognitive **Domains at the Fourth and Eighth Grades are**

Domain	Grade Fourth	Grade Eighth
Content Domain	• Life Science 45% • Physical Science 35% • Earth Science 20%	• Biology 35% • Chemistry 20% • Physics 25% • Earth Science 20%
Cognitive Domain	• Knowing 40% • Applying 40% • Reasoning 20%	• Knowing 35% • Applying 35% • Reasoning 30%

The content domains differ for the fourth and eighth grades, reflecting the nature and difficulty of the science taught at each grade. There is more emphasis at the fourth grade on life science than its counterpart, biology, at the eighth grade. At the eighth grade, physics and chemistry are assessed as separate content domains and receive more emphasis than at fourth grade, where they are assessed as one content domain (physical science).The three cognitive domains (knowing, applying, and reasoning) also differ in the both grades, encompassing the range of cognitive processes involved in learning science concepts, and then applying these concepts and reasoning with them.

In 2019, TIMSS Science also will assess science practices. These practices include skills from daily life and school studies that students use in a systematic way to conduct scientific inquiry. Increasing emphasis has been placed on science practices and science inquiry in many countries' current science curricula, standards, and frameworks (Mullis, Martin, Goh, and Cotter, 2016).

6.4. Science Assessment Framework

Pakistan decided first time participation in TIMSS 2019 for grade 4. So Assessment in science must have to use of wide variety of assessment tools to evaluate the multi-disciplinary scientific literacy.

Suggested assessment strategies can be following

i. Observation

Observational assessment supports teaching in several ways, allowing teachers to focus on

1. Knowledge, acquisition and application
2. Learning outcomes

3. Group learning skills
4. Individual learning style

It is equally valid and applicable in all learning domains intellectual, emotional, physical, social and aesthetic.

ii. Interviews

Interviews as an assessment tool enable students to

1. Receive immediate feedback
2. Provide a unique setting to explain their work
3. Feel more responsible and accountable regarding their work.

iii. Group/Peer Assessment

Assessing other student's work leads towards the

1. Applying assessment criteria
2. Developing responsibility and Enterprise
3. Promoting autonomous and reflective learning
4. Valuing Group work
5. Discouraging uneven workload

iv. Self-Assessment

Self-assessment is a powerful mechanism for enhancing learning. It encourages learner to

1. Criticize on their own work
2. Promote metacognition
3. Impart Reflective skills

v. Performance based Assessment

Performance based assessment are worthwhile especially in science as these assessments inculcate

1. Creativity and innovation
2. Critical thinking and problem solving
3. Communication and collaboration among science students.

vi. Science Journal Entries

Student science Journal entries are an effective tool for

1. identifying gaps in their cognitive learning
2. pinpointing events in the environment that may contribute to increase/decrease of learning

vii. Rubrics/Checklists

Rubrics offer systematic ways of collecting data about specific behaviors, knowledge and skills. Its purpose is to

1. Provide samples of criteria for students prior to collecting and evaluating data on their work.
2. Record the development of specific skills, strategies, attitudes and behaviors necessary for demonstrating learning.
3. Clarify students' instructional needs by presenting a record of current accomplishments.

viii. Visual Displays

When students or student groups prepare visual displays, they are involved in processing information and producing a knowledge frame work. The poster, concept map, diagram, model etc., is the product with which teachers can determine what their students are thinking.

ix. Laboratory Report

Laboratory reports allow teachers to gauge the ability of students to observe, record and interpret experimental results. These tools can aid teachers in determining how well students understand the content.

x. Paper Pencil Tasks

Quizzes can be used as discrete assessment tools, and test can be larger assessment experiences. These written tasks may include items such as multiple-choice questions, competition of drawing or labeled diagram, problem solving, or long answer questions. Ensure that both restricted and extended, expository responses are included in these assessment devices.

xi. Research reports/Presentation

Research projects allow students to achieve the learning outcomes in individual assessment should be built into the project at every stage, from planning to researching ,from researching to presenting the finished product.

xii. Portfolios

Portfolios are effective assessment tools that show students reflections on their own work. Basically, portfolio is a systematic collection of student's works that exhibit student learning accomplishment over a period of time. E-portfolios are more evidentiary as they include input text, electronic files, images, ppts, blog entries, hyperlinks etc.

xiii. E-Assessments

In e-Assessment digital tools are used for the assessment of learning. In science gamification can engage students in tasks related to different disciplines of science in a very effective way.

CHAPTER 07

GUIDELINES TO THE TEXTBOOK AUTHORS

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GUIDELINES TO THE TEXTBOOK AUTHORS

A textbook is an important teaching and learning tool and standard source of information for formal study of a subject. Writing a textbook is an extremely important and technical task in the sense that it requires the translation of curriculum learning outcomes at the proper cognitive level of the students. Textbook authors need to consider, among others, the following guidelines:

- A textbook author should be to translate the spirit of curriculum into content and activities/ exercises of textbook. Therefore, curriculum should be studied time and again in order to have an in depth understanding if its true spirit.
- Prepare a mind map of themes and learning outcomes, that is, chapter wise distribution/ presentation scheme of SLOs.
- Retain and limit the textual material to the learning outcomes details. Consider the time allocated to a subject in the scheme of studies. This will help to decide length, width and depth of chapters/ topics and concepts.
- Select accurate, authentic, and up-to-date text and real life examples.
- Make science concepts interesting and easy to understand for the children through relevant activities, information boxes and pictures etc.
- The material must help to enhance the knowledge of students, develop the inquiry skills and engage in higher order thinking.
- The content should be interactive and motivating for further learning of students.
- The material should help students understand the world in which they live in, and be a lifelong learner.
- The material must be error free and relevant.
- The material must be free from gender, ethnic, regional and all sorts of biases.
- Use attractive and engaging text along with illustrations, tables, graphs etc.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 include clues 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.
- Add an assessment after a few concepts/ themes, topics/ subtopics or chapters.
- Should give students material to think beyond the textbook too.

7.1 Guidelines for Writing a Chapter

In order to make the learning 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 colored 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 colour coding to show different levels of activities.***
- ***Science tid bits*** to provide snippets of interesting and useful knowledge.
- **Attractive and colourful illustrations to captivate students.**
- ***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.***
- ***Skills and processes to infuse values, ethics and attitudes.***
- ***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.
- **Addresses of relevant websites and Online Learning Centres** at the end of each chapter should be mentioned so that students and teachers can get up-to-date information about the concepts. The material should reflect the role of technology in promoting understanding based learning.
- Teacher Guide gives tips to teachers at relevant places in chapters to explain different concepts and to use a variety of tools/ materials and activities.

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 suitable for the needs of the learner?
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
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 colors)
c. Page size (23x36/8)
d. Line spacing (1.25)
e. Titles and sub-titles (28-32, 18-22)
f. Font size (14 Arial)

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 related questions. Alternatively, a textbook can include short notes for teachers on teaching of particular topics.

7.4. Dimensions for Teacher Training

Some salient features of Teacher Training for Single National Curriculum are:

- Vision of Single National Curriculum- ONE NATION ONE CURRICULULM.
- Understanding of Strands, Standard, Benchmarks, Progression Grid, Student Learning Outcomes and Learning Objectives.
- Transition of STEM into STEAM Approach in Teaching Learning Process.
- Insight of Cross Cutting Elements.
- Awareness of New Normal Teaching /Hybrid Model of Teaching Learning On line Teaching and Self Learning.
- Technology Integration with visible outcomes through Projects to make learner skillful to meet Global Market Needs.
- Inclusion of Global Citizenship and Digital Citizenship in Science Curriculum.
- Innovative trends of Teaching Learning Process to promote 21st century skills.
- Comprehension of Cross Curriculum Linkages.
- Content and Pedagogy.
- Promote Inquiry Based, Learner centered, Problem Based and Project Based Learning.
- Developing Higher Order Thinking Skills in learners according to the international standards for Elementary Level.
- The science experimental work should be Inquiry based using Innovative learning approaches. The lab in natural environment could be carried out effectively through **"Science Journal app"** through google app store **(https://play.google.com/store/apps/details?id=com.google.android.apps.forscience.whistlepunk&hl=en&gl=US)**
- Use of Web links for making teaching learning interesting and effective.
- Assessment approaches aligned with TIMSS.

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