Grade 10

Science

Teacher's Guide

(To be Implimented from 2015)

Department of Science
National Institute of Education
Maharagama
Sri Lanka
www.nie.lk

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Message from the Director General

The first phase of the new competency based curriculum, with 8 years curriculum cycle was introduced to secondary education in Sri Lanka in 2007 replacing the existed content based education system with basic objective of developing the national level competencies recommended by the National Education Commission.

The second phase of the curriculum cycle to be introduced to grades 6 and 10 starts from 2015. For this purpose, National Institute of Education has introduced a rationalization process and developed rationalized syllabi for these grades using research based outcomes and various suggestions made by different stakeholders.

In the rationalization process, vertical integration has been used to systematically develop the competency levels in all subjects from fundamentals to advanced levels using the bottom up approach. Horizontal integration is used to minimize the overlapping in the subject content and to reduce the content over loading in the subjects to produce more students friendly and implementable curricular.

A new format has been introduced to the teachers' guide with the aim of providing the teachers with the required guidance in the areas of lesson planning, teaching, carrying out activities and measurement and evaluation. These guidelines will help the teachers to be more productive and effective in the classroom.

The new teachers' guides provide freedom to the teachers in selecting quality inputs and additional activities to develop the competencies of the students. The new teachers' guides are not loaded with subject content that is covered in the recommended textbooks. Therefore, it is essential for the teacher to use the new teachers' guides simultaneously with the relevant textbooks prepared by Education Publication Department as reference guides to be more aware of the syllabi.

The basic objectives of the rationalized syllabi and the new format of teachers' guide and newly developed textbooks are to bring a shift from the teacher centered education system into a student centered and more activity based education system in order to develop the competencies and skills of the school leavers and to enable the system to produce suitable human resource to the world of work.

I would like to take this opportunity to thank the members of Academic Affairs Board and Council of National Institute of Education and all the resource persons who have immensely contributed in developing these new teacher guides.

Director General

National Institute of Education

Message from the Deputy Director General

Education from the past has been constantly changing and forging forward. In recent years, these changes have become quite rapid. Past two decades have witnessed a high surge in teaching methodologies as well as in the use of technological tools and in the field of knowledge creation.

Accordingly, the National Institute of Education is in the process or taking appropriate and timely steps with regard to the education reforms of 2015.

It is with immense pleasure that this Teachers' Guide where the new curriculum has been planned based on a thorough study of the changes that have taken place in the global context adopted in terms of local needs based on a student-centered learning-teaching approach, is presented to you teachers who serve as the pilots of the schools system.

An instructional manual of this nature is provided to you with the confidence that, you will be able to make a greater contribution using this.

There is no doubt whatsoever that this Teachers' Guide will provide substantial support in the classroom teaching-learning process at the same time. Furthermore the teacher will have a better control of the classroom with a constructive approach in selecting modern resource materials and following guide lines given in this book.

I trust that through the careful study of this Teachers Guide provided to you, you will act with commitment in the generation of a greatly creative set of students capable of helping Sri Lanka move socially as well as economically forward.

This Teachers' Guide is the outcome of the expertise and unflagging commitment of a team of subject teachers and academics in the field Education.

While expressing my sincere appreciation of this task performed for the development of the education system, my heartfelt thanks go to all of you who contributed your knowledge and skills in making this document such a landmark in the field.

M.F.S.P. Jayawardhana
Deputy Director General
Faculty of Science and Technology

National Institute of Education

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Instructions to use the Teacher's Guide

The new rationalized syllabus for the subject of Science and Technology is going to be implemented from the year 2025. From there onwards, the teachers will have to use this teachers' guide in place of the teachers' instructional manual. The syllabus is included in the teachers' guide to make the process easy for the students.

This teachers' guide consists of a compilation of instructions given to the teachers in order to make use of in the classroom to achieve specific competency levels. Further, the specific competencies thus highlighted are included in the teachers' guide with the time suggested for each of the competency levels.

Learning outcomes to be achieved at the end of each lesson are mentioned clearly in the teachers' guide and it is expected that the teachers will be guided to arrive at a comprehensive conclusion on the behavioral changes expected of the children based on the three domains, knowledge, attitudes and kills. Further, the learning outcomes will help the teachers to determine the depth and width and the limits of the subject content to be considered.

The section on "Instructions for lesson planning" consists of a set of suggestions for the teachers to organize and manage the learning teaching process within the allocated number of periods. The teacher is at liberty to make necessary changes to suit the learning teaching environment they encounter and it is the teacher's sole responsibility to make such changes in order to ensure that students reach the learning outcomes.

The teachers' guide also includes the basic concepts and essential technical terms the students are expected to acquire gradually when the competency levels are developed. Whether the students have achieved expected mastery levels has to be determined by way of assessment and evaluation.

Compared to the other subjects, teaching of science subject involves the use of a wide range of equipment and tools since it should happen in a very much practical context with an analytical approach. Minimum requirement of resources thus necessary for the lesson planning strategies is mentioned here as quality input. If teacher intends to introduce lesson planning strategies different from the suggested ones here, they are expected to make necessary changes in quality inputs accordingly.

Measuring of whether the learning and teaching process was successful within a particular learning environment paves way to achieve feedback and at the same time to use remedial methods accordingly. At the end of each unit there are suggested evaluation and assessment procedures suitable for the said purpose. Here it is expected to examine whether the students have achieved expected mastery in a particular competency level. Assessment process may happen during the lesson or at the end of the lesson and the teacher is free to obtain the assistance of their students too in this regard. Here, it is essential to pay special attention to the National Goals, Basic Competencies and the objectives of the science curriculum, given at the beginning of the teachers' guide.

Content

INTRODUCTION

The main aim of Science subject is the personal development of the student through a scientific lifestyle, thereby paving the way to national development, thus building a unique, wondrous and prosperous Sri Lanka.

A series of objectives exclusive to the subject of Science has been established as a foundation for the progressive achievement of this admirable goal. To reach this target, the student must learn Science with zeal and enthusiasm. We proudly present you with the duly equipped Science syllabus for Grade 10.

Sri Lanka has claimed to a significant level of literacy rate and upholds a level of education on a par with the countries reputed for the highest standard of education in the world. This standard is sustained through regular revising of the syllabus, and improving, developing and updating it every eight years.

Therefore, the syllabus presented in 2015 is merely a further improvement of the existing competency based curriculum. These changes have been made, based on the data and suggestions provided by the erudite community of the educational sphere and the research done by both the National Institute of Education and other educational institutions on the syllabus introduced to the education system in 2007.

Learning outcomes are also included in this syllabus so that the teacher would be able to identify the limitations of the subject content clearly and plan assessments effectively as well.

Now, more time is provided for the teacher to more effectively orchestrate the learning-teaching process in the classroom. In the construction of the new syllabus, the excessive weight of the previous syllabus has been lessened by reducing the subject content and essential information has been added. Thus the teacher has more freedom to engage in the learning-teaching process in the classroom utilizing his/her own creativity to the maximum effect.

National goals

1. Based on the concept of respecting human values and understanding the differences between the Sri Lankan multi-cultural society, building up the nation and confirming the identity of Sri Lanka by promoting national integrity, national unity, national coherence and peace
2. While responding to the challenges of the dynamic world, identifying and conserving the National heritage.
3. Creating an environment which comprises of the conventions of social justice and the democratic life to promote the characteristics of respecting the human rights, being aware of the responsibilities, concerning each other with affectionate relationships.
4. Promoting a sustainable life style based on the people's mental and physical well being and the concept of human values
5. Promoting the positive feelings needed for balanced personality with the qualities of creative skills, initiative, critical thinking and being responsible
6. Through education, developing the human resources, needed for the progress of the well being of an individual, the nation as well as the economic growth of Sri Lanka.
7. Preparing the people for the changes that occur in a rapidly changing world by adapting to it and controlling them; developing abilities and potentialities of people to face the complex and unexpected occasions.
8. Sustaining the skills and attitudes based on justice, equality, mutual respect which is essential to achieve a respectable place in the international community.
   National Education Commission Report (2003).

Basic Competencies

The competencies promoted though the education mentioned below might help to achieve the above mentioned National Goals.

(i.) Competencies in Communication

This first set of competencies is made up of four subsets - Literacy, Numeracy, Graphics and information communication skills:

Literacy : Carefully listening, speaking clearly, and reading for comprehension, writing clearly and accurately.

Numeracy: Using numbers to count, calculate, code and to measure, matter, space and time.

Graphics : Making sense of line and form, expressing and recording essential data, instructions and ideas with line, form, colour, two and three-dimensional configurations, graphic symbols and icons

ICT Competencies: Knowledge on computers, and the ability to use the information communication skills at learning or work as well as in the private life

(ii.) Competencies relating to the Personality Development

- Generic skills such as creativity, divergent thinking, initiative, decision making, problem-solving, critical and analytical thinking, team work, inter-personal relationships, discovering and exploring
- Values such as integrity, tolerance and respect for human dignity.
- Cognition

(iii.) Competencies relating to the Environment.

This is the second set of competencies related to the Social, Biological and Physical Environments.

Social Environment: Awareness, sensitivity and skills linked to being a member of society, social relationship, personal conduct, general and legal conventions, rights, responsibilities, duties and obligations.

Biological Environment: Awareness, sensitivity and skills linked to the living world, man and the ecosystem, the trees, forests, seas, water, air and life - plant, animal and human life.

Physical Environment: Awareness, sensitivity and skills relating to space, energy, fuels, matter, materials and their links with human living, food, clothing, shelter, health, comfort, respiration, sleep, relaxation, rest, wastes and excretion, media of communication and transport.
Included here are the skills in using tools to shape and for materials for living and learning.

(iv.) Competencies relating to Preparation for the world of work

Employment related skills to maximize their potential and to enhance their capacity to contribute to economic development; to discover their vocational interests and aptitudes; to choose a job that suits their abilities and; to engage in a rewarding and sustainable livelihood

(v.) Competencies relating to religion and ethics

This fourth set of competencies laden with values and attitudes. It is essential for individuals to assimilate values, so that they may function in a manner consistent with the ethical, moral and religious modes of conduct, rituals, practices in everyday living, selecting the most appropriate.

(vi.) Competencies in Play and Use of Leisure

Competencies that link up with pleasure, joy, emotions and such human motivations. These find expression in play, sports, athletics and leisure pursuit of many types. These also link up with such values as cooperation, team work, healthy competition in life and work. Here are included such activities as are involved in aesthetics, arts, drama, literature, exploratory research and other creative modes in human living

(vii.) Competencies relating to 'Learning to learn'.

These competencies flow directly from the nature of a rapidly changing, complex and interdependent and crowded world. Whatever one learns, that learning will need updating and review. This requires that one should be aware of, sensitive and skilful in sustained attention, and be willing to persevere and attend to details that matter in a given situation.

Course objectives grade 6 - 11 science

- Develop scientific concepts and principles systematically through a joyful learning environment.
- Develop competencies related to problem solving by using processes in science and scientific method appropriately.
- Develop competencies pertaining to managing environmental resources intelligently by understanding the potential of such resources.
- Develop competencies related to the usage of scientific knowledge to lead a physically and mentally healthy life.
- Develop competencies pertaining to becoming a successful individual who will contribute to the development of the nation in collaboration, engage in further studies and undertaking challenging job prospects in the future.
- Develop competencies related to understanding the scientific basis of the natural phenomena and the universe
- Use appropriate technology to maintain efficiency and effectiveness at an optimum level in utilizing energy and force.
- Develop competencies related to evaluation of day to day life experiences and information acquired through media by employing scientific criteria with the background of limitations and dynamic nature of science.

Teaching Sequence

School term	Competency level	Time (periods)
1st term	1.1 Investigates the importance of chemical basis of life	10
	3.1 Investigates the quantities related to rectilinear motion and the use of graphs of motion to analyze the rectilinear motion	09
	2.1 Investigates scientific findings about structure of matter	12
	3.2 Uses Newton's laws of motion to describe the effects of a force	09
	3.3 Investigates the nature and uses of friction	03
	1.2 Discovers the structure of plant and animal cells on the basis of microscopic observation	07
2nd term	2.2 Use mole to quantify elements and compounds	12
	1.3 Uses characteristic's of living things to differentiate the living from non-living	05
	3.4 Makes jobs easy using resultant of forces	05
	2.3 Relates properties of compounds with the existing bonds	10
	3.5 Estimates and measures the turning effect of a force	05
	3.6 Investigates the conditions of equilibrium	04
	1.4 Classifies organisms using suitable methods	12
	1.5 Investigates the patterns of inheritance of traits in organisms	11
3rd term	3.7 Uses the principles and laws of hydrostatics to realize activities related to sinking, floating and pressure transmission	08
	2.4 Uses chemical changes suitably to fulfill necessities in life	13
	2.5 Takes necessary measures to control the rate of a reaction as required in day-to-day life	05
	3.8 Quantifies the mechanical energy and power in mechanical processes	05
	3.9 Uses fundamental principles and laws of current electricity to understand and control the action of simple circuits	10
	1.6 Investigates the contribution of reproduction in maintaining the continuity of organisms	10

Syllabus
Grade 10 -Science

Competency	Competency level	Contents	Learning outcomes	Time
1.0 Explores life and life processes in order to improve productivity of biological systems	**1.1** Investigates the importance of chemical basis of life	• Chemical basis of life • Carbohydrates • proteins • lipids • Nucleic acids • Minerals • Vitamins • Water	**Student should be able to** • state carbohydrates, proteins, lipids and nucleic acids as major bio molecules of living matter. • state that carbon, hydrogen, oxygen and nitrogen are most abundant elements in living matter. • state the composition and examples of carbohydrates, proteins, lipids and nucleic acids. • introduce enzymes as proteins which catalyze chemical reactions in the cell or body. • conduct simple activities to demonstrate the action of enzyme. • briefly explain unique characteristics of water related to life (respiratory medium, as a solvent, thermal regulation of body, as a medium of transport, and living medium). • describe the roles of carbohydrates, proteins, lipids, nucleic acids, minerals, vitamins and water. • illustrate the importance of minerals and vitamins to the biological systems.	10

Competency	Competency level	Contents	Learning outcomes	Time
			• state the deficiencies of minerals and vitamins. • appreciate the nature of living matter. • accept that water is essential for life forms on the Earth.	
	1.2 Discovers the structure of plant and animal cells	• Basic unit of life • Concept of cell • Cell structure • Plant cell • Animal cell • Organelles and structures • Plasma membrane • Nucleus • Cell wall • Mitochondria • Cytoplasm • Vacuoles • Golgi body • Endoplasmic reticulum • Ribosome • Cell growth • Cell division	**Student should be able to** • classify a set of given cells as plant and animal cells using specific features. • state the concept of a typical cell. • compare and contrast the structure of the animal and plant cells. • state that the cell is structural and functional unit of life, all organisms are made up of one or more cells and all cells arise from pre-existing cells. • outline briefly the structure and functional relationship of cell organelles. • label organelles in a given diagram of cell. • explain cell growth and cell division. • state that mitosis and meiosis are the types of cell division. • compare mitosis and meiosis. • accept the microscopic nature of cell organelles. • appreciate cell as a structural and functional unit of life.	07

Competency	Competency level	Contents	Learning outcomes	Time
	1.3 Uses characteristic's of living matter to differentiate the living from non-living	• Characteristics of living things • Cellular organization • Nutrition • Respiration • Sensitivity • Excretion • Movement • Reproduction • Growth and development	**Student should be able to** • explain cellular organization, nutrition, respiration, sensitivity, excretion, movement, reproduction, growth and development as characteristics of living matter. • evaluate evidences to classify living and non-living matter.. • respect all living matter as life forms. • accept that some living forms are difficult to differentiate as living or non-living.	**05**
	1.4 Classifies organisms using suitable methods	• The world of life • Classification • Natural classification • Domains (introduction only) • Kingdoms • Protista • Fungi • Plantae • Animalia • Plantae • Non-flowering plants • Seed bearing plants • Non-seed bearing plants • Flowering plants	**Student should be able to** • explain the importance of classification. • state that there are natural and artificial methods of classification. • state the domains as Archaea, bacteria and Eukarya. • classify the living organisms as major groups –bacteria, protista, fungi, plantae and animalia based on their specific features. • identify monocots from dicots using their distinct features. • classify non flowering plants as seed bearing and non seed bearing with examples. • classify vertebrates as Pisces, Amphibia,	**12**

Competency	Competency level	Contents	Learning outcomes	Time
		• Monocotyledonous • Dicotyledonous • Animalia • Invertebrate • Coelenterata • Annelida • Mollusca • Arthropoda • Echinodermata • Vertebrate • Pisces • Amphibia • Reptilia • Aves • Mammalia • Nomenclature • Binomial nomenclature	Reptilia, Aves and Mammalia. • classify invertebrates as Coelenterate, Annelida, Mollusca, Arthropoda and Echinodermata. • write scientific names using binomial nomenclature.	
	1.5 Investigates the contribution of reproduction in maintaining the continuity of organisms	• Continuity of life -Reproduction • Reproduction • Sexual reproduction and asexual reproduction • Plant reproduction • Vegetative propagation • Traditional methods • Tissue culture • Sexual reproduction in plants	**Student should be able to** • differentiate sexual and asexual reproduction using suitable examples. • conduct simple activities to demonstrate vegetative propagation in plants. • explain basics behind tissue culture. • explain sexual reproduction in plants.	**10**

Competency	Competency level	Contents	Learning outcomes	Time
		• Seed formation • Dispersal of fruits and seeds • Human reproduction • Process • Hormonal control • Sexually transmitted diseases	• identify the methods of dispersal of fruits and seeds and their adaptations for it. • accept the concept of sustainable use of plant resources. • describe the processes of fertilization and implantation. • explain importance of menstrual cycle in human reproduction. • describe sexually transmitted diseases • act as a responsible citizen with regard to sexual behaviour.	
	1.6 Investigates the patterns of inheritance of traits in organisms	• Continuity of life - Heridity • Hereditary variations among living world • The work of Gregor Mendel • Applying Mendel's patterns • Key concepts in genetics • Chromosomes • Sex chromosomes • Autosomes • Gene • Gene expression • Gene linkage • Human heredity • Sex determination	**Student should be able to** • collect and present some examples to show common heredity characteristics in living world. • conduct bead experiment to investigate patterns in heredity. • explain Mendel's work on heredity using one contrasting characteristic. • describe chromosomes, sex chromosome, autosome, gene, gene expression and gene-linkage. • show understanding of concepts in gene linkage to explain genetic disorders such as Hemophilia, Color blindness, Thalasemia	11

Competency	Competency level	Contents	Learning outcomes	Time
		• Genetic disorders • Genetic engineering • Applications of genetic engineering in the field of agriculture, medicine and industries	and Albinism. • describe the possibility of manipulating genes quoting examples from the fields of food, agriculture, medicine and industries. • construct a Punnet square. • appreciate Mendel's experimental procedure as an example for effective use of scientific method. • accept the importance of avoiding marriages among blood relatives. • explain how genetic engineering is applied in various fields.	

Competency	Competency level	Contents	Learning outcomes	Time

2.0 Investigates matter, properties of matter and their interaction to enhance the quality of life	**2.1** Investigates scientific findings about structure of matter	• Planetary model of an atom
		• Electronic configuration (atomic number 1-20 only)
		• Modern periodic table
		  • Periods and groups
		• Isotopes
		• Patterns in the periodic table across a period and down a group
		  • First ionization energy
		  • Electronegativity
		  • Metals
		  • sodium, magnesium
		  • Metalloids
		  • silicon,boron
		  • Non -metals
		  • carbon, sulphur, nitrogen
		• Acidic, basic, amphoteric nature of oxides
		• Chemical formulae
		  • Valency
			Student should be able to
			• describe planetary model of atoms.
			• accept that electrons exist in energy levels and there is a maximum number of electrons that each energy level can occupy.
			• describe electronic configuration as a way of expressing the arrangement of electrons in energy levels.
			• write the electronic configuration of first 20 elements in the periodic table.
			• construct periodic table of first 20 elements based on their electronic configuration.
			• describe the terms group and period.
			• derive a relationship between the position of an element in the periodic table and its electronic configuration.
			• define the term ‘isotope’.
			• denote isotopes of an element with the standard notation.
			• accept that classification of elements facilitates learning about elements.
			• describe the term first ionization energy.
			• describe the term electronegativity.
				12

Competency	Competency level	Contents	Learning outcomes	Time
			• identify the variation pattern of first ionization energy and electronegativity of elements along the period and down the group. • accepts that there is a pattern in the variation of first ionization energy and electronegativity along the period and down the group. • describe the properties of metals, non metals and metalloids in relation to given examples. • state the acidic, basic and amphoteric nature of oxides of third period of elements. • define valency of an element. • deduce the valency of first twenty elements based on their positions in the periodic table. • formulate chemical formulae of compounds using valency.	

Competency	Competency level	Contents	Learning outcomes	Time
	2.2 Uses mole to quantify elements and compounds	• Atomic mass unit • Relative atomic mass • Relative molecular mass • Avogadro constant • Mole • Molar mass	**Student should be able to** • define the term atomic mass unit. • define the term relative atomic mass. • calculate relative atomic mass of a given atom. • define the term relative molecular mass. • calculate relative molecular mass of a given molecule. • calculate relative molecular mass of a compound using relative atomic mass of constituent elements. • define Avogadro constant. • describe mole as the unit of amount of substance. • state the definition of mole. • carry out calculations based on the relationship among mass, amount of substances and molar masses. • accept that relative atomic mass and relative molecular mass have no units while molar mass has unit.	**12**

Competency	Competency level	Contents	Learning outcomes	Time
	2.3 Relates properties of compounds with the existing bonds	• Chemical bonding • Ionic bonds • Covalent bonds • Polarity of bonds	**Student should be able to** • express that electrons participate in the formation of chemical bonding. • describe that atoms form cations by losing electrons and anions by gaining electrons. • determine the charge of an ion formed by a [Type a quote from the document or the summary of an interesting point. You can position the text box anywhere in the document. Use the Text Box Tools tab to change the formatting of the pull quote text box.]given atom based on its electronic configuration. • state that electron transfer takes place during the formation of ionic bonds. • illustrate the formation of ionic compounds diagrammatically. • accept ionic bond as a strong electrostatic attraction between cations and anions. • describe that covalent bond is formed by sharing pairs of electrons between atoms. • draw Lewis structures for simple covalent compounds. • construct models of ionic and covalent compounds • describe that a bond formed between two	**10**

Competency	Competency level	Contents	Learning outcomes	Time
			different atoms are polarized due to their electronegativity differences. • state that intermolecular bonds are formed in water due to the polarization of water molecule. • conduct simple activities to demonstrate physical properties of ionic and covalent compounds. • accept that elements form chemical bonds to become stable.	

	2.5 Takes necessary measures to control the rate of reaction as required in day-to-day life	• Rate of reaction
		• Factors affecting the rate of reaction
		  • Surface area/physical nature
		  • Temperature
		  • Concentration / pressure (only for gaseous system)
		  • Catalyst
			Student should be able to
			• give examples from day to day life for relatively fast and slow reactions.
			• define the term rate of reaction.
			• state the factors affecting the rate of reaction.
			• conduct simple activities to demonstrate the factors affecting the rate of reaction.
			• explain how a given factor affects the rate of reaction.
			• accept that the rate of reaction can be controlled as required.
				05

Competency	Competency level	Contents	Learning outcomes	Time

3.0 Utilizes various forms of energy, their interaction with matter and energy transformations by maintaining efficiency and effectiveness at an optimum level	**3.1** Investigates the quantities related to rectilinear motion and the use of graphs of motion to analyze the rectilinear motion	• Rectilinear motion
		  • Physical quantities related to motion
		  • Average speed and average velocity
		  • Speed and velocity
		  • Acceleration
		  • Acceleration due to gravity
		  • Graphs of motion
		  • Displacement- time (*s*-*t*) graphs
		  • Velocity- time (*v*-*t*) graphs
			Student should be able to
			• describe physical quantities related to motion (distance, displacement, speed, velocity and acceleration).
			• distinguish between average speed and speed, average velocity and velocity.
			• solve problems using *average speed = distance travelled/time taken*, *average velocity = displacement/time taken* & *acceleration = change in velocity/time taken.*
			• construct *s*-*t* graphs using given data and data obtained from a simple activity.
			• describe velocity from *s*-*t* graphs.
			• construct *v*-*t* graphs using given data.
			• explain that gradient obtained from *v*-*t* graph is the acceleration of motion.
			• state that the area under the curve of a *v*-*t* graph is the displacement of the object.
			• obtain relevant information from *s*-*t* and *v*-*t* graphs.
			• describe the nature of the rectilinear motion of a body using *s*-*t* and *v*-*t* graphs.
			• accept the importance of the information obtained from *s*-*t* and *v*-*t* graphs in
				09

			describing the nature of rectilinear motion of a body. (In *s-t* graphs, variation of the gradient is expected but no calculations are expected. In straight line *s-t* graphs, calculation of the gradient is expected. *v-t* graphs are expected only for uniformly accelerated motions. Calculation of acceleration from the gradient of the curve and calculation of displacement from the area under the curve is expected.)	

	3.2 Uses Newton's laws of motion to describe the effects of a force	• Force and its effects
		  • Newton's laws of motion
		  • Newton's first law of motion
		  • Newton's second law of motion
		  • Newton's third law of motion
		  • Momentum
			Student should be able to
			• conduct simple activities to show the effect of a force.
			• state Newton's laws of motion.
			• describe the concept of force using Newton's first law of motion.
			• show experimentally that
			$a \propto F$ (when m is constant)
			$a \propto \frac{1}{m}$ (when F is constant).
			• express Newton's second law of motion as $F=ma$.
				09

			• define the SI unit of force. • express Newton's third law of motion. • explain that action and reaction are two mutual forces equal in magnitude and opposite in direction which are acting in the same straight-line on two bodies. • use the relationship $F = ma$ relevantly in appropriate situations to solve problems. • appreciate the importance of Newton's laws of motion to explain the applications of force in day-to-day life. • state that the weight of an object is the force attracting towards the Earth and its magnitude is equal to the product of the mass and acceleration due to gravity. • explain the concept of momentum using relevant examples from day-to-day life. • conduct simple activities to show the factors affecting momentum. • represent momentum as the product of mass and velocity. • accept that the concept of momentum can be used to explain the relevant day-to-day phenomena.	

	3.3 Investigates the nature and uses of friction	• Friction
		  • Nature of friction
		  • Static friction
		  • Limiting friction
		  • The factors affecting the limiting frictional force
		  • Dynamic friction
			Student should be able to
			• conduct simple activities to show the nature of friction.
			• explain the variation of static frictional force between two surfaces with the external force.
			• conduct experiments to identify the factors affecting the limiting frictional force (It depends on the nature of the surfaces and the normal reaction. It does not depend on the area of the surfaces).
			• distinguish ‘ static friction’, 'limiting friction' and ‘dynamic friction’.
			• state that the dynamic frictional force acts on a moving object and it is constant. Also it is slightly lower than the limiting frictional force.
			• accept that friction always opposes relative motion between two surfaces. However, it is also utilized to produce motion.
			• appreciate the uses of friction in human activities.
				03

	3.4 Makes jobs easy using resultant of forces	• Resultant of forces • Resultant of two collinear forces • Resultant of two parallel forces	**Student should be able to** • describe the concept of the resultant of forces. • conduct simple activities to show the effect of resultant of forces. • conduct simple activities to find resultant of two collinear forces acting in the same direction and also in opposite directions. • conduct simple activities to find the resultant of two parallel forces acting in the same direction. • solve simple numerical problems to find the resultant of two collinear forces and of two parallel forces (the line of action of resultant force is not necessary). • accept that a large force can be obtained by a collection of small forces. • accept that there are ways of varying the magnitude and direction of a force according to the situation.	05

	3.5 Estimates and calculates the turning effect of a force	• Turning effect of force
		  • Moment of force
		  • Moment of couple of forces
			Student should be able to
			• conduct simple activities to demonstrate the turning effect of a force.
			• describe the factors affecting the moment of force.
			• express the moment of a force about a point as the product of the force and the perpendicular distance from the point to the line of action of the force.
			• express the unit of the moment of a force as N m.
			• state that the turning effect of the moment of a force can be clockwise or anti-clockwise.
			• describe the moment of a couple of forces.
			• make a list of instances where moment of a couple of forces apply in day-to-day life.
			• make calculations involving the moment of force.
			• accept the importance of turning effect of a force in day-to-day activities.
			• accept that moments appear in couples in many practical situations.
				05

	3.6 Investigates the conditions of equilibrium of forces	• Equilibrium of forces • Equilibrium under two forces • Equilibrium under three forces • Parallel forces • Non-parallel forces	**Student should be able to** • explain the equilibrium of forces on a body. • construct simple arrangements to demonstrate the equilibrium of forces. • explain the conditions necessary for two forces to be in equilibrium. • explain the conditions necessary for three parallel forces to be in equilibrium. • describe practical applications of equilibrium of forces. • state the conditions necessary for three non-parallel forces to be in equilibrium (qualitatively). • accept that the equilibrium can exist under more than three forces too. •	04
	3.7 Uses the principles and laws of hydrostatics to realize activities related to sinking, floating and pressure	• Pressure and its effects • Hydrostatic pressure • Factors affecting the hydrostatic pressure • Expression for hydrostatic pressure, $p = h\rho g$ • Atmospheric pressure • Measuring atmospheric pressure	**Student should be able to** • make simple devices to show the pressure exerted by liquids and gases. • express hydrostatic pressure (p) in terms of height of liquid column (h),density of liquid (ρ) and gravitational acceleration (g). • calculate the pressure exerted by a liquid using the expression $p = h\rho g$ • present instances where pressure exerted by	08

	transmission	• Sinking and floating
		  • Up-thrust
		  • Archimedes' principle
		  • Hydrometer
			liquids is productively used.
			• conduct simple activities to show the transmission of pressure.
			• accept the importance of pressure to make work easier.
			• accept that the transmission of pressure is very useful in modern technology.
			• state that atmospheric pressure can be measured by using the mercury barometer and the aneroid barometer.
			• state that atmospheric pressure varies with altitude.
			• obtain the reading of atmospheric pressure using aneroid barometer.
			• conduct simple activities to show the factors affecting up-thrust acting on a body due to a liquid.
			• demonstrate Archimedes' principle using a simple activity (calculations are not expected).
			• use simple set-ups to show the conditions necessary for sinking and floating.
			• explain the concepts of sinking and floating according to the weight of the object and the up-thrust.
			• accept that sinking and floating of objects	

			in liquids is determined by the up-thrust exerted by the liquid and the weight of the object. • explain the principle and the use of hydrometer. • use the hydrometer to measure density of liquids.	

	3.8 Quantifies the mechanical energy and power in mechanical processes	• Work, Energy and Power
		  • Mechanical energy
		  • Kinetic energy, $E_K = \frac{1}{2}mv^2$
		  • Potential energy
		  • Gravitational potential energy, $E_P = mgh$
		  • Elastic potential energy
		  • Power
			Student should be able to
			• state that the work done by a force is the product of the magnitude of the force and the displacement in the direction of the force.
			• make simple devices to demonstrate the applications of kinetic energy and potential energy.
			• explain the two forms of mechanical energy as kinetic energy and potential energy.
			$E_K = \frac{1}{2}mv^2$
			• provide the expression for kinetic energy as .
			• provide the expression for gravitational potential energy as
				05

			$E_P = mgh$ with reference to a zero potential level. • do calculations involving work, kinetic energy and gravitational potential energy. • accept that kinetic energy, gravitational potential energy and elastic potential energy can be used for human energy requirements. • accept that energy is used to do work. • state power as the rate of doning work. (*work done*/*time taken*) • calculate the power.	

	3.9 Uses fundamental principles and laws of current electricity to understand and control the action of simple circuits	• Current electricity
		  • Electric current
		  • Electron flow and conventional current
		  • Unit of current
		  • Use of ammeter to measure the current
		  • Potential difference
		  • Unit of potential difference
			Student should be able to
			• conduct simple activities to demonstrate the difference between static electricity and current electricity.
			• state the direction of conventional current in relation to the direction of electron flow.
			• accept that a flow of current occurs due to a potential difference.
			• describe that an electric source is used to supply a potential difference to a circuit.
				10

		• Use of voltmeter to measure the potential difference
		• Electric source and electromotive force (emf)
		• Resistance and resistors
		  • Units of resistance
		  • Factors affecting resistance
		  • Length of the conductor
		  • Cross sectional area of the conductor
		  • Resistivity of the material
		  • Resistor colour code
		• Ohm's law
		• Combination of resistors
		  • Equivalence resistance of series combination
		  • Equivalence resistance of parallel combination
			• state that the emf of a source is the potential difference between its terminals when no current flows from the source.
			• explain the resistance as a factor which opposes the flow of electric current.
			• conduct a simple activity to show the factors affecting the resistance of a conductor (length, cross-sectional area and resistivity).
			• conduct a simple experiment to show the relationship between V across a conductor and I.
			• show graphically the variation of potential difference with current.
			• use the relationship between V and I to express Ohm's law as $V = IR$.
			• state R as resistance of the conductor.
			• find the resistance of a resistor using the resistor colour code.
			• identify different types of resistors.
			• show qualitatively the variation of resistance in series and parallel combinations using simple devices.
			• give expressions for the equivalent resistance of resistors in series and parallel combinations.	

			• calculate the equivalent resistance in series and in parallel combinations. • accept that series and parallel combinations of resistors are very important in controlling the current in a circuit to suit the given condition.	

Instructions for Learning-Teaching Process

Competency 1.0: Explores life and life processes in order to improve productivity of biological systems

Competency level 1.1: Investigates the importance of chemical basis of life

Number of periods: 10

Learning outcomes:

Student should be able to

- state carbohydrates, proteins, lipids and nucleic acids as major bio molecules of living matter.
- state that carbon, hydrogen, oxygen and nitrogen are most abundant elements in living matter.
- state the composition and examples of carbohydrates, proteins, lipids and nucleic acids.
- introduce enzymes as proteins which catalyze chemical reactions in the cell or body.
- conduct simple activities to demonstrate the action of enzyme.
- briefly explain unique characteristics of water related to life (respiratory medium, as a solvent, thermal regulation of body, as a medium of transport, and living medium).
- describe the roles of carbohydrates, proteins, lipids, nucleic acids, minerals, vitamins and water.
- illustrate the importance of minerals and vitamins to the biological systems.
- state the deficiencies of minerals and vitamins.
- appreciate the nature of living matter.
- accept that water is essential for life forms on the Earth.

Instructions for lesson plans:

- Lead a discussion with students highlighting carbohydrates, proteins, lipids and nucleic acids as major bio-molecules in living matter.
- State the importance of minerals and vitamins
- Get students to engage in simple laboratory activities to show evidences for existence of carbon, hydrogen and oxygen in living matter.
- Use visual aids to make them understand on abundance of major elements in living matter (carbon, hydrogen, oxygen and nitrogen).
- Conduct a discussion and construct a concept map to describe role/ importance of major groups of bio-molecules in living matter.
- Conduct simple activities to demonstrate the action of enzyme as catalyst of chemical reactions in the cell.
- Engage students in preparing collection of sample plant specimens (specimen box) showing mineral deficiencies. Guide them to present plant mineral deficiencies in a tabulate form.

- Engage students in collecting photographs and illustrations of vitamin deficiency syndromes in human. Guide them to present vitamin deficiency syndromes in human in a tabulate form.
- Instruct students to collect articles written about unique characteristics of water related to life and let them to present their facts and information in front of the class (This may be organized as a group activity). Conduct a discussion to summarize unique characteristics of water related to life.

Keywords/ concepts:

Bio molecules
Enzymes
Catalysts

Instructions for assessment and evaluation:

- Assess students presentation skills while they are presenting their findings on "unique characteristics of water" based on
  - The content (number of characteristics they explored)
  - The suitability of presentation format
  - The quality of facts and information
  - The way they communicate
- Assess specimen box prepared by each students based on
  - The method of preservation
  - The quantity and diversity of specimens
  - Sufficiency and appropriateness of information collected with samples

Competency 1.0: Explores life and life processes in order to improve productivity of biological systems

Competency level 1.2: Discovers the structure of plant and animal cells

Number of periods: 07

Learning outcomes:

Student should be able to

- classify a set of given cells as plant and animal cells using specific features.
- state the concept of a typical cell.
- compare and contrast the structure of the animal and plant cells.
- state that the cell is structural and functional unit of life, all organisms are made up of one or more cells and all cells arise from pre-existing cells.
- outline briefly the structure and functional relationship of cell organelles.
- label organelles in a given diagram of cell.
- explain cell growth and cell division.
- state that mitosis and meiosis are the types of cell division.
- compare mitosis and meiosis.
- accept the microscopic nature of cell organelles.
- appreciate cell as a structural and functional unit of life.

Instructions for lesson plans:

- Let students observe epidermal peel of onion/Rhoeo/betel leaf under a optical microscope.
- Lead a discussion highlighting that hundreds of tiny box like structures seen under the microscope are called cells.
- Display labeled pictures/diagrams of plant and animal cells and build up the concept of typical cell.
- Involve students into following activities
  - List the features of a typical cell
  - Write major structural similarities between animal and plant cells.
  - Write major structural differences between animal and plant cells.
- Discuss with students about their findings.
- Introduce cell as a structural and functional unit of a living organism.
- Lead a discussion which would build up the following
  - Cell is the structural and functional unit of an organism
  - All living organisms are made up of one or more cells
  - All cells arise from the existing cells
- Introduce organelles as structural and functional sub units of a cell.

- Group the students and give them the pictures of plant and animal cells and make them involved in the following activities.
  - Tabulate the organelles as found both in plant and animal cells or plant cell /animal cell.
  - List down the major functions of organelles based on given text book/resource material.
  - Discuss with students about their findings and elaborate the functions of the organelles and chromosomes.
- Conduct a discussion highlighting the followings
  - Cell growth is a result of cell enlargement to a certain limit
  - Cell divides to produce two daughter cells
  - Introduce mitosis and meiosis are the two types of cell division
  - Comparison of mitosis and meiosis based on
    - Number of daughter cells produced
    - Chromosomal number
    - Importance

Keywords / concepts:

Cell
Typical cell
Organelle
Chromosomal number
Cell division
Cell growth

Instructions for assessment and evaluation:

- Assess the students while they are engaged in group activity based on the following criteria
  - Label correctly
  - Functions of organelles
  - Working cooperatively
- Assign students to prepare report about the importance of cell division
- Conduct an open book test

Competency 1.0: Explores life and life processes in order to improve productivity of biological systems

Competency level 1.3: Uses characteristics of living matter to differentiate the living from non-living

Number of periods: 05

Learning outcomes:

Student should be able to

- explain cellular organization, nutrition, respiration, sensitivity, excretion, movement, reproduction, growth and development as characteristics of living matter.
- evaluate evidences to classify living and non-living matter..
- respect all living matter as life forms.
- accept that some living forms are difficult to differentiate as living or non-living.

Instructions for lesson plans:

- Guide students observe the cellular organization of living things through microscopic slides and specimens.
- Let students observe and record some animals on modes of nutrition, breathing movements during respiration, responses to stimuli, locomotion and excretion.
- Let students observe and record some plants on gaseous exchange, responses to stimuli, growth and development.
- Explain nutrition and reproduction as characteristics of living things.
- Lead a discussion to explain the characteristics of living things based on the findings.
- Assign a group activity to evaluate similarities between plants and animals.
- Make students evaluate plants as life forms and should be given proper respect
- Discuss virus, emphasizing its living and non living nature.

Keywords / concepts:

Cellular organization
Nutrition
Respiration
Reproduction
Movement
Excretion
Sensitivity
Growth and development

Instructions for assessment and evaluation:

- Assess students while they are engaged in group activity based on following criteria
  - Relevancy of information
  - Extent of the content (similarities between plants and animals)
  - Presentation format/skills
  - Working cooperatively
- Conduct an open book test

Competency 1.0: Explores life and life processes in order to improve productivity of biological systems

Competency level 1.4: Classifies organisms using suitable methods

Number of periods: 12

Learning outcomes:

Student should be able to

- explain the importance of classification.
- state that there are natural and artificial methods of classification.
- state the domains as Archaea, bacteria and Eukarya.
- classify the living organisms as major groups – bacteria, protista, fungi, plantae and animalia based on their specific features.
- identify monocots from dicots using their distinct features.
- classify non flowering plants as seed bearing and non seed bearing with examples.
- classify invertebrates as Coelenterate, Annelida, Mollusca, Arthropoda and Echinodermata.
- classify vertebrates as Pisces, Amphibia, Reptilia, Aves and Mammalia.
- write scientific names using binomial nomenclature.

Instructions for lesson plans:

- Discuss the importance of classification.
- State there are natural and artificial methods of classification
- Introduce three domains.
- Guide students to present specific characteristics of bacteria, protista, fungi, plantae and animalia with examples, using suitable methods.
- Using suitable activities, lead students to classify plants as flowering and non flowering (examples only) and to further classify flowering plants as monocotyledonous and dicotyledonous and non flowering as seed bearing and non seed bearing plants giving examples.
- Let student find and present the characteristics of monocotyledonous and dicotyledonous plants.
- State that animals can be classified as invertebrate and vertebrate.
- Formulate suitable activities to lead students to classify invertebrates giving specific characteristics and examples for Coelenterates, Annelids, Mollusks, Arthropods and Echinoderms.
- Make students engage in suitable activities to classify vertebrates giving specific characteristics and examples for Pisces, Amphibians, Reptiles, Aves and Mammals.

- Conduct a discussion to lead to the fact that there is a hierarchical organization of classification and give hierarchical organization of classification from domain to species with suitable examples.
- Conduct a discussion to highlight the importance of standard method of nomenclature of organisms.
- Introduce binomial nomenclature of organisms.

Keywords / concepts:

Classification
Hierarchical organization
Vertebrates
Invertebrates
Binomial nomenclature

Instructions for assessment and evaluation:

- Assess students while they are engaged in activities to classify plants and animals based on following criteria
  - Quality of information
  - Relevancy of information
  - Presentation skill
- Assign students to present a report on classification of plants and animals based on following criteria
  - Organization of information
  - Relevancy of information
  - Sources used to gather information
  - Presentation format
- Conduct a written test

Competency 1.0: Explores life and life processes in order to improve productivity of biological systems

Competency level 1.5: Investigates the contribution of reproduction in maintaining the continuity of organisms

Number of periods: 10

Learning outcomes:

Student should be able to

- differentiate sexual and asexual reproduction using suitable examples.
- conduct simple activities to demonstrate vegetative propagation in plants.
- explain basics behind tissue culture.
- explain sexual reproduction in plants.
- identify the methods of dispersal of fruits and seeds and their adaptations for it.
- accept the concept of sustainable use of plant resources.
- describe the processes of fertilization and implantation.
- explain importance of menstrual cycle in human reproduction.
- describe sexually transmitted diseases
- act as a responsible citizen with regard to sexual behaviour.

Instructions for lesson plans:

- Divide the class into groups. Guide students to differentiate the given samples (pictures…etc) of plants and animals according to their reproductive methods and categorize as sexual and asexual. Explain the differences between sexual and asexual reproductions.
- Guide students to prepare simple activities to show natural and artificial methods of plant propagation including tissue culture.
- Explain that flower is the sexual reproductive organ of flowering plants.
- Let students perform a laboratory activity to identify parts of flower and draw L.S of flower. Conduct a discussion describing the roles of parts of a flower.
- Let students explore pollination methods in plants and guide them to conduct a project about plant pollination (Topics could include – different pollination methods and agents).
- Explain briefly how fertilization takes place in flowering plants and seed formation and dispersal of fruits and seeds.
- Conduct a discussion on the basic events pertaining to fertilization and implantation in human using pictures or outline diagrams/ video.
- Let students construct concept maps showing functions of reproduction in human.

- Explain menstrual cycle using suitable diagrams/illustration emphasizing importance of cyclic form of menstrual cycle of human and highlight the following concepts
  - Puberty
  - Secondary sexual characteristics
  - Hormonal effects on menstrual cycle
  - Birth
- Let students investigate sexually transmitted diseases such as syphilis, gonorrhea, HIV- AIDS and herpes and present a report. This reports should include
  - Causative organisms
  - Symptoms
  - Prevention

Instructions for assessment and evaluation:

- Let students use a diagram to trace the pathway of pollen from stigma to ovary during the fertilization process and assess them on the following criteria
  - Accuracy
  - Proportion of diagram
  - Proper labeling
- Conduct a written test on plant and animal reproduction
- Assess students reports based on
  - Incorporation of information from various sources
  - Accuracy
  - Clarity and sequence in presentation

Competency 1.0: Explores life and life processes in order to improve productivity of biological systems

Competency level 1.6: Investigates the patterns of inheritance of traits in organisms

Number of periods: 11

Learning outcomes:

Student should be able to

- collect and present some examples to show common heredity characteristics in living world.
- conduct bead experiment to investigate patterns in heredity.
- explain Mendel's work on heredity using one pair of contrasting characteristics.
- describe chromosomes, sex chromosome, autosome, gene, gene expression and gene-linkage.
- show understanding of concepts in gene linkage to explain genetic disorders such as Hemophilia, Color blindness, Thalasemia and Albinism.
- describe the possibility of manipulating genes quoting examples from the fields of food, agriculture, medicine and industries.
- construct a Punnet square.
- appreciate Mendel's experimental procedure as an example for effective use of scientific method.
- accept the importance of avoiding marriages among blood relatives.
- explain how genetic engineering is applied in various fields.

Instructions for lesson plans:

- Ask the students to observe and list out the following characteristics among them; tongue rolling, attached ear lobes, dimples, straight thumb, widow's peak etc
- Conduct a discussion to explain above characteristics as hereditary characteristics (use visual aids if necessary)
- Assign students to collect information and report on hereditary characteristics in the living world
- Direct the students to present their findings
- Guide students to conduct the experiment using beads (or any other suitable material) to investigate patterns in heredity and instruct the students to present their findings. Conduct a discussion to analyze the results of the experiment and relate the findings to explain Mendel's work
- Describe Mendel's work on heredity using one pair of contrasting characteristics (Tall/short plants, round/ wrinkled seeds, yellow/green seeds, green/ yellow pod color etc)
- Conduct a discussion on Mendel's experimental procedure as an example for effective use of scientific process (sharp observations, proper recording, mathematical analysis of experimental results etc)

- Explain that the factors responsible for carrying hereditary characteristics from one generation to the next are called genes
- Explain the terms chromosome, sex chromosome, autosome, gene expression and gene linkage
- Describe genetic disorders such as hemophilia, color blindness, thalassaemia and albinism ,emphasizing their social effects
- Highlight the importance of abstaining from marriages among blood relatives
- Let the students work out the ratios as normal: diseased: carrier offspring when at least one parent is a carrier/ diseased
- Let the students construct a Punnet square for contrasting pairs of characteristics and find out the phenotype ratios of the offspring.
- Assign the students to find out and present examples for gene manipulation from the following fields ;food , agriculture ,medicine and Industry

Keywords / concepts:

Chromosome
Gene
Gene expression
Gene linkage
Human heredity
Sex determination
Genetic disorders

Quality inputs:

Beads (100 white and 100 red per group), beakers or suitable containers, text book, web resources, relevant pictures and articles

Instructions for assessment and evaluation:

- Assess students on their presentation of hereditary characteristics
  - Relevancy of the information
  - Presentation skills
- Assess students while they are engaged in the bead experiment
  - Analyzing the results
  - Team work
  - Presentation skills
- Evaluate students on solving the problems regarding inheritance
  - Analyzing the results
  - Accuracy

Competency 2.0: Investigates matter, properties of matter and their interaction to enhance the quality of life

Competency level 2.1: Investigates scientific findings about structure of matter

Number of periods: 12

Learning outcomes:

Student should be able to

- describe planetary model of atoms.
- accept that electrons exist in energy levels and there is a maximum number of electrons that each energy level can occupy.
- describe electronic configuration as a way of expressing the arrangement of electrons in energy levels.
- write the electronic configuration of first 20 elements in the periodic table.
- construct periodic table of first 20 elements based on their electronic configuration.
- describe the terms group and period.
- derive a relationship between the position of an element in the periodic table and its electronic configuration.
- define the term 'isotope'.
- denote isotopes of an element with the standard notation.
- define valency of an element.
- deduce the valency of first twenty elements based on their positions in the periodic table.
- formulate chemical formulae of compounds using valency.
- accept that classification of elements facilitates learning about elements.
- describe the term first ionization energy.
- describe the term electronegativity.
- identify the variation pattern of first ionization energy and electronegativity of elements along a period and down a group.
- accepts that there is a pattern in the variation of first ionization energy and electro negativity along a period and a group.
- describe the properties of metals, non metals and metalloids in relation to the given examples.
- state the acidic, basic and amphoteric nature of oxides formed by of third period determents

Instructions for lesson plans:

- Recall the knowledge of atom and sub atomic particles.
- Ask students' views about how sub atomic particles exist in the atom.
- Remind the way that planets orbit around the sun.
- Simulate the arrangement of the planetary system to the arrangement of sub atomic particles in the atom.
- Assign students to make models using commonly available materials to illustrate the planetary model of the atom.
- Provide the information about shells, the highest number of electrons that can exist in each shell.
- Ask students to illustrate diagrammatically how electrons are distributed in shells of an atom of each element from atomic number 1-20.
- Guide students to write electronic configurations of elements from atomic number 1-20.
- Ask students to categorize the elements of atomic number 1-20 based on the number of electrons in the outermost shell and the number of occupied orbits.
- Recall students' knowledge about Dalton's atomic theory.
- Describe the existence of isotopes as a deviation of Dalton's atomic theory.
- Let students study about isotopes of several elements by referring to the number of electrons, protons and neutrons.
- Denote isotopes of different elements using standard notation.
- Introduce the periodic table, periods and groups.
- Let students to identify the relationships between the position of an element in the periodic table and its electronic configuration.
- Discuss the importance of classifying elements.
- Describe the concepts electronegativity and first ionization energy.
- Highlight that the periodic patterns in the periodic table by referring to electronegativity graph and first ionization energy graph.
- Provide students with the long form of periodic table and let them find the distribution of metals, non metals and metalloids in it.
- Assign student groups to refer the long form of periodic table and extract as many information as possible from it.
- Let them present their finding in a form of a small booklet.
- Describe physical and chemical properties of metals, non metals and metalloids taking the elements given elements in the syllabus as examples.
- Describe acidic, basic and amphoteric nature of oxides of elements in the third period.
- Assign each student to gather as many information as possible about one element given under metal or non metal or metalloid and prepare a poster about the assigned element.

- Conduct a poster session in the classroom and let each student brief the information exhibited.
- Introduce the concept valency.
- Provide a table of data for them to find valencies of simple ions and ion groups.
- Illustrate how valency can be used to derive chemical formulae of simple compounds with the help of a suitable teaching aid.
- Assign students to derive chemical formula of simple compounds in relation to the constituent elements and/or ion groups.
- Ask student groups to illustrate how chemical formulae can be derived from the valencies of constituent elements using suitable methods.

Keywords / concepts:

Electronic configuration
Isotopes
Periodic table, groups and periods
Valency
Ionization energy
Electronegativity
Metals, non metals and metalloids
Acidic, basic and amphoteric nature

Quality inputs:

Samples of metals, non metals and metalloids given in the syllabus, a modern full periodic table, wire, beads of different sizes and colours, Styrofoam boards, marker pens

Instructions for assessment and evaluation:

- Assess students' group activity based on the following criteria.
  - Amount of information gathered
  - Presentation of information in the booklet
  - Contribution to the group activity
- Assess each student's poster and presentation based on the following criteria.
  - Amount of information gathered
  - Presentation of information in the poster
  - Comprehension about the information exhibited
- Assess student groups based on the following criteria
  - Creativity of the model
  - Use of suitable and low cost materials
  - Clarity and accuracy of presentation
  - Participation in the group work

Competency 2.0: Investigates matter, properties of matter and their interaction to enhance the quality of life

Competency level 2.2: Uses mole to quantify elements and compounds

Number of periods: 12

Learning outcomes:

Student should be able to

- define the term atomic mass unit.
- define the term relative atomic mass.
- calculate relative atomic mass of a given atom.
- define the term relative molecular mass.
- calculate relative molecular mass of a given molecule.
- calculate relative molecular mass of a compound using relative atomic mass of constituent elements.
- define Avogadro constant.
- describe mole as the unit of amount of substance.
- state the definition of mole.
- carry out calculations based on the relationship among mass, amount of substances and molar masses.
- accept that relative atomic mass and relative molecular mass have no units while molar mass has unit.

Instructions for lesson plans:

- Conduct a discussion on the units used to measure the mass of various substances. (ie:huge stones, a brick, spoonfull of sugar, amount of drug in a tablet, a molecule, an atom)
- Describe that the smallest unit of mass, the atto gram (1 ag = 10^{-18} g) is too large to measure the mass of small particles such as molecules, atoms, ions etc..
- Introduce the atomic mass unit (amu) as the unit of mass used to express the mass of very small particles.
- Define the atomic mass unit as one twelveth of the mass of ^{12}C.
- Explain how average relative atomic mass is calculated by using the relative abundance of isotopes of an element (take Cl as an example).
- Define the relative atomic mass (A_r or RAM) as the ratio of the average atomic mass of an element to $1/12^{th}$ of the mass of ^{12}C atom.
- Direct students to calculate A_r of some elements using mass of those atoms and the mass of ^{12}C atom are given.
- Define the relative molecular mass (M_r or RMM) as the ratio of molecular mass of an element or a compound to $1/12^{th}$ of the mass of ^{12}C atom.

- Conduct a discussion leading to the fact that neither A_r nor M_r has units.
- Workout, with students, examples of calculating M_r of some molecules using the A_r values of the constituent atoms referring data tables.
- Direct the students to calculate relative molecular mass of given compounds using relative atomic mass of constituent elements.
- Lead a discussion to define the mole (mol) as the amount of substance that contains as many entities as there are atoms in 0.012 kg of ^{12}C. Express that accurate experimental determination shows that the number basic entities contained in one mole of a substance is 6.022×10^{23} .
- State that this constant associated with one mole of substance is known as Avagadro's Constant. ($N_A = 6.022 \times 10^{23}$)
- Carryout a simulation using beads or seeds of various masses to clarify that there is a constant number of atoms in A_r of various elements when weighed in grams.
- Clarify that there is a constant number of molecules in M_r of various elemente and compounds when weighed in grams as well.
- Describe Molar Mass as the mass of one mole of particles of a substance.
- Workout the following examples, with the students.
- calculation of number of atoms/molecules when the masses of elements/compounds are given in grams.
- calculation of number of atoms/molecules when the number of moles are given.
- calculation of the number of moles when the masses of elements/ compounds are given.
- calculation of the masses when the number of moles are given.

Keywords / concepts:

Atomic Mass Unit (amu)

Relative Atomic Mass (A_r)

Relative Molecular Mass (M_r)
Avogadro Constant (N_A)
Mole (mol)
Molar Mass

Quality inputs:

Textbook, beads or seeds of various masses

Instructions for assessment and evaluation:

- Evaluate the students giving them exercises similar to worked out examples given in the relevant chapter of the textbook

Competency 2.0: Investigates matter, properties of matter and their interaction to enhance the quality of life

Competency level 2.3: Relates properties of compounds with the existing bonds

Number of periods: 10

Learning outcomes:

Student should be able to

- express that electrons participate in the formation of chemical bonding.
- describe that atoms form cations by losing electrons and anions by gaining electrons.
- determine the charge of an ion formed by a given atom based on its electronic configuration.
- state that electron transfer takes place during the formation of ionic bonds.
- illustrate the formation of ionic compounds diagrammatically.
- accept ionic bond as a strong electrostatic attraction between cations and anions.
- describe that covalent bond is formed by sharing pairs of electrons between atoms.
- draw Lewis structures for simple covalent compounds.
- construct models of ionic and covalent compounds
- describe that a bond formed between two different atoms are polarized due to their electronegativity differences.
- state that intermolecular bonds are formed in water due to the polarization of water molecule.
- conduct simple activities to demonstrate physical properties of ionic and covalent compounds.
- accept that elements form chemical bonds to become stable.

Instructions for lesson plans:

- Ask the students to give examples for molecules and mono atomic gases.
- Conduct brain storming session to explain the stability of mono atomic gases using electronic configuration and lead to a discussion why bonds are formed.
- Use different colour beads to denote electron and proton and explain the formation of cations and anions and guide to deduce the charge of the ion formed.
- Develop the discussion to highlight that electrons participate in the formation of chemical bonding.
- Guide the students to explain the formation of ionic bonds using different colour beads.
- Ask students to illustrate diagrammatically the formation of ionic bond.
- Give examples for ionic compounds.
- Introduce covalent bond as a bond formed by sharing pairs of electrons between atoms.
- Guide the students to explain the covalent bond using different colour beads.
- Let students to draw Lewis structures of molecules of simple covalent compounds.

- Give examples for covalent compounds.
- Divide the class into small groups and give each group the materials needed and guide groups to construct models of ionic and covalent bonds.
- Introduce electronegativity as the tendency of an atom in a bond to attract bonding electrons towards itself.
- Explain that when similar atoms are in bonding there is no difference in electronegativity.
- Explain polarity of covalent bonds using diagrams based on the electronegativity differences.
- Conduct a discussion on the nature of bonding (polarity) in water and the intermolecular bonds in water.
- Conduct simple activities to demonstrate physical properties of ionic and covalent compounds (using salt and sugar solution showing the electrical conductivity of compounds, melting points of sodium chloride and wax).
- Let students list the physical properties of ionic and covalent compounds.

Keywords / concepts:

Cation
Anion
Ionic bond
Covalent bond
Electronegativity
Polarity
Intermolecular forces

Quality inputs:

Different colour beads, ekkels and clay, beakers, connecting wires, bulbs, sodium chloride, sugar, Bunsen burner, batteries/dry cells, laboratory atomic model sets.

Instructions for assessment and evaluation:

- Assess student groups work on constructing models of ionic and covalent compounds based on the following criteria.
  - Construction of models
  - Explanation for the structure
  - Accuracy of the models
  - Sharing of materials
- Assess students while they engage in group activity based on the following criteria
  - Arrangement of set ups
  - Recording the observations
  - Conclusions based on observation
  - Working cooperatively

Competency 2.0: Investigates matter, properties of matter and their interaction to enhance the quality of life

Competency level 2.4: Uses chemical changes suitably to fulfill necessities in life

Number of periods: 10

Learning outcomes:

Student should be able to

- differentiate chemical changes from physical changes.
- conduct simple activities to demonstrate different types of chemical reactions.
- state the types of reactions with examples.
- classify given reactions under each type.
- write balanced chemical equations using inspection method.
- appreciate the importance of chemical symbols, formulae and equations as a way of communication.
- conduct simple activities to demonstrate reactions of the given metals with air, water and dilute acids.
- compare reactivity of given metals with air , water and dilute acids and construct the activity series for the given metals based on their reactivity.
- state that activity series is based on reactivity of metals.
- determine the position of given metals in the activity series based on displacement reactions.
- state uses of activity series.
- accept that there is a relationship between reactivity of the metal and its position in the activity series.
- explain how the method of extraction of the metals is related to their positions in the activity series.
- describe the method of extraction of iron by reduction using blast furnace.
- write the basic reactions involved in the extraction of iron from hematite.
- relate the method of extraction of gold with its position in the activity series.
- suggest a suitable extraction method for a given metal based on its position in the activity series.
- name suitable chemicals that can be used to prepare hydrogen, oxygen and carbon dioxide gases in school laboratory.
- write relevant chemical reactions of the preparation of hydrogen, oxygen and carbon dioxide gases in school laboratory.
- collect samples of hydrogen, oxygen and carbon dioxide gases using suitable apparatus.
- state physical properties of hydrogen, oxygen and carbon dioxide gases.
- conduct simple tests to identify hydrogen, oxygen and carbon dioxide gases.
- list the uses of hydrogen, oxygen and carbon dioxide gases.

Instructions for lesson plans:

- Demonstrate few physical and chemical changes. Conduct a discussion by highlighting the following concepts:
  1. Chemical changes
  2. Difference between chemical and physical changes
  3. Evidence for chemical changes
- Conduct following laboratory practical or any other suitable reactions to demonstrate the four types of reactions.
  - Reaction of Mg with O_2
  - Reaction of Fe with S
  - Thermal decomposition of $KMnO_4$
  - Thermal decomposition of $KClO_3$ or KNO_3
  - Reaction of Zn with $CuSO_4$
  - Reaction of Mg with dilute HCl
  - Reaction of $BaCl_2$ with Na_2SO_4
  - Reaction of $FeSO_4$ with NaOH
- Let the students record the observations including the followings.
  - Nature of the reactants
  - Observations during the reaction
  - Nature of the products
- Write word equations for the above reactions and guide the students to write chemical equations for them.
- Classify the above reactions based on the observations as Combination, Decomposition, Single Displacement and Double Displacement. Illustrate them by g generalized equations.
- Explain how to balance chemical equations by following the inspection method.
- Conduct a discussion about the information that can be gathered from a balanced chemical equation and appreciate the importance of chemical symbols, formulae and balanced chemical equations as a way of communication.
- Divide the class into five groups. Give each group a card with five written chemical changes using word equation. Then, ask each group to,
  1. write chemical equations for them
  2. balance them using inspection method
  3. classify them according to type of reactions

  and ask each group to present their findings to the class. Correct and enrich their finding.

- Direct the students to observe the changes with time, when exposing following metals to air.
  1. freshly cut piece of sodium
  2. Cleaned 2 cm magnesium ribbon

- According to the observations, compare the reactivity of two metals. Let them identify the difference of reactivites of various metals.
- Conduct laboratory activities to observe the reactivity of the given metals separately with the followings.
  1. Air
  2. Hot water and cold water
  3. Diluted acids

Metals: Na, Mg, Al, Zn, Fe, Cu

Caution! Never attempt to react Na with acids or hot water

- Compare the reactivity of the above metals based on the observations.
- Let students arrange these metals according to decreasing order of reactivity.
- Introduce the activity series and let students check whether their findings agree with it.
- Conduct a laboratory practical to show the displacement reactions using the following.
  1. Fe with $CuSO_4$
  2. Cu with $FeSO_4$
- Mention methods of extraction of metals based on their positions in the activity series
  1. Electrolysis of molten compounds
  2. Reduction of the metal ore
  3. Physical methods to separate them from the impurities.
- Conduct a discussion about iron extraction on the following topics.
  1. raw materials
  2. process
  3. main reactions involved in the extraction of iron from hematite.
- Highlight that physical separation techniques are used for the extraction of gold.
- Assign student groups to prepare one of the gases given below and to find their properties. Let them conduct simple tests to identify the gases.
  1. O_2
  2. CO_2
  3. H_2
- Let each group record the observations and present their findings to the class.
- Conduct a discussion about the uses of the above gases and list them out.

Keywords / concepts:

Physical changes
Chemical changes
Balanced chemical equations
Activity series
Metal extraction
Combination reaction
Decomposition reaction
Single displacement reaction
Double displacement reaction

Quality inputs:

Mg ribbon, Fe powder, Zn, Cu, Sulphur powder, $KMnO_4$, $KClO_3$, Zn, $CuSO_4$ solution, Cu

Instructions for assessment and evaluation:

- Assess the students based on the following criteria when presenting their findings
  - Recording of observations
  - Accuracy of the information
  - Completeness of the information
  - Presentation skills
- Assess students based on the following criteria when presenting the balanced chemical equations.
  Accuracy in writing chemical formulae,
  - balancing chemical equations
  - classifying reactions
- Conduct an open book test based on the facts in the textbook about activity series.
- Assess the students while they are engaged in the of preparation of gases based on the following criteria.
  - following the given instructions
  - active participation
  - arrangement of the set-up
  - observation skills
  - presentation skills
  - manipulating skills
- Assess the students by the diagrams drawn for the set up of production of gases.
  - neatness of the diagram
  - accuracy of the labeling
  - drawing the instruments to the relevant ratio
  - drawing the instrument to show correct shape

Competency 2.0: Investigates matter, properties of matter and their interaction to enhance the quality of life

Competency level 2.5: Takes necessary measures to control the rate of reaction as required in day-to-day life

Number of periods: 05

Learning outcomes:

Student should be able to

- give examples from day to day life for relatively fast and slow reactions.
- define the term rate of reaction.
- state the factors affecting the rate of reaction.
- conduct simple activities to demonstrate the factors affecting the rate of reaction.
- explain how a given factor affects the rate of reaction.
- accept that the rate of reaction can be controlled as required.

Instructions for lesson plans:

- Ask the students to give examples for fast and slow reactions.
- Define rate of reaction and conduct a brain storming session to highlight the importance of controlling the rate of reaction in daily life.
- Design simple activities to demonstrate the factors affecting the rate of reaction.
  - Surface area/ Physical nature
  - Temperature
  - Concentration/pressure
  - Catalyst
- Let students present their findings to the class.
- Lead the discussion to highlight how each factor. affects the rate of the reaction (explanation is not necessary for how catalyst affects rate of reaction).
- Lead a discussion to highlight where the factors effecting rate of reaction are controlled to get desired results in day to day life.
-

Keywords / concepts:

Rate of the reactions
Catalyst
Surface area
Concentration

Quality inputs:

$Na_2S_2O_3$, $CaCO_3$, HCl acid, Iron wool and nails H_2O_2, MnO_2 Thermometer.

Instructions for assessment and evaluation:

- Assess students while they are involved in group work using the following criteria.
  - Accuracy of the information presented
  - Completeness of the information presenter
  - Presentation skills
- Conduct a written test on factors affecting rate of reaction.

Competency 3.0: Utilizes various forms of energy, their interaction with matter and energy transformations by maintaining efficiency and effectiveness at an optimum level

Competency level 3.1: Investigates the quantities related to rectilinear motion and the use of graphs of motion to analyze the rectilinear motion

Number of periods: 09

Learning outcomes:

Student should be able to

- describe physical quantities related to motion (distance, displacement, speed, velocity and acceleration).
- distinguish between average speed and speed, average velocity and velocity.
- solve problems using
  average speed = distance travelled/time taken
  average velocity = displacement/time taken
  acceleration = change in velocity/time taken
- construct *s-t* graphs using given data and data obtained from a simple activity.
- describe velocity from *s-t* graphs.
- construct *v-t* graphs using given data.
- explain that gradient obtained from *v-t* graph is the acceleration of motion.
- state that the area under the curve of a *v-t* graph is the displacement of the object.
- obtain relevant information from *s-t* and *v-t* graphs.
- describe the nature of the rectilinear motion of a body using *s-t* and *v-t* graphs.
- accept the importance of the information obtained from *s-t* and *v-t* graphs in describing the nature of rectilinear motion of a body.

(In *s-t* graphs, variation of the gradient is expected but no calculations are expected.
In straight-line *s-t* graphs, calculation of the gradient is expected.
v-t graphs are expected only for uniformly accelerated motions.
Calculation of acceleration from the gradient of the curve and calculation of displacement from the area under the curve is expected.)

Instructions for lesson plans:

- Conduct a discussion highlighting the physical quantities, distance Speed velocity and acceleration and displacements (*s*) related to recti-linear motion.
- Introduce the physical quantities average speed and average velocity.
- Engage students in solving simple numerical problems using the expressions for average speed, average velocity and acceleration.
- Direct students to draw a displacement-time (*s*-*t*) graph for given experimental data of displacement and time.
- Direct students to do a simple activity to obtain data for displacement and time and then to plot a displacement-time (*s*-*t*) graph using this data.
- Conduct a discussion highlighting the fact that the gradient of the *s*- *t* graph gives velocity.
- Provide students experimental data for velocity and time related to uniformly accelerated motion of a body and guide them to plot a velocity-time (*v*-*t*) graph.
- Conduct a discussion highlighting the facts that the gradient of the *v*-*t* graph gives the acceleration and the area under the curve gives the displacement of the object.
- Explain that a negative gradient of a *v*-*t* graph indicates a deceleration.
- Guide the students to calculate the gradient of a straight-line *s*-*t* graph, the gradient of a *v*-*t* graph of a uniformly accelerated motion and also the area under this graph.
- Explain the nature of linear motion of various objects using the gradient of displacement-time (*s*-*t*) graph.
- Guide the students to explain the linear motion of an object using given a displacement-time (*s*-*t*) and velocity-time (*v*-*t*) graphs (including uniform velocity and uniform acceleration).
- Explain that an object movies with uniform vertical acceleration under gravity and it is named as gravitational acceleration.

Keywords / concepts:

Distance
Displacement
Time
Speed
Uniform speed
Average speed
Velocity
Uniform velocity
Average velocity
Acceleration
Deceleration

Quality inputs:

A smooth trolley, a long pin, a small amount of clay, a stop watch, a long smooth flat plank (8 feet x 6 inches), a metre tape, a clamp stand

Instructions for assessment and evaluation:

- Access students according to the following criteria while they involved in plotting graphs using the following criteria
  - Selecting proper scales for axes
  - Plotting correctly the given data
  - Constructing the graph correctly
- Assess students according to the following criteria while they are obtaining information from the given graph.
  - Responses to the guidance
  - Relevance of the in information obtained
  - Accuracy of the information obtained
- Evaluate the students using a short test paper laying emphasis on the use of *s*-*t* and *v*-*t* graphs in predicting the nature of the linear motion of a body

Competency 3.0: Utilizes various forms of energy, their interaction with matter and energy transformations by maintaining efficiency and effectiveness at an optimum level

Competency level 3.2: Uses Newton's laws of motion to describe the effects of a force

Number of periods: 09

Learning outcomes:

- conduct simple activities to show the effect of a force.
- state Newton's laws of motion.
- describe the concept of force using Newton's first law of motion.
- show experimentally that

  $a \propto F$ (when m is constant)

  $a \propto \frac{1}{m}$ (when F is constant).
- express Newton's second law of motion as $F=ma$.
- define the SI unit of force.
- express Newton's third law of motion.
- explain that action and reaction are two mutual forces equal in magnitude and opposite in direction which are acting in the same straight-line on two bodies.
- use the relationship $F=ma$ relevantly in appropriate situations to solve problems.
- Express that weight of an object is the forces attracted towards the earth and it is equal to the product of the mass and the gravitational acceleration
- appreciate the importance of Newton's laws of motion to explain the applications of force in day-to-day life.
- explain the concept of momentum using relevant examples from day-to-day life.
- conduct simple activities to show the factors affecting momentum.
- represent momentum as the product of mass and velocity.
- accept that the concept of momentum can be used to explain the relevant day-to-day phenomena.

Instructions for lesson plans:

- Show that when there is no external unbalanced force acting on an object at rest, it remains at rest.
- Show that as long as there is no external unbalanced force acting on an object which is moving it continues to move with the uniform velocity.
- State Newton's first law of motion and explain it using a simple activity.
- Conduct a simple activity to demonstrate Newton's second law of motion.
- Using the above activity, obtain the relationship $F = ma$.

- Define SI unit and of forces Newton and express Newton's 2nd law as $F = ma$.
- Direct students to solve simple numerical problems using $F = ma$.
- Explain the difference between the terms mass and weight of an object.
- Introduce action and reaction using simple activities.
- Highlighting the following facts regarding action and reaction, conduct a discussion leading to stating Newton's third law of motion.
  - Do not act on a single object and act mutually on each other
  - Act on the same straight line with equal magnitudes but in opposite directions
- Define momentum as the product of mass and velocity of the body (momentum = m x v)
- Show that the momentum of a body depends on its mass and the velocity of the body.
- Group students and assign them to write instances in everyday life that can be explained by Newton's laws of motion. Then get them to make presentations to the class.

Keywords / concepts:

Newton's laws of motion
newton
Momentum
Action and reaction

Quality inputs:

Smooth pulleys, smooth trolleys, spring balances, rubber bands

Instructions for assessment and evaluation:

- Students explain using Newton's laws, three instances involving motion as mentioned by the teacher.
- Assess the above activity with respect to the following criteria.
  - Use of the relevant law for the explanation
  - Correctness and clarity of the explanation

Competency 3.0: Utilizes various forms of energy, their interaction with matter and energy transformations by maintaining efficiency and effectiveness at an optimum level

Competency level 3.3: Investigates the nature and uses of friction

Number of periods: 03

Learning outcomes:

Student should be able to

- conduct simple activities to show the nature of friction.
- explain the variation of static frictional force between two surfaces with the external force.
- conduct experiments to identify the factors affecting the limiting frictional force (It depends on the nature of the surfaces and the normal reaction. It does not depend on the area of the surfaces).
- distinguish ‘ static friction’, 'limiting friction' and ‘dynamic friction’.
- state that the dynamic frictional force acts on a moving object and it is constant. Also it is slightly lower than the limiting frictional force.
- accept that friction always opposes relative motion between two surfaces. However, it is also utilized to produce motion.
- appreciate the uses of friction in human activities.

Instructions for lesson plans:

- Show by means of simple activities that when an attempt is made to move an object on a surface, a force acts opposing it.
- Introduce friction as the property which attempts to prevent motion of an object on a surface.
- Introduce frictional force as the force which opposes the relative motion between two surfaces in contact.
- Through simple activities show that when an external force acting on an object parallel to the surface on which the object is kept is gradually increased, the frictional force too increases and reaches a maximum value.
- Explain that the frictional force acting before the object begins to move, is the 'static frictional force'.
- Also explain that when the applied force is further increased the body will start to move at a certain moment and the static frictional force at this moment is called the ‘limiting frictional force’.

- Explain through a discussion that the frictional force acting when the object is in continuous motion is called the 'dynamic frictional force' and it is little less than the limiting frictional force.
- Engage students in a simple activity to investigate how the following factors affect the limiting frictional force.
  - nature of surfaces
  - normal reaction
  - area of the surfaces
- Make a list of situations where the frictional force is used.

Keywords / concepts:

Static frictional force
Limiting frictional force
Dynamic frictional force

Quality inputs:

A cuboid wooden block of equal size, sand papers, rubber bands, spring balances and newton balances

Instructions for assessment and evaluation:

- Assess students' practical activities using the following criteria
  - Accuracy of the activities
  - Active participation
  - Presentation skills, quality and adequacy of information
- Evaluate using a written test

Competency 3.0: Utilizes various forms of energy, their interaction with matter and energy transformations by maintaining efficiency and effectiveness at an optimum level

Competency level 3.4: Makes jobs easy using resultant of forces

Number of periods: 05

Learning outcomes:

Student should be able to

- describe the concept of resultant of forces.
- conduct simple activities to show the effect of the resultant of forces.
- conduct simple activities to find resultant of two collinear forces acting in the same direction and also in opposite directions.
    - conduct simple activities to find the resultant of two parallel forces acting in the same direction.
    - solve simple numerical problems to find the resultant of two collinear forces and of two parallel forces

(the line of action of resultant force is not necessary).

- accept that a large force can be obtained by collection of small forces.
- accept that there are ways of varying the magnitude and direction of a force according to the situation.

Instructions for lesson plans:

- Conduct a discussion enabling the students to understand the general meaning of the term, 'resultant'.
- Group the students, design and conduct simple activities which would enable the students to grasp the concept of resultant force
- Direct the students to identify the resultant acting in the following instances
- collinear forces acting in the same direction and also in opposite directions
- two parallel forces acting in the same direction
- Lead a discussion with students to reach to the conclusion that a single force can be found to produce the same effect as that of two or more forces acting on a body.
- Discuss with the students that when two forces act at an angle to each other, the resultant will act in a direction between the two forces (the magnitude of the resultant need not be considered).
- Guide the students to determine the magnitudes and the directions of the resultants of two collinear forces and of two parallel forces acting in the same direction. (the line of action of resultant of two parallel forces is not expected)

- Provide suitable problems which include calculations on the resultant of collinear forces and of parallel forces.
- Guide students to find out instances where many forces are acting on the same object

Keywords / concepts:

Resultant force
Collinear forces
Parallel forces
Magnitude of resultant forces

Quality inputs:

Trolleys, pulleys, a horizontal surface with white paper pasted slotted mass.

Instructions for assessment and evaluation:

- Based on the following criteria, assess the students when they perform the group activities
  - Describing resultant force
  - Accuracy of the readings obtained
  - Solving mathematical problems involving addition and subtraction of forces
  - Manipulating skills
  - Working co-operatively
- Evaluate the students by giving numerical exercises

Competency 3.0: Utilizes various forms of energy, their interaction with matter and energy transformations by maintaining efficiency and effectiveness at an optimum level

Competency level 3.5: Estimates and calculates the turning effect of a force

Number of periods: 05

Learning outcomes:

Student should be able to

- conduct simple activities to demonstrate the turning effect of a force.
- describe the factors affecting the moment of force.
- express the moment of a force about a point as the product of the force and the perpendicular distance from the point to the line of action of the force.
- express the unit of the moment of a force as N m.
- state that the turning effect of the moment of a force can be clockwise or anti-clockwise.
- describe the moment of a couple of forces.
- make a list of instances where moment of a couple of forces apply in day-to-day life.
- make calculations involving the moment of force.
- accept the importance of turning effect of a force in day-to-day activities.
- accept that moments appear in couples in many practical situations.

Instructions for lesson plans:

- Conduct a discussion to highlight the uses of the turning effect of a force in day to day life
- Conduct a simple activity to demonstrate the turning effect of a force.
- Conduct a simple activity to show that the factors affecting the turning effect of a force about a point are

1. magnitude of the force
2. perpendicular distance from the point to the line of action of the force
   (By hanging different loads at different distances from the centre of a uniform wooden or aluminum strip which is pivoted at its centre, direct students to study how the load and the perpendicular distance to the load from the pivoted point affect the magnitude of the moment)

- Build up the concept of moment of a force through a discussion and define the moment of a force about a point as the product of magnitude of force and the perpendicular distance from the point to the line of action of force and introduce its unit as N m.

- Plan simple activities leading to numerical calculations related to moments
- Guide students to solve simple numerical problems related to moment of a force
- Express a couple of forces as two parallel forces equal in magnitude and opposite in directions acting on a body.
- Guide students to find the instances where the couples of force are used in day-to-day life

Keywords / concepts:

Moment of a force
Moment of a couple of forces

Quality inputs:

A uniform wooden or aluminum strip in which holes are drilled at equal distances from its centre, suitable stand to pivot the wooden or aluminum strip at a height of about 25 cm from the table, weights of several values

Instructions for assessment and evaluation:

- Based on the following criteria, assess students while they involved in the discussion.
  - Active participation of students
  - Presentation of relevant examples using turning effect of a force
- Based on the following criteria, assess students while they involved in the activities.
  - Preparation of the experimental set up using suitable materials
  - Performing the activity / experiment manipulating the variables properly
  - Safe handling of tools and usage of apparatus
- Evaluate students using a written test
  - explanations for the problems / situations
  - calculations to solve the problems (numerical)

Competency 3.0: Utilizes various forms of energy, their interaction with matter and energy transformations by maintaining efficiency and effectiveness at an optimum level

Competency level 3.6: Investigates the conditions of equilibrium of forces

Number of periods: 04

Learning outcomes:

Student should be able to

- explain the equilibrium of forces on a body.
- construct simple arrangements to demonstrate the equilibrium of forces.
- explain the conditions necessary for two forces to be in equilibrium.
- explain the conditions necessary for three parallel forces to be in equilibrium.
- describe practical applications of equilibrium of forces.
- state the conditions necessary for three non-parallel forces to be in equilibrium (qualitatively).
- accept that the equilibrium can exist under more than three forces too.

Instructions for lesson plans:

- Explain the equilibrium of an object.
- Surface the concept of equilibrium of forces through simple activities.
- Perform an activity to keep an object in equilibrium under two forces. Using it, show the conditions essential to keep two forces in equilibrium (the two forces should be equal in magnitude, opposite in direction and collinear).
- Perform an activity to keep an object in equilibrium under three parallel forces. Using it, show the conditions essential for the equilibrium of three parallel forces (the three forces should be coplanar, one force should act on opposite direction to the other two and the resultant of two forces should be equal in magnitude and opposite in direction to the third force).
- Work out simple calculations related to the equilibrium of two forces and of three parallel forces.
- Conduct an activity to keep an object in equilibrium under three non-parallel forces. Using it show the conditions essential for the equilibrium of three non-parallel forces (calculations are not required)
  (the three forces should be coplanar, concurrent and the resultant of two forces should be equal in magnitude and opposite in direction to the third force).
- Present examples to convince that objects can be in equilibrium under more than three forces too.

Keywords / concepts:

Collinear forces
Coplanar forces
Parallel forces
Inclined forces
Equilibrium of forces

Quality inputs:

Spring balances, a metre ruler, a plastic pan with a diameter of 3 cm on which two connectors are fixed across two edges of a diameter and a similar plastic pan on which three connectors are fixed from three places

Instructions for assessment and evaluation:

- Assess the activities using the following criteria
  - Clear expressions of the concept of equilibrium
  - Active participation
  - Presentation skills

Competency 3.0: Utilizes various forms of energy, their interaction with matter and energy transformations by maintaining efficiency and effectiveness at an optimum level

Competency level 3.7: Uses the principles and laws of hydrostatics to realize activities related to sinking, floating and pressure transmission

Number of periods: 08

Learning outcomes:

Student should be able to

- make simple devices to show the pressure exerted by liquids and gases.
- express hydrostatic pressure (p) in terms of height of liquid column (h), density of liquid (ρ) and gravitational acceleration (g).
- calculate the pressure exerted by a liquid using the expression $p = h\rho g$
- present examples of instances where liquid pressure is used productively at present.
- Conduct simple activity to demonstrate pressure transmission.
- accept the importance of pressure to make work easier.
- accept that the transmission of pressure is very useful in modern technology.
- state that atmospheric pressure can be measured by using the mercury barometer and the aneroid barometer.
- state that atmospheric pressure varies with altitude.
- obtain the reading of atmospheric pressure using aneroid barometer.
- conduct simple activities to show the factors affecting up-thrust acting on a body due to a liquid.
- demonstrate Archimedes' principle using a simple activity (calculations are not expected).
- use simple set-ups to show the conditions necessary for sinking and floating.
- explain the concepts of sinking and floating according to the weight of the object and the up-thrust.
- explain the principle and the use of hydrometer.
- use the hydrometer to measure density of liquids.
- accept that sinking and floating of objects in liquids is determined by the up-thrust exerted by the liquid and the weight of the object.

Instructions for lesson plans:

- Using suitable activities show that liquids exert pressure.
- Using suitable activities demonstrate that the pressure changes with the changes in the height of the liquid column and with the density of the liquid.

- Since the acceleration due to gravity, g remains constant show that the liquid pressure increases when the vertical height of the liquid column, $h$and the density of the liquid column, ρ increase. Hence present the equation, $p = h\rho g$.
- Direct the students to solve a few simple problems using the equation, $p = h\rho g$.
- Assign students to collect and present information regarding the instances where liquid pressure is utilized in everyday life.
- Explain using examples that transmission of liquid pressure is used tactically in modern technological equipment to ease performance of work.
- Engage student groups in creating simple devices by transmission of liquid pressure.
- Demonstrate by a suitable activity that gases exert pressure.
- Direct the students to measure the atmospheric pressure by taking the readings from an aneroid barometer.
- Explain the action and the use of the mercury barometer.
- Discuss that the atmospheric pressure decreases with increasing altitude.
- Direct student groups to collect information on instances where gas pressure is used in everyday life. Conduct a discussion on the information presented by them.
- Conduct a simple activity to demonstrate the up-thrust exerted on an object by a liquid.
- Distinguish between sinking, completely immersed floatation and partially immersed flotation, using an activity.
- Explain the above three phenomena using the weight and the up-thrust.
- Explain the principle of the hydrometer and direct the student groups measure the density of several liquids using the hydrometer.
- Explain Archimedes' principle using a simple activity (calculations are not expected).

Keywords / concepts:

Liquid pressure
Gas pressure
Sinking
Floating
Up-thrust
Archimedes' principle

Quality inputs:

An aneroid barometer, a hydrometer, a Ureka vessel, a cylinder-bucket apparatus

Instructions for assessment and evaluation:

Correct performances in activities, written tests, problem solving, adequate collection of information and correct presentation, creation of simple apparatus, and accurate measurement by instruments

Competency 3.0: Utilizes various forms of energy, their interaction with matter and energy transformations by maintaining efficiency and effectiveness at an optimum level

Competency level 3.8: Quantifies the mechanical energy and power in mechanical processes

Number of periods: 05

Learning outcomes:

Student should be able to

- state that the work done by a force is the product of the magnitude of the force and the displacement in the direction of the force.
- make simple devices to demonstrate the applications of kinetic energy and potential energy.
- explain the two forms of mechanical energy as kinetic energy and potential energy.
- provide the expression for kinetic energy $E_K = \frac{1}{2}mv^2$ as .
- provide the expression for gravitational potential energy as $E_P = mgh$ with reference to a zero potential level.
- do calculations involving work, kinetic energy and gravitational potential energy.
- accept that kinetic energy, gravitational potential energy and elastic potential energy can be used for human energy requirements.
- accept that energy is used to do work.
- state power as the rate of doing work.
  (*work done*/*time taken*)
- calculate the power.

Instructions for lesson plans:

- Express the work done by a force as the product of magnitude of the force and the displacement of the force in the direction of force.
- State 'newton metre (N m)', 'joule (J)' as the unit of measuring work.
- Express energy as ability to do work.
- State joule (J) as the unit of measuring energy.
- Conduct a discussion convincing that potential energy and kinetic energy are two forms of mechanical energy.

- Explain that gravitational potential energy and elastic potential energy are two forms of potential energy.
- Conduct simple activities to demonstrate gravitational potential energy, elastic potential energy and kinetic energy.
- Assign students to find out instances where the above forms of energy are used in day-to-day life activities.
- Present expressions for gravitational potential energy and kinetic energy $E_p = mgh$ and $E_K = \frac{1}{2}mv^2$ respectively.
- Direct students to solve simple numerical problems using the expressions for gravitational potential energy and kinetic energy
- Demonstrate the energy transformations between gravitational potential energy and kinetic energy using activities.
- Express power as the rate of work done (work done / time) and state the unit of power as watt (W) or joules per second (J s^{-1}).
- Guide students to solve simple numerical problems related to power.

Keywords / concepts:

Mechanical energy
Potential energy
Kinetic energy
Gravitational potential energy
Elastic potential energy
Power

Quality inputs:

A rubber band, a helical spring, a suitable apparatus to show the energy transformations between gravitational potential energy and kinetic energy

Instructions for assessment and evaluation:

- Relevance of examples presented for various energy forms
- Clear explanations of situations involving energy transformations
- Correctly solving numerical problems related to potential energy and kinetic energy

Competency 3.0: Utilizes various forms of energy, their interaction with matter and energy transformations by maintaining efficiency and effectiveness at an optimum level

Competency level 3.9: Uses fundamental principles and laws of current electricity to understand and control the action of simple circuits

Number of periods: 10

Learning outcomes:

Student should be able to

- conduct simple activities to demonstrate the difference between static electricity and current electricity.
- state the direction of conventional current in relation to the direction of electron flow.
- accept that a flow of current occurs due to a potential difference.
- describe that an electric source is used to supply a potential difference to a circuit.
- state that the emf of a source is the potential difference between its terminals when no current flows from the source.
- explain the resistance as a factor which opposes the flow of electric current.
- conduct a simple activity to show the factors affecting the resistance of a conductor (length, cross-sectional area and resistivity).
- conduct a simple experiment to show the relationship between V across a conductor and I.
- show graphically the variation of potential difference with current.
- use the relationship between V and I to express Ohm's law as $V = IR$.
- state R as resistance of the conductor.
- find the resistance of a resistor using the resistor colour code.
- identify different types of resistors.
- show qualitatively the variation of resistance in series and parallel combination using simple devices.
- give expressions for the equivalent resistance of resistors in series and in parallel combinations.
- calculate the equivalent resistance in series and in parallel combinations.
- accept that series and parallel combinations of resistors are very important in controlling the current in a circuit to suit the given condition.

Instructions for lesson plans:

- Conduct simple activities to demonstrate the difference between static electricity and current electricity.
- State that free electrons in a conductor contribute to conduct an electric current through it.
- Explain that there is no flow of an electric current through an insulator as there are no free elections in an insulator.
- Show that an electric source is necessary to provide a potential difference across a circuit.
- Point out that when a potential difference is applied at the two ends of a conductor, the free electrons drift in one direction and state that the conventional current flows in the opposite direction.
- Explain the potential difference between two terminals of a source using simple analogies.
- Introduce electromotive force as the potential difference between the two terminals of the source when no current flows through it.
- Obtain readings for V and I using a simple circuit.
- Using experimental data, plot the readings of V against those of I. Using the graph develop Ohm's law. Present it in the standard form.
- Express Ohm's law by the equation $V=IR$.
- Introduce R as the resistance of the conductor. State that its unit is ohm (Ω).
- Through simple activities show that the resistance of a conductor changes with its length (l), area of cross-section (A) and the type of the material.
- Provide students with three types of resistors; permanent resistors, variable resistors and light sensitive resistors. Explain their special features and uses. Show how values are marked on them.
- Introduce the resistor colour code that gives the value of resistance and direct the students to calculate the resistance of several resistors provided to them.
- Show that resistor systems with various values of resistance can be constructed by connecting resistors in series and parallel.
- Introduce equivalent resistance.
- Direct students to calculate the equivalent resistance of a series resistor combination using the formula, $R = R_1 + R_2 + \ldots$

- Direct students to calculate the equivalent resistance of a parallel resistor combination using the formula, $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$

Keywords / concepts:

Conductors
Insulators
Electric current (conventional current)
Potential difference
Electromotive force
Resistance
Resistor
Equivalent resistance

Quality inputs:

Resistors, a voltmeter, an ammeter, connecting wire, a switch, a rheostat

Instructions for assessment and evaluation:

- Assess students using suitable criteria
    - Correct use of equipment
    - Protective use of equipment
    - Recording results correctly
    - Formulating conclusions correctly
    - Performing calculations using suitable formulae

List of Practical

- Identification of Major elements present in living matter
- Observation of animal and plant tissue
- Measuring the growth of a plant by using an anxanmoter.
- Absorption of Oxygen in respiration
- Emission of carbon dioxide in respiration
- Investigation of patterns in genetics
- Demonstration of artificial propagation of plants
- Identification of parts of a flower
- Demonstration of enzymatic activity
- Identification of characteristic features of monocots and dicots
- Classification of invertebrate animals through characteristic features
- Classification of vertebrate animals through chanactensistia features.
- Conduct simple activities to demonstrate physical properties of ionic and covalent compounds.
- Conduct simple activities to demonstrate different types of chemical reactions.
- Compare reactivity of the given metals with air, water and dilute acids.
- collect samples of hydrogen, oxygen and carbon dioxide gases using suitable apparatus.
- Conduct simple tests to identify hydrogen, oxygen and carbon dioxide gases.
- Conduct simple activities to demonstrate the factors affecting the rate of reaction.
- Investigation of the variation of displacement with time of an object in a straight line motion.
- Finding the factors which affect the acceleration of an object moving under constant acceleration and verification of Newtons 2^{nd} Law.
- Finding the nature of the frictional force between solid surfaces and factors which affect the limiting frictional force.
- Finding the factors which affect the moment of a force.
- Finding the factors that is to be satisfied for the equilibrium of an object under three forces
- Experimental verification of Archimedes principle
- Experimental verification of ohm's law.