Science

Grade 11

Teacher's Guide

(Implemented from 2016)

Department of Science

Faculty of Science and Technology

National Institute of Education

Sri Lanka

www.nie.lk

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Message from the Director General

This Manual provides the teacher with the essentials required to implement the subject curriculum in their respective school. In implementing the curriculum, teachers must always bear in mind that their work will have paramount and far-reaching consequences for the child's cognitive achievement and behavioural development.

On the dimension of cognitive achievement, teachers must pay attention, inter alia, to the following where learning quality is higher:

- When the learner is aware of his/her life goals and the task is both relevant to goal achieve ment as well as abilities;
- When the learner is involved actively in the process of teaching/learning (student-centered process). Recall what Confucius said: What they hear, they forget; What they see, they remember; & What they do, they learn.
- When the learning environment is conducive, i.e. resourceful and challenging. Ensure access to study materials, equipment, labs, cases and experiences from multiple sources; and
- When the learner is given prompt feedback, both positive and constructive. In doing so, enable the learning to occur sequentially with higher levels of absorption, and integration with existing knowledge, skills and goals of the learner.

In education, expectation of the government is to enable all children in schools to reach the required levels of mastery of fundamentals of the subject matter, so that they experience the joy of achievement after facing examinations.

In the dimension of behavioural development of the child, the objective of education is to link cognitive achievement with the world of work. Therefore, curriculum delivery in the hand of teacher must foster the competencies that the learner requires to possess in dealing with the world outside the school. Some of the important, generic competencies are in these areas:

- Industrious work ethic - Positive attitudes, will to innovate, and persevere;
- Interpersonal relations - Teamwork, discipline, and effective communication;
- Moral values - A person with integrity possessing civic values such as respect for diversity

In conclusion, I wish to ask all principals, teachers and other staff in schools to look at the process of teaching and learning with attention to 4AS in management: Attitude, Analysis, Action, & Accountability. Start with the relevant and positive attitudes about the ends and means of what you do (your lesson, etc.); search, obtain and analyse information in order to organize (session plans etc.); consider options and take prompt action efficiently (deliver); and monitor, assess and measure results to take accountability (ownership).

I take this opportunity to wish all the teachers involved the joy of teaching and learning. Please do not hesitate to write to the relevant Head of Department at NIE, with copy to me where desirable, on your experiences and observations of this Manual.

Prof. Gunapala Nanayakkara, PhD (Carleton)
Director General

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

Foreword

Teachers are leading personalities among those who render a great service for the progression of the society. Teachers guide the children to mould their characters.

The Educational Publications Department takes measures to print and publish these Teacher Instructional Manuals to facilitate the teachers to cary out the teaching process successfully in accordance with the new syllabi to be implemented with effect from 2015. I strongly believe that this Teacher Instructional Manual compiled by the National Institute of Education will provide the required guidance to create a favourable learning environment for the children to learn.

This venture will achieve its success on the effort made to utilize the experience acquired by using this Teacher Instructional Manual in the teaching learning process. I bestow my gratitude on all those who dedicated themselves for this national endeavour.

Tissa Hewavithana
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22.09.2015

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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 2015. From then onwards, the teachers will 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 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 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 skills. 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 the subject science 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 the teacher intends to introduce lesson planning strategies different from the suggested ones here, they are expected to make the necessary changes in quality inputs accordingly.

Measuring of whether the learning and teaching process was successful within a particular learning environment paves the 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. The 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 the 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 the subject science 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 Teacher's guide for Grade 11.

Sri Lanka has a claim to a significant level of literacy rate and upholds a level of education on 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 2016 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.

0.1 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 the conventions of social justice and democratic life to promote the characteristics of respecting 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 positive feelings needed for a balanced personality with the qualities of creative skills, initiative, critical thinking and being responsible
6. 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, Through education,

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).

0.2 Basic Competencies

The competencies promoted through the education mentioned below 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 : Listening, carefully 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, color, 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 private life

(ii.) Competencies relating to 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, fuel, matter, materials and their links with human living, food, clothing, shelter, health, comfort, respiration, sleep, relaxation, rest, waste 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 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 skilful and 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 undertake 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 the dynamic nature of science.

Proposed teaching learning Sequence

School term	Competency level	Time (periods)
1st term	1.1 Discovers the characteristics of plant tissues	04
	1.2 Discovers the characteristics of animal tissues	04
	1.3 Investigates the importance of photosynthesis	05
	2.1 Investigate different types of mixtures.	05
	2.2 Use different criteria to express the composition of mixtures	05
	2.3 Uses different techniques to separate mixtures	05
	3.1 Investigate properties of mechanical waves and electromagnetic waves.	07
	3.2 Uses the knowledge of sound waves in day to day activities and scientific work	04
	3.3 Uses principles and laws of geometrical optics in day to day activities and scientific work	12
2nd term	1.4 Investigates the process of digestion in human	04
	1.5 Investigates the process of respiration in human	05
	1.6 Investigates the process of excretion in human	03
	1.7 Investigates the process of circulation in human	05
	1.8 Investigates the process of co-ordination and homeostasis in human	05
	2.4 Investigates properties of acids, bases and salts	07
	2.5 Investigates heat changes associated with chemical reactions	08
	3.4 Investigates thermal effects	12
	3.5 Quantifies electrical energy and power in electrical appliances	05
2nd term	3.6 Uses the knowledge of electronics in day – day activities and scientific work	05
	2.6 Investigates the components of an electrochemical cell and the relevant reactions	04
	2.7 Investigates different electrolysis process	04
	2.8 Investigates the process of corrosion	03
	3.7 Investigates the nature of electromagnetic force and uses of it	05
	3.8 Investigates the phenomenon of electromagnetic induction and uses of it	04
	2.9 Investigates the nature and uses of hydro carbons and their derivatives	03
	2.10 Investigates different types of polymers	03
	4.1 Investigates the organizational levels of the biosphere and interactions existing within it	03
	4.2 Investigates the mechanisms that contribute to maintain the balance of the ecosystems	05
	4.3 Explores various types of pollutants and their adverse effects	05
	4.4 Explores the effects of change in life style	05
	4.5 Investigates on ways to contribute to sustainable development	10

Competency	Competency level	Content	Outcomes	No. of periods

1.0 Explores life and life processes in order to improve the productivity of biological systems.	1.1 Discovers the characteristics of plant tissues	• Tissues
		  • Plant tissues
		  • Meristematic tissue
		  • Permanent tissue
		  • Simple permanent tissue
		  • Complex permanent tissue
			• lists characteristics of meristematic and permanent tissues.
			• states parenchyma, collenchyma and sclerenchyma as simple permanent tissues
			• states xylem and phloem as complex permanent tissues .
			• identifies xylem and phloem as complex permenent tissues using their specific characteristics.
			• states the functions of xylem and phloem tissues.
				04

	1.2 Discover the characteristics of animal tissues	• Animal tissues
		  • Epithelial tissues
		  • Connective tissue
		  • Muscular tissue
		  • Nervous tissue
		  • Functions and locations of major types of tissues in human body
			• introduces epithelial, connective, muscular, and nervous tissues as major types of animal tissues.
			• states the functions and locations of epithelial tissues.
			• explains blood as a connective tissue.
			• states smooth, cardiac and skeletal muscles as muscular tissues.
			• states functions and locations of smooth, cardiac and skeletal muscles.
			• identifies muscular tissues by the shape of cell.
			• states the structure and functions of the nerve cell.
				04

	1.3 Investigates the importance of photosynthesis	• Photosynthesis
		  • Factors affecting photosynthesis
		  • Carbon dioxide
		  • Water
		  • Light energy
		  • Chlorophyll
		  • Products of photosynthesis
		  • Role of photosynthesis
			• states what photosynthesis is.
			• states factors affecting photosynthesis.
			• conducts simple activities to identify end products of photosynthesis.
			• conducts simple activities to prove the necessity of carbon dioxide, light energy and chlorophyll for photosynthesis.
			• states the balanced chemical equation for photosynthesis.
			• explains the importance of photosynthesis.
				05

	1.4 Investigates the process of digestion in human	• Digestion
		  • Process of human digestion
		  • Role of liver, pancreas and salivary glands in digestion
		  • Diseases and disorders related to the digestive system and their prevention
		  • Diarrhea
		  • Constipation
		  • Gastritis
		  • Typhoid
			• states what digestion is.
			• describes the process of digestion and functions of the mouth, esophagus, stomach, small and large intestines and rectum.
			• states the role of the liver, pancreas and salivary glands.
			• lists the end products of digestion of carbohydrates, proteins, lipids and related enzymes.
			• presents information on diseases and disorders associated with the digestive system and their prevention.
				04

	1.5 Investigates the process of respiration in human	• Respiration
		  • Respiratory process/ breathing
		  • Inspiration/Inhaling
		  • Expiration/Exhaling
		  • Characteristics of a respiratory surface
		  • Types of respiration
		  • Aerobic respiration
		  • Anaerobic respiration
		  • Energy storage
		  • Diseases and disorders related to the respiratory system and their prevention(common cold, tuberculosis,pneumonia,asthma and bronchitis)
			• conducts simple activity to explain the mechanism of external respiration (inspiration and expiration).
			• describes the characteristics of a respiratory surface for efficient gaseous exchange and role of mucous membranes and cilia.
			• explains what external and cellular respiration is.
			• states the balanced chemical equation for aerobic respiration.
			• explains the role of ATP as energy carrier/energy currency.
			• compares aerobic and anaerobic respiration in terms of oxygen and the amount of energy released.
			• presents information on diseases and disorders associated with the respiratory system and their prevention.
				05

	1.6 Investigates the process of excretion in human	• Human excretion
		  • Functions of the kidney
		  • Steps of process of urine formation
		  • Diseases and disorders related to excretory system and their prevention
		  • Kidney failure
		  • Nephritis
		  • Kidney stones
			• states what excretion is.
			• lists out excretory products and excretory organs of human.
			• states the functions of kidney.
			• explains briefly the process of urine production.
			• presents information on diseases and disorders associated with excretory system and their prevention.
				03

	1.7 Investigates the process of circulation in human	• Human blood circulation
		  • Composition and functions of blood
		  • Blood Circulation
		  • Pulmonary circulation
		  • Systemic circulation
		  • Blood pressure
		• Lymphatic circulation
		• Diseases and disorders related to the circulatory system and their prevention
		  • Atherosclerosis
		  • Cardiac arrest
		  • Hypertension
		  • Thrombosis
			• states the composition and functions of blood.
			• describes the pulmonary and systemic circulation.
			• explains blood pressure as systolic and diastolic pressure.
			• explains the cardiac cycle and heart sound.
			• describes the role of lymph and the lymphatic system
			• presents information on diseases and disorders associated with the circulatory system and their prevention.
				05

	1.8 Investigates the process of co ordination and homeostasis in human	• Human co-ordination
		  • Nervous co-ordination
		  • Main functions of brain and spinal cord
		  • Reflex action
		  • Reflex arc
		  • Peripheral nervous system
		  • Autonomic nervous system
		  • Chemical co-ordination
		• Homeostasis
			• lists the main functions of the central nervous system (brain and spinal cord)
			• states that reflex action is an immediate and involuntary response to stimuli .
			• identifies the reflex arc as the functional unit of the nervous system.
			• identifies the parts of the reflex arc.
			• states the importance of the autonomic nervous system.
			• gives examples for sympathetic and parasympathetic actions.
			• Explains the main endocrine glands, their locations and functions.
			• states what homeostasis is.
			• explains the homeostasis of body temperature, blood glucose and water content.
				05

Competency	Competency level	Content	Outcomes	No. of periods

2.0 Investigate matter, properties of matter and their interaction to enhance the quality of life	2.1 Investigates different types of mixtures.	• Mixtures
		  • Types of mixtures
		  • Homogeneous mixtures
		  • Heterogeneous mixtures
		• Solubility
		  • Factors affecting solubility
		  • Nature of solute
		  • Nature of solvent
		  • Temperature
			• explains the term mixtures
			• explains what homogeneous and heterogeneous mixtures are.
			• lists characteristics of homogeneous and heterogeneous mixtures
			• prepares different types of mixtures
			• differentiates given mixtures as homogeneous or heterogeneous based on observations
			• defines the term 'solubility'
			• states the factors affecting solubility
			• examines the factors affecting solubility
			• shows awareness to control factors affecting solubility in day to day life
				05

	2.2 Uses different criteria to express the composition of mixtures	• Composition of mixtures
		  • Mass fraction
		  • Volume fraction
		  • Mole fraction
		  • Composition by m/v
		  • Composition by n/v (concentration)
			• expresses the composition of a mixture as a mass fraction
			• expresses the composition of a mixture as a volume fraction
			• expresses the composition of a mixture as a mole fraction
			• expresses the composition of a solution in relation to mass and volume
			• expresses the composition of a solution (concentration) in relation to mole and volume
			• names the composition expressed in terms of n/v as concentration
			• prepares a mixture of a given composition
			• Prepares a standard solution
			• accepts the importance of preparing standard solutions
			• solves simple problems related to the composition of mixtures
				05

	2.3 Uses different technique to separate mixtures	• Separation techniques
		  • Mechanical separation
		  • Evaporation
		  • Filtration
		  • Crystallization
		  • Recrystallization
		  • Solvent extraction
		  • Simple distillation
		  • Fractional distillation
		  • Steam distillation
		  • Chromatography
		• Applications of separation techniques
		  • Preparation of salt from sea water
		  • Extraction of essential oils
			• describes the given separation techniques
			• separates components of a mixture by using different separation techniques
			• gives examples for instances where given separation techniques are used
			• describes the process of salt production from sea water
			• points out the separation techniques that are being used in the salt industry
			• describes the process of extraction of essential oils from natural sources in Sri Lanka eg.: cinnamon/ citronella
				05

	2.4 Investigates properties of acid, bases and salts	• Acids, bases and salts
		  • Strong acids and weak acids
		  • Physical properties, chemical properties and uses of acids
		  • Strong bases and weak bases
		  • Physical properties, chemical properties and uses of bases
		  • Neutralization of acids/bases
		  • Salts
			• lists the characteristic properties of acids, bases and salts
			• explains acids as a source of hydrogen ions and bases as a source of hydroxyl ions
			• states the difference between strong acids and weak acids
			• gives examples for strong and weak acids
			• states the difference between strong bases and weak bases
				07

			• gives examples for strong and weak bases • differentiates acids and bases using litmus paper and pH paper • states that acids and bases react to produce salts and water • explains the term 'neutralization' • discusses the application of the neutralization process in day to day life • investigates and lists application of acids, bases and salts in day to day activities	

	2.5 Investigates heat changes associated with chemical reaction	• Heat changes associated with reactions
		  • Exothermic and endothermic reactions
		  • Heat of reaction
		• Determination of heat changes associated with reactions
			• expresses by experience that heat changes occur during chemical reactions
			• gives examples for endothermic and exothermic reactions
			• demonstrates a few endothermic and exothermic reactions
			• explains what endothermic and exothermic reactions are
			• determines the heat change of a given reaction experimentally
				10

			• states the assumptions made in determining the heat of reaction experimentally. • accepts that heat changes associated with chemical reactions are important for all living beings and are being used in day to day life and in industries	
	2.6 Investigates components of an electro - chemical cell and relevant reactions.	• Electrochemistry • Electrochemical cells • Cathode and cathodic reaction • Anode and anodic reaction • Overall reaction	• makes an electrochemical cell by using zinc, copper and dilute sulphuric acid • states oxidation and reduction as loss and gain of electrons respectively • identifies the electrode where oxidation takes place as anode • identifies the electrode where reduction takes place as cathode • writes the anodic, cathodic and overall reaction of the following simple electrochemical cells Zn/Cu, Fe/Cu, and Zn/Fe. • states that electrons flow from anode to cathode through external circuit	04

	2.7 Investigates different electrolysis processes	• Electrolysis
		  • Electrolysis of acidulated water
		  • Electrolysis of aqueous copper sulphate solution
		  • Electrolysis of aqueous sodium chloride solution
		  • Extraction of sodium by using Down's cell
		  • Electroplating
		  • Electroplating of copper on iron
			• distinguishes electrolytes and non electrolytes by testing for electrical conductivity
			• identifies the anode and cathode of an electrolysis process
			• demonstrates electrolysis of sodium chloride solution, acidulated water and copper sulphate solution.
			• writes anodic, cathodic and overall reactions of given electrolysis processes
			• describes the extraction process of sodium using Down's cell
			• explains what electroplating is
			• describes the process of electroplating of copper on iron with the relevant reactions
			• conducts simple activities to demonstrate copper on iron electroplating
			• states the uses of electroplating
				04

	2.8 Investigates the process of corrosion	• Corrosion
		  • Rusting of iron
		  • Controlling rusting
			• describes what corrosion is
			• explores the factors affecting the rusting of iron
			• states the conditions needed for rusting
			• writes the relevant reactions occurring during the process of rusting
			• describes how the rusting of iron is controlled
			• explains the process of the sacrificial protection of iron
			• selects suitable metals for cathodic protection of iron by referring to the activity series
			• shows an appreciation the importance controlling rusting
				03

	2.9 Investigates the nature and uses of hydrocarbons and their derivatives	• Hydrocarbons
		  • Alkane series
		  • Ethene (ethylene)
		  • Derivatives of ethene
		  • Chloro ethene (Vinyl chloride)
		  • Tetrafluoro ethane
			• describes hydrocarbons as a group of compounds containing only carbon and hydrogen.
			• describes alkanes as a group of hydrocarbons containing only C-C single bonds and C-H bonds
			• draws structures of alkanes (maximum of 5 carbon atoms)
			• draws structures of ethene and its derivatives
				03

	2.10 Explores the diversity of polymers	• Polymers
		  • Monomers and polymerization
		  • Types ofpolymers
		  • Based on origin (natural/ synthetic)
		  • Based on structure (linear/ branched/cross linked)
		  • Properties and uses of polymers
			• explains the terms monomers, Polymers, Polymerization and repeating units.
			• categorizes polymers based on their origin
			• gives examples for natural and synthetic polymers
			• categorizes polymers based on their structures
			• illustrates linear, branched and cross linked polymers diagrammatically
			• states uses of polymers derived from the given monomers
			• appreciates the importance of polymers in day- to - day life and in industries.
				03

Competency	Competency level	Content	Learning outcomes	period

3.0 Utilizes various forms of energy, their interaction with matter and energy transformation by maintaining efficiency and effectiveness at an optimum level.	3.1 Investigates the properties of mechanical waves and electromagnetic waves.	• Waves
		  • Mechanical waves
		  • Transverse waves
		  • Longitudinal waves
		• Physical quantities related to wave motion
		  • frequency
		  • wavelength
		  • speed
		  • amplitude
		  • Electromagnetic waves
		  • Electromagnetic spectrum
			• demonstrates the nature of mechanical wave motion through activities .
			• states that waves transfer energy without transferring matter.
			• distinguishes between transverse and longitudinal waves and gives suitable examples.
			• uses graphical representation of waves to explain the nature of mechanical wave motion and the Physical quantities related to wave motion(frequency, wave length, amplitude and speed of wave)
			• state that electromagnetic waves produced by oscillating electric field and magnetic field perpendicular to each other, without oscillating particles in the medium.
			• states that electromagnetic waves propagate in a direction perpendicular to the both electric field and magnetic field.
			• states that medium is not essential for the propagation of electromagnetic waves.
			• states that electromagnetic waves have a constant speed of 3×10^8 m s^{-1} in vacuum.
			• State that electromagnetic waves propagate as transverse waves.
				07

			• introduces electromagnetic spectrum and explains the productive uses of Radio waves, micro waves, IR, visible, uv, x-ray and γ rays. • expresses that light and heat propagate to the earth from the sun as electromagnetic waves	

	3.2 Uses the knowledge of sound waves in day to day activities and scientific works	• Sound waves
		  • Propagation of sound waves
		  • Speed of sound
		  • Musical Instruments
		  • Characteristics of sound
		  • Audible range of sound and other frequencies
			• describes the longitudinal nature of sound waves.
			• describes that sound waves consist of a series of compressions and rarefactions
			• states that a medium is needed to propagate sound waves.
			• states the order of magnitude of the speed of sound in air, liquids and solids.
			• categorizes musical instruments based on the method of sound production.
			• states pitch, loudness and quality of sound as characteristics of sound.
			• states that pitch depends on frequency, loudness on amplitude and quality of sound on the sound source.
			• expresses audible range, infra sound and ultra sound frequencies.
				04

	3.3 Uses the Principles and laws of geometrical optics in day to day activities and scientific work	• Geometrical optics • Reflection • Curved mirrors • Terms related to curved mirrors • Images formed by curved mirrors • Convex mirrors • Concave mirrors • Refraction • Refraction through plane surface • Laws of refraction • Rarer medium, denser medium	• carries out activities to investigate the nature of images of curved mirrors. • identifies pole, centre of curvature, focus and principal axis • uses the laws of reflection to explain the behavior of the rays incident on the convex and concave mirrors. a ray parallel to principal axis a ray passing through the center of curvature a ray passing through the focus • draws ray diagrams for images of convex mirrors. • draws ray diagrams for images of concave mirrors. (u $\rightarrow\infty$, $u > r$, $u = r$, $f < u < r$, $u = f$, $u < f$) • uses curved mirrors in relevant situations. • carries out simple activities to demonstrate refraction. • explains the terms denser medium and rarer medium. • states laws of refraction. • explains the term refractive index. • carries out activities to demonstrate total internal reflection. • explains the term 'critical angle'.	12

		• Refractive index
		• Critical angle and total internal reflection
		• Images formed by lenses
		  • Convex lens
		  • Concave lens
		  • Simple microscope
			• describes the phenomenon of total internal reflection and its applications
			• carries out activities to investigate the nature of images of convex lenses and concave lenses
			• explains the 'terms' principal axis, focus, optical center
			• explains the behavior of the following rays incident on a lens
			  a ray parallel to the principal axis
			  a ray through the optical centre
			  a ray passing the focus
			• states the principle of reversibility of light
			• draws ray diagrams for images formed by concave lens
			• draws ray diagrams for images formed by convex lenses.
			  (u $\rightarrow\infty$ $u > 2f$, $u = 2f$, $f < u < 2f$, $u = f$, $u < f$)
			• gives examples for the uses of convex and concave lenses
			• explains the action of the simple microscope using a ray diagram	

	3.4 Investigates thermal effects	• Thermal energy and uses
		  • Temperature
		  • Thermometers
		
		  • Heat exchange
		  • Heat capacity
		  • Specific heat capacity
		  • Amount of heat exchange , $Q = mc\theta$
		
		  • Change of state
		  • Fusion
		  • Vaporization
		  • Evaporation
		  • Latent heat of fusion
		  • Latent heat of vaporization
		
		  • Expansion
		  • Solids
		  • Liquids
		  • Gases
		
		  • Transfer of heat
		  • Conduction
		  • Convection
		  • Radiation
			• names various thermometers (mercury-glass, alcohol-glass, digital).
			• explains briefly the action of mercury-glass thermometer.
			• identifies Celsius temperature scale.
			• identifies Kelvin temperature scale (absolute).
			• states the relationship between Celsius and Kelvin.
			
			• uses thermometers to measure various temperatures.
			• states the condition that is needed for heat exchange from one object to another.
			• define heat capacity of a body.
			• defines specific heat capacity of a substance.
			• uses the relationship $Q = mc\theta$ to find the amount of heat exchange.
			• carries out simple activities to show the change of state at boiling point and melting point without changing the temperature.
			• compares vaporization and evaporation qualitatively.
			• explains the terms melting point. freezing point and boiling point.
			• defines latent heat of fusion and latent heat of vaporization
			• demonstrates the expansion of solids,
				12

		• Applications of effects of thermal energy	liquids and gases. through activities. • describes the three methods of heat transfer. • gives examples for instances of use of heat transfer by conduction, convection and radiation.	
	3.5 Quantifies electrical energy and power in electrical appliances	• Electrical energy and power • Energy dissipation of an electrical appliance E = VIt • Power of an electrical appliance P = VI • House wiring circuit	• explains energy dissipation and power of an electrical appliance. • solves simple numerical problems involving energy and power • compares power rating and energy consumption of various electrical appliances. • compares various electrical appliances in terms of efficient use of energy. • describes ways of increasing energy efficiency • names components of house wiring circuit • explains the connection of a house wiring circuit using a circuit diagram. • explains safety precautions in using house wiring circuit. • uses "kWh" as a unit of electrical energy consumption .	05

	3.6 Use the knowledge of electronics in day- to- day activities and scientific works	• Electronics • Semiconductors • Intrinsic semiconductor • Extrinsic semiconductors • n- type • p - type • Junction diode • Structure of a diode • Action of a diode • Various types of diodes and uses • Rectifier diodes • Half wave rectification • Full wave rectification • LED • Signaling • Lighting • Photo diode • Solar cell • Transistor • Structure of a transistor • Uses of transistors • Signal amplification • Switching	• distinguishes between conductors and semiconductors. • gives examples for intrinsic semiconductors. • describes the two types of extrinsic semiconductors. • describes the structure of a junction diode. • demonstrates the action of a diode using simple activities. • demonstrates half-wave rectification and full- wave rectification using activities. • explains half-wave and full-wave rectification using circuit diagrams including smoothing. • conducts simple activities using LED, solar cell and photo diode. • explains characteristics and uses of LED, Photodiode and solar cell • describes the structure of npn and pnp transistor and introduce the circuit symbol • describes the action of npn transistor as an amplifier using a simple activity. • describes the action of npn transistor as a switch using a simple activity. • explains the action of a transistor as an amplifier and as a switch using circuit diagrams	05

	3.7. Investigates the nature of electromagnetic force and the uses of it.	• Magnetic Force on a current carrying conductor placed in a magnetic field
		  • Factors affecting the magnitude of force
		  • Length
		  • Current
		  • Strength of the magnetic field
		  • The direction of the force
		  • Fleming's left hand rule
		• Uses of magnetic force
		  • Loud speaker
		  • dc motor
			• carries out activities to demonstrate the magnetic force exerted on a current carrying conductor placed in a magnetic field
			• states the factors which affect the magnitude of the force.
			• uses Fleming's left hand rule to find the direction of the force.
			• describes the action of the loud speaker
			• constructs a device to demonstrate Fleming's left hand rule.
			• name the main parts of a dc motor and explain necessity of those parts.
			• explains the action of a dc motor using a diagram.
				05

	3.8 Investigates the phenomenon of electromagnetic induction and the uses of it.	• Electromagnetic induction
		  • voltage (emf) induced across a conductor
		  • Factors affecting the magnitude of the voltage (emf)
		  • emf induced across a straight conductor moving in a magnetic field
		  • Direction of induced Current
		  • Fleming's right hand rule
		  • Uses of electromagnetic induction
		  • Bicycle dynamo
		  • Dynamic microphone
		  • Alternating current generator (ac)
		  • Transformer
		  • Step-up transformer
		  • Step-down transformer
			• carris out simple activities to demonstrate the phenomenon of electromagnetic induction.
			• explains electromagnetic induction qualitatively.
			• states the factors which affect the magnitude of induced voltage.
			• uses Fleming's right hand rule to find the direction of induced current in straight conductor.
			• uses the phenomenon of electro -magnetic induction to describe the action of bicycle dynamo and dynamic microphone.
			• explains the main parts of an alternating current generator and their necessity.
			• illustrates graphically the variation of voltage with time of an alternating current generator.
			• distinguish direct current and alternating current.
			• describes the structure of a transformer.
			• explains and demonstrates the action of a transformer.
			• gives the relationship between number of turns of coils and input/output voltages.
			• expresses the relationship between input and output power.
				05

			• describes the structure and action of step-up and step-down transformers. • Presents examples for the uses of step-up and step – down transformers. • carries out simple calculations related to the transformer.	

4.0 Explores nature, properties and processes of earth and space by understanding natural phenomena for intelligent and sustainable use	4.1 Investigates the organizational levels of the biosphere and interactions existing within it.	• Environmental equilibrium
		• Organizational levels of the biosphere
		  • Individual
		  • Population
		  • Community
		  • Ecosystem
		  • Biosphere
		• Population growth and growth curve
			• states organizational levels of the biosphere in a hierarchical order.
			• describes organizational levels of the biosphere.
			• identifies the pattern of typical population growth curve.
			• identifies the pattern of change in human population growth curve.
			• explains the factors affecting human population growth.
				03

	4.2 Investigates the mechanisms that contribute to maintaining the balance of eco systems	• Energy and nutrient flow
		  • Energy flow in an ecosystem
		• Cycling of matter in an eco system
		
		• Bio-geo chemical cycles
		  • Carbon cycle
		  • Nitrogen cycle
			• describes how energy and nutrients flow through food chains and food webs.
			• states the importance of the energy pyramids with respect to number and biomass pyramids.
			• accepts that flow of energy in an eco system is unidirectional.
			• illustrates that matter flows cyclically within the natural environment
			• describes what bio-geo chemical cycle is
			• names Carbon, Nitrogen and Phosphorous cycles as bio-geo chemical cycles
			• illustrates the carbon Cycle and Nitrogen cycle diagrammatically.
			• describes the factors affecting the ecological balance.
			• accepts that environmental balance depends on cycling of matter.
				05

	4.3 Explores various types of pollutants and their adverse effects	• Soil, water and air Pollution
		• Factors affecting pollution
		  • Extensive use of agrochemicals and fertilizers
		  • Disposal of e-waste, nuclear waste, household waste and industrial waste
		  • Industrial effluents
		  • Hydrocarbons, SO_2, NO_2, CFC, particulate matter, green house gases, heavy metals
		  • Extensive use of household chemicals
		  • Burning of fossil fuels and disposals
		• Adverse effects of pollution
		  • Direct effects
		  • Global warming
		  • Acid rain
		  • Ozone layer depletion
		  • Photochemical smog
		  • Biological magnification
		  • Eutrophication
		  • Increased level of radiations
			• states what pollution is
			• explores the factors affecting soil, water and air pollution.
			• presents a survey report on various pollutants emitted from different sources
			• names chemical substances that may occur in pollutants emitted from different sources
			• assesses the personal contribution to the environmental pollution
			• assesses the contribution of different institutions to the environmental pollution
			• explains different phenomena associated with environmental pollution that lead to the listed adverse effects.
			• uses various methods to communicate adverse effects of pollution.
			• accepts that all types of environmental pollutions are hazardous
			• accepts that pollution of one resource is interconnected with the pollution of other resources
			• accept that human intervention is necessary to minimize environmental pollution
				05

		• Indirect effects
		  • Loss of habitats
		  • Desertification
		  • Loss of productivity of plants
		  • Destruction and degradation of manmade structures and natural environment
		  • Health hazards
		  • Loss of biodiversity
		  • Blooming invasive species
		  • Damage to the economy		

	4.4 Explores effects of change in life style	• Facts and effects of changing life style
		• Urbanization
		• Industrialization
		• Commercialized agriculture
		• Man made irrigation systems
		• Extensive and diverse use of materials and energy forms
		• Increase of non- communicable diseases and disorders
		  • Unknown chronic kidney disease
		  • Diabetes
		  • Cancer
			• states the factors affecting the changing life style
			• designs and carries out a project to explore the issues generated by change in the life style
			• applies suitable methods to communicate findings of the project with other groups.
			• states what a non communicable disease is
			• accepts that change in life style is a cause for some non communicable diseases
			• describes the interrelationship between NCD and the life style/pollution
				05

		• Heart diseases • Cataract • Asthma • Lung diseases • Gastritis	• explores the possible causes for unknown chronic kidney disease and its distribution pattern in the island • values that the impact of man on environment returns negatively • accepts the importance of re-change towards an environmental friendly life style	

	4.5 Investigates on ways to contribute to sustainable development	• Environmental management and sustainable development
		  • Poly-culture instead of monoculture
		  • Biological control of pests
		  • Usage of organic fertilizers
		  • Reforestation
		  • Application of indigenous knowledge and technology
		  • agriculture
		  • medicine
		  • food
		  • irrigation
		  • Reducing of foot prints
		  • carbon footprint
		  • Water footprint
		  • food miles
		  • Waste management-reduce , reuse, recycle
		  • Solid
		  • Water
		  • Gases and airborne particles
		  • Thorough/proper implementation of legislative measures
			• states what is meant by sustainable development and environment management
			• explores poly-culture instead of monoculture, biological control of pests and usage of organic fertilizers as sustainable agricultural strategies
			• describes reforestation as a recovery method to maintain the environmental balance
			• explores indigenous knowledge and technology in the field of agriculture, medicine, food and irrigation
			• values The Sri Lankan 'wewa' as a unique example in water management
			• values indigenous medicine as another discipline and its scientific nature as yet to be explored
			• accepts that the indigenous food culture is compatible with our climate and life styles and supports a healthy life
			• explains what a footprint is, with respect to Carbon and water
			• explains food miles
			• values the importance of the reduction of foot prints and food miles
			• explains what waste and garbage are
			• describes and practices waste management techniques with respect to
				05

		• Energy management
		  • Energy crisis and technological problems
		  • Day-to-day monitoring of energy consumption
		  • Energy efficiency
		• Sustainable use of energy
		• Use of renewable energy resources
		  • Hydro power
		  • Wind power
		  • Solar power
			solid, water, gases and airborne particles
			• accepts the implementation of related legislative measures and the importance of adhering to them
			• explains the energy crisis with respect to availability of energy sources and technology.
			• explains matching of work with relevant energy sources in day-to-day life as energy management.
			• explains energy management as a remedy for energy crisis.
			• searches for the optimum use of energy with minimum waste.
			• explores the efficiency of domestic appliances.
			• accepts the importance of the monitoring of energy consumption.
			• consumes energy appropriately using most suitable energy sources.
			• uses appropriate methods for energy consumption according to the situation.
			• searches for the maximum use of natural energy in designing architectural structures.
			• accepts the importance of wise use of technology in energy consumption.	

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

Competency level 1.1: **Discovers the characteristics of plant tissues.**

No. of periods **04 periods**

Learning outcomes **:**

- lists characteristics of meristematic and permanent tissues
- states parenchyma, collenchyma and sclerenchyma as simple permanent tissues
- states xylem and phloem as complex permanent tissues
- identifies xylem and phloem as complex permanent tissues using their specific characteristics
- states functions of xylem and phloem tissues

Instructions for lesson planning

- Describe what a tissue is and guide students to find out examples for tissues that can be found in plants.
- Explain what meristematic tissues are and let student groups list their characteristics
- Use diagrams to show the locations of different kinds of meristematic tissues in plants
- explain what permanent tissues are and guide students to group permanent tissues as simple and complex permanent tissues using their characteristics
- explain xylem and phloem as complex permanent tissues
- let students observe permanent slides of xylem and phloem tissues and identify them as complex tissues
- Guide student groups to compare functions of xylem and phloem tissues
- Instruct student groups to present information on plant tissues

Key concept

simple tissues, complex tissues, meristematic tissues, permanent tissues, xylem, phloem

Quality inputs

Permanent slides of xylem and phloem tissues, diagrams, models of parenchyma , sclerenchyma and collenchyma tissues

Assessment and evaluation

Assess students' presentations using following criteria

- Use of visual aids
- Team work
- Accuracy of information
- Time management

Competency Level 1.2 : Discovers the characteristics of animal tissues

No. of periods 04 periods

Learning outcomes :

- introduces epithelial , connective, muscular and nervous tissues as main types of animal tissues
- states the functions and locations of epithelial tissues
- explains blood as a connective tissue
- states smooth, cardiac and skeletal tissues as muscular tissues
- states functions and locations of smooth, cardiac and skeletal muscles
- identifies muscular tissues by using the shape of cell
- states the structure and functions of nerve cell

Instructions for lesson planning

- Show some slides, pictures/videos of how animals are made up of different types of tissues
- Let the students find out the functions and locations of epithelial tissues from reading material/ video
- Show prepared slides/videos on blood tissue and explain that blood is a connective tissue
- Show prepared slides/videos /diagrams on muscle tissues and highlight their functions and locations
- Provide prepared slides of muscle tissues and let them identify smooth, cardiac and skeletal muscles
- Describe the structure and functions of a nerve cell using visual aids
- Instruct the student groups to present information on animal tissues

Key concepts

- Epithelial tissue, muscle tissue, connective tissue, nervous tissue, blood, smooth muscle, skeletal muscle, cardiac muscle

Quality inputs

- Prepared slides, reading material/video clip, microscope

Assessment and evaluation

Assess students' presentations using the following criteria

- Use of visual aids
- Team work
- Accuracy of information
- Time management

Competency level 1.3: **Investigates the importance of photosynthesis**

No. of periods **05 periods**

Learning outcomes :

- states what photosynthesis is
- states factors affecting photosynthesis
- conducts simple activities to prove the necessity of carbon dioxide, light energy and chlorophyll for photosynthesis
- conducts simple activities to identify end products of photosynthesis
- states the balanced chemical equation for photosynthesis
- explains the importance of photosynthesis

Instructions for lesson planning

- Introduce to students what photosynthesis is
- Let them identify carbon dioxide, water, chlorophyll and light energy as factors affecting photosynthesis
- Ask them to conduct simple activities to prove the necessity of the above factors (except water) for photosynthesis and ask them to prepare a report on it
- Guide students to conduct experiments identify the end products of photosynthesis
- Let students understand that glucose is not stored, instead starch is stored in plant tissues
- Let students identify oxygen as the byproduct of photosynthesis
- Ask students to conduct simple activities to identify starch as the product of photosynthesis and ask them to prepare a report on that
- Guide them to construct a balanced chemical equation for photosynthesis
- Ask students to explore the importance of photosynthesis for a balanced environment

Quality inputs

NaOH/ KOH solution, Bunsen burner, tripods, test tubes, polythene bags, beakers, black papers, pins, threads, Ethanol, Iodine solution, Petri dish, demy papers, marker pen, funnel, measuring cylinder, wire mesh

Key concepts

- Photosynthesis, chlorophyll

Assessment and evaluation

Asses the experiments of students using following criteria

- Correct experimental set up
- Correct observations and recordings
- Accurate conclusions
- Time management

Competency level 1.4: **Investigates the process of digestion in humans**

No. of periods **04 periods**

Learning outcomes :

- states what digestion is
- Describes the process of digestion and functions of mouth, oesophagus, stomach, small and large intestines and rectum.
- states the role of the liver, pancreas and salivary glands
- lists the end products of digestion of carbohydrates, proteins , lipids and related enzymes
- presents information on diseases and disorders associated with the digestive system and their prevention

Instructions for lesson planning

- Conduct a brain storming session to highlight parts of the digestive system using video clips/diagrams
- Discuss the process of digestion and functions of mouth, esophagus, stomach, small and large intestines
- Highlight the roles of liver, pancreas, salivary glands using diagrams
- Discuss and report the end products of digestion of carbohydrates, proteins, lipids and relevant enzymes
- Make students present the process and end products of digestion using visual aids and models
- Let students prepare a booklet on diseases and disorders related to digestive system and their prevention.

Key concepts

Process of digestion, end products of digestion, diseases and disorders related to digestive system

Quality inputs

Models, reading material /video clip

Assessment and evaluation

Assess students' presentations using following criteria

- Use of visual aids
- Team work
- Accuracy of information
- Time management

Competency level 1.5: Investigates process of respiration in human

No. of periods 05 periods

Learning outcomes :

- conducts simple activity to explain the mechanism of external respiration (Inspiration and Expiration).
- describes the characteristics of a respiratory surface for efficient gaseous exchange and role of mucous membranes and cilia.
- explains what external and cellular respiration is
- states the balanced chemical equation for aerobic respiration
- explains the role of ATP as energy carrier/energy currency
- compares aerobic and anaerobic respiration in terms of oxygen and amount of energy released
- presents information on diseases and disorders associated with respiratory system and their prevention.

Instructions for lesson planning

- Explain the process of inspiration and expiration through appropriate working model.
- Guide students to explore characteristics of a respiratory surface for efficient gaseous exchange.
- Guide student groups to identify the characteristics of a respiratory surface by using diagrams/ animations/ video clips and allow them to explore how those surface features help to play the role of gas exchange.
- Conduct discussion to highlight cellular respiration.
- Guide them to develop an appropriate balanced chemical equation for aerobic respiration.
- Guide students to understand that Adenosine Tri Phosphate (ATP) is a universal currency for energy transactions of living organisms and help them to realise that all productive energy yielded from respiration is stored/transferred in the form of ATP.
- Explain aerobic and anaerobic respiration by using suitable examples
- Guide them to differentiate between both types of respiration in terms of energy and oxygen released.
- Guide students to collect relevant information with regard to diseases as well as disorders and their prevention associated with the respiratory system, and ask them to present their work in groups. (Common cold, Tuberculosis, Pneumonia, Asthma, Bronchitis)

Key Concepts

Inspiration, expiration, respiratory surface, aerobic respiration, anaerobic respiration, Adenosine Tri Phosphate (ATP), Tuberculosis, Pneumonia, Asthma, Bronchitis,

Quality Inputs :

Diagrams, charts, models, video clips

Assessment and Evaluation

- Assess students' participation during the preparation of working models to demonstrate inspiration and expiration
  - Selecting a suitable model
  - ability to explain the function
  - team work
- Assess students' performance in presenting information on diseases and disorders
- Time management
- Team work
- Accuracy of information

Competency level 1.6: **Investigates the process of excretion in human**

No. of periods **03 periods**

Learning outcomes **:**

- states what excretion is
- lists out excretory products and excretory organs of human
- states the functions of kidney
- explains briefly the process of urine production
- presents information on diseases and disorders associated with excretory system and their prevention

Instructions for lesson Planning

- Explain the term excretion through appropriate diagrams/articles/video clips.
- Guide students to distinguish between excretion and defecation
- Assist them to list out the excretory products of human.
- Explain briefly the process of urine production
- Assist student groups to prepare a presentation to demonstrate and explain the functions of kidney, diseases and disorders

Key words and Concepts

Excretion, kidney, urine, nephron

Quality Inputs

Diagrams/video clips/photographs, articles

Assessment and Evaluation

- Assess students' presentations on functions of kidney using the following criteria
  - Use of visual aids
  - Team work
  - Accuracy of information
  - Time management

Competency level 1.7: Investigates the process of circulation in human

No. of periods 05 periods

Learning outcomes :

- states the composition and functions of blood
- describes pulmonary and systemic circulation
- explains blood pressure as systolic and diastolic pressure
- explains cardiac cycle and heart sound
- describes the role of lymph and the lymphatic system.
- presents information on diseases and disorders associated with the circulatory system and their prevention

Instructions for lesson planning

- Show videos/articles/ diagrams to describe the composition of blood
- Use charts /diagrams/ tables to show main parts of blood circulatory system
- Explain functions of the heart using models/ diagrams
- Explain the functions of blood
- Explain the production & functions of lymph and lymphatic system.
- Let students prepare a booklet on diseases and disorders related to the circulatory system and their prevention
- Conduct a class quiz based on short questions prepared by students

Key Concepts

Pulmonary circulation, blood pressure, systolic and diastolic pressure, heart sounds, lymph

Quality inputs

Models, reading materials/ video clips

Assessment and evaluation

Assess the class quiz using the following criteria,

- Quality and relevance of questions
- planning
- correct answers
- organizing skills

Competency level 1.8: **Investigates the process of coordination and homeostasis in human**

No. of periods **05 periods**

Learning outcomes **:**

- lists the main functions of the central nervous system (brain and the spinal cord)
- states that reflex action is an immediate and involuntary response to stimuli
- identifies the reflex arc as the functional unit of the nervous system
- identifies the parts of the reflex arc
- states the importance of autonomic nervous system
- gives examples for sympathetic and parasympathetic actions
- explain the main endocrine glands, their locations and functions
- states what homeostasis is
- explains the homeostasis of body temperature, blood glucose and water content

Instructions for lesson planning

- Explain the functions of the brain and the spinal cord using diagrams/ videos/ models.
- Explain reflex action & the reflex arc
- Conduct a discussion on the importance of the autonomic nervous system and its functions.
- Explain the main endocrine glands, their locations and functions
- Explain that homeostasis is a mechanism to regulate the internal environment
- Briefly explain the homeostasis of the body temperature, blood glucose level and water content.
- Conduct a structured essay questionnaire prepared by students.

Key Concepts

Human co-ordination, homeostasis, reflex action, reflex arc, central nervous system, peripheral nervous system, autonomic nervous system.

Quality inputs

Models, reading materials/ video clips

Assessment and evaluation

Assess structured essay questions of students using following criteria

- Relevancy and accuracy of questions
- Accuracy of marking scheme
- Division of marks
- Marking the answer scripts

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

Competency level 2.1: **Investigates different types of mixtures,**

No. of periods **05 Periods**

Learning outcomes **:**

- explains the term mixtures
- explains what homogeneous and heterogeneous mixtures are
- lists the characteristics of homogeneous and heterogeneous mixtures
- prepares different types of mixtures
- differentiates the given mixtures as homogeneous or heterogeneous based on observations
- defines the term solubility
- states the factors affecting solubility
- examines the factors affecting solubility
- shows awareness to control the factors affecting solubility in day to day life

Instructions for lesson plans

- Explain the term "mixture" using suitable examples given by the students with their experience.
- Build up a list of mixtures and categorize them according to the types homogenous and heterogeneous.
- Assign group of students to prepare different types of mixtures.
- Guide the students to differentiate the mixtures prepared, as homogenous and heterogeneous mixtures.
- Describe the term solubility using suitable examples
- Group students and assign them to investigate the factors affecting solubility.
- Discuss with the students the importance of solubility in day to day life.

Keywords / concepts

- Mixtures
- Homogeneous mixtures / solutions
- Heterogeneous mixtures
- Solubility

Quality inputs

Beakers, glass rod

Assessment and evaluation

- Assess the students when engaged in group activities using following criteria.
    - Following instructions
    - Active participation
    - Setting up the equipment properly
    - Observation skills
    - Reporting data
    - Use of solvents and solutes in accurate propotions

Competency level 2.2: **Uses different criteria to express the composition of mixtures.**

No. of periods **05 periods**

Learning outcomes **:**

- expresses the composition of a mixture as a mass fraction
- expresses the composition of a mixture as a volume fraction
- expresses the composition of a mixture as a mole fraction
- expresses the composition of a solution in relation to mass and volume
- expresses the composition of a solution in relation to the number of moles and volume.
- states the composition expressed in terms of mole/volume as concentration
- prepares a mixture of a given composition
- prepares a standard solution
- accepts the importance of preparing standard solutions
- solves simple problems related to the composition of mixtures

Instructions for lesson planning:

- Discuss with the students the instances where the composition of a mixture is important.
- Explain to the students that the composition of a mixture can be expressed as
  - a mass fraction
  - a volume fraction
  - a mole fraction
  - mass/volume
  - mole/volume
- Group the students and assign them to prepare mixtures of different compositions
- Guide students to solve simple problems on mass fraction, volume fraction, mole fraction, mass/volume and mole/volume.
- Instruct students to collect different bottles or containers of which the composition of constituents is given by m/v, v/v and n/v.
- Introduce the composition expressed in terms of the number of moles/volume as concentration.
- Group students and assign them to prepare standard solutions.

Keywords / concepts :

- Composition of a mixture
- Mass fraction
- Volume fraction
- Mole fraction
- Concentration

Quality inputs

Volumetric flask, funnel, measuring cylinder, wash bottle, relevant chemicals, relevant balance

Assessment and evaluation:

- Assess the students when engaed in group activities preparing the standard solutions using following criteria.
    - Handling equipment and materials
    - Active participation
    - Accuracy of measurements taken
    - Cleanliness of the work station
- Let students solve numerical problems on composition and evaluate them

Competency level 2.3: **Uses various techniques for separation of mixtures.**

No. of periods **05 periods**

Learning outcomes **:**

- describes the given separation techniques
- separates constituents of a mixture by using different separation techniques
- gives examples for instances where given separation techniques are used
- describes the process of salt production from sea water
- presents separation techniques that are used in the salt industry
- describes the processes of extraction of essential oils from natural sources in Sri Lanka
  E.g.: Cinnamon / Citronella

Instructions for lesson plans

- Conduct a classroom discussion on simple separation techniques used at home
- Assign activities that provide opportunities for students to observe the following separating techniques
  - Mechanical separation
  - Evaporation / Vaporization
  - Filtration
  - Crystallization
  - Recrystallization
  - Chromatography
- Demonstrate the following separation techniques in the classroom and discuss their advantages and disadvantages
  - Simple distillation
  - Solvent extraction
  - Steam distillation
  - Fractional distillation
- Describe the theories behind the above four separation techniques
- Discuss with the students, the separation techniques that can be used to separate constituents of a given mixture

- Describe the separation process of salt from sea water emphasizing the separation techniques applied
- Carry out a discussion to describe the process of extraction of essential oils from natural sources in Sri Lanka. Example: cinnamon oil / citronella oil

Keywords / concepts

- Mechanical separation
- Evaporation / Vaporization
- Filtration
- Crystallization
- Chromatography
- Simple distillation
- Solvent extraction
- Steam distillation

Quality inputs

Funnels, filter papers, chromatography papers, beakers, glass rod, separating funnels, Liebig condensers, distillation flask, clamp, Bunsen burner

Assessment and evaluation:

- Assess the students when they are engaged in group activities on separation techniques, using the following criteria.
  - Handling equipment and materials
  - Active participation
  - Reporting observations and discussion
  - Cleanliness at the work station

Competency level 2.4: **Investigates properties of acids, bases and salt.**

No. of periods **07 periods**

Learning outcomes **:**

- lists the characteristic properties of acids, bases and salts
- explains acids as a source of hydrogen ions and bases as a source of hydroxyl ions
- states the difference between strong acids and weak acids
- gives examples for strong and weak acids
- states the difference between strong bases and weak bases
- gives examples for strong and weak base
- differentiates acids and bases using litmus paper, pH paper and common acid – base indicators
- states that acids and bases react to produce salts and water
- explains the term neutralization
- discusses the applications of the neutralization process in day to day life
- lists and investigates applications of acids, bases and salts in day to day activities.

Instructions for lesson planning

- Assign students to find out the characteristics of acids, bases and salts which are important in day to day life.
- State that acids contain hydrogen ions.
- State that bases contain hydroxyl ions.
- Design a simple activity to differentiate acids and bases using litmus paper, pH paper and common acid base indicators.
- Demonstrate strong acids and weak acids by using pH indicators.
- Explain the difference between strong acids and weak acids using examples.
- Explain the term 'neutralization'.
- List some examples for salts.
- Mention that salts and water are formed when acids and bases react.
- Discuss the properties of salts.
- Discuss some applications of neutralization in day to day life.

- List and investigate applications of acids, bases and salts in day to day life and discuss their role in specific application.

Keywords / concepts

- Acid, base, salt, neutralization

Quality inputs

Litmus papers, pH papers, relevant acid and base solutions, relevant natural indicators, phenolphthalein, methyl orange

Assessment and evaluation:

- Assess the students performance when engaged in group activities to differentiate acids, bases and salts using indicators
  - Handling equipment and materials
  - Active participation
  - Reporting observations and discussion
  - Cleanliness at work station

Competency level 2.5: **Investigates heat changes associated with chemical reaction**

No. of periods **08 periods**

Learning outcomes **:**

- expresses by experience that heat changes occur during chemical reactions
- gives examples for endothermic and exothermic reactions
- demonstrates few endothermic and exothermic reactions
- explains what endothermic and exothermic reactions are
- determines the heat change of a given reaction experimentally
- states the assumptions made in determining the heat change of reaction in a given experiment
- accepts that heat changes associated with chemical reactions are important for all living beings and are being used in day to day life and in industries

Instructions for lesson planning

- Demonstrate an exothermic reaction by using a suitable experiment.
- Demonstrate an endothermic reaction by using a suitable experiment.
- Discuss other relevant exothermic and endothermic reactions.
- Explain exothermic and endothermic reactions based on the energy of reactants and products.
- Explain that the energy of the products is less than that of the reactants in exothermic reactions.
- Express that the energy content of the products is more than that of the reactants in endothermic reactions.
- Illustrate an exothermic reaction by means of an energy diagram.
- Illustrate an endothermic reaction by means of an energy diagram.
- Determine the heat change of a reaction by using strong acid and strong base.
- Assume that the density of dilute solutions is equal to the density of water and the specific heat capacity of dilute solution is equal to the specific heat capacity of water.
- Guide students to solve simple problems relating heat change in reactions.

- Explain that heat changes associated with chemical reactions are very important.
- Mention not to add water into strong acids to dilute them but to add acids to water.
- Discuss with students may have had experiences about heat changes when they were learning about chemical changes in grade 10.
- Give an assignment to recall their experiences regarding exothermic and endothermic reactions.
- Discuss the heat changes occurring in the following instances in day to day life.

  When glucose is added to water

  When CaO is added to water

  When urea is added to water

Keywords / concepts

Exothermic reactions

Endothermic reactions

Heat changes

Quality inputs

Test tubes, wash bottles, glass rod, relevant chemicals
(eg : Hc1, NaOH, NH_4Cl)

Assessment and evaluation

- Assess the students when solving simple problems relating heat change in reactions.
  - Identify relevant data accurately for the calculation.
  - Subsitution of relevant data to the equation.
  - Final answer by correct calculation.

Competency level 2.6: **Investigates the components of an electrochemical cell and the relevant reactions**

No. of periods **04 periods**

Learning outcomes **:**

- makes an electrochemical cell by using zinc, copper and dilute sulphuric acid
- states oxidation and reduction as loss and gain of electrons respectively
- defines the electrode where oxidation takes place as anode
- defines the electrode where reduction takes place as cathode
- writes anodic, cathodic and overall reactions of a simple electrochemical cell such as Zn/Cu, Fe/Cu, and Zn/Fe
- states that electrons flow from the anode to the cathode through an external circuit

Instructions for lesson planning

- Make an electrochemical cell by using zinc, copper, and dil. H_2SO_4 acid.
- Let students observe the action of the cell.
- Explain the generation of electric current by an electrochemical cell.
- Describe which metal loses electrons and becomes positively charged ions.
- Explain the reason for dissolving of the immersed part of the zinc rod.
- Mention that electron flow is from Zn rod to Cu rod.
- Discuss with students, what will happen to these electrons at the copper rod.
- Mention that these electrons are gained by H^+ ions present in the solution. (as a result, hydrogen gas is formed, and evolved at the copper rod.)
- Describe how to write the chemical equation of the reaction which is involved with the removal of electrons.
- Introduce the removal of electrons as oxidation.
- Introduce anode as the electrode where oxidation occurs.
- State that the zinc rod is the anode in the above electrochemical cell.
- Introduce the gaining of electrons as reduction.
- Explain that electrons are gained by H^+ ions at the cathode.
- Mention that the copper rod is the cathode in this electrochemical cell.

- Explain the anodic, cathodic, and the overall reaction of the following electrochemical cells.
    - Zn / Cu cell
    - Fe / Cu cell
    - Zn / Fe cell
- Describe how to identify the anode and the cathode of the above cell by using activity series

Keywords / concepts

- Electrochemical cell
- Anode
- Cathode
- Oxidation
- Reduction

Quality inputs

Beakers, dil. H_2SO_4, Cu sheet, Zn sheet, Cu wires

Assessment and evaluation

- Assess the students when engaged in group activities using the following criteria
    - Following instructions
    - Active participation
    - Observation skills

Competency level 2.7: Investigates different electrolysis processes

No. of periods 04 periods

Learning outcomes :

- distinguishes electrolytes and non electrolytes by testing for electrical conductivity
- writes anodic, cathodic and overall reaction of a given electrolysis processes
- defines the anode and cathode of an electrolysis process
- demonstrates the electrolysis of a sodium chloride solution, acidulated water and a copper sulphate solution
- describes how sodium is extracted using Down's cell
- explains what electroplating is
- describes the process of electroplating of copper on iron with the relevant reactions
- conducts a simple activity to demonstrate the deposit of copper on iron in the electroplating processes
- states the uses of electroplating

Instructions for lesson planning

- Do simple activities to demonstrate electrolytes and non electrolytes.
- Let the students identify electrolytes and non electrolytes by giving them the following liquids and solutions. e.g. kerosene, distilled water, salt water, acidulated water, ethanol
- Demonstrate the electrolysis of acidulated water and mention its anodic, cathodic and overall reactions.
- Demonstrate the electrolysis of an aqueous copper sulphate solution by using two carbon rods (carbon electrode).
- Make students demonstrate the electrolysis of aqueous NaCl solution by using a carbon electrode.
- Guide the students to write anodic, cathodic and overall reactions of electrolysis of aqueous NaCl solution.
- Explain the anode and the cathode of this electrolysis process.
- State that sodium metal is extracted by using electrolysis of molten NaCl (fused sodium chloride).

- Mention that when sodium is extracted on a large scale a special cell has to be used and it is named as Down's cell.
- Name the relevant electrodes which are used in Down's cell.
- Make students write down equations of anodic and cathodic reactions occurring in Down's cell.
- State that chlorine is the byproduct of the above process.
- Explain the structure of Down's cell using a chart or a video clip.
- Discuss the uses of sodium.
- Discuss the uses of chlorine.
- Explain that electroplating is done by using the knowledge of electrolysis.
- Demonstrate how copper is electroplated on an iron surface.
- Mention that the object which should be electroplated has to be used as the cathode.
- Mention that the electrolyte should be a solution which contains positive ions of the metal which has to be plated.
- Mention that the anode should be the relevant metal that can give positive ions of the metal to be plated to the solution.
- Discuss the uses of electroplating.

Keywords / concepts

- Electrolytes
- Non electrolytes
- Metal extraction
- Electroplating

Quality inputs

Beakers, $CuSO_4(aq)$, carbonelectrodes, NaCl(aq)

Assessment and evaluation

- Assess the students engaged in group activities using the following criteria
  - Following instructions
  - Active participation
  - Observation skills
  - Cleanliness at the work station

Competency level 2.8: **Investigates the process of corrosion**

No. of periods **03 periods**

Learning outcomes **:**

- describes what corrosion is
- explores the factors affecting rusting of iron
- states the conditions needed for rusting
- writes the relevant reactions occur during the process of rusting
- describes how the rusting of iron is controlled
- explains the process of the sacrificial protection of iron
- selects suitable metals for the cathodic protection of iron by referring to the activity series
- shows appreciation of the importance of controlling of rusting

Instructions for lesson planning

- Describe what metal corrosion is and explain how it occurs.
- Guide students to express their experiences on rusting in day to day life.
- Represent diagrams / video clips to show the harmful effects of rusting .
- Conduct experiments to show the necessity of water and oxygen for rusting.
- Conduct simple activities to demonstrate how the following factors affect rusting.

  Acid , basic and salty conditions
- Describe the effect of acid , base and salt conditions for the process of rusting.
- Explain how rust is formed when a piece of iron is exposed to air and water.
- Conduct activities to demonstrate bimetallic corrosion and cathodic protection.
- Discuss the importance and methods of controlling rusting and prepare a report to present how these methods can be used in day to day life.

Keywords / concepts

Corrosion

Rusting

Bimetallic corrosion

Cathodic protection

Quality inputs

Test tubes, iron nails

Assessment and evaluation

- Assess the report prepared by students on rusting according to the following criteria
    - Accuracy of data
    - Sufficiency of data
    - Presentation of the prevention methods of rusting

Competency level 2.9: **Investigates the nature and uses of hydrocarbons and their derivatives.**

No. of periods **03 periods**

Learning outcomes **:**

- describes hydrocarbons as a group of compounds containing only carbon and hydrogen
- describes alkanes as a group of hydrocarbons containing only C-C single bonds and C-H bonds
- draws structures of alkanes (linear structures for maximum of 5 carbon atoms)
- draws structures of ethene and its derivatives

Instructions to prepare the lesson

- Ask children to make a list of fuel that are used in day to day life. [e.g. :- kerosene oil, petrol, candle wax, biomass]
- Initiate a discussion on the composition of above given fuels
- Conduct a simple activity for testing the presence of C and H in one of the above fuels
- Explain that most fuels mostly contain C and H.
- Mention that compounds containing only C and H are referred to as hydrocarbons.
- Describe alkanes as a group of hydrocarbons containing only C-C single bonds and C-H bonds.
  Let students draw the structures of alkanes maximally for 5 carbon atoms (linear structures only)
- Construct structures of simple alkanes by using proper materials. (Maximum of 2 carbon atoms)
- Derive the common formula of alkanes as $C_nH_{(2n+2).}$ (n = No. of carbon atoms)
- Introduce the structure of ethene and (C = C)
- Introduce chloroethene (Vinyl Chloride) and tetrafluroethene as derivatives of ethene.
- Let the students draw the structures of chloroethene and tetrafluroethene

Key words and Concepts

- Hydrocarbons
- Alkane
- Ethene
- Chloroethene (Vinyl Chloride)
- Tetrafluroethene

Quality inputs

- Petrol
- Diesel
- Kerosene oil
- Candle wax
- $Ca(OH)_2$
- $CuSO_4$
- Beaker
- A plate of glass
- Bristol boards
- Sticks and ball set
- Clay / Styrofoam board

Assessment and evaluation

- Assess students performance during constructing the models of alkenes, ethene and their derivatives.
    - Creativity.
    - Use of appropriate and cheap materials.
    - Correctness.

Competency level 2.10: **Explores different kinds of polymers**.

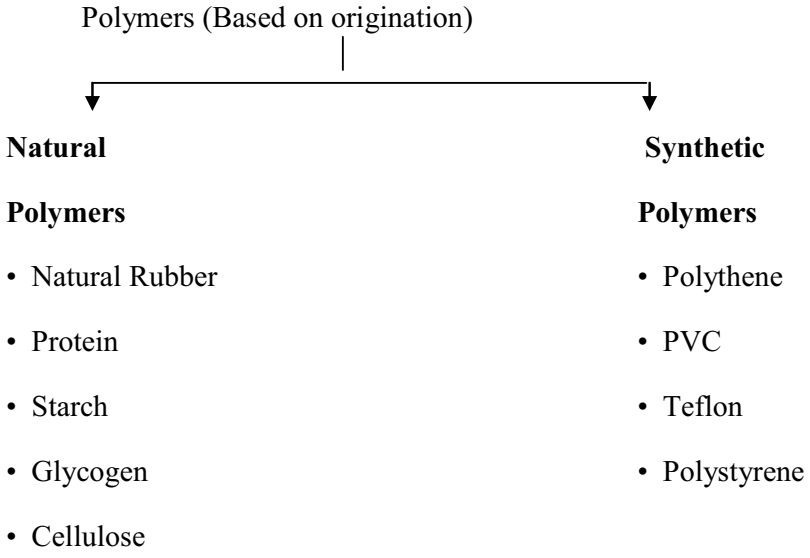
No. of periods **03 periods**

Learning outcomes **:**

- explains the terms monomers, polymers, polymerization and repeating units
- categorizes polymers based on their origin
- gives examples for natural and synthetic polymers
- categorizes polymers based on their structures
- states uses of polymers derived from the given monomers
- illustrates linear, branched and cross linked polymers diagrammatically
- appreciates the importance of polymers in day to day life and in industries

Instructions for lesson planning:-

- Ask the students to draw the structures of ethene molecules by combining them in a suitable manner.
- Explain that ethane molecules are combined together to form long chain molecules which is known as polyethylene molecules.
- Describe the terms monomer, polymer and repeating unit in relation to the above example.
- State that the process of making polymers by combining of monomers is called polymerization.
- State that the molecule formed by combining monomers is called polymer.
- State those simple molecules that combined with each other to make polymers are referred as monomers.
- Assign students to draw the structures of polyvinyl chloride (PVC) and polytetrafluoroethene.
- Categorize polymers as natural polymers and synthetic polymers based on their origin.



- Categorize polymers as linear, branched and cross linked based on their structures
- Illustrate linear, branched and cross linked polymers diagrammatically.
- Assign students to explore the uses of polymers in day to day life and industries.

Key words and Concepts:

- Monomer
- Polymers
- Repeating unit
- Natural polymers
- Synthetic polymers
- Linear polymers
- Branched polymers
- Cross linked polymers

Quality inputs :

- Clay / Styrofoam balls
- Sticks
- Bristol board
- Marker pen
- Text book
- Other printed materials

Assessment and evaluation

- Assess students performances based on the assignment on uses of polymers in day to day life and in industries.
    - Use of resource books, papers, media etc
    - Creativity
    - Accuracy
    - End products

Competency 03: **Utilizes various forms of energy, their interaction with matter and energy transformation by maintaining efficiency and effectiveness at an optimum level.**

Competency Level 3.1: **Investigates properties of mechanical waves and electromagnetic waves.**

No. of periods **07 periods**

Learning outcomes :

- demonstrates the nature of mechanical wave motion through activities .
- states that mechanical waves transfer energy without transferring matter.
- distinguish between transverse and longitudinal waves and gives suitable examples.
- uses graphical representation of waves to explain the nature of wave motion and the physical quantities related to wave motion (frequency, weave length, amplitude and speed of wave)
- state that electromagnetic waves produced by oscillating electric field and magnetic field perpendicular to each other, without oscillating particles in the medium.
- states that electromagnetic waves propagate in a direction perpendicular to the both electric field and magnetic field.

- states that medium is not essential for the propagation of electromagnetic waves.
- states that electromagnetic waves have a constant speed of 3×10^8 m s^{-1} in vacuum.
- states that electromagnetic waves propagate as transverse waves
- introduces electromagnetic spectrum and explains the productive uses of radio waves, micro waves, IR, visible range, UV, X – ray and γ rays.
- expresses that light and heat propagate to the earth from the sun as electromagnetic waves

Instructions for lesson plans:

- Demonstrate the nature of longitudinal and transverse wave motion using a slinky or suitable set up

- Using the observations of the activity, guide the student to understand that
    - in longitudinal waves, particles oscillate along the direction of propagation.
    - in transverse waves, particles oscillate perpendicular to the direction of propagation of waves
    - energy is transferred by waves without transferring matter
- Describe longitudinal and transverse wave propagation using diagrams
- Guide the students to come out with examples for transverse and longitudinal waves
- Introduce displacement – distance graph for longitudinal and transverse waves and state that this is the graphical representation of a wave.
- Explain physical quantities **frequency, wavelength, speed** and **amplitude** related to wave motion using the displacement-distance graph of a wave motion.
- Explain briefly seismic waves and tsunami waves.
- Explain using a suitable diagram how electromagnetic waves propagate with oscillating electric and magnetic field perpendicular to each other.
- Conduct a discussion highlighting that following characteristics of electromagnetic waves
    - medium is not essential for the propagation
    - have a constant speed of 3×10^8 ms^{-1} is vacuum
    - propagate as transverse wave.
- Introduce electromagnetic.
    - discuss briefly the uses of radio waves, micro waves, IR, visible light , UV, X – ray, and γ - ray

Quality inputs: slinky

Keywords / concepts:

- Mechanical waves
- Longitudinal waves
- Transverse waves
- Frequency

- Wavelength
- Speed of waves
- Amplitude
- Electromagnetic waves
- Electromagnetic spectrum

Assessment and Evaluation:

- Assess students using the following criteria when they engage in the group activity and the discussion
  - Active participation in the discussions
  - Responding with the correct observation.
  - Handling apparatus properly

Competency Level 3.2: **Uses the knowledge of sound waves in day to day activities and scientific works**

No. of periods **04 periods**

Learning outcomes :

- describes the longitudinal nature of sound waves
- describes that sound waves consist of a series of compressions and rarefactions
- states that a medium is needed to propagate sound waves
- states the order of magnitude of the speed of sound in air, liquids and solids
- categorizes musical instruments based on the method of sound production
- states that pitch, loudness and quality of sound as characteristics of sound
- states that pitch depends on frequency, loudness on amplitude and quality of sound on the sound source
- expresses audible range, infra sound and ultra sound frequencies

Instructions for lesson planning:

- Using diagrams and other available resources (computer animations, video clips…), describe that:
  - sound waves consist of a series of compressions and rarefactions
  - sound propagates as longitudinal waves.
- Explain that medium is needed for the propagation of sound
- State that the magnitude of speed of sound in gas, liquid and solids increases accordingly.
- Demonstrate the method of production of sound using musical instruments and categorize them according to the vibration of air columns, strings and membranes
- Allow students to experience pitch, loudness and quality of sound using suitable sound sources
- State the variation of pitch with the frequency, loudness with the amplitude, quality of sound with the sound source.

- Carry out a discussion with the view of introducing audible range of sound, infra sound and ultra sound.
- Discuss the uses of infra sound and ultra sound.

Quality inputs:

Musical instruments, set of tuning forks

Keywords / concepts:

- Sound waves
- Speed of sound
- Pitch
- Loudness
- Quantity of sound
- Audible range of sound
- Infra sound
- Ultra sound

Assessment and Evaluation:

- Assess students using the following criteria when they engage in discussion
- Active participation in the discussions
- Present relevant information
- Caring others ideas

Competency Level 3.3: **Uses Principles and laws of geometrical optics in day to day activities and scientific needs.**

No. of periods **12**

Learning outcomes **:**

- carries out activities to investigate the nature of images of curved mirrors.
- identifies pole, centre of curvature, focus and principal axis
- uses the laws of reflection to explain the behavior of rays incident on the convex and concave mirrors.
  - a ray parallel to principal axis
  - a ray passing through the center of curvature
  - a ray passing through the focus
- draws ray diagrams for images of convex mirrors.
- draws ray diagrams for images of concave mirrors.
  (u tends to infinity, $u > r$, $u = r$, $f < u < r$, $u = f$, $u < f$)
- uses curved mirrors in relevant situations
- carries out simple activities to demonstrate refraction
- explains the terms denser medium and rarer medium.
- states laws of refraction.
- explains the term refractive index.
- carries out activities to demonstrate total internal reflection
- explains the term 'critical angle'
- describes the phenomenon of total internal reflection and its applications
- carries out activities to investigate the nature of images of convex lenses and concave lenses
- explain the 'terms" principal axis, focus, optical center for a lens
- explains the behavior of the following rays incident on a lens
  - a ray parallel to the principal axis
  - a ray through the optical centre
  - a ray through the focus
- States the principle of reversibility of light.
- draws ray diagrams for images formed by concave lenses.
- draws ray diagrams for images formed by convex lenses.
  (u $\rightarrow\infty$ $u > 2f$, $u = 2f$, $f < u < 2f$, $u = f$, $u < f$)
- gives examples for the uses of convex and concave lenses
- explains the action of a simple microscope using a ray diagram.

Instructions for lesson planning:

- Carry out simple activities and let students observe different images formed by convex and concave mirrors.
- Conduct a discussion with students about their observations highlighting the nature of the images. (real/ virtual. erect/invert,/diminished/ magnified)
- Explain pole, centre of curvature, focus and principal axis of a curved mirror
- Guide students to draw reflected rays for the rays incident on the curved mirror parallel to the principal axis. Rays passing through centre of curvature and focus.
- Guide students to draw ray diagrams to locate images formed by the convex mirror.
- Direct students to draw ray diagrams to locate images formed by the concave mirror for states

  ((u $\rightarrow\infty$, $u > r$, $u = r$, $f < u < r$, $u = f$, $u < f$)
- Conduct a discussion with students about the uses of curved mirrors in day to day life and other relevant situations.
- Demonstrate refraction of light using a pencil of ray and two different transparent media such as air / water or air/ glass.
- Explain the terms denser medium and rarer medium with examples.
- State laws of refraction and introduce incident ray, refracted ray, angle of incidence, angle of refraction and as related terms
- Introduce the refractive index. (qualitatively)
- Demonstrate total internal reflection using a suitable activity
- Explain the "term critical angle" based on observations of the demonstration.
- Direct students to investigate the nature of images of convex and concave lenses by observing different images formed by lenses.
- Guide students to draw ray diagrams to locate images formed by the concave lens
- Guide students to draw ray diagrams to locate images formed by convex lens for states (u $\rightarrow\infty$ $u > 2f$, $u = 2f$, $f < u < 2f$, $u = f$, $u < f$)
- Explain the action of a simple microscope with the help of a ray diagram.

Keywords / concepts

- Real images
- Virtual images
- Pole
- Center of curvature
- Focus
- Principal axis
- Pencil of ray
- Refractive index
- Critical angle
- Total internal reflection
- Simple microscope

Quality inputs

Concave and convex mirrors, concave and convex lenses, glass block, optical pins

Assessment and Evaluation:

Asses students using following criteria when they engaged in activities

- Handling apparatus properly and safely
- Taking correct observations
- Come to the conclusions
- Helping others

Competency Level 3.4: **Investigates thermal effects**

No. of periods **12 periods**

Learning outcomes **:**

- names various types of thermometers (mercury-glass, alcohol-glass, digital)
- explains briefly the action of mercury-glass thermometer
- identifies the Celsius temperature scale
- identifies the Kelvin temperature scale (absolute)
- states the relationship between Celsius and Kelvin
- uses thermometers to measure various temperatures
- state the condition that is needed to exchange heat from one object to another
- defines heat capacity of a body
- defines specific heat capacity of a substance
- uses the relationship $Q = mc\theta$ to find the amount of heat exchange
- states that the change of state occurs at boiling point and melting point without changing the temperature
- compares vaporization and evaporation qualitatively
- explains the terms the "melting point", "freezing point", "boiling point"
- defines specific latent heat of fusion and specific latent heat of vaporization
- demonstrates the expansion of solids, liquids and gases through activities
- describes the three methods of heat transfer
- gives examples for the methods of heat transfer

Instructions for lesson plans:

- Show various types of thermometers to students and name those.
- Describe the construction of mercury glass thermometer and explain that the expansion of a mercury column is used to measure the temperature.
- Explain that the Celsius temperature is based on the freezing point and boiling point of water.
- Introduce absolute temperature scale and state that its zero point is equal to -273 ^{0}C.

- Give the relationship between Celsius scale and Kelvin scale.
- Direct students to measure various temperatures using given thermometers.
- Explain that heat flows from higher temperature object to the lower temperature object
- Introduce heat transfer methods and name those methods.
- Explain briefly how heat is transferred through various methods.
- Define the specific heat capacity of a substance.
- Define the heat capacity of an object and state that heat capacity is equal to the product of the mass and specific heat capacity of the substance
- Show that the amount of heat exchange is given by $Q = mc\theta$
- Direct students to carry out simple calculations using $Q = mc\theta$
- Explain the change of state of matter (Solid – liquid and liquid – gas)
- Define specific latent heat of fusion and specify latent heat of vaporization.
- Explain the similarities and differences between vaporizing and evaporation.
- Describe qualitatively the thermal expansion of solid, liquids and gases through simple activities
- Direct Students to investigate some of the day – to - day applications and consequences of thermal expansion.

Quality inputs: bimetallic strip**,** thermometers, thermostat.

Keywords / concepts

- Celsius temperature scale, absolute (Kelvin) temperature scale,
- Specific heat capacity
- Heat capacity
- Freezing point
- Boiling point
- Melting point
- Expansion
- Conduction
- Convection
- Radiation
- Change of state
- Evaporation

- Vaporization
- Latent heat of fusion
- Latent heat of vaporization

Assessment and Evaluation:

- Asses students using the following criteria in the activity for measuring temperatures and determining heat exchange
    - Use the thermometer correctly
    - Take the readings correctly
    - Correct calculations
    - Obtain correct results

Competency Level 3.5: **Quantifies electrical energy and power in an electric circuit**

No. of periods **05 periods**

Learning outcomes **:**

- explains energy dissipation and power of an electrical appliance
- solves simple numerical problems involving energy and power
- compares power rating and energy consumption of various electrical appliances
- compares various electrical appliances in terms of efficient use of energy
- describes ways of increasing energy efficiency
- names the components of house wiring circuit
- explains the connection of a house wiring circuit using a circuit diagram
- explains the safety precautions used in house wiring circuit
- uses "kWh" as a unit of electrical energy consumption.

Instructions for lesson plans:

- Explain that electrical energy is transferred to other forms of energy in electrical appliances by using examples
- Define the power of an electrical appliance
- State that energy consumed by an electrical appliance is given by E = pt
- State that the rate of energy dissipation when voltage V is applied and if current I flows through it given I by P = VI
- Explain that the energy dissipation of an electrical appliance V under the above conditions and the current flow though it in time t is given by E = VIt
- Assign students to list out the power consumption of domestic electrical appliances and calculate the electric energy consumed by electric appliances.
- State that the electricity supply to our homes by the National Grid is alternating current with 230 V and 50 Hz
- State that there are two cables from main supply – one live, the other neutral
- State that there are lighting circuits and ring in house wiring circuits
- State that there are 5A and 13A/15A circuits in the house wiring circuits.

- Name the components in house wiring circuit and explain the connections and actions of those.
- Explain safety precautions of house wiring circuits .
- Introduce kilowatt hour as a unit of electrical energy.
- State that the electricity supplied to the houses is measured in kilowatt hours (kWh).

Keywords / concepts

- Power
- kilowatt hours
- Alternating current

Quality inputs

House wiring circuit model, wires, switches, circuit breakers

Assessment and Evaluation:

Asses students using following criteria for the assignment

- Amount of relevant information gathered.
- Comparing various apparatus
- Correct calculations
- Suggestions for the efficient use of electricity

Competency Level 3.6: **uses the knowledge of electronics in day to day activities and scientific work**

No. of periods **05 periods**

Learning outcomes **:**

- distinguishes conductors and semiconductors
- gives examples for intrinsic semiconductors
- describes the two types of extrinsic semiconductors
- describes the structure of a junction diode
- demonstrates the action of a diode using simple activities
- demonstrates half-wave rectification and full wave rectification using activities
- explains half-wave and full-wave rectification using circuit diagrams including smoothing
- conducts simple activities using LED, solar cell and photo diode.
- explains characteristics and uses of LED, photo diode and solar cell.
- describes the structure of npn and pnp transistor and introduces the circuit symbol
- describes the action of npn transistor as an amplifier using a simple activity
- describes the action of npn transistor as a switch using a simple activity
- explains the action of a transistor as an amplifier and as a switch using circuit diagrams

Instructions for lesson plans:

- Explain simply the electrical conductivity of electrical conductors and electrical insulators, using the behaviour of free electrons.
- Introduce semiconductors as a material which shows the properties in between electrical conductors and electrical insulators.
- Explain the way of increasing conductivity of a semi-conductor lattice based on increase in temperature.
- Introduce Silicon (Si) and Germanium (Ge) as elements which show the properties of semiconductors and name as intrinsic semiconductors
- Name compounds and substances which show the properties of semiconductors

- Explain simply the way of construction of p- type and n – type extrinsic semiconductors by doping Si and Ge with elements like Boron (B) and phosphorsus (P) by using (diagrams)
- Introduce p –n junction
- Explain the flow of current across a p-n junction in states where p-n junction is in forward bias and in reverse bias
- Explain the arrangement, appearance and standard symbol of a p-n junction diode
- Explain the changes that occur when an alternating current passes through a junction diode, and interpret those graphically
- Explain the practical application of a diode as

  Half wave rectification,

  Full wave rectification (bridge circuit only) including smooth.

- Explain by a circuit diagram the use of diode as a safety component to protect the damage due to changing positive and negative terminals of the power supply to a direct current instrument.
- Introduce the light emitting diode giving circuit symbols and instances where it is used.
- Introduce solar cells as an application of a p-n junction and explain its importance as an electric source.
- Describe the p-n junction arrangements of pnp and npn transistor and introduce their terminals with the help of diagrams
- Introduce standard symbols of pnp and npn transistor and name their terminals
- Mention that the arrow head in the symbol indicates the direction of current flow in the transistor.
- Direct students to arrange a set up for a transistor as an electrical signal amplifier according to a given circuit diagram and direct them to observe its action
- Direct students to arrange a setup for a transistor as a switch according to a given circuit diagram and direct them to observe its action

Quality inputs: Diodes, transistor**s,** resistors, connecting wires.

Keywords / concepts

- Intrinsic semiconductors
- Extrinsic semiconductors
- p – type semiconductors
- n – type semiconductors
- p – n junction
- Diode
- Half – Wave rectification
- Full – Wave rectification
- Smoothing
- Transistor
- Biasing transistor
- Transistor amplifiers
- Transistor switch

Assessment and Evaluation:

Asses the students according to the following criteria when they are engaged in circuit wiring

- Making the circuit according to the circuit diagram
- Working conditions of the circuits constructed
- Good finish of the circuit

Competency Level 3.7: Investigates the nature of electromagnetic force.

No. of periods 05 periods

Learning outcomes :

- carries out activities to demonstrate the force exerted on a current carrying conductor placed in a magnetic field
- states the factors which affect the magnitude of magnetic force
- use Fleming's left hand rule to find the direction of the magnetic force
- describes the action of the speaker
- constructs a device to demonstrate Fleming's left hand rule
- name the main parts of a dc motor and explains necessity of those parts
- explains the action of a dc motor using diagrams

Instructions for lesson plans:

- Recall the magnetic effect of an electric current using a simple activity
- State the direction of the magnetic field using the right hand grip rule
- Use current balance or any other suitable set up to demonstrate that a force exerted on a current carrying conductor placed in a magnetic field
- Show that the magnitude of the force depends on the magnitude of the current, strength of the magnetic field and the length of the conductor in the magnetic field.
- Describe that the direction of the force can be found by using Fleming's left hand rule.
- Direct students to use Fleming's left hand rule to find the direction of the force on the conductor when changing the direction of the current and the direction of the magnetic field.
- Describe the action of the speaker through activities.
- Guide students to construct a device to demonstrate Fleming's left hand rule.
- Explain the necessity of the essential parts of a dc motor (armature, magnetic poles, commutator and brushes).
- Describe the action of a dc motor using diagrams and laboratory motor model
- Explain that motor is used to convert electrical energy into mechanical energy

Quality inputs: Current balance
Speaker
Laboratory motor model

Keywords / concepts

- Magnetic force, Flemings left hand rule, dc motor, armature, commutator, brushes

Assessment and Evaluation:

- Assess students according to the following criteria when they engaged in making the model for the demonstration of Fleming's left hand rule
    - Ability to demonstrate the directions of relevant quantities clearly and accurately
    - Smooth action
    - Good finish of the device
    - Ability to make the device easily
    - Simplicity of the device

Competency Level 3.8: **Investigates the phenomenon of electromagnetic induction and uses of it.**

No. of periods **05 periods**

Learning outcomes **:**

- carries out simple activities to demonstrate the phenomenon of electromagnetic induction
- explains electromagnetic induction qualitatively
- states the factors which affect the magnitude of induced voltage
- uses Fleming's right hand rule to find the direction of induced current in a straight conductor
- uses the phenomenon of electro -magnetic induction to describe the action of a bicycle dynamo and microphone.
- describes the differences between direct current and alternating current
- explains the main parts of an alternating current generator and their necessity.
- illustrates graphically the variation of voltage with time of an alternating current generator.
- describes the structure of a transformer.
- explains and demonstrates the action of a transformer.
- gives the relationship between number of turns of primary and secondary coils and input/output voltages.
- expresses the relationship between input and output power.
- describes the structure and action of step-up and step-down transformers.
- Carries out simple calculations related to the transformer.

Instructions for lesson planning:

- Guide students to get the experience of electromagnetic induction through simple activities
- Explain that a voltage is induced across a straight conductor or solenoid when a magnetic field changes through it.
- Name the induced voltage as electromotive force because it can drive a electric current through a circuit.
- State the factors which affect the magnitude of induced emf
- Guide students to do activities in order to find the direction of the induced emf
- Conduct a discussion to identity examples for electromagnetic induction
- Explain that an emf is induced across a straight conductor when it moves perpendicularly to a magnetic field.

- State Fleming's right hand rule and use it to Predict the direction of induced current.
- Conduct a discussion to collect examples for electromagnetic induction.
- Introduce the main parts and explain the action, of a bicycle dynamo and a microphone.
- introduce the main parts of an alternating current generator and explain the action using diagrams and a laboratory model dynamo.
- Explain that the direction of the induced current in the coil changes once in half revolution
- Represent graphically the variation of induced emf with time.
- Describe the difference between direct current and alternating current.
- Explain that mechanical energy is converted electrical energy in a dynamo.
- Introduce main parts of a transformer using a laboratory transformer model or any other suitable setup.
- Explain the action of a transformer using the principle of electromagnetic induction.
- Introduce the transformer as a device to change the varying voltage from one value to another value.
- Give the relationship between the number of turns of primary and secondary coils and voltages.
- Direct students to carry out simple calculations using the above relationship.
- Give the relationship between input power and output power of an ideal transformer and carry out simple calculations using the relationship.
- Introduce step – up and step-down transformer and their uses.

Quality inputs: laboratory dynamo model, microphone

Laboratory transformer model

Keywords / concepts

- Electromagnetic induction
- Induced emf
- Induced current
- Dynamo
- Step up transformer, step down transformer

Assessment and Evaluation:

Assess students according to the following criteria when identifying the main parts of the given apparatus

- Name the main parts of apparatus
- Explain the functions of the parts
- Present information's about the safe use of the apparatus

Competency 4.0: **Explores nature, properties and processes of earth and space by understanding natural phenomena for intelligent and sustainable use**

Competency level 4.1: **Investigates the organizational levels of the biosphere and interactions existing within it.**

No. of periods **03 periods**

Learning outcomes **:**

- states organizational levels of the biosphere in hierarchical order
- describes the organizational levels of the biosphere
- identifies the pattern of typical population growth curve
- identifies the pattern of change in human population growth curve
- explains the factors affecting human population growth

Instructions for lesson planning:

- allow student to use diagrams / photographs/ models/ animations/ videos to identify the organizational levels of the biosphere in a hierarchical order
- explain the term 'species'
- guide student groups to identify the characteristics of each organizational level
- construct a typical population growth curve through a discussion
- guide student groups to analyze a typical growth curve
- introduce the human population growth curve
- explain how the typical growth curve differentiates from the human population growth curve
- let them explain the factors affecting human population growth and present as a poster

Key concepts:

Species/ individual
Population
Community
Ecosystem
Biosphere

Population growth curve

Quality inputs:

Diagrams, photographs, models, videos

Assessment and Evaluation:

Asses the students according to the following criteria when preparing the poster

- Accuracy of the information
- Relevancy of information
- Creativity (use of diverse models/colours)
- Attractive end product

Competency Level 4.2: **Investigates the mechanisms that contribute to maintaining the balance of the ecosystems**

No. of periods **05**

Learning outcomes **:**

- describes how energy and nutrients flow through food chains and food webs
- states the importance of energy pyramids with respect to number pyramids and biomass pyramids.
- accepts that flow of energy in an ecosystem is unidirectional.
- explain with the aids of illustrations that matter flows cyclically within the natural environment
- describes what bio-geo chemical cycle is
- names Carbon cycle, Nitrogen cycle and Phosphorus cycle as bio-geo chemical cycles
- explain carbon Cycle and Nitrogen cycle diagrammatically
- describes the factors affecting the ecological balance
- accepts that environmental balance depends on cycling of matter

Instructions for lesson planning

- Guide students to explore what a primary energy source is and how energy and nutrients flow in eco systems
- Group the students and let them analyze given ecosystems and let them construct food webs
- Let the students find the food chains in the food web
- Describe the energy reduction in each trophic level of a food chain
- Describe Bio-magnification
- Let the students illustrate the number, biomass and energy pyramids by using data given on trophic levels and introduce them as ecological pyramids
- Highlight that only the Energy pyramid is always in an upright position and the flow of energy is unidirectional in an eco-system
- Initiate a discussion on the cyclic flow of matter in the natural environment
- Introduce Carbon cycle, Nitrogen cycle and Phosphorous cycle as bio-geo chemical cycles
- Guide students to illustrate Carbon and Nitrogen cycles

- Ask students to describe the factors affecting the ecological balance
- explain how environmental balance depends on the cycling of matter

Quality inputs

- reading materials
- Charts
- Diagrams
- Video

Key concepts

Food chain, Food web, Energy pyramids, Number pyramids, Bio mass pyramids, Bio-geo chemical cycle

Assessment and Evaluation:

Asses the activity of constructing ecological pyramids according to the following criteria

- Correct scale
- Conceptual understanding of various types of pyramids.

Competency level 4.3: **Explores various types of pollutants and their adverse effects**

No. of periods **05 periods**

Learning outcomes **:**

- states what the environmental pollution is
- Explores the factors affecting soil, water and air pollution
- Presents a survey report on various pollutants emitted from different sources
- Name chemical substances that may occur in pollutants emitted from different sources
- Assesses the personal contribution to environmental pollution
- Assesses the contribution of different institutions to environmental pollution
- Explains effect of different phenomena associated with environmental pollution that lead to the listed adverse effects
- Uses various methods to communicate the adverse effects of pollution
- Accepts that all types of environmental pollutions are hazardous
- Accepts that pollution of one resource is interconnected with the pollution of other resources
- Accepts that human intervention is necessary to minimize environmental pollution

Instructions for lesson planning

- Guide groups of students to explore and present the following-
  - what environmental pollution is
  - the main ways by which it occurs
  - the factors affecting soil, water and air pollution
- Indicate the chemical substances that may occur in soil, air, and water pollutants
- Make student groups assess and present personal and institutional contribution to the environmental pollution.
- Guide students to mention indirect and direct adverse effects on environmental pollution
- Discuss that pollution of one resource is interconnected with the pollution of other resources
- Using suitable examples explain that human intervention is important to minimize environmental pollution
- Present video clips to show methods of environmental pollution

Quality inputs

Reading material, Diagrams, tables, video clips

Key concepts

Environmental pollution, water pollution, Soil pollution, air pollution, pollutants

Assessment and evaluation

Assess students' presentations using following criteria

- Relevancy of information
- Team work
- Communicating ideas effectively
- Using various resources to collect information

Competency level 4.4: **Explores the effects of change in life style**

No. of periods **05**

Learning outcome: **:**

- states factors influencing changing life style
- designs and carries out a project to explore the issues generated by change in life style
- applies suitable methods to communicate findings of the project with other groups
- states what a non communicable disease is
- accepts that change in life style is a cause for some non communicable diseases
- describes the relationship between the NCD and life style/ pollution
- explores the possible causes for unknown chronic kidney disease and its distribution pattern in the island
- values that the impact of man on environment returns negatively
- accepts the importance of a rechange towards an environmental friendly life style

Instructions for lesson planning

- Discuss factors affecting the life style of a person (food, occupation, spending leisure time, health and dwelling etc)
- Recall the lifestyle of our ancient people
- Direct students to design and carry out a group project to explore the impact of change in the life style
- Assign the following sub topics (urbanization, industrialization, commercialized agriculture, man made irrigation systems, extensive and diverse use of materials and energy forms) to each group and facilitate to present their findings
- Explain what non communicable diseases are
- State some non communicable diseases
- Guide the students to do an assignment to find the possible factors which are causative to unknown chronic kidney disease and other non communicable diseases

- Conduct a discussion on distribution of the above diseases , interrelationships between life style pollution and non communicable diseases
- Explain the importance of change towards an environmental friendly life style

Quality inputs

Reading material, video clip, photographs

Key concepts

Non communicable diseases, urbanization, industrialization

Assessment and evaluation

Assess students' assignment on unknown chronic kidney disease using following criteria

- Accuracy of information
- Sufficiency of information
- Presentation

Competency level 4.5: **Investigates on ways to contribute to sustainable development**

No. of periods **10**

Learning outcomes :

- states what is meant by sustainable development and environmental management
- explores poly-culture instead of monoculture, biological control of pests and usage of organic fertilizers as sustainable agricultural strategies
- describes reforestation as a recovery method to maintain the environmental balance
- explores the indigenous knowledge and technology in the field of agriculture, medicine, food and irrigation
- values Sri Lankan 'wewa' as the unique example in water management
- values indigenous medicine as another discipline and its scientific nature is yet to be explored
- accepts that indigenous food culture is compatible with our climate and life style and supports a healthy life.
- explains food miles
- accepts the importance of wise use of technology in energy consumption.
- explains what a footprint is, with respect to Carbon and water
- values the importance of reduction of footprints and food miles
- explains what waste and garbage are
- describes and practices waste management techniques with respect to solid, water and gasses and airborne particles
- accepts the implementation of related legislative measures and the importance of adhering to them
- explains energy crisis with respect to availability of energy sources and technology.
- explains matching of work with relevant energy sources in day-to-day life as energy management.
- explains energy management as a remedy for energy crisis.
- searches for the optimum use of energy with minimum waste.
- explores the efficiency of domestic appliances.
- accepts the importance of monitoring of energy consumption
- consumes energy appropriately using most suitable energy sources.
- uses appropriate methods for energy consumption according to the situation.
- searches for the maximum use of natural energy in designing architectural structures.

Instructions for lesson planning

- Explain what is meant by sustainable development and environmental management.
- Introduce what is meant by mono culture and polyculture.
- Discuss with students the value of polyculture in place of monoculture.
- Explain the value of biological control of pests.
- Describe the value of biological pest control using local examples.
- Discuss with students the value of using organic fertilizers.
- Explain the value of reforestation as a recovery method to maintain the environmental balance.
- Assign the students to do a report on "Using indigenous knowledge and technology in the following fields."
    - Agriculture
    - Medicine
    - Food
    - Irrigation
- Explain what is meant by carbon footprint, water footprint and food miles.
- Discuss with the students the value of the Sri Lankan wewa as the unique example in water management.
- Assign students to collect information on indigenous medicine.
- Explain the importance of exploring the scientific nature (background) of indigenous medicine.
- Have a discussion about indigenous food culture.
- Discuss with students what energy crisis is (with respect to the availability of energy sources and technology.)
- Assign students to prepare a report on energy management methods which could be adopted in day to day life.
- Discuss the value of energy management as a remedy for energy crisis.
- Assign the students to do a report on “Instances when energy is used at optimum level with minimum wastage”.
- Describe how the efficiency of domestic appliances could be measured.
- Discuss with students the value of monitoring energy consumption
- Have a discussion with students and make a list of energy consumption methods.
- Explain the importance of using natural energy in the field of architecture.
- Ask students to give examples for waste and garbage.
- Explain the harm done by them.

- Explain different methods of waste management using video clips /pictures.
- Explain the importance of implementing related legislative measures and adhering to them.
- Assign students to prepare a small booklet on renewable energy sources.

Key concepts

Food miles, footprint, renewable and non renewable energy source

Assessment and evaluation

Asses the report using followings criteria

- Energy efficiency of domestic applications
- Energy wastage
- Energy management