

The New Senior Secondary Curriculum for Sierra Leone

Subject syllabus for Biology

Subject stream: Sciences and Technologies



This subject syllabus is based on the National Curriculum Framework for Senior Secondary Education. It was prepared by national curriculum specialists and subject experts.



Curriculum Elements for Biology – a core subject

Subject Description

Biology involves the study of living things and their interactions with the environment. It also helps students understand and cope with everyday problems such as food security, diseases, environment management and misuse of our natural resources. The subject has two main branches, Botany and Zoology. It includes diverse areas of study like bacteriology, entomology (study of insects), parasitology, ecology and genetics. Through knowledge gained in Biology, people must realize that they cannot live without plants and animals.

Rationale for Inclusion of Biology in Senior Secondary School Curriculum

The study of Biology will:

1. help us to understand and solve environmental problems e.g food shortage, poor health and misuse of our natural resources.
2. provide an entry point to many careers, e.g., medicine, health and agriculture.
3. help us to understand the challenges of a world where rapid change is threatening the survival of many species, and be capable of acting to tackle those challenges.

General Learning Outcomes (Broad Goals)

At the end of the course, students would:

- have basic knowledge of the body and the necessary skills to maintain health.
- acquire and practice positive health habits in the community.
- appreciate the ecological relationship between man and his environment as a basis for preventing diseases, and be able to
 - make observation and draw inferences from practical experiences that may have implications for health
 - move on to professional training in related careers.
 - apply biological principles in everyday life in matters that affect personal, social, environmental, community health.
 - have an awareness of the interrelationships between biology and other scientific disciplines.



Content (Themes/Topics)

Introduction to Biology

- Living and non-living things
- Diversity of living things
 - Plants
 - Animals
- Classification

Cell theory

- Levels of organisation
- Structure and functions of plant and animal cells
- Physical and biological processes in cells
 - diffusion
 - osmosis.
 - active transport

Structure of Plants

- Internal structure of roots, stems and leaves of monocot and dicot plants

Plant Nutrition

- Photosynthesis
 - Process
 - Condition
 - Importance
- Mineral Nutrition in plants
 - macro and micro nutrients
 - water culture experiments

Nutrient Cycles

- Nitrogen cycle
- Carbon cycle

- Water cycle

Animal Nutrition

- Classes and sources of food
- Enzymes
- Modes of nutrition
- The alimentary canal
- Digestion
- Dentition

Transport System

- Transport in animals
 - structure of the heart and blood vessels
 - structure and functions of blood and lymph
 - general circulation
- Transport in Plants
 - Intake of water and mineral salt
 - Translocation
 - Transpiration
 - Movement of water in a plant

Excretory System

- Types of excretory systems
- Excretion in animals
 - structure and function of the kidney and how it works
 - structure and function of the skin
- Excretion in Plants
 - excretory products in plants
 - structure for excretion in plants





Respiration

- Respiratory surfaces
- Mechanism for gaseous exchange in fish, toads, mammals, and plants,
- Aerobic and Anaerobic respiration
- Respiration in man
 - mechanism of breathing
 - tissue respiration
- Respiration in plants

Reproduction

- Types of reproduction
- Metamorphosis in butterfly and cockroaches
- Reproduction in flowering plants
 - structure of the flower
 - pollination and fertilisation
 - fruits and seeds
 - dispersal
 - germination
- Reproduction in Humans
 - structure and function of the male and female reproductive organs
 - fertilization and development of the embryo to birth

Tissues and Supporting System

- Supporting systems in animals
 - structure and functions of the skeleton
 - structure and functions of the vertebrae
 - the limb girdles
- Supporting systems in plants
 - supporting tissues in plants

Co-ordination

- Hormonal co-ordination
 - Animal Hormones
 - Plant Hormones
- Growth
- Tropisms

Nervous Co-ordination

- The central nervous system
- Types of nervous reactions
- The sense organs - structure and functions of the:
 - eye
 - ear
 - skin

Biology of the Environment (Ecology)

- Ecological Concepts
- Ecological factors (biotic and abiotic)
- Feeding relations
- Energy flow

Human Influences on the Environment

- Pollution
- Deforestation

Ecological Management

- Biological associations
- Adaptations of organisms in a habitat
- Ecology of population succession

Conservation of National Resources

- Resources to be conserved
- Ways to ensure conservation



- Need for conservation
- Conservation laws

Biology and Health

- Micro-organisms
- Refuge and sewage disposal
- Immunisation

Biology and Agriculture

Genetics

- Mendel's work
- Terminologies
- Transmission of characteristics
 - experiments on monohybrid crosses
 - structures of chromosomes and DNA molecules
 - probability in genetics

- sex determination
- gene linkage
- Application of genetics
 - Agriculture
 - cross breeding for new varieties
 - inbreeding
 - advantages of cross fertilization
 - medicine
- Variation

Behavioral Adaption in Social Insects

- Termites
- Bees

Evolution

- Theory of evolution
- Evidence of evolution





Structure of the Syllabus Over the Three Year Senior Secondary School Cycle

	SSS 1	SSS 2	SSS 3
Term 1	<p>Introduction to Biology</p> <ul style="list-style-type: none"> • Living and non-living things • Diversity of living things <ul style="list-style-type: none"> ○ plants ○ animals • Classification <p>Cell theory</p> <ul style="list-style-type: none"> • Structure and functions of plant and animal cells • Physical and biological processes in cells <ul style="list-style-type: none"> ○ diffusion ○ osmosis. ○ active transport 	<p>Transport System</p> <ul style="list-style-type: none"> • Transport in animals <ul style="list-style-type: none"> ○ structure of the heart and blood vessels ○ structure and functions of blood and lymph ○ general circulation • Transport in Plants <ul style="list-style-type: none"> ○ Intake of water and mineral salt ○ Translocation ○ Transpiration ○ Movement of water in a plant <p>Excretory System</p> <ul style="list-style-type: none"> • Types of excretory systems • Excretion in animals <ul style="list-style-type: none"> ○ structure and function of the kidney and how it works ○ structure and function of the skin • Excretion in Plants <ul style="list-style-type: none"> ○ excretory products in plants ○ structure for excretion in plants 	<p>Co-ordination</p> <ul style="list-style-type: none"> • Hormonal co-ordination <ul style="list-style-type: none"> ○ Animal Hormones ○ Plant Hormones • Growth • Tropisms <p>Nervous Co-ordination</p> <ul style="list-style-type: none"> • The central nervous system • Types of nervous reactions • The sense organs - structure and functions of the: <ul style="list-style-type: none"> ○ eye ○ ear ○ skin
Term 2	<p>Structure of Plants</p> <ul style="list-style-type: none"> • Internal structure of roots, stems and leaves of monocot and dicot plants 	<p>Respiration</p> <ul style="list-style-type: none"> • Respiratory surfaces • Mechanism for gaseous exchange in fish, toads, mammals, and plants, 	<p>Biology of the Environment (Ecology)</p> <ul style="list-style-type: none"> • Ecological Concepts • Ecological factors • Feeding relations



	<p>Plant Nutrition</p> <ul style="list-style-type: none"> • Photosynthesis <ul style="list-style-type: none"> ○ Process ○ Condition ○ Importance • Mineral Nutrition in plants <ul style="list-style-type: none"> ○ macro and micro nutrients ○ water culture experiments 	<ul style="list-style-type: none"> • Aerobic and Anaerobic respiration • Respiration in man <ul style="list-style-type: none"> ○ mechanism of breathing ○ tissue respiration • Respiration in plants <p>Reproduction</p> <ul style="list-style-type: none"> • Types of reproduction • Metamorphosis in butterfly and cockroaches • Reproduction in flowering plants <ul style="list-style-type: none"> ○ structure of the flower ○ pollination and fertilisation ○ fruits and seeds ○ dispersal ○ germination 	<ul style="list-style-type: none"> • Energy flow <p>Human Influences on the Environment</p> <ul style="list-style-type: none"> • Pollution • Deforestation <p>Ecological Management</p> <ul style="list-style-type: none"> • Biological associations • Adaptations of organisms in a habitat • Ecology of population succession <p>Conservation of National Resources</p> <ul style="list-style-type: none"> • Resources to be conserved • Ways to ensure conservation • Need for conservation • Conservation laws <p>Biology and Health</p> <ul style="list-style-type: none"> • Micro-organisms • Refuse and sewage disposal • Immunisation <p>Biology and Agriculture</p> <ul style="list-style-type: none"> • Cross breeding for new varieties • Inbreeding • Advantages of cross fertilization
Term 3	<p>Nutrient Cycles</p> <ul style="list-style-type: none"> • Nitrogen cycle • Carbon cycle • Water cycle <p>Animal Nutrition</p>	<ul style="list-style-type: none"> • Reproduction in Man <ul style="list-style-type: none"> ○ structure and function of the male and female reproductive organs ○ fertilization and development of the embryo to birth 	<p>Genetics</p> <ul style="list-style-type: none"> • Mendel's work • Terminologies • Transmission of characteristics <ul style="list-style-type: none"> ○ experiments on monohybrid crosses



- Classes and sources of food
- Enzymes
- Modes of nutrition
- The alimentary canal
- Digestion
- Dentition

Tissues and Supporting System

- Supporting systems in animals
 - structure and functions of the skeleton
 - structure and functions of the vertebrae
 - the limb girdles
- Supporting systems in plants
 - supporting tissues in plants

- structures of chromosomes and DNA molecules
- probability in genetics
- sex determination
- gene linkage
- Application of genetics
 - Agriculture
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 - inbreeding
 - advantages of cross fertilization
 - medicine
- Variation

Evolution

- Theory of evolution
- Evidence of evolution



Teaching Syllabus

Topic/ Theme/ Unit	Expected learning outcomes	Recommended teaching methods	Suggested resources	Assessment of learning outcomes
Introduction to Biology <ul style="list-style-type: none"> Living and non-living things Diversity of living things <ul style="list-style-type: none"> plants animals Classification 	Students will be able to: <ul style="list-style-type: none"> understand the meaning of biology. state the various branches of biology. state the reasons why biology should be studied in school. list the life processes shared by all living things. understand what classification means. list the main characteristics of the various kingdoms list the other ranks. classify some organisms into their kingdom, phylum, and class. 	<p>Start by defining Biology. State the branches (Botany and Zoology) and define them.</p> <p>Ask pupils why it is important to study Biology.</p> <p>Ask pupils to name a variety of organisms and list them on the black board.</p> <p>Ask pupils to produce the lists of organisms from a previous lesson.</p> <p>Let them state what characteristics these organisms have in common and list them on the blackboard</p> <p>Talk about life processes in living organisms, differences between plants and animals using their list again.</p> <p>Let them group their plants and animals according to their similarities and differences.</p> <p>Introduce the idea of classification. State the major characteristics of the major phyla and kingdoms:</p> <ul style="list-style-type: none"> prokaryote 	<ul style="list-style-type: none"> Blackboard Flip charts of Plants and Animals Text books Charts showing pictures of organisms in the various kingdom. Pictures of tissues, organs and systems, e.g. hydra, amoeba, heart and digestive system Slides Pictures of variety of plants and animals. 	<ul style="list-style-type: none"> Groupwork: pupils list reasons why it is important to study Biology. Pupils make a list of different kinds of plants and animals. Group work: List the characteristics of plants and animals. Group the plants and animals according to similarities and differences. Pupils classify some of the organisms using biological keys.



		<ul style="list-style-type: none"> ○ fungi ○ plantae ○ animalia <p>Talk about the other ranks in classification, i.e., phylum, class, order, family, genus, species</p>		
<p>Cell theory</p> <ul style="list-style-type: none"> • Levels of organisation • Structure and functions of plant and animal cells • Physical and biological processes in cells <ul style="list-style-type: none"> ○ diffusion ○ osmosis. ○ active transport 	<p>Students will be able to:</p> <ul style="list-style-type: none"> • name the main parts of the cell. • explain the functions of the parts of the cell. • state the similarities and difference between plant and animal cells • list various types of cells. • explain the process of: <ul style="list-style-type: none"> ○ diffusion ○ osmosis ○ active transport • perform simple experiments to demonstrate diffusion/ osmosis • state the importance of diffusion and 	<p>Start by letting the pupils know that the cell is the basic unit from which all living things are built.</p> <p>Define the following cells, tissues or organs and systems and give examples.</p> <ul style="list-style-type: none"> ○ cell - amoeba ○ tissue - hydra ○ organ - heart ○ system - organ system in plan and animals. <p>Explain advantages of complexity.</p> <p>Draw a typical cell on the blackboard and talk about the various parts.</p> <p>Draw both plant and animal cell on the blackboard and label them.</p> <p>Let the pupils write down the similarities and differences between them.</p> <p>Demonstrate plasmolysis using the epidermal cell of Rhea leaf (upper surface is purple, lower surface is green)</p> <p>Let pupils observe both a turgid and flaccid cell under the microscope/lens</p>	<ul style="list-style-type: none"> • Prepared slides of plant and animal cells • Microscope • Slides • Cover slips • Water • Thin skin from the inner surface of fleshy onion scale. • Perfume/ shell tox spray • Salt • Water • Petri-dishes • Microscope • Rhea leaf • Long leaf • Paw-paw • Irish potato 	<ul style="list-style-type: none"> • Ask pupils to give other examples of cells, tissues, organs, systems. • Practical Exercises in which the pupils; <ul style="list-style-type: none"> ○ observe the prepared slides of plant and animal cells. ○ remove the thin skin from the inner surface of the fleshy onion scale, mount on a slide and observe under the microscope. ○ pupils draw and label a plant and animal cell. • Pupils find out other specialized cells and name them.



	<p>osmosis to the cell activities.</p> <ul style="list-style-type: none"> explain the terms: <ul style="list-style-type: none"> turgidity temolysis plasmosis crenation differentiate between cells, tissues, organs, and systems. state the advantages and disadvantages of complexity 	<p>Name some specialized cells, e.g., sperm cells, nerve cells, leaf epidermal cell, root tip cell, palisade cell.</p> <p>Demonstrate the process of diffusion using a perfume spray or shell tox spray.</p> <p>Now define the process from their observation of the process. Let pupils give other examples around them, e.g., smoke from a fire.</p> <p>Define osmosis and demonstrate the process using unripe paw-paw (has a natural cavity) or Irish potatoes.</p> <p>Explain osmosis in terms of diffusion.</p> <p>Explain how active transport takes place.</p> <p>State where osmosis and diffusion take place in living cells and explain how the process affects cell activities.</p> <p>Explain haemolysis, turgidity, plasmolysis, and crenation.</p>		<ul style="list-style-type: none"> Experimentation - Group Work <ul style="list-style-type: none"> Diffusion: get one member to stand at the back of the class while one member sprays shell tox. Osmosis: set up an experiment using a small green paw-paw to show osmosis. Leave overnight and record result the next day. Let pupils observe the experiments and record their results.
<p>Structure of Plants</p> <ul style="list-style-type: none"> Internal structure of roots, stems and leaves of monocot and dicot plants 	<p>Students will be able to:</p> <ul style="list-style-type: none"> describe the internal structures of the roots, stem, and leaves. 	<p>Start by reviewing the functions of roots, stems, and leaves.</p> <p>Describe the internal structure of the roots, stems, and leaves, pointing out the</p>	<ul style="list-style-type: none"> Slides Text books Blackboard Flip charts Models 	<ul style="list-style-type: none"> Pupils to each draw and label the internal structure of roots, stems and leaves in both





	<ul style="list-style-type: none"> explain how these structures are related to their functions. 	structures which enable them to perform those functions.		<p>monocots and dicots.</p> <ul style="list-style-type: none"> Pupils compare the internal structure of dicot root and stem / monocot root and stem.
<p>Plant Nutrition</p> <ul style="list-style-type: none"> Photosynthesis <ul style="list-style-type: none"> Process Condition Importance Mineral Nutrition in plants <ul style="list-style-type: none"> macro and micronutrients water culture experiments 	<p>Students will be able to:</p> <ul style="list-style-type: none"> explain the term of photosynthesis. describe the process of photosynthesis. state how the structure of a leaf enables it to carry out photosynthesis. describe the factors that affect the rate of photosynthesis. state the mineral elements necessary for plant growth and development. 	<p>Define nutrition. Explain the terms autotropic and hetero- trophic nutrition.</p> <p>Define photosynthesis and sine it's equation.</p> <p>Refer the students to the internal structure of the leaf as you talk about adaptations of the leaf for photosynthesis.</p> <p>Distinguish between factors affecting photosynthesis and conditions for photosynthesis.</p> <p>Describe the process of photosynthesis explaining the light and dark reactions.</p> <p>Let the pupil state the importance of photosynthesis from what has been during the lesson.</p> <p>Explain how to test a leaf for starch In groups let pupils set up experiment to show;</p>	<ul style="list-style-type: none"> Potted plants Variiegated leaves Alcohol Heat source Water Beaker Strips of cardboards Bell Jars Practical Books or Work Sheets Iodine Dropper Soda lime Test-tubes Maize seed lips Culture solution Cotton wool Water 	<ul style="list-style-type: none"> Pupils write down the importance of photosynthesis Group work <ul style="list-style-type: none"> Group investigate the importance of light for photosynthesis. Group work 2 Investigate the importance of carbon-dioxide for photosynthesis. Group work 3 Investigate the importance of chlorophyll for photosynthesis. Group Presentation Practical investigation of the importance of



		<ul style="list-style-type: none"> ○ The importance of light for photosynthesis. ○ The importance of carbon-dioxide for photosynthesis. ○ The importance of chlorophyll for photosynthesis. <p>Ask the pupils to name some mineral elements that they know. List these on the blackboard.</p> <p>Next group them into micro and macro nutrients and explain why some are macro and others micro-nutrients.</p> <p>In a tabular form on the blackboard, list the macro nutrients, their function in the plant and deficiency shown.</p> <p>Together with the pupils set up water culture experiments to investigate the importance of the macronutrients.</p>		<p>macro minerals for plant work.</p> <ul style="list-style-type: none"> ● Pupils work in groups and submit their observations after two weeks.
<p>Nutrient Cycles</p> <ul style="list-style-type: none"> ● Nitrogen cycle ● Carbon cycle ● Water cycle 	<p>Students will be able to:</p> <ul style="list-style-type: none"> ● explain how nitrogen is cycled in nature. ● name the bacterial involved in the nitrogen cycle. ● draw and label the nitrogen cycle. 	<p>Talk about nitrogen as part of the protein molecule. Refer them to the function of nitrogen in mineral nutrition. Explain how nitrogen is cycled in nature and the reason why legumes are used in crops rotation. Examine root nodules of leguminous plants. Explain nitrification, nitrogen fixation, denitrification, decomposition</p>	<ul style="list-style-type: none"> ● A leguminous plant such as beans ● Microscope ● Slides ● A leguminous plant ● Charts ● Pictures of water sources ● Charts 	<p>Draw and label the nitrogen cycle</p> <p>Draw and label the carbon-cycle.</p> <p>Find out about the greenhouse effect and global warming.</p> <p>Balance of oxygen and carbon-dioxide in nature.</p>





	<ul style="list-style-type: none"> state the importance of the carbon cycle in nature list the sources of carbon in nature draw and label the carbon cycle. state the importance of water explain how water is lost in nature. explain how water is replaced. 	<p>Talk about the processes that add and remove carbon in nature</p> <p>-state the role of photosynthesis in the carbon-cycle. Also talk about the role of respiration, and decomposers in the cycle. Talk about the greenhouse effect and global warming.</p> <p>Ask pupils about some of the ways that they use water. Now talk about water as a component of living organisms and as a medium of chemical reactions.</p> <p>Talk about how water is lost and how it is replaced.</p>		<p>Draw and label the water cycle.</p>
<p>Animal Nutrition</p> <ul style="list-style-type: none"> Classes and sources of food Enzymes Modes of nutrition The alimentary canal Digestion Dentition 	<p>Students will be able to:</p> <ul style="list-style-type: none"> define carnivores, omnivores, parasites, saprophytes, and give examples. list the different classes of food and state their importance. name different types of enzymes state the characteristics of enzymes. 	<p>Discuss with pupils the different modes of feeding and ask them to give examples.</p> <p>Explain modification associated with these modes of feeding.</p> <p>Discuss the difference classes of food and their importance. Tests for food substances should carried out.</p> <p>Discuss the importance of a balanced diet. Talk about malnutrition and uses of food to the body.</p> <p>Define enzymes. State the different types of enzymes and the substrate they act on.</p> <p>Discuss the characteristics of enzymes</p>	<ul style="list-style-type: none"> Pictures of different organisms. Pictures of a variety of food substances (iodine, starch, milk, butter, fruits, e.g, orange, cassava, yam etc.) Fehling's solution, Benedict's solution, Millons reagent. Filter paper Heat source Test tube 	<ul style="list-style-type: none"> Students group carnivores, herbivores, omnivores, saprophytes, and parasites. Students classify them as carbohydrates, proteins, and fats. In groups students draw up a balanced diet. Investigate classes of food substances. In groups pupils do food tests on



	<ul style="list-style-type: none"> investigate some characteristics of enzymes. discuss the parts of the alimentary canal. state the functions of the various parts. name enzymes produce in the various parts. explain how each part is adapted to carry out its function. describe the step-by-step digestion of carbohydrates, proteins, and lipids. state what happens to the digested food. explain the term absorption and assimilation. describe the arrangement of the teeth on one side of the jaw and draw. 	<p>Let the students investigate the action ptyalin.</p> <p>Use a flipchart showing the alimentary canal and describe the various parts.</p> <p>Explain how each part is adapted for its various function. State the enzymes produced in each part.</p> <p>Dissect a bird and compare the structure of its alimentary canal to that of humans.</p> <p>Start by asking the pupils how food enters the body.</p> <p>Let the pupils say what happens to food in the mouth. Explain what happens to food in the rest of the alimentary canal.</p> <p>At each stage explain how that part is adapted to carry out digestion.</p> <p>Define and explain absorption and assimilation.</p> <p>Ask the pupils to state the functions of the teeth.</p> <p>Describe the arrangement of the teeth in the human jaws.</p>	<ul style="list-style-type: none"> Watch glasses Stirrer Starch Saliva Test-tube Heat source Acid-solution Alkaline Solution Dissected chicken, rats, cockroach Dissecting kit Flipchart showing the digestive system Model of the human skull Jaw of a herbivore Jaw of a carnivore 	<p>various types of food substances and analyze their results.</p> <ul style="list-style-type: none"> In a group let the pupil investigate the action of PH, temperature, on the action of ptyalin. Pupils draw and label the human alimentary canal and that of a bird. State some differences between the two. Assessment: Explain how the alimentary canal is adapted to carry out digestion. Find out how a protozoa feeds and digests its food. Draw and label an L.S of a normal tooth. Draw and label the jaw of a herbivore and a
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	<ul style="list-style-type: none"> describe the internal and external structure of a named tooth. explain how the jaws of an herbivore and a carnivore are adapted for feeding. talk about the importance of dental care. 	<p>Talk about dental formula, milk, and the permanent set of teeth.</p> <p>Explain how the jaws of an herbivore and carnivore are adapted for feeding.</p>		<p>carnivore from actual specimens.</p> <ul style="list-style-type: none"> Calculation of number of teeth from dental formula e.g. $I = \frac{3}{3}$, $C = \frac{1}{1}$, $PM = \frac{4}{4}$, $M = \frac{2}{3}$ In group let pupils discuss the importance of dental care.
<p>Transport System</p> <ul style="list-style-type: none"> Transport in animals <ul style="list-style-type: none"> structure of the heart and blood vessels structure and functions of blood and lymph general circulation 	<p>Students will be able to:</p> <ul style="list-style-type: none"> explain why multicellular organisms need a transport system describe the structure of the heart state the characteristics of arteries, veins, and capillaries show understanding of how blood flows through arteries, veins, and capillaries 	<p>Talk about how substances are transported in simple organisms and why this method cannot be used in multicellular organisms.</p> <p>Talk about substances that need to be transported. Explain why a transport system is necessary. E.g., surface areal/volume ratio.</p> <p>Use a ship chart diagram to describe the heart. Point out how it is adapted to its functions</p> <p>Buy a piece of heart from the market and show the tendons. Let the pupils draw and label the heart for homework</p>	<ul style="list-style-type: none"> Text books Flip chart Piece of heart Prepared slides of arteries Veins in transverse section Microscope and light bulb Prepared slides of the blood Flip chart showing the general circulation. 	<ul style="list-style-type: none"> Let the students write down why a transport system is necessary Question & answer session Examine a cut heart and identify the value tendons and its muscular nature Pupils draw and label the heart for homework Let the pupils give the difference between arteries and veins





	<ul style="list-style-type: none"> list the components of blood and lymph and state the functions of the components of the blood. explain why human are said to have a double circulation explain pulmonary and systemic circulation 	<p>State the characteristics of the three vessels, mention the arteries and veins found on the heart.</p> <p>Let pupils check their pulse rate at the wrist.</p> <p>Discuss the composition of the blood. State how each component is related to its functions.</p> <p>Explain the role of the heart and blood vessels in pulmonary and systemic circulation:</p> <p>State the difference between pulmonary and systemic circulation and the blood flow in both of them</p>		<ul style="list-style-type: none"> Pupils work in pairs and check their pulse (heartbeat) for 30secs. Let them write their results on the board and do a histogram of the class result Let students write down the difference red and white blood cells Let the pupils in group trace the journey of a red blood cell from the right ventricle to the leg
<ul style="list-style-type: none"> Transport in Plants <ul style="list-style-type: none"> Intake of water and mineral salt Translocation Transpiration Movement of water in a plant 	<p>Students will be able to:</p> <ul style="list-style-type: none"> explain how water is absorbed and moved from the soil through plants. describe the uptake of mineral salts in plants investigate how water moves in a plant. define translocation and 	<p>Start by reviving osmosis and diffusion for pupils to understand how these substances move along the plant:</p> <p>Describe intake of water and mineral salts using diagram of set up on experiment with a small herbaceous plant to show movement of water in the plant.</p> <p>Start by defining translocation. Explain where the food is transported to.</p> <p>With the help of the students set us an experiment on translocation</p>		<ul style="list-style-type: none"> In groups, pupils set up an experiment to show the uptake of water using dye and a small herbaceous plant. In groups, pupils set up their translocation experiment and record and explain their observations





	<p>explain the process</p> <ul style="list-style-type: none"> define transpiration and state the factors affecting transpiration 	<p>Explain the term transpiration. Discuss factors affecting transpiration Explain the importance of transpiration to plants.</p>		<ul style="list-style-type: none"> Example practical work to show that transpiration occurs through the leaf Question and answer session - investigate in group environment factors affecting transpiration
<p>Excretory System</p> <ul style="list-style-type: none"> Types of excretory systems Excretion in animals <ul style="list-style-type: none"> structure and function of the kidney and how it works structure and function of the skin Excretion in Plants <ul style="list-style-type: none"> excretory products in plants structure for excretion in plants 	<p>Students will be able to:</p> <ul style="list-style-type: none"> define excretion name excretory and products in plants and animals. describe the structure of the kidney explain how the kidney works state why the kidney and liver are excretory organs name the excretory products in plants. 	<p>Define excretion. Let pupils name some excretory products.</p> <p>Let pupils also name some excretory organs e.g., kidney, skin, liver</p> <p>Using a model of the kidney, describe the structure of the kidney and excretory system</p> <p>Discuss urine formation in the kidney</p> <p>Use model or diagram of the skin to show structure of the skin that aids excretion.</p> <p>State excretory product of the liver</p> <p>Ask pupils to suggest the structure for excretion in plants.</p>	<ul style="list-style-type: none"> Text books Small herbaceous plant Beakers Dye solution water Potted plant Knife Shrub Cobalt chloride paper slides Rubber Model of the kidney Chart showing the excretory organ Diagram or model of the skin 	<ul style="list-style-type: none"> Test, question, and answer session. Pupils draw the excretory system List of the parts of the kidney Pupils in group discuss urine Draw and label the parts of the skin Explain the structure concerned with excretion in plants Let pupils find out excretory products in plant that are useful





	<ul style="list-style-type: none"> identify useful excretory products in plant. name the structure for excretion in plants 	Explain how plants cope with the process of excretion		
<p>Respiration</p> <ul style="list-style-type: none"> Respiratory surfaces Mechanism for gaseous exchange in fish, toads, mammals, and plants, Aerobic and Anaerobic respiration Respiration in man <ul style="list-style-type: none"> mechanism of breathing tissue respiration Respiration in plants 	<p>Students will be able to:</p> <ul style="list-style-type: none"> define respiration share the characteristics of respiratory surfaces explain the mechanism of gaseous exchange in fish, toads, mammals, and plants state the differences between aerobic and anaerobic respiration understand the differences between external and internal respiration explain respiration in food processing outline cellular respiration in man 	<p>Outline how cellular respiration occurs</p> <p>Explain the role of diffusion and turgidity of the guard cells in gaseous exchange in plants</p> <p>Define respiration and state the characteristics of respiratory surface</p> <p>Use fish gills to explain these characteristics.</p> <p>Let pupils name the parts for gaseous exchange in plants.</p> <p>Explain mechanisms for gaseous exchange in fish toad and plants.</p> <p>Discuss types of respiration. Let the pupils give the difference between the two types from the equations on-the black board</p> <p>Discuss bread making and the production of Omole (anaerobic respiration)</p>	<ul style="list-style-type: none"> Text books Internet Gills Piece of lung Charts Model of the respiratory organs. Bell jar Balloons Rubber sheet Rubber bands Conical flasks Line Water Glass tubing's Small mammal Prepared slide to show the guard cells 	<ul style="list-style-type: none"> Practical: observe the gills as a respiratory surface and list the observable features which adapts it for respiration Pupils breathe in and out and observe movement of the chest cavity Practical: pupils make a model of the chest cavity. Pupils write down the differences between external and internal respiration Practical: pupils carry out experiments to demonstrate aerobic respiration





	<ul style="list-style-type: none"> draw and label the respiratory organs in humans understand the structure for gaseous exchange in plants 			<ul style="list-style-type: none"> Draw and label the respiratory organs of man Compare respiration and photo synthesis In groups, pupils discuss how turgidity of guard cells affect gaseous exchange in plants.
<p>Reproduction</p> <ul style="list-style-type: none"> Types of reproduction Metamorphosis in butterfly and cockroaches Reproduction in flowering plants <ul style="list-style-type: none"> structure of the flower pollination and fertilisation fruits and seeds dispersal germination 	<p>Students will be able to:</p> <ul style="list-style-type: none"> differentiate between asexual and sexual reproduction. name some methods of asexual reproduction explain conjugation (spirogyra) differentiate between complete and incomplete metamorphic reproduction 	<p>Define sexual and asexual reproduction. Discuss forms of asexual reproduction</p> <p>Mount prepared slide showing conjugation in spirogyra for pupils to observe</p> <p>Explain complete and incomplete metamorphosis</p> <p>Ask pupils to each come with a flower. With the pupils, dissect the flower, name the parts, and talk about the function of the parts</p> <p>Define the term pollination. Use an insect pollinated flower and a wind pollinated flower, such as maize flower, to teach the characteristics of insect and wind pollinated flowers</p>	<ul style="list-style-type: none"> Prepared slides Onion bulbs Cocoyam Ginger Irish potato Cassava stick Cockroach and cockroach eggs Cow flies, maggots Tadpoles Flower of the flamboyant tree (pride of Barbados) Maize flowers Prepared slides that show fertilisation Beans pods 	<ul style="list-style-type: none"> Practical: pupils draw and label onion, ginger, cocoyam Pupils bring cockroaches and house flies to draw and label both insects Practical: draw and label various stages of the tadpole Practical: pupils draw and label a vertical section of the flower. Pupils give the differences between insect





	<ul style="list-style-type: none"> name organisms with external and internal fertilization draw and label a flower and state the functions of the parts define pollination and fertilization list the characteristics of insect and wind pollinated flowers list the agent of pollination give examples of the processes of pollination and fertilization classify fruits and seeds describe the internal structure of beans, orange, maize and tomato 	<p>Explain the processes of pollination and fertilisation.</p> <p>Explain how fruits and seeds are produced from flowers. Bring a collection of fruits and seeds to class and classify them.</p> <p>Cut sections of tomato, beans and maize and describe the structure of fruits</p>	<ul style="list-style-type: none"> Orange Maize Tomato Razor blades Hand lens Text books 	<p>and wind pollinated plants</p> <ul style="list-style-type: none"> Draw and label the diagram of fertilisation Practical: pupils cut and draw sections of tomato, maize and bean pod
<ul style="list-style-type: none"> Reproduction in Humans <ul style="list-style-type: none"> structure and function of the male and female reproductive organs 	<p>Students will be able to:</p> <ul style="list-style-type: none"> describe the structure of the male and female reproductive organs. 	<p>Compare reproduction in fish amphibians, reptiles, birds, mammals</p> <p>Using a flip chart, describe the structure of male and female reproductive organs. State the functions of the various part organs.</p>	<ul style="list-style-type: none"> Rat Chart Models Textbook Blackboard Laboratory assistant 	<ul style="list-style-type: none"> Dissect a rat and observe its reproductive organs Group presentation on physical characteristics of



<ul style="list-style-type: none"> ○ fertilization and development of the embryo to birth 	<ul style="list-style-type: none"> ● draw and label the male and female gamete ● describe the physical characteristics of male and female jump puberty ● describe fertilization, the development of the embryo and birth. ● understand birth control/contraception, and the 	<p>Draw and label the male and female gametes on black board.</p> <p>Divide class into two and group list all the male characteristic at puberty, and the female characteristic at puberty. Groups make presentations</p> <p>Describe fertilization, embryo development and birth</p> <p>Explain and discuss birth control, the pros and cons, and the contraceptive choices available.</p>	<ul style="list-style-type: none"> ● Resource person from PPA or midlives association 	<p>males and females at puberty</p>
<p>Tissues and Supporting System</p> <ul style="list-style-type: none"> ● Supporting systems in animals <ul style="list-style-type: none"> ○ structure and functions of the skeleton ○ structure and functions of the vertebrae ○ the limb girdles ● Supporting systems in plants 	<p>Students will be able to:</p> <ul style="list-style-type: none"> ● list the function of the skeleton ● draw and label the different vertebrae and state their functions ● draw and label the limb bones and their girdles ● describe and draw the structure of a moveable joint 	<p>Discussion the functions of the skeleton with the students. Write their contributions on the blackboard supply those not mentioned.</p> <p>Use the model or chart to name the bones of the axial and appendicular skeleton.</p> <p>Name the different type of joint and describe the structure of a moveable joint</p> <p>Mention collenchyma xylem and sclerenchyma as supporting tissues in plants. Refer students to SS1 notes on transverse sections (TS) of roots and stems.</p>	<ul style="list-style-type: none"> ● Model of the skeleton ● Chart ● Vertebrae ● Limb bones ● Skull ● Prepared slides of TS stem and TS root 	<ul style="list-style-type: none"> ● Practical: - examine different vertebrae, limb and girdle bones ● Question and answer session





<ul style="list-style-type: none"> ○ supporting tissues in plants 				
<p>Co-ordination</p> <ul style="list-style-type: none"> • Hormonal co-ordination <ul style="list-style-type: none"> ○ Animal Hormones ○ Plant Hormones • Growth • Tropisms 	<p>Students will be able to:</p> <ul style="list-style-type: none"> • name the endocrine glands and state their location • state the function of the various hormones • name some hormonal deficiencies • state the effect of auxins on plant growth • investigate auxin production and its effect on shoot and root elongation • explain the meaning of growth • differentiate between primary and secondary growth • investigate tropisms 	<p>Start by defining a hormone and naming the endocrine glands.</p> <p>Ask the pupils to state where the endocrine glands are found in the body. Let pupils state the hormones produced by them. Label a diagram of the body with the locations of the endocrine glands and annotate.</p> <p>Talk about hormonal deficiency. Show pictures of goiter, dwarfs. Explain diabetes, the causes, and symptoms.</p> <p>Talk about over and under secretion of key hormones, and mention thyroxin in the development of toads.</p> <p>Start a question and answer and answer session on the meaning of growth. Talk about primary and secondary growth.</p> <p>Explain how auxins affect growth of shoot and root. Emphasize the role of auxins in plant growth especially in lateral bud development, leaf fall and initiation of adventitious roots.</p>	<ul style="list-style-type: none"> • Pictures of effects of hormonal deficiency • Resource person from Association of diabetics • Maize seedlings • Agar • Black flowerpots • Pictures • Bean seeds and seedlings • Saw dust • Porous pot • Cardboard box with an opening 	<ul style="list-style-type: none"> • Question and answer session • Research: let pupils find out about how people cope with diabetes • Group investigation: pupils experiment on the coleoptile of maize • Pupils find out the role of auxins on weed control and crop harvesting • Group work: investigating tropism <ul style="list-style-type: none"> ○ Grp 1- Phototropism ○ Grp 2- Geotropism ○ Grp 3- Hydrotropism





		<p>Show students pictures of a potted plant bending towards a window and a fallen tree with the shoots turned upwards</p> <p>Introduce the idea of tropism as growth curvature Explain the role of auxin in photo tropism and geotropism</p>		
<p>Nervous Co-ordination</p> <ul style="list-style-type: none"> • The central nervous system • Types of nervous reactions • The sense organs - structure and functions of the: <ul style="list-style-type: none"> ○ eye ○ ear ○ skin 	<p>Students will be able to:</p> <ul style="list-style-type: none"> • list the parts of the brain and state their functions. • draw and label the brain • draw and label a section of the spinal cord • describe the structure and function of the neuron. • describe voluntary and reflex actions (Pavlov's experiment). • perform simple activities to explain voluntary and reflex actions. • describe the structure and function of the eye. 	<p>Use a model of the brain and the spinal cord to show pupils the parts of the brain and spinal cord. Give the functions of the parts as they are identified.</p> <p>Use pictures or charts to show pupils the section of the spinal cord. Inform pupils that the brain and spinal cord make up the central nervous system.</p> <p>Describe the structure and functions of the neurons. Explain how the sensory motor and relay neurons transmit nerves impulses. Explain that the nerves are part of the peripheral nervous system.</p> <p>Ask pupils to perform these simple activities:</p> <ul style="list-style-type: none"> • retrieve a book that had fallen on the ground. • wave a feather close to their eyes. <p>Talk about the difference between these two activities.</p>	<ul style="list-style-type: none"> • Charts • Blackboard • Model of the brain and spinal cord. • Permanent slides of a neuron. • Model of the eye. • Model of a mammalian ear • Model of the skin. • Chart that illustrates the structure of the mammalian skin. 	<ul style="list-style-type: none"> • Examine charts of the neurons systems and identify the main parts. • Question and answer session on the part of the brain and spinal cord • Assignment: draw and label <ul style="list-style-type: none"> ○ the brain ○ TS spinal cord ○ a nerve cell or neuron • Activities: In groups, pupils test the knee jerk; pinch a friend • Research: pupils find out how conditioning affects reflex actions.



	<ul style="list-style-type: none"> • name common eye defects and how they can be corrected. • explain the function of the mammalian ear. • identify the main structures on the model of an ear. • explain how we are able to hear. • identify the structure of the skin. • identify the structure of the skin which enable it to act as a sense organ. • state the functions of the skin. 	<p>Talk about voluntary and reflex actions and explain that reflex actions are automatic.</p> <p>Explain how conditioning reflex actions affects our behavior. Give some examples: process of learning, driving, riding a bicycle, etc.</p> <p>Explain how conditioning increases survival chances in animals.</p> <p>Use a model of the eye to show the students the parts of the eye.</p> <p>Ask the pupils who wear glasses to tell you why they started wearing glasses. Talk about eye defects and how they can be corrected. Use diagrams on the board to explain.</p> <p>Use a model of the ear to identify structures whilst describing the ear.</p> <p>Explain the mechanism of hearing. Show pupils the semi-circular canals on the model and explain how they control our balance.</p> <p>Use a model of the skin or a chart with a diagram to describe the structure of the skin.</p>		<ul style="list-style-type: none"> • Pupils draw and label the structure of the eye • Pupils draw diagrams to illustrate long and short sightedness and how these defects can be corrected. • Ask pupils to explain how we hear and how we maintain balance. • Get pupils to draw and label mammalian ear. • Pupils write down how the skin is adapted to carry out its function.
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<p>Biology of the Environment (Ecology)</p> <ul style="list-style-type: none"> • Ecological Concepts • Ecological factors (biotic and abiotic) • Feeding relations • Energy flow 	<p>Students will be able to:</p> <ul style="list-style-type: none"> • define ecology • define and explain the following terms; <ul style="list-style-type: none"> ○ biosphere. ○ ecosystem, ○ environment, ○ habitats, ○ community, ○ population, ○ ecological niche • state and explain the biotic ecological factors. • list abiotic factors which affect organisms in the environment. • explain the terms producers, consumers, and decomposers • construct food web. • describe energy flow within the ecosystem. 	<p>Explain how the skin carries out temperature regulation.</p> <p>Start with definition of the term biosphere and ecology. Use a few familiar examples to explain these terms. E.g., Aminata lives at Brookfields (environment) in the Bass Street community and her address (habitat) is 24 Bass Street. She has a room (niche) in the house Define terms and give examples.</p> <p>Explain the terms abiotic and biotic factors. Ask the pupils to state some abiotic factor and list them on the blackboard.</p> <p>Discuss with them how these factors can affect organisms.</p> <p>Let them state areas where rainfall has affected organisms (e.g., Mortomeh, Kroobay, and Kaningo).</p> <p>List/ show the instruments used to measure these factors (show pictures if instruments not available).</p> <p>Discuss with the pupils some biotic factors, e.g.,</p> <ul style="list-style-type: none"> ○ herbivores destroying plants ○ carnivores feeding on the other animals. ○ pollination 	<ul style="list-style-type: none"> • School garden or a nearby field. • Bottle • Hand lens • Scale • Pen • Forceps • Maximum/ minimum thermometer; • Rain gauge • Anemometer • Light meter • Hydrometer • Barometer (or pictures of all of them). • Local Resource persons from Meteorological Department • Pictures of organisms on land and in the water. • School garden or field 	<ul style="list-style-type: none"> • Field work: groups collect as many different types of plant and animals from a given area in the school compound. Record all the different population of plants & animals in the area. Repeat this task in a nearby pond or bush. • Questions and answer session on the abiotic factors and the instruments used to measure them. Draw some of these instruments • Practical: measure the temperature in various parts of the school garden/ compound. • Get pupils to make a simple
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	<ul style="list-style-type: none"> • construct a pyramid of energy 	<ul style="list-style-type: none"> ○ parasites Let pupils find out some more at home. <p>Explain, with examples, the terms producers, consumers and decomposers. State the role of decomposers in nature. Levels of consumers should be mentioned.</p> <p>Explain the term food chain and food web. Illustrate this on the blackboard and get the students to construct food chains and food webs from a list of organisms. Let the list include aquatic and terrestrial organisms.</p> <p>Talk about energy flow in the ecosystem. Define trophic level, construct a pyramid of energy and numbers. Allow pupils to do the same from a list of organisms.</p>		<p>windvane with paper and use it to determine direction of the wind.</p> <ul style="list-style-type: none"> • Homework: get pupils to find out five other biotic factors • Pupils name examples of primary, secondary and tertiary consumers. • From a list of organisms pupils write down one terrestrial and one aquatic food chain. • Pupils draw a pyramid of energy from a list of organisms. • Identify some organisms in the school garden and do a pyramid of energy. • Pupils fill in their questionnaires on the trip and submit
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<p>Human Influences on the Environment</p> <ul style="list-style-type: none"> • Pollution • Deforestation 	<p>Students will be able to:</p> <ul style="list-style-type: none"> • list some of the influences of man on the environment. • explain the meaning of pollution. • name some sources of air pollution and effects of the pollutants. • name some sources of water pollution and their effects. • name some sources of land pollution and their effects. • suggests some methods of solving land, water, and soil pollution. • state why people cut down trees. • state the effect of deforestation. • suggest ways of minimizing deforestation. 	<p>Ask the pupils to state some activities of humans that affect the environment and other organisms, e.g., cutting of trees for timber/ firewood, hunting, mining. Pupils will find out some more at home.</p> <p>Discuss air pollutants with pupils, e.g., smoke, gases, dust. Ask about air pollution during the harmattan.</p> <p>Let pupils who live near bars/ pubs talk about noise pollution.</p> <p>Talk about acid rain and water pollution. Discuss pollutants in drains blocked by garbage; and some waterways polluted by garbage and sewage.</p> <p>Talk about flooding at Kroobay, and the flooding due to hydroelectricity schemes.</p> <p>Move on to land pollution: discuss the problems faced by the people at Bormeh site; pollution caused by use of fertilizers, mining activities, disposal of plastic bottles and packets, indiscriminate dumping of garbage.</p> <p>Discuss the effect of pollution on plants and animal life, e.g., greenhouse effects.</p> <p>Pupils work in groups to discuss and write down ways of minimizing pollution.</p>	<ul style="list-style-type: none"> • Text books • Internet • Pictures and charts of road construction, • Timber logging, • Pictures of flooding at Kroobay, • Landslide at Motormeh or any area of landslide. • Field trip to Kroobay, Bormeh, any other dumping site or slum community • Fields trips to areas of deforestation, e.g., Mortormeh, Mt. Sugar Loaf, the Tacugama forest area • Questionnaires 	<ul style="list-style-type: none"> • Questions and answer session: why do people cut down trees? (e.g., for fire-wood, road construction, farming etc.) • What are some of the main effects of deforestation? (e.g., erosion, landslide) • Homework: pupils find out five other activities of humans that affect the environment. • Find out how mining activities in Sierra Leone have affected the land. Name areas of mining activities. • In groups pupils talk about ways of minimizing pollution. Group presentation. • Report on field trips. (Questionnaires: pupils write down
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		How can we reduce deforestation; e.g., tree planting, Government laws		the answers to the questions posed).
<p>Ecological Management</p> <ul style="list-style-type: none"> • Biological associations • Adaptations of organisms in a habitat • Ecology of population succession 	<p>Students will be able to:</p> <ul style="list-style-type: none"> • define with examples the following terms: parasitism, symbiosis, commensalism, and saprophytism. • state the general characteristics of succession. • state the outcomes of succession. • state how plants and animals are adapted in a known habitat • state factors that can affect population • explain how these factors affect population. 	<p>Define the terms and ask pupils to give examples of parasites and saprophytes which they have studied before.</p> <p>Parasite should include ecto-parasite like mosquitoes and lice and endoparasites like tapeworms and round worms.</p> <p>Explain how the Remora fish acts as a commensal on the jaw of the shark. Mention bacteria on the intestines of termites as showing a symbiotic relationship.</p> <p>Explain the term adaptation. Choose a terrestrial and an aquatic habitat. Observe the plants and animals in these environments and state how they are adapted to live in these environments, e.g., a pond and a grass land.</p> <p>Ask pupils to define population given in a previous lesson.</p> <p>What factors can affect organisms in an environment.</p> <p>Pupils should explain how these factors affect populations: nationality, mortality,</p>	<ul style="list-style-type: none"> • Nearby pond or grass land • Pictures of plants and animals in a pond. • Pictures of plants and animals in grass lands • Statistics from births and deaths • Statistics from Immigration • Field Trip to an abandoned farmland (Questionnaire) • School compound 	<ul style="list-style-type: none"> • Homework: pupils find some more examples of parasites, saprophytes, commensals, symbionts. • Assignment: state how one named plant and animal are adopted to live in a pond. • State how one plant and one animal is adapted to live in a grass land. • Use the statistics obtained from statistics office and represent these on graph. • Pupils fill their questionnaire during the farmland trip and submit. •





		<p>emigration, migration, food shortage, predation, competition, and diseases.</p> <p>Define population density</p> <p>Explain the meaning of succession. Discuss structural changes and species composition during succession.</p> <p>Clear a marked area in the school compound. Observe succession until the original vegetation is restored.</p> <p>Take the pupils to abandoned farmland to observe succession.</p>		
<p>Conservation of National Resources</p> <ul style="list-style-type: none"> Resources to be conserved Ways to ensure conservation Need for conservation Conservation laws 	<p>Students will be able to:</p> <ul style="list-style-type: none"> explain the meaning of natural resources. define conservation state why our natural resources need to be conserved. explain how we can protect our natural resources. 	<p>Start by defining natural resources and conservation.</p> <p>Let the pupils explain why we need to conserve our natural resources e.g., forests, wildlife, water, soil, minerals.</p> <p>Divide pupils into groups to talk about one natural resource and make their presentations.</p> <p>Discuss ways of protecting our natural resources, e.g., tree planting. (Mention the mudslide).</p>	<ul style="list-style-type: none"> Information from Agencies responsible for conservation Resource persons from: <ul style="list-style-type: none"> conservation society environmental mining Ministry of Agriculture and Forestry 	<ul style="list-style-type: none"> Pupils in groups discuss ways of conserving our natural resources. Research: find out what the Ministry of Environment is responsible for.
<p>Biology and Health</p> <ul style="list-style-type: none"> Micro-organisms Refuge and sewage disposal 	<p>Students will be able to:</p> <ul style="list-style-type: none"> describe various methods of preserving food. 	<p>Ask pupils to tell you methods used to preserve food. e.g. freezing, salting, drying, smoking, adding chemicals.</p>	<ul style="list-style-type: none"> Dried fish Salted fish Or pig's feet Canned food 	<ul style="list-style-type: none"> Pupils write down food preserved by salting, freezing,



<ul style="list-style-type: none"> • Immunisation 	<ul style="list-style-type: none"> • explain biological processes involved in food preservation. • state what are micro-organisms • name some carriers of micro-organisms • state beneficial effects of micro-organisms. • state how microbes enter the body. • name diseases caused by micro-organisms. • explain how micro-organisms can be controlled. • explain the terms sewage and refuse disposal. • explain how refuse and sewage are disposed of in Sierra Leone. • explain the term Immunization. • name some diseases that one 	<p>Explain the biological processes involved in these processes.</p> <p>Explain what micro-organisms and vectors are.</p> <p>Let pupils know about bacteria, virus and fungi.</p> <p>Ask pupils to name some vectors of micro-organisms, and state other methods by which they enter the body.</p> <p>Discuss beneficial effects of micro-organisms in nature, medicine, and industry, e.g., nitrogen cycle, penicillin, bread making.</p> <p>Harmful effects of micro-organisms should include Ebola and COVID 19.</p> <p>Discuss how micro-organisms can be controlled, e.g., high temperature and control of the vectors.</p> <p>Ask pupils to find out other methods of controlling micro-organisms. Control of house flies and mosquitoes are discussed.</p> <p>Explain the meaning of refuse and sewage. Ask pupils the type of refuse people dispose of.</p>	<ul style="list-style-type: none"> • Pictures of preserved food • Pictures of push charts (kiln Salone) • Pictures of septic tank • Lorries • Dustbins • Types of toilets(pictures) • Under five health-card • Resource person e.g., medical doctor • Pictures • Charts • Text-books • Internet 	<p>drying, and adding chemicals.</p> <ul style="list-style-type: none"> • Research: pupils find out five useful micro-organisms • List diseases caused by: <ul style="list-style-type: none"> ○ virus ○ bacteria ○ fungi ○ protozoa • In groups, pupils come up with ideas to ease the work of garbage collectors_ • Pupils do research on the work of Edward Jenner and Louis Pasteur.
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	<p>can be immunized against.</p>	<p>Who collects refuse and where is it taken to.</p> <p>Talk about sewage disposal. How is sewage removed from homes? Where is it taken to. Discuss the role of the city council in refuse disposal. Mention Cleaning Saturday that has been phased out.</p> <p>Discuss the history of Germ Theory of Disease and Immunization with the pupils. Discuss the work of Louis Pasteur on Germ Theory and Edward Jenner on Immunization.</p> <p>Explain what happens when one gets immunized. Vaccination is the process of immunization. Talk about the COVID-19 vaccine and Ebola vaccine.</p> <p>Let the pupils name the children's diseases that they get immunized for.</p>		
<p>Biology and Agriculture</p>	<p>Students will be able to: describe the external feature, mode of life adaptation and economic importance of weevils and the Cotton Stainer bug.</p>	<p>Bring some grain weevil and Cotton Stainer bugs to class.</p> <p>Ask the pupils where weevils and Cotton Stainer bugs can be found.</p> <p>Allow the pupils to observe them using a hand lens and describe the structure and their adaptive features.</p>	<ul style="list-style-type: none"> • Weevils • Cotton Stainer Bugs • Hand lenses 	<p>Draw and label weevils and Cotton Stainer bugs</p>



		<p>Discuss their economic importance. Discuss how pests can be controlled, e.g., biological, chemical methods of control. State the advantages and disadvantages of these methods of control.</p>		
<p>Genetics</p> <ul style="list-style-type: none"> • Mendel's work • Terminologies • Transmission of characteristics <ul style="list-style-type: none"> ○ experiments on monohybrid crosses ○ structures of chromosomes and DNA molecules ○ probability in genetics ○ sex determination ○ gene linkage • Application of genetics <ul style="list-style-type: none"> ○ Agriculture <ul style="list-style-type: none"> ▪ cross breeding for new varieties ▪ inbreeding 	<p>Students will be able to:</p> <ul style="list-style-type: none"> • explain the terms: genetics, hereditary, chromosomes, heterozygous, genotype, phenotype • state the conclusion from Mendel's experiment. • demonstrate how characteristics are passed on from parents to offspring. • describe the structure of the chromosome and DNA molecules. • explain why the genetics can only carry half the number of chromosomes 	<p>Define the term genetics. Explain that genes are the basic physical and functional unit of heredity and they are found within the chromosomes.</p> <p>Talk about dominant and recessive genes. Explain the differences between genotype and phenotype, homozygous and heterozygous.</p> <p>Do illustrations on the blackboard to explain. Use colored beads to explain homozygous and heterozygous.</p> <p>Ask pupils to talk about characteristics they share with their parents.</p> <p>Explain Mendel's experiments with red and white flowered peas.</p> <p>Do crosses to illustrate how characteristics are passed from parents to offspring to monohybrid and dihybrid crosses. Talk about genetics ratios.</p> <p>Use pictures to describe chromosome and DNA molecules. Explain the role of</p>	<ul style="list-style-type: none"> • Text books • Chart paper • Internet • Blackboard • Red and white beads, • Black bag or paper bag • Pictures • Coins • Resource person from the Ministry of Agriculture • Resource person from cybercrime unit at the CID. • Medical doctor from association of people with sickle cell • Rule sticks • Graph paper • Stamp pad 	<ul style="list-style-type: none"> • Ask pupils to put 30 red and 30 white beads in a bag and randomly take two out each time. • Pupils write down the number of homozygous red, homozygous white and heterozygous • Pupils do several monohybrid and hybrid crosses, and interpret the results • Pupils draw the structure of the chromosome • Pupils calculate the numbers of chromosomes in the gametes of some organisms given the number





<ul style="list-style-type: none"> ▪ advantages of cross fertilization <ul style="list-style-type: none"> ○ medicine • Variation 	<ul style="list-style-type: none"> • define probability • state the mathematical formular for probability • explain how sex is inherited in humans • do the cross to show how sex is determined. • name some sex-linked characters. • show how genetics can produce new varieties of plants and animals • name varieties of plants and animals that have been produced through genetics. • name ways in which genetics can contribute to medicine. • explain what morphological and physiological variations are. • give example of morphological variations 	<p>chromosomes, genes, and DNA in inheritance.</p> <p>Talk about chromosome number in different species, e.g., dog 78, cat 38, humans 46</p> <p>Explain that gametes can only carry half the number of chromosomes.</p> <p>Emphasize the DNA contains all the instructions of the body and accounts for the diversity of life forms.</p> <p>Start by explaining the meaning of probability and give the mathematical formula for calculating probability</p> <p>Relate Mendel's to formula for probability.</p> <p>Explain that the phenotypic and genotypic ratio are determine by chance.</p> <p>Explain that the probability is applied in the formation of gametes and offspring.</p> <p>Explain to pupils that in determined by two sex chromosomes, X and Y , half the sperm carry X chromosome and half carry Y chromosomes.</p> <p>The eggs only carry X chromosomes. Do the cross on the board to show sex determination.</p>		<p>of chromosomes in the cell.</p> <ul style="list-style-type: none"> • Toss coins up twenty times. Record the number of heads and tails. Calculate the probability of heads and tails • From simple crosses, let pupils state the probability of the resulting genotypes and phenotypes. • Let the pupils calculate the probability of getting a male and female child. • Pupils find out more about gene linkage on the internet. • Let pupils find out about hemophilia, colour blindness and baldness. • Pupils find out who produced
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	<ul style="list-style-type: none"> • name some causes of morphological variation • give examples of physiological variations • name some causes physiological variations. 	<p>Explain to the pupils that genes located on the same chromosomes are transmitted together and known as linked genes.</p> <p>Explain that some characteristics are sex linked, e.g., hemophilia, colour blindness, baldness</p> <p>Talk about how new varieties of livestock and crops can be produced by cross breeding. Mention the advantages and disadvantages of cross breeding.</p> <p>Ask pupils to name varieties of rice produced in Sierra Leone., e.g., Nerica rice</p> <p>Mention other contributions to agriculture like plants and animals that are able to adapt to climate conditions and are disease resistant.</p> <p>Talk about increase in crop yield and improvement of farm produce.</p> <p>Talk about how genetics can contribute to determination of paternity, help in blood transfusion, crime detection, and marriage counselling in the case of people with sickle cell.</p>		<p>Nerica rice in Sierra Leone</p> <ul style="list-style-type: none"> • Pupils do more research on contributions of genetics in medicines. • Pupils compare their fingerprints with their peers. • Groupwork: pupils take height and record for all the members of the group. • Draw a graph to represent their height. • Get all the members of the class to roll their tongue. Write down how many can and how many cannot. • Pupils in groups list environmental factors that cause variation.
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		<p>Define variation. Explain what morphological variation means.</p> <p>Get pupils to stand up and group them according to their height - short and tall.</p> <p>Explain that variations can be continuous and discontinuous. Explain the two and make pupils realize that the earlier exercise should show continuous variation. Let pupils give some other examples.</p> <p>Explain how genes control variation.</p> <p>Physiological variations include tongue rolling and blood groups. Explain that these have no intermediate forms</p> <p>Ask pupils to suggest some reasons for the variations among them, e.g., environmental factors, genetics factors, malnutrition.</p> <p>Explain what mutation means.</p>		
<p>Behavioral Adaption in Social Insects</p> <ul style="list-style-type: none"> • Termites • Bees 	<p>Students will be able to:</p> <ul style="list-style-type: none"> • identify the different castes of termites and bees • state the role of the different castes. 	<p>Try to bring various castes of termites from anthills.</p> <p>Describe the adaptations of the various castes for their roles.</p> <p>Explain how they work as a group for running of the colony.</p>	<ul style="list-style-type: none"> • Various castes of termites and/ or bees • Piece from an anthill or beehive. • Visit an area with an anthill or bee- 	<p>Practical: termites - draw a worker, soldier, and queen</p>





	<p>explain the term division of labour with respect to these insects</p>	<p>Discuss the roles of the workers, soldiers, queens and compare with the roles of the workers, soldiers and queen in the beehive.</p> <p>Let pupils draw a worker, soldier, and queen termite to show their adaptation.</p> <p>Talk about how these insects communicate.</p> <p>Discuss behavioral adaptations in the other animals like lizards (basking), territorial behavior of some organisms, warning cries.</p>	<p>hive (don't go too close!)</p>	
<p>Evolution</p> <ul style="list-style-type: none"> • Theory of evolution • Evidence of evolution 	<p>Students will be able to:</p> <ul style="list-style-type: none"> • explain Darwin's and Lamarck's theories of evolution • explain how records of fossils and comparative anatomy has contributed to understanding evolution 	<p>Give a brief explanation of Darwin's and Lamarck's theories.</p> <p>Explain that these trends in plants move from simple to complex.</p>	<ul style="list-style-type: none"> • Text books • Internet 	<p>Research: pupils find out more on Darwin's and Lamarck's theories of evolution.</p>

