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**Republic of Zambia
Ministry of Education**

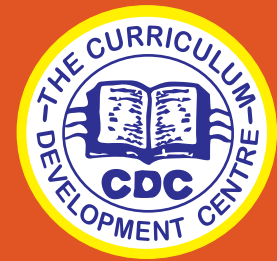
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BIOLOGY SYLLABUS

**SECONDARY EDUCATION ORDINARY LEVEL
FORM 1 - 4**



**DEVELOPED BY THE CURRICULUM DEVELOPMENT CENTRE
LUSAKA
2024**



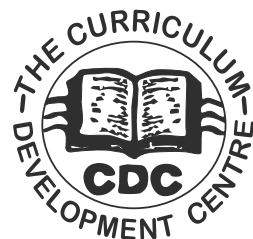
Republic of Zambia

MINISTRY OF EDUCATION

BIOLOGY SYLLABUS

SECONDARY EDUCATION ORDINARY LEVEL

FORMS 1 – 4



Developed by The Curriculum Development Centre

2024

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VISION

Quality, life long education for all which is accessible, inclusive and relevant to individual, national and global needs

PREFACE

The **Biology Ordinary Secondary School Syllabus** has been reviewed by the need to provide a national responsive curriculum for learners at Forms 1 to 4. The syllabus aims to provide quality education that is aligned with the **Competence-Based Curriculum** and 21st Century Skills. It also aims to impart the knowledge, skills, values and positive attitudes that are aimed at enabling learners to live and grow into productive and useful members of their communities and the Zambian society.

This syllabus comprises six concepts broken down into various topics. The subject is designed to promote and support the linkage with Advanced Level (Form 5 and 6) as part of the secondary school subsector of the education system.

The concepts and topics provided in this syllabus are aimed at facilitating hands-on experiences through manipulation of real objects, interaction with nature and learning through research and practical work. Thus, the learners will develop knowledge, desirable lifelong skills, values and positive attitudes needed for their personal and national development.

Cross cutting themes and emerging issues such as Life Skills and Health Education, and Climate Change have been incorporated in the syllabus to ensure that children cultivate a mindset, skills, values and positive attitudes that prepare them to live responsible lives and be protected from life threatening vices.

It is hoped that the syllabus will make learning at Secondary School level more meaningful and enjoyable as it is highly activity oriented and allows for a smooth transition from Ordinary Secondary School to Advanced Secondary School level.



Joel Kamoko, (Mr.)

Permanent Secretary- Educational Services

MINISTRY OF EDUCATION

ACKNOWLEDGEMENT

This syllabus outlines the content of Biology and the order in which it will be taught at Ordinary Secondary School level. It is intended to guide teachers and other experts in Biology to appropriately offer relevant lessons at this level.

Many thanks go to individuals, institutions and organisations that provided financial and technical support to the successful development of this syllabus. These include; the teachers, lecturers from colleges, and public universities in Zambia, the Examinations Council of Zambia, the Directorates of National Science Centre, and Secondary Education in the Ministry of Education.

Last but not least, I recognise the commitment and hard work of all the staff at the Curriculum Development Centre in ensuring that this syllabus comes to reality.



Charles Ndakala (Dr.)
Director – Curriculum Development
MINISTRY OF EDUCATION

INTRODUCTION

The Biology Syllabus is designed for learners pursuing Ordinary Secondary School level in Zambian schools. This is a Competence-Based syllabus which emphasises what the learners are expected to do as opposed to what they are expected to know. Through hands-on activities, learners will generate knowledge and life-long learning skills. The course will provide an engaging and explorative journey designed to spark curiosity, nurture foundational skills, and instill love for learning in the young minds. In this course, there is a recognition that the learners are not empty vessels that have to be loaded with knowledge but come with prerequisites and prior knowledge. Therefore, the methods used in teaching them must take into consideration the fact that they have immense potential to create a dynamic and stimulating environment where they can joyfully discover the wonders of Biology. From the moment they begin to explore and discover the world around them, they engage in processes of observation, questioning, and experimentation. The syllabus aims to harness and tap into these innate abilities to provide a solid foundation for further studies in Biology related education and smooth transition to Advanced level Education.

The course covers the following themes/concepts:

1. Concepts and Methods in Biology
2. Principles of Cellular Life
3. Maintenance of the Organism
4. Continuity of Life
5. Coordination and Response
6. Ecological Relationships and Evolution.

Objectives

The main objectives of providing Biology education to every learner is to;

- Instill curiosity to nurture a sense of wonder by encouraging learners to be inquisitive, explore their surroundings, and make connections between the natural world and the biological concepts.
- Build a foundation for biological thinking through interactive activities and play.
- Introduce fundamental biological concepts such as patterns, measurement, sorting, manipulation, ordering and basic experiments. These experiences act as the future.

- Inculcate scientific inquiry that foster hands-on approach to Biology by engaging young learners in manageable, safe and age-appropriate experiments to observe the causes and effects, explore the properties of materials and develop keen interest in the world of Biology and Science at large.
- Encourage collaborative learning by recognising the value of social interactions in the process of learning. The learner activities should be patterned so as to promote teamwork, communication, and the sharing of ideas, creating a supportive community of learners.
- Foster awareness of climate change and measures to mitigate it.
- Encourage sustainable environmental management practices aimed at evading the impact of climate change

Suggested Teaching Methodology

The success of Biology can be achieved by maximum participation of the learners. This learning area embraces creativity, analysis, problem solving and investigative approach. Therefore, Biology can be taught effectively using competence-based education approach both in and outside the classroom. Learners are expected to conduct investigations and make scientific inquiries through experiments, field work, group work, individual work, scientific research and project work. Suffice to mention that learners will be given the opportunity to use the scientific research in many phases of the study of biology during the course. The scientific research will be done in groups, or individuals in areas of special interest. The learners will also be expected to follow all the steps of the scientific research during the investigations of a problem, phenomenon, or the principles and laws.

Assessment

Assessment of competences describes the knowledge, skills, values and attitudes that learners are expected to demonstrate during the course of learning.

They reflect those aspects such as:

A. Knowledge with understanding

Learners will be demonstrating knowledge and understanding in relation to:

- facts, laws, definitions, concepts and theories relating to biological phenomena
- biological vocabulary, terminology, convention (including symbols, quantities and units)
- scientific instruments and apparatus used in Biology, including techniques of operations and aspects of safety
- scientific quantities and their determination, and
- biological and technological applications with their social, economic and environmental implications.

B. Handling information and solving problems

Using oral, written, symbolic, graphical and numerical materials, learners will be:

- locating, selecting, organising and presenting information from a variety of sources
- translating information from one form to another
- manipulating numerical and other data
- using information to identify patterns, report trends and draw inferences
- presenting reasoned explanations for phenomena, patterns and relationships
- making predictions and propose hypotheses, and
- solving problems.

C. Experimental skills and investigations

Learners will be:

- using scientific inquiry method
- following a sequence of instructions
- selecting appropriate techniques, apparatus and materials
- using techniques, apparatus and materials appropriately
- making and recording observations and measurements accurately
- interpreting and evaluating observations and experimental data, and
- evaluating methods and suggesting possible improvements.

Continuous assessment will be conducted in line with concepts and topics using various methods of testing at various levels. The Examinations Council of Zambia (ECZ) will prepare detailed procedures on how Continuous Assessment will be conducted by the teachers. ECZ will also develop Assessment Schemes which will provide guidelines on the competences to be tested. The scheme of assessment will consist of School Based Assessments (SBAs) to be administered by schools which will include; tests, practical work, projects and scientific research. The final examinations that will be conducted by ECZ.

TIME ALLOCATION

Time allocation for this syllabus will require 6 periods of 40 minutes each per week, all of which must be taught in 80 minutes per lesson.

KEY COMPETENCES TO BE DEVELOPED

S/N	COMPETENCE	DESCRIPTORS
1	Analytical Thinking	<ul style="list-style-type: none"> • Identify patterns • Compile data, create mental images and address issues • Evaluate solutions
2	Communication	<ul style="list-style-type: none"> • Use mathematical/scientific language in different situations • Express oneself using different media and symbols • Ask for feedback
3	Creativity and Innovation	<ul style="list-style-type: none"> • Explore the objects around them. • Show creativity and innovativeness • Explore areas of interest
4	Collaboration	<ul style="list-style-type: none"> • Solving puzzle in groups • Play with peers to build relationships • Participate in and express themselves through play activities
5	Critical Thinking	<ul style="list-style-type: none"> • Ask and answer simple questions • Classify objects according to their attributes • Manipulate different objects • Solve simple problems in life • Match different things according attributes • Arrange objects according to attributes • Compare similarities or differences between objects • Explore the environment • Differentiate good from bad • Recognize and name items in the environment
6	Environmental Sustainability	<ul style="list-style-type: none"> • Dispose trash in the designated place. • Adhere to best practices in environmental management. • Identify a clean environment. • Identify types of waste in local environment
7	Problem Solving	<ul style="list-style-type: none"> • Make connections/link with the inner world or social environment • Use numeracy patterns and relations to solve problems • Manipulate numbers, shapes and symbols to complete a task

FORM 1

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
1.1.0 Concepts and Methods in Biology	1.1.1 Nature of Science Inquiry in Biology	1.1.1.1 Apply scientific inquiry in carrying out scientific investigations	<ul style="list-style-type: none"> • Describing the scientific inquiry method • Investigating the stages of scientific inquiry (<i>observation, identifying a problem, forming hypothesis, testing hypothesis through experimentation, recording and analysing data, forming a conclusion</i>) • Applying scientific inquiry method in investigating biological facts and phenomena given a situation • Sharing the findings of the investigations with peers • Using the findings of the investigations to solve real life problems 	<ul style="list-style-type: none"> • Scientific inquiry method in scientific investigation applied correctly
	1.1.2 Nature of Biology	1.1.2.1 Categorise the study of Biology	<ul style="list-style-type: none"> • Exploring the nature of Biology • Identifying the branches of biology (<i>botany, zoology, entomology, genetics, mycology</i>) • Creating a concept map on the nature of Biology 	<ul style="list-style-type: none"> • Study of Biology categorised correctly
	1.1.3 Levels of Biological Organisation	1.1.3.1 Classify the levels of biological organisation from simple to complex	<ul style="list-style-type: none"> • Classifying levels of biological organisation (<i>atom, molecule, cell, tissue, organ, system, organism, population, communities, ecosystem, biosphere</i>) 	<ul style="list-style-type: none"> • Levels of biological organisation classified from simple to complex correctly
	1.1.4 Characteristics of Living Things	1.1.4.1 Analyse the characteristics of living things	<ul style="list-style-type: none"> • Investigating the characteristics of living things (<i>feeding/nutrition, respiration, excretion, reproduction, sensitivity/irritability, movement/locomotion, growth</i>) 	<ul style="list-style-type: none"> • Characteristics of living things analysed correctly

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
			<ul style="list-style-type: none"> Distinguishing living things from non-living things Analysing the concept of life 	
		1.1.4.2 Categorise life processes of living organisms	<ul style="list-style-type: none"> Describing life processes in living organisms Analysing life processes in living organisms Categorising life processes of living organisms (<i>catabolism and anabolism</i>) 	<ul style="list-style-type: none"> Life processes of living organisms categorised appropriately
1.2.0 Principles of Cellular Life	1.2.1 Microscopes	1.2.1.1 Use different types of microscopes to examine specimens	<ul style="list-style-type: none"> Exploring different types of microscopes (<i>simple and compound microscopes</i>) Relating parts of a compound microscope to the functions (<i>eye piece lens, objective lenses, body tube, adjustment knobs revolving nose piece, stage, diaphragm, aperture, light source, arm and base</i>) Practicing the use of microscopes (<i>preparing the specimen slides, mounting, focussing and observing</i>) Calculating magnification of examined specimen 	<ul style="list-style-type: none"> Different types of microscopes to examine specimens used accordingly
	1.2.2. Basic Cell Structure	1.2.2.1 Explore the basic cell structure	<ul style="list-style-type: none"> Examining the basic structure of cells using a microscope (<i>use cells of different organisms</i>) Illustrating the basic structure of cells Creating models of cells showing basic structure 	<ul style="list-style-type: none"> Basic structure of cells explored correctly
	1.2.3. Types of Cells	1.2.3.1 Distinguish between eukaryotic and prokaryotic cells	<ul style="list-style-type: none"> Investigating eukaryotic cells (<i>plant and animal cells, fungi, amoeba</i>) and prokaryotic cells (<i>bacterial cells</i>) 	<ul style="list-style-type: none"> Eukaryotic and prokaryotic cells distinguished correctly

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
			<ul style="list-style-type: none"> Differentiating eukaryotic and prokaryotic cells (<i>structure</i>) Explaining the functions of animal and plant cell organelles Comparing and contrasting animal and plant cells 	
	1.2.4 Cell Specialisation	1.2.4.1 Relate adaptive features of specialised cells to their functions	<ul style="list-style-type: none"> Identifying specialised cells in animals and plants (<i>nerve cell, blood cells, ciliated cell, muscle cell, sperm cell, root hair cell, palisade cell, guard cell, phloem, xylem</i>) Observing adaptive features of specialised cells (<i>use pictures, slides, models, videos, simulations</i>) Relating the adaptive features of observed cells to their functions 	<ul style="list-style-type: none"> Adaptive features of specialised cells related to their functions correctly
1.3.0 Maintenance of the Organism	1.3.1 Nutrition in Man	1.3.1.1 Classify types of food nutrients	<ul style="list-style-type: none"> Exploring sources of food nutrients (<i>carbohydrates e.g. cereals; proteins e.g. meat and legumes; lipids e.g. butter, cooking oil; vitamins e.g. fruits and vegetables; roughage e.g. vegetables and unpolished cereals</i>) Classifying foods according to their nutrient content (<i>carbohydrates, proteins, lipids, vitamins, minerals, roughage, water</i>) Discussing the importance of food nutrients in humans (<i>tissue repair, energy supply, growth, and protection...</i>) 	<ul style="list-style-type: none"> Types of food nutrients classified correctly
	1.3.2 Dietary Needs of	1.3.2.1. Apply good eating	<ul style="list-style-type: none"> Designing appropriate diets for persons with different 	<ul style="list-style-type: none"> Good eating practices applied accordingly

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
	Different Persons	practices for good health	nutritional needs (<i>infants, adolescents, manual workers, pregnant women, lactating women, sick /invalids, the aged</i>) <ul style="list-style-type: none">• Justifying the designed diets for persons with different nutritional needs	

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
	1.3.3 Plant Nutrients	1.3.3.1 Categorise types of plant nutrients	<ul style="list-style-type: none"> Identifying plant nutrients Classifying macro and micro nutrients (<i>macro: nitrogen, phosphorous, potassium; micro: magnesium, boron, sulphur, copper, iron, calcium, molybdenum, zinc</i>) Analysing the effects of macro nutrients (NPK) on plant growth 	<ul style="list-style-type: none"> Types of plant nutrients categorised correctly
	1.3.4 Nutritional Deficiency Diseases and Disorders	1.3.4.1 Recommend appropriate nutrients to address deficiency diseases and disorders in plants and human beings	<ul style="list-style-type: none"> Investigating nutritional deficiency diseases and disorders in human beings (<i>Kwashiorkor, marasmus, rickets, beriberi, scurvy, pellagra, goitre, anaemia, obesity</i>) Investigating the deficiency diseases and disorders in plants associated with lack of one or more nutrients (<i>chlorosis, poor root development, stunted growth, abnormal colouration, shortened internodes</i>) Treating the deficiency diseases and disorders in plants and human beings 	<ul style="list-style-type: none"> Appropriate nutrients to address deficiency diseases in plants and human beings recommended accordingly
1.4.0 Continuity of Life	1.4.1 Reproduction in Living Organisms	1.4.1.1 Demonstrate understanding of how living organisms reproduce	<ul style="list-style-type: none"> Investigating reproduction in different living organisms Demonstrating asexual and sexual reproduction using seeds, spores, and vegetative parts Comparing and contrasting asexual and sexual reproduction in living organisms 	<ul style="list-style-type: none"> Understanding of reproduction in living organisms demonstrated appropriately

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
	1.4.2 Reproduction and Development in Human Beings	1.4.2.1 Demonstrate understanding of reproductive system in human beings	<ul style="list-style-type: none"> • Describing the reproduction system in human beings • Drawing the male and female reproductive system • Explaining functions of different parts of the reproductive system • Outlining the secondary sexual characteristics (<i>male: pubic hair, armpit hair, beards, deepening of voice, widening of the chest, production of sperms and enlargement of the penis and testes; female: widening of hips, menstruation, enlargement of breasts, pubic hair, underarm hair, and vagina</i>) • Practicing personal hygiene 	<ul style="list-style-type: none"> • Understanding of the reproductive system in human beings demonstrated correctly

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
	1.4.3 Reproduction in Viruses, Protozoa, Bacteria and Fungi	1.4.3.1 Demonstrate understanding of reproduction in viruses, protozoa, bacteria and fungi	<ul style="list-style-type: none"> • Outlining the processes of reproduction in viruses (<i>replication in suitable host</i>), protozoa and bacteria (<i>binary fission</i>), and fungi (<i>spore formation</i>) • Investigating the structure of fungi (<i>growing fungi on food-Rhizopus and Mucor</i>) 	<ul style="list-style-type: none"> • Importance of reproduction in viruses, protozoa, bacteria and fungi evaluated correctly
1.5.0 Coordination and Response	1.5.1 Coordination and Response in Plants	1.5.1.1 Explore tropisms in plants and their relevance	<ul style="list-style-type: none"> • Describing tropisms in plants • Investigating the effect of light and gravity on shoots and roots (<i>phototropism and geotropism</i>) • Investigating the effect of water on roots (<i>hydrotropism</i>) • Investigating the effect of chemicals on roots (<i>chemotropism</i>) • Evaluating the importance of tropisms 	<ul style="list-style-type: none"> • Tropisms in plants and their relevance explored accordingly
	1.5.2 Coordination and Response in Animals	1.5.2.1 Explore taxic responses in invertebrates and their relevance	<ul style="list-style-type: none"> • Describing taxic responses • Investigating taxic responses to light, chemicals and gravity (<i>phototaxis: cockroaches, woodlice, flying ants, bed bugs; geotaxis: earthworms; chemotaxis: bacteria, liver fluke</i>) • Evaluating the relevance of taxic responses to the organism • Applying the mechanism of taxic responses to eliminate pests and insects in homes • Differentiating tropic from taxic responses 	<ul style="list-style-type: none"> • Taxic responses in invertebrates and their relevance explored appropriately
1.6.0 Ecological Relationships and Evolution	1.6.1 Ecosystem	1.6.1.1 Explore features of ecosystems in the local	<ul style="list-style-type: none"> • Describing an ecosystem • Observing key features of terrestrial and aquatic 	<ul style="list-style-type: none"> • Features of ecosystems explored in the local

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
		environment	ecosystems in the local environment <ul style="list-style-type: none"> • Recording key features in the ecosystems under study • Applying best practices to protect ecosystems (<i>Protecting habitats, restoring habitats, planting indigenous plants...</i>) • Constructing models of different ecosystems 	environment accordingly

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
	1.6.2 Biotic and Abiotic Interactions	1.6.2.1 Interpret biotic and abiotic interactions	<ul style="list-style-type: none"> • Distinguishing biotic and abiotic factors in an ecosystem • Analysing the three kinds of relationships that exists in an ecosystem (<i>Refer to the interaction in the biotic community; interaction between the biotic community and the physical environment, and Interactions within the physical environment</i>) 	<ul style="list-style-type: none"> • Biotic and abiotic interactions interpreted correctly
	1.6.3 Waste Management	1.6.3.1 Manage waste in the local environment	<ul style="list-style-type: none"> • Analysing types of waste found in the environment (<i>Wet and dry waste; sources of waste...</i>) • Evaluating the benefits of living in waste-free environment • Devising different ways of managing wastes in the local environment (<i>The three Rs, incineration, correct disposal of waste in designated places...</i>) • Identifying the challenges communities face which lead to accumulation of waste in the environment. • Creating waste-free zones in the environment (<i>School project</i>) • Reaching out to communities in creating awareness on effective waste management practices 	<ul style="list-style-type: none"> • Waste in the local environment managed accordingly
	1.6.4 The Soil - Composition and Fertility	1.6.4.1 Analyse soil composition and fertility	<ul style="list-style-type: none"> • Identifying different soil components (<i>air, microorganisms, soil particles and humus</i>) • Classifying types of soil (<i>clay, sandy and loamy</i>) and their properties (<i>capillarity, particle size, drainage</i>) 	<ul style="list-style-type: none"> • Soil composition and fertility analysed appropriately

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
			<ul style="list-style-type: none"> • Investigating features of fertile soil • Investigating causes of loss of soil fertility • Practicing ways to improve and retain soil fertility • Comparing crop yield in different types of soil 	

FORM 2

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
2.1.0 Concepts and Methods in Biology	2.1.1 Experimental Design	2.1.1.1 Apply experimental design in scientific investigations	<ul style="list-style-type: none"> Analysing sampling methods Carrying out investigations using the scientific design. Practising the use of two or more variables when conducting experiments (<i>independent, dependent and control</i>) 	<ul style="list-style-type: none"> Experimental design applied correctly
	2.1.2 Limits of Science	2.1.2.1. Identify the limits of science	<ul style="list-style-type: none"> Explaining the limits of science (<i>laws, language, tools, dynamic nature of elements, inconsistency of elements</i>) Classifying limits of science (<i>beliefs, natural laws, ecological laws</i>) 	<ul style="list-style-type: none"> Limits of science identified accordingly
	2.1.3 Scientific Ethics	2.1.3.1 Evaluate ethics of scientific research	<ul style="list-style-type: none"> Determining scientific ethics of a given research (<i>consent, no discrimination, honesty, confidentiality</i>) Applying the ethics of scientific research 	<ul style="list-style-type: none"> Scientific ethics evaluated appropriately
2.2.0 Principles of Cellular Life	2.2.1 Micrographs	2.2.1.1 Interpret micrographs	<ul style="list-style-type: none"> Identifying types of micrographs Explaining micrographs of plant and animal tissues (<i>Plant: palisade, spongy, epidermal; animal: blood cells, muscle cells, nerve cells</i>) Interpreting micrographs Communicating scientific information effectively using micrographs 	<ul style="list-style-type: none"> Micrographs interpreted correctly
	2.2.2 Staining Specimen and Preparation of permanent Slides	2.2.2.1 Apply appropriate staining techniques on specimen	<ul style="list-style-type: none"> Exploring staining techniques on specimen Staining of specimen Preparing permanent plant tissue slides 	<ul style="list-style-type: none"> Appropriate staining techniques on specimen applied accordingly
	2.2.3 Detailed cell Structure	2.2.3.1 Illustrate detailed cell structure of an organism	<ul style="list-style-type: none"> Drawing detailed cell structure Designing detailed models of cells Applying knowledge of organelles and their functions in order to understand cellular functions 	<ul style="list-style-type: none"> Detailed cell structure of an organism illustrated accordingly
	2.2.4 Properties of Water	2.2.4.1. Analyse the properties of water in relation to supporting life	<ul style="list-style-type: none"> Investigating properties of water in relation to supporting life (<i>transparent to light, universal solvent, liquid at room temperature, has neutral pH, surface tension, its density reduces</i>) 	<ul style="list-style-type: none"> Properties of water in relation to supporting life analysed accordingly

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
			<p>when in solid form, ability to resist temperature changes)</p> <ul style="list-style-type: none"> Evaluating importance of water in a cell (<i>medium of chemical reaction, acts as a solvent, turgidity in plant cells</i>) 	
2.3.0 Maintenance of the Organism	2.3.1 Nutrition-Types of Nutrition	2.3.1.1 Categorise types of nutrition in living organisms	<ul style="list-style-type: none"> Describing nutrition (<i>autotrophic and heterotrophic</i>) Identifying types of heterotrophic nutrition in organisms in the local environment (<i>parasitism, saprophytic and holozoic</i>) Distinguishing autotrophic nutrition from heterotrophic nutrition Relating nutrition to different organisms found in the environment 	<ul style="list-style-type: none"> Types of nutrition in living organisms categorised correctly
	2.3.2 Autotrophic Nutrition	2.3.2.1 Analyse phototrophic nutrition in plants	<ul style="list-style-type: none"> Examining external and internal structures of a leaf Explaining the process of photosynthesis in plants (<i>light and dark reactions</i>) Tracing the fate of glucose produced by photosynthesis (<i>glucose, sucrose, starch, proteins, lipids</i>) Identifying storage organs of the products of photosynthesis (<i>leaves, root and stem tubers, fruits, seeds</i>) Investigating factors necessary for the process of photosynthesis in plants Designing experiments on factors necessary for photosynthesis in plants (<i>carbon dioxide, light energy, chlorophyll</i>) Relating how the factors that affect photosynthesis improve crop yield Constructing word and chemical equations for photosynthesis process 	<ul style="list-style-type: none"> Phototrophic nutrition in plants analysed correctly

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
		2.3.2.2 Evaluate the importance of photosynthesis to the environment	<ul style="list-style-type: none"> Explaining the importance of photosynthesis to the environment (<i>economic importance, balance of carbon dioxide and oxygen in the atmosphere, carbon sink...</i>) 	<ul style="list-style-type: none"> Importance of photosynthesis evaluated appropriately
	2.3.3 Heterotrophic Nutrition	2.3.3.1 Analyse types of heterotrophic nutrition in living organisms	<ul style="list-style-type: none"> Identifying the different types of heterotrophic nutrition in living organisms (<i>parasitic, saprophytic, holozoic</i>) Illustrating types of heterotrophic nutrition in living organisms (<i>parasitic-ticks; saprophytic-bread mould; holozoic-human beings</i>) 	<ul style="list-style-type: none"> Types of heterotrophic nutrition in living things analysed correctly
		2.3.3.2 Evaluate the importance of heterotrophic nutrition to organisms and the environment	<ul style="list-style-type: none"> Evaluating the need for heterotrophic nutrition to organisms and the environment (<i>obtaining of nutrients; preventing accumulation of dead organic matter in the environment: saprophytes</i> <i>bacteria: sewage treatment, biological control of population, nutrient recycling- Rhizobium, dairy products; fungi: source of food, brewing, manufacture of antibiotics, causing diseases...</i>) 	<ul style="list-style-type: none"> Importance of heterotrophic nutrition to organisms and the environment evaluated correctly
	2.3.4 Transport in Plants	2.3.4.1 Demonstrate understanding of transport system of flowering plants	<ul style="list-style-type: none"> Describing transport system of flowering plants Identifying the organs involved in the transport system in flowering plants (<i>root, stem, leaf</i>) Analysing root systems in monocotyledonous and dicotyledonous plants Examining the internal structures of dicot and monocot plants (<i>cross sections of roots and stems of herbaceous and woody plants-vascular bundles</i>) Examining the longitudinal section of 	<ul style="list-style-type: none"> Understanding of transport system of flowering plants demonstrated appropriately

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
			xylem and phloem • Tracing the uptake and movement of mineral salts and water in the xylem; translocation of nutrients in the phloem	
		2.3.4.2 Analyse the process of transpiration in plants	• Describing the process of transpiration • Investigating factors that affect the rate of transpiration • Examining adaptive features in plants that reduce excess loss of water. • Evaluating the significance of transpiration	• Process of transpiration analysed correctly
2.4.0. Continuity of Life	2.4.1 Reproduction in plants	2.4.1.1 Propagate different plants using asexual reproduction modes	• Explaining the different modes of asexual reproduction in plants • Analysing the advantages and disadvantages of vegetative propagation (advantages: increase yields, genetic stability, increased rate in maturity; disadvantages: no genetic variation, plants prone to diseases, overcrowding, undesirable characteristics maintained) • Applying different modes of asexual reproduction to propagate different plants (grafting, budding, layering: - vegetative structures, runners, suckers, stems, corms, stem tubers, root tubers, bulbs, rhizomes)	• Different plants propagated appropriately
		2.4.1.2 Analyse sexual reproduction in flowering plants	• Describing sexual reproduction in flowering plants • Collecting flowers from different plant species found in the local environment • Identifying the male parts (<i>stamen: filament, anther</i>); and female parts (<i>carpel: stigma, style, ovary, ovules</i>) of a flower • Observing, drawing and labelling parts of a typical flower • Explaining the functions of the parts of a typical flower (<i>monocot and dicot</i>)	• Sexual reproduction in flowering plants analysed correctly

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
			flowers) • Describing the process of pollination • Deducing the type of pollination based on the physical features of the flower (<i>cross pollination and self pollination</i>) • Deducing the agents of pollination based on the features of the flower (<i>wind pollinated and insect pollinated</i>) • Illustrating the path taken by a pollen tube leading to double fertilisation of polar nuclei and egg cell	
		2.4.1.3 Deduce the methods of seed and fruit dispersal	• Collecting different seeds and fruits in the local environment • Comparing and contrasting features of collected seeds and fruits in relation to the method of dispersal • Predicting the method of seed and fruit dispersal based on seed and fruit structure	• Methods of seed and fruit dispersal deduced accordingly
	2.4.2 Germination, Growth and Development in Plants	2.4.2.1 Explore germination, growth and development in plants	• Describing germination in flowering plants • Investigating conditions necessary for germination (<i>moisture, suitable temperature and oxygen</i>) • Distinguishing hypogeal and epigeal germination in plants • Describing growth and development in plants (<i>primary and secondary growth</i>) • Examining regions of growth using microscopes, micrographs (<i>cell division, elongation, and differentiation into phloem and xylem and cambium</i>)	• Germination, growth and development in plants explored accordingly
2.5.0 Coordination and Response	2.5.1 Role of plant Hormones on Response	2.5.1. Demonstrate understanding of the role of auxins in phototropism and geotropism	• Describing coordination and response in plants • Investigating the effects of light on plant shoots and roots (<i>refer to auxins concentrations</i>) • Investigating the effects of gravity on	• Understanding of the role of auxins in phototropism and geotropism demonstrated accordingly

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
			plant shoots and roots. (<i>Refer to auxin concentrations</i>) <ul style="list-style-type: none"> • Relating the effect of hormones to plant responses 	
	2.5.2 Health and Disease	2.5.2.1 Explore infectious diseases that affect human beings	<ul style="list-style-type: none"> • Describing health and disease • Identifying infectious diseases (<i>TB, cholera, COVID-19, influenza, HIV and AIDS and STIs...</i>) • Categorising infectious diseases (<i>airborne: TB, COVID-19, influenza ...; waterborne: cholera, dysentery, typhoid, bilharzia...; foodborne: cholera...</i>) • Exploring the causative agents, signs and symptoms, methods of transmission, prevention and treatment. • Dispelling myths and misconceptions of infectious diseases such as TB, AIDS and COVID-19 • Evaluating the economic importance of infectious diseases 	<ul style="list-style-type: none"> • Infectious diseases that affect human beings explored accordingly
		2.5.2.2 Explore non- infectious diseases that affect human beings	<ul style="list-style-type: none"> • Describing non-infectious diseases • Categorising non-infectious diseases: parasitic (<i>malaria, bilharzia</i>); genetic (<i>asthma, sickle cell anaemia</i>); mental illness; dietary diseases (<i>type 2 diabetes, hypertension, hypotension</i>) • Exploring causative agents, signs and symptoms, management and treatment of non-infectious diseases. • Investigating life cycles of a housefly and a mosquito (<i>egg, larva, pupa, adult</i>) • Identifying the role of houseflies and mosquitoes in disease transmission • Relating the control of malaria to the life cycle of the mosquito (<i>biological and chemical control</i>) • Relating the control of waterborne 	<ul style="list-style-type: none"> • Non-infectious diseases effectively explored accordingly

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
			diseases to the life cycle of a housefly <ul style="list-style-type: none"> Devising home-made remedies to eliminate or control causative agents of diseases (<i>refer to houseflies and mosquitoes</i>) Evaluating the economic importance of non-infectious diseases 	
2.6.0 Ecological Relationships and Evolution	2.6.1 Classification of Organisms	2.6.1.1 Classify different organisms into kingdoms	<ul style="list-style-type: none"> Exploring the local environment to collect different living organisms Grouping organisms into specific kingdoms-(<i>Archea-bacteria, Eubacteria, Fungi, Protista, Plantae and Animalia</i>) Analysing characteristics of organisms in each kingdom Evaluating the importance of classifying organisms 	<ul style="list-style-type: none"> Different organisms classified into kingdoms accordingly
	2.6.2 Feeding Relationships and Energy Flow	2.6.2.1 Demonstrate understanding of feeding relationships and energy flow in the ecosystem	<ul style="list-style-type: none"> Illustrating the flow of energy along food chains and food webs (<i>ultimate source of energy- the sun, non-cyclical nature of energy flow</i>) Designing a food chain based on living organisms in the local environment Designing a food web based on living organisms in the local environment Distinguishing a food chain from a food web Predicting effects of a disturbance in food chains and food webs (<i>decrease/increase in population of predators/ prey</i>) 	<ul style="list-style-type: none"> Understanding of feeding relationships and energy flow in the ecosystem demonstrated accordingly
	2.6.3 Pollution	2.6.3.1 Analyse the undesirable effects of pollution on the environment	<ul style="list-style-type: none"> Describing pollution Categorizing types of pollution (<i>air, water, land pollution</i>) Analysing the undesirable effects of pollution on the environment (<i>Green house effects, global warming leading to climate change, acid rain, eutrophication...</i>) 	<ul style="list-style-type: none"> Undesirable effects of pollution on the environment analysed appropriately

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
			<ul style="list-style-type: none">• Recommending appropriate measures to minimise pollution	

FORM 3

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
3.1.0 Concepts and Methods in Biology	3.1.1 Chemicals of Life	3.1.1.1 Explore the chemicals of life	<ul style="list-style-type: none"> • Describing the chemicals of life • Identifying the chemicals of life (<i>carbohydrates, proteins, lipids and nucleic acids</i>) • Using the burn test to determine the organic molecules • Analysing the chemical composition of carbohydrates, lipids and proteins (<i>include the building blocks</i>) • Writing molecular and structural formulae of the common carbohydrates, proteins and lipids and their monomers • Constructing molecular structural models of the molecules of life • Describing hydrolysis and dehydration synthesis reactions and their relevance to biological molecules • Evaluating the significance of the chemicals of life 	<ul style="list-style-type: none"> • The chemicals of life explored accordingly
		3.1.1.2 Prepare reagents used in investigating the chemicals of life	<ul style="list-style-type: none"> • Preparing reagents using provided chemicals (<i>Benedict's solution: hydrated copper (II) sulphate, sodium carbonate, sodium citrate and distilled water, Iodine solution: iodine crystals, potassium iodide and distilled water; and Biuret reagent: hydrated copper (II) sulphate, sodium hydroxide and distilled water- add hydrated sodium potassium tartrate as a stabiliser</i>) 	<ul style="list-style-type: none"> • Reagents used in investigating the chemicals of life prepared correctly

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
	3.1.2 Food Confirmatory Tests	3.1.1.2 Carry out confirmatory tests for the presence of chemicals of life in food samples	<ul style="list-style-type: none"> • Carrying out food tests for reducing sugar, non-reducing sugar, proteins, lipids and starch 	<ul style="list-style-type: none"> • Confirmatory tests for the presence of chemicals of life in food samples carried out accordingly
	3.1.3 Research Proposal	3.1.3.1 Formulate a research proposal	<ul style="list-style-type: none"> • Outlining components of a research proposal (<i>title, background, statement of the problem, aim, purpose of the study, objectives of the study, research questions, hypothesis, significance of the study, limitations, delimitations of the study, definition of operational terms, time frame, bibliography, literature review, methodology, Budget</i>) • Designing a research proposal based on a given topic or identified problem 	<ul style="list-style-type: none"> • A research proposal formulated correctly
3.2.0 Principles of Cellular Life	3.2.1 Movement of substances across the cell	3.2.1.1 Analyse the movement of substances across the cell membrane	<ul style="list-style-type: none"> • Describing the processes of diffusion, osmosis and active transport • Experimenting on diffusion and osmosis • Investigating the factors that affect diffusion and osmosis • Investigating the effects of osmosis on plant and animal tissues (<i>plasmolysis, turgidity, crenation, cell lysis</i>) • Applying the principle of movement of substances across cell membranes to real life situations 	<ul style="list-style-type: none"> • Movement of substances across the cell membrane analysed appropriately
	3.2.2 Energy and Metabolism	3.2.2.1 Analyse metabolism processes in living cells	<ul style="list-style-type: none"> • Describing the types of metabolism (<i>anabolism: photosynthesis, protein synthesis; catabolism: respiration</i>) 	<ul style="list-style-type: none"> • Metabolism processes in living cells analysed accordingly

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
			<ul style="list-style-type: none"> Comparing and contrasting the types of metabolism 	
	3.2.3 Enzymes and their Actions	3.2.3.1 Demonstrate understanding of enzymes and their actions	<ul style="list-style-type: none"> Investigating enzymes and their actions. Analysing characteristics of enzymes Applying nomenclature to identify the enzymes acting on the given substrate Investigating the factors that affect enzyme activity (<i>experimenting on the effects of the factors</i>) Applying enzymes in everyday life (<i>brewing, baking, detergents, tanning leather</i>) 	<ul style="list-style-type: none"> Understanding of enzymes and their actions demonstrated accordingly
3.3.0 Maintenance of the Organism	3.3.1 Nutrition: Dentition in Mammals	3.3.1.1 Analyse dentition in mammals	<ul style="list-style-type: none"> Examining the structure (<i>shape</i>) and type of teeth in relation to their function. Describing the internal structure and function of a human tooth (<i>enamel, dentine, pulp cavity, cement, nerve endings, blood capillary</i>) Studying dental formulae of different mammals (<i>carnivore, herbivore and omnivore</i>) Relating dentition of mammals (<i>carnivores, herbivores and omnivores</i>) to diet. Identifying the causes, signs, symptoms and prevention of gum disease and tooth decay Devise remedies to address gum diseases and tooth decay 	<ul style="list-style-type: none"> Dentition in mammals analysed accordingly
	3.3.2 Holozoic Nutrition	3.3.2.1 Analyse holozoic nutrition	<ul style="list-style-type: none"> Describing holozoic nutrition Explaining the main processes in holozoic nutrition (<i>ingestion, digestion, absorption,</i> 	<ul style="list-style-type: none"> Holozoic nutrition analysed accordingly

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
			<p><i>assimilation and egestion</i>)</p> <ul style="list-style-type: none"> • Relating the main regions of the alimentary canal and associated organs (<i>liver and pancreas</i>) to their functions (<i>Refer to the alimentary canal of man</i>) • Describing the processes of digestion, absorption and assimilation of nutrients in the alimentary canal of man (<i>carbohydrates, proteins and lipids</i>) • Drawing the alimentary canal of human beings • Making a model to trace the movements of food materials along the alimentary canal • Examining the internal detailed structure of the small intestines • Analysing the common ailments of the alimentary canal (<i>dehydration: loss of mineral salts and loss of fluids and inflammation of the alimentary canal, colon cancer, constipation, appendicitis, stomach ulcers</i>) • Describing the metabolic functions of the liver (<i>deamination, detoxification, production of bile, regulation of blood sugar, storage of glycogen, fat soluble vitamins and iron</i>) • Describing the effects of common ailments of the liver (<i>poor bile formation, high blood sugar, low blood sugar and high toxin levels in the</i> 	

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
	3.3.3 Transport in Animals		<p><i>blood</i>)</p> <ul style="list-style-type: none"> Devising remedies to address ailments of the alimentary canal and the liver 	
		3.3.3.1 Analyse the composition of blood	<ul style="list-style-type: none"> Identifying the components of blood (<i>solid: leucocytes, erythrocytes, thrombocytes; Liquid: plasma</i>) Identifying the sites where the blood cells are produced (<i>bone marrow: red blood cells, platelets and white blood cells; lymph nodes, thymus gland and spleen: white blood cells</i>) Distinguishing between the red and the white blood cells (<i>structural and functional differences</i>) Investigating common blood disorders (<i>leukaemia, sickle cell anaemia, iron-deficiency anaemia and haemophilia</i>) 	<ul style="list-style-type: none"> Composition of blood analysed accordingly
		3.3.3.2 Explore the functions of blood	<ul style="list-style-type: none"> Analysing the functions of blood (<i>transport, homeostatic and defense</i>) Exploring the mechanism of blood clotting (<i>change of enzyme prothrombin to thrombin, fibrinogen to fibrin and role of calcium ions, vitamin K and thromboplastin</i>) 	<ul style="list-style-type: none"> Functions of blood explored accordingly
		3.3.3.3 Demonstrate understanding of ABO blood groups	<ul style="list-style-type: none"> Describing blood groups (<i>A, B, AB and O</i>) in relation to presence or absence of antigens and antibodies Explaining the importance of determining the blood groups and Rhesus factors (<i>blood transfusions and transplants;</i> 	<ul style="list-style-type: none"> Understanding of ABO blood groups demonstrated correctly

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
			<p><i>the danger of Rhesus antibodies to the Rhesus positive foetus: haemolytic disease)</i></p> <ul style="list-style-type: none"> • Relating the importance of blood screening to blood transfusion • Determining the donor-recipient compatibility of blood groups (<i>antibody and Antigen reaction when blood of different groups is mixed</i>) 	
		<p>3.3.3.4 Demonstrate understanding of the structure and function of the human heart</p>	<ul style="list-style-type: none"> • Describing the structure of the human heart (<i>drawing/model showing chambers, valves, vessels, including coronary arteries</i>) • Comparing and contrasting the structure of the human heart and that of four chambered animals (<i>cow, goat, sheep, chicken ...</i>) • Drawing and labeling a longitudinal section of the four chambered heart • Describing the mechanism of the diastole and systole of the cardiac cycle (<i>include heart beat and pulse</i>) • Investigating the causes of coronary heart disease (<i>lifestyle: diet, stress, smoking, lack of exercise; exposure to air pollutants: carbon monoxide</i>) • Preventing coronary heart diseases (<i>health diet, regular exercises, stress management, avoid smoking and exposure to air pollutants</i>) 	<ul style="list-style-type: none"> • Understanding of the structure and function of the human heart demonstrated accordingly

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
		3.3.3.5 Demonstrate understanding of the blood circulatory system	<ul style="list-style-type: none"> • Describing types of blood circulatory systems (<i>closed: Humans; and open: insects</i>) • Illustrating double circulation (<i>pulmonary and systemic circulation</i>) • Distinguishing between single circulation (<i>fish e.g. Tilapia</i>) and double circulation (<i>mammals e.g. humans</i>) • Relating the main blood vessels in the double circulatory system to functions (<i>arteries and veins transporting blood to and from major organs: heart, lungs, head, limbs, intestines, liver and kidneys</i>) • Comparing and contrasting the structure and functions of arteries, veins and capillaries (<i>transverse and longitudinal sections</i>) 	<ul style="list-style-type: none"> • Understanding of the blood circulatory system demonstrated correctly
		3.3.3.6 Demonstrate understanding of the lymphatic system	<ul style="list-style-type: none"> • Describing the structure and functions of the lymphatic system (<i>structure: lymph vessels, lymph nodes, thymus gland, and spleen; function: defence, transport of materials back into blood circulatory system</i>) • Identifying the structure of lymph vessels (<i>transverse section only</i>) • Distinguishing the blood circulatory system from the lymphatic system. • Explaining the formation of tissue fluid and lymph (<i>capillary pressure</i>) 	<ul style="list-style-type: none"> • Understanding of the lymphatic system demonstrated accordingly

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
	3.3.4 Gaseous Exchange and Respiration	3.3.4.1 Demonstrate understanding of gaseous exchange and respiration	<ul style="list-style-type: none"> • Comparing and contrasting tissue fluid and lymph to blood (<i>composition and functions</i>) • Evaluating the significance of the lymphatic system • Describing the respiratory structures in animals (<i>insects: spiracles, trachea and tracheoles; fish: operculum, mouth, gills; humans: nostrils, trachea, bronchi, bronchioles, alveoli</i>) • Relating the parts of the respiratory structures in animals to their functions • Demonstrating the mechanism of gaseous exchange in animals (<i>inspiration and expiration in an insect, fish and human beings: diffusion of gases in respiratory organs of humans, fish and insects</i>) • Making of models on gaseous exchange in animals • Investigating the composition of inspired and expired air (<i>oxygen, carbon dioxide, nitrogen, water vapour</i>) • Exploring the adverse effects of air pollutants on health of human beings (<i>nicotine, tar, sulphur dioxide and carbon monoxide</i>) • Describing gaseous exchange in plants (<i>during day time and night time</i>) • Describing types of tissue respiration (<i>aerobic and anaerobic respiration</i>) • Comparing and contrasting 	<ul style="list-style-type: none"> • Understanding of gaseous exchange and respiration demonstrated accordingly

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
			aerobic and anaerobic respiration. <ul style="list-style-type: none"> • Describing the conversion of adenosine diphosphate to adenosine triphosphate (<i>word and chemical equations</i>) • Investigating the production of carbon dioxide (CO_2) during respiration (<i>experiment to show production of CO_2 during aerobic and anaerobic respiration</i>) • Evaluating the importance of respiration in daily life (<i>production of biological energy, maintenance of levels of carbon dioxide and oxygen in the atmosphere</i>) • Exploring the significance of energy released during respiration (<i>chemical synthesis of macromolecules, muscle contraction, nerve impulse propagation, iron transport, substrate phosphorylation, cell division, temperature regulation</i>) • Applying respiration in everyday life (<i>baking, brewing, dairy, sewage treatment</i>) 	
3.4.0 Continuity of Life	3.4.1 Reproduction in amphibians	3.4.1.1 Demonstrate understanding of reproduction in frogs	<ul style="list-style-type: none"> • Investigating the process of reproduction in frogs (<i>number of eggs laid, nature of fertilisation</i>) • Identifying stages of development and care for the young • Evaluate advantages and disadvantages of the mode of reproduction exhibited in 	<ul style="list-style-type: none"> • Understanding of reproduction in frogs demonstrated correctly

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
			amphibians	
	3.4.2 Fertilisation and Development in Human Beings	3.4.2.1 Demonstrate understanding of development in human beings	<ul style="list-style-type: none"> • Describing the development process in human beings from conception to adulthood (<i>Refer to the life cycle</i>) • Analysing the menstrual cycle (<i>stages: follicular growth and ovulation; roles of hormones: FSH, LH, Oestrogen and progesterone</i>) • Explaining the processes of fertilisation (<i>fusion of sperm and ovum nuclei</i>) and implantation (<i>attachment of embryo to uterine wall</i>) in human beings • Describing development of the embryo in the uterus (<i>functions of amnion, amniotic fluid, umbilical cord and placenta</i>) • Exploring health risks associated with foetal development (<i>Poor nutrition, smoking, intake of alcohol, abuse of drugs and herbal medicines during pregnancy</i>) • Describing healthy pregnancy and safe child birth (<i>antenatal services, good nutrition, exercise, giving birth at a health facility</i>) • Evaluating the advantages and disadvantages of reproduction in human beings (<i>viviparous</i>) 	<ul style="list-style-type: none"> • Understanding of the development in human beings demonstrated accordingly
	3.4.3 Infertility and birth control in humans	3.4.3.1 Explore the causes of infertility in human beings	<ul style="list-style-type: none"> • Identifying causes of infertility in human beings (<i>Females: blocked oviducts, ovulation disorders, fibroids, hormonal imbalance, STIs, alcoholism, infections of</i> 	<ul style="list-style-type: none"> • Causes of infertility in human beings explored correctly

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
			<p><i>upper part of uterus due to medical procedures; males: weak sperms, STIs, alcoholism, low sperm count, testicular malfunction, azoospermia)</i></p> <ul style="list-style-type: none"> • Investigating ways of addressing challenges of infertility in humans • Demystifying infertility in humans 	

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
		3.4.3.2 Evaluate birth control methods in human beings	<ul style="list-style-type: none"> • Describing birth control • Explaining some methods of birth control (<i>mechanical: condoms, IUDs; surgical: tubal ligation, vasectomy; hormonal: injectable, contraceptive pills and implants; and natural control: rhythm, withdrawal and abstinence</i>) • Evaluating the benefits and possible risks of using contraceptives (<i>benefits: Planned families; varying risks of individual contraceptive methods</i>) 	<ul style="list-style-type: none"> • Birth control methods in human beings evaluated accordingly
3.5.0 Coordination and Response	3.5.1 Immunity	3.5.1.1 Relate immunity to disease prevention	<ul style="list-style-type: none"> • Explaining immunity to disease • Categorising immunity (<i>natural: active and passive; artificial: active and passive</i>) • Investigating factors that reduce immunity to pathogenic disease (<i>poor diet, repeated invasions by pathogens, developing resistance to strains of pathogens, tolerance to drugs</i>) • Recommending factors that improve immunity (<i>adherence to treatment, healthy diet, exercising, immunisations and vaccinations...</i>) • Evaluating the importance of the immune system (<i>control of diseases</i>) • Demystifying vaccinations and immunisations in the community 	<ul style="list-style-type: none"> • Immunity to disease prevention related accordingly

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
	<p>3.5.2 The Endocrine System</p>	<p>3.5.2.1 Demonstrate understanding of the endocrine system</p>	<ul style="list-style-type: none"> • Describing hormones in humans • Identifying the endocrine glands in human beings and the hormones they produce (<i>pancreas: insulin and glucagon; adrenal gland: adrenaline; thyroid gland: thyroxine; pituitary gland: ADH, TSH, FSH, GH</i>) • Analysing the functions of thyroxine, insulin, glucagon and adrenaline (<i>effects of over and under secretion of hormones</i>) • Evaluate the importance of endocrine system 	<ul style="list-style-type: none"> • Understanding of the endocrine system demonstrated correctly

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
	3.5.3 The Nervous System	3.5.3.1 Demonstrate understanding of the nervous system	<ul style="list-style-type: none"> • Describing the composition of the nervous system (<i>peripheral nervous system and central nervous system</i>) • Identifying main parts of the nervous system in a human being (<i>neurones, spinal cord and brain</i>) <p>Neurones:</p> <ul style="list-style-type: none"> • Describing neurones (<i>structure and functions of sensory, motor and relay neurons</i>) <p>Spinal cord:</p> <ul style="list-style-type: none"> • Elaborating the path taken by an impulse through a spinal reflex arc (<i>movement of an impulse through sensory neurone to the CNS and to effectors</i>) • Demonstrating spinal, cranial and the conditioned reflex actions (<i>spinal reflex: knee jerk, arm flexing</i>); cranial reflex: <i>blinking, coughing, pupil reflex</i>) conditioned reflex: <i>Pavlov's experiment</i>) <p>Brain:</p> <ul style="list-style-type: none"> • Identifying the main parts of the brain of a human being (cerebral hemispheres, cerebellum, hypothalamus, pituitary gland and medulla oblongata). • Explaining the functions of the forebrain and the hindbrain (<i>fore brain: cerebrum, pituitary gland and hypothalamus; and hind brain: cerebellum and</i> 	<ul style="list-style-type: none"> • Understanding of the nervous system demonstrated correctly

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
			<p><i>medulla oblongata</i>)</p> <ul style="list-style-type: none"> • Analysing the effects of abuse of drugs on the nervous System (<i>depressants e.g. alcohol, heroine: increase reaction time; stimulants e.g. cocaine, caffeine, nicotine: increase in motor activity, increased heart rate improved attention; hallucinogens e.g. marijuana: distort judgment</i>) • Explaining the effects of tetanus infection (<i>damage to brain cells and impairment of nerve tissue</i>) • Comparing and contrasting the endocrine and nervous system 	

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
3.6.0 Ecological Relationships and Evolution	3.6.1 Nutrient Cycles in the Ecosystem	3.6.1.1 Explore the cycling of carbon and nitrogen in the biosphere	<ul style="list-style-type: none"> Describing carbon and nitrogen cycles in the biosphere (<i>include the roles of micro-organisms</i>) Designing the Carbon and Nitrogen cycles in the ecosystem Evaluating the importance of carbon and nitrogen cycles in the ecosystem Investigating factors that disrupt the carbon and nitrogen cycles 	<ul style="list-style-type: none"> The cycling of carbon and nitrogen in the biosphere explored accordingly
		3.6.1.2 Explore the water cycle	<ul style="list-style-type: none"> Describing the water cycle Investigating the factors that affect the water cycle (<i>deforestation, overgrazing, wild fires, temperature</i>) Evaluating the importance of water in the ecosystem 	<ul style="list-style-type: none"> Water cycle explored accordingly
	3.6.2 Levels of Classification	3.6.2.1 Classify various types of plants and animals	<ul style="list-style-type: none"> Identifying various types of plants in the local environment (<i>chlorophytes, bryophytes, pteridophytes, gymnosperms and angiosperms</i>) Identifying various types of animals in the local environment (<i>mammals, reptiles, amphibians, birds, arthropods and protozoa</i>) Formulating a dichotomous key to classify plants and animals Using a dichotomous key to identify common plants and animals up to species level (<i>maize, mango, human being, lion</i>) 	<ul style="list-style-type: none"> Various types of plants and animals classified accordingly

FORM 4

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
4.1.0 Concepts and Method in Biology	4.1.1 Research Project in Biology	4.1.1.1 Conduct a research project	<ul style="list-style-type: none"> Carrying out research (<i>data collection, data analysis, write a research report and make presentations</i>). Developing an innovation to resolve a Biological related problem 	<ul style="list-style-type: none"> Research project conducted accordingly
4.2.0 Principles of Cellular Life	4.2.1 Cell Division	4.2.1.1 Demonstrate understanding of the process of cell division	<ul style="list-style-type: none"> Demonstrating the stages of cell division (<i>mitosis and meiosis: Interphase, Prophase, Metaphase, Anaphase, and Telophase</i>) Observing cell division using a microscope Evaluating the importance of mitosis and meiosis (<i>Meiosis: reproduction, Mitosis: growth, uncontrolled cell division, cancer</i>) 	<ul style="list-style-type: none"> Understanding of the process of cell division demonstrated accordingly
4.3.0 Maintenance of the Organism	4.3.1 Excretion in Plants and Animals	4.3.1.1 Explore the mechanism of excretion in plants and animals	<ul style="list-style-type: none"> Describing the process of excretion in plants and animals Identifying excretory structures in plants (<i>seeds, roots, stems, leaves, xylem, fruits, flowers</i>) Carrying out experiments to identify excretory products in plants (<i>latex, oils, anthocyanin, cyanide, resins, mucilage, oxygen and carbon dioxide</i>) Identifying the excretory organs and products in animals. (<i>Kidneys: nitrogenous wastes, Lungs: carbon dioxide, skin: excess salts, urea</i>) Relating the organs of the urinary system to their functions (<i>kidney, ureter, renal blood vessels, urinary bladder, urethra</i>) Relating the internal structures 	<ul style="list-style-type: none"> Mechanism of excretion in plants and animals explored accordingly

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
			<p>of the kidney to their functions (<i>cortex, medulla, pelvis and pyramid</i>)</p> <ul style="list-style-type: none"> • Describing the mechanism of excretion in the kidney. (<i>ultrafiltration, selective re-absorption and osmoregulation in the nephron</i>) • Identifying common disorders and diseases associated with the kidney (<i>Kidney stones, nephritis, Kidney failure</i>) • Investigating the role of the lungs in excretion (<i>elimination of carbon dioxide</i>) • Describing the role of the human skin in excretion (<i>removal of excess salts, urea as waste products</i>) • Explaining the importance of excretion to plants and animals (<i>removal of unwanted products and toxic wastes; regulation of water content of body fluids and pH</i>) • Exploring ways of managing the common disorders and diseases associated with excretory organs; the kidney (<i>dialysis machine and kidney transplant, treatment of infections</i>) • Exploring ways in which excretory products are used in everyday life (<i>rubber and glue making, carbonated drinks</i>) 	

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
	4.3.2 Homeostasis in Human Beings	4.3.2.1 Analyse the mechanism of the process of homeostasis in human beings	<ul style="list-style-type: none"> • Describing homeostasis • Identifying organs involved in homeostasis (<i>kidney, skin and liver</i>) • Analysing the role of the kidney in maintaining the balance of water and salt ions (<i>ref. Anti-diuretic hormone: ADH</i>) • Relating the structure of the skin to its functions • Analysing the mechanism of thermoregulation by the skin (<i>overheating: vasodilation and sweating; overcooling: vasoconstriction and shivering</i>) • Exploring the role of the liver in the regulation of blood sugar and body temperature • Practising healthy habits for proper maintenance of the internal environment of human beings (<i>keeping warm when it's cold, taking less sugar or salt...</i>) 	<ul style="list-style-type: none"> • Mechanism of the process of homeostasis in human beings analysed accordingly
4.4.0 Continuity of Life	4.4.1 Heredity	4.4.1.1 Demonstrate understanding of inheritance of traits in plants and animals	<ul style="list-style-type: none"> • Describing inheritance • Exploring the terms used in the study of genetics (<i>Gene, allele, chromosome, dominance-complete and co-dominance; genotype, phenotype, dominant gene, recessive gene, gamete, first filial generation-F1, second filial generation-F2</i>) • Illustrating monohybrid inheritance (<i>genetic diagram, Punnett square</i>) • Demonstrating the inheritance of human characteristics (<i>height, eye colour, albinism</i>) • Demonstrating the inheritance 	<ul style="list-style-type: none"> • Understanding of inheritance of traits in plants and animals demonstrated correctly

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
			<p>of plant characteristics (<i>leaf shape, seed/flower colour, height, flower scent</i>)</p> <ul style="list-style-type: none"> • Determining the sex of a human being (<i>X and Y chromosomes</i>) • Exploring the inheritance of sex-linked characteristics (<i>red-green colour blindness and haemophilia</i>) • Illustrating the mechanism of ABO blood group inheritance (<i>ABO blood group inheritance</i>) • Describing mutation (<i>chromosome and gene mutation</i>) • Identifying the causes of mutation (<i>natural radiation - nuclear emission, x-rays and ultra-violet light</i>) • Explaining effects of mutation (<i>Down's Syndrome, haemophilia, sickle cell anaemia</i>) • Applying mutations in everyday life (<i>induced mutation in Agriculture-Polyploidy...</i>) 	

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
		4.4.1.2 Explore variation in plants and animals.	<ul style="list-style-type: none"> • Describing variations in living organisms (<i>Refer to animals and plants-continuous and discontinuous</i>) • Investigating variations in human beings (<i>Eye colour, skin colour, finger print, tongue rolling, height</i>) • Investigating variations in flowering plants (<i>fruit structure and scent, height -tall, dwarf. Include leaf size, shape, and weight</i>) • Distinguishing continuous and discontinuous variations (<i>Continuous: height, skin colour, body mass; discontinuous variations: eye colour, blood group, sex and tongue rolling</i>) • Investigating the factors that cause variations among plants and animals of the same species (<i>genetic factors, climatic factors, nutrition, soils</i>) • Applying the concept of inheritance to influence intended characteristics in plants and animals 	<ul style="list-style-type: none"> • Variation in plants and animals explored correctly
4.5.0 Coordination and Response	4.5.1 Sense Organs in Human Beings	4.5.1.1 Analyse the sense organs in human beings	<ul style="list-style-type: none"> • Describing sense organs (<i>eye, ear, skin, tongue and nose</i>) Eye: • Relating the external and internal structures of the eye to their functions • Demonstrating accommodation of the eye • Exploring the causes of short and long sightedness • Explaining the correction of 	<ul style="list-style-type: none"> • Sense organs in human beings analysed accordingly

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
			<p>short and long sight</p> <ul style="list-style-type: none"> Investigating the common causes and methods of preventing blindness (<i>causes: Vitamin A deficiency, filarial worm, physical injury and diabetes mellitus. Prevention: foods rich in Vitamin A, surgery</i>) <p>Ear:</p> <ul style="list-style-type: none"> Drawing and labeling the external and internal structure of the human ear (outer: <i>pinna, auditory canal; middle:</i> <i>ear drum, ossicles and Eustachian tube; inner ears:</i> <i>semi-circular canals, cochlea, oval window</i>) Relating the parts of the ear to their functions (<i>eardrum, ossicles, Eustachian tube, cochlea and semi-circular canals</i>) Investigating the causes and methods of preventing deafness <p>Skin:</p> <ul style="list-style-type: none"> Exploring the role of the skin as a sense organ (<i>sensory receptors for heat, pain, touch and pressure</i>) <p>Tongue:</p> <ul style="list-style-type: none"> Exploring the role of the tongue as a sense organ (<i>taste buds, test receptors, fungiform papillae, glossopharyngeal nerve</i>) <p>Nose:</p> <ul style="list-style-type: none"> Exploring the role of the nose as a sense organ (<i>nostrils, nasal cavity, olfactory epithelium, olfactory receptors, olfactory</i> 	

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
			<p><i>nerve</i>)</p> <ul style="list-style-type: none"> • Caring for sense organs to prevent damage • Relating the sense organs to the nervous system • Identifying the interdependence of the sense organs on each other 	

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
	<p>4.5.2 The Skeletal System</p>	<p>4.5.2.1 Examine the structures and composition of skeletons</p>	<ul style="list-style-type: none"> • Describing the Skeletal System in animals (<i>invertebrates and vertebrates</i>) • Exploring the functions of the skeleton (<i>support, protection, structure and locomotion</i>) • Identifying various types of skeletons (<i>hydrostatic, exoskeleton and endoskeleton</i>) • Investigating the structure and composition of an exoskeleton (<i>skeleton of an insect</i>) • Identifying joints and muscles in the limbs of a grasshopper (<i>flexors and extensors</i>) • Describing the general plan of the endoskeleton (<i>bones of the axial and the appendicular skeleton; Axial skeleton: skull, vertebral column; Appendicular skeleton: girdles, limbs</i>) • Explaining a bone as a living tissue (<i>living cells in bones, production of red blood cells</i>) • Describing the structure of a skeletal muscle (<i>shape and quantity of mitochondria</i>) • Demonstrating the action of antagonistic muscles (<i>contraction and relaxation of biceps and triceps; circular and longitudinal muscles in oesophagus, circular and radial muscles in the iris</i>) • Identifying the parts and functions of the synovial joint (<i>functions of the cartilage, ligament, capsule, synovial fluid and membrane</i>) 	<ul style="list-style-type: none"> • Structure and composition of skeletons examined accordingly

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
			<ul style="list-style-type: none"> • Distinguishing the ball and socket joint and the hinge joint (<i>movement, location, structure</i>) • Comparing the joints, muscle attachment and movement in endoskeletons and exoskeleton (<i>endoskeleton: human beings and exoskeleton: insects</i>) • Investigating the skeletal disorders (<i>bone disorders: cancer, TB, osteopenia, osteoporosis, rickets, fracture, polio; Joint disorders: Gout, arthritis, dislocation, sprain, tendinitis</i>) • Managing the skeletal disorders (<i>diet, treatment</i>) • Applying First-Aid measures during injury of bones 	

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
4.6.0 Ecological Relationship and Evolution	4.6.1 Biodiversity	4.6.1.1 Conserve biodiversity in the environment	<ul style="list-style-type: none"> • Describing biodiversity of living organisms • Investigating diversity of organisms in a given ecosystem (<i>school grounds, a pond or nearby wetland, organic reserves</i>) • Evaluating the importance of diversity of organisms in an ecosystem (<i>equilibrium of organisms in the ecosystem</i>) • Investigating the impact of human activity on biodiversity (<i>human activities: poaching, encroachment, human-animal conflict, poor fishing methods, deforestation, industrialisation, charcoal production, open air burning. Impact: threatened extinction of organisms, climate change, pollution, loss of habitat for organisms, outbreak of diseases</i>) • Evaluating effectiveness of legislation in conserving of Biodiversity in Zambia • Exploring the economic reasons for maintaining bio-diversity (<i>source of income through tourism, aesthetic value, source of medicine, source of food...</i>) • Conserving Bio-diversity in the local environment 	<ul style="list-style-type: none"> • Biodiversity in the environment conserved accordingly
	4.6.2 Conservation of Natural Resources	4.6.2.1 Practise sustainable use of natural resources in the local environment	<ul style="list-style-type: none"> • Exploring the importance of conserving plant and animal species (<i>preserving biodiversity, climate change mitigation, research, nutrient cycling, source of food, prevent extinction, source of medicine</i>) 	<ul style="list-style-type: none"> • Sustainable use of natural resources in the local environment practised appropriately

CONCEPTS	SUB-TOPICS	SPECIFIC COMPETENCES	LEARNING ACTIVITIES	EXPECTED STANDARD
			<ul style="list-style-type: none"> Practising effective ways of using natural resources sustainably (<i>3Rs: reuse, reduce and recycle materials</i>) 	
	4.6.3 Natural Selection	4.6.3.1 Applying the principles of natural selection in real world	<ul style="list-style-type: none"> Exploring the four principles of natural selection (<i>variation, survival of the fittest, inheritance and mutation</i>) Analysing how some organisms are adapted to the environment (<i>adaptive characteristics of organisms: tortoise, chameleon, earth worm, pine trees, cacti, aloe vera</i>) Evaluating the importance of natural selection (<i>improved plant varieties and animal breeds, disease resistance, genetic diversity, regulation of population size, eliminating undesirable genes/traits</i>) 	<ul style="list-style-type: none"> Principles of natural selection in real world applied accordingly selection correctly
	4.6.4 Evolution	4.6.4.1 Explore the process of evolution	<ul style="list-style-type: none"> Describing evolution (<i>change of organisms over time through changes in their genetic material</i>) Investigating causes of evolution (<i>mutation, natural selection, genetic drift, gene flow, non-random mating</i>) 	<ul style="list-style-type: none"> Process of evolution explored correctly

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SCOPE AND SEQUENCE

S/N	CONCEPTS/ THEMES	FORM 1	FORM 2	FORM 3	FORM 4
1	1.0 Concepts and Methods in Biology	1.1.1 Nature of Science Inquiry 1.1.2 The study of Biology 1.1.3 Levels of Biological Organisation 1.1.4 Characteristics of living things	2.1.1 Experimental Design 2.1.2 Limits of Science 2.1.3 Scientific Ethics	3.1.1 Chemicals of life 3.1.2 Food Tests 3.1.3 Research Proposal	4.1.1 Research Project in Biology
2	2.0 Principles of Cellular Life	1.2.1 Microscopes 1.2.2. Types of cells 1.2.3. Basic Cell structure and function 1.2.4 Cell Specialisation	2.2.1 Micrographs 2.2.2 Staining specimen and Preparation of permanent slides 2.2.3 Detailed cell structure 2.2.4 Properties of water	3.2.1 Movement of substances across the cell 3.2.2 Energy and metabolism (Anabolic and catabolic) 3.2.3 Enzymes and their actions	4.2.1 Cell Division
3.	3.0 Maintenance of the Organism	1.3.1 Nutrition- Types of Food Nutrients 1.3.2 Dietary needs of different persons 1.3.3 Plant Nutrients 1.3.4 Nutritional deficiency diseases/ disorders	2.3.1 Nutrition- types of nutrition 2.3.2 Autotrophic nutrition 2.3.3 Heterotrophic nutrition 2.3.4 Transport in Plants	3.3.1 Nutrition: Dentition in Mammals 3.3.2 Holozoic Nutrition 3.3.3 Transport in Animals 3.3.4 Gaseous Exchange and Respiration	4.3.1 Excretion in Plants and Animals 4.3.2 Homeostasis in Human Beings
4.	4.0 Continuity of Life	1.4.1 Reproduction-Types of reproduction 1.4.2 Reproduction and development in human beings 1.4.3 Reproduction in Viruses, Protozoa, bacteria and fungi	2.4.1 Reproduction in plants 2.4.2 Growth, germination and development in plants	3.4.1 Reproduction in Frogs 3.4.2 Reproduction in human beings (menstrual cycle, fertilization and embryo development) 3.4.3 Fertility and birth control in humans	4.4.1 Heredity
5.	5.0 Coordination and Response	1.5.1 Coordination and Response in Plants 1.5.2 Coordination and response in animals	2.5.1 Effects of plant hormones on response 2.5.2 Health and Disease	3.5.1 Immunity 3.5.2 The endocrine system 3.5.3 The nervous system	4.5.1 Sense organs 4.5.2 Support and locomotion
6	6.0 Ecological Relationships and Evolution	1.6.1 Ecosystem 1.6.2 Biotic and abiotic interactions 1.6.3 The soil - Composition and fertility	2.6.1 Classification of organisms 2.6.2 Feeding relationships and energy flow 2.6.3 Pollution	3.6.1 Ecology (The cycles-Carbon, Nitrogen and water) 3.6.2 Levels of classification (characteristics of plants and animals, Dichotomous key)	4.6.1 Biodiversity 4.6.2 Conservation 4.6.3 Natural Selection 4.6.4 Evolution

