

## ADVANCED SYLLABUS BIOLOGY (A16)

### ADVANCED BIOLOGY (A16)

The course is designed to provide the trainees with further knowledge of Biology to prepare students for entry into higher level of study. This course will also expand the students' skills in observation, classification and interpretation of Biological data and to develop a scientific attitude to problem-solving. It is also expected that their ability to apply biological principles in everyday life will increase.

The Syllabus is organized into eight (8) major sections:

- Cell Structure
- Diversity of organisms
- Forms and functions of living systems
- Biostatistics
- Basic Microbiology
- Ecology
- Genetics
- Evolution

#### Examination Scheme

The subject will be examined in two (2) papers:

Paper 1: Short Structure and Essay questions

Paper 2: Practical

Paper 1 is divided into two (2) sections: Section A and B. Section A consists of 10 short structured which will last for 1 hour while section B consists of SIX essay questions and the candidate is required to answer only 4 questions. Section B will last for 2 hours for 80 marks.

Paper 2 is the Practical (Real practical) for May/June and Alternative to Practical for November/December candidates. There will be FOUR questions for practical paper and candidate is required to answer all the FOUR questions. This will last for 3 hours.

#### WEIGHTING

PAPER 1:	Ten short structured questions	(40 marks)
	Essay questions	(80 marks)
Paper 2:	Practical	(80 marks)
-	Total	200 marks

This will be scaled down to 100% to determine candidates' marks

## ADVANCED BIOLOGY

S/N	TOPIC/OBJECTIVES	CONTENTS	ACTIVITIES/REMARKS
1	INTRODUCTORY BIOLOGY	(i) Definition of Biology (ii) Different Branches of Biology (iii) Botany and zoology microbiology.	
2	STRUCTURE AND FUNCTION OF CELLS.	(i) A brief definition of cell and theory (ii) Microscopes and microscopy Drawing and Labelling of the parts, functions, advantages and disadvantages of light microscope, functions of electron microscope, types, advantages and disadvantages. Use of dissecting microscope.	A practical class of how to make Biological drawings recording and reporting of practical.
2.1	STATE THE DIFFERENCE BETWEEN A TYPICAL PLANT CELL AND ANIMAL CELL.	(iii) Detailed structure of typical animal and plant cells as seen under light microscope. (iv) Functions of organelles in plant and animal cells. (v) The skeleton on cilia and flagella. (vi) The fluid-mosaic model of the cell membrane (vii) Characteristics of prokaryotic and eukaryotic cells.	Practicals should be conducted to study plant cell (using onion bulb or tomato fruit) and animal cell (e.g cheek scrapings).
2.2	Tissues, Organs and Organisation.	(i) Study of (a) Epithelial Tissue (b) Connective Tissue (c) Skeletal Tissue (d) Muscular Tissue (e) Nervous Tissue.	Tissue and Organs and Organisation.
2.3	Mention the different, types of tissues found in animal and their functions.	Animal tissue (a-e). Emphasis should be on their types, structures, classification, arrangement, functions and importance.	Slides of the different types of epithelial, connective skeletal, muscular and nervous tissues should be provided in a practical.
2.4	Describe the internal structure of a named dicotyledonous plant.	(ii) Cell size and development of the multicellular state. (iii) Study of plant Tissues (a) Parenchymatous Tissues (b) collenchymas Tissues (c) sclerenchymatous tissues (d) Vascular or Conducting Tissues (e) Epidermal and peridermal tissues. Emphasis should be on their composition, distribution forms and functions of each tissue.	Draw and label the (tes) of a stem to show, parenchyma collenchymas and sclerenchyma cells.

3. 3.1 3.2	<p><b>MOVEMENT IN AND OUT OF CELLS.</b></p> <p>(i) Describe and explain the process of diffusion osmosis and plasmolysis.</p> <p>(ii) State the significance of these processes to cell activities.</p>	<p>(i) Definitions and principles of (a) Osmosis (b) Diffusion (c) Plasmolysis.</p> <p>(ii) Significance of these processes in regulating the internal and external environment of cells</p> <p>(iii) The water potential concept.</p>	<p>Use potato, osmometer, spirogyra, filaments, and red blood cells to demonstrate these processes in both plant and animal.</p>
4. 4.1 4.2 4.3 4.4 4.5	<p><b>THE CHEMICALS OF LIFE</b></p> <p>(i) Carry out tests for reducing and non-reducing sugars.</p> <p>Describe the ring forms of X- glucose and B-glucose.</p> <p>(ii) Describe the molecular structure of polysaccharides including starch, glycogen and cellulose and relate these structures to their functions in living organisms.</p> <p>(iii) Describe the structure of amino acids and the formation of peptide bond.</p> <p>Explain the meaning of the terms primary, secondary and tertiary structure.</p> <p>Describe the molecular structure of triglyceride and phospholipids and explain their functions in living organisms.</p> <p>Describe and explain the roles of water in living organisms.</p>	<p>(i) carbohydrates</p> <p>Study the structure of simple sugars (monosacchrrides) e.g glucose fructose, double sugars disaccharides e.g sucrose lactose and polysaccharides e.g starch, glycogen, cellulose outline the condensation reactions leading to their formation and hydrolytic reactions and their role in energy production.</p> <p>(ii) Proteins</p> <p>Study the structure of proteins nucleotides and nucleic acids; state the serve-conservative and conservative theories of nucleic acid and replication.</p> <p>(i) Roles of DNA and RNA in protein synthesis</p> <p>(ii) Meaning of primary structure, secondary structure, tertiary structure and types of bonding that hold the molecule in shape.</p> <p>(ii) Lipids</p> <p>Structure of triglyceride a phosphoric functions of these structure in living organisms</p> <p>(iv) Water and Living organisms</p>	<p>Use different types of starch, bandit's solution and Iodine. Solution to test for starch and reducing sugars.</p> <p>Use different types of protein to test for proteins in plantar animal.</p> <p>Use different types of lipids from plant and animal sources to conduct practical test.</p>

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5. 5.2 5.3	<p>CHEMICAL REACTIONS IN CELLS.</p> <p>Explain the term metabolism</p> <p>Outline the need for energy in living organisms.</p> <p>Explain that enzyme is globular proteins that catalyse metabolic reactions.</p> <p>Explain the mode action of enzymes in terms of an active site, enzyme/substrate complex, lowering of activation energy and enzyme specificity.</p>	<p>(i) Metabolism and analysis of metabolic pathways</p> <p>(ii) Energy the need for energy in living organisms.</p> <p>(iii) Enzymes</p> <ul style="list-style-type: none"> <li>• Classification and naming of enzymes</li> <li>• Properties of enzymes</li> <li>• Mechanism of enzyme election (i) Lock and key hypothesis (ii) Induced fit hypothesis.</li> <li>• Enzyme inhibitors</li> <li>• Competitive reversible inhibition.</li> </ul> <p>(iii) Non competitive irreversible inhibition.</p>	<p>Perform and experiment to determine the factors that affect the rate of enzyme catalysed reactions.</p>
6. 6.1 6.2 6.3 6.4	<p>THE RELEASE OF ENERGY</p> <p>Describe the structure of ATP</p> <p>Outline the kreb's cycle</p> <p>Outline the process of oxidative phosphorylation including the role of oxygen</p> <p>Define respiration quotient (RQ)</p>	<p>(i) Respiration as an energy transfer process</p> <p>(ii) structure of ATP</p> <p>(iii) The link between glycolysis and the kreb's cycle an A-Z metabolism.</p> <p>(iv) Aerobic respiration</p> <p>(v) Anaerobic respiration</p>	
7. 7.1 7.2 7.3	<p>GAS EXCHANGE IN ANIMALS</p> <p>Describe the structure of human gas exchange system.</p> <p>Describe the distribution of cartilage, ciliated epithelium, goblet cells and smooth muscle in the trachea, bronchi, bronchioles.</p> <p>Describe the process of gas exchange between alveoli and the blood.</p>	<p>(i) The gas exchange system in human.</p> <p>(ii) The gas exchange in fishes</p> <p>(iii) The gas exchange in insects</p> <p>(iv) The nervous control of breathing.</p> <p>(v) Detailed account of the alveolar barrier.</p>	

8.	HETEROTROPHIC NUTRITION	(i) Meaning and types of heterotrophic nutrition (a) Holozotic nutrition (b) saprotrophic nutrition (c) parasitic nutrition.	Draw the structure of the wall of the mammalian gut.
8.1	Explain the term heterotrophic nutrition		
8.2	Explain the process of digestion in man	(ii) Physical and chemical Digestion (iii) Protein digesting enzymes at the molecular level and cellulose digestion (iv) Feeding and digestion in humans (v) Nutrition in other Heterotrophy Viz: Herbivores, Carnivores, Liquid feeders, Micro phagous feeders.	Draw the human alimentary canal and associated organs.
9.	AUTOTROPHIC NUTRITION	(i) Meaning and types of Autotrophic nutrition.	Perform an experiment to show that carbon dioxide, light and chlorophyll are necessary for photosynthesis.
9.1	Explain that energy transferred as light is used during the light dependent photosynthesis to produce complex organic molecules.	(a) photosynthesis (b) Chemosynthesis photosynthesis	Draw the internal structure of leaf to show its photosynthetic functions.
9.2	Describe the structure of a dicotyledonous leaf, a palisade cell and a chloroplast and relate their structures to their roles in photosynthesis.	<ul style="list-style-type: none"> <li>• Conditions required for photosynthesis, carbon dioxide, light, water, chlorophyll.</li> <li>• The site of photosynthesis</li> <li>• Study the structure of the leaf, chloroplast and leaf as an organ of photosynthesis.</li> <li>• The chemistry of photosynthesis</li> <li>• Investigation of limiting factors in photosynthesis</li> <li>• Autotrophic Bacteria Viz: photosynthetic Bacteria and Chemosynthetic Bacteria.</li> </ul>	Demonstrate the different related pigments present in chloroplast by using acetone to extract pigments from leaves and chromatography paper.
10.	Transport in Animals	Transport in mammals	Draw the mammalian circulating system
10.1	Describe the structure of red blood cells, phagocytes, lymphocytes.	(i) the composition and function of blood (ii) The structure of the circulatory system and the mechanism by which blood is conveyed through it.	
10.2	State and explain the differences between blood, tissue fluid and lymph.	(iii) Structure and functioning of mammalian heart.	

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10.3	Describe the role of haemoglobin in carrying oxygen and carbon dioxide.	(iv) Single and double circulations. (v) Open and closed circulation.	Draw the structure of the mammalian heart.
11.	UPTAKE AND TRANSPORT IN PLANTS.	(i) uptake of carbon dioxide	Draw the structure of stomata to show its action i.e closing and opening.
11.1	Explain the need for transport systems in multicellular plants in animals in terms of size and surface area of volume.	<ul style="list-style-type: none"> <li>• Structure and functions</li> <li>• Stomata</li> <li>• The mechanism of stomata opening and closure</li> </ul>	
11.2	Describe the pathways and explain the mechanism by which water is transported from soil to xylem and from roots to leaves	(ii) uptake and transport of water	Perform the experiment to show the rate of transpiration sol.
11.3	Describe the structure of xylem vessel elements, sieve tube elements and companion cells and be able to recognise these using the light microscope.	<ul style="list-style-type: none"> <li>• Transport</li> <li>• Factors affecting the rate of transpiration</li> <li>• Structure of the root</li> <li>• Uptake of water by the roots</li> <li>• Structure of the stem</li> <li>• Xylem tissue</li> <li>• The xylem and water transport</li> <li>• The flow of water through the whole plant.</li> </ul>	Draw the diagram to show the relation concentration of different ions in pond water (colour boxes) and in the cell sap 13 of the green algae.
11.5	Describe how the leaves of xerophytes plants are adapted to reduce water loss by transpiration.  Explain the translocation of sucrose using the mass flow hypothesis.	<ul style="list-style-type: none"> <li>• Special method of obtaining essential elements</li> </ul> (iv) transport of organic substances <ul style="list-style-type: none"> <li>• Phloem tissue</li> <li>• The site of translocation</li> <li>• The mechanism of translocation</li> </ul>	Using the concentrated sugar sol and weak sugar solutions perform the experiment to illustrate the mass flow of hypothesis.
12.	HOMEOSTASIS	(i) The principles of homeostasis.	
12.1	Explain the principle of homeostasis in terms of receptors, effectors and negative feedback.	<ul style="list-style-type: none"> <li>• The meaning of internal environment</li> <li>• The formation of intercellular fluid</li> <li>• Constant factors in the internal environment Viz: chemical constituent's e.g glucose, ions etc, osmotic pressure, level of carbon dioxide and temperature.</li> </ul>	

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12.2	Explain the way the liver perform its homeostatic function.	<ul style="list-style-type: none"> <li>The homeostatic control of glucose</li> <li>Role of pancreas</li> <li>Secretion of insulin</li> </ul> (ii) The mammalian liver. <ul style="list-style-type: none"> <li>Structure and functions of the liver.</li> </ul>	
13.	EXCRETION AND OSMOREGULATION	(i) Structure and functions of the kidney (including the nephron), liver and skin.	Examine and draw the L.S of mammalian kidney, skin and liver.
13.1	Define the term excretion and explain the importance of eliminating nitrogenous waste products and carbon dioxide from the body.	<ul style="list-style-type: none"> <li>Mechanisms of their function and excretory products</li> <li>Discuss regulation of internal environment by skin</li> <li>Conditions that affect the function of the kidney</li> <li>Types and causes of disease of kidney, skin and liver.</li> </ul>	
13.2	Describe the structure of the nephron with the associated blood vessels.	(ii) Osmoregulation in fresh water, marine and terrestrial environment and give specific examples. (iii) Osmoregulation in plants and give specific examples.	
14.	Temperature Regulation	(i) Physical process of loss and gain of heat	Draw and summarise the reflex control of body temperature in a mammal.
14.1	Explain the physical process by which heat can be lost or gained	Viz: Radiation, Evaporation, Conduction and convection. <ul style="list-style-type: none"> <li>Response to cold by an endothermic animal</li> <li>Response to heat by an endothermic animal</li> </ul> (ii) The role of brain in temperature regulation. <ul style="list-style-type: none"> <li>Effect of changing the environmental temperature.</li> </ul> (iii) Behavioural control of body temperature. (iv) Temperature control in plants.	

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15. 15.1 15.2	<p><b>INFECTIONS DISEASE</b></p> <p>Define the term disease and explain the difference between an infectious and non infectious disease, cholera and malaria</p> <p>Explain how they are transmitted. Outline the role of antibiotics in the treatment of these diseases.</p>	<p>(i) Cholera, malaria, tuberculosis (TB) and HIV/AIDS.</p> <p>(ii) Antibiotics.</p>	
16. 16.1 16.2	<p><b>IMMUNITY</b></p> <p>Relate the molecular structure of antibodies to their function.</p> <p>Describe the modes of action of B-lymphocytes</p> <p>Distinguish between active and passive natural and artificial immunity.</p> <p>Explain how vaccination can control disease.</p>	<p>(i) The immune system.</p> <ul style="list-style-type: none"> <li>• Structure and functions of antibodies.</li> <li>• Production of antibodies</li> <li>• Band T lymphocytes</li> </ul> <p>(ii) Vaccination.</p>	<p>Examine phagocytes and lymphocytes under the light microscope</p>
17. 17.1	<p><b>NERVOUS AND HORMONAL COMMUNICATION</b></p> <p>Describe the structure of a sensory neurone and outline their functions in a reflex arc</p>	<p>(i) The Nerve Cell and its impulse.</p> <ul style="list-style-type: none"> <li>• Structure of Nerve Cells</li> <li>• The electrical Nature of the nerve impulse</li> <li>• Properties of nerves and nerve impulses</li> <li>• The snaps its structure and its role in the nervous system</li> <li>• Reflex action</li> </ul> <p>(ii) Organisation of the nervous system.</p> <ul style="list-style-type: none"> <li>• Central Nervous system</li> <li>• Autonomic Nervous system</li> <li>• Functions of main parts of the Brain in mammals.</li> </ul>	<p>Draw the structure of a vertebrate motor neurone to show its different parts.</p>



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17.2 17.3 17.4	<p>17.2 Explain the importance of the myelin sheath (salutary conduction) and the refractory period in determining the speed of nerve impulse transmission</p> <p>17.3 Outline the roles of synapses in the nervous system in determining the direction of nerve impulse transmission and in allowing the interconnection of nerve pathways.</p> <p>17.4 Explain how hormones control cells.</p>	<p>(iii) The primitive Nervous system. E.g Hydra.</p> <ul style="list-style-type: none"> <li>• Interneural and neuromuscular facilitation.</li> <li>• Through conduction pathways</li> <li>• The role of Brain in lower animals</li> </ul> <p>(iv) Hormonal Communication.</p> <ul style="list-style-type: none"> <li>• Comparism of Hormonal Communication with Nervous Communication</li> <li>• Principles of Hormone action as illustrated by Thyroid Gland and control of Thyroxin production.</li> </ul>	<p>Draw the structure of the nervous system of an invertebrate such as an annelid.</p>
18. 18.1 18.2	<p>18. RECEPTION OF STIMULI</p> <p>18.1 Describe the working operation of a receptor cell.</p> <p>18.2 Describe the structure of a mammalian eye and ear and state the functions of each part.</p>	<p>(i) Classification of Receptors.</p> <ul style="list-style-type: none"> <li>• Structure and functions of a sensory cell</li> <li>• Working operation of a receptor cell including frequency of discharge, adaptation, fusion of stimuli.</li> <li>• Inhibitions</li> </ul> <p>(ii) Sensory Organs.</p> <ul style="list-style-type: none"> <li>• Structure and functions of the mammalian eye and ear complexity in the retina</li> <li>• The organ of corti</li> </ul>	<p>Draw the structure of the two types of sensory cell found in vertebrates.</p> <p>Draw the structure of a mammalian eye and ear.</p>
19 19.1 19.2 19.3	<p>19. EFFECTORS</p> <p>19.1 Explain what you understand by effectors</p> <p>19.2 Describe the structure and properties of a skeletal muscle</p> <p>19.3 Analyse the factors affecting muscle performance</p>	<p>(i) Definition of an effectors and example of effectors. Muscle and glands. (a) Different types of muscle, skeletal muscle (b) visceral muscle (c) cardiac muscle.</p> <p>(ii) Properties of skeletal muscle.</p> <ul style="list-style-type: none"> <li>• The molecular basis of muscle contraction explanation on the chemistry of muscle, the sliding</li> </ul>	<p>Draw the structure of a sample of skeletal muscle as seen under the light microscope.</p> <p>Draw the schematic diagram to summarise ratchet mechanism is controlled and muscle spindle.</p>

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19.4	Explain the sliding filament hypothesis.	filaments hypothesis, what propels the filaments, muscle spindle. (iii) Brief discussion on other effectors e.g chromatopores, (a) electric organs (b) light producing organs (c) Nematopblast.	
20.	LOCOMOTION Identify different types of skeleton as found in all vertebrates	(i) Definition and reasons for locomotion function of skeleton, the skeleton and supporting system in animals. (ii) Mechanism of locomotion.	Draw a mammalian skeleton to show different parts  Also provide wall charts of individual bones of the mammalian skeletal system.
20.2	Describe the process of locomotion in dogfish and birds.	<ul style="list-style-type: none"> <li>• Movement in water fishes, amoeboid, ciliate and flagellate</li> <li>• Movement on land leaping, hopping, looping, crawling and walking in tetra pads. Explain muscles and main muscles responsible for locomotion and how is achieved by muscles and skeleton.</li> <li>• Movement of air flight in Birds, flight in insects.</li> </ul>	
21.	BEHAVIOUR	(i) Meaning and types of behaviour.	
21.1	Analyse the earthworms  Escape response in terms of receptors, nerves and effectors	(ii) Fundamental processes in an animals behaviour. <ul style="list-style-type: none"> <li>• Reflex action Explanation on scope Responses of earthworms and squid</li> <li>• Orientation Kinesis and taxis</li> </ul>	
21.2	Describe the role of stimuli in behaviour	(iii) Analysis of species. <ul style="list-style-type: none"> <li>• Characteristic behaviour</li> <li>• The role of stimuli</li> <li>• Releasers and its functions</li> <li>• Stimulus selection</li> <li>• Synchronisation in sexual behaviour</li> <li>• Motivation</li> <li>• The role of hormones and hypothalamus on behaviour</li> </ul>	
21.3	Describe the role of hormones and hypothalamus on behaviour	(iv) Learning- Meaning, Types of Learning. <ul style="list-style-type: none"> <li>• Habitation</li> <li>• Associative learning</li> <li>• The conditional reflex</li> <li>• Trial and error learning</li> <li>• Bird migration</li> </ul>	

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22.	CELL DIVISION	(i) Mitosis and Meiosis as a basic process of cell multiplication.	Using permanent slides
22.1	Explain the importance of mitosis in the production of genetically identical cells, growth, repair and asexual reproduction.	<ul style="list-style-type: none"> <li>• Definition of mitosis, where it takes place and its importance in multiplication for growth and development of living organisms</li> <li>• Different phases of mitosis and the role played by each phase.</li> </ul>	Draw and label chromosomes e.g onion or lily root tips under light microscope.
22.2	Describe with the aid of chromosomes during the mitotic cell cycle and the associated behaviour	(ii) Definition of meiosis, where it takes place and its significance in the evolution of plant and animals. Illustrate the different stages and sub-stages of meiosis.	
22.3	Explain the meanings the terms haploid and diploid and the need for reduction division (meiosis) prior to fertilisation in sexual reproduction	(iii) Gametogenesis. Meiosis as a means of gamete formation with reference to spermatogenesis, oogenesis, microsporogenesis and megasporogenesis should be discussed and illustrated  (iv) Comparison between Mitosis and Meiosis.	
23.	REPRODUCTION	(i) Definition of sexual and asexual reproduction.	Draw the male and female human reproductive organs.
23.1	Describe the histology of the mammalian ovary and testis, outline gametogenesis in a male and female human.	(ii) The genetic importance of sex-Bacterial conjugation.  (iii) Evolutionary development of gametes.	Observe slides of sections of mammalian testis and ovary.
23.2	Explain the role of hormones in maintaining of human menstrual cycle and link this to changes in the uterus and ovary during the cycle.	(iv) Sexual reproduction in mammals. <ul style="list-style-type: none"> <li>• Histology of testis and ovary structure of sperm and ovum</li> </ul>	Dissect a small mammal to show male and female primogenital systems and associated organs.
23.3	Discuss and evaluate the biological social and ethical implications of the use of contraception.	(v) Need for birth. Control, dangers involved in early pregnancy. Diseases associated with unprotected sex including HIV/AIDS.  (vi) Sexual reproduction in flowering plants. <ul style="list-style-type: none"> <li>• Structure of the flower</li> <li>• Self versus cross fertilization.</li> </ul>	

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24. 24.1 24.2	<p><b>THE LIFE CYCLE</b></p> <p>Examine how an organisms life cycle relates to the production of new individuals</p> <p>Describe the process of alternation of generation in the coelenterates</p>	<p>(i) Definition of life cycle.</p> <p>(ii) The life cycle of the human.</p> <ul style="list-style-type: none"> <li>• Life cycle of moss and fern</li> <li>• Flowering plants and conifers</li> </ul> <p>(iii) Alternation of generations in animals.</p>	<p>Outline the life cycle of the human on a chart.</p>
25. 25.1	<p><b>GROWTH AND DEVELOPMENT</b></p> <p>Explain the term growth and development</p>	<p>(i) Definition of growth.</p> <p>Growth curve, rate of growth, percentage growth, intermittent growth, including cell number cell size increase in fresh and dry weight.</p> <p>(ii) Animal development.</p> <p>Discuss chordate cleavage gastrulating and organogenesis</p> <p>(iii) Development of the flowering plant.</p> <ul style="list-style-type: none"> <li>• The physiology of seed germination</li> <li>• Geotropism in roots</li> </ul>	<p>Relevant wall chart can be made.</p>
26. 26.1	<p><b>GENETICS</b></p> <p>Describe with the aid of diagrams, the behaviours of chromosomes during meiosis and the associated behaviour of the nuclear envelope, cell membrane and centrioles (names of the main stages are expected but not the subdivisions of prophase).</p>	<p>(i) Definition of terms in genetics, heredity and variation, gene, phenotype, genotype, homozygous, heterozygous, homologous, dominant, recessive cross ratio, dihybrid, monohybrid cross/ratio.</p> <p>Test, cross/back cross, co-dominance, allele (allelomorphs), lethal genes linkage, crossing over, sex linkage, polyploidy clonings, genetic engineering, locus traits.</p> <p>(ii) Mendel and the laws of heredity.</p> <ul style="list-style-type: none"> <li>• Monohybrid mendels first law should be deduced from monohybrid concept is first filial generation, dominant and recessive inheritance</li> </ul>	<p>Weight, height individuals of the same age group can be taken to explain variation.</p>

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26.2	Explain with examples how mutation may affect the phenotype.	<ul style="list-style-type: none"> <li>• Dihybrid</li> <li>• Concept of punnet squares its construction and the formation of gametes, the concept of segregation recombination and Independent assortment, mendels second law of inheritance. Deviation from mendels ratios. Incomplete dominance, lethal genes and complementary genes to illustrate deviation from mendels ratios.</li> </ul> (iii) The Mechanisms of inheritance. <ul style="list-style-type: none"> <li>• Chromosome and gene</li> </ul> Theory of inheritance <p>A connection between the mendelian laws of inheritance and the behaviour of the nucleus in cell divisions, i.e. mitosis and meiosis should be used to explain the theory of inheritance structure of DNA as the basis of inheritance.</p> <ul style="list-style-type: none"> <li>• Linkage and crossing over and their importance.</li> </ul> (iv) Mutation and its importance in the evolution of plants and animals. <p>The different types of genome, chromosome gene and plasma/extra nuclear mutations, nature and importance.</p> Types of mutagenic agents and effects, physical chemical and high temperature.           (v) Applications of the principles of heredity. <ul style="list-style-type: none"> <li>• ABO blood group Rhesus factor (system) sickle cell anaemia.</li> <li>• Antigen and antibody relationships.</li> <li>• Use of blood grouping in marriage counselling, blood transfusion and paternity determination as well as sickle cell anaemia and DNA finger printing.</li> </ul> (vi) Sex linked characters, Significance of sex linkage of characters with examples (haemophilia) baldheadedness and colour blindness.	
26.3	State that a gene is a sequence of nucleotides as part of a DNA molecule which codes for a polypeptide and state that mutation is a change in the sequence that may result in an altered polypeptide.		
26.4	Describe the structure of DNA and RNA and explain the importance of base pairing and the different hydrogen bonding between bases.		

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		<p>(vii) Plant and animal improvement through breeding and genetic engineering.</p> <p>(viii) The application of genetic engineering.</p> <p>The applications of genetics in agriculture, behaviour, social structure, ecology law and religion.</p> <ul style="list-style-type: none"> <li>Genetic medicine and genetic engineering.</li> <li>The concept of gene therapy, nuclear cell and molecular cloning should be discussed.</li> </ul> <p>(ix) Nature of gene.</p> <ul style="list-style-type: none"> <li>Structure, composition and significance of DNA and RNA as hereditary materials.</li> <li>DNA replication and its replication and its theory.</li> </ul>	
27.	<p><b>ECOLOGY</b></p> <p>Define the terms habitat, niche, population, community and ecosystem and state examples of each.</p>	<p>(i) Basic ecological concepts Niche, Habitats and Macro-Habitats, species, population, community, ecosystem, biome and biosphere.</p> <p>(ii) The physical environment.</p> <ul style="list-style-type: none"> <li>Biotic or Abiotic factors</li> </ul> <p>Biotic factors are predation, competition parasites e.t.c and how they affect organisms and their populations.</p> <p>Abiotic factors are light, water, humidity, temperature e.t.c and how they affect organisms and populations.</p> <ul style="list-style-type: none"> <li>Ecological</li> <li>Succession and dominance in a simple community.</li> <li>Balance in nature dynamics of populations</li> <li>Factors that maintain a balance in communities nasality, competition, immigration, emigration, mortality, predation e.t.c.</li> </ul>	<p>A field study of simple ecological communities such as a road-side pond or a small garden should be undertaken.</p> <p>A study of how some abiotic factors are measured using appropriate equipment e.g Thermometers and Rainguage.</p>
27.2	<p>Mention and Discuss various ways which human population can be controlled.</p>		
28.	<p><b>TYPES OF HABITAT</b></p>	<p>(i) Habitat types.</p> <ul style="list-style-type: none"> <li>Fresh water e.g river stream e.t.c.</li> <li>Marine</li> <li>Terrestrial</li> <li>Characteristics of various habitat types e.g desert, forest, marine e.t.c. including</li> </ul>	
28.1	<p>Describe the mode of adaptations of an organism living a marine habit.</p>		

S/N	TOPIC/OBJECTIVES	CONTENTS	ACTIVITIES/REMARKS
28.2	What are the ecological characteristics of a named zone in Nigeria	<p>plant and animals associated with them.</p> <ul style="list-style-type: none"> <li>Problems of living in these habitats and the corresponding adaptations of organisms</li> <li>Ecological zones of Nigeria based on vegetation characteristics e.g forest and guinea</li> </ul> <p>(ii) Soil Ecosystem.</p> <ul style="list-style-type: none"> <li>Process of soil formation</li> <li>Factors that can affect soil organisms and soil fertility.</li> </ul>	
29. 29.1	<p>ASSOCIATIONS BETWEEN ORGANISMS</p> <p>Draw common food chains and construct ecological pyramids.</p> <p>Describe how nitrogen is cycle within and in an ecosystem.</p>	<p>(i) Interspecific and intraspecific associations.</p> <ul style="list-style-type: none"> <li>Interactions between and among organisms e.g parasitism, commensalisms, predation, mutualism</li> <li>Food chains and food webs</li> <li>Ecological pyramids</li> <li>Biogeochemical cycles water, nitrogen and carbon cycles.</li> </ul>	
30. 30.1	<p>HUMAN AND THE ENVIRONMENT</p> <p>State and explain the advantages and disadvantages of monoculture practice of farming.</p>	<p>(i) Agriculture.</p> <ul style="list-style-type: none"> <li>Ecological consequences of traditional and modern agriculture</li> <li>advantages and disadvantages of each system e.g monoculture and plant diseases, chemical fertilizers and pollution and loss of biological diversity e.t.c. and human related activities e.g overgrazing deforestation</li> </ul> <p>(ii) Air and water pollution.</p> <ul style="list-style-type: none"> <li>Sources of pollutants</li> <li>Examples of pollutants e.g radioactive, materials, carbon oxide crude oil e.t.c.</li> <li>Effects of these pollutants and how they can be controlled</li> <li>Sewage treatment and sanitation</li> <li>Importance of the recycling of wastes.</li> </ul>	

S/N	TOPIC/OBJECTIVES	CONTENTS	ACTIVITIES/REMARKS
31.	APPLIED ECOLOGY	(i) Biological control	
31.1	Discuss the reasons why one named species has become endangered, and use this information in the context of other endangered species.	<ul style="list-style-type: none"> <li>• Examples of biological control</li> <li>• Advantages of biological control over conventional chemical control of pests</li> </ul>	
31.2	Discuss the term biodiversity	(ii) Conservation of nature (Biodiversity).	
31.3	Discuss the reasons for the need to maintain biodiversity.	<ul style="list-style-type: none"> <li>• Importance of wise use of renewable natural resources i.e wildlife and fisheries forests e.t.c.</li> <li>• Techniques widely employed to achieve conservation. E.g creation of nature reserves.</li> <li>• Integrated pest management.</li> </ul>	
32.	EVOLUTION	(i) The theories of evolution.	
32.1	Explain how natural selection may bring about evolution.	<ul style="list-style-type: none"> <li>• Lamarck</li> <li>• Darwin</li> <li>• Contribution of Lamarck and Darwin to the theory of evolution.</li> </ul>	
32.2	Explain why variation is important in selection.	<ul style="list-style-type: none"> <li>• Examples of convergent and Divergent Evolution, Link between Evolution and Variation</li> </ul>	
32.3	Explain the role of isolating mechanisms in the evolution of new species.	(ii) Natural selection and speciation.	
	Describe one example of artificial selection.	<ul style="list-style-type: none"> <li>• Steps in evolution of human</li> <li>• Concepts of natural selection</li> <li>• Mechanisms for speciation. Role of mutation and genetic drift as the driving force for evolution.</li> </ul>	
32.4	Evidence for Evolution	(i) Fossils	
		(ii) Comparative anatomy	
		(iii) Embryology	
		(iv) Geographical distribution	
32.5		(v) Adaptive radiation	Visitation to a natural museum
		<ul style="list-style-type: none"> <li>• Concepts of evolutionary trends in organisms from simple to complex structural adaptations</li> <li>• Modern techniques of DNA and gene mapping in evolution.</li> </ul>	



S/N	TOPIC/OBJECTIVES	CONTENTS	ACTIVITIES/REMARKS
32.6	Classification and Diversity of Organisms	<p>(i) The principle groups of organisms, the super kingdoms, and the five kingdom system of classification.</p> <ul style="list-style-type: none"> <li>• A general survey of super kingdoms. Eukaryote.</li> <li>• Major differences between prokaryote and eukaryote</li> <li>• Five kingdoms of organism-prokaryote, protocista, fungi, plantae and animalia</li> <li>• Distinguishing features of each of the kingdoms of organisms, protozalanalgae</li> <li>• Major differences between plant and animals</li> </ul> <p>(ii) Classification.</p> <ul style="list-style-type: none"> <li>• Meaning and value of classification of organisms</li> <li>• Definitions of taxonomic terms; classification, systematic, taxon</li> <li>• Use of molecular biology taxonomy Binomial system of nomenclature and its rules.</li> </ul>	
33.	Protista	(i) Algae	
33.1	Describe the major characteristics of the class.	<ul style="list-style-type: none"> <li>• Morphology and classification</li> <li>• Major class/divisions of the algae</li> <li>• Characteristics of the phylum</li> <li>• Classify to generic level</li> <li>• Characteristics of individual classes</li> </ul> <p>(ii) Protozoa.</p> <ul style="list-style-type: none"> <li>• Morphology a classification</li> <li>• Major phyla, classify to generic, major diagnostic characteristics of individual classes</li> <li>• Reproduction study the method of reproduction</li> <li>• Evolution</li> </ul> <p>Range of forms as in simple as complex types such as Amoeba, Trypanosona, Trichomonas, Parameclum and Plasmodium</p> <ul style="list-style-type: none"> <li>• Economic importance of protozoa.</li> </ul>	
33.2	Explain the method of reproduction in protozoa		

S/N	TOPIC/OBJECTIVES	CONTENTS	ACTIVITIES/REMARKS
34.	FUNGI	(i) Morphology and classification	
34.1	Describe the process of asexual reproduction in a named fungi	<ul style="list-style-type: none"> <li>Major classes/division</li> <li>General characteristics of the phylum, classify to generic level</li> <li>Major diagnostic features of individual classes</li> </ul>	
34.2	Explain economic importance of fungi lichens	(ii) Reproduction The life cycle of reproductives species to show sexual and asexual reproduction.  (iii) Evolution <ul style="list-style-type: none"> <li>Range of forms and mode of nutrition as in unicellular and multicellular types e.g yeasts, Rhizopus, Micorpemmiillum, phytophthora and mushrooms e.t.c</li> <li>Types and range of forms</li> <li>Economic/ecological importance e.g in succession as sources of dyes e.t.c.</li> </ul>	
35.	PLANTAE	(i) Bryophyte	Collection of the specimens of bryophytes
35.1	What are the major characteristics of the mode of reproduction in ricciasp	<ul style="list-style-type: none"> <li>Morphology and classification Major classes of the bryophyte and characteristics, classification to gene i.e. level and their characteristics</li> <li>Reproduction Life cycle of each species e.g ricca, marchantia, financial, polytrichum, alternation of generation</li> <li>Evolution features that facilitated transition from water to land</li> <li>Economic/ecological importance e.g soil enrichment, retardation of erosion e.t.c.</li> </ul>	Examination and drawing of the specimen bryophyte.
35.2	Describe the features that enable this class to transit from water to land		
35.3	Outline the major characteristics of these class pteridophytes.	(ii) Pteridophyta <ul style="list-style-type: none"> <li>Morphology and classification Major classes and their characteristics. classify to the generic level.</li> <li>Reproduction Life cycle of representative species e.g the (selaginalla), the ferns (e.g Nephrepis, Deyopteris e.t.c.), Alternation of generations</li> <li>Evolution</li> </ul>	
35.4	Explain the factors which make pteridophytes, to survive on land.	(iii) Spermatophyte <ul style="list-style-type: none"> <li>Morphology and classification</li> </ul>	

S/N	TOPIC/OBJECTIVES	CONTENTS	ACTIVITIES/REMARKS
35.5	Outline the economic importance.	Major classes and their characteristics. Classify to the generic level.	Collection of gymnosperms and angiosperms specimens. Classify and draw the specimens.
35.6	What are the characteristics of the plants in this class?	<ul style="list-style-type: none"> <li>• Characteristics of gymnosperms and angiosperms</li> <li>• The range of forms in angiosperms (trees, shrubs, herbs) with regards to their adaptations to habitats (aquatic and terrestrial)</li> </ul>	
35.7	Outline the mode of adaptations of this class to their different habitats.	<ul style="list-style-type: none"> <li>• Diagnostic vegetative and reproductive features.</li> <li>• Life cycle of representative species of gymnosperms e.g pinus and angiosperms (e.g any flowering plant).</li> <li>• Evolution</li> <li>• Economic/ecological importance</li> </ul>	
36.	ANIMALIA	<ul style="list-style-type: none"> <li>• Invertebrates and vertebrates</li> </ul>	Collection and classification of specimens of platyhelminthes
36.1	State the differences and characteristics between invertebrates and vertebrates.	Major differences and characteristics of vertebrates and invertebrates	
36.2	Describe the life cycle of taenia solium fasciola hepatic and state the importance of this organism to man.	(i) Cnidaria (coelenterate) <ul style="list-style-type: none"> <li>• Morphology and classification</li> <li>• Reproduction e.g sp hydra</li> <li>• Evolution</li> <li>• Economic/ecological importance</li> </ul> (ii) Platyhelminthes <ul style="list-style-type: none"> <li>• Morphology and classification</li> <li>• Reproduction e.g. sp Taenia solium fasciola hepatica</li> <li>• Evolution</li> <li>• Economic/ecological importance</li> </ul> (iii) Nematoda <ul style="list-style-type: none"> <li>• Morphology and classification</li> <li>• Reproduction e.g. sp. Ascaris, Trichella, Onchocerca</li> <li>• Evolution</li> <li>• Economic/ecological importance</li> </ul>	
36.3	State the major characteristics to which this class belong to.	(iv) Annelida <ul style="list-style-type: none"> <li>• Morphology and classification</li> <li>• Reproduction species Lumbricus, Nercis and Hirudo.</li> <li>• Evolution</li> <li>• Economic/ecological importance</li> </ul>	

S/N	TOPIC/OBJECTIVES	CONTENTS	ACTIVITIES/REMARKS
36.4	What are the major characteristics of this class Annelida	<p>(v) Mollusca</p> <ul style="list-style-type: none"> <li>• Morphology and classification</li> <li>• Reproduction e.g Snails, Clams/Bivalves and otopus.</li> <li>• Evolution</li> <li>• Economic/ecological importance</li> </ul> <p>(vi) Arthropoda</p> <ul style="list-style-type: none"> <li>• Morphology and classification</li> <li>• Reproduction e.g Spiders, Centipede, Crayfish and Insects</li> <li>• Evolution</li> <li>• Economic/ecological importance</li> </ul> <p>(vii) Echinodermata</p> <ul style="list-style-type: none"> <li>• Evolutionary significance</li> </ul> <p>(ix) Chordata</p> <ul style="list-style-type: none"> <li>• Morphology and classification</li> <li>• Reproduction species</li> <li>• Economic importance of Fungi</li> </ul> <p>Hemichordate Balanoglossus and Urochordata (sea squirts) Cephalochordate e.g (Amphioxus) and vertebrate (e.g Fishes, Frogs, Toads, Lizards/Snakes, Birds and Mammals).</p> <ul style="list-style-type: none"> <li>• Evolution</li> <li>• Economic/medical/ecological importance</li> </ul>	
37. 37.1	<p>FORMS AND FUNCTIONS OF LIVING SYSTEMS.</p> <p>Describe the structure of a named flowering plant.</p>	<p>(i) Plant</p> <ul style="list-style-type: none"> <li>• Structure in flowering plants</li> <li>• Morphology- Root, Stem, Leaves, Flowers and Fruits.</li> </ul> <p><b>Root</b> Types of roots e.g Tap root, Fibrous stilt e.t.c. their distinguishing characteristics related to function.</p> <p><b>Stem</b> Types of stem e.g Corn, Rhizome, Runner e.t.c. their distinguishing characters.</p> <p><b>Leaves</b> Leaf arrangement and modifications to suit habitat dicot and monocot leaf shape and structure in relation to function</p>	Draw the examples of each type.

		<p><b>Flower</b></p> <p>Types and structure of dicot and monocot flower and function of each part. Inflorescent types and their significance</p> <p><b>Fruits</b></p> <p>Types of fruits and placentation.</p> <p>Reproduction</p> <p>(i) Asexual</p> <p>Definition, types and differences between them and significance</p> <p>Examples of binary, fission, sporulation, budding, regeneration and vegetative propagation.</p> <p>(ii) sexual</p> <ul style="list-style-type: none"> <li>• Development and structure of pollen grains</li> <li>• Process of pollination and fertilization</li> <li>• Significance of double fertilization.</li> </ul> <p>(iii) The Flower</p> <ul style="list-style-type: none"> <li>• Different shapes, types structure and size to ensure/prevent self pollination and ensure cross pollination.</li> <li>• Significance of heterostyled protandry, protogynye diecious, monoecious e.t.c.</li> </ul> <p>(iv) Fruits dispersal.</p> <ul style="list-style-type: none"> <li>• Types of fruits</li> <li>• Agents of dispersal</li> <li>• Advantages and disadvantages of dispersal in ecology.</li> </ul>	<p>Draw the L.S of dicot flower and type of inflorescence</p> <p>Mount and observe pollen from wind animal pollinated flowers to show difference.</p>
37.2	Describe the process of asexual reproduction in a named plant.		
37.3	Describe the structure of the fruit in maize and explain the function of the endosperm.		
37.4	Compare and contrast self pollination and cross-pollination in terms of genetic variation.		
37.5	Describe and explain the structural features of a named wind pollinated plant		

S/N	TOPIC/OBJECTIVES	CONTENTS	ACTIVITIES/REMARKS
38.	VIRUSES What are the general characteristics of virus	<p>(i) Structure</p> <ul style="list-style-type: none"> <li>• General characteristics and morphological classification.</li> <li>• Association of bacteriophage with bacteria.</li> </ul> <p>(ii) Viruses and Diseases</p> <ul style="list-style-type: none"> <li>• Plant diseases e.g. Mosaic diseases of plants, Mosaic diseases of flowers swollen shoot diseases of plants.</li> <li>• Human and Animals diseases Role of viruses in diseases like poliomyelitis, yellow fever, small pox, common cold, HIV/AIDS, SARS, MAD-COW.</li> </ul>	
39.	BACTERIA Describe the mode of reproduction in bacteria	<p>(i) Structure</p> <ul style="list-style-type: none"> <li>• General characteristics, taxonomic classification</li> <li>• Identification</li> <li>• Differences between bacteria and viruses</li> </ul> <p>(ii) Reproduction</p> <p>(iii) Nutrition</p> <p>(iv) Bacteria and Diseases</p> <ul style="list-style-type: none"> <li>• Plant diseases e.g. blight of cassava, potatoes.</li> <li>• Animal diseases e.g. sexually transmitted diseases.</li> </ul> <p>Use of Bacteria</p> <ul style="list-style-type: none"> <li>• Agriculture</li> <li>• Industrial uses</li> <li>• Sanitation</li> <li>• Medical uses</li> <li>• Research</li> </ul> <p>(v) Control of bacterial activity.</p>	
	FUNGI	(i) Structure	

40.	Explain the mode of nutrition in fungi	<p>(ii) Reproduction</p> <p>(iii) Nutrition</p> <p>(iv) Importance of Fungi</p> <ul style="list-style-type: none"> <li>• Food processing</li> <li>• Medical uses</li> <li>• Industrial uses</li> <li>• Agriculture</li> <li>• Plant and animal diseases.</li> </ul>	
41.	DATA COLLECTION AND PRESENTATION.	<p>(i) Data collection</p> <ul style="list-style-type: none"> <li>• Sources of data</li> <li>• Methods of data collection e.g interviews, questionnaires.</li> </ul> <p>(ii) Data presentation</p> <ul style="list-style-type: none"> <li>• Tabulation</li> <li>• Presentation</li> <li>• Charts</li> <li>• Process of constructing histograms, frequently, polygons, cumulative frequency polygons.</li> <li>• Pie charts Process of constructing of pie chart.</li> </ul>	Collection of data e.g heights weight e.t.c. could be used to classify and construct frequency tables.
42.	MEASUREMENT OF POPULATION PARAMETERS.	<p>(i) Measure of location.</p> <ul style="list-style-type: none"> <li>• Simple formula and basic computation methods.</li> </ul> <p>(ii) Measure of dispersion</p> <ul style="list-style-type: none"> <li>• Computation of range standard deviation, standard error and variance.</li> <li>• Concepts of probability</li> <li>• Set theory, conditional probability and exclusive events</li> <li>• Concepts of correlation and regression to illustrate between two variables.</li> <li>• Method of predicting one variable from the other vesfecsurely.</li> </ul>	Measurement of height weight could be used.
42.1	PROBABILITY		Tossing of a fair coin, casting of die to illustrate chance occurrence.