

WEST AFRICAN SENIOR SCHOOL CERTIFICATE EXAMINATION BIOLOGY

PREAMBLE

This is an international Senior School Certificate Examination Syllabus drawn up from the Teaching Curricula of the member countries of the West African Examinations Council.

The international syllabus should be used in conjunction with the respective teaching syllabuses where the candidates are domiciled.

The Syllabus is divided into three sections, A, B, and C. Section A is for all candidates. Section B is for candidates in Ghana, Sierra Leone and The Gambia. Section C is for candidates in Nigeria.

AIMS AND OBJECTIVES

This syllabus is designed to assess candidates'

1. understanding of the structure and functions of living organisms as well as appreciation of nature;
2. acquisition of adequate laboratory and field skills in order to carry out and evaluate experiments and projects in Biology;
3. acquisition of necessary scientific skills for example observing, classifying and interpreting biological data;
4. relevant knowledge in Biology, needed for future advanced studies in biological science;
5. Acquisition of scientific attitudes for problem solving;
6. Ability to apply biological principles in everyday life in matters that affect personal, social, environmental, community health and economic problems.

EXAMINATION SCHEME

There will be two papers, Paper 1/3 and Paper 2, both of which must be taken with a total score of 200 marks.

Paper 1: This paper will be a practical test (for school candidates only) lasting 2 hours and consisting of three parts I, II and III. The paper will carry a total score of 80 marks. Candidates will be expected to answer **all** the questions in part I and in addition **one** question from either part II or III.

Part I : This part will consist of **two** compulsory questions drawn from Section A of the Syllabus each carrying 25 marks.

Part II : This part is for candidates in Ghana, Sierra Leone and The Gambia. It will consist of **one** question drawn from section B of the Syllabus, carrying 30 marks.

WEST AFRICAN SENIOR SCHOOL CERTIFICATE EXAMINATION
BIOLOGY

Part III: This part is for candidates in Nigeria. It will consist of **one** question drawn from Section C of the Syllabus, carrying 30 marks.

Paper 2: This paper will consist of **two** sections A and B, lasting 2½ hours.

SECTION A: This section will consist of 60 multiple-choice objective questions drawn from Section A of the Syllabus. It will carry 60 marks and last for one hour.

SECTION B: This section will consist of eight (8) essay questions drawn from all the sections of the syllabus. The section will consist of three parts : I, II and III candidates will be expected to answer **three** questions in 1½ hours. Taking **two** questions from part I and **one** question from either part II or III. Each question will carry 20 marks. The total score will be 60 marks.

Part I : This part will consist of **four** questions drawn from Section A of the Syllabus.
Candidates are expected to answer **two** questions from this part.

Part II : This part is for candidates in Ghana, Sierra-Leone and The Gambia. It will consist of **two** questions drawn from Section B of the Syllabus. Each question carries 20 marks. Candidates will be expected to answer **one** question from this part.

Part III : This part is for candidates in Nigeria. It will consist of **two** questions drawn from Section C of the Syllabus, each question carries 20 marks. Candidates will be expected to answer **one** question from this part.

Paper 3: This paper which is for private candidates only, will be a Test of Practical Work lasting 2 hours and carrying 80 marks.
The paper will consist of **three** parts, I, II and III.
Candidates will be expected to answer **all** the questions in part I and in addition, **all** the questions in either part II or part III.

Part I : This part will consist of questions drawn from section A of the Syllabus carrying a total of 50 marks.

Part II : This part is for candidates in Ghana, Sierra-Leone and The Gambia. It will consist of questions drawn from section B of the Syllabus carrying a total of 30 marks.

Part III : This part is for candidates in Nigeria. It will consist of questions drawn from section C of the Syllabus carrying a total of 30 marks.

WEST AFRICAN SENIOR SCHOOL CERTIFICATE EXAMINATION
BIOLOGY

**DETAILED SYLLABUS
SECTION A
(FOR ALL CANDIDATES)**

CONTENTS	NOTES
<p>A. Concept of Living</p> <ol style="list-style-type: none"> 1. Classification <ol style="list-style-type: none"> (a) Living and non-living things (b) Differences between plants and animals. 2. Organization of life <ol style="list-style-type: none"> (a) Levels of organization <ol style="list-style-type: none"> (i) cell (single-celled organisms): Amoeba, Euglena, Paramecium. (ii) Tissue: Hydra (iii) Organ (storage organ) bulb, rhizome and heart. (iv) System: In mammals, flowering plants – reproductive system, excretory system etc. (b) Complexity of organization in higher organisms: advantages and disadvantages. 	<p>Classification of objects into living and non-living, giving examples of each group.</p> <p>These examples should be used to illustrate differentiation and specialization in organisms.</p> <p>The significance of different levels of organization including volume/surface area ratio should be discussed.</p>

WEST AFRICAN SENIOR SCHOOL CERTIFICATE EXAMINATION
BIOLOGY

CONTENTS	NOTES
<p>3. Cell as a living unit</p> <p>Forms in which living cells exist:</p> <p>(a) Single and free-living: Amoeba, Paramecium, Euglena, and Chlamydomonas</p> <p>(b) Colony: Volvox</p> <p>(c) Filament: Spirogyra</p> <p>(d) Part of a living organism: Cheek cell, onion root tip cells and epidermis of fleshy leaves.</p>	<p>The structure of these organisms in relation to the forms of existence should be studied to illustrate dependence and interdependence.</p> <p>Distinguish groups of cells that form tissues from those that form colonies or filaments.</p>
<p>4. (a) Cell structure and functions of cell components.</p> <p>(b) Similarities and differences between plant and animal cells.</p>	<p>Cell structure should include: Cell wall, cell membrane, cytoplasm, cytoplasmic organelles: nucleus, mitochondria, lysosomes, chloroplast, endoplasmic reticulum, ribosomes, centrosomes, Golgi body, chromosome.</p> <p>The function performed by organelles should be known.</p>
<p>5. The Cell and its environment: Physical and Biophysical processes.</p> <p>(a) diffusion</p> <p>(b) osmosis</p> <p>(c) plasmolysis</p>	<p>The significance of these processes should be discussed as factors that affect cell activities in its environment.</p> <p>Haemolysis, turgidity and cremation should be mentioned.</p>

WEST AFRICAN SENIOR SCHOOL CERTIFICATE EXAMINATION
BIOLOGY

CONTENTS	NOTES
<p>6. Properties and functions of the living cell</p> <p>(a) Nutrition</p> <p>(i) Autotrophic (photosynthesis)</p> <p>(ii) Heterotrophic (holozoic)</p> <p>(iii) Mineral nutrition: Macro and micro-nutrients</p> <p>(b) Cellular respiration</p> <p>Definition and processes of:</p> <p>(i) aerobic respiration</p> <p>(ii) anaerobic respiration</p> <p>(iii) energy release</p> <p>(c) Excretion</p> <p>(i) Excretion in single celled aquatic organism. Diffusion by body surface; by contractile vacuole.</p> <p>(ii) Waste products of metabolism.</p>	<p>These should be discussed as processes occurring within living cells.</p> <p>Experiment to show the effects of mineral deficiencies in plants especially nitrogen, phosphorus, potassium should be carried out.</p> <p>Macro elements should include: carbon, hydrogen, oxygen, nitrogen, potassium, phosphorus, magnesium, sulphur, calcium and iron. The micro elements should include: copper, manganese, zinc and boron.</p> <p>A simplified outline of the chemical processes involved in glycolysis and Krebs's cycle; Reference should be made to the role of ATP.</p> <p>Reference should be made to carbon dioxide, water and ammonia as examples of waste products.</p>

WEST AFRICAN SENIOR SCHOOL CERTIFICATE EXAMINATION
BIOLOGY

CONTENTS	NOTES
(d) Growth	
(i) Basis of growth – cell division (mitosis), enlargement and differentiation.	
(ii) Aspects of growth: Increase in dry weight. Irreversible increase in size and length. Increase in number of cells.	
(iii) Regions of fastest growth in plants.	Observation of root tip and shoot tip are required.
(iv) Influence of growth hormones and auxins.	Regulation of growth by hormones should be mentioned.
(v) Growth curvatures (Tropisms)	Types of tropisms should be demonstrated.
	Microscopic examination of the different regions of growth and development: region of cell division; elongation; differentiation; maturation.
(e) Development: Enlargement and differentiation.	
(f) Reproduction: Types of reproduction.	Prepared slides of:
(i) Asexual: fission, Budding, vegetative propagation.	(a) fission in Paramecium (b) budding in yeast and Hydra ; should be observed and drawn. Reference should be made to artificial methods of vegetative propagation in flowering plants.
(ii) Sexual: Conjugation, formation of male and female gametes (meiosis), fusion of gametes (fertilization).	Prepared slides of conjugation should be studied.

WEST AFRICAN SENIOR SCHOOL CERTIFICATE EXAMINATION
BIOLOGY

CONTENTS	NOTES
<p>7. (a) Tissues and supporting systems: Skeleton and supporting systems in animals:</p> <p>(i) Biological significance.</p> <p>(ii) Skeletal materials, e.g. bone</p> <p>(iii) Types of skeleton: exoskeleton, endoskeleton.</p> <p>(iv) Bones of the vertebral column, girdles and long bones of the appendicular skeleton.</p> <p>(v) Mechanism of support in animals.</p> <p>(vi) Functions of skeleton in animals: Protection, support, locomotion, respiratory movement.</p> <p>(b) Different types of supporting tissues in plants.</p> <p>(i) Main features of supporting tissues in plants.</p> <p>(ii) Functions of supporting tissues in plants: strength, rigidity (resistance against the forces of the wind and water), flexibility and resilience.</p>	<p>The location and arrangement of skeletal and supporting tissues in animals should be mentioned. Candidates should be familiar with the general plan of mammalian skeleton and the different types of joints. They should be able to identify, draw, label and state the functions of the individual bones listed in the content column. Detailed structure of the skull will not be required. Histological structure of bones and cartilages will also not be required.</p> <p>Candidates should be able to explain how these functions are performed. The relationship of skeleton and muscles during movement should be used to illustrate the different functions of the skeleton.</p> <p>The different types of supporting tissues: turgid parenchyma; collenchyma, xylem (wood) sclerenchyma should be studied.</p> <p>Candidates should be able to cut and draw the low power of the T.S. of stem and root of a herbaceous plant and label the different tissues; epidermis, cortex, stele.</p>

WEST AFRICAN SENIOR SCHOOL CERTIFICATE EXAMINATION
BIOLOGY

CONTENTS	NOTES
<p>8. Transport System:</p> <p>(a) Need for transportation:</p> <p>(i) surface area/volume ratio.</p> <p>(ii) substances have to move greater distances.</p> <p>(b) Composition and function of blood and lymph</p> <p>(c) Materials for transportation: excretory products, gases, digested food, and other nutrients.</p> <p>(d) Structure of the heart, arteries, veins, capillaries and vascular bundles.</p>	<p>Source of materials and forms in which they are transported and where they are transported to should be studied.</p> <p>Candidates should be familiar with the general circulatory system. The names of the blood vessels responsible for transporting excretory products, gases, digested food and other nutrients should be known. The detailed structure of the xylem and phloem is not required.</p>
<p>9. Respiratory System:</p> <p>(a) Body surface, cutaneous, gills, lungs.</p> <p>(b) Mechanisms of gaseous exchange in fish, toad, mammals and plants.</p>	<p>Characteristics of respiratory surfaces in these systems should be studied.</p> <p>Candidates should be able to observe, draw and label the respiratory organs of a bony fish (<i>e.g. Tilapia</i>) and a small mammal (<i>e.g. rat</i>)</p> <p>Respiratory movements in these animals should be discussed. The mechanisms of opening and closing of stomata should be discussed.</p>
<p>10. Excretory Systems and Mechanisms</p> <p>Types of excretory systems: Kidney, stomata and lenticel.</p>	<p>Characteristics of excretory organs in these systems should be studied.</p> <p>Candidates should observe, draw and label the excretory organs of a small mammal (<i>e.g. rat</i>).</p>

WEST AFRICAN SENIOR SCHOOL CERTIFICATE EXAMINATION
BIOLOGY

CONTENTS	NOTES
<p>11. Regulation of Internal Environment (Homeostasis)</p> <p>(a) Kidney: Structure and functions</p> <p>(b) Liver: Functions of the liver.</p> <p>(c) The skin: Structure and function</p> <p>12. Hormonal Coordination</p> <p>(a) Animal hormones: Site of secretion, functions and effects of over and under-secretion.</p> <p>(b) Plant hormones</p>	<p>Osmoregulation, excretion and maintenance of acid-base balance should be discussed. The conditions that affect functions of the kidney such as the water and salt content of the blood, environmental temperature.</p> <p>Excretory products such as urea, water, salts, uric acid should be discussed.</p> <p>Candidates should be able to identify the liver; and its position relative to the gall bladder, bile duct, pancreas, duodenum and stomach.</p> <p>Candidates should observe, draw and label the mammalian skin. The regulation of internal environment by the skin should be emphasized.</p> <p>Endocrine glands: pituitary, thyroid, adrenal, pancreas, gonads and their secretions should be discussed. The role of thyroxine in the metamorphosis of toad should be mentioned.</p> <p>Demonstration of the effects of auxins on lateral bud development, leaf fall and initiation of adventitious roots should be carried out.</p>

WEST AFRICAN SENIOR SCHOOL CERTIFICATE EXAMINATION
BIOLOGY

CONTENTS	NOTES
13. Nervous Coordination	
(a) The central nervous system	
(i) Components of the central nervous system	
(ii) Parts of the brain and their functions; cerebrum, cerebellum, medulla oblongata, hypothalamus and their functions	Candidates should be able to locate the position of the brain and spinal cord in a dissected vertebrate and identify the various regions of the brain.
(iii) Structure and function of the Spinal Cord.	
(b) Peripheral Nervous System.	
(i) Somatic Nervous System	
(ii) Automatic nervous system.	Functions of the sympathetic and parasympathetic systems only.
(iii) Structure and functions of the neurone.	Candidates should observe, draw and label a neurone from a slide.
(iv) Classification of neurons.	Afferent (sensory), efferent (motor) and intermediate neurones should be mentioned.
(c) Transmission of Impulses.	Simple treatment of transmission of nerve impulses by a change in electrical potential is required.
(d) Types of nervous actions	Candidates should perform experiments to illustrate reflex actions such as blinking of the eyes, knee jerk, and withdrawal of hand from hot objects.
(i) Reflex and voluntary actions	
(ii) The reflex arc	

WEST AFRICAN SENIOR SCHOOL CERTIFICATE EXAMINATION
BIOLOGY

<p style="text-align: center;">(iii) Differences between reflex and voluntary actions.</p> <p>14. Sense Organs:</p> <p style="padding-left: 40px;">(a) Structure and function of the eye and ear.</p> <p style="padding-left: 40px;">(b) The skin</p> <p>15 (a) Reproductive system of mammals</p> <p style="padding-left: 40px;">(i) Structure and function of male and female reproductive systems.</p> <p style="padding-left: 40px;">(ii) Differences between male and female reproductive organs.</p> <p style="padding-left: 40px;">(iii) Structure of the gametes (sperm and ovum)</p> <p style="padding-left: 40px;">(iv) Fertilization, development of the embryo and birth.</p> <p style="padding-left: 20px;">(b) (i) Stages in the development of toad.</p> <p style="padding-left: 40px;">(ii) Metamorphosis in insects, life histories of housefly/butterfly and cockroach.</p>	<p>Candidates should examine the mammalian eye noting the shape, colour and positions of the optic muscle and optic nerve.</p> <p>Mention should be made of eye defects and their correction.</p> <p>The function of the skin as a sensory organ should be emphasized.</p> <p>Candidates should examine and draw dissected male and female mammals showing the reproductive organs. They should also draw sperm and ovum from prepared slides or from fresh specimens.</p> <p>The different stages of the tadpole should be drawn and labelled.</p> <p>These examples should be used to illustrate complete and incomplete metamorphosis. The period it takes to develop from egg to adult should be studied. The different stages in the life history of butterfly/housefly should be drawn and labelled.</p>
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WEST AFRICAN SENIOR SCHOOL CERTIFICATE EXAMINATION
BIOLOGY

<p>(c) Comparison of reproduction in fish, amphibia, reptile, bird and mammal.</p> <p>(d) Reproduction of flowering plants</p> <p>(i) Arrangements of floral parts of a named insect pollinated flower and a named wind pollinated flower.</p> <p>(ii) Structure and function of the male and female parts of a flower.</p> <p>(e) Pollination in Plants</p> <p>(i) Types of pollination</p> <p>(ii) Features of cross-pollinated and self pollinated flowers</p> <p>(iii) Agents of Pollination</p> <p>(f) Process of Development of Zygote in flowering plants: Fertilization.</p> <p>(g) (i) Structure of fruits</p> <p>(ii) Types of fruits (classification).</p>	<p>Reference should be made to the method of fertilization, number of eggs and parental care.</p> <p>Named examples should be used to illustrate the types of pollination.</p> <p>The features of the flower should be related to the agents of pollination.</p> <p>Pollen grains germinated in sucrose solution should be observed, prepared slides showing various stages of embryo development in flowering plants should be observed and drawn.</p> <p>Fruits should be classified into dry and fleshy fruits. The internal structure of a leguminous fruit, orange, maize and tomato should be examined and drawn.</p>
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WEST AFRICAN SENIOR SCHOOL CERTIFICATE EXAMINATION
BIOLOGY

CONTENTS	NOTES
<p>(h) Dispersal of fruits and seeds</p> <p style="padding-left: 40px;">Agents of dispersal</p> <p>(i) Germination of seeds</p> <p style="padding-left: 80px;">(i) Essential factors which affect developing embryo.</p> <p style="padding-left: 80px;">(ii) Types of germination</p> <p>B. Plant and Animal Nutrition</p> <p>Plant Nutrition</p> <p>1 (a) Photosynthesis:</p> <p style="padding-left: 40px;">(i) Process of photosynthesis and its chemical equation</p> <p style="padding-left: 40px;">(ii) Light and dark reactions</p> <p style="padding-left: 40px;">(iii) Materials and conditions necessary for photosynthesis</p> <p style="padding-left: 40px;">(iv) Evidence of photosynthesis</p> <p>(b) Mineral requirement of plants</p> <p style="padding-left: 40px;">(i) Soil and atmosphere as source of Mineral elements</p>	<p>The following fruits should be studied as examples to show the features that aid their respective methods of dispersal. Sunflower (achene) Combretum, cotton, Crotalaria/bean, Desmodium, Bidens Spp. And coconut.</p> <p>Distinguishing differences between a fruit and a seed should be mentioned.</p> <p>Experiments to show the importance of oxygen, adequate moisture and suitable temperature, should be carried out.</p> <p>The stages in hypogeal and epigeal germination should be observed and drawn.</p> <p>Biochemical nature of photosynthesis, photoactivation of chlorophyll resulting in the conversion of light energy to ATP and the reduction of NADP (no biochemical detail is required)</p> <p>The translocating and storage of excess food as a result of photosynthesis should be mentioned. Test for starch in green leaves should be carried out.</p> <p>Candidates should distinguish between food produced and mineral elements.</p>

WEST AFRICAN SENIOR SCHOOL CERTIFICATE EXAMINATION
BIOLOGY

<p>2. Animal Nutrition</p> <p>(a) Food substances; classes and sources</p> <p>(b) Balanced diet and its importance</p> <p>(c) Food tests</p> <p>(d) Digestive enzymes</p> <p>Classes, characteristics and functions</p> <p>(e) Modes of Nutrition</p> <p>(i) Autotrophic: Photosynthesis,</p> <p>(ii) Heterotrophic, holozoic, parasitic, symbiotic, and saprophytic.</p> <p>(f) Alimentary System: Alimentary tract of different animals.</p> <p>(g) Feeding in protozoa, and mammals</p>	<p>Local examples as sources of food substance should be given. Reference should be made to food relationship between plants and animals.</p> <p>Importance of each class of food in balanced diet should be stressed. Candidates should relate the idea of balanced diet to their own diet.</p> <p>Tests for starch, reducing sugar, protein, fats and oil should be carried out.</p> <p>Candidates should perform experiments to show that ptyalin in saliva changes cooked starch to reducing sugar.</p> <p>Candidates should know source, site of action, substrate and effect of each digestive enzyme.</p> <p>Experiments to show the characteristics of enzymes, including effects of pH, temperature and concentration, should be carried out.</p> <p>Named examples should be used to illustrate different modes of nutrition.</p> <p>Comparison should be made using dissected named bird and mammal.</p> <p>Reference should be made to feeding habits in protozoa and mammals. Adaptation of teeth and dentition in mammals (herbivore, carnivore and omnivore) should be studied.</p>
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WEST AFRICAN SENIOR SCHOOL CERTIFICATE EXAMINATION
BIOLOGY

CONTENTS	NOTES
<p>C. Basic Ecological Concepts</p> <p>1. Ecosystem:</p> <p>Components of the ecosystem and sizes</p> <p>(a) Ecological components: environment, biosphere, habitat, population, biotic community, ecosystem.</p> <p>(b) Components of the ecosystem: Biotic, and abiotic.</p> <p>2. Ecological factors:</p> <p>Ecological factors in aquatic and terrestrial ecosystems</p> <p>3. Simple Measurement of Ecological Factors.</p> <p>(a) Physical factors: Climatic, topographic and gaseous.</p> <p>(b) Edaphic factors: Chemical and physical composition, moisture content and soil texture.</p> <p>4. Food Webs and Trophic levels</p> <p>(a) Autotrophs and Heterotrophs</p>	<p>Examples and explanation are required.</p> <p>Importance of ecological factors common to all habitats should be mentioned. The importance of ecological factors to population of animals and plants should be stressed.</p> <p>Candidates should make histograms or graphs using rainfall and temperature data and interpret graphs showing ecological factors of a habitat.</p> <p>Candidates should measure some of the ecological factors including humidity, temperature, wind speed, rainfall, and light intensity.</p> <p>Candidates should be able to classify organisms as producers, consumers and decomposers.</p>

WEST AFRICAN SENIOR SCHOOL CERTIFICATE EXAMINATION
BIOLOGY

CONTENTS	NOTES
<ul style="list-style-type: none"> (i) Producers: autotrophs (ii) Consumers: heterotrophs (iii) Decomposers 	<p>Aquatic and terrestrial producers, consumers and decomposers should be known.</p>
<ul style="list-style-type: none"> (b) Trophic Levels Energy relationships <ul style="list-style-type: none"> (i) Food chain (ii) Food web 	<p>Candidates should illustrate food relationship in a food chain and food web using specific examples.</p>
<ul style="list-style-type: none"> (c) Energy flow <ul style="list-style-type: none"> (i) Food/Energy relationship in aquatic and terrestrial environment. (ii) Pyramid of energy and Pyramid of numbers 	<p>Non-cyclic nature of energy transfer should be mentioned.</p> <p>Candidates should be able to construct and explain pyramid of energy, pyramid of numbers and point out the major differences between them.</p>
<p>5. Energy Transformation in Nature</p> <ul style="list-style-type: none"> (a) Energy loss in the ecosystem <ul style="list-style-type: none"> (i) Solar radiation: its intake and loss at the earth's surface. (ii) Energy loss in the biosphere. 	<p>Candidates should discuss energy as a limiting factor in primary production i.e. production of autotrophs.</p> <p>Reference should be made to harvest as a means of measuring primary production.</p>

WEST AFRICAN SENIOR SCHOOL CERTIFICATE EXAMINATION
BIOLOGY

CONTENTS	NOTES
<p>(b) Decomposition in Nature</p> <p>(i) Decomposers: (micro and macro-decomposers)</p> <p>(ii) Gaseous products</p> <p>(iii) Role of decomposers</p> <p>6. Ecological Management</p> <p>(a) Associations</p> <p>Type of associations: Parasitism, symbiosis, commensalism and saprophytism.</p> <p>(b) Adaptation of organisms to habitats.</p> <p>(c) Pollution of the atmosphere</p> <p>(i) Nature, names, sources and effects of air pollutants.</p> <p>(ii) Effect of noise</p>	<p>Candidates should observe demonstrations to show that carbon dioxide, hydrogen sulphide, heat energy are released during decomposition.</p> <p>Features of biological importance associated with each type should be discussed. Named examples should be used to illustrate these associations.</p> <p>Adaptations of plants and animals to environmental conditions with particular reference to differences in habitats should be discussed.</p> <p>Examples of air pollutants should include carbon monoxide, sulphur dioxide, oxides of nitrogen, smoke, smog, dust and particles released into the air from factories.</p> <p>Health hazards and damage to environment should be emphasized.</p> <p>Discuss harmful effect of noise from generators and electronic sound gadgets.</p>

WEST AFRICAN SENIOR SCHOOL CERTIFICATE EXAMINATION
BIOLOGY

CONTENTS	NOTES
<p>(d) Water and Soil Pollution</p> <p>Types, composition and effects of pollutants</p> <p>7. Ecology of Population</p> <p>(a) Ecological succession</p> <p>(i) Structural changes in species composition, variety or diversity and increase in numbers.</p> <p>(ii) General characteristics and outcomes of succession</p> <p>(b) Primary succession. Succession in terrestrial habitats.</p> <p>(c) Secondary succession, climax of the succession: characteristic of a stable ecosystem.</p> <p>(d) Factors that may cause overcrowding: natality and immigration, survival rate.</p>	<p>Water and soil pollutants to be studied include: synthetic substances, (detergent) insecticides, artificial fertilizers, herbicides, sewage, domestic and industrial wastes, crude oil and decaying organic matter. The health hazards and harmful effects of water and soil pollutants on organisms should be discussed. Mention should be made of oil spillage and its effects</p> <p>Candidates should study succession in an abandoned farmland, lawn, over a period of time to discover a definite sequence of colonising plants.</p> <p>Reference should be made to population. Candidates should determine the space available for each member of the class when:</p> <p>(i) only the class members are present</p> <p>(ii) members from another class are added. Using the following formula</p> $\text{Space} = \frac{\text{Area of habitat}}{\text{Number of Organisms}}$

WEST AFRICAN SENIOR SCHOOL CERTIFICATE EXAMINATION
BIOLOGY

CONTENTS	NOTES
8. Micro-organisms: Man and health	
(a) Carriers of micro-organisms	Effects of micro organisms on our bodies should be discussed. Examples of carriers: housefly; mosquitoes; tsetsefly should be mentioned.
(b) Micro-organisms in action	Candidates should perform experiments on fermentation and curdling of milk to illustrate the beneficial uses of micro-organisms.
(i) Beneficial effects in nature, medicine and industries.	
(ii) Harmful effects of micro-organisms, diseases caused by micro-organisms: cholera, measles, malaria and ring worm.	The diseases should be studied with respect to the causative organisms, mode of transmission and symptoms.
(c) Towards better Health	
(i) Methods of controlling harmful micro-organisms, high temperature, anti biotics, antiseptics, high salinity and dehydration.	Effects of these methods on the micro-organisms should be discussed.
(ii) Ways of controlling the vectors.	Methods of controlling housefly and mosquito should be studied.
D. Conservation of Natural Resources:	
1. Resources to be conserved: soil, water, wildlife, forest and minerals.	The meaning and need for conservation of natural resources should be discussed. Problems of conservation should be discussed in relation to economic, and social development, overgrazing and poaching.

WEST AFRICAN SENIOR SCHOOL CERTIFICATE EXAMINATION
BIOLOGY

CONTENTS	NOTES
2. Ways of ensuring conservation	The following should be studied: (a) agencies responsible for conservation (b) conservation education (c) conservation laws.
E. Variation in Population	
1. Morphological variations in the physical appearance of individuals (a) size, height, weight (b) colour (skin, eye, hair coat of animals) (c) finger prints	Candidates are required to measure heights and weights of pupils of the same age group and plot graphs of frequency distribution of the height and weight. Observe and record various skin colour, colour pattern of some animals (cow, goat, rabbits), colour pattern of plants (maize cob and leaves). Make finger prints and classify them into arches, loops, whorls and compounds.
2. Physiological Variations (a) Ability to roll tongue (b) Ability to taste phenylthiocarbamide (PTC) (c) Blood groups (ABO) classification)	
F. Biology of Heredity (Genetics)	
1. Transmission and expression of characteristics in organisms. (a) Hereditary variation (b) Mendel's work in genetics	Reference should be made to characters that can be transmitted from generation to generation such as colour of skin, eye and hair, blood group, sickle cell, shape of face and nose. Mendel's experiment with red and white flowered pea should be reviewed and discussed.

WEST AFRICAN SENIOR SCHOOL CERTIFICATE EXAMINATION
BIOLOGY

CONTENTS	NOTES
(i) Mendel's experiments	Candidates are required to determine the ratio of grains of different colours in the maize cob and compare their findings with that obtained by Mendel in monohybrid inheritance.
(ii) Mendelian traits	Reference should be made to dominant and recessive characters in plants and animals.
(iii) Mendelian laws	
2. Chromosomes: The basis of heredity	Candidates should observe chromosomes in permanently prepared slides of cells and root tips of onion or lily.
(a) Structure	Simple treatment of DNA will be required.
(b) Process of transmission of hereditary characters from parents to offspring.	Segregation of genes at meiosis and recombination at fertilization should be used to explain the process of transmission of hereditary characters from parents to offspring.
3. Probability in genetics	Computation of probability is not required.
4. Application of the principles of heredity in:	Data on cross-breeding experiments should be studied.
(a) Agriculture	Examples of new varieties of crop and livestock obtained through cross-breeding should be mentioned. The advantages and disadvantages of cross-fertilization, out and inbreeding should be explained.

WEST AFRICAN SENIOR SCHOOL CERTIFICATE EXAMINATION
BIOLOGY

CONTENTS	NOTES
<p>(b) Medicine</p> <p>G. Evolution</p> <p>1. Behavioural Adaptations in Social animals</p> <p>(a) Termites</p> <p>(b) Bees</p> <p>2. Theories of evolution</p> <p>(a) Larmack's theory</p> <p>(b) Darwin's theory</p>	<p>The application of knowledge, of heredity in marriage counselling with particular reference to sickle cell anaemia and rhesus factor should be mentioned.</p> <p>Candidates should be able to identify the various castes of social insects.</p> <p>The division of labour in social insects and the roles of different castes should be stressed. Examples of communication among animals such as contact notes and warning cries should be discussed. Reference should be made to basking by lizard, territorial behaviour in birds and lizards and behaviour of other animals under unfavourable conditions-hibernation and aestivation. The behaviour of an organism as a member of a group and the effect of grouping on the behaviour of an organism should be mentioned.</p> <p>Reference should be made to organic evolution. The contributions of Larmack and Darwin to the development of the theory of evolution should be discussed.</p> <p>Evidences for evolution such as fossil records, comparative anatomy and physiology and embryology should be known.</p> <p>Candidates are expected to know the evolutionary trends in plants and animals such as from simple to complex structural adaptations and from aquatic to terrestrial organisms.</p>

WEST AFRICAN SENIOR SCHOOL CERTIFICATE EXAMINATION
BIOLOGY

SECTION B
FOR CANDIDATES IN GHANA, SIERRA LEONE AND THE GAMBIA

CONTENTS	NOTES
1. INTRODUCING BIOLOGY	
(a) Biology as a Science	The importance of Biology and the scientific method should be stressed.
(b) The microscope	Parts of the microscope. Preparation of wet/temporary mounts.
2. THE CELL	
(a) Types of cells	Viral, bacterial, plants and animal cells as examples of akaryotic, prokaryotic and eukaryotic cells respectively.
(b) Specialized eukaryotic cells	The structure and function of red blood cells, sperm cells, leaf epidermal cells, nerve cells, palisade cells.
(c) DNA and protein synthesis	Treatment should include the role of RNA, TRNA and ribosome only. Detailed structure of these not required.
3. THE DIVERSITY OF LIVING THINGS	
(a) Classification of living things	Classification of organisms according to kingdom. Phylum/division, class, order, family, genus, species.
(b) Identifying living things using key	Only dichotomous key is required
(c) The main characteristics of major phyla and divisions of the kingdom	Viruses should be treated as a group that share the same characteristic with living and non living things.
(i) Prokaryotae	The main characteristics of major phyla of the kingdom protocista: Rhizopoda e.g. Amoeba
(ii) Protoctista	Zoomastigina e.g. Trypanosoma , Apicomplexa (Sporozoa) e.g. Plasmodium . Ciliophora e.g. Paramecium, Euglenophyta e.g. Euglena , Oomycota (Slime moulds) e.g. Phytophthora , Chlorophyta e.g. Spirogyra , Rhodophyta (red algae), Phaeophyta (brown algae)
(iii) Fungi	The main characteristics of major phyla of the Kingdom Fungi: Zygomycota e.g. yeast Xylaria Cookeina

WEST AFRICAN SENIOR SCHOOL CERTIFICATE EXAMINATION
BIOLOGY

CONTENTS	NOTES
(iv) Plantae	<p>Basidiomycota: toad stools, bracket fungi and mushroom.</p> <p>The main characteristics of the major divisions and class of the Kingdom Plantae.</p> <p>Bryophyta</p> <ul style="list-style-type: none"> class Hepaticae class Musci <p>Lycopophyta (clubmosses)</p> <p>Filicinophyta (ferns)</p> <p>Angiospermophyta</p> <ul style="list-style-type: none"> class monocotyledoneae class Dicotyledoneae
(v) Animalia	<p>The main characteristics of the major phyla, classes, and orders of the kingdom.</p> <p>Animalia:</p> <p>Cnideria (Coelenterates)</p> <p>Platyhelminthes:</p> <ul style="list-style-type: none"> class Tubellaria class Trematoda class Cestoda <p>Nematoda</p> <p>Annelida:</p> <ul style="list-style-type: none"> class Polychaeta class Oligochaeta <p>Mollusca:</p> <ul style="list-style-type: none"> class Gastropoda class Pelycopoda (Bivalvia) class Cephalopoda

WEST AFRICAN SENIOR SCHOOL CERTIFICATE EXAMINATION
BIOLOGY

CONTENTS	NOTES
	<p>Arthropoda:</p> <ul style="list-style-type: none"> • class Crustacea, class Chilopoda (Centipedes) • class Diplopoda (Millipedes), class Insecta, • class Arachnida. Distinguishing features of the following orders of the class insecta are required: Odonata, Orthoptera, Lepidoptera, Coleoptera, Hymenoptera, Hemiptera, Diptera, Isoptera <p>Chordata:</p> <ul style="list-style-type: none"> • class Chondrichthyes (cartilaginous fishes) • class Osteichthyes (bonyfish) class Amphibia, • class Reptilia, class Aves and class Mammalia
4. LIFE PROCESSES IN LIVING THINGS	In studying this section, relationship between structure and function is required.
(a) Amoeba	External structures, movement, osmoregulation, nutrition, reproduction, respiration.
Paramecium	
Euglena	Emphasis on Euglena exhibiting plant, as well as some animal features is required.
(b) Spirogyra, Rhizopus	Nutrition and reproduction only
(c) Mosses and Ferns	Reproduction in Mosses and ferns. Details of structure of antheridia and archegonia of fern are not required.
(d) Cockroach and Butterfly	Nutrition, respiration, excretion, irritability and movement for the cockroach only.
(e) Tilapia (or any other bony fish)	Nutrition, respiration, excretion, movement and reproduction
Toad (Bufo) or Frog (Rana)	Differences between toad and frog. In this section adaptations to their various environments are required.
(f) Flowering Plants	Root, stem and leaf and their modifications.
(i) External structure of monocotyledonous and dicotyledonous plants	Internal structure of root, stem and leaf should be treated with respect to their functions. Examination of these structures under the microscope is required.

WEST AFRICAN SENIOR SCHOOL CERTIFICATE EXAMINATION
BIOLOGY

CONTENTS	NOTES
(ii) Internal structure of roots, stem and leaf	Structural adaptations of the leaf for photosynthesis. Factors affecting the rate of photosynthesis; light, temperature and carbon dioxide concentration.
(iii) Nutrition Photosynthesis	Fixation and reduction of Carbon dioxide. In treating the Calvin cycle; only the following compounds should be mentioned; Ribulose-disphosphate, unstable carbon compounds diphospho glyceraldehyde, glucose and starch. Conversion of starch to fat and protein should be mentioned. Details of the conversion not required.
(g) Excretion and Excretory products.	Treatment should include water, carbon dioxide, oxygen, alkaloids, tannin, acid, resin, gum.
(h) Reproduction (i) Floral formula (ii) Pollination	Caesalpinia Sp, Crotolaria Sp , floral diagram not required. Agents (wind and insect) mechanism and adaptation
(i) Growth and Development: Primary and Secondary growth	Simple measurement of growth by increase in length, area/volume and mass Graphical representation of growth data are required
(j) Dentition	Tooth structure. Dental care should also be stressed.
(k) Respiration Cell tissue respiration principles of aerobic and anaerobic pathways	The importance of anaerobic respiration in food processing Observation, drawing and labelling of the transverse section of a bone from a slide under the microscope is required. Types of muscle: smooth, striated and cardiac muscle. Examination of different types of muscle is required.
(l) Movement Action of muscles on bones to effect Movement	Locomotion should be treated in a named mammal.
(m) Reproduction (i) Testis and Ovary (iii) Secondary Sexual characters	Structure and function. Histological study is required but developmental stages are not required. The role of hormones in development of secondary sexual characteristics is required.

WEST AFRICAN SENIOR SCHOOL CERTIFICATE EXAMINATION
BIOLOGY

CONTENTS	NOTES
5. ECONOMIC IMPORTANT OF SOME INSECTS	The structure, mode of life, and economic importance of weevil, termites, cotton stainers, grasshoppers, honey bee are required.
6. SOIL	
(a) Soil Formation	Sizes of soil particles should be noted. The following mineral salts,
(b) Soil Components	Ca^{2+} , Fe^{2+} , Mg^{2+} , and some anions
(c) Mineral Salts	e.g. SO_4^{2-} , NO_3^- are required
(d) Organic matter	
(i) Water Content	
(ii) Air Content	
(iii) Living organisms in the soil	Determination of organic matter, water, air, and living organisms, in the soil should be discussed.
(e) Physical nature and Properties of soil types	Activities to compare properties of sandy, loamy clayey soil regarding permeability, capillarity, pH, water holding capacity are required.
(f) Conservation, maintenance and Renewal of Soil fertility	The various methods used for conserving, maintaining and renewing soil fertility should be known: bush fallowing, surface terracing, contour ploughing, strip cultivation, crop rotation, manuring, irrigation, cover crops and mulching should be known.
	Activities to demonstrate the effect of these methods are required.
7. FUNDAMENTAL CONCEPTS IN ECOLOGY	
Dominance, environment, energy flow	The study should include energy flow in food chain and food webs, producers, consumers, decomposers tropic levels, pyramid of numbers, biomass and energy.
	Methods of determination of food chains and food webs should include direct observation and dissection.
Population dynamics	Population density, immigration, emigration, population growth. Method of measuring population: Sampling-transact, total counts, capture-mark-release-recapture methods are required.

WEST AFRICAN SENIOR SCHOOL CERTIFICATE EXAMINATION
BIOLOGY

<p>8. MAN AND HIS BIOLOGICAL ENVIRONMENT</p> <p>(a) Health and Hygiene</p> <p>(b) Community Health</p> <p style="padding-left: 40px;">(i) Criteria for good housing</p> <p style="padding-left: 40px;">(ii) Personal hygiene</p> <p style="padding-left: 40px;">(iii) Water supply, source and purification</p> <p style="padding-left: 40px;">(iv) First Aid</p>	<p>School buildings, siting, design, building materials orientation, surroundings, ventilation, and sanitation should be discussed.</p> <p>Study should include care of all parts of the body.</p> <p>The dangers posed by drug abuse including smoking, alcoholism should be emphasized.</p> <p>Mention should be made of ways through which drinking water may be contaminated and purified. Filtration should include the use of clean cloth and sand.</p> <p>First aid in cases of drowning, bleeding, snake bite, burns and scalds, fracture, fits, epilepsy, dislocation. fainting, the importance of methods employed in first and should be stressed.</p>
<p>9. GENETICS AND EVOLUTION</p> <p>(a) Genetic engineering.</p> <p>(b) DNA and gene replication.</p>	<p>Candidates should know the meaning of genetic engineering.</p> <p>Candidates should study the structure and gene replication using models.</p>

WEST AFRICAN SENIOR SCHOOL CERTIFICATE EXAMINATION
BIOLOGY

SECTION C
(FOR CANDIDATES IN NIGERIA)

CONTENTS	NOTES
A. CONCEPT OF LIVING	
1. The Cell	The cell theory including the work of Hooke, Dujardin, Schleiden and Schwann should be outlined.
2. Cell's reaction to its environment	
(a) Irritability as a basic characteristic of Protoplasm	
(b) Types of responses; taxis, nastism	Reference should be made to pseudopodia. The organelles should be observed from prepared slides.
(c) Environmental factors that evoke responses: temperature, pH.	
3. Movement	
(a) Cyclosis,	The different supporting tissues: turgid parenchyma, collenchma, xylem (wood) sclerenchyma should be studied.
(b) Organelles for movement: cilia, flagella	
4. Tissues and supporting Systems, Skeletal supporting systems in animals.	
(a) Biological significance	Compare and contrast various mechanisms of transportation. The following mechanisms should be mentioned – protoplasmic streaming, pumping of blood in higher animals, open circulatory system in invertebrates, transpiration pull, root pressure, and active transport in plants. Compare and contrast various mechanisms of transportation, experiments illustrating transport in plants should be performed.
(b) Skeletal materials, e.g. chitin, cartilage	
5. Supporting tissues in plants	
6. Transport System	
(a) Media of Transportation: Cytoplasm in cells, cell sap or latex in most plants, body fluid in invertebrates.	
(b) Mechanism of transportation in multicellular organisms, invertebrates higher animals and higher plants.	

WEST AFRICAN SENIOR SCHOOL CERTIFICATE EXAMINATION
BIOLOGY

SECTION E
(FOR CANDIDATES IN NIGERIA)

CONTENTS	NOTES
<p>7. Respiratory System: Stomata and lenticel in plants, tracheal system in insects.</p> <p>Mechanism of gaseous exchange in insects.</p>	<p>Candidates should observe, draw and label the excretory organs of flatworm, earthworm and insect (e.g. cockroach).</p>
<p>8. (a) Excretory System and Mechanisms:</p> <p>Types: flame cell, nephridia, Malpighian tubes</p> <p>(b) Diseases of the kidney: Nephritis, kidney stone and diuresis, Their effects and remedy.</p> <p>(c) (i) Liver</p> <p>(ii) Diseases of the liver: infective hepatitis, cancer of the liver and gall stones, their effects and remedy.</p> <p>(d) The skin: Care of the mammalian skin</p>	<p>Excretory mechanism of earthworm and insects should be mentioned.</p> <p>Reference should be made to the need for regular washing of the body.</p>
<p>9. Hormonal Coordination Plant hormones Modern application of auxins</p>	<p>Particular reference to crop harvesting, growth, and weed control should be made.</p>
<p>10. Nervous Coordination, Peripheral Nervous System, Conditioned reflex and its role on behaviour.</p>	<p>Candidates should be able to enumerate conditioned reflexes such as salivation, driving a car, walking and swimming.</p>
<p>11. Sense Organs</p> <p>(a) The skin as a sense organ. Sensations received by the skin: touch, pressure, pain, cold and heat.</p>	

**WEST AFRICAN SENIOR SCHOOL CERTIFICATE EXAMINATION
BIOLOGY**

CONTENTS	NOTES
(b) Organ of smell (c) Organ of taste	<p>The process of perception of smell including the roles of sensory cells in nose and olfactory lobes should be studied. Mention should be made of taste buds.</p> <p>Experiments should be carried out to determine the different areas of the tongue associated with different tastes. The association between the organs of taste and smell should be discussed</p>
<p>12. Reproduction</p> <p>(a) Courtship behaviour in animals:</p> <p>(i) Pairing</p> <p>(ii) Display e.g. peacocks</p> <p>(iii) Territoriality</p> <p>(iv) Seasonal migration associated with breeding in herrings, eels and birds.</p> <p>(b) Adaptive features in a developing animal:</p> <p>(i) Yolk in egg of fish, toad and birds for nourishment</p> <p>(ii) Placenta in animals</p> <p>(iii) Kinds of placentation: axile, marginal and parietal</p> <p>(c) Structure of a monocotyledonous and dicotyledonous embryo</p> <p>(d) Fruits Development of fruits and seed and ovary wall</p>	<p>Courtship pattern in male and female animals and territorialism in lizards should be observed.</p> <p>The content (yolk and albumen) of birds' egg should be examined.</p> <p>Candidates should observe the connection of the foetus to the mother and the adaptive features of the placenta, umbilical cord and amnion in a dissected pregnant rat.</p> <p>The meaning of oviparity and viviparity should be discussed.</p> <p>Location of the position of embryo in seed should be noted. External changes which take place in fertilized ovum should be discussed.</p>
B. PLANT AND ANIMAL NUTRITION	
<p>1. (a) Nitrogen cycle</p>	<p>The names and roles of bacteria involved in nitrogen cycle should be known. Candidates to observe root nodules in leguminous plants.</p>

WEST AFRICAN SENIOR SCHOOL CERTIFICATE EXAMINATION
BIOLOGY

CONTENTS	NOTES
<p>2. (b) Modes of nutrition: autotrophic, chemosynthetic, carnivorous plants</p> <p>(c) Alimentary System</p> <p>(i) Alimentary tracts of different animals</p> <p>(ii) Description and function of various parts.</p> <p>(iii) Modifications of parts as they affect their digestive function.</p> <p>(d) Feeding habits</p> <p>(i) Categories: Carnivorous, herbivorous and omnivorous</p> <p>(ii) Modifications and mechanisms associated with the following habits: filter feeding, fluid feeding, feeding adaptation in insects, saprophytic feeding, parasitic feeding</p> <p>(e) Feeding in Hydra</p> <p>C. BASIC ECOLOGICAL CONCEPTS</p> <p>1. Ecological Components: Lithosphere, hydrosphere, atmosphere, niche</p> <p>2. Local biotic communities or biomes</p> <p>(a) Tropical rain forest</p> <p>(b) Southern Guinea savanna</p> <p>(c) Northern Guinea savanna</p> <p>(d) Sahel</p> <p>(e) Desert</p> <p>(f) Swamp/estuarine</p>	<p>Example of carnivorous plants should be studied.</p> <p>Comparison should be made using dissected earthworm, grasshopper/cockroach to show the important features of the alimentary canal.</p> <p>Use a bird and cockroach/grasshopper to show modifications for functions</p> <p>Mosquito larva, housefly, butterfly, cockroach, adult mosquito, maize weevil, rhizopods, tapeworm should be used to illustrate the different types of feeding mechanisms and various modification.</p> <p>Reference should be made to feeding habits in Hydra</p> <p>Candidates are expected to explain and give examples of the terms.</p> <p>Identify these local biotic communities and associate each state in Nigeria with a particular biotic community.</p>

WEST AFRICAN SENIOR SCHOOL CERTIFICATE EXAMINATION
BIOLOGY

CONTENTS	NOTES
<p>3. Major Biomes of the World</p> <p>(a) Tropical forest</p> <p>(b) Savanna</p> <p>(c) Desert</p> <p>(d) Shrub</p> <p>(e) Afro Alphine</p> <p>(f) Swamp</p>	<p>Difference in structure should be mentioned and contrast between the temperate regions and the tropics should be stressed.</p>
<p>4. Population Studies by Sampling</p> <p>(a) Population size</p> <p>(b) Dominance</p> <p>(c) Density</p> <p>(d) Factors that affect population</p>	<p>Candidates are required to carry out a project to determine population density by counting the individual types of plants and animals and record such count in a given plot.</p>
<p>5. Energy transformation in nature:</p> <p>Energy loss in the biosphere</p>	<p>Reference should be made to harvest as a means of measuring primary production.</p> <p>Laws of thermodynamics and its application to ecological phenomena should be discussed. The laws of thermodynamic should be used to explain energy flow across tropic levels.</p>
<p>6. Nutrient Cycling in Nature</p> <p>(a) Carbon Cycle:</p> <p>(i) Process of carbon cycle</p> <p>(ii) Importance of carbon in nature.</p> <p>(b) Water Cycle:</p> <p>(i) Importance of water cycle,</p> <p>(ii) Importance of water to living organisms.</p>	<p>Candidates should be able to draw the carbon cycle, list the sources of carbon (burning, respiration, decay) and discuss the relative importance of the cycle.</p> <p>Reference should be made to carbon dioxide-oxygen balance in nature. Candidates should carry out experiments to show absorption of carbon dioxide and release of oxygen during photosynthesis.</p> <p>Candidates should carry out experiments to show the presence of water in expired air and that water is given off during respiration.</p>
<p>7. Ecological Management: Tolerance</p> <p>(a) Minimum and maximum range,</p> <p>(b) Geographic range</p>	<p>Candidates should perform experiments to show the limit of tolerance of Tilapia to various concentrations of salt solution or sensitivity of wood lice to temperature.</p> <p>Reference should be made to geographical distribution of organisms from the equator to the poles as example of geographic range of tolerance.</p>

WEST AFRICAN SENIOR SCHOOL CERTIFICATE EXAMINATION
BIOLOGY

CONTENTS	NOTES
8. Habitats	
(a) Aquatic habitat: marine, estuarine fresh water under the following headings: <ul style="list-style-type: none"> (i) characteristics of habitat (ii) distribution of plants and animals in the habitat. (iii) adaptive features of plants and animals in the habitat. 	<p>One of the mentioned habitats should be chosen for study. Measurement of physical factors: temperature, salinity, light intensity, turbidity, current, pH, should be carried out.</p> <p>The pattern of distribution including dominant types and seasonal changes of population, size of organisms in the habitat should be noted.</p>
(b) Terrestrial habitat: marsh forest, grass land, arid land should be studied under the following headings: <ul style="list-style-type: none"> (i) characteristics of habitat (ii) distribution of plants and animals in habitat. 	<p>One of the mentioned habitats should be studied. The measurement of the physical factors, temperature, relative humidity, light, wind, and pH should be carried out.</p> <p>Reference should be made to edaphic factors.</p> <p>The effect of physical factors on distribution of plants and animals should be mentioned.</p>
(c) Primary Succession: Succession in aquatic habitat	Candidates should study succession in a pond over a period of time to discover a definite sequence of colonising plants.
(d) Balance in Nature <ul style="list-style-type: none"> (i) Dynamic equilibrium population and population density (ii) Factors affecting a population (iii) Response of population to abiotic and biotic factors. 	<p>The process by which carnivores maintain a constant population should be discussed.</p> <p>Reference should be made to pest, abiotic factors; temperature, space, water and light.</p> <p>Biotic factors; food, competition, mortality, dispersal, parasites, pathogens and predators.</p>
(e) Population growth and Food Supply <ul style="list-style-type: none"> (i) Relationship between availability of food and human population. (ii) Family Planning (iii) Factors that affect availability of food. 	<p>Candidates should carry out experiments to show the effects of limited food on mice population. Reference should be made to the effect of food shortage on human population during famine</p> <p>Human population and family planning should be discussed.</p>

WEST AFRICAN SENIOR SCHOOL CERTIFICATE EXAMINATION
BIOLOGY

CONTENTS	NOTES
9. Food production and storage	Reference should be made to factors affecting food production, distribution, (transport and roads), and government's efforts to increase food production.
(a) Factors affecting food production and storage	
(b) Causes of wastage	The effect of harvesting method, storage, and pest should be known.
(c) Food shortage	
(i) Causes of food shortage	Reference should be made to effects of drought, and diseases e.g. rinderpest on food production.
(ii) Effect of food shortage on the size of population. Competition, emigration, decline in rate of reproduction and mortality.	Candidates should perform experiments using rats or Zonocerus with adequate/inadequate supply of food to observe their behavior over a period of time.
(d) Methods of preserving and storing food, salting, drying, smoking, refrigeration, canning and use of chemicals.	The principles involved in using these methods of food preservation should be discussed. Reference should be made to their effects on flavour and quality of food.
(e) Ways of improving crop yield	Reference should be made to cross breeding, pest control, improved farming technique and use of fertilizer.
10. Relevance of Biology to Agriculture	
(a) Classification of plants	Candidates should classify plants using the following criteria: (i) botanical classification (ii) agricultural classification (iii) classification based on life cycle.
(b) Effects of agricultural practices on ecology	
(i) Bush burning	
(ii) Tillage	
(iii) Fertilizer	
(iv) Herbicide/pesticide	
(v) Different farming methods.	Effects of human activities on ecological systems should be discussed.

WEST AFRICAN SENIOR SCHOOL CERTIFICATE EXAMINATION
BIOLOGY

CONTENTS	NOTES
<p>(c) Pests and Disease of agricultural importance</p> <p>(i) Pests</p> <p>(ii) Diseases</p> <p>11. Micro organisms: Man and His Health.</p> <p>(a) Micro-organisms around us</p> <p>(i) Micro-organisms in air and water</p> <p>(ii) Groups of micro-organisms bacteria, viruses, some algae, protozoa and some fungi.</p> <p>(b) Micro-organisms in our bodies and food</p> <p>(c) Public Health:</p> <p>The importance of the following to the maintenance of good health: refuse disposal, sewage disposal, protection of water, food hygiene, control of disease, health organisations.</p> <p>D. Benefits of Conservation</p>	<p>The effect of pest on crop and livestock with respect to their cycle and control should be studied using specific examples.</p> <p>The effect of diseases on crops and livestock with respect to their causative organisms and control should be studied using specific examples.</p> <p>Micro-organisms in air, water and expired air should be observed and identified by their colour, pattern of growth and appearance of their colony.</p> <p>Micro-organisms under the finger nails, mouth cavity, expired air, and decomposing food substance should be observed and identified by their colour, pattern of growth, and appearance of colony.</p> <p>Candidates should be familiar with the proper methods of carrying out these public health activities in their community. Reference should be made to the roles of national and international health organisations in maintenance of good public health. Various forms of immunisation should be mentioned.</p> <p>Reference should be made to prevention of erosion, prevention of desert encroachment, protection of plant and game animals for planned harvesting and regulating the use of minerals.</p>

WEST AFRICAN SENIOR SCHOOL CERTIFICATE EXAMINATION
BIOLOGY

CONTENTS	NOTES
E. Application of Variations	
1. Crime detection	The uniqueness of each individual's finger print should be discussed in relation to crime detection.
2. Blood transfusion	Reference should be made to importance of knowledge of blood groups in blood transfusion and determination of paternity.
3. Determination of paternity	
F. Evolution	
1. Adaptation for survival	Reference should be made to the factors such as food, space, water, light and mates which organism share and form the basis of competition.
(a) Factors that bring about competition	
(b) Intra and Interspecies competition	The effects of intra-species competition should be observed by growing many seedlings of maize in a small area, while the effects of interspecies competition can be observed by planting many seedlings of maize and pepper in a small area.
(c) Relationship between competition and succession	Candidates should observe competition and succession on a moistened exposed slice of bread over a period of time.
2. Structural Adaptation for:	Candidates should observe examples of organisms that show structural adaptation for obtaining food, escaping from enemies, securing mate, regulating body temperature and conserving water.
(a) obtaining food	
(b) protection and defence	
(c) securing mates for reproduction	
(d) regulating body temperature	
(e) conserving water	
3. Adaptive Colouration	Candidates are required to observe examples of adaptive colouration in plants and animals.
(a) Plants and animals	
(b) Colouration and their functions	
4. Darwin's Theory of evolution	Reference should be made to modern evolutionary theories (evidence from genetic studies and role of mutation in evolution).