INTERIM JOINT MATRICULATION BOARD

BIOLOGY

SYLLABUS

INTERIM JOINT MATRICULATION BOARD EXAMINATION (IJMBE)
BIOLOGY SYLLABUS (REVISED 2012)

1. Introduction:

The IJMB Biology syllabus is designed to provide a guide for instruction at colleges of advanced studies (A Levels), which prepare students for entry into the 200 level Biology programmes in Nigerian Universities. It assumes that students of Biology at this level have completed the 'O' Level Biology syllabus as prescribed by WAEC/ NECO. The syllabus is planned for delivery over a contact period of **at least 12 months**.

As much as possible, students are expected to expand their skills in observation, classification and interpretation of biological data, and to develop a scientific attitude to problem solving. It is also expected that their abilities to apply biological principles in everyday life will increase.

2. Aims and Objectives:

This syllabus has the following aims and objectives:

i. To **further develop** candidates' understanding of levels of organization in living organisms.

ii. To **enhance** candidates' knowledge of the natural (taxonomic) relationships between the various plant and animal phyla.

iii. To **increase** candidates' capacity to relate structure and function within living systems.

iv. To **develop** candidates' competence in application of simple statistical concepts in biological studies.

v. To **introduce** candidates' to basic concepts in microbiology, as relevant to plant, human and animal life.

vi. To **increase** candidates' understanding of simple ecological concepts and their applications in everyday life.

vii. To **enhance** candidates' understanding of the major principles of genetics and their relevance to heredity.

viii. To **expose** candidates to the theories of evolution and the role of natural selection in the evolution of living organisms.

The syllabus is therefore organized into eight (8) major sections, viz:

SECTION A: SUBCELLULAR AND CELLULAR LEVELS OF ORGANIZATION

SECTION B: DIVERSITY OF ORGANISMS

SECTION C: FORM AND FUNCTION OF LIVING SYSTEMS
SECTION D: BIOSTATISTICS
SECTION E: BASIC MICROBIOLOGY
SECTION F: ECOLOGY
SECTION G: GENETICS
SECTION H: EVOLUTION

3. Examination Scheme:

The IJMB Examination in Biology will consist of two Theory Papers of 3 hours each, which together will constitute 60% of the final mark.

A. Paper I: GENERAL BIOLOGY AND BOTANY (Statistics, Ecology, Botany and Basic Microbiology)

Candidates will be required to answer **FOUR** out of **SIX** questions. The first question, which will include statistics in addition to short answer questions covering relevant areas of the syllabus, will be compulsory. The paper will cover the following sections of the syllabus:

Section A: Plant Tissues (see Cellular and sub cellular levels of organization)

Section B: Diversity of Organisms (Plants and Plant like organisms):

1. Protoctista
2. Algae
3. Fungi
4. Plants

Section C: **Form and function of living systems:**

1. Plants
   - a) Plant structures
   - b) Nutrition in plants (Autotrophic & heterotrophic Nutrition)
   - c) i. Vascular systems in plants
     ii. Transport in plants
   - d) Respiration (as applicable)
   - e) Reproduction in plants
   - f) Growth and development
   - g) Co-ordination (as applicable)

Section D: Biostatistics
Section E: Basic microbiology
Section F: Ecology

B. Paper II: GENERAL BIOLOGY AND ZOOLOGY (Genetics and Evolution, Cell Biology and Zoology)

Candidates will be required to answer **FOUR** out of **SIX** questions. The first question, which will be drawn from Genetics and will include short answer questions covering the relevant areas of the syllabus, will be compulsory.

The paper will cover the following sections of the syllabus:

Section A:
1. Animal Tissues (see Cellular and sub cellular levels of Organization
2. Cell processes
3. Enzymes

Section B: Diversity of Organisms (Animals and Animal like organisms):
1. Protoctista
2. Protozoa
3. Animalia

Section C: Form and function:
2. Animals
a) Nutrition in Animals
b) Transport in vertebrates
c) Respiration (as applicable)
d) Excretion in Animals
e) Support and Locomotion in Animals
f) Reproduction in Animals
g) Growth and development
h) Co-ordination (as applicable)

Section G: Genetics

Section H: Evolution

NOTE: The above grouping of the various sections of the syllabus is for Examination purposes only and is therefore purely for convenience. Inevitably, there are a few areas of overlap (e.g. Cell Biology and Cell Physiology).

Historic background and experimental approaches, which led to major biological discoveries, are to be touched upon in appropriate topics to create interest and curiosity in students. While it is necessary that physical and chemical principles underlying biological phenomena be understood, the detailed study of

complex chemical processes (e.g. Kreb's cycle, chloride shift, and unit effect) **is not required**.

C. PRACTICAL WORK:

Practical work will form an important and integral part of the course. Candidates will be taken through a course of practicals, based on theory wherever possible and thereby covering all the major topics of the syllabus. These shall be assessed internally and the marks obtained shall constitute a percentage of the Final Mark in Biology.

The IJMB Secretariat may, at any time, require that candidates' Practical Notebooks be submitted for inspection by Chief Examiners and Moderators.

In addition, each college will arrange a formal practical examination for its candidates during the course and the mark obtained during this examination shall constitute 20% of the final grade in Biology. The IJMB Secretariat may require the submission of the question papers and the scripts to the Chief Examiners and Moderators for scrutiny.

PAPER III: PRACTICAL WORK

In this course, practical techniques, such as the use of light microscope, making slides (not permanent preparations), dissection of plants and animals and how to make biological drawings, should be emphasized. There is no special syllabus for practical work. Some suggestions are listed below:

1. **Introductory Practical** – How to make drawings, use of microscope, cell study using plant cells (e.g. onion peels) and animal cells (e.g. cheek scrapings).

2. **Classification:**
   (a) Protoctista
      i. Algae
      ii. Protozoa
   (b) Fungi
   (c) Plants (Bryophytes, Pteridophytes, Gymnosperms, Angiosperms)
   (d) Animals (Cnidaria / Coelenterata, Platyhelminthes, Annelida, Nematoda, Mollusca, Arthropoda, Chordata)

3. **Morphology of Angiosperms** – Roots, stems, leaves, flowers (floral diagrams and floral formulae; one dicot, one hermaphrodite, one unisexual, one monocot).

4. **Plant Anatomy** – Sections of roots, stems and leaves of both monocots & dicots.

5. **Animal Form and Function** – A suitable vertebrate (e.g. rat, rabbit, guinea pig), fowl, lizard, etc. to show features and viscera; venous, arterial, digestive and urinogenital systems, heart. Display of external features of above.

6. **Physiology** – Food tests, digestion using enzymes, enzyme experiments (effects of varying concentrations, temperatures and pH). Osmosis (using potatoes, yams, onion peels or other suitable plant materials).Plasmolysis.Blood groups.Growth (rate of growth of leaves and stems).

7. **Transpiration** – Relevant experiments (mostly demonstration), e.g. transpiration rates measured by loss of weight methods/cobalt chloride paper, photometer, root pressure (manometer).

8. **Respiration** – Use of respirometers (using small insects, plant materials, etc.).

9. **Photosynthesis** – Mostly demonstrations of the effects of varying light intensities, CO_2 concentration and temperature. Extraction of chlorophyll, measurement of PPS in leaf disks.

10. **Histology** – Alimentary canal (stomach ileum and duodenum), liver, kidney, testis, ovary, muscle (cardiac, striated, non-striated, smooth), tissues (epithelial: ileum, duodenum and skin), skeletal tissues (bone, cartilage), connective tissue (including blood).

11. **Ecology** – Measurements of abiotic factors, Estimation of populations (plants and animals), investigations of soil organisms (not micro-organisms), Moisture, organic matter, air, porosity and capillarity.

12. **Statistics** – Measurements of statistical variables, frequency distributions, cumulative frequency curves, histograms, frequency polygons,

measurements of central tendency (means, median, mode), measurements of dispersion (ranges, standard deviation, variance), concepts of probability.

13. **Genetics** – Mitosis and meiosis (use of slides or squash preparations), demonstration of inheritance using coloured beads, beans, etc. Problems on Mendel's "laws", and deviations from them.

D. CONTINUOUS ASSESSMENT:

Continuous assessment shall form an element of the final examination, accounting for 20% of the Final Mark. This shall consist of:

(a) Continuously assessed practical work - 10%.
(b) Essays and Quiz - 10%.

DETAILED SYLLABUS
FIRST SEMESTER SYLLABUS
SECTION A: SUBCELLULAR AND CELLULAR LEVELS OF ORGANIZATION

S/NO:	TOPICS AND CONTENTS	ACTIVITIES / PRACTICAL GUIDE	INSTRUCTIONAL MATERIALS	DURATION L	DURATION P Hours
1.	THE GENERALIZED CELL (a) The cell as a fundamental unit of structure and function A brief definition of cell and summarized form of cell theory i. Microscopes and Microscopy **Light** and **electron** microscopes. The parts, drawing and naming of the parts, functions, advantages and disadvantages of a light microscope should be enumerated. Brief account of function of electron microscope, types, functions, advantages and disadvantages. Use of dissecting microscopes ii. Animal and plant cells as seen under light microscope. A simple treatment of the structure of cellular constituents of plant and animal cells as seen under light microscope with emphasis on -shape, structure and functions iii. Ultrastructure/Fine structure of the cell A detailed treatment of the fine structure and functions of various cellular constituents as illustrated by the electron microscope in plant and animal cells especially: plant cell wall, membranes, nucleus, endoplasmic reticulum, golgi bodies, lysosomes, vacuoles, mitochondria, cytoskeleton, centrioles, cilia, flagella and chloroplasts, ribosome iv. Molecular structure of the plasma membrane - Differences and similarities	A practical class on how to make Biological drawings, recording and reporting of practical should be introduced. The use, handling, drawing, labelling and functions of a light microscope should be emphasized Practicals should be conducted to study plant cell (using onion bulb/tomato fruit) and animal cell (e.g. cheek scrapings). Emphasis should be placed on simple cells constituting the bodies of both plants and animals	Provide simple and compound light microscopes, as well as dissecting microscopes Provide plain glass	18	9

	between the fine structures of plant and animal cells should be highlighted.		slides with cover slips. Provide relevant permanent slides. Provide relevant stains, etc. Provide plant materials/ specimens
	A simple illustration of a triple-layered structure of the cell membrane (i.e. protein – lipid – protein molecules)	Permanent/prepared slides should be used to allow candidates observe, draw and label chromosomes (e.g. Onion or Lilly root tips under light microscope in a practical class. Emphasis should be given to different stages, nature and behaviour of chromosomes and other associated organelles.	
	(b) Mitosis and Meiosis as a basic processes of cell multiplication i. Mitosis - Definition of mitosis, where it takes place and its significance in multiplication for growth and development of living organisms, illustrating the different stages/phases of mitosis and the role played by each phase		
	ii. Meiosis - Simple definition of meiosis, where it takes place and its significance in the evolution of plants and animals illustrating the different stages and sub-stages of meiosis in both first and second meiotic division).	Permanent/temporary prepared slides should be used to identify, draw and label the stages and sub-stages of meiosis. Emphasis should be placed on the nature, number and orientation of the chromosomes to identify the stages	
	iii. Gametogenesis - Meiosis as a means of gamete formation with reference to spermatogenesis, oogenesis, microsporogenesis and macrosporogenesis should be briefly discussed and illustrated		
	iv. Comparison between Mitosis and Meiosis - Emphasis should be given to points highlighting contrasting differences between mitosis and meiosis		
	(v) Introduction to concept of organizati organisms: tissues, organs and syste Definition and classificat tissues, organs and system as level of organization		Provide relevant permanent slides
	(c) Plant Tissues i. Parenchymatous tissues ii. Collenchymatous tissues	Study of slides of stem ent to locate, draw and label parenchyma.	

	iii. Sclerenchymatous tissues iv. Vascular or Conducting tissues v. Epidermal and Peridermal tissue A study of (i – v) plant tissues, emphasizing composition, distribution, forms and functions of each tissue **(d) Animal Tissues** i. Epithelial tissue ii. Connective tissue Skeletal iii. Muscular tissue iv. Nervous tissue A study of (i – iv) animal tissues, emphasizing types, classification, structures, arrangement, functions and importance of each tissue	collenchyma and sclerenchyma cells, relating the structures of these cells to their functions Permanent slides of the different types of epithelial, connective, skeletal, muscular and nervous tissues should be provided in a practical class stressing the distinguishing features of each and their location in animals body			
2.	CELL PROCESSES **(a) Biological processes in cells** i. Osmosis ii. Diffusion iii. Plasmolysis Outline of definitions and principles. Discuss the significance of these processes in regulating the internal and external environment of cells. Details of physio-chemical equations and equilibria involved are not required. Brief mention of other processes such as haemolysis, phagocytosis and pinocytosis	Conduct simple experiments to demonstrate these processes, using plant and animal materials	Provide potato osmometer, spirogyra filaments, red blood cells, etc. Provide hypotonic and hypertonic solutions	12	6

3.	ENZYMES **(a)Characteristics of enzymes and role in biochemical reactions** The importance of biochemical reactions and industrial usage of enzymes should be stressed **(b) Mechanism of enzyme action** i. Lock and key hypothesis ii. Induced fit hypothesis The specific nature of enzymes should be emphasized **(c) Enzyme inhibition** i. Competitive ii. Non-competitive reversible iii. Non-competitive irreversible Examples of enzyme inhibitors should also include drugs and poison **(d) Co-factors** i. Inorganic ions ii. Prosthetic groups, and iii. Co-enzymes Examples and types of reaction they act on should be given	Experiment should be undertaken to determine factors such as temperature, pH, enzymes concentration and substrate concentration that affect the rate of enzyme catalysed reactions	Provide relevant enzymes (e.g. invertase) and substrates (e.g. sucrose), etc.	6	3
4.	DIVERSITY OF ORGANISMS **(a)The principal groups of organisms. The super kingdoms and the five kingdom system of classification** A general survey of the Super Kingdoms. Eukaryotae. The major differences between Prokaryotae and Eukaryotae. An overview of the 5 Kingdoms of organisms: Prokaryotae, Protoctista, Fungi, Plantae and Animalia. A note on the status of the protozoa and algae. Distinguishing features of each of the kingdoms. Major differences between plants and animals **(b) Classification** A general idea of the meaning and value of classification of organisms. Definitions of taxonomic terms: Classification, Systematic, Taxon,	Engage students in collection, identification and classification of locally available specimens into their various groups and sub-groups based on observable external features to illustrate the value of classification and the use of taxonomic keys in identification	Relevant specimens, simple taxonomic keys (such as numbered keys and indented keys)	12	6

	etc. A mention of the use of molecular biology in taxonomy. A brief discussion of the binomial system of nomenclature and its rules				
5.	**PROTOCTISTA** **(a) Algae** i. Morphology and classification Outline the major classes/divisions of the algae. Study the general characteristics of the phylum. Classify algae up to the generic level. Outline major diagnostic characteristics of individual classes Discuss the range of forms as seen in unicellular, colonial, filamentous, siphonaceous and thalloid genera (e.g. *Chlorella*, *Chlamydomonas*, *Volvox*, *Spirogyra*, *Fucus*, *Laminaria*, etc.) ii. Importance Discuss economic/ecological importance of algae (e.g. as basis of aquatic food chains, roles in eutrophication, of water treatment, limestone formation, uses/products, etc.) **(b) Protozoa** i. Morphology and classification Outline the major phyla of the protozoa and their characteristics. Classify the protozoa up to generic level. Outline major diagnostic characteristics of individual classes Discuss the range of forms as seen in simple and complex types using examples such as *Amoeba*, *Trypanosoma*, *Trichomonas*, *Paramecium* and *Plasmodium* ii. Importance Discuss the economic importance of protozoa	Students should collect and classify specimens of algae Students should observe and draw specimens of algal species Students should collect and classify specimens of protozoa Students should observe and draw specimens and slides or protozoans	Relevant algal specimens Relevant protozoan specimens	12	6
6.	**FUNGI** i. Morphology and classification Outline the major fungal	Students should	Relevant fungal	12	6

	classes/divisions. Study the general characteristics of the phylum. Classify the fungi up to generic level. Outline major diagnostic features of individual classes	collect and classify specimens of the fungi	specimens		
6	Discuss the range of forms and mode of nutrition as seen in unicellular and multi-cellular types, e.g. Yeasts, *Rhizopus*, *Mucor*, *Aspergilus* *Penicillium*, *Phytophtora*, Mushrooms, etc. ii. Importance Study the economic/ecological importance of fungi (see section E)	Students should observe and draw specimens of fungi			
7.	LICHENS Types and range of forms. Economic/ecological importance, e.g. in succession, as sources of dyes, etc			6	-
8.	PLANTAE Outline the major groups of plants. Discuss their major differences and characteristics **(a) Bryophyta** i. Morphology and classification Outline the major classes of the bryophyta and their characteristics. Classify the bryophytes up to the generic level. Outline major diagnostic characteristics of the individual classes with reference to representative species, e.g. *Riccia*, *Marchantia*, *Funaria*, *Polytrichum*, etc. Discuss alternation of generations in these plants Discuss major morphological features that facilitated the transition from water to land ii. Importance Outline economic/ecological roles of these plants, e.g. in succession, soil enrichment, retardation of erosion, etc. **(b) Pteridophyta** i. Morphology and classification Outline the major classes of the pteridophytes and their characteristics. Classify the	Students should collect and classify specimens of bryophytes Students should examine and draw specimens of bryophytes	Relevant specimens of bryophytes Relevant specimens of pteridophytes	18	9

pteridophytes up to the generic level. Outline the major characteristics of the individual classes with reference to representative species, e.g. the club mosses (e.g. *Selaginella*), the ferns (e.g. *Nephrolepis, Dryopteris*, etc.). Discuss alternation of generations, emphasizing the dominance of the sporophyte and separate existence of the two generations at maturity. Highlight heterospory and its significance. Highlight the factors which contributed to the success of pteridophytes as land plants ii. Importance Outline economic/ecological importance of the pteridophytes, including their possible roles in formation of fossil fuels	Students should collect and classify specimens of pteridophytes	
	Students should examine and draw specimens of pteridophytes	Relevant specimens of Spermatophytes
(c) Spermatophyta i. Morphology and classification Outline the major classes of Spermatophyta and their characteristics. Classify the spermatophytes up to generic level. Comparatively study the major characteristics of gymnosperms and angiosperms. Mention extinct orders of the gymnosperms. Discuss the range of forms (trees, shrubs, herbs) in angiosperms with regards to their adaptations to habitats (aquatic and terrestrial). Discuss the diagnostic vegetative and reproductive features of monocots and dicots with reference to representative species of gymnosperms (e.g. *Pinus*) and angiosperms (e.g. any flowering plant). Highlight the development of the seed habit and its significance. Emphasize the dominance of the sporophyte and progressive increase in its complexity iv. Importance Discuss the economic/ecological roles of spermatophytes as dominant land flora, which provide food, shelter, clothing, energy, etc. to	Students should collect, classify and draw specimens of gymnosperms and angiosperms, monocots and dicots, various groups of dicots as adapted to different habitats	

	humans and other animals			18	9
9.	ANIMALIA Outline the major groups of invertebrates and vertebrates. Discuss their major differences and characteristics **(a) Cnidaria (formerly coelenterata)** i. Morphology and classification Outline the major classes of cnidaria and their characteristics. Classify the cnidarians up to generic level. Outline the major characteristics of the classes, with reference to representative species such as *Hydra* and *Obelia*. Highlight polymorphism. Discuss the range of forms/increase in complexity and level of organization of cnidarians as a factor in evolution ii. Importance Highlight the economic/ecological roles of cnidarians in the ecosystems (e.g. marine food chains, corals, etc.) **(b) Platy helminthes** i. Morphology and classification Outline the major classes of the Platy helminthes, and their characteristics. Classify the Platy helminthes up to the generic level. Outline the major diagnostic characteristics of the classes, with reference to representative species such as *Taenia, solium, Fasciola hepatica, Macrogyrodactylus/ Gyrodactylus/Planaria* Discuss the range of forms/increase in complexity and level of organization as a factor in evolution ii. Importance Highlight the economic/medical roles of platyhelminthes	Students should collect and classify cnidarian specimens Students should examine and draw specimens of cnidarians Students should collect and classify specimens of platyhelminthes Students should examine and draw specimens of platyhelminthes	Relevant fresh / preserved specimens of cnidaria Relevant fresh/preserved specimens of platyhelminthes		

S/NO:	TOPICS AND CONTENTS	ACTIVITIES/ PRACTICAL GUIDE	INSTRUCTIONAL MATERIALS		
	(c) Nematoda i. Morphology and classification Outline the major classes of the nematodes, and the characteristics of the phylum. Classify the nematodes up to the generic level. Outline the major diagnostic characteristics of the classes, with reference to representative species, such as *Ascaris, Trichinella, Necator, Onchocerca*	Students should collect and classify Nematode specimens	Relevant fresh/preserved specimens of Nematodes		
	Discuss the range of forms/increase in complexity and level of organization as a factor in evolution ii. Importance Highlight the economic/medical roles of nematodes(e.g in soil & as parasites of plants, animals, including man)	Students should examine and draw nematodes specimens			
	(d) Annelida i. Morphology and classification Outline the major classes of annelids, and discuss their characteristics. Classify the annelids up to the generic level. Outline major diagnostic characteristics of the classes, with reference to representative species, such as *Lumbricus, Nereis* and *Hirudo.*	Students should collect and classify annelid specimens	Relevant fresh/ preserved specimens of Annelids		
	Discuss the range of forms/increase in complexity and level of organization as a factor in evolution. Highlight metameric segmentation, true coelom ii. Importance Highlight the economic/ecological roles of annelids (e.g. in the soil, marine and freshwater ecosystems)	Students should observe and draw specimens of annelids			
	(e) Mollusca i. Morphology and classification Outline the major classes of the mollusca and their characteristics.				

Classify the mollusca up to the generic level. Outline major diagnostic characteristics of the classes, with reference to representative species, such as snails, clams/bivalves, *Octopus* Outline features of evolutionary significance such as advanced coelom, cephalization, presence of gills, shells, etc. Mention fossil molluscs	Students should collect and classify mollusca specimens	Relevant fresh/preserved specimens of Molluscs
ii. Importance Outline the economic/ecological significance of molluses (e.g. as intermediate hosts of disease causing organisms, food, source of ornaments, roles in aquatic food chains, etc.)	Students should observe and draw Mollusc specimens	
(f) Arthropoda		
i. Morphology and classification Outline the major classes of the arthropods and their characteristics. Classify the arthropods up to the generic level. Outline major diagnostic characteristics of the classes, with reference to representative species, such as spiders, scorpions, millipedes, centipedes, crayfish, crabs, and insects from different orders. Highlight complete and incomplete metamorphosis using examples such as mosquitoes/housefly, cockroach /grasshopper, butterfly/bee. Highlight features of evolutionary significance, such as reduction of the coelom, development of the exoskeleton, heart and related structures molting and ecdysis, social behaviour and flight in insects, etc. Mention fossil arthropods. Factors related to success of insects	Students should collect and classify arthropods Students should observe and draw arthropods	Relevant fresh/preserved specimens of Arthropods
ii. Importance Outline the economic / ecological / medical significance of arthropods	Students should	Relevant fresh/

	(g) Chordata i. Morphology and classification Outline the major classes of the chordata and their characteristics. Classify chordata up to the generic level. Outline major diagnostic features of the classes, with reference to representative species of hemichordata (*Balanoglossus*) and urochordata (e.g. sea squirts/tunicates, cephodochordata (e.g. *Amphioxus*) and vertebrata (e.g. fishes, frogs/toads, lizards/snakes, birds and mammals) Highlight features of evolutionary significance in the various sub-groups. Briefly discuss the position of Amphibia as the first terrestrial vertebrates, and the various adaptations for life on land ii. Importance Outline the economic / ecological / medical importance of the chordate	collect and classify chordates Students should observe and draw chordates	specimens of Chordates		
	SECTION C: FORM AND FUNCTION OF LIVING SYSTEMS				
10.	PLANTS **(a) Structures in flowering plants** i. Their morphology - Root Types of roots, e.g. pneumatophores, fibrous, stilt, tap root, etc. Their distinguishing characteristics related to function. - Stem Types of stems, e.g. corm, rhizome, runner, etc. Their distinguishing characteristics related to function - Leaves Leaf arrangement and	Named examples of each should be observed and drawn Diagrams of L.S. dicot flower	Provide plants with each type of root, stem, leaf, flower and fruit modification Provide relevant slides. Refer to relevant wall charts	12	6

	modifications to suit habitat. Dicot and monocot leaf shape and structure in relation to function - Flower Types and structure of dicot and monocot flower and function of each part. Differences between the two should be highlighted. - Fruits Types of fruits and placentation; Fruit and seed dispersal mechanisms.	examples. Floral diagram and formula should be introduced. Specimens of various fruit types should be dissected (L.S. and T.S.) observed and drawn	during teaching		
	ii. Anatomy of monocot and dicot: - Root - Stem - Leaf General arrangement of tissues in the three organs in relation to function and ecological environment (leaf) should be discussed. Root hair structure and function	Slides of T.S. and L.S. of the three organs.	Provide materials for experimental set-ups		
	(b) Nutrition in Plants i. Types of Nutrition - Autotrophic – photosynthesis and chemosynthesis Requirements and the process of photosynthesis. Dark and light reactions with cycles drawn to illustrate them. (No need for the biochemical details of substances named). Final products and their significance should be discussed. An outline of chemosynthesis with examples -Holozoic/ Heterotrophic Mention cf plants which trap and digest insects, their habitats and designs, e.g. Venus fly trap - Mineral requirements of plants Their sources including chemical fertilizer compositions, roles and deficiency symptoms	Growth of maize seedling in dark and light to demonstrate etiolation. Measurement of photosynthesis in leaf disks	Provide materials for experimental set-ups Provide materials for experimental set-ups. Refer to relevant wall charts during teaching Provide materials for experimental set-ups. Refer to relevant wall charts		

	- Transport Systems Explain need for transport system due to increase in size and change in habitat. Importance of the following processes, their composition, structure and function should be stressed - Water relations Explain concepts of Osmotic, Suction and Turgor pressure, plasmolysis (see section A 2a) - Transport in Xylem Movement of water and dissolved mineral salts from soil through root hair to Xylem vessel and ascent of sap together with diagrams - Transport in Phloem Movement of synthesized food from leaves to other parts of plants, active transport, effect of ringing should be explained - Transpiration Process and factors affecting transpiration **(c) Respiration** i. Ventilation structures Stomata apparatus, lenticels. Mechanism of gaseous exchange and utilization of end products ii. Aerobic and Anaerobic respiration Definitions, equations and examples and uses. Differences between aerobic and anaerobic respiration.	Growth experiments to show deficiency symptoms Experiments to demonstrate each Experiments to demonstrate effect of changing light intensity, temperature, wind, measurement of transpiration rates by loss of weight method/cobalt chloride paper, photometer Set-up an observation to take 12 – 48 hours	during teaching Provide materials for experimental set-ups. Refer to relevant wall charts during teaching Provide materials e.g. for experimental set-ups. Refer to relevant wall charts during teaching Provide materials e.g. for experimental set-ups. Refer to relevant wall charts during teaching		
	(d) Reproduction General outlines of Sexual and Asexual reproduction in plants. (e) Plant growth and development Various definitions of growth should be stated. Rate, pattern and stages of growth with explanation	Diagrams of named examples mount and observe pollen from wind and animal pollinated flowers to show difference Named examples should be examined and drawn	Provide relevant pollen types Provide relevant fruit and seed types. Refer to wall charts, etc. during teaching		

	of sigmoid curve. Various methods of measurement of growth. Meristems should be introduced. Germination, types with named examples. Conditions necessary for growth, light, temperature and mineral requirements, etc. Plant growth substances (auxins, gibberellins, cytokinins, ethylene as inhibitors and promoters). Their location, movement and effects should be mentioned	Grow maize and measure growth. Observe L.S. Onion root tip as e.g. of meristem Grow *Amaranthus / Bryophyllum* and show lateral bud inhibition	Provide materials for experimental set-ups. Refer to relevant wall charts during teaching		
11.	ANIMALS **(a) Nutrition in animals** i. Food substances: carbohydrates, proteins, lipids, vitamins, mineral salts and water. Nutritional deficiencies. Brief mentioning of the component of animal and plant carbohydrates, their sources, roles and function. Sources and functions of vitamins, mineral salts, and water ii. Nutritional types in animal Discuss and give examples of Heterotropic: Holozoic, Parasitic and Saprophytic. Briefly mention subtypes iii. Structure of teeth Herbivores, carnivores and omnivores, dental formular of each, and their specialization to types of diet iv. Digestion Organs associated with digestion, absorption and assimilation of digested food in animals. Mention digestive enzymes, and their functions v. Histology and function of deuodenum, stomach, small and large intestines and liver Structure and functions of different parts of alimentary canal should be highlighted	Test for starch, reducing sugar, protein, fats and oil. Compare digestive systems of Reptile or Amphibian, bird and that of a mammal indicating their differences and similarities Histology and functions of various sections of the digestive tract, including liver and pancreas Examine and draw slides of composition of blood, arteries,	Provide specimens for dissection. Refer to relevant models/wall charts. Provide relevant slides Provide relevant models/ wall charts Provide relevant slides and specimens for dissection	12	6

	(b) Transport in vertebrates: Mention the need for transportation i. Structure and function of the mammalian heart and major blood vessels. Mention the structure and functions of main arteries, capillaries and veins, and their differences. General pattern of blood vessels to be treated briefly for understanding of transport of materials between blood and tissues. Mention names of blood vessels, heart diseases/ arteriosclerosis. Transportation of materials such as excretory products, gases, digested food and nutrients should be treated briefly (c) Respiration in vertebrates: i. Ventilating structures General characteristics of respiratory surfaces. Mechanism of gaseous exchange in fish, toad and mammal should be explained, including body surface, cutaneous, gills and lungs as ventilating structures. Mention importance of mouth-to-mouth resuscitation and the use of ventilators. Muscular depletion of oxygen during heavy exercise **(d) Excretion in animals** Discuss need for excretion i. Excretory organs Discuss the kidney (including the nephron), liver, lungs and skin, their structure, function, mechanisms of carrying out functions and their excretory products. Emphasize regulation of internal environment by skin. Mention conditions that affect function of the kidney, e.g. water and salt content of blood, and	veins, capillaries and heart tissues. Dissect a mammal; expose the circulatory system and draw. Examine and draw the respiratory structures of fish, toad and mammal Muscular depletion of oxygen during running Examine and draw the L.S. of mammalian kidney, skin and liver	Provide relevant specimens for dissection	3	3

	environmental temperature. Mention types and causes of disease of kidney, liver and skin ii. Osmoregulation and excretion, and their relationship Osmoregulation in freshwater, marine and terrestrial environment, and give specific examples, e.g. *Tilapia* (in freshwater), dog fish (in marine) and humans (in terrestrial) (e) Support and locomotion in animals: Definition and reasons for locomotion, function of skeleton, the skeleton and supporting systems in animals. Candidates should be familiar with the general plan of mammalian skeleton and different types of joints Mechanism of Locomotion - In water Amoeboid, ciliate flagellate, and swimming, different types of swimming as found in fish. Mention types and functions of fins - On land Leaping, looping, hopping, crawling and walking in tetrapods. Mention importance of muscles and the main muscles responsible for locomotion, and how locomotion is achieved by muscles and skeleton - In air Treatment of flight in insects and birds. Brief mention of muscles responsible for flight in insects and birds (f) Reproduction in Animals: Sexual and asexual, significance and differences between them (e.g. binary, multiple, sporulation, budding, regeneration, conjugation, etc.)	Individual bones of the mammalian skeletal system should be emphasized Observe slides of sections of the mammalian testis and ovary. Dissect a small mammal to show the male and female urinogenital systems and associated organs	Provide relevant models/ wall charts Provide relevant models/wall charts Provide relevant permanent slides. Provide suitable mammalian specimens for dissection Refer to relevant models/ wall charts		

i. Formation of gametes Discuss methods of ensuring fertilization; sexual dimorphism and sexual display/behaviour relating to ensuring fertilization process			during teaching Refer to relevant models/ charts during teaching		
ii. Male and female reproductive systems in higher vertebrates Mention their differences; histology of testis and ovary, structure of sperm and ovum			Refer to relevant models/ charts during teaching		
iii. Rhythmic cycles in animals Brief mention of monoestrous, polyestrous and menstrous cycles (e.g. fox, dogs, rabbits/humans)			Refer to relevant models/ charts during teaching		
iv. The sexual cycle in mammals Use humans as examples, discuss the need for birth control, mention the dangers involved in early pregnancy and unwanted pregnancy. Brief mention of diseases associated with unprotected sex, including HIV/AIDS. Describe the event of pregnancy, (fertilization), development of embryo and birth. Childhood diseases.			Refer to relevant models/ charts during teaching Refer to relevant models/ charts during teaching		
v. Comparison of reproduction in insects, fish, amphibians, reptiles, birds and mammals Include method of fertilization, number of eggs, complete and incomplete metamorphosis, parental care, viviparity, ovovivipaprity, oviparity in animals should be highlighted, and their significance as it relates to economy of reproduction and survival of the young					
(g) Chemical co-ordination in animals Pituitary hormone, thyroxin, adrenalin, insulin, gonadal			Provide relevant models/ charts for exercises		

	hormones, including their site, secretions, functions, effect of over and under secretions should be mentioned. Feedback mechanisms **(h) Nervous co-ordination in animals** Including parts of brain and their functions structure and function of spinal chord - Reflex and voluntary actions Including reflex arc, and actions such as blinking of the eye, knee jerk, withdrawal of hand from hot objects. Conditioned reflex - The central nervous system - Autonomic nervous system **(i) Structure and function of mammalian ear and eye** Describe accommodation, stereoscopic vision and inversion of retina; Defects of the eye and their correction; Hearing and balancing	Observe and draw from models of eye and ear			
	SECTION D: BIOSTATISTICS				
12.	BIOSTATISTICAL VARIABLES (a) Measurement Classification of physiological concentration of biological fluids, measurements of some optical machinery into continuous variables (e.g. size, height and weight) and discontinuous variables, should be outlined and discussed (b) Attributes Attributes such as colour of skin, eye, hair coat of animals, seeds, types of flowers, tongue rolling,	Candidates are to observe and record these attributes of animals and plants Candidates to collect height and weight of students of the same age group	Suitable plant and animal populations should be used for generating data The class should be used as a population for collecting these data	12	6

	taste of phenylthio carbamide (PTC) and Blood Group (ABO system) should be highlighted and explained				
13.	DATA COLLECTION AND PRESENTATION (a) Data Collection i. Sources of data Different sources where data can be collected should be outlined and explained ii. Methods of data collection Methods - experimentation, interviews, questionnaires, etc. and the advantages and disadvantages of each method should be discussed (b) Data Presentation i. Tabulation Classification of data by tallying, construction of frequency tables should be taught. Characteristics of frequency table (class size, class interval, class limits and class mid-point should be outlined and explained ii. Presentation * Charts Processes of constructing histograms, frequency polygons, cumulative frequency polygons should be taught * Pie-Charts Process of constructing pie-chart highlighting how sections represent different proportion of data	The data collected on heights, weight, etc. could be used to classify and construct frequency tables, Histograms and Pie-charts		12	6
14.	MEASUREMENT OF POPULATION PARAMETERS			6	3

	(a) Measure of Location Definition of mean, mode and median, simple formula and basic computation methods using single and grouped as data should be highlighted (b) Measure of Dispersion The computation of range, standard deviation, standard error and variance should be taught	Measurements on height and weight or other generated data could be used to for this exercise			

SECOND SEMESTER SYLLABUS
SECTION E: BASIC MICROBIOLOGY

S/NO:	TOPICS AND CONTENTS	ACTIVITIES / PRACTICAL GUIDE	INSTRUCTIONAL MATERIALS		
15.	VIRUSES (a) General characteristic of viruses (b) Viruses and Diseases i. Plant diseases Mosaic diseases of plants, mosaic disease of flowers, swollen shoot diseases of plants should be outlined and explained. Mode of transmission and control should be discussed ii. Human and Animal diseases Role of viruses in diseases like poliomyelitis, yellow fever, smallpox, influenza, measles, rabies and common cold should be outlined. Others such as **HIV/AIDS, SARS, MAD-COW** and their		Refer to relevant wall charts during teaching	12	-

	mode of transmission should be mentioned				
16.	BACTERIA (a) General characteristics of bacteria (b) Bacteria and Diseases i. Plant diseases Blight diseases giving relevant examples should be discussed (e.g. blight of cassava, potatoes) ii. Animal diseases Pathogenic effects of bacteria on human and animals. Relevant examples of diseases should be outlined and discussed, with emphasis on sexually transmitted diseases (c) Uses of Bacteria i. Agriculture Role of bacteria in decaying of organic compounds, Nitrification of proteins in dead plants and animals in soil, Nitrogen fixation and conversion of cow dung and animal wastes should be outlined and discussed. De-nitrification of nitrates to free nitrogen ii. Industrial uses - Food Ripening of cheese, flavouring of foods, fermentation, curdling of milk should be discussed - Manufacture		Refer to relevant wall charts during teaching	18	-

	Curing and ripening of tobacco and tea leaves; fermentation of leaves, retting of fibres, tanning, and formation of vinegar from alcohol should be discussed iii. Sanitation The degradation of sewage in septic tanks should be mentioned and explained iv. Medical uses of bacteria Bacteria as sources of antibiotics. Names of the bacteria and antibiotics should be outlined and discussed. The role of bacteria in the control of putrefactive and pathogenic bacteria in the intestine should be mentioned. Production of cellulobiose for the digestion of cellulose in ruminants should be highlighted v. Research The use of bacteria in biotechnological research should be highlighted (e.g. single cell proteins – SCP) (d) Control of bacterial activity - Food preservation Methods, e.g. salting, freezing, drying, Pasteurization, canning, smoking, etc. should be outlined and discussed - Sanitation Use of antiseptics				

	should be highlighted				
17.	FUNGI (a) General characteristics of fungi (b) Importance of Fungi i. Food processing Source of food, e.g. mushroom, vitamin B and use of yeast in baking should be mentioned ii. Industrial uses Fermentation for production of alcohol should be mentioned iii. Medical uses Outline their roles as sources of antibiotics, giving examples iv. Agricultural Fungi as decomposers be discussed v. Plant and animal diseases Diseases like potato blight, smut of maize and wheat, rust of sugarcane, mildew of grapes, athletes foot, ringworm, candidiases, etc. should be highlighted			12	-
	SECTION F: ECOLOGY				
18.	BASIC ECOLOGICAL CONCEPTS - Niche, habitats and macro-habitats, species, population, community, ecosystem, biome and biosphere	Candidates should also undertake a guided detailed field study of simple ecological communities, such as a road-side pond or a small garden	Fieldwork	12	9 (including field work)
19.	THE ENVIRONMENT - Biotic and abiotic	Candidates should study how some	Provide field equipment for fieldwork	12	6

	factors Mention should be made of how various biotic (e.g. parasites, predators, etc.) and abiotic environmental factors (e.g. temperature, rainfall, humidity, etc.) affect organisms and their populations - Ecological Succession and dominance in a simple community should be studied - Balance in nature (i.e. the dynamics of populations) Mention should also be made of factors (e.g. natality, competition, mortality, immigration, emigration, predation, etc.) that maintain a balance in communities	abiotic factors are measured using appropriate equipment, e.g. thermometers, rain gauge, barometer, secchi disc, etc.			
20.	SOIL BIOLOGY (a) The soil ecosystem - Soil formation - Soil profile - Soil temperature, water and pH Simple treatment of soil formation processes, texture (particle sizes) and profile should be undertaken. Candidates should also study how environmental factors affect soil organisms and soil fertility	Candidates should carry out simple experiments to determine soil moisture, organic matter and air contents, as well as porosity and capillarity	Provide relevant experimental equipment	6	3
21.	THE WEB OF LIFE - Symbiosis Interactions between			12	6

	and among organisms (e.g. parasitism, commensalisms, predation, mutualism, co-operation, etc.) should be highlighted - Food chains and food webs - Ecological pyramids Candidates should be able to draw common food chains or webs, and construct ecological pyramids of numbers, biomass and energy for simplified communities				
22.	HUMANS AND THE ENVIRONMENT - Agriculture Ecological consequences of traditional and modern agriculture should be discussed; advantages and disadvantages of each system (e.g. monoculture and plant diseases, chemical fertilizers and pollution, and loss of biological diversity, etc.) and other human related activities (e.g. overgrazing, deforestation, wild fires, urbanization, etc.) should be mentioned - Air and water pollution Knowledge of sources of pollutants will be required of candidates. Candidates should also be able to list specific pollutants (e.g. radioactive materials carbon II oxide and carbon IV oxide, crude oil, chlorofluorocarbons			12	6

	[CFCs], etc.) their effects and how they can be controlled. Simple mention of the problems of global climate change, the greenhouse effect, acid rain, and ozone layer depletion - Sewage treatment and sanitation Elementary consideration of septic tank and sewage treatment systems with emphasis on the importance of proper sewage disposal. The importance of the recycling of wastes should be outlined				
23.	APPLIED ECOLOGY - Biological control Some common examples of biological control should be given. Mention should be made of the advantages of biological control over conventional chemical control of pests - Conservation of nature (biodiversity) The importance of wise (sustainable) use of renewable natural resources (i.e. wildlife and fisheries, water, forests, etc.) should be emphasized. Some techniques widely employed to achieve conservation (e.g. creation of nature reserves, legislation, etc.) should be discussed	A field trip to nearby natural reserve should be considered important	Fieldwork	12	6

	- Integrated pest management (IPM) Highlight the principles of IPM as a systematic approach involving biological, chemical, physical, etc. means of pest control management				
SECTION G: GENETICS					
24.	HEREDITY Definition of terms in genetics, heredity and variation, gene, phenotype, genotype, homozygous, heterozygous, homologous, dominant, recessive, monohybrid cross/ratio, dihybrid cross/ratio, Test cross/back cross, codominance, allele (allelomorphs), lethal genes, linkage, crossing over, sex-linkage, polyploid, clonings, genetic engineering, locus, traits, etc. (a) Mendel's work – inheritance of characters General treatment of Mendelian principles and their deviations. (b) The Mechanisms of inheritance i. Chromosome and gene Theory of inheritance 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		Students should be exposed to charts. Use of models, e.g. beaded chain to illustrate chromosomes	18	9

inheritance. Simple treatment of nature and structure of genes and DNA as the basis of inheritance ii. Linkage and crossing over Definition of linkage, crossing over and their importance (c) Mutation - Definition of mutation and its importance in the evolution of plants and animals - The different types of genome, chromosome, gene and plasma/extra nuclear mutations, nature and importance should be discussed - The types of mutagenic agents and effects, physical, chemical and high temperature should be briefly discussed d) Applications of the principles of heredity i. ABO blood group; Rhesus factor (system); Sickle cell anaemia The ABO blood group and Rhesus factor/system should be discussed with special emphasis on **antigen** and **antibody** relationships. Use of blood grouping in marriage counseling, blood transfusion and paternity determination, as well as sickle cell anaemia and DNA finger printing ii. Sex-linked characters	A practical class should be conducted to allow candidates measure height, weight of individuals organisms of the same age group and explain the variation	Use class as a population to generate data		

	Simple treatment of the significance of sex-linkage of characters with examples (haemophilia, bald-headedness, and colour blindness) iii. Plant and animal improvement through breeding and genetic engineering - The applications of genetics in agriculture, behaviour, social structure, ecology, law and religion should be briefly discussed - Genetics, medicine and genetic engineering. The concept of gene therapy, nuclear, cell and molecular cloning should be discussed (d) Nature of Gene - Definition of gene - The structure, composition and significance of DNA and RNA as hereditary materials highlighting their differences should be discussed - DNA replication and its theories should be briefly discussed				
SECTION H: EVOLUTION					
25.	THE THEORIES OF EVOLUTION - Lamarck - Darwin The contributions of Lamarck and Darwin to the theory of evolution should be outlined. Simple mention of examples of convergent			6	-

	and divergent evolution. The link between evolution and variation should be established. Key steps in the evolution of humans should be mentioned				
	- Natural selection and speciation An overview of the concepts of natural selection and mechanisms for speciation (i.e. roles of mutation and genetic drift, etc.) as the driving force for evolution				

Recommended Texts / Reference Materials:

A. Basic Recommended Textbooks:

1. Taylor, D.J.; Green, N.P.O. and Stout, G.W. (1997): Biological Science (3rd Edition). Cambridge University Press, 984 pp.

2. Keeton, W.T. and Gould, J.L. (1986): Biological Science (4th Edition). W.W. Norton and Co., New York, London, 1175 pp.

3. Roberts, M.B.V. (1980): Biology: A Functional Approach (2nd Edition). Thomas Nelson and Sons Ltd., 637 pp.

4. Sokal, R.R. and Rohlf, J.F. (1973): Biometry. W.H. Freeman and Co., San Francisco.

5. Dutta, A.C. (1979): Botany for Degree Students (5th Edition). McGraw-Hill Inc., 909 pp.

6. Kershaw, D.R. (1988): Animal Diversity. Chapman and Hall, 428 pp.

7. Bibby, C. (1964): Simple Experiments in Biology (2nd Edition). Heinemann Educational Books Ltd., London, 216 pp.

8. Jepson, M. (1942): Biological Drawings (With Notes) (Parts I and II) 5thEdition. John Murray Ltd., 60 pp.

9. Rowett, H.G.Q. (1962): Guide to Dissection (1st Edition). John Murray Ltd., 251 pp.

10. Jegede, O.J. (1987): Tropical Biology: A Practical Course (2nd Edition). Macmillan Publishers, 154 pp.

B. Other Relevant Texts:

1. Vines, A.E. and Rees, N. (1972): Plant and Animal Biology Vols 1and 2 (4th Edition).Pittman Press Bath Great Britain (1345pp; 1092pp).

2. Sokal, R.R. and Rohlf, J.F. (1969): Introduction to Biostatistics. W.H. Freeman and Co., San Francisco.

3. Singha, P. (1996): An Introductory Text on Biostatistics (2nd Edition).

4. Fullick, A. (1994): Advanced Biology. Heinemann Educational Publishers, Halley Const, Jordan Hill, Oxford, 522 pp.

5. Hill, J.B.; Overholts, L.O.; Popp, H.W. and Grove Jr., A.R. (1960): Botany: A Textbook for Colleges (3rd Edition). McGraw-Hill Book Co. Inc., New York, London, 571 pp.

6. Muller, W.H.: Botany: A Functional Approach (4th Edition). Collier Macmillan International, 687 pp.

7. Ever, D.W. and Hall, J.B. (1972): Ecological Biology Volumes 1 and 2. Longman, 334 pp, 526 pp.

8. Rost, T.L.; Babour, M.G.; Thornton, R.M.; Weier, T.E. and Stocking, R.C. (1979): Botany: A Brief Introduction to Plant Biology. John Wiley and Sons Inc., 118 pp.

9. Bell, P. and Woodcock, C. (1971): The Diversity of Green Plants (2nd Edition).Edward Arnold Ltd. (ELBS Edition), 374 pp.

10. Ewusie, Y.J. (1980): Elements of Tropical Ecology. Heinemann Educational Book Ltd., 205 pp.

11. Barnes, R.D. (1980): Invertebrate Zoology (4th Edition). Hong Kong, Holt-Saunders. 1089 pp.

12. Barnes, R.S.K.; Calow, P. and Olive, P.J.W. (1989): The Invertebrates: A New Synthesis. London, Blackwell Scientific Publications, Hong Kong, Holt-Saunders, 582 pp.

13. Buchsbaun, R.; Buchsbaun, M.; Pearse, J. and Pearse, V. (1987): Animals without Backbones (3rd Edition). London, The University of Chicago Press, 572 pp.

14. Colbert, E.H. (1969): Evolution of the Vertebrates. John Wiley and Sons Inc., New York.

15. Romer, S.A. and Parsons, T.S. (1977): The Vertebrate Body (5th Edition). Philadelphia, W.B. Saunders, 624 pp.

16. Webb, J.E.; Wallwork, J.A. and Elgood, J.H. (1978): Guide to Invertebrate Animals (2nd Edition). Macmillan Education Ltd., London, 305 pp.

17. Young, J.Z. (1962): The Life of Vertebrates. Oxford University Press, Ely House, London, 820 pp.

C. Other relevant Practical Guides/Manuals:

1. Witham, F.H.; Diaydes, D.F. and Devlin, R.M. (1970): Experiments in Plant Physiology. Van Nostrand Reinbold Co., 245 pp.

2. Dunn, A. and Arditti, S. (1968): Experimental Physiology. Holt, Rinehart and Winston, Inc., New York, London, 312 pp.

3. Dales, R.P. (1981): Practical Invertebrate Zoology (2nd Edition). Blackwell Scientific Publishers, Oxford, London, Boston, 356 pp.

4. Freeman, W.H. and Brucegirdle, B. (1967): An Atlas of Histology (2nd Edition). Heinemann Educational Books, London. 140 pp.

NOTE: The list provided above is not exhaustive. Other texts. which cover the relevant topics in great enough detail for 'A' Level Biology (as may be ascertained by the Chief Examiner) can also be used.