231 - BIOLOGY

GENERAL SUBJECT OBJECTIVES

By the end of the course, the learner should be able to:

1. communicate biological information in a precise, clear and logical manner
2. develop an understanding of interrelationships between plants and animals and between humans and their environment
3. apply the knowledge gained to improve and maintain the health of the individual, family and the community
4. relate and apply relevant biological knowledge and understanding to social and economic situations in rural and urban settings
5. observe and identify features of familiar and unfamiliar organisms, record the observations and make deductions about the functions of parts of organisms
6. develop positive attitudes and interest towards biology and the relevant practical skills
7. demonstrate resourcefulness, relevant technical skills and scientific thinking necessary for economic development
8. design and carry out experiments and projects that will enable them understand biological concepts
9. create awareness of the value of cooperation in solving problems
10. acquire a firm foundation of relevant knowledge, skills and attitudes for further education and for training in related scientific field.

1.0.0 INTRODUCTION TO BIOLOGY

1.1.0 Specific Objectives

By the end of the topic, the learner should be able to:

(a) define biology
(b) list branches of biology
(c) explain the importance of biology
(d) state the characteristics of living organisms
(e) state the main differences between plants and animals.

1.2.0 Content

1.2.1 Definition of biology
1.2.2 Branches of biology
1.2.3 Importance of biology
1.2.4 Characteristics of living organisms
1.2.5 Comparison between plants and animals

1.3.0 Practical Activities

1.3.1 Collecting, observing and recording external features of plants and animals

2.0.0 CLASSIFICATION I

2.1.0 Specific Objectives

By the end of the topic, the learner should be able to:

(a) use the magnifying lens to observe the external features of plants and animals
(b) record observations of the main external characteristics of living organisms, preserved specimens and photographs
(c) state the necessity and significance of classification
(d) name the major units of classification
(e) state the application of binomial nomenclature in naming organisms.

2.2.0 Content

2.2.1 The use of magnifying lens
2.2.2 External features of Plantae, Arthropoda and Chordata
2.2.3 Necessity and significance of classification
2.2.4 Major units of classification:

- Kingdoms: Monera, Protoctista, Fungi, Plantae, Animalia *(Give examples of each)*
- For the kingdom Plantae and Animalia, cover phylum/division, class, order, family, genus and species. Show the relationship between the taxonomic units *(Give examples of each taxon)*

2.2.5 Binomial nomenclature

2.3.0 Practical activities

- Use of collecting nets, cutting instruments and hand lens
- Collection and detailed examination of external features of:
  - Animals such as arthropods and chordates
  - Plants - rhizoids, root systems (taproot, fibrous and adventitious), stems and leaves

3.0.0 CLASSIFICATION II

3.1.0 Specific Objectives

By the end of the topic, the learner should be able to:

(a) state briefly the general principles of classification of living organisms
(b) state general characteristics of each of the five kingdoms
(c) state the main characteristics of arthropoda, chordata.
(d) state the main characteristics of major division of plantae
(e) state the characteristics of classes of spermatophyta
(f) describe the main characteristics of classes of arthropoda and chordata
(g) use observable external features to construct simple dichotomous keys of plants and animals
(h) Use already constructed dichotomous keys to identify organisms

3.2.0 Content

3.2.1 Review of binomial nomenclature
3.2.2 General principles of classification
3.2.3 General characteristics of kingdoms: Monera, Protoctista, Fungi, Plantae, Animalia.

3.2.4 Main characteristics of major divisions of plantae: Bryophyta, Pteridophyta, Spematophyta (cover subdivision Gymnospermae and Angiospermae).
For Angiopermae cover classes monocotyledonae and dicotyledonae.

3.2.5 Main characteristics of the Phyla Arthropoda and Chordata (cover up to classes as shown)

- Arthropoda: diplopoda, chilopoda, insecta, crustacea, arachnida
- Chordata: pisces (emphasis on sub-class osteochythes), amphibia, reptilia, aves, mammalia.

3.2.6 Construction and use of simple dichotomous keys based on observable features of plants and animals

3.3.0 Practical activities

3.3.1 Examine live/preserved specimens or photographs of representatives of major divisions of plantae and phyla arthropoda and chordata

3.3.2 Construct simple dichotomous keys using leaves/parts of common plants/arthropods/common chordates in the local environment

3.3.3 Use dichotomous keys to identify organisms

4.0.0 THE CELL

4.1.0 Specific Objectives

By the end of the topic, the learner should be able to:

(a) define the cell
(b) state the purpose of a light microscope
(c) identify the parts of a light microscope and state their functions
(d) use and care of the light microscope and calculate the magnification
(e) identify the components of a cell as seen under the light and electron microscopes and relate the structures to functions
(f) compare plant and animal cells
(g) mount and stain temporary slides of plant cells
(h) describe animal cells as observed from permanent slides
(i) estimate cell size
(j) state the differences between cells, tissues, organs and organ systems.

4.2.0 Content

4.2.1 Definition of the cell

4.2.2 Structure and functions of parts of a light microscope

4.2.3 Use and care of the light microscope

4.2.4 Cell structure and functions as seen under

- a light microscope
- an electron microscope

4.2.5 Preparation of temporary slides of plant cells

4.2.6 Estimation of cell size

4.2.7 Cell specialization, tissues, organs and organ systems

4.3.0 Practical activities

4.3.1 Observe, identify, draw and state the functions of parts of the light microscope

4.3.2 Prepare and observe temporary slides of plant cells
4.3.3 Observe prepared slides of animal cells
4.3.4 Compare plant and animal cells
4.3.5 Observe, estimate size and calculate magnification of plant cells

5.0.0 CELL PHYSIOLOGY

5.1.0 Specific Objectives

By the end of the topic, the learner should be able to:
(a) define cell physiology
(b) correlate the membrane structure with cell physiology in relation to permeability
(c) differentiate between diffusion, osmosis and active transport
(d) state and describe factors affecting diffusion, osmosis and active transport
(e) carry out experiments on diffusion and osmosis
(f) explain the roles of diffusion, osmosis and active transport in living organisms
(g) explain turgor and plasmolysis in terms of osmotic pressure

5.2.0 Content

5.2.1 Meaning of cell physiology
5.2.2 Structure and properties of cell membrane (Theories of membrane structure not required)
5.2.3 Physiological processes – diffusion, osmosis and active transport
5.2.4 Factors affecting diffusion, osmosis and active transport
5.2.5 Role of diffusion, osmosis and active transport in living organisms
5.2.6 Water relations in plant and animal cells: tugor, plasmolysis, crenation and haemolysis
5.2.7 Wilting

5.3.0 Practical activities

5.3.1 Diffusion as demonstrated with potassium permanganate or potassium iodide/flower dyes/coloured plant extracts/smoke
5.3.2 Experiments using visking tubing and living tissues: fresh arrow roots/cassava/sweet potatoes/leaf petioles/irish potatoes/carrots
5.3.3 Plasmolysis can be demonstrated by using any of the following: Spirogyra, epidermal cells of onion or raw eggs that have been put in dilute hydrochloric acid overnight

6.0.0 NUTRITION IN PLANTS AND ANIMALS

6.1.0 Specific Objectives

By the end of the topic, the learner should be able to:
(a) define nutrition and state its importance in living organisms
(b) differentiate various modes of feeding
(c) describe photosynthesis and show its importance in nature
(d) explain how the leaf is adapted to photosynthesis
(e) explain the factors affecting photosynthesis
(f) distinguish between carbohydrates, proteins and lipids

(g) state the importance of various chemical compounds in plants and animals
(h) relate various types of teeth in mammals to their feeding habits
(i) describe internal structure of mammation (human) teeth
(j) differentiate between omnivorous, carnivorous and herbivorous modes of feeding
(k) relate the structures of the mammalian (human) alimentary canal to their functions
(l) explain the role of enzymes in digestion in a mammal (human)
(m) explain the properties and functions of enzymes
(n) explain the factors that determine energy requirements in humans.

6.2.0 Content

6.2.1 Meaning, importance and types of nutrition

6.2.2 Nutrition in plants (autotrophism)

- Definition of photosynthesis and its importance in nature
- Adaptations of leaf to photosynthesis
- Structure and function of chloroplast
- Process of photosynthesis – light and dark stages (omit details of electron transport system and chemical details of carbon dioxide fixation)
- Factors influencing photosynthesis: light intensity, temperature, carbon dioxide concentration, water.

6.2.3 Chemical compounds which constitute living organisms

- Chemical composition and functions of carbohydrates, proteins and lipids (omit details of (i) chemical structure of these compounds and (ii) mineral salts in plant nutrition)
- Properties and functions of enzymes (omit lock and key hypothesis)

6.2.4 Nutrition in Animals (heterotrophism)

Meaning and types of heterotrophism

- Modes of feeding in animals
- Dentition of a named carnivorous, herbivorous and omnivorous mammal
- Adaptations of the three types of dentition to feeding
- Internal structure of mammalian human (human) teeth
- Common dental diseases, their causes and treatment

6.2.5 Digestive system and digestion in a mammal (human)

- Digestive system, regions, glands and organs associated with digestion
- Ingestion, digestion, absorption, assimilation and egestion

6.2.6 Importance of vitamins, mineral salts, roughage and water in human nutrition

6.2.7 Factors determining energy requirements in humans

6.3.0 Practical Activities

6.3.1 Carry out experiments on factors affecting photosynthesis

6.3.2 Observe distribution of stomata from plant adapted to different habitats

6.3.3 Carry out experiments on food tests

6.3.4 Carry out experiments on factors affecting enzymatic activities

6.3.5 Investigate the presence of enzymes in living tissues (plants and animals) such as catalase.
6.3.6 Observe, identify, draw and label different types of mammalian teeth
6.3.7 Carry out dissection of a small mammal to observe digestive system and associated organs (demonstration).

7.0.0 TRANSPORT IN PLANTS AND ANIMALS

7.1.0 Specific Objectives

By the end of the topic, the learner should be able to:

(a) define transport and explain the necessity of transport in plants and animals
(b) relate the structure of the root, root hair, xylem and phloem to their functions
(c) relate the internal structure of the leaf to transpiration
(d) explain possible forces involved in the movement of water and mineral salts through the plant
(e) explain the significance of and factors affecting transpiration
(f) demonstrate simple experiments on transpiration
(g) distinguish between closed and open circulatory systems
(h) relate the structure of the heart and the blood vessels to their functions
(i) trace the path taken by blood from the heart to all parts of the body, and back to the heart
(j) name the common diseases of the circulatory system in humans and suggest methods of control/prevention
(k) relate the structure of the components of blood to their functions
(l) explain how oxygen and carbon dioxide are transported in the blood
(m) describe the mechanism of blood clotting and its importance
(n) describe the human blood groups and their importance in blood transfusion
(o) explain immunity and describe immune responses

7.2.0 Content

7.2.1 Meaning and importance of transport systems
7.2.2 Absorption of water and mineral salts
- Internal structure of root and root hairs
- Absorption of water
- Active uptake of mineral salts

7.2.3 Transpiration
- Definition of transpiration
- Review of the structure of the leaf
- Structure and function of xylem
- Factors affecting transpiration
- Forces involved in water movement in plants: Transpiration pull, Cohesion and adhesion, Capillarity, Root pressure

7.2.4 Translocation
- Structure and function of phloem
- Materials translocated (omit mechanisms of translocation)

7.2.5 Comparison between open and closed circulatory system
7.2.6 Mammalian circulatory system

- Structure and functions of the heart, arteries, veins and capillaries
- Diseases and defects of the circulatory system (thrombosis, varicose veins, arterio-sclerosis) and how to control them

7.2.7 The Structure and functions of blood
- Composition of blood
- Functions of blood plasma
- The structure and functions of red and white blood cells
- Mechanism of blood clotting and its importance

7.2.8 Blood groups (ABO system and the Rhesus factor)

7.2.9 Immune responses
- Natural and artificial immunity
- Allergic reactions
- Importance of vaccinations against diseases (tuberculosis, poliomyletis, measles, diphtheria, whooping cough)

7.3.0 Practical Activities

7.3.1 Observe permanent/temporary slides of sections of stems and roots of monocotyledonous and dicotyledonous plants

7.3.2 Carry out experiments to compare transpiration on lower and upper leaf surfaces

7.3.3 Observe wall charts/models

7.3.4 Analyse data on transpiration rate of structures involved in transport in plants under different environmental conditions

7.3.5 Dissect a small mammal and observe its transport system (demonstration)

7.3.6 Make a longitudinal section of the mammalian heart to display the chambers and associated blood vessels

7.3.7 Record pulse rate at the wrist before and after vigorous exercises and analyse the results

7.3.8 Demonstrate the unidirectional flow of blood in the cutaneous veins of the fore-arm

8.0.0 GASEOUS EXCHANGE

8.1.0 Specific Objectives

By the end of the topic, the learner should be able to

(a) explain the necessary for gaseous exchange in living organisms

(b) explain the mechanism of gaseous exchange in plants

(c) compare the internal structure of aquatic and terrestrial plant root, stem and leaves

(d) examine various types of respiratory structures in animals and relate them to their functions

(e) state the characteristics of respiratory surfaces

(f) describe the mechanisms of gaseous exchange in protozoa, insect, fish, frog and mammal (humans)

(g) describe the factors which control the rate of breathing in humans

(h) state the causes, symptoms and prevention of respiratory diseases.

8.2.0 Content

8.2.1 The necessity of gaseous exchange in living organisms

8.2.2 Gaseous exchange in plants

- Mechanisms of opening and closing of stomata
- The process of gaseous exchange in root, stem and leaves of both aquatic and terrestrial plants

8.2.3 Gaseous exchange in animals

- Types and characteristics of respiratory surfaces - cell membrane, gills, buccal cavity, skin and lungs
- Mechanism of gaseous exchange in : Protozoa (amoeba), Insect (grasshopper), Fish (bonyfish), Amphibia (frog), Mammal (human)

8.2.4 Factors affecting rate of breathing in humans

8.2.5 Respiratory diseases: asthma, bronchitis, pulmonary tuberculosis, pneumonia and whooping cough

8.3.0 Practical Activities

8.3.1 Observe permanent/temporary slides of cross-sections of aerial and aquatic leaves and stems

8.3.2 Examine the distribution of spiracles in insects such as grasshoppers

8.3.3 Examine the gills of a bony fish

8.3.4 Dissect a small mammal and identify the structures of the respiratory system (demonstration)

8.3.5 Construct and use models to demonstrate breathing mechanisms in a mammal (human)

8.3.6 Demonstrate the effect of exercise on the rate of breathing

9.0.0 RESPIRATION

9.1.0 Specific Objectives

By the end of the topic, the learner should be able to:

(a) explain the significance of respiration in living organisms

(b) distinguish between aerobic and anaerobic respiration

(c) describe the economic importance of anaerobic respiration in industry and at home

(d) describe experiments to show that respiration takes place in plants and animals.

9.2.0 Content

9.2.1 Meaning and significance of respiration

9.2.2 Tissue respiration

- Mitochondrion - structure and function
- Aerobic respiration (Details of kreb's cycle not required)
- Anaerobic respiration in plants and animals, the products and by-products
- Application of anaerobic respiration in industry and at home
- Compare the energy output of aerobic and anaerobic respiration

9.3.0 Practical Activities

9.3.1 Carry out experiments to investigate

- The gas produced when food is burnt
- The gas produced during fermentation
- Heat production by germinating seeds

10.0.0 EXCRETION AND HOMEOSTASIS

10.1.0 Specific Objectives

By the end of the topic, the learner should be able to:

(a) distinguish between excretion and egestion
(b) explain the necessity for excretion in plants and animals
(c) state the uses of excretory products of plants
(d) describe the methods of excretion in a named unicellular organism
(e) relate the structures of the human skin, lungs, liver and kidney to their functions
(f) name common kidney diseases
(g) explain the concept of internal environment and homeostasis
(h) compare responses to changes in temperature by behavioural and physiological methods in animals
(i) relate heat loss to body size in mammals
(j) describe methods by which mammals gain and lose heat
(k) explain how the functions of the following relate to homeostasis - skin, hypothalamus, liver and kidney
(l) discuss the role of antidiuretic hormone, insulin and glucagon
(m) describe simple symptoms of *Diabetes mellitus* and *Diabetes insipidus*.

10.2.0 Content

10.2.1 Excretion in Plants

- Methods of excretion in plants
- Useful and harmful excretory products of plants and their economic importance e.g. caffeine in tea and coffee, quinine, tannins, colchicine, cocaine, rubber, gum, papain from pawpaw and products of cannabis sativa (bhang) and khat (miraa)

10.2.2 Excretion and homeostasis in animals

- Distinction between excretion, homeostasis and egestion
- Excretion in a named unicellular organism
- Structure and functions of skin and kidney
- Neuro-endocrine system and homeostasis
  - Water balance - blood osmotic pressure
  - Blood sugar level
  - Temperature regulation - mention the role of hypothalamus

10.2.3 Common kidney diseases, their symptoms and possible methods of prevention and control

10.2.4 The role of the skin in thermoregulation, salt and water balance

10.2.5 Major functions of the liver and their contributions to homeostasis

10.2.6 Common diseases of the liver, their symptoms and possible methods of prevention/control

10.3.0 Practical Activities

10.3.1 Examine and draw the mammalian kidney
10.3.2 Make a vertical section of the kidney to identify the cortex and medulla
10.3.3 Observe permanent slides of a mammalian skin
10.3.4 Investigate the effect of catalase enzyme on hydrogen peroxide

11.0.0 ECOLOGY

11.1.0 Specific Objectives

By the end of the topic, the learner should be able to:

(a) define the terms ecology, habitat, biomass, ecosystem and carrying capacity
(b) identify the physical (abiotic) and biological (biotic) factors in a given ecosystem
(c) describe the inter-relationships of organisms in the ecosystem
(d) differentiate between saprophytism, parasitism and symbiosis
(e) explain the importance of fungi and bacteria as decomposers
(f) relate the mode of transmission to prevention/control of named parasites
(g) describe the adaptive characteristics of named parasites to hosts
(h) explain the importance of symbiotic bacteria in leguminous plants
(i) describe the nitrogen cycle
(j) explain the flow of energy in the ecosystem
(k) identify and construct food chains and food webs, pyramids of numbers, pyramids of biomass
(l) explain the use of various methods of estimating population
(m) relate adaptations of plants to various habitats
(n) describe the effects of pollutants in air, water and soil on humans and other living organisms
(o) identify symptoms of different types of human diseases, methods of transmission and control.

11.2.0 Content

11.2.1 Concepts of Ecology: Ecology , Habitat, Niche, Population, Community, Ecosystem, Biomass, Carrying capacity
11.2.2 Factors in an ecosystem
- Abiotic factors (environmental factors) - light, temperature, atmospheric pressure, salinity, humidity, pH and wind
- Biotic factors
- Inter-relationships - competition, predation, saprophytism, parasitism and symbiosis
- Nitrogen cycle

11.2.3 Energy flow in an ecosystem: Food chains, food webs, decomposers, pyramids of numbers and pyramids of biomass
11.2.4 Population estimation methods: Quadrant, Line transect, Belt transect, Capture-recapture

11.2.5 Adaptations of plants to various habitats: Xerophytes, Mesophytes (common terrestrial plants), Hydrophytes - *Nymphea, Salvinia* spp, Halophytes - mangrove

11.2.6 Effect of pollution on human beings and other organisms: Causes, effects and control of pollutants in air, water and soil

11.2.7 Human diseases

- Bacterial diseases - cholera and typhoid
- Protozoa - malaria and amoebic dysentry (amoebiasis)
- *Ascaris lumbricoides* and Schistosoma: Mode of transmission, Effects of the parasites on the hosts, Adaptive characteristics of the parasites, Control/prevention of diseases associated with the parasites

11.3.0 Practical Activities

11.3.1 Collect, record, analyse and interpret data from ecological studies. Food chains should be used to make food webs. Calculate ratios of consumers to producers from data provided

11.3.2 Examine specimens of hydrophytes, mesophytes and xerophytes and identify the features that adapt them to their habitat

11.3.3 Examine roots of legumes taken from fertile and poor soils to compare the number of root nodules

11.3.4 Estimate populations using sampling methods

11.3.5 Measure pH, temperature, wind direction and humidity

12.0.0 REPRODUCTION IN PLANTS AND ANIMALS

12.1.0 Specific Objectives

By the end of the topic, the learner should be able to:

(a) describe location and appearance of chromosomes and chromosome movements during mitosis and meiosis

(b) differentiate between mitosis and meiosis stating their significance in reproduction

(c) describe and state the importance of asexual eproduction (binary fission, spore formation and budding)

(d) compare adaptations of wind and insect pollinated flowers

(e) describe the process of fertilization in flowering plants

(f) describe and explain how different fruits and seeds are formed and dispersed

(g) differentiate between internal and external fertilization as exhibited by amphibians and mammals (humans)

(h) relate the structure of the human reproductive system to functions

(i) describe the role of hormones in human reproduction

(j) identify the symptoms and explain the method of transmission and prevention of sexually transmitted infections (S.T.Is)

(k) explain the advantages and disadvantages of sexual and asexual reproduction.

12.2.0 Content

12.2.1 Concept of reproduction

- Importance of reproduction

12.2.2 Chromosomes, mitosis and meiosis (relate to gamete formation)

12.2.3 Asexual reproduction
- Binary fission in amoeba
- Spore formation/production in mucor/Rhizopus
- Budding in yeast

12.2.4 Sexual reproduction in plants
- Structure and functions of parts of named insect and wind pollinated flowers
- Pollination and agents of pollination
- Features and mechanisms that hinder self-pollination and self-fertilization
- The process of fertilization
- Fruit and seed formation and dispersal

12.2.5 Sexual reproduction in animals
- External fertilization in amphibians
- Structure of the reproductive system of a named mammal (human)
- Functions of parts of the reproductive system
- Fertilization, implantation and the role of placenta
- Gestation period
- Role of hormones in reproduction in humans (secondary sexual characteristics, menstrual cycle)
- Sexually transmitted infections (S.T.Is): Gonorrhoea, Herpes simplex, Syphilis, Trichomoniasis, Hepatitis, Candidiasis, HIV/AIDS (Acquired Immune Deficiency Syndrome)

Emphasize preventive measures especially behavioural

12.2.6 Advantages and disadvantages of sexual reproduction

12.3.0 Practical Activities

12.3.1 Examine stages of mitosis using squashed young onion root tip/charts/electron micrographs

12.3.2 Examine stages of meiosis using anthers of a flower

12.3.3 Grow bread mould and examine using a hand lens

12.3.4 Examine spores in sori of a fern

12.3.5 Examine various types of insect and wind pollinated flowers and relate structure to function

12.3.6 Collect, classify and dissect fruits and seeds and relate their structure to mode of dispersal

12.3.7 Dissect a small mammal to show organs associated with reproduction (demonstration)

13.0.0 GROWTH AND DEVELOPMENT

13.1.0 Specific Objectives

By the end of the topic, the learner should be able to:

(a) differentiate growth from development

(b) analyse experimental data on growth rates

(c) identify parts of a named seed and factors affecting viability and dormancy in seeds
(d) investigate conditions necessary for germination and distinguish the types of germination
(e) measure one aspect of growth in a given seedling
(f) determine the region of growth in seedlings
(g) explain apical dominance
(h) distinguish between complete and incomplete metamorphosis in insects
(i) explain the role of hormones in regulating growth and development

13.2.0 Content

13.2.1 Concept of growth and development

13.2.2 Growth and development in plants

- Dormancy and ways of breaking it
- Conditions necessary for germination
- Epigeal and hypogeal germination
- Measurement of one aspect of growth in a named seedling e.g. region of growth
- Primary and secondary growth
- Role of growth hormones in plants
- Apical dominance

13.2.3 Growth and development in animals

- Complete and incomplete metamorphosis in insects
- Role of growth hormones in insects

13.3.0 Practical activities

13.3.1 Examine, draw and differentiate between monochotyledonous & dicotyledonous seeds

13.3.2 Determine region of growth in shoots and roots

13.3.3 Investigate hypogeal and epigeal germination

13.3.4 Carry out experiments to demonstrate apical dominance

13.3.5 Observe stages of complete and incomplete metamorphosis in insects

13.4.0 Project work:

Measure either length of intenodes/breadth of leaves/height/dry weight of seedlings over a known period of time, analyse and present the data obtained in form of graphs, charts or histograms

14.0.0 GENETICS

14.1.0 Specific Objectives

By the end of the topic, the learner should be able to:
(a) distinguish between continuous and discontinuous variations
(b) describe the structure and properties of chromosomes
(c) state the first law of inheritance and describe Mendel's work
(d) construct and use punnet square/checker board

(e) distinguish between F_1 and F_2 generations, genotype and phenotype, haploidy and diploidy, homozygosity and heterozygosity, dominance and recessiveness, linkage and sex linkage, mutations and mutagens
(f) predict and explain the inheritance of the ABO blood groups and Rhesus (Rh) factor
(g) give examples of genetically inherited disorders
(h) explain causes of chromosomal mutations
(i) explain the practical application of genetics

14.2.0 Content

14.2.1 Concepts of genetics
- Variation within plant and animal species
- Review of chromosomes
- Brief mention of genes and DNA (without details of the molecular structure of genes and DNA)

14.2.2 First law of heredity
- Mendel's experiments - monohybrid inheritance (3:1 ratio)
- Complete and incomplete dominance, backcross/testcross
- Inheritance of ABO blood groups and Rh factor

14.2.3 Sex determination in humans

14.2.4 Linkage
Sex linked genes, sex linked characteristics e.g. colour blindness, haemophilia, hairy ears and nose

14.2.5 Mutations
- Types of mutations
- Causes and consequences of chromosomal mutations
- Gene mutation-cover the following examples of genetic disorders:-- albinism, sickle cell anaemia, haemophilia, colour blindness

14.2.6 Practical applications of genetics
- Blood transfusion
- Plant and animal breeding using artificial selection
- Genetic counseling
- Genetic engineering (details of techniques not required)

14.3.0 Practical Activities

14.3.1 Measure and record heights of classmates and represent data in graphs

14.3.2 Demonstrate chromosome behaviour in mitosis and meiosis by using clay/plasticine/insulated coloured wires/coloured threads

14.3.3 Carry out investigations of finger prints/tongue rolling

15.0.0 EVOLUTION

15.1.0 Specific Objectives

By the end of the topic, the learner should be able to:
(a) explain the meaning of evolution and the current concepts of evolution
(b) describe the struggle for existence and survival for the fittest
(c) describe the evidences for organic evolution

(d) explain resistance organisms to antibiotics, fungicides and pesticides

15.2.0 Content

15.2.1 Meaning of evolution

15.2.2 The origin of life: Special creation, Chemical evolution (omit details)

15.2.3 Evidences for organic evolution

- Fossil records - brief mention of human evolution
- Geographical distribution - continental drift
- Comparative embryology
- Comparative anatomy (convergent and divergent evolution based on homology and analogy)
- Cell biology

15.2.4 Mechanisms of evolution

- Lamarck's theory
- Evolution by natural selection
- Natural selection in action e.g. peppered moth (industrial melanism)
- Resistance to drugs, pesticides and antibiotics

15.3.0 Practical Activities

15.3.1 Compare vertebrate limbs

15.3.2 Compare wings of birds and insects

15.3.3 Education tour to an archeological site/local museum

16.0.0 RECEPTION, RESPONSE AND COORDINATION IN PLANTS AND ANIMALS

16.1.0 Specific Objectives

By the end of the topic, the learner should be able to:

(a) define irritability, stimulus and response

(b) explain differences between tactic and tropic responses and their survival values

(c) explain the production of plant hormones and their effects on tropisms (growth responses)

(d) relate the structure of the mammalian nervous system to its functions

(e) distinguish between simple and conditioned reflex actions

(f) explain the role of the endocrine system in humans

(g) state the effects of drug abuse

(h) relate structure to function of the human ear and eye

(i) explain defects of the eye and ear

(j) explain correction of eye defects

16.2.0 Content

16.2.1 Meaning of stimulus, response and irritability

16.2.2 Reception, response and coordination in plants

- Response to a variety of external stimuli
- Tropisms and tactic movements and their survival values
- Productions of auxins and their effects on plant growth

16.2.3 Reception, response and coordination in animals
- Components of the nervous system in a mammal
- Structure and functions of the neurones
- Functions of major parts of human brain
- Simple and conditioned reflex actions

16.2.4 The role of hormones in coordination in a mammal
- Effects of over secretion and under secretion of adrenaline and thyroxine in humans
- Functional differences and similarities between endocrine and nervous systems

16.2.5 Effects of drug abuse

16.2.6 Structure and functions of parts of the mammalian (human) eye
- Accommodation, image formation and interpretations
- Common eye defects and their corrections

16.2.7 Structure and functions of parts of the mammalian (human) ear
- Hearing (omit details of cochlea)
- Balance and posture (omit details)

16.3.0 Practical Activities

16.3.1 Carry out experiments to investigate tactic responses e.g. chemotaxis - use any of the following organisms: worker termites/fly maggots/earthworms/honey bees/grasshoppers/woodlice

16.3.2 Carry out experiments on tropisms and etiolation

16.3.3 Determine the distance of blind spot

16.3.4 Carry out knee jerk experiment

17.0.0 SUPPORT AND MOVEMENT IN PLANTS AND ANIMALS

17.1.0 Specific Objectives

By the end of the topic, the learner should be able to:

(a) explain the necessity of support and movements in animals and plants
(b) describe the arrangement and the role of supporting tissues in young and old plants
(c) list functions of the exoskeletons and endoskeletons
(d) describe locomotion in a named finned fish
(e) identify the bones of the axial and appendicular skeleton in a mammal
(f) describe he structure and functions of different types of joints in a mammal and explain how muscles bring about movement
(g) distinguish between the different types of muscles, their locations and functions.

17.2.0 Content

17.2.1 Plants
- Necessity for support and movement in plants
- Review of tissue distribution in monocotyledonous and dicotyledonous plants (Histological details of tissues are not required)

17.2.2 Animals

- Necessity for support and movement in animals
- Types and functions of the skeleton: exoskeleton in arthropods, endoskeleton in vertebrates

17.2.3 Locomotion in a finned fish
17.2.4 Identification of the bones of axial and appendicular skeletons (names of individual bones of coccyx not required)
17.2.5 Types and functions of movable joints (ball and socket, hinge joint)
17.2.6 Structure, function and location of cardiac, smooth and skeletal muscles (Details of fine structure not required)
17.2.7 Role of muscles in movement of the arm in humans

17.3.0 Practical Activities

17.3.1 Observe permanent/temporary slides of transverse sections of the stems of herbaceous and woody plants
17.3.2 Observe wilting in young herbaceous plants
17.3.3 Examine the exoskeleton in arthropods
17.3.4 Observe and identify external features of a finned fish
17.3.5 Examine and draw different types of bones in mammals.