



# **ZIMBABWE SCHOOL EXAMINATIONS COUNCIL (ZIMSEC)**

## **ZIMBABWE GENERAL CERTIFICATE OF EDUCATION (ZGCE)**

**For Examination in June/November 2011 – 2020**

**O Level Syllabus**

**BIOLOGY (5008)**

# **BIOLOGY**

## **G.C.E. ORDINARY LEVEL**

### **A. INTRODUCTION**

This syllabus assumes knowledge of the content of the two year Zimbabwe Junior Science Syllabus. It prepares pupils for studies in biological sciences beyond 'O' Level as well as being a worthwhile qualification for those proceeding with study beyond this level. It places less emphasis on factual recall of material and more emphasis on the understanding and application of scientific concepts, principles and skills.

Applications of science and technology to agriculture, environmental, social and economic issues are included to extend subject concepts and skills. A practical and investigative approach must be adopted in teaching this syllabus. This will serve to develop the skills and abilities necessary to achieve the stated aims and objectives.

This syllabus may not be taken with Human and Social Biology, 5097.

### **B. AIMS**

The aims of the syllabus are to help pupils:

1. develop interest, and curiosity, in science;
2. develop concepts and skills that are relevant to the study and practice of biology;
3. appreciate and enjoy biology and its methods of enquiry;
4. develop creativity, initiative and skills of enquiry;
5. develop good practices for health and safety;
5. develop accuracy and precision, objectivity and integrity;
6. recognise the usefulness and limitations of science;
8. apply scientific method in other disciplines and in everyday life;
9. appreciate the beneficial and detrimental effects of the applications of science;
10. recognise that the study and practice of science are inter-related and are subject to economic, technological, social, political, ethical and cultural influences;
11. communicate scientific information effectively;
12. participate in the technological development of Zimbabwe;
13. develop interest in, and participate in, caring for the local and global environment.

## **C. ASSESSMENT OBJECTIVES**

The following objectives reflect those aspects of the aims that will be assessed. Specific behavioural learning objectives are stated in each section of the syllabus.

### **1.0 KNOWLEDGE AND UNDERSTANDING**

Pupils should be able to demonstrate knowledge and understanding of:

- 1.1 scientific instruments and apparatus, techniques and operation and aspects of safety;
- 1.2 biological units, terminology, symbols and conventions;
- 1.3 scientific quantities and how they are determined;
- 1.4 biological phenomena, facts and laws, definitions, concepts, theories and models;
- 1.5 the personal, social, economic and environmental implications of biological applications.

### **2.0 HANDLING INFORMATION AND SOLVING PROBLEMS**

Pupils should be able to demonstrate, in familiar and unfamiliar situations, their ability to:

- 2.1 extract information relevant to a particular context from data presented in diagrammatic, symbolic, graphical, numerical or verbal form;
- 2.2 use data to recognise patterns, formulate hypotheses and draw conclusions;
- 2.3 translate information from one form to another.
- 2.4 communicate logically and concisely;
- 2.5 explain facts, observations and phenomena in terms of scientific laws, theories and models;
- 2.6 explain the effects of technological applications on the environment and the organisms within it;
- 2.7 make logical decisions based on the examination of evidence and arguments;

- 2.8 apply scientific principles, formulae and methods to solve qualitative and quantitative problems;
- 2.9 suggest explanations of unfamiliar facts, observations and phenomena;
- 2.10 identify the practical constraints affecting biological investigations.

### **3.0 EXPERIMENTAL SKILLS**

Pupils should be able to:

- 3.1 follow instructions for practical work;
- 3.2 plan, organise and carry out experimental investigations;
- 3.3 select appropriate apparatus and materials for experimental work;
- 3.4 use apparatus and materials effectively and safely;
- 3.5 make accurate, systematic observations and measurements, recognising the variability of experimental measurements;
- 3.6 observe, measure and record results of experimental procedures;
- 3.7 identify possible sources of error in experimental procedures;
- 3.8 draw conclusions and make generalisations from experiments;
- 3.9 extract information from data presented in diagrammatic, graphical or numerical form.

#### 4.0 WEIGHTING OF ASSESSMENT OBJECTIVES

	ASSESSMENT OBJECTIVE	WEIGHTING
<b>Papers 1 and 2</b>		
Knowledge and understanding	1.0	55%
Handling information	2.0	45%
<b>Paper 3 or Paper 4</b>		
Experimental skills	3.0	100%

#### D. ASSESSMENT SCHEME

Paper	Type of Paper	Duration	Marks	Paper Weighting
1	Theory	1h	40	30%
2	Theory	2h	100	50%
3	Practical Examination	1h 30min	40	20%
4	Alternative to Practical (Written)	1h	40	20%

Candidates will be required to enter for Papers 1 and 2 and either Paper 3 or Paper 4.

**Paper 1** Theory (1 hour, 40 marks)  
This paper will consist of 40 compulsory multiple-choice items.

**Paper 2** Theory (2 hours, 100 marks)  
Section A (40 marks, 55 min) will consist of a number of compulsory short-answer and structured questions of variable mark value.  
Section B (60 marks, 1 hour 20 min) will consist of five free-response questions of twenty marks each and each designed to take 25 minutes. Candidates will be required to answer any three questions. All questions will be designed to give the same weighting to the assessment objectives.

**Paper 3** Practical Examination (1 hour 30 min, 40 marks)  
This paper is designed to assess the extent to which a candidate displays competence practical skills. It will consist of 2 practical questions of 20 marks each.

**Paper 4** Alternative to Practical (1 hour, 40 marks)  
This is a written paper of four compulsory short-answer and structured questions designed to test familiarity with practical laboratory procedures.

The practical examination and the alternative to the practical examination are designed to test candidate's abilities to:

- (a) perform simple calculations;
- (b) make clear, labelled, line drawings;
- (c) describe tests for foods, water, carbon dioxide and oxygen, pH and/or draw conclusions from tests.
- (d) use familiar and unfamiliar techniques to record their observations and make deductions from them;
- (e) recognise and observe features of familiar and unfamiliar biological specimens, record the observations and make deductions about functions of whole specimens or their parts.
- (f) interpret unfamiliar data and draw conclusions;
- (g) record readings from diagrams and draw conclusions;
- (h) describe, explain, analyse or suggest experimental arrangements, techniques and procedures;
- (i) interpret, draw conclusions from and evaluate experimental data, including graphical data.

In addition, the practical examination is designed to test candidates' abilities to:

- (a) make clear line drawings of the specimens provided, indicate magnification and label familiar structures;
- (b) manipulate and assemble apparatus, use chemical reagents and such instruments as mounted needles, scalpels and razor blades, forceps and scissors;
- (c) observe reactions, read simple measuring instruments and perform simple mathematical calculations;
- (d) complete tables of data and/or plot graphs;
- (e) construct simple models; follow carefully a sequence of instructions within a set time allowance.

**NOTE:** Examination questions on all papers may be set requiring candidates to apply knowledge to novel situations.

## **E      METHODOLOGY**

Emphasis is placed on the acquisition of experimental skills through practical experience. Experiments should be planned and designed in advance. A pupil-centered problem-solving approach should be adopted. Individual and group work is encouraged.

Emphasis must be on the understanding of concepts rather than on the memorisation of specific examples that illustrate these concepts.

The syllabus is a two-year course of study. A minimum of six teaching periods (3½ hours) per week is required.

Wherever possible, specimens, models, slides, photomicrographs, photographs and diagrams must be examined. In order to assist their own practical work and to supply possible examination specimens, schools are asked to build up a reference collection of materials, e.g. bones of the rabbit, rat or guinea pig, teeth of herbivores and carnivores.

In the interest of public health and safety, fresh human tissue must not be used. Wild animals must not be brought into the laboratory or science room for observation or dissection. Safety precautions must be observed during practical work.

Teachers may use an integrated, co-ordinated, topic based approach or any other style of organisation and delivery. Emphasis on investigations and practical work is expected. Schools are encouraged to rearrange the topics to suit their own conditions.

SI units of measurement are to be used together with units in common scientific use.

Where it will facilitate learning, the drawing of diagrams should be encouraged.

Direction should be given in the correct taking of notes and writing up of experiments.

## **F. MATHEMATICAL REQUIREMENTS**

Many topics in the syllabus provide opportunities for quantitative work, including appropriate calculations. The mathematical knowledge and skills which pupils may need in order to cope with the specified objectives and content are listed below. **Calculators may be used in all papers.**

Candidates will be expected to:

- recognise and use expressions in decimal form;
- add, subtract, multiply and divide numbers, including decimal numbers and common fractions.
  
- make approximations and estimates to obtain quick order-of-magnitude answers or to make simple mental checks of answers obtained by calculator;
  
- calculate and use averages, ratios, direct proportion and percentages;
  
- draw and interpret graphs, bar and pie charts;
  
- select appropriate axes and scales for plotting graphs;
  
- choose, by simple inspection, a set of points and then draw the best smooth curve through them;
  
- determine the intercept of a linear graph;
  
- read, interpret and draw simple inferences from tables and statistical diagrams;
  
- substitute numbers for letters or words in simple equation;
  
- measure triangles, rectangles, circles and cuboids;
  
- take account of variability of experimental measurements;

- manipulate and solve simple equations;
- demonstrate a qualitative understanding of inverse proportion;
- use a ruler graduated in millimetres and centimetres;
- use a protractor to measure angles;
- read graduated scales of various forms.

## **G. PRESENTATION OF CONTENT**

The syllabus consists of twelve compulsory sections listed below.

1. Cells and cellular functions.
2. Nutrition in plants.
3. Nutrition in humans.
4. Gaseous exchange and respiration.
5. Transport in plants.
6. Transport in mammals.
7. Skeletal system.
8. Homeostasis, coordination and response.
9. Reproduction.
10. Micro-organisms and disease.
11. Inheritance.
12. Ecosystems.

The learning objectives are presented in behavioural form.

The content column serves to limit the extent to which the learning objectives should be covered.

The notes and activities in the last column are in no way exhaustive. Teachers are encouraged to use their own additional examples to assist pupils in understanding concepts and acquiring skills.

## Glossary of terms used in question papers in Science

The glossary is meant only as a guide; it is neither exhaustive nor definitive. The glossary has been kept brief in respect of the number of terms and their definitions. It should be borne in mind that the meaning of a term depends in part on its context.

1. *Calculate* is used when a numerical answer is required. Working should be shown.
2. *Deduce* means that the candidate is expected to draw logical and valid conclusions from given information. Such information may be all be given in the question or may depend on answers extracted in an earlier part of the question. Candidates are not expected to produce and answer by recall.
3. *Define* (the term(s) ..... ) means to state precisely the meaning of a term.
4. *Describe* is often used with reference either to particular phenomena or to particular experiments. When used with reference to particular phenomena the term usually implies that the description should include reference to (visual) observations associated with the phenomena. When used with reference to particular experiments the description usually follows a standard pattern, e.g. Apparatus, Method, Measurements, Results and Precautions.

In other contexts, *describe and give an account of* should be interpreted more generally, i.e. the candidate had greater discretion about the nature and the organisation of the material to be included in the answer.

5. *Determine* implies that the quantity concerned cannot be measured directly but is obtained by calculation, substituting measured or known values of other quantities into a standard formula, for instance density of an object may be calculated using
$$d = \frac{m}{V}$$
6. *Estimate* implies an approximate calculation of the magnitude or quantity concerned.
7. *Find* means that the candidate is expected to calculate, measure or determine.
8. *Find* means to establish the quantity concerned using a suitable measuring instrument, e.g. length, using a ruler, or mass, using a balance.
9. *Measure* means to establish the quantity concerned using a suitable measuring instrument, e.g. length, using a ruler, or mass, using a balance.
10. *Outline* means to give the essential points.
11. *Predict* implies that the candidate is expected to state what is likely to happen by analysis given information. Such information may all be given in the question or may depend on answers extracted in an earlier part of the question. Candidates are not expected to produce an answer by recall.

12. *Sketch*, when applied to graph work, implies that the shape and/or position of the curve need only be qualitatively correct.  
In diagrams, sketch implies that the candidate is expected to make a simple, freehand drawing: nevertheless, care should be taken over proportions. Important details must be shown.
13. *State* means to give a concise answer with little or no supporting argument.
14. *Suggest* may imply that there is more than one possible answer or that candidates are expected to apply their general knowledge to a novel situation.
15. *What do you understand by/What is meant by* (the term(s) ...) implies that a definition should be given, as well as some relevant comment or explanation. The amount of detail expected is determined by the marks allocated.

## BIOLOGY SYLLABUS

TOPIC	LEARNING OBJECTIVES Pupils should be able to:	CONTENT	NOTES AND ACTIVITIES
<b>1.0 CELLS AND CELLULAR FUNCTIONS</b>			
1.1 Cell structure and function	<ul style="list-style-type: none"> <li>- identify cells as basic units of living organisms;</li> <li>- identify cell parts;</li> <li>- compare plant and animal cells;</li> </ul>	<p>Functional units and building blocks.</p> <p>Basic plant and animal cell structure: Nucleus, cytoplasm, mitochondria, cell membrane, cell wall, chloroplast, permanent vacuole and starch grains.</p>	<p>Slide preparations: leaf epidermis, e.g. onion; squash preparations: e.g. root tip, or blood.</p> <p>Examination of cells from diagrams and photosynthesis.</p>
1.2 Cell specialisation	<ul style="list-style-type: none"> <li>- identify specialised cells;</li> <li>- relate cell structure to function;</li> </ul>	<p>Palisade - photosynthesis Root hair - absorption Neurone - transmission of impulses Red cell - transport of oxygen Muscle cell – contraction</p>	<p>Observation of cells from fresh or preserved materials under microscope or bio-viewer. Examination of diagrams or photomicrographs.</p>
1.3 Movement of molecules	<ul style="list-style-type: none"> <li>- define diffusion;</li> <li>- investigate factors that affect the rate of diffusion;</li> <li>- define osmosis;</li> <li>- describe the effect of water gain/loss plant and animal cells;</li> <li>- define active transport;</li> </ul>	<p>Movement of particles in liquids and gases.</p> <p>Surface area/volume ratio and temperature.</p> <p>Water movement across a partially permeable membrane.</p> <p>Turgor, plasmolysis.</p> <p>Movement of molecules and ions against concentration gradients.</p>	<p>Diffusion is the movement of particles from a region of their higher concentration to a region of their lower concentration.</p> <p>Experiments on diffusion in gases, liquids and solids.</p> <p>Osmosis is the movement of water molecules from a region of their higher concentration through a partially permeable membrane.</p> <p>Experiments to demonstrate osmosis, turgor and plasmolysis. Use of visking tubing, eggshell membrane, plant tissue e.g. potato or onion skin and animal tissue e.g. ox blood. Water potential <u>not</u> required.</p> <p>Active transport requires energy to move molecules against concentration gradients.</p>

TOPIC	LEARNING OBJECTIVES Pupils should be able to:	CONTENT	NOTES AND ACTIVITIES
1.4 Enzyme	<ul style="list-style-type: none"> <li>- define enzymes;</li> <li>- explain the function of enzymes;</li> </ul>	<p>Biological catalysts.</p> <p>Role in metabolic processes.</p> <p>Protein nature and substrate specificity. Option conditions: pH and temperature.</p>	<p>An enzymes is a chemical which acts as a biological catalyst, accelerating the rate of chemical change in an organism.</p> <p>Experiments with analyse from germinating seedlings e.g. rupoko and catalase from fresh plant tissue.</p> <p>Experiments to investigate properties of enzymes. Interpretation of data.</p>
<b>2.0 NUTRITION IN PLANTS</b>			
2.1 Photosynthesis	<ul style="list-style-type: none"> <li>- define photosynthesis;</li> <li>- state the word equation for photosynthesis;</li> <li>- investigate conditions necessary for photosynthesis;</li> <li>- investigate gaseous exchange in plants;</li> <li>- describe factors that affect the rate of photosynthesis;</li> <li>- identify parts of the internal structure of a dicotyledonous leaf;</li> <li>- describe how leaf structure is adapted for photosynthesis;</li> </ul>	<p>Conversion of light energy to chemical energy stored in carbohydrates.</p> <p>Carbon dioxide + water <math>\xrightarrow[\text{chlorophyll}]{\text{light}}</math> Carbon</p> <p>Chlorophyll, light and carbon dioxide.</p> <p>Carbon dioxide and oxygen.</p> <p>Light intensity, carbon dioxide concentration and temperature.</p> <p>Palisade and spongy mesophyll, vascular bundles (xylem and phloem), cuticle, epidermis and stomats.</p> <p>Surface area and cross-section of leaf (lamina and thinness), venation, presence of stomata, arrangement of cells and chloroplasts in palisade and spongy mesophyll.</p>	<p>Starch test on leaf.</p> <p>Controlled experiments to show conditions necessary for photosynthesis.</p> <p>Experiments to demonstrate gaseous exchange in plants using bicarbonate indicator solution.</p> <p>Experiments to show effect of these factors.</p>

TOPIC	LEARNING OBJECTIVES	CONTENT Pupils should be able to:	NOTES AND ACTIVITIES
2.2 Mineral nutrition	<ul style="list-style-type: none"> <li>- describe the functions of nitrogen; phosphorus and potassium on plant growth;</li>   <li>- describe the effects of deficiencies of nitrogen, phosphorus and potassium.</li> </ul>	<p>Nitrogen (N) - Protein synthesis.</p> <p>Phosphorus (P) - Synthesis of ATP energy carrier.</p> <p>Potassium (K) - Ion and osmotic balance. Respiration and photosynthesis.</p> <p>Nitrogen - stunted growth and chlorosis.</p> <p>Phosphorus - stunted growth especially roots, sometimes purplish leaf colouring.</p> <p>Potassium - yellow and brown leaf margins, premature death (poor flowering and fruiting).</p>	<p><u>No</u> details of protein and ATP synthesis are required.</p> <p>N needed for good leaf growth, P needed for good root growth, K needed for flowering and fruiting.</p> <p>Culture experiments.</p>
2.3 Productivity	<ul style="list-style-type: none"> <li>- define biomass.</li> <li>- define productivity;</li>   <li>- identify types of plant pests and disease;</li>   <li>- explain how pests and disease affect productivity;</li>   <li>- describe methods of controlling pests and disease;</li>   <li>- state the advantages and disadvantages of each method.</li> </ul>	<p>Biomass – organic content increase in biomass over time.</p> <p>Light, mineral salts, temperature, availability of water, pests and disease.</p> <p>Tissue-eating and sap-sucking pests. Bacterial wilt, fungal rust.</p> <p>Reduced yields</p> <p>Management, chemical and biological.</p>	<p>Experiments to measure biomass.</p> <p>Qualitative description only required.</p> <p>Examination of pests and plant damage.</p>  <p>Cotton and tobacco for management control.</p>

TOPIC	LEARNING OBJECTIVES	CONTENT	NOTES AND ACTIVITIES
<b>3.0 NUTRITION IN HUMANS</b>			
3.1 Nutrients	<ul style="list-style-type: none"> <li>- state composition and properties of carbohydrates, proteins and fats;</li> <li>- compare energy content of nutrients;</li> <li>- test food for presence of nutrients;</li> <li>- list major sources of nutrients;</li> <li>- list the major functions of the nutrients;</li> <li>- state the effects of deficiencies of vitamins A and C, calcium, iodine and iron;</li> <li>- list sources of vitamins A and C, calcium, iodine and iron;</li> </ul>	<p>Elements, sub-units, energy content, molecular size and solubility.</p> <p>Carbohydrates and fats.</p> <p>Starch, sucrose, reducing sugars, protein and fats.</p> <p>Food rich in: carbohydrates, fats, proteins, vitamins, minerals, fibre (roughage) and water.</p> <p>Metabolic processes.</p> <p>Vitamin A      - respiratory tract infections, poor sight and blindness.</p> <p>Vitamin C      - poor healing, bleeding under skin.</p> <p>Calcium        - poor bone formation.</p> <p>Iodine         - mental and physical retardation, goitre.</p> <p>Iron            - anaemia.</p> <p>Sources.</p>	<p>Tests for solubility of glucose, sucrose, starch and cellulose.</p> <p>Experiments on energy in food.</p> <p>Iodine, Benedict's biuret and ethanol emulsion tests using foodstuffs.</p> <p>Sources to include locally available and traditional foods.</p> <p>Energy, development, growth, repair, protection and storage.</p> <p>Effects of deficiencies in children and adults. Test for Vitamin C using DCPIP or suitable alternative e.g. potassium (VII) manganate.</p> <p>Intake of foods rich in the missing nutrients to treat deficiency.</p>

TOPIC	LEARNING OBJECTIVES Pupils should be able to	CONTENT	NOTES AND ACTIVITIES
3.2 Diet	<ul style="list-style-type: none"> <li>- defined balanced diet,</li> <li>- explain the importance of a balanced diet.</li> </ul>	<p>Balanced diet.</p> <p>Balance between food intake and energy expenditure, growth and health requirements.</p> <p>Age, sex and activity: sedentary and manual workers, young child, pregnant woman.</p> <p>Protein and energy deficiency: kwashiorkor, marasmus. Excess fat and salt – obesity and heart disease.</p>	<p>A diet containing all essential nutrients in the right quantities and proportions for a healthy life.</p> <p>Use simple tables of dietary requirements.</p> <p>Malnutrition as under nourishment and over nourishment.</p>
3.3 Alimentary canal	<ul style="list-style-type: none"> <li>- identify the main regions in the mammalian alimentary canal and associated organs.</li> <li>- state functions of parts of the alimentary canal;</li> </ul>	<p>Mouth, salivary glands, oesophagus, stomach, duodenum, pancreas, gall bladder, liver, ileum, caecum, appendix, colon, rectum, anus.</p> <p>Ingestion, digestion, absorption, assimilation and egestion.</p>	<p>Mouth, salivary glands, oesophagus, stomach, duodenum, pancreas, gall bladder, liver, ileum, caecum, appendix, colon, rectum, anus.</p>
3.4 Mechanical digestion	<ul style="list-style-type: none"> <li>- describe the structure of a tooth.</li> <li>- describe main functions and types of teeth.</li> <li>- relate structure of tooth surface to diet.</li> <li>- describe mechanical breakdown and movement of food in the alimentary canal;</li> </ul>	<p>Crown, neck, root, enamel, dentine pulp cavity.</p> <p>Canines – cutting and tearing. Molars and premolars – chewing.</p> <p>Herbivorous and carnivorous teeth. Chewing and peristalsis.</p>	<p>Functions of parts of a tooth .</p> <p>Examination of teeth.</p>
3.5 Care of teeth	<ul style="list-style-type: none"> <li>- identify causes of dental decay.</li> <li>- describe the proper care to teeth;</li> </ul>	<p>Plaque containing bacteria.</p> <p>Diet, brushing of teeth and use of toothpaste or substitute, visits to dental workers.</p>	<p>Action of bacteria on sugary food producing acids. Experiments showing action of acid on tooth.</p> <p>Experiments on the action of toothpaste and the determination of pH of toothpaste. Use of salt and bicarbonate of soda as a substitute.</p>

TOPICS	LEARNING OBJECTIVES Pupils should be able:	CONTENT	NOTES AND ACTIVITIES
3.6 Chemical digestion	<ul style="list-style-type: none"> <li>- explain why most foods must be digested;</li> <li>- describe the function of a typical amylase, protease and lipase;</li> <li>- state substrates and the end-product of their digestion by enzymes;</li> <li>- explain the roles hydrochloric acid, rennin and bile;</li> </ul>	<p>Molecule size and solubility.</p> <p>Breakdown of starch, protein and fats.</p> <p>Buffer, destruction of bacteria and hydrolysis. Clotting of milk . Emulsification of fats.</p>	<p>Extracellular digestion. Reduction in molecule size and increase solubility.</p> <p>Experiment with starch and amylase in visking tubing as a model gut. Specific names of enzymes <u>not</u> required.</p> <p>Experiments to demonstrate hydrolysing clotting of milk and emulsification of fats.</p>
3.7 Absorption and assimilation	<ul style="list-style-type: none"> <li>- describe structural adaptations in the small intestines to acid absorption.</li> <li>- describe absorption of end products of digestion.</li> <li>- identify the role of the large intestine;</li> <li>- state the function of the hepatic portal vein;</li> <li>- outline the role of the liver in metabolism.</li> </ul>	<p>Features of small intestines: length, folding, villi, thin lining, rich blood supply.</p> <p>Diffusion and active transport.</p> <p>Absorption of water and vitamin B, formation and expulsion of faeces.</p> <p>Transportation of products of digestion to liver.</p> <p>Glucose and amino acid metabolism, breakdown of alcohol and toxins, storage of fat, glycogen and vitamin A and D and the production of urea.</p>	<p>Water soluble products enter blood capillaries; fatty acids and glycerol enter lacted.</p> <p>Production of vitamin B by bacteria. Role of fibre in preventing constipation.</p> <p>Liver as a storage and regulatory organ. Large molecules synthesized from small basic units: glycogen from simple sugar, proteins from amino acids and lipids from fatty acids and glycerol. Role of fat as a economic storage substance. Details of urea formation not required.</p>

TOPIC	LEARNING OBJECTIVES Pupils should be able to:	CONTENT	NOTES AND ACTIVITIES
<b>4.0 GASEOUS EXCHANGE AND RESPIRATION</b>			
4.1 Gaseous exchange in mammals	<ul style="list-style-type: none"> <li>- identify parts of the respiratory system,</li> <li>- state the functions of the parts of the respiratory system.</li> <li>- describe factors which increase the efficiency of gaseous exchange.</li> <li>- describe the mechanism of breathing.</li> <li>- describe the structure and role of the alveoli;</li> <li>- state the difference between inhaled exhaled air;</li> <li>- explain the effects of physical activity on breathing and blood circulation;</li> <li>- describe some effects of smoking on respiratory system;</li> </ul>	<p>Nasal passages, larynx, trachea, bronchi, bronchioles, alveoli and capillaries.</p> <p>Large surface are. Thin membrane. Moist . Good blood supply. Ventilation.</p> <p>Inhalation of exhalation.</p> <p>Exchange of carbon dioxide and oxygen.</p> <p>Changes in percentage volume of carbon dioxide, oxygen and water vapour.</p> <p>Depth and rate of breathing. Pulse rate.</p> <p>Short term effects – increased carbon dioxide content of inhaled air, irritation and damage to surfaces used for gaseous exchange. Long term effects – emphysema and lung cancer.</p>	<p>Identification of parts from diagrams, photographs, models.</p> <p>The role of the diaphragm, ribs and intercostals muscles. Use of models.</p> <p>Experiments to show that exhaled air contains a higher proportion of carbon dioxide.</p> <p>Measurement of pulse rates and breathing rates before and after exercise. Trial volume, vital capacity etc <u>not</u> included.</p> <p>Cough and mucus build-up, destruction of cilia. The strong link between smoking and respiratory disease must be emphasised.</p>

TOPIC	LEARNING OBJECTIVES Pupils should be able to:	CONTENT	NOTES AND ACTIVITIES
4.2 Aerobic respiration	<ul style="list-style-type: none"> <li>- define aerobic respiration.</li> <li>- state the sites of aerobic respiration in the cell.</li> <li>- state of equation for aerobic respiration;</li> <li>- list uses of energy in the body;</li> </ul>	<p>Release of energy in plentiful supply of oxygen.</p> <p>Mitochondria.</p> <p>Glucose + oxygen → carbon dioxide + water + energy</p> <p>Metabolic processes: Muscle contractions, protein synthesis, growth, Cell division, active transport, transmission of impulses, maintenance of a constant body temperature (homeostasis), digestion and excretion.</p>	<p>The release of a relatively large amount of energy by the complete oxidation of food substance in the presence of oxygen.</p> <p>Experiments to show release of heat and carbon dioxide and oxygen uptake.</p>
4.3 Anaerobic respiration	<ul style="list-style-type: none"> <li>- define anaerobic respiration;</li> <li>- state the site of anaerobic respiration.</li> <li>- state the equations for anaerobic respiration in plants and in animals;</li> <li>- describe the production and effect of lactic acid on muscles during exercise.</li> </ul>	<p>Release of energy in limited supply of oxygen.</p> <p>Cytoplasm</p> <p>Plants:            glucose → carbon dioxide + alcohol + energy.</p> <p>Animals:         glucose → lactic acid + Energy.</p> <p>Fatigue; Oxygen debt, Role of liver.</p>	<p>The release of a relatively small amount of energy by the incomplete oxidation of food substances in the absence of oxygen.</p> <p>Fermentation of sugar by yeast.</p> <p>Details of conservation of lactic acid <u>not</u> required.</p>

TOPIC	LEARNING OBJECTIVES Pupils should be able to:	CONTENT	NOTES AND ACTIVITIES
<b>5.0 TRANSPORT IN PLANTS</b>			
5.1 Plant structure	<ul style="list-style-type: none"> <li>- distinguish between monocotyledonous and dicotyledonous plants;</li> <li>- identify parts of the internal structure of a young dicotyledonous root and stem;</li> <li>- state functions of xylem.</li> </ul>	<p>Seeds, leaves and stem and root systems.</p> <p>Epidermis, cortex, vascular tissues (xylem and phloem) and root hairs.</p> <p>Support and transport.</p>	<p>External and internal features.</p> <p>Using diagrams and photomicrographs of transverse sections of a root and a stem to show distribution to tissues.</p> <p>Use of dyes to identify vascular tissue.</p>
5.2 Water and ion uptake	<ul style="list-style-type: none"> <li>- explain functions of root hairs;</li> </ul>	<p>Diffusion, osmosis and active transport.</p>	<p>Relation of surface area of root hairs to water and ion uptake to be discussed.</p>
5.3 Transpiration and translocation	<ul style="list-style-type: none"> <li>- define transpiration;</li> <li>- describe the functions of transpiration;</li> <li>- investigate factors affecting the rate of transpiration;</li> <li>- describe adaptations of leaves to minimise water loss;</li> <li>- describe how wilting occurs;</li> <li>- define translocation.</li> </ul>	<p>Water loss: evaporation and diffusion.</p> <p>Water movement is xylem and cooling effect.</p> <p>Surface area and stomata. Temperature, wind, humidity and light intensity.</p> <p>Reduction of surface area, thickness of cuticle, distribution of stomata and presence of hairs.</p> <p>Wilting.</p> <p>Movement of organic solutes in phloem.</p>	<p>Loss of water vapour from leaves and stem.</p> <p>Transpiration stream, limited only to a continuous column of water.</p> <p>Experiments to investigate transpiration under various conditions using potometer, weighing and cobalt chloride paper.</p> <p>Experiments to investigate the distribution and role of stomata in water loss.</p> <p>Excessive loss of water during transpiration.</p> <p>Reference to bark ringing.</p>

TOPIC	LEARNING OBJECTIVES Pupils should be able to:	CONTENT	NOTES AND ACTIVITIES
<b>6.0 TRANSPORT IN MAMMALS</b>			
6.1 Circulatory system	<ul style="list-style-type: none"> <li>- describe the circulatory system;</li> <li>- state functions of the circulator system;</li> <li>- name of parts of the heart;</li> <li>- name of parts of the heart;</li> <li>- outline how the heart pumps blood;</li> <li>- relate the structure of vessels of their function;</li> <li>- relate pressure difference in the dual circulatory system to the functions of the two circuits;</li> <li>- identify possible causes of high blood pressure;</li> <li>- identify possible causes of coronary heart disease;</li> <li>- describe the effects of high blood pressure and coronary heart disease.</li> </ul>	<p>Heat, vessels and valves.</p> <p>Transport of materials and distribution of heat.</p> <p>Aorta, vena cava, hepatic portal vein, hepatic, pulmonary and renal veins and arteries.</p> <p>Atria, ventricles, valves and cardiac muscle.</p> <p>Cardiac cycle. Valve function and movement of blood.</p> <p>Arteries, veins, capillaries.</p> <p>Pulmonary and systemic.</p> <p>Genetic predisposition, stress, diet.</p> <p>Diet, stress, smoking, obesity, high blood pressure.</p> <p>Stroke, heart attack and death.</p>	<p>A system of tubes with a double pump and valves allowing a one-way flow of blood.</p> <p>Dissection of a four-chambered heart or examination of a model of a heart.</p> <p>The heart as a double pump. Use of terms diastole and systole <u>not</u> required.</p> <p>Examine photomicrographs of blood vessels to compare their walls.</p> <p>Low pressure circulation to the heart, lungs and high pressure circulation to body tissues.</p> <p>Depositing of cholesterol aggravated by excess fat in diet, stress, smoking and high blood pressure.</p> <p>Damage to artery lining by deposits of cholesterol causes ruptures or blood clots which obstruct blood flow to brain (stroke) or heart (coronary heart attack).</p>

TOPIC	LEARNING OBJECTIVES	CONTENT	NOTES AND ACTIVITIES
6.2 Blood	<ul style="list-style-type: none"> <li>- list components of mammalian blood;</li>   <li>- describe the movement of materials between capillaries and tissue fluid.</li> </ul>	<p>Red blood cells – oxygen transport.  White blood cells – phagocytic action and antibody production.  Platelets – clotting.  Plasma – transport of blood cells, ions digested food substances, hormones, carbon dioxide, urea, vitamins, fibrinogen and plasma proteins.</p> <p>Diffusion and pressure filtration.</p>	<p>Identification of red and white blood cells from prepared slides, and photomicrographs.  Observation of reed blood cells in tadpole or fish tails.</p> <p>Brief mention of movement of white blood cells through capillary walls.</p>
6.3 Immunity	<ul style="list-style-type: none"> <li>- explain how the body protects itself against disease;</li> <li>- describe events leading to active immunity;</li> <li>- describe events leading to pasisive immunity;</li> <li>- describe the effect of the human immunodeficiency virus (HIV) on the body;</li> <li>- discuss the significance of immunization.</li> </ul>	<p>Skin, tears, mucus, clotting of blood, white blood cells: engulfing action, production of antibodies.</p> <p>Infection leading to antibody production. Vaccination.</p> <p>Transfer via placenta and breastmilk, serum injection.</p> <p>Inability to resist infection.</p> <p>Extended programme of immunization.</p>	<p>Natural active immunity artificial active immunity.</p> <p>Natural passive immunity in infants artificial passive immunity against e.g. snake bite and rabbies.</p> <p>HIV and immune system.</p> <p>Using immunization card.</p>
<b>7.0 SKELETAL SYSTEM</b>			
7.1 Support and Movement	<ul style="list-style-type: none"> <li>- identify the main bones of the fore and hind limb of a mammal;</li> <li>- describe types of joints;</li> <li>- describe the types of movement permitted by joints;</li> <li>- describe the action of muscles at a hinge joint.</li> </ul>	<p>Scapula, humerus, radius, ulna, pelvis, femur, tibia and fibula.</p> <p>Hinge joints; ball and socket joints.</p> <p>One plane and all planes.</p> <p>Antagonistic muscles: extensor and flexor muscles.</p>	<p>Specimen of bones to be examined.</p>

TOPIC	LEARNING OBJECTIVES Pupils should be able to:	CONTENT	NOTES AND ACTIVITIES
<b>8.0 HOMEOSTASIS, COORDINATION AND RESPONSE</b>			
8.1 Homeostasis	<ul style="list-style-type: none"> <li>- define homeostasis;</li> <li>- identify and label parts of the skin;</li> <li>- relate the function of parts of the skin to the maintenance of a constant body temperature;</li> <li>- describe the coordination function of the brain in homeostasis;</li> </ul>	<p>The maintenance of a constant internal environment.</p> <p>Epidermis, dermis, adipose tissue, hairs, sweat gland, blood vessels, receptors.</p> <p>Temperature sensitivity. Shivering, sweating, vaso-dilation and vaso-constriction.</p> <p>The hypothalamus. Negative feedback.</p>	<p>Regulation of temperature – skin Water, pH and ion – kidney Glucose concentration – liver</p> <p>Limited to temperature control.</p>
8.2 Excretion	<ul style="list-style-type: none"> <li>- define excretion;</li> <li>- list substances that must be excreted and organs involved;</li> <li>- describe the structure of the urinary system;</li> <li>- state the function of the parts of the urinary system;</li> </ul>	<p>Excretion.</p> <p>Kidney: urea, salt, water and toxins. Lungs: carbon dioxide and water. Skin: salts and water.</p> <p>Kidney: pelvis, cortex, medulla, kidney tubules and ureters. Bladder and urethra.</p> <p>Osmoregulation, urea excretion, urine production and storage.</p>	<p>The removal of toxic materials and waste products of metabolism.</p> <p>Names of parts: Bawman’s capsule, glomerules, tubule, loop.</p> <p>Ultrafiltration and selective reabsorption.</p>
8.3 Nervous system	<ul style="list-style-type: none"> <li>- describe the structure of a neurone and a nerve;</li> <li>- describe a simple spinal reflex;</li> <li>- outline functions of the main parts of the brain;</li> <li>- describe the kidney dialysis machine.</li> </ul>	<p>Sensory, relay and motor neurone, nerve.</p> <p>Spinal chord: white and grey matter, receptor, neurone, effectors.</p> <p>Cerebrum, cerebellum, pituitary gland, hypothalamus, medulla.</p> <p>Kidney failure.</p>	<p>Practical observation of reflex actions knee jerk, withdrawal reflex.</p>

TOPIC	LEARNING OBJECTIVES Pupils should be able to:	CONTENT	NOTES AND ACTIVITIES
<b>9.0 REPRODUCTION</b>			
9.1 Sexual and asexual reproduction	- define and compare asexual and sexual reproduction;	Binary and multiple fusion. Nuclear fusion and genetic variation.	Asexual reproduction as the process resulting in the production of genetically identical offspring from one parent. Sexual reproduction as the process involving the fusion of nuclei to form a zygote and the production of genetically different offspring.
9.2 Sexual reproduction in plants	<ul style="list-style-type: none"> <li>- describe the structure and characteristics of wind- and insect-pollinated flowers;</li> <li>- distinguish between self- and cross-pollination;</li> <li>- outline the process of fertilisation.</li> <li>- describe the changes that occur after fertilisation.</li> </ul>	<ul style="list-style-type: none"> <li>Adaptation of flower parts to mode of pollination.</li> <li>Pollen transfer.</li> <li>Development of pollen tube. Fusion of male and female nuclei.</li> <li>Formation of seeds and fruits.</li> <li>Wind, animal and mechanical dispersal.</li> </ul>	<ul style="list-style-type: none"> <li>Comparison of fresh specimens of insect-pollinated and wind-pollinated flowers.</li> <li>Practical examination of growing pollen tubes. <u>No</u> knowledge of double fertilisation and endosperm formation required.</li> <li>Examination of a variety of seeds and fruits.</li> </ul>
9.3 Vegetation reproduction	<ul style="list-style-type: none"> <li>- describe vegetative reproduction in plants;</li> <li>- state advantages and disadvantages of vegetative production;</li> </ul>	<ul style="list-style-type: none"> <li>Rhizomes, tube, sucker and cutting.</li> <li>Resistance to disease, genetic variation, survival of offspring and rate of propagation.</li> </ul>	Grass, Irish potato, banana, sugar cane or sweet potato stem.
9.4 Fruit and seed structure	<ul style="list-style-type: none"> <li>- describe the basic structure of a fruit.</li> <li>- describe the basic structure of a seed.</li> <li>- describe adaptation for fruit and seed dispersal.</li> <li>- describe the conditions necessary for germination.</li> </ul>	<ul style="list-style-type: none"> <li>Fruit wall, seed, locule scars and remains of style and sepals.</li> <li>Embryo of radicle, plumule and cotyledon, endosperm, testa, scar.</li> <li>Wind, animal and mechanical dispersal.</li> <li>Oxygen, suitable temperature, water.</li> </ul>	<ul style="list-style-type: none"> <li>Examination of a legume and a berry.</li> <li>Examination of seeds, bean and maize grain.</li> <li>Examination of a variety of fruit and seeds. Controlled experiments on conditions for germination.</li> </ul>

TOPIC	LEARNING OBJECTIVES Pupils should be able to:	CONTENT	NOTES AND ACTIVITIES
8.4 The Eye	<ul style="list-style-type: none"> <li>- describe the gross structure of the eye;</li> <li>- describe the functions of parts of the eye;</li> <li>- describe how the eye focuses images on the retina.</li> <li>- describe eye defects and their correction.</li> </ul>	<p>Front view and horizontal section.</p> <p>Cornea, lens, scela, aqueous and vitreous humours, iris, pupil, ciliary muscles, choriod, retina, optic nerve.</p> <p>Retraction, image formation, accommodation.</p> <p>Short and long sightedness.</p>	<p>Observing own eye using mirror.</p> <p>Mechanism of photoreception <u>not</u> required.</p> <p>Blind spot demonstration. Corrective lenses.</p>
8.5 Endocrine system	<ul style="list-style-type: none"> <li>- define hormone;</li> <li>- describe action of a hormone;</li> <li>- describe the effects of adrenaline;</li> <li>- outline the role of insulin in homeostasis;</li> </ul>	<p>Hormones.</p> <p>Production, transport and effect.</p> <p>Adrenal gland. Flight or fight responses.</p> <p>Regulation of blood glucose level. Feedback mechanism. Diabetes mellitus.</p>	<p>A chemical substance produced by a gland and carried by blood, which affects the activities of a target organ.</p> <p>Signs of diabetes: frequent urination, tiredness, thirst. Increased blood glucose level and glucose urine.</p>
8.6 Drug use and abuse	<ul style="list-style-type: none"> <li>- define drug:</li> <li>- describe medical uses of drugs;</li> <li>- describe the effects of abuse of alcohol cannabis and solvents.</li> </ul>	<p>Effect on body.</p> <p>Antibiotic – penicillin. Analgesics – aspirin and paracetamol. Anti-malaria – chloroquine and paludrine.</p> <p>Physical, mental and social ill-effects.</p>	<p>Any administered substance which modifies or affects chemical reactions in the body.</p> <p>Discuss the importance of proper administration and use of medicinal drugs. Allergic reactions to drugs in some individuals.</p> <p>Social effects of smoking.</p>

TOPIC	LEARNING OBJECTIVES Pupils should be able to:	CONTENT	NOTES AND ACTIVITIES
9.5 Reproduction in human being	<ul style="list-style-type: none"> <li>- describe the structure and function of the human reproductive system;</li>   <li>- compare male and female gametes;</li>   <li>- describe the human menstrual cycle;</li>   <li>- describe fertilisation;</li>   <li>- explain causes of infertility;</li>   <li>- describe the early development of a zygote;</li>   <li>- describe how the embryo is maintained and protected by the placenta;</li>   <li>- describe how the embryo is protected in the uterus;</li>   <li>- outline various methods of contraception;</li>   <li>- explain factors affecting rate of human population growth.</li> </ul>	<p>Male: testes, scrotum, penis, prostate gland, seminal vesicles, epididymis and sperm duct. Female: ovary, oviduct, uterus, cervix and vagina.</p> <p>Size, mobility and numbers produced.</p> <p>Changes in uterus lining and ovulation. Fertile and infertile phases of cycle.</p> <p>Pathway of sperm from testes to ovum. Fusion of gametes.</p> <p>Hormonal, sperm quantity and quality, physical, STD's, cancers.</p> <p>Cell division and multiplication. Implantation. Growth and development.</p> <p>The placenta and umbilical cord: exchange of nutrients, gases and excretory products. Separation of foetal from material blood.</p> <p>Amnion and amniotic fluid.</p> <p>Abstinence and natural methods. Chemical: spermicides. Barriers: condom and diaphragm. Intra-uterine devices (IUD's). Hormonal: injection and pills.</p> <p>Availability of resources, disease, birth control.</p>	<p><u>No</u> detail of the internal structure of the testes or ovaries required.</p> <p>Role of oestrogen (oestradiol) and progesterone.</p> <p>Cancers: cervical, prostate gland.</p> <p>Limited to the function of a ball of cells which becomes implanted in uterine wall. Early development – organ formation. Later development – mass increase.</p> <p>Dangers of taking drugs, smoking and drinking alcohol during pregnancy should be discussed. Reference to passage of antibodies, toxins and certain viruses including HIV should be made.</p> <p>Stock absorber, temperature fluctuation;</p> <p>The reliability, limitations and appropriateness of methods should be discussed.</p>

TOPIC	LEARNING OBJECTIVES Pupils should be able to:	CONTENT	NOTES AND ACTIVITIES
9.6 Sexually transmitted infections	<ul style="list-style-type: none"> <li>- describe symptoms and effects of sexually transmitted infections.</li>   <li>- discuss the spread of sexually transmitted diseases and the human immunodeficiency virus (HIV) and methods by which it may be controlled.</li> </ul>	<p>Chancroid, gonorrhoea, syphilis and human immunodeficiency virus. Effects on health and fertility.</p> <p>Mutually faithful, long term relationships, Abstinence and the use of condoms. Contact tracing. Treatment with antibiotics for STI's.</p>	<p>Note that one symptom alone is not necessarily indicative of a particular disease.</p> <p>Discuss the incurability of AIDS and the social implications.</p>
<b>10.0 MICRO-ORGANISMS AND DISEASE</b>			
10.1 Viruses, bacteria and fungi	<ul style="list-style-type: none"> <li>- list main characteristics of viruses, bacteria and fungi;</li>   <li>- describe the roles played by bacteria and fungi;</li> </ul>	<p>Size, structure, reproduction, mode of nutrition.</p> <p>Pathogenic and saprophytic roles.</p>	<p>Observation of mould using hand lens and/or microscope.</p> <p>Reference to the recycling of the nutrients carbon and nitrogen.</p>
10.2 Cholera	<ul style="list-style-type: none"> <li>- identify the causative agent for cholera;</li>   <li>- state method of transmission;</li>   <li>- describe treatment of cholera;</li> </ul>	<p>Bacterium.</p> <p>Water and food borne bacteria: faecal contamination and vectors.</p> <p>Diarrhoea, vomiting, fever, muscular cramps.</p> <p>Oral Rehydration Therapy.</p> <p>Personal and food hygiene. Settlement planning: water and sanitation, Immunisation and notification.</p>	<p>Comma-shaped bacterium.</p> <p>Preparation of salt and sugar solution. Antibiotic treatment necessary. Medical advice should be sought.</p> <p>Reference to overcrowding as a major problem in public health and the outbreak and spread of epidermis.</p>

TOPIC	LEARNING OBJECTIVES Pupils should be able to:	CONTENT	NOTES AND ACTIVITIES
10. Malaria	<ul style="list-style-type: none"> <li>- outline the life cycle of the anopheles mosquito;</li> <li>- identify the causative agent for malaria;</li> <li>- describe symptoms of malaria;</li> <li>- state treatment and preventive measures for malaria;</li> <li>- describe methods of control by breaking the cycle of anopheles mosquito.</li> </ul>	<p>Eggs, larvae, pupae and adults.</p> <p><i>Plasmodium.</i></p> <p>Fever, loss of appetite, headaches, aching joints.</p> <p>Prevention: (prophylaxis). Treatment: Chloroquine. Avoidance of mosquito bites.</p> <p>Physical, chemical and biological methods.</p>	<p>Practical examination of specimens.</p> <p>Norol/Malaquine. Deltaprim/Malasone, Paludrine. A discussion of chloroquine resistance. Need to complete the dosage must be stressed. Use of drugs according to up to date recommendation by health workers. Use of mosquito nets, repellents and insecticides.</p>
<b>11.0 INHERITANCE</b>			
11.1 Variation	<ul style="list-style-type: none"> <li>- identify variable features in plants and animals;</li> <li>- distinguish between continuous and discontinuous distribution of characteristics;</li> <li>- draw graphs to show continuous distribution of characteristics.</li> <li>- identify causes of variation;</li> </ul>	<p>Variation.</p> <p>Continuous and discontinuous variation.</p> <p>Genetic and environmental causes.</p>	<p>Observation of variation in height, weight, leaf size, tongue-rolling, left – and right-handedness.</p> <p>Line and bar graphs.</p> <p>Difficulties in determining actual causes of variation must be recognised.</p>

TOPIC	LEARNING OBJECTIVES Pupils should be able to:	CONTENT	NOTES AND ACTIVITIES
11.2 Chromosomes and genes	<ul style="list-style-type: none"> <li>- describe chromosomes;</li> <li>- describe the behaviour of chromosomes in mitosis and meiosis;</li> <li>- define gene;</li> <li>- distinguish between the terms gene and allele;</li> </ul>	<p>Site of genetic information.</p> <p>Mitosis: parent and daughter cells Identical.</p> <p>Meiosis: separation of homologous chromosomes.</p> <p>Genes</p> <p>Gene pairs.</p>	<p>Structures in nucleus that carry genes.</p> <p>Halving the number of chromosomes. Source of variation. (No stage of mitosis and meiosis ) A basic structural unit of inheritance.</p> <p>An allele as the alternative form of the same gene.</p>
11.3 Monohybrid inheritance	<ul style="list-style-type: none"> <li>- describe complete dominance;</li> <li>- predict possible outcomes of monohybrid crosses;</li> <li>- explain codominance;</li> <li>- explain how sex is determined in mammals;</li> <li>- describe mutation;</li> </ul>	<p>Dominant and recessive alleles. Phenotypes and types.</p> <p>Gametes, F<sub>1</sub> and F<sub>2</sub> generations.</p> <p>Inheritance of ABO blood group- Phenotype A, B, AB, O: Gene alleles I<sup>A</sup> I<sup>B</sup> and I<sup>o</sup>.</p> <p>Sex chromosomes X and Y.</p> <p>Sickle cell anaemia. Down's syndrome. Albinism.</p>	<p>Genetic diagrams/pannetsquare. Use of coloured beads or beans picked at random to demonstrate monohybrid inheritance.</p> <p>A change in the structure of a gene or chromosomes or in chromosome number.</p>
11.4 Selection and evolution	<ul style="list-style-type: none"> <li>- explain how selection occurs in natural communities;</li> <li>- define evolution;</li> <li>- discuss natural selection as a possible mechanism for evolution;</li> <li>- describe applications of artificial selection;</li> <li>- give reasons for plant and animal breeding.</li> </ul>	<p>Variation, competition, selective survival and reproduction.</p> <p>Evolution.</p> <p>Natural selection.</p> <p>Plant and animal breeding.</p> <p>Productivity, quality of breed, resistance to drought and disease.</p>	<p>Struggle for existence and survival of the fittest.</p>

TOPIC	LEARNING OBJECTIVES Pupils should be able:	CONTENT	NOTES AND ACTIVITIES
<b>12.0 ECOSYSTEMS</b>			
12.1 Ecosystem	<ul style="list-style-type: none"> <li>- define ecosystem;</li> <li>- list components of an ecosystem;</li> <li>- identify soil as a key component of ecosystems;</li> <li>- compare properties of clay, loam and sandy soils;</li> <li>- identify biological components of soil;</li> <li>- state the role of the biological components;</li> </ul>	<p>Organisms and their environment.</p> <p>Physical and biological components – air, water, soil, light and living organisms.</p> <p>Role of soil.</p> <p>Size of particles. Air content. Water holding capacity. Drainage. Leaching. Acidity/alkalinity (pH).</p> <p>Litter, earthworms, nematodes, termites, fungi, bacteria and humus.</p> <p>Crumb structure, aeration, fertility and pH.</p>	<p>A self-contained system of interdependent organisms and their physical environment. Reference to be made to energy flow.</p> <p>Examine an ecosystem, for example pond, forest, field.</p> <p>Construction of tables to compare water retention and drainage of clay and sandy soils.</p> <p>Experiments to show techniques of measuring air, water, organic content, pH of a soil sample.</p> <p>Extraction of organisms from soil. Use of keys <u>not</u> required.</p> <p>Experiments to show presence of micro-organisms in the soil by carbon dioxide production.</p>

TOPIC	LEARNING OBJECTIVES Pupils should be able to:	CONTENT	NOTES AND ACTIVITIES
12.2 Natural ecosystems	<ul style="list-style-type: none"> <li>- construct simple food chains;</li> <li>- interpret food webs;</li> <li>- explain the loss of energy in food chains;</li> <li>- interpret pyramids;</li> <li>- describe nutrient cycles;</li> <li>- explain the importance of nutrients recycling;</li> </ul>	<p>Tropic levels:- Producers, consumers and decomposers.</p> <p>Inter-relationships between food chains.</p> <p>Respiration and heat loss.</p> <p>Pyramids of numbers and biomass.</p> <p>The carbon cycle. The nitrogen cycle.</p>	<p>Examples to illustrate concepts to be taken from local ecosystems.</p> <p>Energy input and energy flow.</p> <p>Scientific names of bacteria <u>not</u> required.</p>
12.3 Artificial ecosystems	<ul style="list-style-type: none"> <li>- describe an artificial ecosystem.</li> <li>- compare species (bio-) diversity in natural artificial ecosystems;</li> <li>- state problems caused by limited species (bio diversity);</li> </ul>	<p>Human-influenced, limited species diversity.</p> <p>Soil fertility; pest problems.</p>	<p>Study of cultivated piece of land (garden or field).</p>
12.4 Management of ecosystems	<ul style="list-style-type: none"> <li>- describe effect of ground cover on run off, erosion and evaporation;</li> <li>- describe the harmful effects of human activities on ecosystems;</li> </ul>	<p>Topsoil preservation. Water retention by soil. Role of mulching as artificial cover.</p> <p>Agricultural, industrial and social activities resulting in: soil erosion, pollution, desertification and reduction in bio-diversity.</p>	<p>Effects of soil cover in field and controlled experiments.</p> <p>Effects of pollution to include acid rain, global warming.</p>

TOPIC	LEARNING OBJECTIVES Pupils should be able to:	CONTENT	NOTES AND ACTIVITIES
12.5 Population Dynamics	<ul style="list-style-type: none"> <li>- define population,</li>   <li>- describe factors affecting population change.</li>   <li>- describe factors that limit population size;</li>   <li>- explain the concept of carrying capacity.</li>   <li>- describe the effects of exceeding the carrying capacity (overstocking);</li> </ul>	<p>Numbers of organisms.</p> <p>Birth, death, mortality, growth rates and migration.</p> <p>Competition for space and resources, predation, disease (pathogens and parasites).</p> <p>Limiting factors: water, food, oxygen, space and shelter.</p> <p>Degradation of ecosystem; overgrazing, deterioration of veld, disease and pollution.</p>	<p>The number of organisms of the same species, living in an area at the same time.</p>    <p>Carrying capacity defined as the maximum number of organisms an area can support without deterioration.</p>