**District: GASABO**

**Academic Year: 2022-2023**

 **School:**

**Subject: BIOLOGY**

**Teacher:**

**Class: S6MCB, BCG & PCB**

**No of period per week: 7**

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| **TERM 1** |
| **Dates** | **Unity title** | **Lesson title+ Evaluation** | **Learning objectives + Key Unit competence** | **Teaching methods& techniques +Evaluation procedures** | **Resources & References** | **Observations** |
| **WEEK 1** **26-30/09 /2022** | **Unit1**: Population and natural resources  | **Lesson title1**: Population characteristics: density, age structure, growth patterns, birth and death rates**Lesson title2**: population density dependent and independent factors**Lesson title3:** Methods or techniques of measuring and estimating population density. **Lesson title4:** Population growth patterns.***Evaluation procedures such as oral, written quizzes, practical’s…*** | A learner can * State and define population characteristics.
* Explain factors that affect population density.
* Explain population growth patterns.
* Explain the terms renewable and nonrenewable resources.
* Explain how environmental resistance affects the balance of nature.
* Explain the importance of natural resources in growth of the Rwandan economy and methods of conservation.
* Demonstrate methods used in estimating populations by using quadrats and line transects.
* Research how the human population has grown over the past 250 years
* Compare statistics on the population age, sex structure of developing and developed countries.
* Analyze the costs and benefits of managing renewable and non-renewable resources
 | * + Learners practically estimate populations using quadrats and line transects.
	+ Learners use the capture method and the Lincoln index to estimate population sizes.
	+ Use illustrations and videos to discuss population growth patterns of organisms.
	+ Learners discuss how the human population has grown over the past 250 years.
	+ Learners compare statisticson the population age-sexstructure of developing anddeveloped countries anddiscuss the implications to resource use.
	+ In pairs undertake a researchproject on the importanceof natural resources in thegrowth of the Rwandaneconomy and methods ofconservation.
 | 1. Biology 8th ed by Campbell and Reece2. Certificate biology for Rwanda schools, book63. Principles of Biology volume 3 and 44. Online references5. Other documents |  |
| **WEEK 2.****03-07/10/2022** | **Lesson title5:** Environmental resistance (density dependent factors that affect the balance of nature).**Lesson title6:** Natural resources (renewable and nonrenewable). **Lesson title7:** Importance of natural resources and methods of conserving natural resources***Evaluation procedures such as oral, written quizzes, practical’s…*** |  |
| **Key Unit Competence:** To be able to describe the factors affecting population size and the importance of natural resources. |

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| **WEEK 3****10-14/10** | **Unit2: concept of ecosystem**  | **Lesson title1:** Ecosystem.**Lesson title2:** Types of ecosystems: terrestrial, aquatic and their properties.**Lesson title3:** Ecological factors influencing the life of organisms**Lesson title4:** Energy flow in ecosystems.***Evaluation procedures such as oral, written quizzes, practical’s…*** | A learner can * + Describe an ecosystem.
	+ State the types and properties of an ecosystem.
	+ Describe the main components of an ecosystem
	+ Explain the ecological factors influencing the life of organisms in an ecosystem.
	+ Define the terms: populations, communities, ecosystems, biomes, niche and biosphere.
	+ Describe feeding relationships in an ecosystem.
	+ Describe a food chain and a food web.
	+ Explain the relative merits of pyramids of numbers, biomass and energy.
	+ Explain what is meant by trophic efficiency.
	+ Explain energy flow and the recycling of nutrients in an ecosystem.
	+ Describe biogeochemical cycles. Identify processes, components, and roles of organisms in the hydrologic, carbon and nitrogen cycles.
 | * In groups analyse the relationship between organisms (e.g., producers, consumers, and decomposers) and their trophic levels.
* Individually interpret energy flow diagrams and charts.
* In groups, compare gross primary, net primary production, and secondary production.
* Distinguish between primary and secondary succession in biotic communities.
* Discuss the relative merits of pyramids of numbers, biomass and energy.
* Discuss the processes, components, and the roles of organisms in the hydrologic, carbon and nitrogen cycles.
 | 1. Biology 8th ed by Campbell and Reece2. Certificate biology for Rwanda schools, book63. Principles of Biology volume 3 and 44. Online references5. Other documents |  |
| **WEEK 4****17-21/10** | **Lesson tile5:** Bioaccumulation/ biological magnification.**Lesson title6:** Efficiency of production.**Lesson title7:** Biogeochemical cycles: nitrogen, carbon and water.***Evaluation procedures such as oral, written quizzes, practical’s…*** |  |
| **Key unit competence2:** To be able to describe the different components of an ecosystem, biogeochemical cycles and how energy flows in an ecosystem |

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| **WEEK 5****24-28/10** | **Unit3: Effects of human activities on ecosystems** | **Lesson title1:** Impact of human activities on ecosystems.**Lesson title2:** Agriculture: modern technology to increase food supply, negative impacts of largescale monoculture and livestock on ecosystems. **Lesson title3:** Fishing.**Lesson title4:** Deforestation: habitat destruction. ***Evaluation procedures such as oral, written quizzes, practical’s…*** | A learner can * Explain how modern technology has resulted in increased food production in terms of agricultural machinery, chemical fertilizers, insecticides, herbicides, and selective breeding.
* Explain the negative impacts to an ecosystem of large scale monoculture of crop plants.
* Explain the reasons for habitat destruction (agriculture and extraction of natural resources
* Explain the undesirable effects of habitat destruction.
* Explain the sources and effects of the pollution of air, water and land.
* Explain the causes and effects of acid rain, eutrophication of water and non-biodegradable plastics.
* Explain the main methods of the conservation of resources.
* Describe an example of conservation in action
 | * In groups, discuss the negative impacts of techniques used by farmers to increase their yield.
* Learners make a trip to polluted sites and assess the impact of industrial sewage and fertilizer application on nearby land to wetlands and water bodies.
* Learners research the mandate of the Rwanda Environmental Management Authority (REMA).
* Learners perform role plays to appreciate the viewpoints of various stakeholders and parties in balancing conservation and agriculture. Learners to investigate potential solutions.
 | 1. Biology 8th ed by Campbell and Reece2. Certificate biology for Rwanda schools, book63. Principles of Biology volume 3 and 44. Online references5. Other documents |  |
| **WEEK 6****31/10-04/11** | **Lesson title5:** Mining**Lesson title6:** Industrialization**Lesson title7:** pollution **Lesson title8:** Biological conservation**Lesson title9:** conservation methods***Evaluation procedures such as oral, written quizzes, practical’s…*** |
| **Key unit competence3:** To be able to evaluate the effects of human population size, resource use, and technology on environmental quality. |

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| **WEEK 7****07-11/11****WEEK 8****14-18/11** | **Unit4: The circulatory system**  | **Lesson title1:** The need for transport system in animals.**Lesson title2:** The blood circulatory system (advantages and disadvantages of open and closed, single and double circulatory systems) in insects, annelids, fish and mammals.**Lesson title3:** Internal and external structure of the mammalian**Lesson title4:** Initiation of a heartbeat.**Lesson title5:** Mammalian cardiac cycle.**Lesson title6:** Control of the heart (nervous control)**Lesson title7:** Hormonal control | A learner can* Explain the need for a transport system in animals.
* Explain the advantages and disadvantages of different types of circulatory systems.
* Describe the external and internal structure of a mammalian heart.
* Explain how a heartbeat is initiated.
* Describe the main events of the cardiac cycle.
* Explain the relationship between the structure and function of blood vessels.
* Explain how blood circulation is controlled.
 | * In pairs, investigate and state the effect of physical activity on the pulse rate and blood pressure.
* Individually, describe the events that occur during a heartbeat.
* Conduct dissections to indicate the major structures of the circulatory systems in insects and mammals.
* Observe prepared slides of blood vessels using a microscope and make comparisons.
* Use computer simulations to observe the initiation of a heart beat and the cardiac cycle.
 | 1. Biology 8th ed by Campbell and Reece2. Certificate biology for Rwanda schools, book63. Principles of Biology volume 3 and 44. Online references5. Other documents |  |
| **WEEK 9****21-25/11****WEEK 10****28/11-02/12** | **Unit4: The circulatory system**  | **Lesson title8:** Effect of drugs, physical activity and temperature on cardiac frequency.**Lesson title9:** Structure of blood vessels.**Lesson title10:** Blood and its functions.**Lesson title11:** Lymphatic system.**Lesson title12:** Carriage of respiratory gases by red blood cells.**Lesson title13:** Oxygen dissociation curve.**Lesson title14:** Common cardio vascular diseases.***Evaluation procedures such as oral, written quizzes, practical’s…*** | * Describe the effects of exercise on respiration and on circulation.
* Describe the process of blood clotting.
* Recall the structure of haemoglobin and explain how haemoglobin transports oxygen. Explain how tissue fluid and lymphsare formed.
* Describe the risk factors associated with cardiovascular diseases
 | * Observe a blood smear and draw the structure of blood cells.
* Observe and make plan diagrams of the structure of blood vessels.

Individually complete a flow chart for the pathway of blood through the heart. | 1. Biology 8th ed by Campbell and Reece2. Certificate biology for Rwanda schools, book63. Principles of Biology volume 3 and 44. Online references5. Other documents |  |
| **Key unit competence4:** To be able to relate the structures of the circulatory and lymphatic systems to their functions. |

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| **WEEK 11****05-09/12** | **REVISION**  |
| **WEEK 12****12-16/12** | **EXAMINATIONS PERIOD** |
| **WEEK 13****19-23/12** | **MARKING AND PREPARATION OF SCHOOL REPORTS**  |

**SECOND TERM**

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| **WEEK 1****09-13/01/2023** | **Unit5: Energy from respiration** | **Lesson title1:** The need for energy by organisms.**Lesson title2:** Structure of ATP.**Lesson title3:** Synthesis and breakdown of ATP.**Lesson title4:** The roles of coenzymes (NAD, FAD and coenzyme A) in respiration.**Lesson title5:** Respiratory substrates and their relative energy values**Lesson title6:** Measurement of respiration and respiratory quotients by using respirometers.***Evaluation procedures such as oral, written quizzes, practical’s…*** | A learner can * Discuss the need for energy in living organisms, as illustrated by anabolic reactions, active transport, and the movement and maintenance of body temperature.
* Describe the structure of ATP as a phosphorylated nucleotide formed by condensation reaction.
* Explain that ATP is synthesized in substrate-linked reactions in glycolysis and in the Krebs cycle. (tri-carboxylic acid (TCA) cycle) Outline the roles of the coenzymes NAD, FAD and coenzyme A in respiration.
* Explain that the synthesis of ATP is associated with the electron transport chain on the membrane of the mitochondrion and chloroplast.
* Explain the relative energy value of carbohydrate, lipid and protein as respiratory substrate and explain why lipids are particularly energy-rich.
* Define the term respiratory quotient (RQ) as the ratio of the volume of CO2 evolved to the volume of oxygen uptake during aerobic respiration.
 | * Learners read and then discuss in groups the need for energy in living organisms.
* Learners research from the internet or library, the structure and roles of ATP and present their findings.
* Using provided learning resources, learners discuss in groups, the roles of the coenzymes NAD, FAD and coenzyme A in respiration.
* Learners carry out an investigation showing the respiratory rate of germinating seeds or woodlice using respirometers.
* In groups, learners use simple respiration equations to calculate values of the respiratory quotient.
* Individually, interpret graphs for varying RQ values during seed germination.
 | 1. Biology 8th ed by Campbell and Reece2. Certificate biology for Rwanda schools, book63. Principles of Biology volume 3 and 44. Online references5. Other documents  |  |
| **Key Unit Competence:** To be able to describe the structure and importance of ATP, and outline the roles of the coenzymes NAD, FAD and coenzyme A during cellular respiration. |

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| **Dates** | **Unity title** | **Lesson title+ Evaluation** | **Learning objectives + Key Unit competence** | **Teaching methods& techniques +Evaluation procedures** | **Resources & References** | **Observations** |
| **WEEK 2****16-20/01** | **Unit6: Cellular respiration** | **Lesson title1:** Aerobic respiration. **Lesson title2:** Glycolysis. **Lesson title3:** The link reaction. **Lesson title4:** TCA cycle. ***Evaluation procedures such as oral, written quizzes, practical’s…*** | A learner can * Outline the four stages in aerobic respiration (glycolysis, link reaction, TCA cycle and oxidative phosphorylation) and state where each occurs in the eukaryotic cells.
* Explain that when oxygen is available pyruvate is converted into acetyl coenzyme A, which then combines with oxaloacetate (4C) to form citrate (6C).
* Explain that reactions in the TCA cycle involve decarboxylation and dehydrogenation and the reduction of NAD and FAD.
* Outline the process of oxidative phosphorylation including the role of oxygen (details of the carriers are not required).
* Describe the relationship between the structure and function of the mitochondrion.
* Explain the production of a small yield of ATP from anaerobic respiration in yeast and mammalian muscle tissue, including the concept of oxygen debt
* Explain how other substrates are involved in glycolysis and the TCA cycle.
 | * Learners discuss the four stages of aerobic respiration using illustrations.
* Using computer simulations and suitable illustrations, learners work in groups to study the process of glycolysis and link reactions. Learners then present to the class.
* Learners work in groups to draw charts summarising the essential reactions of the TCA cycle, showing the link with NAD and FAD. Learners then present their charts to class.
* Learners discuss the process of oxidative phosphorylation using computer aided learning materials or illustrations.
* Observe a micrograph or diagram of mitochondrion and relate the structure with its function.
* Use the internet or library resources to research why rice is able to grow with its roots submerged in water.
 | 1. Biology 8th ed by Campbell and Reece2. Certificate biology for Rwanda schools, book63. Principles of Biology volume 3 and 44. Online references5. Other documents |  |
| **WEEK 3****23-27/01** | **Lesson title5:** Oxidative phosphorylation.**Lesson title6:** Efficiency of aerobic and anaerobic respiration.**Lesson title7:** Factors which affect the rate of respiration. **Lesson title8:** Use of other substrates in respiration.***Evaluation procedures such as oral, written quizzes, practical’s…*** |  |
| **Key unit competence6:** to be able to describe the process of cellular respiration |
| **WEEK 4****30/01-03/02** | **Unit7: Excretion and osmoregulation**  | **Lesson title1:** Structure and functions of excretory organs in mammals: kidney, liver and skin. Structure and the functions of the nephron. **Lesson title2:** Formation of urea and urine. **Lesson title3:** Role of the hypothalamus, pituitary gland, adrenal gland and nephron in varying the osmotic pressure of blood***Evaluation procedures such as oral, written quizzes, practical’s…*** | A learner can* Describe the structure and role of excretory organs in mammals.
* Describe the detailed structure of the nephron with its associated blood vessels.
* Describe and outline the ornithine cycle and its role in the conversion of ammonia to urea.
* Describe how the process of ultrafiltration and selective reabsorption are involved in the formation of urine in the nephron.
* Describe the use of dialysis in kidney machines.
* Describe how kidney transplant are performed.
* Describe the role of hypothalamus, posterior pituitary, ADH and collecting ducts in osmoregulation.
* Explain the principles of osmoregulation in organisms living in marine, freshwater and terrestrial habitats.
* Explain dialysis in terms of salt balance, the maintenance of glucose concentration and the removal of urea.
* Explain why plants do not have specialized excretory organs
* State the excretory products of plants and how they are eliminated.
 | * Learners carry out research on the structure and the function of the kidney, liver and skin. Learners to focus on the excretory functions.
* Learners dissect a rabbit kidney to study its structure.
* Learners use models and charts to describe the structure of a nephron with its associated blood vessels.
* Learners carry out research on the osmoregulation of marine animals, fresh water animals and terrestrial animals to show their difference in terms of excretory organs and nitrogenous waste products.
* Learners analyse the generalised flow chart of osmoregulation and identify the role of the Hypothalamus, Pituitary, ADH and collecting duct.
 | 1. Biology 8th ed by Campbell and Reece2. Certificate biology for Rwanda schools, book63. Principles of Biology volume 3 and 44. Online references5. Other documents |  |
| **WEEK 5****06-10/02** | **Lesson title4:** Kidney transplants and dialysis machines. **Lesson title5:** Excretion and osmoregulation in other organisms – protoctista, insects, fish, amphibians and birds. ***Evaluation procedures such as oral, written quizzes, practical’s…*** |  |
| **WEEK 6**(13-17/02) | **Lesson tilte6:** Principles of osmoregulation in marine, freshwater and terrestrial organisms. **Lesson title7:** Excretion in plants***Evaluation procedures such as oral, written quizzes, practical’s…*** |  |
| **Key unit competence7:** to be able to explain the principles of excretion ad osmoregulation  |

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| **WEEK 7**(20-24/02) | **Unit8: General principles of reception and response in animals**  | **Lesson title1:** Importance of responses to the internal and external environment. **Lesson title2:** Types of sensory receptors and stimuli. **Lesson title3:** Components of the sensory system: transduction, transmission and processing***Evaluation procedures such as oral, written quizzes, practical’s…*** | A learner can* Explain the necessity of responding to internal and external changes in the environment.
* Describe the main types of sensory receptors.
* Discuss the main functions of a sensory system.
* Explain the significance of sensory adaptation.
* Describe the structure of the human eye.
* Describe the structure of the retina.
* Explain how rods transduce light energy into nerve impulses.
* Explain how retinal convergence improves sensitivity.
* Explain how the cones achieve visual acuity.
* Explain how cone cells produce color vision.
* Discuss the significance of binocular vision.
* Describe the structure of the human ear and the functions of its main parts.
* Describe the process of hearing and balance.
* Locate the taste buds on the tongue and sensory cells
 | * Learners demonstrate their ability to perceive various stimuli: smooth/loud sounds, dim/bright lights, cold/warm items, perfume, and water/ brine. Learners then discuss the types of stimuli.
* Using the 3D model of the sense organs, learners discuss the structure of these organs.
* Learners dissect the eye of a mammal and identify the three layers of the eyeball.
* Learners research from the internet or textbooks the location of taste buds on the human tongue.
* Learners individually investigate the relative location of rods and cones in the retina by focusing at objects in dim light.
* Learners carry out experiments on reverse colour sense by cones.
* Use computer animations to discuss the process of light perception, hearing and balance.
* Interpret graphs of sensory adaptation when sensory cells lose their responsiveness.
 | 1. Biology 8th ed by Campbell and Reece2. Certificate biology for Rwanda schools, book63. Principles of Biology volume 3 and 44. Online references5. Other documents |  |
| **WEEK 8** (27/02-03/03) |  **Lesson title4:** Sensory adaptation. **Lesson title6:** Structure and functioning of the eye and the ear. Location of taste buds on the tongue and sensory cells in the skin.***Evaluation procedures such as oral, written quizzes, practical’s…*** |  |
| **Key unit competence:** to be able to explain the general principles of reception and response in animals |

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| **WEEK 9**(06-10/03) | **Unit9: Nervous coordination**  | **Lesson title1:** Control and coordination in mammals. **Lesson title2:** Structure and functions of neurons. **Lesson title3:** Generation of nerve impulses (resting and action potential).**Lesson title4:** Transmission of a nerve impulse:**Lesson title5:** Propagation of a nerve impulse. ***Evaluation procedures such as oral, written quizzes, practical’s…*** | A learner can * Describe the arrangement of neurons in a reflex arc. Describe the structure neurones.
* Explain how a resting potential is maintained.
* Explain how an action potential is generated.
* Explain how a nerve impulse is propagated along a neurone.
* Explain the factors affecting the speed of impulse transmission.
* Describe the properties of a nerve impulse limited to: saltatory conduction, all or nothing law, and refractory period.
* Describe the functions of neurones in a reflex arc. Explain how information passes across a synapse from one neurone to another or from a neurone to its effector.
* Outline the roles of synapses.
* Describe the roles of neuromuscular junctions, transverse system tubules and sarcoplasmic reticulum in stimulating contraction in striated muscle.
 | * Discuss reasons for having reflexes as responses in the body.
* In groups, learners describe and explain the transmission of an action potential in a myelinated neurone.
* Investigate knee jerk, pupil and the blinking reflexes.
* Use charts and computer simulations to observe the structure and mode of impulse transmissions.
* Demonstrate electric activity in the nerve of a frog.
* Learners carry out project work for the simulation of the transmission of nerve impulses along the axon and across the synapse.
 | 1. Biology 8th ed by Campbell and Reece2. Certificate biology for Rwanda schools, book63. Principles of Biology volume 3 and 44. Online references5. Other documents |  |
|  | **Lesson title6:** Transmission in a myelinated fibre/ saltatory conduction. **Lesson title7:** All or nothing law The refractory period.**Lesson title8:** Functions of sensory, relay and motor neurones in a reflex arc. **Lesson title9:** Structure and function of a cholinergic synapse.**Lesson title10:** Roles of synapses in the nervous system***Evaluation procedures such as oral, written quizzes, practical’s…*** |  |
| **Key unit competence9:** To be able to describe the structure of neurones and explain the mechanisms of impulse transmission. |

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| **WEEK 10**13-17/03 | **Revision**  |
| **WEEK 11**20-24/03 | Examinations periodand supervision of examinations |
| **WEEK 12**27-31/03 | Marking, Preparation school reports period. |

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| **THIRD TERM** |
| **Dates** | **Unity title** | **Lesson title+ Evaluation** | **Learning objectives + Key Unit competence** | **Teaching methods& techniques +Evaluation procedures** | **Resources & References** | **Observations** |
| **WEEK 1****( 17-21/04)** | **Unit10: Hormonal coordination in animals** | **Lesson title1:** Structure and function of the endocrine system in humans: location of endocrine glands and functions of their secretions.**Lesson title2:** Principles of the negative feedback mechanism of hormonal action. ***Evaluation procedures such as oral, written quizzes, practical’s…*****Lesson title3:** Necessity of hormonal balances.**Lesson title4:** Effects of hormonal imbalance: diabetes, goitre, dwarfism and gigantism.**Lesson title5:** Comparison of hormonal and nervous systems.***Evaluation procedures such as oral, written quizzes, practical’s…*** | **A learner can** * Define hormones.
* Explain why hormonal balance is necessary for coordinating the functions in the body.
* Describe the principle of the negative feedback mechanism by which hormones produce their effects on target cells.
* Describe the structure and function of the endocrine system.
* Explain the effects of hormonal imbalances
 | * Learners use illustrations to identify and name the endocrine glands in human body.
* Learners discuss the hormones secreted by each gland and their functions.
* Learners discuss picture/ photographs or movies showing gigantism and dwarfism with reference to hormonal disorders.
* Learners research the necessity of hormone balance and the effects of imbalance and write a report
* Learners use computer simulations to study and analyse the principles of the negative feedback mechanism of hormonal action.
* In groups, learners discuss the similarities and differences between the structure and functioning of nervous and hormonal systems.
 | 1. Biology 8th ed by Campbell and Reece2. Certificate biology for Rwanda schools, book63. Principles of Biology volume 3 and 44. Online references5. Other documents |  |
| **Key unit competence:** to be able to identify the location and functions of endocrine glands in the body |
| **WEEK 2**(24-28/04) | **Unit11: Skeletons, muscles and movement** | **Lesson title1:** Types of animal skeletons: hydrostatic, exoskeleton and endoskeleton. Types of muscles (cardiac, smooth and skeletal muscle). **Lesson title2:** Vertebrate joints and locomotion: structure of joints, and types of joints (fibrous, cartilaginous, and synovial). **Lesson title3:** Ultrastructure and functioning of striated muscle**Lesson title4:** The sliding filament theory of muscle contraction.***Evaluation procedures such as oral, written quizzes, practical’s…*** | A learner can * Describe the three main types of animal skeletons.
* Discuss the functions of skeletons.
* State and discuss the advantages and disadvantages of exoskeletons.
* Describe the main types of mammalian muscles.
* Describe the ultrastructure of striated muscles with particular reference to the sarcomere structure.
* Explain the sliding filament model of muscle contraction, including the roles of troponin, tropomyosin, calcium ions and ATP.
* Explain the role of antagonistic muscles in a joint.
* Describe the features of a synovial joint.
* Explain the function of a motor unit/ neuromuscular junction/motor end plate.
* Distinguish between temporal summation and muscle fibre recruitment.
 | * Observe earthworms and insects to compare a hydrostatic skeleton and exoskeleton respectively.
* Learners use prepared slides of the three types of muscles and compare their characteristics.
* Learners dissect a frog/toad heart and observe myogenic contraction.
* Use prepared slides and micrographs to compare structures of cardiac, smooth and skeletal muscles.
* Use diagrams to discuss the structure of different types of joints.
* In pairs students observe others bicep muscles and write their observations (shortening and thickening of the antagonistic muscles).
 | 1. Biology 8th ed by Campbell and Reece2. Certificate biology for Rwanda schools, book63. Principles of Biology volume 3 and 44. Online references5. Other documents |  |
| **Key unit competence:** to be able to explain the structure of muscle in relation to movement |
| **WEEK 3**(01-05/05) | **Unit 12: Human reproduction** | **Lesson title1:** The menstrual cycle in humans.**Lesson title2:** Copulation, fertilization and fetal development. **Lesson title3:** Role of placenta in the development of an embryo.**Lesson title4:** Physiological changes in females during pregnancy.**Lesson title5:** Gestation period and birth. **Lesson title6:** Parental care.**Lesson title7:** Twins and multiple births. **Lesson title8:** Infertility and in-vitro fertilization. **Lesson title9:** Family planning and contraceptive methods. **Lesson title10:** Causes and prevention of STIs and HIV.***Evaluation procedures such as oral, written quizzes, practical’s…*** | A learner can * Describe the main events of the menstrual cycle.
* Explain how hormones interact to regulate the menstrual cycle.
* Describe how mammals mate.
* Explain how a sperm enters and fertilizes an ovum and how only one sperm fertilizes an ovum.
* Outline the technique of in-vitro fertilization (IVF).
* Explain the physiological changes in females during pregnancy.
* Define implantation.
* Describe how a human embryo develops.
* Describe the role of the extra embryonic membranes in pregnancy.
* Explain how the placenta forms and discuss its functions.
* Explain the gestation period and birth.
* Describe the main stages of birth.
* Discuss the significance of parental care in mammals.
* Explain how twins and multiple births arise.
* Describe the main types of birth control techniques.
 | * Learners research the structure of the motor end plate using the internet or library.
* Use of computer aided simulations to demonstrate the structure and functioning of the sarcomere during muscle contraction with reference to sliding filament theory.
* Watch a simulation of the stages that bring about the fertilisation and development of an embryo.
* Using a diagram of the placenta, learners discuss its structure related to its functions.
 | 1. Biology 8th ed by Campbell and Reece2. Certificate biology for Rwanda schools, book63. Principles of Biology volume 3 and 44. Online references5. Other documents |  |
| **Key unit competence:** To be able to explain the role of hormones in human reproduction, stages of pregnancy and fetal development |

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| **WEEK 4**( 08-12/05) | **Unit 13: Principles of gene technology**  | **Lesson title1:** Recombinant DNA.**Lesson title2:** Gene manipulation (transfer of genes from one organism to another).**Lesson title3:** Properties of plasmids.**Lesson title4:** Principles of Polymerase Chain Reaction (PCR) in cloning and amplifying DNA.***Evaluation procedures such as oral, written quizzes, practical’s…*** | A learner can * Define the term recombinant DNA.
* Explain that genetic engineering involves the extraction of genes from one organism or the synthesis of genes, in order to place them in another organism (of the same or another species) such that the receiving organism expresses the gene product.
* Describe the properties of plasmids that allow them to be used in gene cloning.
* Explain the use of genes in fluorescent or easily stained substances as markers in gene technology.
* Describe the principles of the Polymerase Chain Reaction (PCR) to clone and amplify DNA (the role of Taq polymerase should be emphasised).
* Describe and explain how gel electrophoresis is used to analyse proteins and nucleic acids, and to distinguish between the alleles of a gene (limited to the separation of polypeptides and the separation of DNA fragments cut with restriction endonucleases).
* Explain the roles of restriction endonucleases, reverse transcriptase and ligases in genetic engineering.
* Explain and outline, how microarrays are used in the analysis of genomes and in detecting mRNA in studies of
 | * Interpret a chart on the transfer of DNA from a eukaryotic cell to a bacterial cell using a plasmid.
* Using diagrams, learners show how a transgenic organism and a clone are produced.
* In groups, students discuss how biotechnologists might transform harmless bacteria to pathogenic forms in the course of their studies.
* Using computer animations students observe the gel electrophoresis used to analyse proteins and nucleic acids to distinguish between alleles of a gene. (Alternatively, visit a local university, health centre or forensic lab)
* In groups, learners discuss the mechanisms of artificial DNA synthesis.
 | 1. Biology 8th ed by Campbell and Reece2. Certificate biology for Rwanda schools, book63. Principles of Biology volume 3 and 44. Online references5. Other documents |  |
|  | **Lesson title5:** Gel electrophoresis. **Lesson title6:** Roles of enzymes in genetic engineering.**Lesson title7:** Use of microarrays in the analysis of genomes and in detecting mRNA***Evaluation procedures such as oral, written quizzes, practical’s…*** |  |
| **Key unit competence:** to be able to explain the principles of gene technology |

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| **WEEK 5**( 15-19/05) | **Unit 14: Application of gene technology** | **Lesson title1:** Bioinformatics.**Lesson title2:** Production of human proteins by recombinant DNA technology. **Lesson title3:** Genetic technology applied to medicine: genetic screening, and treatment of genetic diseases by gene therapy.***Evaluation procedures such as oral, written quizzes, practical’s…*** | A learner can* + Define the term bioinformatics.
	+ Outline the role of bioinformatics following the sequencing of genomes, such as those of humans and parasites, e.g. Plasmodium. (Details of the methods of DNA sequencing are not required).
	+ Explain the advantages of producing human proteins by recombinant DNA techniques. (Reference should be made to some suitable examples, such as insulin, factor VIII for the treatment of haemophilia and adenosine deaminase for treating severe combined immunodeficiency (SCID)).
	+ Outline the advantages of screening for genetic conditions. (Reference may be made to tests for specific genes such as those for breast cancer, BRCA1 and BRCA2, and genes for haemophilia, sickle cell anaemia, Huntington’s disease and cystic fibrosis).
	+ Outline how genetic diseases can be treated with gene therapy and discuss the challenges in choosing appropriate vectors, such as: viruses, liposomes and naked DNA, (Reference may be made to SCID, inherited eye diseases and cystic fibrosis). Outline the way in which the production of crops such as maize, cotton, tobacco and rape seed oil may be increased by using varieties that are genetically modified for herbicide resistance and insect resistance.
	+ Explain the ethical and social implications of using genetically modified organisms (GMOs) in food production
 | * In groups discuss the role of bioinformatics in the sequencing of genomes.
* Discuss the social and ethical considerations of using gene testing and gene therapy in medicine.
* Using the internet, students read articles, journals, and publications on the research underway in agriculture e.g. improvement of crop varieties and animal breeds.
* In groups discuss the role of bioinformatics in the sequencing of genomes.
 | 1. Biology 8th ed by Campbell and Reece2. Certificate biology for Rwanda schools, book63. Principles of Biology volume 3 and 44. Online references5. Other documents |  |
| **WEEK 6**( 22-26/05) | **Lesson title4:**Significance of genetic engineering in improving the quality and yield of crop plants and livestock. **Lesson title5:** Ethical and social implications of using genetically modified organisms (GMOs) in food production.***Evaluation procedures such as oral, written quizzes, practical’s…*** |  |
| **Key unit competence:** To be able to evaluate how gene technology is applied in areas of medicine, forensic science and agriculture |

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| **WEEK 7**(29/05-02/06) | **Unit15: Variation** | **Lesson title1:** Variation.**Lesson title2:** Types of variation: continuous (quantitative) and discontinuous (qualitative)**Lesson title3:** Causes of variation: genetic and environmental factors.***Evaluation procedures such as oral, written quizzes, practical’s…*** | A learner can * Explain population traits and types of variation.
* Describe the differences between continuous and discontinuous variation.
* Describe the causes of variation.
* Explain the genetic basis of continuous (many additive genes control characteristics) and discontinuous variation.
* Explain, with, examples, how the environment may affect the phenotype of plants and animals.
* Explain why genetic variation is important in selection.
 | * Observe natural populations and identify various types of variation.
* Collect measurements from populations of organisms in two varying sites and use t-tests to distinguish whether or not these are likely to represent two distinct populations
* Classify the variations as continuous and discontinuous.
* Independently, use data intables on continuous anddiscontinuous variationsamong organisms (heightand blood groups) to drawand interpret graphs.
* In pairs discuss the effectof the environment on thephenotype of organisms
 | 1. Biology 8th ed by Campbell and Reece2. Certificate biology for Rwanda schools, book63. Principles of Biology volume 3 and 44. Online references5. Other documents |  |
| **Key unit competence15:** To be able to explain variation and mutation as a source of biodiversity. |

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| **WEEK 8**(05-09/06) | **Unit16: Artificial and natural selection** | **Lesson title1:** Natural selection with specific examples: antibiotic resistance in bacteria, pesticide resistance in insects and mammals and industrial melanism. **Lesson title2:** Role of over production and variation in natural selection.***Evaluation procedures such as oral, written quizzes, practical’s…*** | A learner can* Explain that natural selection occurs as populations have the capacity to produce many offspring that compete for resources.
* In the struggle for “existence” only the individuals that are best adapted survive to breed and pass on their alleles to the next generation.
* Explain, with examples, how environmental factors can act as either stabilizing, disruptive and directional forces of natural selection.
* Explain how selection, the founder effect and genetic drift may affect allele frequencies in populations.
* Explain how a change in allele frequency in a population can be used to measure evolution.
* Describe how selective breeding (artificial selection) has been used to improve the milk yield of dairy cattle.
* Outline the following examples of crop improvement by selective breeding:
* The introduction of disease resistant varieties of wheat, tomatoes, Irish potatoes, and rice.
* Inbreeding and hybridization to produce vigorous, uniform varieties
 | * In groups, construct and interpret graphs on how temperature affects fur length in a population of a particular mammal.
* Learners in groups use the Hardy–Weinberg principle to calculate allele, genotype and phenotype frequenciesin populations usinggiven data.
* Learners undertakea field study orvisit nearby farms,demonstration centres,and agriculture researchstations to deduceadvantages of selectivebreeding in comparisonwith natural selection.
* In groups, discuss thevarious methods of cropimprovement.
* Individually, carry outproject work on selectivebreeding of varietiesof crops (e.g. maize,tomatoes, cabbagesetc.) at home or schoolgardens from planting toharvesting and producea report for the seasonsor years.
 | 1. Biology 8th ed by Campbell and Reece2. Certificate biology for Rwanda schools, book63. Principles of Biology volume 3 and 44. Online references5. Other documents |  |
|  | **Lesson title3:** Environmental factors as forces of natural selection (selection pressure, stabilizing selection, directional selection and disruptive selection).**Lesson title4:** Artificial selection (selective breeding). **Lesson title5:** Inbreeding and out breeding (selective breeding in cattle.***Evaluation procedures such as oral, written quizzes, practical’s…*** |  |
| **Key unit competence:** To be able to explain the role of artificial and natural selection in the production of varieties of animals and plants with increased economic importance. |

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| **WEEK 9**( 12-16/06) | **Unit17: Evolution and speciation**  | **Lesson title1:** Theories of evolution (Lamarck, Darwin, Neo-Darwinism and creation theory). **Lesson title2:** Molecular evidence of evolution. **Lesson title3:** Causes of evolution.***Evaluation procedures such as oral, written quizzes, practical’s…*** | A learner can * State the general theory of evolution that organisms have changed over time.
* Discuss the molecular evidence that reveals similarities between closely related organisms with reference to mitochondrial DNA and protein sequence data.
* Explain the causes of present day evolution.
* Explain the role of pre-zygotic and post-zygotic isolating mechanisms in the evolution of new species.
* Explain how speciation may occur as a result of geographical separation (allopatric speciation), and ecological and behavioral separation (sympatric speciation).
* Explain why organisms become extinct, with reference to climate change, competition, habitat loss and killing by humans.
* Explain large-scale extinctions in earth’s history.
 | * Using data of mitochondrialDNA and protein sequenceslearners investigate thesimilarities of closelyrelated organisms.
* Interpret pictures ofevolution of Lamarck’stheory of evolution ofgiraffes and Darwin’sfinches.
* Research animals andplants that have becomeextinct in Rwanda and whatmeasures are currentlyin place to overcome thatextinction. Make a report onthe findings.
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| **WEEK 10**( 19-23/06) | **Lesson title4:** Speciation (allopatric and sympatric speciation) **Lesson title5:** Role of natural selection and artificial selection in speciation **Lesson title6:** mechanisms of speciation ***Evaluation procedures such as oral, written quizzes, practical’s…*** |  |
| **Key unit competence:** To be able to analyze the relevance of theories of evolution and explain the process of speciation. |

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| **WEEK 11**26/06-30/06) | **REVISION** |
| **WEEK 12**(03-07/07) | **EXAMINATIONS PERIOD** |
| **WEEK 13**( 10-14/07) | **MARKING AND PREPARATION OF SCHOOL REPORT** |