**District: GASABO**

**Academic Year: 2022-2023**

 **School:**

**Subject: BIOLOGY**

**Teacher:**

**Class: S4 MCB, BCG & PCB**

**No of period per week: 7**

**FIRST TERM**

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| **Dates** | **Unit title** | **Lesson title+ Evaluation** | **Learning objectives + Key Unit competence** | **Teaching methods& techniques +Evaluation procedures** | **Resources & References** | **Observations** |
| **WEEK 1.****26-30/09/2022****WEEK 2.****03-07/10/2022** | **Unit 1:** Introduction to biodiversity. | **Lesson title1**: Definition of Species, Ecosystem, Niche.**Lesson title2**: Biodiversity**:*** Variation in ecosystems or habitats.
* Number of species and their relative abundance.
* Genetic variation within each Species

.**Lesson title3:** Importance ofRandom sampling in determining the biodiversity of an area.**Lesson title4 :**Spearman’s rankcorrelation and Pearson’s linear correlation to analyse the relationships between thedistribution and abundance of species and abiotic or biotic factors.- **Lesson title5:** Simpson’s Index of Diversity (D) to calculate the biodiversity of ahabitat, using the formula:***Evaluation procedures such as oral, written quizzes, practical’s*…** | A learner can explain* Define the terms: species, ecosystemand niche.
* Explain that biodiversity is considered at three different levels
* Support that human population explosion impacts negatively on the environment.
* Recognize that some resources are renewable and others are nonrenewable and that effective use of these resources is of great value.
* Justify the practice of family planning as a tool for reducing population explosion.
 | * Group activities byusing suitable

 methods, suchas frame quadrats, line transects, belt transects, to assess the distribution andabundance oforganisms in a local area.* In groups, students evaluate the consequences of loss of biodiversity in either terrestrial or aquatic habitats.
* Individually characterize the biotic and abioticcomponents that define Rwanda’s ecosystems (e.g. freshwater, marine, andterrestrial).
 | 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 how diversity is threatened by climate change and human activities. |

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| **WEEK 3****10-14/10** | **Unit 2:** Introduction to classification. | **Lesson title1:** The taxonomichierarchy: domain, kingdom, phylum, class, order, family, genus and species.**Lesson title2:** Three domains:archaea, bacteria and eukarya. Focus on structure, characteristics, types aneconomic importance.**Lesson title3:The five kingdoms of living and*****Evaluation procedures such as oral, written quizzes, practical’s…*** | A learner can * Describe the classification
* of species into the taxonomic hierarchy of domain, kingdom, phylum, class, order, family, genus and species.
* Outline the characteristic features of the three domains Archaea, Bacteria and Eukarya.
* Draw and label the structure of bacteria.
* Identify common bacterialdiseases in plants and animals.
 | * Lecturing
* Group discussion by using computer simulations and prepared slides to discuss characteristics, structure and economic importance of living organisms.
* Presentation by using of illustration to discuss types ofbacteria.
 | 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 title 4**: Economic importance of bacteria ***Evaluation procedures such as oral, written quizzes, practical’s…*** | A learner can * Outline the characteristic

features of the kingdomsProtoctista, Fungi, Plantaeand Animalia-Describe the economic importance of bacteria to humans. | * Carry out a field

study trip to a siteof production to study the characteristicfeatures of the kingdomsProtoctista, Fungi, Plantaeand Animalia |  |
|  | **Lesson title5:** Common bacterial diseases in plants and animals and methods of prevention. **Lesson6:** The structure and classification of viruses**Lesson title7:** Dichotomous keys.***Evaluation procedures such as oral, written quizzes, practical’s…*** | A learner can * Explain why viruses are not included in the three domain classification.
* Outline how they are

classified: limited to typeof nucleic acid and whether these are single stranded or double stranded. | * Presentation by using of illustration to discuss types of bacteria.
* Learners observe

collected organismsand constructdichotomous keys. |  |
| **Key Unit Competence:**To be able to apply the basic knowledge of classification to group living organisms into the three domains. |

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| **WEEK 5****24-28/10** | **Unit 3:** Microscopy.**UNIT 4 CELL STRUCTURE AND SPECIALIZATION** | **Lesson title1:** Compound light microscope.**Lesson title2:** Magnification andresolution of a Compound light microscope.**Lesson title3:** Electron microscopes**and** Calculation of magnification.**Lesson title4:**. TransmissionElectron microscopes(TEM) and scanning electronMicroscopes (SEM).**Lesson title5:** Microscopic observations of the structure of plant and animal cell as seen under a light microscope.**Evaluation procedures such as oral, written quizzes, practical’s…****Lesson title1:** Ultra structure of plant and animal cells. | A learner can * State the advantage of using a light microscope
* Observe and draw biological specimens under a light microscope.
* Manipulate a compound lightmicroscope to observe prepared slide**s.**
* Preparetemporary slidesfor observation under lightmicroscopes using different objective lenses.
* Compare light and electronmicroscopes.
 | Group activities where the learners: * Measure and calculate the magnification of different specimens provided.
* Determine the actual size of specimens and micrographs given magnification or vice versa.
* Observe microscopic

Organisms on prepared slides, draw and label the parts visible with alight microscope* Individually a learner draw diagrams and label them
* Make a group presentation aboutthe

differences between a compound light microscopes and electron microscopes outlining the advantages of each. | 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 title2:** Functions ofOrganelles and their interrelationships.**Lesson title3:** Differences between ultrastructure of plant and animal cells.**Lesson title4:** Prokaryotic and eukaryotic cellsRevealing the ultrastructure of cells.**Lesson title5:**Functions of cell membranes.**Lesson title6:** Fluid mosaic model of a cell membrane.**Lesson title7:** Roles of different components of cell membranes.***Evaluation procedures such as oral, written quizzes, practical’s…*** | A learner can * Explain how cellorganelles can beisolated by cellfractionation.
* List the functionsof cell membranes.
* Describe the fluidmosaic structureof cell membranes.
* Explain the roleof the differentcomponents of acell membrane.
 | * In groups, present the comparisons between prokaryotic and eukaryotic cells with reference to charts and diagrams
* Students using charts and micrographs, relate the structure of specialized cells to their functions.
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| **Key Unit Competence:** To be able to distinguish between the types of microscopy and their principal uses. To describe the structure and function of cells in an organism. |

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| **WEEK 7****07-11/11** | **Unit 5:** Diversity of specialized tissues. | **Lesson title1:** Plant tissues: parenchyma tissues, xylem tissue, phloem tissue, and sclerenchyma and collenchyma tissue.**Lesson title2:** Animal tissues: connective and skeletal tissue.**Lesson title3:** Functions and adaptations of epithelial tissues.**Lesson title 4:** Levels of organization: cell, tissue organ, and system.**Lesson title 5:** Advantages and disadvantages of being unicellular.**Lesson title 6:** Advantages of the multicellular state of an organism.***Evaluation procedures such as oral, written quizzes, practical’s…*** | A learner can * Define a tissue as agroup of cells with similar structure working together fora particular function.
* Name the main types of animal and planttissues.
* Explain how epithelial tissues have adapted to perform a diversity of functions in the body.
* State the advantages and disadvantages of being unicellular.
* State the advantages of being multicellular
 | * In groups, discuss and present how epithelial tissues have adapted to their functions.
* Group presentation Using prepared slides and microscopes, observe, identify and draw plant and animal tissues.
* In group activity learners carry out research from the library or internet on categories of animal tissues.
 | 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 different specialized plant and animal cells and adaptation of tissues. |

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| **WEEK 8****14-18/11** | **Unit 6:** Testing for biological molecules. | **Lesson title1:** Test for reducing sugars, non-reducing sugars, starch, proteins and lipids.**Lesson title2:** Test for vitamin C(Ascorbic acid).**Lesson title3:** Semi-quantitativeBenedict’s test on a reducing sugar***Evaluation procedures such as oral, written quizzes, practical’s…*** | A learner can * Write out procedures in the identification of biological molecules
* Explain the importance of the reagents used in the identification of biological molecules
* Show resilience making observations on colour changes during food tests
 | * Individually learners carry outtests forreducing sugars and non-reducing sugars and present results in table form.
* In groups, carry out a test for starch.
* Carry out an experiment for the identification of lipids using the emulsion test.
* Carry out a chemical test for the identification of proteins using Biuret and Millon’s reagent.
* In a group, solve a problem by carrying out a semi-quantitative Benedict’s test on a reducing sugar using standardized dilutions. Use the results (colour standards or time to first colour change) to estimate the concentration of reducing sugars.
 | 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 test for biological molecules in a variety of contexts, such as identifying the contents of mixtures of molecules and to follow the activity of digestive enzymes. |

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| **WEEK 9****21-25/11****WEEK 10****28/11-02/12** | **Unit 7:** Carbohydrates and lipids. | **Lesson title1:** Ring forms of α-glucose and β-glucose.**Lesson title2:** Classes of monomers of the main biological molecules.**Lesson title3:** Formation and breakdown of glycosidic bonds**Lesson title4:** Molecular structure and functions of polysaccharides (starch: amylose and amylopectin), glycogen and cellulose in living organisms.**Lesson title5:** Molecular structure and functions of triglycerides in living organisms.**Lesson title6:** Structure and functions of a phospholipid in living organisms***Evaluation procedures such as oral, written quizzes, practical’s…*** | A learner can * State the roles of carbohydrates and lipids.
* Recall the elements that make up carbohydrates and lipids.
* Explain the proportion of hydrogen in carbohydrates and lipids and relate this to the amount of energy released when oxidized.
* Describe the structure of phospholipids and relate to their functions in living organisms
* Describe the molecular structure and formation of triglycerides and phospholipids, and give their functions in living organisms.
 | * In pairs, learners discuss the reasons why carbohydrates are used to provide energy when fats produce twice as much for the same mass.
* Observe charts of molecules of carbohydrates and lipids and identify monomers and bonds. Relate these to the roles theyplay in the life of an organism and present results.
 | 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 explain the important roles of carbohydrates and lipids in the provision and storage of energy and for a variety of other functions |

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

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| **SECOND TERM** |
| **WEEK 1****09-13/01/2023** | **Unit 8:** Proteins and water. | **Lesson title1:** The structure of an amino acid.**Lesson title2:** Formation and breakage of a peptide bond.**Lesson title3:** Structures of proteins (primary, secondary, tertiary and quaternary structures of proteins).**Lesson title4:** Fibrous andglobular proteins**Lesson title5:** Molecular structure of hemoglobin.**Lesson title6:**  Denaturation of proteins.**Lesson title7:** Functions of proteins.**Lesson title8:** Water and its properties for life.***Evaluation procedures such as oral, written quizzes, practical’s…*** | A learner can* Describe the structure of an amino acid and the formation and breakage of a peptide bond.
* Describe the primary, secondary, tertiary and quaternary structure of proteins
* Describe the molecular structure of haemoglobin as an example of a globular protein.
* Describe the functions with an emphasis on iron in the haemoglobin molecul**e.**
* Explain the effect of heat, pH and chemicals on protein structure.
* Explain howhydrogen bonding occurs between

water molecules and relate the properties of water to its roles in living organisms | * Learners carry out research from the library or internet on formulae of amino acids.
* Carry out an experiment to investigate the effect of temperature, pH and chemicals on the structure of protein.
* Investigate the effect that a lowering temperature has on water.
* Carry out an experimentusing cooking oil, water and detergents to study hydrophilic and hydrophobic effects on 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 |  |
| **Key Unit Competence:** To be able to describe how protein structure is related to function. To be able to describe the role of water as a special molecule with extraordinary properties that make life possible. |

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| **WEEK 2****16-20/01** | **Unit 9:** Vitamins and mineral salts. | **Lesson title1:** Mineral nutrients in humans.**Lesson title2:** Classification ofmineral nutrients**Lesson title3:** Sources, functions and deficiency symptoms of mineral nutrients in humans.**Lesson title4:** Vitamins and the classification of vitamins.**Lesson title5:** Sources, functions and symptoms of vitamin deficiency**.*****Evaluation procedures such as oral, written quizzes, practical’s…*** | A learner can * State the mineral requirements for bodily functions.
* Identify the symptoms of mineral and vitamin deficiency.
* Outline the need for consumption of minerals and vitamins in smallamounts.
 | * In pairs, use tables of vitamin and mineral requirements, along with photographs of individuals with different deficiency diseases, to make a list of minerals and vitamins the individual may be lacking or having in excess.
* In journal form, individually research the most evident dietary diseases in the community and suggest recommendations to improve the nutritional status.
* Presentation of the results.
 | 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 discuss the roles of minerals and vitamins in diet |

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| **WEEK 3****23-27/01** | **Unit 10:** Enzymes. | **Lesson tilte1:** Criteria for naming enzymes.**Lesson tilte2:** Characteristics of enzymes.**Lesson tilte3:** Mode of action of enzymes.**Lesson tilte4:** Factors affecting enzyme action.**Lesson tilte5:** Importance of enzymes in living organisms.**Lesson tilte6:** EnzymeTechnology.**Lesson tilte7:** Importance of enzymes in living organisms.***Evaluation procedures such as oral, written quizzes, practical’s…*** | A learner can* Define the term enzyme
* Explain the criteria of naming enzymes.
* State that enzymes function inside cells and outside cells.
* Explain that enzymes are globular proteins that catalyse metabolic reactions.
* Describe the mode of action of enzymes in terms of the lock and key and the induced fit hypotheses.
* Explain factors affecting enzyme activity.
* Define enzymetechnology and explain its role in industry.
 | * In pairs, learners carry out an experiment to show the effect of mylase on starch at different temperatures.
* In groups, learners find out the effect of digestive enzymes on food substrate in different parts of the alimentary canal.
* Devise an experiment on the effect of temperature, pH and concentration of substrate on enzyme activities.
* Solve a problem with graphs showing the determination rate of an enzyme catalysed reaction.
* In groups, students use a computer or free hand to graphically plot the rate of an enzyme controlled reaction.
* Learners investigate and present research on enzyme technology.
 | 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 mode of action and factors affecting enzymes and their importance for the existence of life. |

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| **WEEK 4****30/01-03/02** | **Unit 11:** Principles of gas exchange systems. | **Lesson title1:**  Relationship between size and surface area to volume ratio.**Lesson title2:** Modifications of gaseous exchange surfaces to speed up diffusion.**Lesson title3:** Characteristics of gaseous exchange surfaces.**Lesson title3:**Smoking andrelated risks.***Evaluation procedures such as oral, written quizzes, practical’s…*** | A learner can* + Explain the relationship between size and surface area to volume ratio.
	+ Describe how different respiratory surfaces are modified to speed up the diffusion process.
	+ State the characteristics of gaseous exchange surfaces.
	+ Describe the effects of tar and carcinogens in tobacco smoke on the gas exchange system with reference to lung cancer and chronic obstructive pulmonary disease (COPD).
	+ Describe the short term effects ofnicotine and carbon monoxide on the cardiovascular system.
 | * Learners measure surface area to volume ratios of objects of various sizes and design. Learners then carry out an experiment to measure the diffusion rate into different sizes of gelatine tubes.
* Research using the internet or textbook material on modifications of gaseous exchange surfaces and report their findings.
* Learners observe prepared slides of gaseous exchange surfaces of different organisms and identify common characteristics.
* Learners dissect fish gills and observe the surface area for gas exchange.
* Observe the lungs of a dissected mammal and identify their adaptations for gaseous exchange.
* Learners observe photographs of healthy lungs to those affected by smoking and draw conclusions on risks related to smoking.
 | 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 principles of gaseous exchange systems. |

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| **WEEK 5****06-10/02** | **Unit 12:** Gas exchange in plants. | **Lesson title1:** Structure of stoma.**Lesson title2:** Theories used to explain the mechanism of opening and closure of stomata.**Lesson title3:** Structural adaptation and function of stomata, lenticels and breathing roots.**Lesson title4:** Comparison of gaseous exchange structures in terrestrial and aquatic plants.**Lesson title5:** Structural adaptation of leaves of aquatic and terrestrial plants to their habitats.***Evaluation procedures such as oral, written quizzes, practical’s…*** | A learner can * Describe the structure of stoma.
* Explain the theories of opening and closure of stomata stating limitations of each.
* Explain how stomata, lenticels and breathing roots are adapted to their function.
 | * Learners observe, draw and label structure of stoma as observed under a light microscope.
* Learners research the theories used to explain the opening and closure of stomata and discuss their findings in class
* Learners observe prepared slides of T.S. of leaves of aquatic and terrestrial plants and discuss the differences.
 | 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 structures of gaseous exchange organs in plants. |

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| **WEEK 6****13-17/02** | **Unit 13:** Growth and development in plants and animals. | **Lesson title1:** Fruit, seed and bud dormancy.**Lesson title2:** Types and stages of germination.**Lesson title3:**Primary andSecondary growth.**Lesson title4:** Determination of growth.***Evaluation procedures such as oral, written quizzes, practical’s…*** | A learner can* Describe dormancy as a state of inactivity to absolute minimum due to the morphological and physiological state of a plant structure.
* Explain how dormancy is maintained and broken.
* State the conditions required for germination.
* Outline the role of enzymes in the process of germination.
* State types of plant growth hormones and their functions.
* Identify the hypocotyl and coleoptile in a germinating seed.
* Describe the stages and types of germination.
 | * Cut and compare longitudinal sections of endospermic and non-endospermic seeds.
* Cut monocot and dicot stems, shoots and meristems of woody trees to compare primary and secondary growth.
* Carry out a research project on the phototropism and geotropism.
* Investigate primary growth in a seedling.
 | 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 7****20-24/02** | **Lesson title5:** Phytohormones.**Lesson title6:** Plant movements.**Lesson title7:** Photoperiodism in plants.**Lesson title8:** Metamorphosis and growth patterns in insects and amphibians.***Evaluation procedures such as oral, written quizzes, practical’s…*** | * State that a meristem is a growing point of the plant and the mainmeristematic regions of a tree.
* Describe current views about photoperiodic control of flowering.
* Describe the process of metamorphosis in arthropods and amphibians.
 | * Investigate the effect of temperature on development of frog eggs.
* In pairs make a hypothesis about what other environmental factors would affect the development of frog eggs and present it for evaluation.
* Discus reasons why complete metamorphosis may have greater adaptive value for an insect than incomplete metamorphosis.
* Interpret data and graphs for growth patterns in arthropods, vertebrates and plants.
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| **Key Unit Competence: To be able to account for the processes of growth and development in plants and animals.** |

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| **WEEK 8****27/02-03/03** | **Unit 14:** Support and locomotion | **Lesson title1**: Need for locomotion.**Lesson title2**: Non-muscular movements or movement without muscles: amoeboid, flagella, and euglenoid.***Evaluation procedures such as oral, written quizzes, practical’s…*** | A learner can * Explain nonmuscular movement in amoeba or paramecium.
 | * Learners discuss reasons why animals move from one place to another.
* Using a microscope, learners observe locomotion in Amoeba and Paramecium from a culture medium.
 | 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**: Arrangement of muscles in fish.**Lesson title4**: Movement and support of fish in water: propulsion and stability.***Evaluation procedures such as oral, written quizzes, practical’s…*** | * Describe support and movement on land.
* Describe skeletal modification in birds.
* Explain how movements and support of fish are brought about in water.
 | * Observe the arrangement of muscles in fish (myotomes) to relate their structure to locomotion.
* Observe external features (fins) and internal features (swim bladder) of a fish (tilapia) that enable locomotion of a fish in water.
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| **WEEK 9****06-10/03** | **Lesson title5**: Support and movement on land/muscular skeletal basis of locomotion.**Lesson title6**: Propulsion of walking tetrapods (mammals), birds and annelids.***Evaluation procedures such as oral, written quizzes, practical’s…*** | * Explain how supportstructures are related to the environment of the animal.
 | * Use models or computer aided simulations to observe the relationship between muscles, joints and musculo skeletal attachments of the antagonistic muscles of fish, birds, frogs and rabbits.
* Watch movies or simulations of the locomotion of different animals, such as a fish in water, a rabbit and lion on land, and insects and birds in the air.
* Learners carry out research from the library or the internet to find out the similarity and difference between the flight of birds and insects.
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| **Key Unit Competence: To be able to explain and demonstrate modes of locomotion in protists, insects, fish, amphibians, birds and mammals.** |
| **WEEK 10****13-17/03** | **GENERAL REVISION** |
| **WEEK 11****20-24/03** | **EXAMINATIONS PERIOD** |
| **WEEK 12****27-31//03**  | **MARKING AND PREPARATION OF SCHOOL REPORTS** |

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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** | **Unit 15:** Classification and patterns of disease. | **Lesson title1:** - Theory of disease, germ theory.Focus on the following diseases: small pox, cholera, TB, malaria, typhus, tinea, scabies (or other skin parasites) and hook worm.**Lesson title2:** Classification of disease.**Lesson title3:** Patterns of disease.**Lesson title4:** Health and community: criteria for good housing**Lesson title5:** Public health services: organisation and functions of local, state and international health services, food inspection, and the need for control of housing conditions, clean water, and hygiene.***Evaluation procedures such as oral, written quizzes, practical’s…*** | A learner can* Explain what is meant by health and disease.
* Identify different categories of disease and give an example of each.

Explain the theory of the disease and the causes, sources, transmission, symptoms and controls of the disease. | * **L**earners discuss in groups, what they think are the causes of death using the story of Semelweiss’ work. From the discussions they arrive at the germ theory of disease.
* After the first activity, using the work of Pasteur learners debate or use drama to show whether a disease is caused by germs or not. This allows them to discover other causes of disease and to classify them.
 | 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****24-28/04** | **Unit 16:** Asexual Reproduction in Plants. | **Lesson title1:** Asexual and sexual reproduction.**Lesson title2:** Methods of asexual reproduction.**Lesson title3:** Advantages andDisadvantages of asexual reproduction.***Evaluation procedures such as oral, written quizzes, practical’s…*** | A learner can * Describe the various methods of asexual reproduction: fragmentation, budding, and spore formation.
* Discuss the advantages and disadvantages of asexual reproduction.
 | * Discuss asexual reproduction in lower organisms and higher plants, outlining advantages and disadvantages.
* Learners observe asexual reproduction in lower organisms and write reports as an out-of-class activity.
* Learners examine prepared slides on asexual reproduction in lower 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 |  |
|  | **Lesson title4:** Vegetative and artificial propagation in flowering plants.**Lesson title5:** Application of artificial propagation in growing improved varieties of plants***Evaluation procedures such as oral, written quizzes, practical’s…*** | * Describe the characteristics of vegetative reproductive parts in a flowering plant.
 | * Learners carry out vegetative propagation of at least two plant species by stem cutting suckers or layering (cassava, Banana, hibiscus).
* Field study on naturaland artificial propagationmethods.
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| **Key Unit Competence:** To be able to account for various methods of asexual reproduction as means of increasing crop yield. |

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| **WEEK 3****01-05/05** | **Unit 17:** Sexual Reproduction in Plants. | **Lesson title1:** Alternation of generations in bryophytes and pteridophytes.**Lesson title2:** Types and structure of flowers.**Lesson title3:** Pollination and double fertilization in flowering plants.***Evaluation procedures such as oral, written quizzes, practical’s…*** | A learner can * + Explain the meaning of the term alternation of generations.
	+ Discuss the significance of alternation of generations.
	+ Describe the types and structure of flowers.
	+ Describe pollination and fertilisation in flowering plants.
 | * + Learners carry out a project to study alternation of generations in mosses and ferns. Learners use a mixture of first hand observations of living specimens and information from textbooks and the internet.
	+ Learners examine the structures of flowers, inflorescences, fruits and seeds using hand lenses and a light microscope.
 | 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****08-12/05** | **Lesson title4:** Events in a flower after fertilisation.**Lesson title5:** Structure and types of seeds and fruits.**Lesson title6:** Fruit and seed dispersal with their adaptation.***Evaluation procedures such as oral, written quizzes, practical’s…*** | * + Explain the events that take place in a flower after fertilisation.
	+ Describe the types and structure of seeds and fruits.
	+ Discuss modes of dispersal of fruits and seeds
 | * + Carry out research from the library and internet on the process of double fertilisation in angiosperms.
	+ Carry out project research on the dispersal of seeds and fruits, through first hand observation and collection linked to information from secondary sources.
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| **Key Unit Competence:** To be able to describe sexual reproduction in plants. |

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| **WEEK 5****15-19/05** | **Unit 18:** Microbiology. | **Lesson title1:** Microbiology.**Lesson title2:** Structure and life cycle of viruses.**Lesson title3:** Viruses as living or non-living.**Lesson title4:** Archaebacteria.**Lesson title5:** Eubacteria.**Lesson title6:** E.coli and food poisoning.**Lesson title7:** Structure and lifecycle of E.coli.***Evaluation procedures such as oral, written quizzes, practical’s…*** | A learner can* Describe the basic structure of viruses.
* Explain how a retrovirus reproduces.
* Identify the effects

of viruses (e.g. AIDS, influenza, measles, feline leukaemia, some humancancers) and prokaryotes(e.g., tuberculosis, bubonic plague, cholera) on organisms.* Describe how plant viruses can be transmitted.
* Explain how and why archaebacteria are thought to have been the first forms of life.
 | * Learners in groups, discuss how viruses are different from living cells.
* Discuss the nutrition of eubacteria.
* Use photomicrographs and charts to describe the structure of different microorganisms.
* Discuss the methods of reducing the risk of food poisoning by pathogenic bacteria.
 | 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 title8:** Evolution of harmful strains.**Lesson title9:** Sources of infection.**Lesson title10:** Fungal Moulds: Rhizopus and Mucor.**Lesson title11:** Non-fungal moulds: water moulds, bacterial moulds, and cellular slim moulds.**Lesson title12:** Life cycle of Rhizopus.**Lesson title13:** Significance of moulds.**Lesson title14:**  Penicillium and saccharomyces. (*Trypanosoma)****Evaluation procedures such as oral, written quizzes, practical’s…*** | * Describe the main structural forms of eubacteria.
* Describe the structure and lifecycle of Escherichia Coli.
* Explain how harmless bacteria can be changed into potentially lethal ones.
* Describe the main features of moulds.
* Describe the structure of Mucor hyphae.
* Explain how Mucor and Rhizopus feed and reproduce.
* Describe the structure of a yeast cell.
 | * Learners interpret charts showing the life cycles of microorganisms.
* Observe prepared slides of Entamoebahystolitica Plasmodium and Trypanosoma to compare their structures.
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| **Key Unit Competence**: To be able to describe the structure and characteristics of viruses, bacteria, fungal and non-fungal moulds. |

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| **WEEK 7****29/05-02/06** | **Unit 19:** Culturing microorganisms. | **Lesson title1:** Requirements for growth of microorganisms:* Essential nutrients limited to: source of carbon, nitrogen, growth factors, mineral salts, source of energy and water.
* Environmental variables limited to: temperature, pH, oxygen concentration and ionic and osmotic balance.

**Lesson title2:** Culture media: solid and liquid, enrichment and selective, and indicator media.**Lesson title3:** Preparing the media.**Lesson title4:** Aseptic techniques.***Evaluation procedures such as oral, written quizzes, practical’s…*** | A learner can* List and describe the roles of microorganisms and their requirements for growth.
* Explain the role of environmental variables in culturing microorganisms.
* Describe the different types of culture media
* Describe the main features of aseptic techniques.
 | * + Draw and interpret the graph of the population growth of bacteria.
	+ Carry out an experiment to stain bacteria for examination with a light microscope.
	+ Interpret charts and illustrations for preparing culture media and the process of inoculating media.
	+ In groups, investigate the bacterial content of fresh and stale milk.
 | 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****05-09/06** |  | **Lesson title5:** Bacterial growth.**Lesson title6:** Measuring population growth of bacteria and fungi.**Lesson title7:** Staining bacteria.**Lesson title8:** Growing viruses.***Evaluation procedures such as oral, written quizzes, practical’s…*** | * Explain how pure cultures of pure bacteria can be obtained.
* Describe the methods of inoculation.
 | * + In pairs, culture fungi on a nutrient agar using sterile techniques.
	+ In groups, carry out research on why microorganisms are particularly suitable for industrial processes.
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| **Key Unit Competence:** To be able to explain the process of culturing microorganisms and the factors affecting their population growth. |

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| **WEEK 9****12-16/06** | **Unit 20**: Biotechnology and its application. | **Lesson title1:** Role of bacteria in biotechnology and genetic engineering.**Lesson title2:** Why bacteria are useful in biotechnology and genetic engineering.**Lesson title3:** Immobilisation of enzymes. Focused on: use of pectinase in fruit juice production, lactase to produce lactose free milk, and biological washing powders that contain enzymes and biosensors.**Lesson title4:** Application of enzyme technology.***Evaluation procedures such as oral, written quizzes, practical’s…*** | A learner can* State that bacteria are useful in biotechnology and genetic engineering due to their rapid reproduction rate and their ability to make complex molecules
* Discuss why bacteria are useful in biotechnology and genetic engineering.
* Describe the role of anaerobic respiration in yeast during bread making.
 | * Carry out research on the action of enzymes with reference to pectinase in fruit juice production and lactase to produce lactose free milk.
* Carry out an experiment on alcoholic fermentation using yeast. Alternatively, use charts and illustrations to describe an experiment on alcoholic fermentation using yeasts.
* Make a list of factors such as temperature and the amount of yeast and flour in dough that might affect the process of fermentation. Justify how each factor will affect the rate of fermentation.
 | 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 10****19-23/06** | **Lesson title5:** Examples of industrial application ofenzymes: brewing (beer and wines), baking, medicine, meat, cheese, and yoghurt)**Lesson title6:** Fermentation andFermenters and the production of penicillin.**Lesson title7:** Antibiotics: Antibiotic resistance and implications of antibiotic use.**Lesson title8:** Biogas production***Evaluation procedures such as oral, written quizzes, practical’s…*** | * Explain how fermenters are used in the production of penicillin.
* Describe the role of the fungus Penicillium in the production of the antibiotic penicillin
* Describe the three stages of biogas production and the role of bioreactors in economically poor rural communities
 | * Visit a nearby bakery and verify how bread is prepared. Write a short report on the raw materials and procedures used in making bread up to the final product.
* In groups, interpret and explain graphs showing how the pH and the concentration of penicillin in a culture changes over time when the pH is controlled.
* Using diagrams orillustrations and visitinga biogas plants in yourregion, describe the stagesof biogas production and itssignificance in your area (asimple biogas generator can also be made in schools).
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| **Key Unit Competence:** To be able to explain the biotechnology involved in the production of ethanol, biogas and bread making. |

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