E.S KANOMBE/EFOTEC

Tr: MAZIMPAKA JEAN CLAUDE

Email: claudemazim33@gmail.com

Phone: 0788547827

BIOLOGY REVISION CONTENTS FOR S6 MCB& PCB

S4 contents.

UNIT 1. Introduction to Biodiversity

– Define the terms: species, ecosystem and niche.

– Explain that biodiversity is considered at three different levels

– Evaluate the consequences of loss of biodiversity. – Characterize the biotic and abiotic components that define Rwanda's ecosystems (example: freshwater, marine, and terrestrial).

– Apply Simpson's Index of Diversity.

– Explain the importance of random sampling in determining the biodiversity of an area.

– Use suitable survey methods such as frame quadrats, line and belt transects to assess the distribution and abundance of organisms in a local area.

– Use Pearson's linear correlation to analyze the relationships between the distribution and abundance of species and abiotic or biotic factors.

– Recognize that the biodiversity of the earth is threatened by human activities and climate change Introductory

UNIT 2: Introduction to Classification

– 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 a typical bacterial cell.

– Identify common bacterial diseases in plants and animals.

– Outline the characteristic features of the kingdoms Protoctista, Fungi, Plantae and Animalia. – Explain why viruses are not included in the three domain classification.

– Outline how viruses are classified limited to type of nucleic acid and their host.

– Describe the role of bacteria in the production of dairy products.

– Describe methods of preventing common bacterial diseases.

– Construct a dichotomous key for a group of organisms.

UNIT 3: Microscope

– Describe the main features and functions of the components of a compound light microscope.

– State that magnification is the increase in the apparent size of the object.

– State that resolution is the ability of the microscope to show two objects as separate.

– Appreciate the importance of magnifying instruments in Biology. – Use of a microscope to determine the relationship between actual size of the specimen and the image.

– Calculate the approximate size of different biological structures using an appropriate unit of measurement

– State the advantages and disadvantages of using an electron microscope.

– State the principles and limitations of TEM (Transmission Electron Microscopy).

– State the advantages and disadvantages of using SEM (Scanning Electron Microscopy).

– Compare light and electron microscopes

UNIT 4: Ultrastructure of a cell

– Identify plant and animal cell structures visible under a light microscope.

– State functions of cell structures as seen under an electron microscope.

– List the functions of cell membranes.

– Describe the fluid mosaic structure of cell membranes. – Explain the role of the different components of a cell membrane.

– Explain cell specialization as the differentiation of a cell or process to do a particular function

– Distinguish between ultra-structures of plant cells and animal cells.

– Compare ultra-structures of prokaryotic and eukaryotic

UNIT 7: Carbohydrates and lipids

– 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.

– Define the terms monomer, polymer, macromolecule, monosaccharide, disaccharide and polysaccharide.

– Describe the ring forms of α-glucose and β-glucose structure.

– Explain the formation of glycosidic bonds.

– 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.

– Demonstrate that phospholipids have a hydrophilic head and hydrophobic tails using a heterogeneous mixture made up of water and cooking oil.

– Interpret the charts and illustrations of molecular structure and the formation of maltose and triglycerides.

– Demonstrate through a process of combustion that sugars and lipids are biological fuel – Differentiate between starch and cellulose.

– Appreciate the importance of carbohydrates and lipids in organisms.

– Be aware of the other roles of lipids in the formation of soap and with carbohydrates and syrups in medicine

UNIT 8: Proteins and water

– 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 hemoglobin as an example of a globular protein.

– Describe the functions with an emphasis on iron in the hemoglobin molecule.

– Explain the effect of heat, pH and chemicals on protein structure.

– Explain how hydrogen bonding occurs between water molecules and relate the properties of water to its roles in living organisms.

– Devise an experiment to investigate the effect of temperature, pH and chemicals on the structure of protein.

– Relate the structure of globular and fibrous proteins to their functions.

– Investigate the effect of lowering temperature on water.

– Distinguish between collagen molecules and collagen fibres

– Appreciate the importance of globular and fibrous proteins in biological processes such as the transport of gases and providing support for tissues.

– Express that protein structure is central to many aspects of biology, such as enzymes, antibodies and muscle contraction.

– Acknowledge that water is a special molecule with extraordinary properties that make life possible on this planet.

UNIT 9: Vitamins and Minerals

– 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 small amounts.

– Organize a list of foods that are good sources of vitamins and mineral salts.

– Recognize the signs and symptoms of scurvy, night blindness, goiter, and anaemia.

– Differentiate between water soluble and lipid soluble vitamins.

– Analyze one's eating habits and suggest improvements

– Appreciate the importance of a balanced diet in relation to health and economic prosperity

UNIT 10: Enzymes

– 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 catalyze 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 enzyme technology and its role in industry.

– Investigate the progress of an enzyme-catalyzed reaction by measuring rates of formation of products.

– Investigate the effects of temperature, pH, enzyme and substrate concentration, and inhibitors on enzyme activity.

– Interpret graphs of the effects of reversible and irreversible inhibitors on the rate of enzyme activity.

– Investigate the effect of immobilizing an enzyme in alginate as compared with its activity when free in solution.

– Use a computer to plot graphs of the rate of enzyme controlled reaction. Calculate Q10 of an enzyme controlled reaction.

– Acknowledge that enzymes are essential in speeding up reactions that would be too slow to sustain life.

– Appreciate the importance of planning and carrying out experiments under controlled conditions.

– Understand the roles of enzymes in industry and medicine.

S5 contents:

Unit 1: Interdependence between organisms within their environment

- **explain the various interactions of organisms in nature.**
- **appreciate the relationships existing among the organisms within their environment.**
- **state the significance of organisms' interactions in nature.**
- **explain the terms interspecific and intraspecific competition.**
- **compare interspecific and intraspecific competition.**
- **describe the adaptations of predators to catch and kill prey and adaptations of prey to avoid predators.**
- **interpret graphs for predator-prey relationships.**
- **classify examples of species interactions, e.g., competition, predation, parasitism, commensalism, and mutualism.**
- **recognise the role of saprophytes in mineral recycling.**

Unit2: Transport across the cell membrane

- **describe and explain the processes and significance of movement in and out of the cell mentioned in the content.**
- **recall that the increasing size of organisms is constrained by its ability to obtain resources through diffusion across the cell surface and its ability to move substances out of cells.**
- **explain the movement of water between cells and solutions with different water potentials and explain the effects on plant and animal cells.**
- **carry out an investigation on simple diffusion using plant tissues and non-living materials.** •
- **apply the knowledge of hypertonic environments in food preservation by salting.**
- **research adaptations of plants and animals to salty habitats.**
- **interpret and present data in graphic and table form on the effects of varying concentrations of : e.g., sugar and salt on plant and animal tissues.**
- **appreciate the importance of movement of substances across cells.**
- **show concern when exposing living organisms to concentrated media.**
- **distinguish between endocytosis and exocytosis.**

Unit 3: Chromosomes and Nucleic Acids

- **describe the composition of chromosomes and the structure of nucleotides.**
- **use of complimentary base pairing to write the sequence for messenger RNA and the first DNA codes for three base codon.**
- **appreciate the importance of the presence of DNA in chromosomes.**
- **state how nucleotides pair.**
- **describe the structure of DNA and RNA.**
- **explain that the structure of the DNA molecule is described as a ladder twisted into a spiral.**
- **draw the structure of DNA (6-10 base pair sequence).**
- **explain the Watson-Crick hypothesis of the nature of DNA.**
- **research on how Watson and Crick determined the nucleotide base pairing pattern.**
- **outline the significance of telomeres in permitting continued replication.**
- **acknowledge the role of telomeres in preventing the loss of genes and its relation to the development of cancer.**
- **distinguish between RNA and DNA.**
- **describe the nature of genes.**
- **describe the structure of a genetic code.**

UNIT 4: DNA replication

- **determine how the structure of DNA enables it to reproduce itself accurately.**
- **appreciate the importance of proper DNA replication.**
- **state semiconservative replication as a process by which DNA unzips and each new molecule of DNA (daughter DNA) contains one intact strand from the original DNA (parent DNA) and one newly synthesised strand.**
- **apply knowledge of complimentary base pairing in DNA to interpret Meselson and Stahl's experiment to test different hypothetical models for DNA replication using E.coli grown in a heavy nitrogen (15N) medium.**
- **acknowledge improper DNA replication would result into genetic changes in the nucleus that would have both positive and negative effects on organisms. For example, changes in the metabolism of cells, variation that can result into evolution and mutations that may lead to death.**
- **state the role of enzymes involved in replication of DNA.**
- **list the ingredients used to make DNA in a test tube.**
- **describe how semi-conservative replication of DNA takes place.**
- **state that conservative and dispersive replications are other hypothesis for DNA replication.**
- **explain the importance of DNA replication in organisms.**

UNIT 5: Cell and Nuclear division

- **describe the main stages of the cell cycle, including: interphase (growth and DNA replication), mitosis and cytokinesis.**
- **explain what is meant by homologous pairs of chromosomes.**
- **explain the meaning of the terms haploid and diploid.**
- **describe the process of mitosis and meiosis.**
- **outline the significance of mitosis in cell replacement and tissue repair by stem cells.**
- **state that uncontrolled cell division can result in the formation of a tumour.**
- **define meiosis as reduction division in which the chromosome number is halved from diploid to haploid.**
- **explain the need for reduction prior to fertilisation in sexual reproduction.**
- **outline the role of meiosis in gametogenesis in humans and in the formation of pollen grain and embryo sacs in flowering plants.**
- **explain how crossing over and random assortment of homologous chromosomes during meiosis and random fusion of gametes at fertilization leads to genetic variation, including the expression of rare recessive alleles.**
- **interpret data related to time for different cell cycles to identify tissues from which the cells came.**
- **apply knowledge of mitosis to predict which set of cells came from and which part of the plant and where other cells have come from.**
- **make a table showing the phases of the cell cycle mentioning one important event that occurs at each phase.**
- **compare mitosis and meiosis.**
- **appreciate the importance of effective cell division.**

Unit 6: Protein synthesis

- **state the features of a genetic code.**
- **state that a gene is a sequence of nucleotides that form part of a DNA molecule that codes for a specific polypeptide.**
- **appreciate the importance of the genetic code in determining the structure of a protein.**
- **describe how the information in DNA is used during transcription and translation to construct polypeptides.**
- **agree that the way DNA code for polypeptides is central to our understanding of how cells and organisms function.**
- **be aware that DNA is an extremely stable molecule that cells replicate with extreme accuracy to minimise possibilities of DNA mutations.**
- **state the roles played by mRNA, tRNA and the ribosomes in the formation of the polypeptide.**
- **appreciate the role of the genetic code in determining the characteristics of an individual.** • **state that ribosomes provide surface area for the attachment of mRNA during polypeptide synthesis.**
- **state that polysomes consists of up to 50 ribosomes on the same mRNA strand and that they speed up polypeptide synthesis.**
- **describe the way in which the nucleotide sequence codes for the amino acid sequence with specific reference to HbA (normal) and HbS(sickle cell) alleles for b-globin poly peptides.**

- **state that gene mutation is a change in the sequence of nucleotides that may result in an altered polypeptide.**
- **construct a flow chart, in proper sequence, for the stages of transcription and translation.**
- **using the evidence, predict the effect of change in genetic code on the structure of the protein manufactured during protein synthesis.**
- **carry out research to find and understand better about protein synthesis and on genetic diseases.**

S6 contents

Unit 1: Population and natural resources

– State and define population characteristics.

– Explain factors that affect population density.

– Explain population growth patterns.

– Explain the terms renewable and non-renewable 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.

– Analyse the costs and benefits of managing renewable and non-renewable resources.

– Support that human population explosion impacts negatively on the environment.

– Recognize that some resources are renewable and others are non-renewable and that effective use of these resources is of great value.

– Justify the practice of family planning as a tool for reducing population explosion.

Unit2: Concept of ecosystem

– 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: population, community, ecosystem, biome, niche and biosphere

– Distinguish among; individuals, populations, communities, niche, habitat, ecosystems, biomes, biosphere

– Describe feeding relationships in an ecosystem

– Describe a food chain and a food web

– Explain the relative merits of pyramids of numbers

– Analyse the relation between organisms (example: producers, consumers, decomposers) and their trophic levels.

– Distinguish between abiotic and biotic factors

– Interpret energy flow diagrams

– Compare; gross primary, net primary production and secondary succession in biotic communities – 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

– Distinguish between primary and secondary succession in biotic communities

– Appreciate the existence of different components of an ecosystem and their roles in the life of organisms

– Beware of the effect of bioaccumulations at different trophic levels.

– Recognise the source and transfer of energy in an ecosystem

Unit 3: Effects of Human activities on ecosystem

– Explain how modern agricultural technology has resulted in increased food production

– 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 and nonbiodegradable plastics

– Explain the main methods of the conservation of resources

– Describe an example of conservation in action – Assess the negative impacts to an ecosystem of intensive livestock production

– Conduct shows and dramas on wildlife conservation

– Research the effects of the excessive use of fertilisers on the environment

– Assess the different methods of the conservation of nature

– Carry out a research project on recycling sewage

– Carry out research on the African species endangered by human activity

– Evaluate the reasons for conserving wildlife

– Demonstrate ways of reducing pollution and protecting the environment

UNIT 4: The circulatory system

– 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.

– 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 lymph are formed.

– Describe the risk factors associated with cardiovascular diseases.

– Carry out an investigation on the effects of exercise on the pulse rate and blood pressure.

– Distinguish between open and closed, single and double circulation with reference to insects, earthworm, fish and mammals.

– Recognize blood vessels from their structures using a light microscope.

– Relate the structure of blood vessels to their functions. – Differentiate between blood, tissue fluid, and lymph.

– Relate blood as a tissue to its functions.

– Interpret oxygen dissociation curves for haemoglobin and other respiratory pigments.

– Appreciate the importance of the need for transport systems when animals become larger, more complex and more active, to supply nutrients to, and remove waste from, individual cells.

– Recognize possible risk factors as diet, stress, smoking, genetic predisposition, age and gender in relation to cardio vascular diseases.

Unit 5: Energy from Respiration

– 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 Krebs (tri-carboxylic acid [TCA] cycle.

UNIT 6: CELLULAR Respiration

– 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.