

## Grade 11 (Bilingual) Biology

### Learning outcomes

Textbook: Advanced Biology for you

## Semester 1: Core principles

Topic 1: Biological molecules

### Learning outcomes

Candidates should be able to:

- a. Distinguish between atoms, molecules, ions and isotopes.
- b. Distinguish between acids and bases.
- c. Explain what a buffer does.
- d. Differentiate between ionic bonds, covalent bonds and hydrogen bonds.
- e. Describe the properties of the water molecule.
- f. Describe the structure of carbohydrates.
- g. Describe the structure of monosaccharides and distinguish between trioses, pentoses and hexoses, giving examples on each.
- h. Describe how monosaccharides link together to form disaccharides, by a condensation reaction.
- i. Describe how disaccharides can be broken down into monosaccharides by a hydrolysis reaction.
- j. Distinguish between sucrose, lactose and maltose and mention the source of each in living organisms.
- k. Distinguish between reducing and non-reducing sugars.
- l. Describe what lactose intolerance is and how the problem can be overcome.
- m. Describe how  $\alpha$ -glucose molecules link to form starch.

- n. Distinguish between starch, glycogen, cellulose and chitin in terms of structure, their source and importance to living things.
- o. Distinguish between amylose and amylopectin.
- p. Describe the general chemical structure of amino acids.
- q. Describe how amino acids link together by peptide bonds to form polypeptides, by condensation reactions.
- r. Distinguish between the primary, secondary and tertiary structure of proteins and show how each kind forms.
- s. Describe the kinds of bonds that hold the protein structure.
- t. Discuss the factors that can lead to denaturation of proteins.
- u. Distinguish between fibrous proteins and globular proteins, in terms of their structure, physical and chemical properties, giving examples on each..
- v. BIOLOGY AT WORK: Describe the process of electrophoresis and its use in medicine and genetic fingerprinting.
- w. BIOLOGY AT WORK: Describe the structure and function of collagen. Discuss the uses of collagen in skin grafting, heart valves. Discuss the process by which collagen replacement therapy is done.
- x. Describe how triglycerides are formed by linking 3 fatty acid molecules to one glycerol molecule by three condensation reactions.
- y. Describe how fatty acids differ from one another.
- z. Describe the structure of phospholipids and their importance to cells.
- aa. Discuss the structure of waxes and their importance.
- bb. Describe the properties of steroids and their importance.
- cc. Describe the role of lipids and phospholipids in living things.
- dd. Discuss the importance of cholesterol to the body, its formation. Describe how hypercholesterolaemia develops. Discuss how cholesterol is transported in the blood. Describe what causes atherosclerosis.

ee. Discuss what anabolic steroids are and their importance to athletes. Discuss the reasons behind banning the use of anabolic steroids by athletes.

## Topic 2: Cells

### Learning outcomes

#### Candidates should be able to:

- a. Explain how the cell theory evolved.
- b. Distinguish between unicellular and multicellular organisms.
- c. Distinguish between prokaryotic and eukaryotic cells.
- d. Describe the ultrastructure of a prokaryotic cell. Describe the function(s) of each of the plasmids, cell wall, mesosomes, ribosomes and flagella in the prokaryotic cell.
- e. Describe the ultrastructure of eukaryotic cells (plant and animal cells).
- f. Distinguish between plant cells and animal cells.
- g. Discuss the structure and function(s) of each of the cellulose cell wall, vacuole, nucleus, nucleoplasm, chromosomes, nucleolus, ribosomes, endoplasmic reticulum, golgi body, lysosomes, mitochondria, chloroplast, cytoskeleton, centrioles, cilia and flagella.
- h. Describe the structure of a virus, and its life cycle, as it infects a cell and reproduces inside it.
- i. Distinguish between the different levels of organization: chemical level, organelle level, cellular level, tissue level, organ level, system level and the organism.
- j. Distinguish between different kinds of specialized cells.
- k. Study the structure of the light microscope and the electron microscope.
- l. Compare between the light microscope and the electron microscope.
- m. Explain what the resolving power is.

- n. Distinguish between the transmission and scanning electron microscopes.
- o. Explain what cell fractionation is and describe how it is carried out.
- p. Discuss the how the laser microscope works, its used and the application of laser imaging techniques in cytological studies.

### Topic 3: The cell membrane and transport

#### Learning outcomes

#### Candidates should be able to:

- a. Discuss why the phosphate head of of a phospholipid is hydrophilic while the tail is hydrophobic.
- b. Describe the ultrastructure of the cell membrane by the fluid mosaic theory.
- c. Discuss the importance of phospholipids, intrinsic and extrinsic proteins as well as cholesterol to the cell membrane.
- d. Describe the importance of carrier proteins, channel proteins, receptor proteins, enzymes and glycoproteins to the cell membrane, in relation to giving each type of membrane its own important function.
- e. Define diffusion and give examples of diffusion in living organisms.
- f. Discuss the factors that affect the rate of diffusion.
- g. Describe what facilitated diffusion is and distinguish between channel proteins and carrier proteins.
- h. Discuss the effect of surface area to volume ration on the rate of diffusion.
- i. Define and explain the process of osmosis.
- j. Explain the meaning of the term *water potential*.
- k. Discuss the ideas of: *solute potential*, *pressure potential*.
- l. Describe what causes turgidity and plasmolysis of plant cells.
- m. Describe what causes haemolysis and crenation of animal cells.

- n. Explain why osmosis is important in osmoregulation.
- o. Define active transport.
- p. Describe the mechanism of active transport across the cell membranes.
- q. Give examples on processes that involve active transport in the human body.
- r. Discuss what cryopreservation is, the importance of cryomicroscopes and cryoprotectants and the use of cryoprotectants in preservation of organs.

## Topic 4: Enzymes

### Learning outcomes

#### Candidates should be able to:

- a. Discuss the nature of enzymes and their importance.
- b. Give examples on reactions that require the presence of an enzyme.
- c. Describe what is meant by the primary, secondary and tertiary structure of an enzyme.
- d. Discuss the mechanism of enzyme action by the *lock and key theory*, *induced fit theory*, and *activation energy*.
- e. Discuss the factors that affect the enzyme activity: temperature, pH, enzyme concentration and substrate concentration on the activity of enzymes.
- f. Discuss what cofactors, prosthetic groups and activators are and their importance to the body.
- g. Discuss what inhibitors are and distinguish between competitive and non-competitive inhibitors.
- h. Discuss the role of enzymes in controlling metabolic pathways.
- i. Describe how enzymes are classified.

- j. Commercial uses of enzymes: Discuss the commercial uses of immobilized enzymes in the production of high-fructose corn syrup and biological washing powders
- k. Discuss how enzymes are immobilized.
- l. Discuss the mode of action of insecticides and the biochemical basis of resistance.

## Semester 2: Genes and genetic engineering

### Topic 5: Nucleic acids and protein synthesis

#### Learning outcomes

#### Candidates should be able to:

- a. Discuss why DNA is considered to carry the genetic information.
- b. Explain what nucleic acids are composed of.
- c. Describe how scientists discovered the double helical form of the DNA.
- d. Describe the structure of DNA by the model of *Watson and Crick*.
- e. Describe how DNA replication takes place and discuss the evidence put to support the semi-conservative DNA replication.
- f. Describe what is meant by the genetic code and the triplet code.
- g. Describe the structure of RNA and distinguish between mRNA, tRNA and rRNA in terms of structure and function.
- h. Describe the process of protein synthesis (transcription and translation).

### Topic 6: Cell division

#### Learning outcomes

#### Candidates should be able to:

- a. Describe the structure of chromosomes and explain the meaning of the terms karyotype, homologous chromosomes, sex chromosomes, autosomes, diploid and haploid.
- b. Discuss the importance of forming haploid gametes.
- c. Distinguish between mitosis and meiosis.
- d. Describe the different stages of mitosis (prophase, metaphase, anaphase and telophase) and state what happens in cytokinesis.

- e. Discuss the significance of mitosis.
- f. Describe the different stages of meiosis (meiosis I and II).
- g. Discuss the importance of meiosis in producing genetic variation through random segregation of chromosomes and crossing over.
- h. Describe how the number of DNA changes during different stages of cell division.
- i. State the differences between mitosis and meiosis.
- j. Discuss what causes cancer and how tumour cells form. Distinguish between malignant and benign tumours. Discuss the factors that can stimulate the formation of cancer cells, and methods of treatment by surgery, radiotherapy and chemotherapy.
- k. Describe how cervical cancer results from a viral infection, its method of screening and treatment.

## Topic 7: Reproduction

### Learning outcomes

#### Candidates should be able to:

- a. Distinguish between the life cycles of animals and plants.
- b. Describe the flower structure and function of its parts.
- c. Define pollination and fertilization.
- d. Distinguish between protandry, protogyny and dioecious.
- e. Distinguish between insect and wind-pollinated flowers.
- f. Describe the process of fertilization in plants.
- g. Describe the structure and functions of the male and female reproductive systems in humans.
- h. Describe the process of gametogenesis in both males and females.
- i. Describe the events that take place throughout the menstrual cycle.



- j. Describe the process of fertilization, implantation and embryo formation in humans.
- k. Describe the structure and function of the placenta.
- l. Describe the process of birth and lactation in humans.
- m. Discuss the causes of infertility in humans and the different methods of treating such cases.
- n. Discuss the uses of hormones in domestic animals as means of increasing the productivity of livestock.

## Topic 8: Gene technology

### Learning outcomes

#### Candidates should be able to:

- a. Describe the principles behind genetic engineering using restriction endonucleases.
- b. Describe the methods used in the production of insulin, industrial fermentation, batch and continuous cultivation, gene cloning using vectors, the polymerase chain reaction, genetic fingerprinting, gene therapy, transgenic organisms, bovine somatotrophin production, transgenic plants, plant tissue culture, cloning from protoplasts, cloning from animals,.
- c. Discuss the ethical issues behind genetic engineering.

#### Biology at work:

- d. Discuss how DNA fingerprinting was used to identify the remains of bones and their relationships
- e. Discuss the ethical issues behind genetically modified food..

Grade 11

Semester 1

Subject: Biology

Chapter	Practical	Resource
1. Biological Molecules	1. Identification of food constituents in milk	Legacy AS Biology, Nelson and Thornes, Molecules and cells
	2. The vitamin C content of fruit juice	Edexcel AS Biology, implementation and assessment, Guide for teachers and technicians
2. Cells	Setting up and using a light microscope	Legacy AS Biology, Nelson and Thornes, Molecules and cells
3. The cell membrane and transport	The effect of temperature on membranes	Edexcel AS Biology, implementation and assessment, Guide for teachers and technicians
4. Enzymes	Enzyme concentration and rate of reaction	Edexcel AS Biology, implementation and assessment, Guide for teachers and technicians

Grade 11

Semester 2

Subject: Biology

Chapter	Practical	Resource
5. Nucleic acids and genetic engineering	Making models of DNA, RNA and protein synthesis	Biology, a functional approach, Students' manual, MBV Roberts and TJ King, p. 301
	Extraction of DNA from a kiwi fruit	Website: <a href="http://www.york.ac.uk/res/sots/activities/diydna.htm">http://www.york.ac.uk/res/sots/activities/diydna.htm</a>
	DNA extraction virtual lab.	Website: <a href="http://learn.genetics.utah.edu/content/labs/extraction/">http://learn.genetics.utah.edu/content/labs/extraction/</a>
6. Cell division	Observing mitosis	Edexcel AS Biology, implementation and assessment, Guide for teachers and technicians
7. Reproduction	Totipotency and plant tissue culture	Edexcel AS Biology, implementation and assessment, Guide for teachers and technicians