

3 Subject content

This syllabus gives you the flexibility to design a course that will interest, challenge and engage your learners. Where appropriate you are responsible for selecting resources and examples to support your learners' study. These should be appropriate for the learners' age, cultural background and learning context as well as complying with your school policies and local legal requirements.

All candidates should be taught the Core subject content. Candidates who are only taught the Core subject content can achieve a maximum of grade C. Candidates aiming for grades A* to C should be taught the Extended subject content. The Extended subject content includes both the Core and the Supplement.

Scientific subjects are, by their nature, experimental. Learners should pursue a fully integrated course which allows them to develop their experimental skills by doing practical work and investigations.

Practical work helps students to:

- use equipment and materials accurately and safely
- develop observational and problem-solving skills
- develop a deeper understanding of the syllabus topics and the scientific approach
- appreciate how scientific theories are developed and tested
- transfer the experimental skills acquired to unfamiliar contexts
- develop positive scientific attitudes such as objectivity, integrity, cooperation, enquiry and inventiveness
- develop an interest and enjoyment in science.

Biology

B1 Characteristics of living organisms

B1.1 Characteristics of living organisms

Core

- 1 Describe the characteristics of living organisms by defining:
 - (a) movement as an action by an organism or part of an organism causing a change of position or place
 - (b) respiration as the chemical reactions in cells that break down nutrient molecules and release energy for metabolism
 - (c) sensitivity as the ability to detect and respond to changes in the internal or external environment
 - (d) growth as a permanent increase in size and dry mass
 - (e) reproduction as the processes that make more of the same kind of organism
 - (f) excretion as the removal of waste products of metabolism and substances in excess of requirements
 - (g) nutrition as the taking in of materials for energy, growth and development

Supplement

B2 Cells

B2.1 Cell structure

Core

- 1 Describe and compare the structure of a plant cell with an animal cell, limited to: cell wall, cell membrane, nucleus, cytoplasm, chloroplasts, ribosomes, mitochondria, vacuoles
- 2 Describe the structure of a bacterial cell, limited to: cell wall, cell membrane, cytoplasm, ribosomes, circular DNA, plasmids
- 3 Identify the cell structures listed in 2.1.1 and 2.1.2 in diagrams and images of plant, animal and bacterial cells
- 4 Describe the functions of the structures listed in 2.1.1 in plant and animal cells
- 5 Describe the meaning of the terms cell, tissue, organ, organ system and organism as illustrated by examples given in the syllabus

Supplement

- 6 State that specialised cells have specific functions, limited to:
 - (a) root hair cells – absorption
 - (b) palisade mesophyll cells – photosynthesis
 - (c) red blood cells – transport of oxygen

B2.2 Size of specimens

Core

- 1 State and use the formula:

$$\text{magnification} = \frac{\text{image size}}{\text{actual size}}$$
- 2 Calculate magnification and size of biological specimens using millimetres as units

Supplement

- 3 Convert measurements between millimetres (mm) and micrometres (μm)

B3 Movement into and out of cells

B3.1 Diffusion

Core

- 1 Describe diffusion as the net movement of particles from a region of their higher concentration to a region of their lower concentration (i.e. down a concentration gradient), as a result of their random movement
- 2 State that some substances move into and out of cells by diffusion through the cell membrane
- 3 Describe the importance of diffusion of gases and solutes in living organisms

Supplement

- 4 Investigate the factors that influence diffusion, limited to: surface area, temperature, concentration gradient and distance

B3.2 Osmosis

Core

- 1 State that water diffuses through partially permeable membranes by osmosis
- 2 State that water moves into and out of cells by osmosis through the cell membrane
- 3 Investigate and describe the effects on plant tissues of immersing them in solutions of different concentrations

Supplement

- 4 Describe osmosis as the net movement of water molecules from a region of higher water potential (dilute solution) to a region of lower water potential (concentrated solution), through a partially permeable membrane
- 5 Explain the effects on plant cells of immersing them in solutions of different concentrations by using the terms: turgid, turgor pressure, plasmolysis, flaccid

B3.3 Active transport

Core

Supplement

- 1 Describe active transport as the movement of particles through a cell membrane from a region of lower concentration to a region of higher concentration (i.e. against a concentration gradient), using energy from respiration
- 2 Explain the importance of active transport as a process for movement of molecules or ions across membranes, including ion uptake by root hairs

B4 Biological molecules

B4.1 Biological molecules

Core

- 1 List the chemical elements that make up: carbohydrates, fats and proteins
- 2 State that large molecules are made from smaller molecules, limited to:
 - (a) starch, glycogen and cellulose from glucose
 - (b) proteins from amino acids
 - (c) fats and oils from fatty acids and glycerol
- 3 Describe the use of:
 - (a) iodine solution test for starch
 - (b) Benedict's solution test for reducing sugars
 - (c) biuret test for proteins
 - (d) ethanol emulsion test for fats and oils

Supplement

B5 Enzymes

B5.1 Enzymes

Core

- 1 Describe enzymes as proteins that are involved in all metabolic reactions, where they function as biological catalysts
- 2 Investigate and describe the effect of changes in temperature and pH on enzyme activity

Supplement

- 3 Describe and explain enzyme action with reference to: the active site, enzyme-substrate complex, substrate and product
- 4 Describe and explain the specificity of enzymes in terms of the complementary shape and fit of the active site with the substrate
- 5 Explain the effect of changes in temperature on enzyme activity in terms of kinetic energy, shape and fit, frequency of effective collisions and denaturation
- 6 Explain the effect of changes in pH on enzyme activity in terms of shape and fit and denaturation