

## **BIOLOGY SENIOR 4 SYLLABUS 2009**

### **TOPIC 1 THE CELL**

#### **1.The cell structure and organisation**

Cellular nature of all living organisms

- identify and describe the structure of a plant cell (palisade cell) and an animal cell (liver cell), as seen under a light microscope
- describe the differences in structure between typical animal and plant cells
- relate the structures seen under the light microscope in the plant cell and in the animal cell to their functions

#### **2. The chemicals of life**

2.1 list the chemical elements that make up: carbohydrates – fats - proteins

2.2 describe the synthesis of large molecules from smaller basic units, i.e. simple sugars to starch and glycogen - amino acids to proteins - fatty acids and glycerol to fats and oils

2.3 describe tests for: starch (iodine solution); reducing sugars (Benedict's solution); protein (biuret test); fats (ethanol)

#### **3. Enzymes**

3.1 Define the term catalyst

- define enzymes as proteins that function as biological catalysts

3.2 Describe the effect of changes in temperature and pH on enzyme activity

3.3 Describe the role of enzymes in the germination of seeds, and their uses in biological washing products and in the food industry

3.4 Outline the use of microorganisms and fermenters to manufacture enzymes for use in biological washing powders

#### **4. Levels of organisation**

Modification of cell structure for specific functions

- define tissue and relate the structure of the following to their functions:

ciliated cells – in respiratory tract

root hair cells – absorption

xylem vessels – conduction and support

muscle cells – contraction

red blood cells – transport

- define organ and organ system

#### **5. Size of specimens**

- calculate magnification and size of biological specimens using millimetres as units.

- drawing cells.

#### **6. Movement in and out of cells**

6.1 Diffusion

6.2 Active Transport

- define diffusion as the movement of molecules from a region of their higher concentration to a region of their lower concentration down a concentration gradient

- describe the importance of gaseous and solute diffusion, and of water as a solvent

- define active transport and discuss its importance as an energy-consuming process by which substances are transported against a concentration gradient, e.g. ion uptake by root hairs and uptake of glucose by epithelial cells of villi

6.3 Osmosis - define osmosis as the passage of water molecules from a region of their higher concentration to a region of their lower concentration, through a partially permeable membrane

- describe the importance of osmosis on the uptake of water by plants, and its effects on plant and animal tissues

- understand the concept of a water potential gradient

## **TOPIC 2 PLANTS**

### **1. Plant Nutrition**

1.1 Define photosynthesis as the fundamental process by which plants manufacture simple sugars from raw materials fibre (roughage) water

- state the equation for the production of simple sugars and oxygen in words/chemical symbols
- describe the intake of the raw materials, the trapping and storing of energy (conversion of light energy into chemical energy), the formation of food substances and their subsequent storage

1.2 Define the term limiting factor and interpret (as limiting factors that affect photosynthesis) the effects of light intensity and carbon dioxide concentration

- explain the use of carbon dioxide enrichment, optimum light and optimum temperatures in greenhouse systems

1.3 Leaf structure - identify the cellular and tissue structure of a dicotyledonous leaf, as seen in cross-section, and demonstrate the significance of these features in terms of functions, i.e. distribution of chloroplasts – photosynthesis stomata and mesophyll cells – gaseous exchange vascular bundles (xylem and phloem) - transport

1.4 Mineral requirements - describe the importance of: nitrate ions for protein synthesis magnesium ions for chlorophyll synthesis

- describe the uses, and the dangers of overuse, of nitrogen fertilisers
- explain: the effects of nitrate ion and magnesium ion deficiency on plant growth

### **2. Transport in plants**

2.1 Water uptake

- identify root hair cells, as seen under the light microscope, and describe their functions
- describe the passage of water through root, stem and leaf

2.2 Transpiration - define transpiration

- describe: how water vapour loss is related to cell surfaces, air spaces and stomata the effects of variation of temperature, humidity and light intensity on transpiration rate how wilting occurs

- explain the mechanism of water uptake and movement in terms of transpiration producing a tension ('pull') from above, creating a water potential gradient in the xylem, drawing cohesive water molecules up the plant.

- discuss the adaptations of the leaf, stem and root to different environments, with emphasis on local examples.

2.3 Translocation - define translocation in terms of the movement of sucrose and amino acids from regions of production or of storage to regions of utilisation in respiration or growth

- describe translocation throughout the plant of applied chemicals, including systemic pesticides
- compare the role of transpiration and translocation in the transport of materials from sources to sinks, within plants at different seasons

### **3. Sexual reproduction in plants**

3.1 Understand sexual reproduction involves the fusion of two different gametes

3.2 Describe the structure and functions of the flower of a named dicotyledonous plant

3.3 Define pollination

- name the agents of pollination
- compare the different structural adaptations of insect-pollinated and wind-pollinated flowers
- describe: the growth of the pollen tube, and the process of fertilization; the formation of seed and fruit and the structure of a non-endospermic seed

3.4 Define dispersal of seeds and fruits

- describe seed and fruit dispersal by wind and by animals
- discuss the implications to a species of self-pollination and cross-pollination

## TOPIC 3 HOW ORGANISMS CHANGE

### **1. Evolution**

- 1.1 Describe four processes needed for the spontaneous origin of life on Earth.
- 1.2 Outline the experiments of Miller and Urey into the origin of organic compounds.
- 1.3 State that comets may have delivered organic compounds to Earth.
- 1.4 Discuss possible locations where conditions would have allowed the synthesis of organic compounds.
- 1.5 Outline two properties of RNA that would have allowed it to play a role in the origin of life.
- 1.6 State that living cells may have been preceded by protobionts, with an internal chemical environment different from their surroundings.
- 1.7 Outline the contribution of prokaryotes to the creation of an oxygen-rich atmosphere.
- 1.8 Discuss the endosymbiotic theory for the origin of eukaryotes.
- 1.9 Outline the process of adaptive radiation.
- 1.10 Compare convergent and divergent evolution.
- 1.11 Discuss ideas on the pace of evolution, including gradualism and punctuated equilibrium.
- 1.12 Describe one example of transient polymorphism.
- 1.13 Describe sickle-cell anemia as an example of balanced polymorphism.

### **2. Human evolution**

- 2.14 Outline the method for dating rocks and fossils using radioisotopes, with reference to  $^{14}\text{C}$  and  $^{40}\text{K}$ .
- 2.15 Describe the major anatomical features that define humans as primates.
- 2.16 Outline the trends illustrated by the fossils of *Ardipithecus ramidus*, *Australopithecus* including *A. afarensis* and *A. africanus*, and *Homo* including *H. habilis*, *H. erectus*, *H. neanderthalensis* and *H. sapiens*.
- 2.17 State that, at various stages in hominid evolution, several species may have coexisted.
- 2.18 Discuss the incompleteness of the fossil record and the resulting uncertainties about human evolution.
- 2.19 Discuss the correlation between the change in diet and increase in brain size during hominid evolution.
- 2.20 Distinguish between *genetic* and *cultural* evolution.
- 2.21 Discuss the relative importance of genetic and cultural evolution in the recent evolution of humans.

### **3. Selection and genetic engineering**

- 3.1 Selection - describe the role of artificial selection in the production of varieties of animals and plants with increased economic importance
  - define natural selection as the passing on of genes by the best adapted organisms
  - describe variation and state that competition leads to differential survival of, and reproduction by, those organisms best fitted to the environment
  - assess the importance of natural selection as a possible mechanism for evolution
  - describe the development of strains of antibiotic resistant bacteria as an example of natural selection
- 3.2 Genetic Engineering - define genetic engineering as taking a gene from one species and putting it into another species
  - explain why, and outline how human insulin genes were put into bacteria using genetic engineering