553 BIOLOGY

O-LEVEL 2006-2010

(May not be taken with 500 general science).

Introduction:

An experimental approach particularly to physiological work is expected. An understanding of controls is essential, together with the realization that when there are several variables they must be investigated one at a time. Where appropriate, quantitative experiments should be carried out. Practical work, both in and outside the laboratory is of great importance and one of its main educational values is the stimulation of interest in Biology. The importance of accuracy and detail in biological drawing and keeping other records should be emphasised.

Aims and Objectives:

(i) To initiate an interest in Biology.

(ii) To promote a wider knowledge and understanding of Biology than at the primary level.

(iii) To develop practical skills further.

(iv) To promote a scientific approach to biological problems, attempt to formulate hypothesis, carry out investigations, analyse results and draw conclusions.

(v) To initiate ability to present and interpret biological materials precisely e.g graphs, charts, photographs, labelled diagrams, lists, tables, maps etc.

(vi) To learn how to communicate biological information clearly.

(vii) To promote an understanding of the importance of Biology in every day life and the ways in which man influences his environment.

(viii) To promote the ability to apply the knowledge and understanding gained during the course to their everyday life situations.

(ix) To stimulate the pupil's ability to find out biological information for himself from text and reference books, investigations and life experiences.

(x) To make use of local materials and information whenever possible.

Notes on Examination.

Any section of the syllabus may be examined in any of the sections of the papers.

1. The practical examination is designed to test candidates for the following abilities:
    (a) To follow carefully a sequence of instructions within a set time allowance.
    (b) To use familiar and unfamiliar techniques in practicals. To record their observations and make deductions from them.
    (c) To observe and recognise features of familiar and unfamiliar biological specimens, record observations and make deductions about functions of whole specimens or their parts.
    (d) To make clear line drawing of the specimens provided, indicate magnification and to label familiar structures.
    (e) To interpret unfamiliar data and draw conclusions from their interpretations.
    (f) To employ manual skills in assembling apparatus, in using chemical reagents and in using such instruments as mounting needles, scalpels and razor blades, forceps and scissors, etc.
    (g) To observe reactions, read simple measuring instruments and perform simple arithmetic calculations.

2 The food tests expected are as follows: -

(a) Reducing sugars: Fehling's or Benedict's solutions.
(b) Non-reducing sugars: Fehling's or Benedict's solution after hydrolysis with dilute hydrochloric acid.
(c) Starch: Iodine solution.
(d) Fats: Ethanol emulsion test/grease spot.
(e) Protein: Millon's Reagent/Biuret test.
(f) Vitamin C: DCPIP (Dichloro- phenol-indo-phenol)

Examination Format:

There will be **two** papers.

Paper 1 (2 ½ hours)

This will consist of **three** sections: A, B and C.

Section A will consist of 30 *compulsory* multiple-choice questions.

(30 marks)

Section B will consist of **three** *compulsory*, structured questions.

(40 marks)

Section C will consist of **four** essay questions. Candidates will be required to answer **two** questions. (30 marks).

Paper 2 (2 hours)

This will consist of **three** compulsory questions. Questions may be set on interpretation of new/unfamiliar biological data, which may include photographs. **One** question will require carrying out laboratory practical procedures.

Any section of the syllabus may be examined in any of the sections of the papers.

Detailed syllabus:

1. Diversity of Living Things:

1.1 Classification: distinction between living and non-living things; classification of plants and animals into groups; use of simple identification keys; quantitative sampling and methods of collection.

1.2 External features and internal structures of the flowering plant: roots and root modifications, leaves and leaf modification; flowers, fruits and seeds.

1.3 External features, life cycles and economic importance of insects: house fly; cockroach; mosquitoes; bees; butterflies.

1.4 Hand lens and microscopes; magnification; examination of pond water, plant and animal cells, eg. leaf epidermal cells, check cells, spirogyra filaments, etc.; structure and functions of plants and animal cells.

2. Soil:.

2.1 Soil formation, composition and soil profiles.

2.2 Physical and chemical properties of soils: importance of air and water; capillarity, porosity and drainage ;water-retaining properties of clay and humus, flocculation of clay and soil pH; inorganic plant nutrients and water culture experiments, (See Section 3.4 note (b))

2.3 Soil erosion and its causes, effects and prevention; farming practices: shifting cultivation, mixed farming, crop rotation and mulching; fertilizers.

2.4 Soil micro-organisms; the role of bacteria in soil fertility; nitrogen cycle, carbon cycle.

3. Nutrition in Plants and Animals:

3.1 Nutrient compounds: Carbohydrates, proteins, fats, vitamins, and minerals; importance of water; tests for reducing and non reducing sugars, starch, fats and proteins; deficiency diseases of proteins (Kwashiorkor), vitamins and minerals in man; digestive and other enzymes and their properties as organic catalysts; e.g. their specificity, sensitivity to temperature, and pH.

.

3.2 Nutrition in animals: feeding methods in Amoeba, insects, toad or frog, birds and mammalian herbivores, carnivores and omnivores; structure and shape of mammalian teeth related to feeding; dental formulae of man, dog and cow or sheep; care of teeth in man, the alimentary tract in a mammal, including man; the function of a caecum and rumen in herbivores; ingestion, digestion, absorption and assimilation; egestion.

3.3 Structure and nutrition of a common mould (Mucor or Rhizopus)

3.4 Nutrition in green plants, the process and rate of photosynthesis; the form and internal structure of leaves in relation to photosynthesis; mineral nutrition.

Note:

(a) Experiments should be performed to show the necessity of light, carbon dioxide and chlorophyll and the formation of starch and oxygen.

(b) Experiments to show the importance of major plant nutrient elements, using water or sand cultures, should be performed (See also section 2.2).

4. Transport of Materials in Plants and Animals:

4.1 Transport of materials in animals: the necessity of a transport system in multi-cellular animals; the circulatory system of a mammal; the structure and function of the mammalian heart, arteries, veins and capillaries including diffusion through capillary walls; composition and functions of blood; structure and function of blood cells; phagocytosis, anti-bodies and clotting of blood; immunisation; lymphatic drainage and elephantiasis.

4.2 Transport of materials in higher plants: diffusion, osmosis and selective permeability; uptake of water and mineral salts; water loss, transpiration steam, turgor and rigidity in plants; environmental conditions and rate of transpiration; transport of products of photosynthesis.

4.3 Food storage: the liver; food storage organs in plants including vegetative structures and seeds.

5. Respiration in Plants and Animals:

5.1 Gaseous exchange: breathing mechanisms in insects (e.g. locust or grasshopper), bony fish, amphibians (tadpole and toad or frog) and mammals, including artificial respiration in man; gaseous exchange in the lungs of a mammal and gas analysis experiments; gaseous exchange in plants; diurnal variation of carbon dioxide in plant environment, including effect of light and darkness on this variation; gaseous relationship between aquatic plants and animals.

5.2 Tissue respiration: chemical oxidation of food and resulting release of energy in cells; anaerobic respiration in muscles; yeast fermentation.

Note: Experiments should be carried out to demonstrate gaseous exchange and production of heat

6. Excretion:

Structure and function of the mammalian skin and kidney; water and heat loss and temperature control in the mammal: water and salt balance, including osmo-regulation in the mammal; urea formation and elimination; role of the mammalian lungs and liver in the regulation of the internal environment; gaseous exchange in flowering plants (See also section 5.1).

7. Co-ordination:

7.1 Tropisms in plants; experiments on phototropism and geotropism in shoots, and geotropism in roots should be performed.

7.2 Control of response in plants: the hormone (auxin) explanation; the effects of decapitating the coleoptiles of germinating cereals and applying indole-acetic acid (IAA) should be demonstrated.

7.3 Tactic responses to light, water and contact exhibited by invertebrates; simple experiments on responses should be performed, e.g. with earth worms, woodlice, blowfly larvae, ants and termites

7.4 The control of response in animals: endocrine organs and hormones; location of the organs in the human body and the function of their secretions; reference should be made to insulin, adrenaline, thyroxin, sex hormones and pituitrine.

7.5 The nervous system: the mammalian nervous system; structure of a nerve cell (neuron); synapses; reflex arcs; simple and conditioned reflexes; gross structure of the brain and spinal cord of a mammal related simply to function.

7.6 Receptor organs: in the skin; the eye; structure and function, accommodation correction of long sight and short sight; the ear: structure and function, hearing and balance.

8. Growth and Development in Plants and Animals:

8.1 Increase in size: apical regions of growth in stems and roots; cell division (mitosis).

8.2 Change of form: structure and germination of a named cereal grain and at

least one other named type of seed; metamorphosis in insects (See also section1.3)

9. Locomotion in Animals

9.1 Locomotion in an insect. e.g. locust or grasshopper; action of muscles on the exoskeleton.

9.2 Locomotion in a bony fish; action of muscle blocks on either side of the body.

9.3 Flight in birds: adaptations to flight; structure and functions of feathers.

9.4 Locomotion in a mammal: the axial and appendicular skeleton; the way muscles act on the bones to cause movement.

Note: (a) A vertebra should be regarded as being composed of a body (centrum) carrying arches, neural spine and transverse processes with facets for articulation.

(b) A functional treatment of the skeleton: different types of joints illustrated by shoulder or hip, elbow or knee.

10 Reproduction in Plants and Animals

10.1 Asexual reproduction: in Ameoba, in Mucor or Rhizopus; in spirogyra; vegetative reproduction in flowering plants.

10.2 Sexual reproduction in plants: spirogyra, Mucor or Rhizopus structure and function of flowers; pollination; fertilisation; ovarian development of fruit and seeds; dispersal of fruits and seed.

10.3 Sexual reproduction in animals: an insect e.g. locusts or grasshopper, an oviparous bony fish; an amphibian, e.g. toad or frog; a bird; mammal, including man.

Note: Breeding habits of these animals should be considered together with the parental care of the young organisms. A simple study of the structure and function of the male and female reproductive organs in a mammal, together with general outline of the development, nutrition, respiration and birth of the embryo is expected.

11. Genetics and evolution

11.1 Variation with in plant and animal species.

Note: Candidates should be aware of genetic and environmental causal factors, and reference should be made to some human characters such as skin colour, sickle cell, tongue rolling and height.

11.2 Monohybrid inheritance

Monohybrid crosses to illustrate complete and incomplete dominance should be studied.

Note: Several examples to illustrate complete and incomplete dominance should include some involving human characters such as Albinism and the A, B, O blood groups.

Reference should be made to the pioneer work of Mendel, Darwin and Morgan.

11.3 Chromosomes and genes

Note: A mention of Chromosomes, genes and DNA without details of structure : Mitosis (see also section 8.1) and Meiosis without details of stages. Chromosomes and sex determination in man. A simple treatment of mutation as a change in chromosome or a gene and Natural Selection should be carried out. The role of variations as the raw material upon which Natural Selection operates to produce evolutionary change should be emphasised. Candidates should be familiar with practical work on variation in relation to plant and animal breeding.

12. Interrelationships

12.1 Food chains: food chains and webs; producers consumers and decomposers; biomass and pyramid of numbers.

12.2 Changes in population: factors affecting population size; control of microbial growth, e.g. temperature, sterilisation, ant-septics; oral hygiene and food spoilage; predator-prey relationships, competition, adaptation and survival; colonisation of habitats and succession by plants and animals; carrying capacity in a habitat;

human population growth; birth rate, death rate and projections for future growth and change.

12.3 Parasitism and symbiosis: feeding habits and host-parasite balance in stomach worms; control of parasite life cycle in relation to tape worm, ticks, tomato blight fungus, malarial parasite and Tryponosoma, Nitrogen-fixing bacteria in root nodules and cellulose-digesting bacteria in the gut of ruminants.

12.4 Man and natural environment: Man's interference with the environment; the importance and conservation water, air, land, forests and wild life; pollution of the environment and control of atmosphere pollutants.