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Syllabus

London Examinations GCE Ordinary Level
Biology (7040) May/June 2006 & January 2007

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Biology 7040

This subject may be taken at both the May/June and January examinations.

There will be a revised syllabus for first examination in June 2007.

Aims

The syllabus aims to:

1. develop an understanding of essential biological principles based upon an elementary knowledge of living organisms
2. provide a balanced view of modern biology in order to develop a contemporary outlook on the subject
3. recognise the inter-relationships between various areas of biology and, in particular, the relationship between structure and function
4. enable candidates to make accurate observations of living material and preparations
5. enable candidates to assess and interpret simple biological experiments and data
6. recognise the value of experimental skills in the study of biology
7. develop a working knowledge of those portions of chemistry, physics and mathematics which are necessary for a proper understanding of biology at this level
8. recognise the social and economic implications of biology
9. encourage a respect for living organisms.

Objectives

The examination will be designed to test candidates in the following areas in relation to biology.

Candidates should be able to:

(a) demonstrate a knowledge of the topics listed in the syllabus

(b) demonstrate a knowledge and understanding of essential biological principles related to living organisms and their environments including the personal, social, economic and technological applications of biology in modern society

(c) use appropriate terminology in demonstrating this knowledge

(d) demonstrate knowledge and understanding of appropriate practical techniques and safety precautions

(e) interpret data presented in the form of tables, charts, graphs, diagrams and photographs

(f) apply elementary mathematics, chemistry and physics to biology

(g) communicate a knowledge and understanding of biology through the media of tables, charts, graphs, diagrams and concise logical prose

(h) apply knowledge of biology to the design and evaluation of experiments and the solution of problems including those of a personal, social, economic and technological nature

(i) select and organise information relevant to particular ideas in biology and to communicate this selected and organised knowledge coherently.

The Examination

The examination will consist of two written papers each of which carries 50% of the total marks.

Paper	Description	Duration	Weighting	Maximum marks
1	Written – structured Questions and essays	2 hours	50%	100
2	Written – structured Questions (short and long)	1½ hours	50%	100

Paper 1 – 2 hours, maximum of 100 marks, 50% weighting

This paper will consist of two sections and questions may be drawn from any part of the syllabus.

Section A (25 marks) – This section will consist of one or two compulsory structured questions. The questions may be of an interpretative nature involving the analysis of data, or the evaluation of an investigation, or they may require the interpretation of a passage relating to an unfamiliar biological situation or they may be designed to test candidates' *experience* of practical skills.

Section B (75 marks) – This section will consist of structured essays intended to test depth of knowledge and understanding of topics in the syllabus. Candidates will be expected to answer three questions from a choice of five questions. Each question will carry 25 marks.

Paper 2 – 1½ hours, maximum of 100 marks, 50% weighting

This paper will consist of a number of compulsory short and longer structured questions. The questions will be designed to test breadth of knowledge and understanding of all sections of the syllabus and to test a range of skills. The questions may refer to or require the use of photographs, diagrams, graphs and data, and candidates may be asked to perform simple calculations. Some questions may test the application of knowledge and principles described in the syllabus to a wider range of biological situations.

Specification for the examination

Content

The distribution of syllabus content in the combined papers will be approximately as follows

Syllabus Section	Approximate mark allocation
1	20%
2	60%

3	20%

The balance will be approximately similar in each paper.

Reference to topics related to the personal, social, economic and technological applications of biology in modern society should be made in teaching any part of the syllabus and will be tested in the examination.

Assessment Objectives

The allocation of marks for the whole examination will be approximately as follows.

Assessment Objectives	Approximate mark allocation
Knowledge	40%
Comprehension	30%
Analysis, Application, Evaluation	30%

Required background in mathematics and other sciences

Candidates are expected to be familiar with the following terms and concepts in mathematics, chemistry and physics and to be able to use and apply them in their study of this biology syllabus: decimals, fractions, percentages, ratios, means; tabulated data; graphs (line, bar, histograms), pie charts, linear scales; solids, liquids, gases; elements, ions, salts; acids, alkalis, pH; composition of air; oxidation, combustion; solubility; diffusion (including osmosis), diffusion gradients; heat transfer by conduction, convection and radiation; insulation; temperature, humidity, evaporation; different forms of energy: light, heat, chemical, electrical; the use of energy in movement.

Syllabus Content

1. VARIETY AND NATURE OF LIVING ORGANISMS

(a) Variety of Living Organisms

A study of a range of organisms to illustrate the variety of life, and their economic importance where appropriate.

a virus

Outline structure; replication within the host cell.

a bacterial cell

Outline structure as *a simple unit of life. Importance of bacteria in the recycling of carbon and nitrogen. One human disease caused by bacteria and its transmission.*

Chlorella (a unicellular alga), a yeast cell and *Amoeba* (a free-living protozoan)

Structure and functions to illustrate the concept of simple cells carrying out all the activities of life. Details of reproduction not required. Economic importance of yeast.

Plasmodium (malarial parasite)

Principles of parasitism; effects on the human host; transmission; control of the insect vector. Details of life cycle not required.

a mould fungus

Mycelial structure and life cycle including an outline of asexual reproduction in relation to survival and dispersal; saprophytic nutrition and its economic importance. Details of sexual reproduction not required.

a monocotyledonous plant

External features of a cereal plant. Details of flower structure not required. Economic importance of cereal crops.

a herbaceous leguminous plant

Externally visible structure of stem, root, leaves and flower.

a dipteran fly

External characteristics common to all insects; life cycle to demonstrate the principle of metamorphosis.

Economic importance of insects in general.

a rat

Structural characters common to mammals including internal features. Economic importance.

(b) Nature of Living Organisms

Characteristics common to all living organisms. Cellular nature of organisms. Differences between plant and animal cells.

Basic structure and functions of generalised plant cell and a generalised animal cell and the differences between them.

Problems of increased size in multicellular organisms in relation to the surface area to volume ratio. Concept of division of labour in multicellular organisms. Details of structure of different cells not required unless specified in the sections below.

Movement of substances in and out of cells: diffusion, osmosis; active transport. The importance of osmoregulation.

Simple understanding of osmosis in terms of diffusion of water molecules from a dilute solution to a more concentrated solution through a differentially permeable membrane.

Simple experiments to demonstrate osmosis.

Composition and properties of carbohydrates, lipids and proteins. Their importance as energy sources, food stores and structural materials.

The importance of water to living organisms.

Composition should include a knowledge of elements present. An appreciation of monosaccharides, fatty acids and amino acids as structural components of polysaccharides, lipids and proteins respectively. One chemical test for each of the following: reducing sugar; starch, lipid and protein.

General characteristics of enzymes and their role in metabolic reactions.

Simple controlled experiments with a suitable enzyme to illustrate the activities and properties of enzymes.

2 FUNCTIONING OF LIVING ORGANISMS

Unspecified reference to animal structure and function may be assumed to refer to humans; similarly, reference to unspecified plants may be assumed to refer to flowering plants.

(a) Nutrition

(i) Plant nutrition

Nature of photosynthesis and its importance in conversion of light energy to chemical energy. Factors affecting photosynthesis.

Morphology and anatomy of a leaf in relation to photosynthesis.

Fate of carbohydrate products in the plant. Mineral salt requirements.

A simple treatment of photosynthesis (reference to light and dark reaction is not required). Simple controlled experiments to demonstrate the evolution of oxygen and the need for chlorophyll, light and carbon dioxide.

An appreciation that external factors may affect the rate of photosynthesis. The need for mineral elements with particular reference to the functions of nitrogen, phosphorus and magnesium.

(ii) Animal nutrition

Ingestion, digestion, absorption, assimilation, egestion. Feeding methods of *Amoeba.*

Human food requirements; structure and function of the human gut.

Adaptations of a sheep as a herbivorous mammal to cellulose digestion.

Food requirements of humans to include carbohydrates, lipids and proteins, vitamins and mineral salts. Sources and functions of Vitamins A, C and D. Sources and functions of calcium, phosphorus and iron.

The basic structure of the human gut and its associated glands.

The sequence of digestive processes through the human gut mediated by the various digestive enzymes and secretions. Absorption through the gut wall by diffusion and active uptake.

The adaptations of a sheep as a herbivorous mammal to its diet, restricted to teeth, relative proportions of the gut and the gut flora (an example of mutualism) associated with cellulose digestion.

(b) Respiration

Aerobic and anaerobic respiration.

A simple treatment of respiration with emphasis on the comparative release of energy in the form of ATP from aerobic and anaerobic respiration.

Reference in anaerobic respiration to lactic acid production in muscles, and ethanol and carbon dioxide release in yeast.

Simple controlled experiments to demonstrate the evolution of carbon dioxide and heat from the respiration of yeast, germinating seeds and small animals.

Gaseous exchange in *Amoeba*, in a human and in a leaf of a flowering plant.

Importance of diffusion in gaseous exchange.

Ventilation of the human lungs.

(c) Transport

The need for transport systems in multicellular organisms.

(i) Flowering plants

Absorption and transport of water and mineral ions in the xylem.

Transport of sucrose and amino acids in the phloem.

The osmotic uptake of water and a simple appreciation of active uptake of mineral ions by root hairs.

An understanding of the relationship between transpiration and the transpiration stream. Factors affecting transpiration rate with appropriate experiments. The internal structure of stems and roots to show distribution of xylem and phloem. (Cellular detail not required.)

(ii) Humans

The structure and functions of the circulatory system.

Blood, tissue fluid and lymph.

General plan of the human circulatory system with the names of the blood vessels to and from the heart, lungs, liver and kidney. Structure and action of the heart (no histological details required). Variation of heart beat rate under different conditions. Structure and function of arteries, veins and capillaries and the variation of blood pressure within them. Structure and function of blood components. Tissue fluid as a medium for diffusion between blood and body cells.

(d) Excretion

The origins and elimination of the waste products of flowering plants and of humans.

The kidney in humans as a major organ for excretion and osmoregulation.

The excretory functions of the skin and lungs.

Carbon dioxide, oxygen and water as waste products of plant cells and their route to the exterior.

The origins of waste products in humans; urea from proteins, carbon dioxide from respiration.

Structure of the human urinary system and of the kidney, including nephrons and associated blood vessels. The filtration process; reabsorption of glucose and regulation of ion and water content of blood. The major constituents of urine.

(e) Coordination

Response to stimuli in plants; positive phototropism of stems; geotropism of roots and stems. Experiments with suitable controls to demonstrate these tropisms.

A knowledge of auxins and an understanding of the mechanisms is restricted to positive phototropism in stems.

Response to stimuli in humans involving hormonal and nervous coordination.

Positions of the following endocrine organs: pituitary, pancreas, adrenals, ovaries and testes.

Feedback control in relation to blood-glucose level and female reproductive hormones.

The role of insulin and glucagon in the control of blood-glucose level.

The effects of adrenaline.

The structure and function of the eye as a receptor.

The structure of the retina is not required.

The structure and function of the skin as a receptor; its role in temperature regulation.

The central nervous system. The structure and function of the following parts of the brain: the cerebral hemispheres, including the position of the sight centres, the cerebellum and the medulla oblongata.

Transmission of impulses by neurones.

The neurones of the reflex arc involved in the reflex withdrawal of the hand.

The spinal cord and associated spinal nerves.

Structure of neurones in reflex arc. Details of impulse transmission not required.

Movement at the elbow joint controlled by nervous stimulation of antagonistic muscles. Details of the elbow joint.

(f) Reproduction and Genetics

Differences between sexual and asexual reproduction, their advantages and disadvantages.

(i) Asexual reproduction

The cloning of plants of economic importance. Principles of tissue culturing.

(ii) Sexual reproduction

The structure of a leguminous insect-pollinated flower; pollination, fertilisation, seed and fruit formation and dispersal, seed structure; germination and the conditions necessary for germination to occur.

Differences between wind-pollinated and insect-pollinated flowers.

Any leguminous insect-pollinated flower may be chosen for the study of sexual reproduction.

Structure and function of male and female reproductive systems in humans; menstrual cycle, copulation, fertilisation, nutrition and protection of the embryo, birth and parental care. Roles of FSH, luteinising hormone, oestrogen and progesterone in the menstrual cycle, of oestrogen and progesterone in pregnancy, and of oestrogen in the development of female secondary sexual characteristics. Roles of testosterone in sperm production and the development of male secondary sexual characteristics.

In the study of the nutrition and protection of the human embryo anatomical details of the extra-embryonic membranes are not required.

(iii) Genetics

Nuclei containing chromosomes. Chromosomes as the sites of DNA. A gene as a section of DNA controlling an identifiable characteristic. Alleles as alternative forms of a gene.

Mitosis to show only exact duplication of genetic material and meiosis to show only halving of chromosome number by separation and independent assortment of chromosomes of each pair.

Diploid and haploid nuclei. Fusion of gametes. Variation as a result of independent assortment and random fertilisation. Monohybrid cross, dominant and recessive alleles. Codominance. Phenotypes and genotypes, homozygous and heterozygous genotypes.

Inherited and non-inherited variation.

Sex determination in humans.

Mutation.

An appreciation of the principles and potential applications of genetic engineering.

A knowledge of nucleic acids and the structure of DNA not required.

Consideration of mitosis and meiosis confined to an understanding of the significance of these processes and the sites where they occur in flowering plants and humans. The separate stages of mitosis and meiosis and a knowledge of crossing over and recombination are not required.

Monohybrid ratios illustrated by simple breeding experiments with a quantitative treatment of the results.

The recessive backcross related to the monohybrid experiment.

An awareness of variation within a species and recognition that not all variation is inherited.

3. ENVIRONMENTAL BIOLOGY AND HUMAN ACTIVITIES

A study of the inter-relationships between organisms and between organisms and the environment. Consideration of the effects of human activities on the environment and the use by humans of biological resources; the social and economic implications where appropriate.

(a) Environmental Biology

Understanding of the terms ecosystem, habitat, community and population.

Study of a local ecosystem.

Pyramids of number and of biomass.

Trophic levels; consumers (including scavengers), decomposers (saprophytes); the transfer of substances along food chains and food webs (including the fate of detritus).

Competition within the community.

Energy flow through an ecosystem.

The fate of light falling on the green parts of plants; the various ways energy is transformed and explanation of why only 10% is transferred from one trophic level to the next. Understanding of quantitative examples from food chains and food webs.

Carbon, nitrogen and water cycles.

(b) Damage to ecosystems by human activity

Land use for agriculture and loss by urbanisation.

Harmful effects of human activity.

Deforestation leading to leaching, soil erosion, disturbance of the water cycle and of the balance in atmospheric oxygen and carbon dioxide; desertification resulting from overcultivation, overgrazing, deforestation and population explosion; over-fishing leading to depletion of fish stocks; examples of loss of species by habitat destruction.

Pollution of air, water and land.

Specific examples of pollutants and their effects.

(c) Use of biological resources

Principles and uses of genetic engineering.

The use of enzymes to cut and join gene DNA and vector DNA to form recombinant DNA; the use of plasmids and viruses as vectors to insert recombinant DNA into cells. Production of human insulin by genetically engineered bacteria.

Outline of a process for the production of single-cell protein.

Outline of the processes in which yeast is used for bread-making, beer and wine production.

Importance of cereal crops as a world food source; fish-farming as a source of animal protein.

Biological control of pests; principles, its use and implications.

Three examples required.

Resources for teachers

Chief Examiner's comments

The mark scheme with examiners' report including the Chief Examiner's comments, is issued to centres after each examination session and can also be found on the Edexcel International

website www.edexcel-international.org . It is also available from Edexcel International Publications.

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