BIOLOGY 0610
IGCSE
FOR EXAMINATION IN 2008

Exclusions

This syllabus must not be offered in the same session with any of the following syllabuses:

0653 Combined Science
0654 Co-ordinated Sciences (Double)
5090 Biology
5096 Human and Social Biology
5125 Science (Physics, Biology)
5126 Science (Chemistry, Biology)
5129 Combined Science
5130 Additional Combined Science

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Biology

Syllabus code: 0610

CONTENTS

NOTES

Attention is drawn to alterations in the syllabus by black vertical lines on either side of the text.

Conventions (e.g. signs, symbols, terminology and nomenclature)
Syllabuses and question papers will conform with generally accepted international practice, in particular, attention is drawn to the following documents, published in the UK, that will be used as guidelines:

(a) Reports produced by the Association for Science Education (ASE):
SI Units, Signs, Symbols and Abbreviations (1981),
Chemical Nomenclature, Symbols and Terminology for use in School Science (1985),
Signs, Symbols and Systematics: The ASE Companion to 5-16 Science (1995).

(b) Report produced by the Institute of Biology (in association with the ASE):
Biological Nomenclature, Standard terms and expressions used in the teaching of biology (2000).

It is intended that, in order to avoid difficulties arising out of the use of l as the symbol for litre, usage of dm^3 in place of l or litre will be made.

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INTRODUCTION

International General Certificate of Secondary Education (IGCSE) syllabuses are designed as two-year courses for examination at age 16-plus.

All IGCSE syllabuses follow a general pattern. The main sections are:

Aims
Assessment Objectives
Assessment
Curriculum Content.

The IGCSE subjects have been categorised into groups, subjects within each group having similar Aims and Assessment Objectives.

Biology falls into Group III, Science, of the International Certificate of Education (ICE) subjects together with Agriculture, Chemistry, Combined Science, Co-ordinated Sciences (Double Award), Natural Economy, Physical Sciences and Physics.

AIMS

The aims of the syllabus are the same for all students. These are set out below and describe the educational purposes of a course in Biology for the IGCSE examination. They are not listed in order of priority.

The aims are to:

1. provide, through well designed studies of experimental and practical science, a worthwhile educational experience for all students, whether or not they go on to study science beyond this level and, in particular, to enable them to acquire sufficient understanding and knowledge to
   1.1 become confident citizens in a technological world, to take or develop an informed interest in matters of scientific import;
   1.2 recognise the usefulness, and limitations, of scientific method and to appreciate its applicability in other disciplines and in everyday life;
   1.3 be suitably prepared for studies beyond the IGCSE level in pure sciences, in applied sciences or in science-dependent vocational courses.
2. develop abilities and skills that
   2.1 are relevant to the study and practice of Biology;
   2.2 are useful in everyday life;
   2.3 encourage efficient and safe practice;
   2.4 encourage effective communication.
3. develop attitudes relevant to Biology such as
   3.1 concern for accuracy and precision;
   3.2 objectivity;
   3.3 integrity;
   3.4 enquiry;
   3.5 initiative;
   3.6 inventiveness.
4. stimulate interest in, and care for, the environment.

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5. promote an awareness that
   5.1 scientific theories and methods have developed, and continue to do so, as a result of the co-operative activities of groups and individuals;
   5.2 the study and practice of science is subject to social, economic, technological, ethical and cultural influences and limitations;
   5.3 the applications of science may be both beneficial and detrimental to the individual, the community and the environment;
   5.4 science transcends national boundaries and that the language of science, correctly and rigorously applied, is universal.

IGCSE Biology places considerable emphasis on understanding and use of scientific ideas and principles in a variety of situations, including those which are well-known to the learner and those which are new to them. It is anticipated that programmes of study based on this syllabus will feature a variety of learning experiences designed to enhance the development of skill and comprehension. This approach will focus teachers and learners on development of transferable life-long skills relevant to the increasingly technological environment in which people find themselves. It will also prepare candidates for an assessment that will, within familiar and unfamiliar contexts, test expertise, understanding and insight.

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ASSESSMENT OBJECTIVES

The three assessment objectives in Biology are:

A Knowledge with understanding

B Handling information and solving problems

C Experimental skills and investigations

A description of each Assessment Objective follows.

A KNOWLEDGE WITH UNDERSTANDING

Students should be able to demonstrate knowledge and understanding in relation to:

1. scientific phenomena, facts, laws, definitions, concepts, theories;
2. scientific vocabulary, terminology, conventions (including symbols, quantities and units);
3. scientific instruments and apparatus, including techniques of operation and aspects of safety;
4. scientific quantities and their determination;
5. scientific and technological applications with their social, economic and environmental implications.

The subject content defines the factual material that candidates may need to recall and explain. Questions testing these objectives will often begin with one of the following words: *define, state, describe, explain (using your knowledge and understanding)* or *outline.* (See the glossary of terms at the back of this syllabus.)

B HANDLING INFORMATION AND SOLVING PROBLEMS

Students should be able, using oral, written, symbolic, graphical and numerical forms of presentation, to:

1. locate, select, organise and present information from a variety of sources;
2. translate information from one form to another;
3. manipulate numerical and other data;
4. use information to identify patterns, report trends and draw inferences;
5. present reasoned explanations of phenomena, patterns and relationships;
6. make predictions and propose hypotheses;
7. solve problems, including some of a quantitative nature.

These assessment objectives cannot be precisely specified in the subject content because questions testing such skills may be based on information that is unfamiliar to the candidate. In answering such questions, candidates are required to use principles and concepts that are within the syllabus and apply them in a logical, reasoned or deductive manner to a novel situation. Questions testing these objectives will often begin with one of the following words: *discuss, predict, suggest, calculate, explain (give reasoned explanations and explain the processes of using information and solving problems)* or *determine.* (See the glossary of terms at the back of this syllabus.)

C EXPERIMENTAL SKILLS AND INVESTIGATIONS

Students should be able to:

1. use techniques, apparatus, and materials (including the following of a sequence of instructions, where appropriate);
2. make and record observations and measurements;
3. interpret and evaluate experimental observations and data;
4. plan and carry out investigations, evaluate methods and suggest possible improvements (including the selection of techniques, apparatus and materials).

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SPECIFICATION GRID

The approximate weightings allocated to each of the assessment objectives in the assessment model are summarised in the table below.

Assessment Objective	**Weighting**
A Knowledge with understanding	50% (not more than 25% recall)
B Handling information and solving problems	30%
C Experimental skills and investigations	20%

Teachers should take note that there is an equal weighting of 50% for skills (including handling information, solving problems, practical, experimental and investigative skills) and for knowledge and understanding. Teacher's schemes of work, and the sequence of learning activities should reflect this balance, so that the aims of the syllabus may be met, and the candidates prepared for the assessment.

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ASSESSMENT

All candidates must enter for three Papers. These will be Paper 1, one from either Paper 2 or Paper 3, and one from Papers 4, 5 or 6.

Candidates who have only studied the Core curriculum or who are expected to achieve a grade D or below should normally be entered for Paper 2. Candidates who have studied the Extended curriculum and who are expected to achieve a grade C or above should be entered for Paper 3.

All candidates must take a practical paper, chosen from Paper 4 (School-based Assessment of Practical Skills), or Paper 5 (Practical Test), or Paper 6 (Alternative to Practical).

Core curriculum Grades C to G available	*Extended curriculum* Grades A* to G available
Paper 1 (45 minutes) **Compulsory** A multiple-choice paper consisting of forty items of the four-choice type. The questions will be based on the Core curriculum, will be of a difficulty appropriate to grades C to G, and will test skills mainly in Assessment Objectives A and B. This paper will be weighted at 30% of the final total available marks.	
Either: **Paper 2** (1 hour 15 minutes) Core theory paper consisting of 80 marks of short-answer and structured questions. The questions will be of a difficulty appropriate to grades C to G and will test skills mainly in Assessment Objectives A and B. The questions will be based on the Core curriculum. This Paper will be weighted at 50% of the final total available marks.	**Or:** **Paper 3** (1 hour 15 minutes) Extended theory paper consisting of 80 marks of short-answer and structured questions. The questions will be of a difficulty appropriate to the higher grades and will test skills mainly in Assessment Objectives A and B. A quarter of the marks available will be based on Core material and the remainder on the Supplement. This Paper will be weighted at 50% of the final total available marks.
Practical Assessment **Compulsory** The purpose of this component is to test appropriate skills in assessment Objective C. Candidates will not be required to use knowledge outside the Core curriculum. Candidates must be entered for one of the following: **Either: Paper 4** Coursework (school-based assessment of practical skills)* **Or: Paper 5** Practical Test (1 hour 15 minutes), with questions covering experimental and observational skills. **Or: Paper 6** Alternative to Practical Paper (1 hour). This is a written paper designed to test familiarity with laboratory based procedures. The practical assessment will be weighted at 20% of the final total available marks.	

*Teachers may not undertake school-based assessment without the written approval of CIE. This will only be given to teachers who satisfy CIE requirements concerning moderation and they will have to undergo special training in assessment before entering candidates. CIE offers schools in-service training in the form of occasional face-to-face courses held in countries where there is a need, and also through the IGCSE Coursework Training Handbook, available from CIE Publications.

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Detailed notes on coursework regulations appear in the Assessment Criteria for Practicals section in this syllabus and in the Distance Training Pack.

Weighting of papers

<table>
<tr><td>Core curriculum</td><td>Extended curriculum</td></tr>
<tr><td colspan="2">Paper 1 30%</td></tr>
<tr><td>Paper 2 50%</td><td>Paper 3 50%</td></tr>
<tr><td colspan="2">Practical assessment
Paper 4 or Paper 5 or Paper 6 20%</td></tr>
</table>

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CURRICULUM CONTENT

NOTE:

1. The curriculum content outlined below is designed to provide guidance to teachers as to what will be assessed in the overall evaluation of the student. Throughout the course, attention should be drawn to the relevance of the concepts to the student's everyday life and to the natural and man-made world. The specified content of the syllabus has been limited in order to encourage this approach and to permit flexibility in teaching programmes. On the CIE Teacher Support website, there is a scheme of work that is available for teachers who do not wish to devise their own.

   Contact international@ucles.org.uk for details of how to access the CIE Teacher Support website.
2. The content is set out in three columns. The main topic areas and concepts are indicated in the left-hand column. The centre column provides amplification of the core topics, which all students are to study. Topics in the right-hand column are supplementary and should be studied by students following the extended curriculum.
3. Students will be expected to give biologically correct definitions of any of the terms printed in italic.

TOPIC/CONCEPT	CORE	SUPPLEMENT
	All students should be able to:	In addition to what is required in the Core, students taking the Extended paper should be able to:
SECTION I – CHARACTERISTICS AND CLASSIFICATION OF LIVING ORGANISMS (5% of teaching time)		
1. Characteristics of living organisms	- list and describe the characteristics of living organisms - define the terms *nutrition, excretion, respiration, sensitivity, reproduction, growth and movement*	
2. Classification and diversity of living organisms		
2.1 Concept and use of a classificatory system	- define and describe the *binomial system* of naming species and classify the five main classes of vertebrates using visible, external characteristic features only	- list the main features used in the classification of the following groups: viruses, bacteria and fungi, and their adaptation to the environment, as appropriate
2.2 Adaptations of organisms to their environment, to be illustrated by examples wherever possible	- list the main features used in the classification of the following groups: flowering plants (monocotyledons and dicotyledons), arthropods (insects, crustaceans, arachnids and myriapods), annelids, nematodes and molluscs, using visible, external characteristic features only	
3. Simple keys	- use simple dichotomous keys based on easily identifiable features	
SECTION II – ORGANISATION AND MAINTENANCE OF THE ORGANISM (50% of teaching time)		
1. 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

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TOPIC/CONCEPT		CORE	SUPPLEMENT
2.	**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*, as illustrated by examples covered in Sections II and III	
3.	**Size of specimens**	- calculate magnification and size of biological specimens using millimetres as units.	
4.	**Movement in and out of cells**		
4.1	Diffusion	- 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	
4.2	Active Transport		- 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
4.3	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
5.	**Enzymes**	- define the term catalyst - define *enzymes* as proteins that function as biological catalysts - describe the effect of changes in temperature and pH on enzyme activity	- describe the role of enzymes in the germination of seeds, and their uses in biological washing products and in the food industry - outline the use of microorganisms and fermenters to manufacture enzymes for use in biological washing powders
6.	**Nutrition**	- define *nutrition* as the obtaining of organic substances and mineral ions from which organisms obtain their energy and their raw materials for growth and tissue repair	
6.1	Nutrients	- list the chemical elements that make up: carbohydrates fats proteins - 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 - describe tests for: starch (iodine solution) reducing sugars (Benedict's solution) protein (biuret test) fats (ethanol) - list the principal sources of, and describe the importance of: carbohydrates fats proteins vitamins (C and D only) mineral salts (calcium and iron only)	- describe the use of microorganisms in the food industry, with reference to yoghurt, bread and single cell protein - describe the uses, benefits and health hazards associated with food additives, including colourings

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TOPIC/CONCEPT		CORE	SUPPLEMENT
		fibre (roughage) water - describe the deficiency symptoms for: vitamins (C and D only) mineral salts (calcium and iron only)	
6.2	Plant nutrition Photosynthesis as the fundamental process by which plants manufacture simple sugars from raw materials		
6.2.1	Photosynthesis	- define *photosynthesis* and state the equation for the production of simple sugars and oxygen in words - 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	- state the equation for photosynthesis in symbols - 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
6.2.2	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	
6.2.3	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
6.3	Animal nutrition Diet as a balance between food intake and energy, growth and health requirements		
6.3.1	Diet	- understand the concept of a *balanced diet* - describe: a balanced diet related to age, sex and activity of an individual the effects of malnutrition in relation to starvation, coronary heart disease, constipation and obesity the effects of alcohol and the dangers of its misuse	- discuss: the problems of world food supplies the problems which contribute to famine (unequal distribution of food, drought and flooding and increasing population)
6.3.2	Human alimentary canal	- identify the gross structure of the alimentary canal and associated organs (mouth, oesophagus, stomach, small intestine: duodenum and ileum, large intestine: colon and rectum, anus, pancreas, liver) - define *ingestion, digestion, absorption, assimilation* and *egestion* - describe the functions of the alimentary canal's various parts in relation to ingestion, digestion, absorption, assimilation and egestion of food	

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TOPIC/CONCEPT		CORE	SUPPLEMENT
6.3.3	Mechanical and physical digestion	- identify the types of human teeth and describe their functions - state the causes of dental decay and describe the proper care of teeth - describe the processes of chewing and peristalsis	- explain the probable action of fluoride in reducing tooth decay and present arguments for and against its addition to public water supplies
6.3.4	Chemical digestion The significance of producing small, soluble molecules	- describe: digestion in the alimentary canal the functions of a typical amylase, protease and lipase, listing the substrate and end-products	
6.3.5	Absorption	- identify the small intestine as the region for the absorption of digested food - describe the significance of villi in increasing the internal surface area	- describe the structure of a villus, including the role of capillaries and lacteals - indicate the role of the hepatic portal vein in the transport of absorbed food to the liver
6.3.6	Assimilation	- describe: the role of the liver in the metabolism of glucose and in the destruction of excess amino acids the role of fat as a storage substance	- define deamination as removal of the nitrogen containing part of amino acids as urea, followed by release of energy from the remainder of the amino acid
7.	**Transportation**		
7.1	Transport in plants		
7.1.1	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	
7.1.2	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 and the factors described in the core
7.1.3	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
7.2	Transport in humans		
7.2.1	Heart	- describe: the gross structure and function of the heart the effect of exercise on heart beat -list the likely causes of a heart attack (diet, smoking and stress), and preventive measures	
7.2.2	Arteries, veins and capillaries	- describe: the structure and functions of arteries, veins and capillaries the double circulatory system	- explain how structure and function are related in arteries, veins and capillaries
7.2.3	Blood	- identify blood cells, as seen under a light microscope - describe: the components of blood the functions of blood, including clotting (**no** details of clotting required) the transfer of materials between capillaries and tissue fluid	- describe the immune system in terms of antibody production, tissue rejection and phagocytosis - describe the process of clotting (fibrinogen to fibrin only) - describe the function of the lymphatic system in circulation of body fluids, and the production of lymphocytes

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TOPIC/CONCEPT		CORE	SUPPLEMENT
8.	**Respiration**	- define respiration as the release of energy from food substances in all living cells	
8.1	Aerobic respiration	- define *aerobic respiration* - state the equation for aerobic respiration, using words - name and describe the uses of energy in the body of humans	- state the equation for aerobic respiration using symbols
8.2	Anaerobic respiration	- define *anaerobic respiration* - state the equation for anaerobic respiration in muscles (glucose → lactic acid) and the microorganism yeast (glucose → alcohol + carbon dioxide), using words - describe the role of anaerobic respiration in brewing and breadmaking - describe the production of lactic acid in muscles during exercise - compare aerobic respiration and anaerobic respiration in terms of relative amounts of energy released	- state the equation for anaerobic respiration in muscles ($C_6H_{12}O_6 \rightarrow 2C_3H_6O_3$) and the microorganism yeast ($C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$), using symbols
8.3	Gaseous exchange	- list the features of gaseous exchange surfaces in animals - state the differences in composition between inspired and expired air - describe a test for carbon dioxide - describe: the effects of physical activity on rate and depth of breathing the effects of tobacco smoke and its major toxic components on the respiratory system	- describe the role of the ribs, the internal and external intercostal muscles and the diaphragm in producing volume and pressure changes leading to the ventilation of the lungs - explain the link between physical activity and rate and depth of breathing in terms of changes in respiratory rate ands therefore of carbon dioxide concentration and pH in tissues and in the blood
9.	**Excretion in humans** The necessity to remove toxic waste products of metabolism	- define *excretion* as the removal of toxic materials, the waste products of metabolism and substances in excess of requirements from organisms - describe: the function of the kidney simply in terms of the removal of urea and excessive water and the reabsorbtion of glucose and some salts (details of kidney structure and nephron are **not** required) the relative positions of ureters, bladder and urethra in the body the formation of urea and the breakdown of alcohol, drugs and hormones in the liver	- outline the structure of a kidney (cortex, medulla, ureter) and outline the structure and functioning of a kidney tubule including role of renal capsule in filtration from blood of water, glucose, urea and salts, and role of tubule in reabsorption of glucose, most of the water and some salts back into the blood, leading to concentration of urea in the urine as well as loss of excess water - explain dialysis and discuss its application in kidney machines - discuss the advantages and disadvantages of kidney transplants, compared with dialysis
10.	**Coordination and response** The ability to detect and to respond to internal and external stimuli		
10.1	Hormones	- define *hormone* - describe the chemical control of metabolic activity by adrenaline	- compare hormonal and nervous systems - discuss the use of hormones in food production
10.2	Tropic and taxic responses	- define *geotropism* and *phototropism* - describe simple behaviour in terms of the taxic responses of invertebrates	- explain the chemical control of plant growth by auxins including geotropism and phototropism in terms of auxins regulating differential growth, and the effects of synthetic plant hormones used as weedkillers
10.3	Nervous control in humans	- describe the human nervous system in terms of the central nervous system (brain and spinal cord as areas of coordination) and the peripheral nervous system	

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TOPIC/CONCEPT		CORE	SUPPLEMENT
		- define *sense organs* as groups of receptor cells responding to specific stimuli: light, sound, touch, temperature and chemicals - identify motor and sensory neurones from diagrams - describe effectors in terms of muscles and glands - describe the action of antagonistic muscles in terms of the biceps and triceps and the associated bones - describe a simple reflex arc in terms of sensory, relay and motor neurones, and a reflex action as a means of integrating and coordinating stimuli with responses - describe the structure and function of the eye, including accommodation and pupil reflex - compare nervous and hormonal control systems	- distinguish between voluntary and involuntary actions - distinguish between rods and cones, in terms of function and distribution
10.4	Homeostasis	- define *homeostasis* as the maintenance of a constant internal environment - describe temperature regulation, and explain the effects of sweating, vasodilation and vasoconstriction only	- describe the control of the glucose content of the blood by the liver, and by insulin and glucagon from the pancreas - discuss the general role of negative feedback in homeostasis
10.5	Drugs	- describe the effects of alcohol and heroin, and the dangers of their misuse - describe the personal and social problems arising from drug abuse, by reference to alcohol and heroin	
SECTION III – DEVELOPMENT OF THE ORGANISM AND THE CONTINUITY OF LIFE (25% of teaching time)			
1.	**Reproduction**		
1.1	Asexual reproduction	- define *asexual reproduction* - describe asexual reproduction in bacteria, spore production in fungi and tuber formation in potatoes	- discuss the advantages and disadvantages to the species of asexual reproduction
1.2	Sexual reproduction	- define *sexual reproduction*	- discuss the advantages and disadvantages of sexual reproduction
1.2.1	Sexual reproduction in plants	- describe the structure and functions of the flower of a **named** dicotyledonous plant - 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 fertilisation the formation of seed and fruit the structure of a non-endospermic seed - 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
1.2.2	Sexual reproduction in humans	- describe: the structure and function of human male and female reproductive systems, including the menstrual cycle sexual intercourse, fertilisation and implantation the development of the fetus in terms of placenta, maternal and fetal blood supplies and exchange of materials ante-natal care in terms of dietary requirements and maintaining good health birth	- indicate the functions of the amniotic sac and amniotic fluid - describe the advantages of breast-feeding compared with bottle-feeding

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TOPIC/CONCEPT		CORE	SUPPLEMENT
1.3	Sex hormones	- describe the roles of testosterone and oestrogen in the development and regulation of secondary sexual characteristics at puberty	- describe the sites of production and the roles of oestrogen and progesterone in the menstrual cycle and in pregnancy
1.4	Methods of birth control	- name and describe the following methods of birth control: natural, chemical, mechanical and surgical	- discuss the social aspects of artificial insemination and the use of hormones in fertility drugs
1.5	Sexually transmissible diseases	- describe the symptoms, signs, effects and treatment of gonorrhoea - describe the methods of transmission of human immunodeficiency virus (HIV), and the ways in which it can be prevented from spreading	- outline how HIV affects the immune system
2.	**Growth and development**	- define *growth* in terms of increase in dry mass - define *development* in terms of increase in complexity - describe the environmental conditions affecting germination	
3.	**Inheritance** The transmission of genetic information from generation to generation, leading to continuity of, and variation within, the species		
3.1	Chromosomes	- define the terms *chromosome*, *gene*, *allele*, *haploid* and *diploid nuclei* - describe the inheritance of sex in humans (XX, XY)	
3.2	Mitosis	- describe mitosis simply, in terms of the exact duplication of chromosomes resulting in identical daughter nuclei (details of stages are **not** required)	
3.3	Meiosis	- describe the production of gametes by meiosis simply, in terms of halving of chromosome number leading to variation (details of stages are **not** required)	
3.4	Monohybrid inheritance	- define the terms *gene*, *allele*, *genotype*, *phenotype*, *homozygous*, *heterozygous*, *dominant* and *recessive* - calculate and predict the results of monohybrid crosses involving 1 : 1 and 3 : 1 ratios	- explain codominance and inheritance of A, B, AB and O blood groups (I^A, I^B and I^o)
3.5	Variation	- describe continuous and discontinuous variation as influenced by the environment and genes, illustrated by height and A, B, AB and O blood groups in humans - define *mutation* - describe mutation as a source of variation, as shown by Down's syndrome - outline the effects of radiation and chemicals on the rate of mutation	- describe sickle cell anaemia, and explain its incidence in relation to that of malaria
3.6	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
3.7	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

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TOPIC/CONCEPT		CORE	SUPPLEMENT
SECTION IV – RELATIONSHIPS OF ORGANISMS WITH ONE ANOTHER AND WITH THEIR ENVIRONMENT (20% of teaching time)			
1.	**Energy flow**	- state that the Sun is the principal source of energy input to biological systems - describe the non-cyclical nature of energy flow	
2.	**Food chains and food webs** Emphasis on examples occurring locally	- define the terms *food chain, food web*, *producer, consumer, herbivore, carnivore, decomposer, ecosystems* and *trophic level* - describe energy losses between trophic levels, and the advantages of short food chains - describe and interpret pyramids of biomass, numbers and energy	- recognise that there is an increased efficiency in supplying green plants as human food and that there is a relative inefficiency, in terms of energy loss, in feeding crop plants to animals
3.	**Nutrient cycles**	- describe the carbon and the water cycles	- describe the nitrogen cycle in terms of the role of microorganisms in providing usable nitrogen-containing substances by decomposition and by nitrogen fixation in roots; the absorption of these substances by plants and their conversion to protein, followed by passage through food chains, death, decay, nitrification and denitrification and the return of nitrogen to the soil or the atmosphere (names of individual bacteria are not required) - discuss the effects of the combustion of fossil fuels and the cutting down of forests on the balance between oxygen and carbon dioxide
4.	**Population size**	- state the factors affecting the rate of population growth, and describe their importance (e.g. food, supply, predation and disease) - identify the phases of a sigmoid curve of population growth resulting from the action of a limiting factor - describe the increase in population size in the absence of limiting factors (human population growth) and the social implications of current human survival rate - interpret graphs and diagrams of human population growth	- explain the factors that lead to the lag phase, exponential phase and stationary phase in the sigmoid curve of population growth
5.	**Human influences on the ecosystem** With emphasis on examples of international importance (e.g. tropical rain forests, oceans and rivers)		
5.1	Agriculture	- discuss, using suitable examples, ways in which the use of modern technology has resulted in increased food production - describe the undesirable effects of deforestation - describe the overuse of fertilisers on the land	
5.2	Pollution	- describe the undesirable effects of water pollution by sewage and chemical waste, air pollution by sulphur dioxide and pollution due to pesticides and herbicides and nuclear fall-out	- assess the significance of non-biodegradable plastics and other, materials used in the manufacturing industry - discuss the causes and apparent effects on the environment of acid rain, and the measures that might be taken to reduce its incidence
5.3	Conservation	- describe the need for conservation of species and their habitats and of natural resources	- describe the principle of recycling materials including sewage (water) and paper

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LABORATORY EQUIPMENT

Practical Assessment – Papers 4, 5 and 6

Whichever assessment route is chosen, the following points should be noted:

- Same assessment objectives for all practical papers
- Same practical skills to be learned and developed by candidates for all practical papers
- Same benefits to theoretical understanding that come from practical work
- Same motivational effect and enthusiasm and enjoyment for teachers and pupils
- Same sequence of practical activities is appropriate

The following is a list of the conditions, materials and equipment that are considered appropriate for the teaching of IGCSE Biology.

In accordance with the COSHH (Control of Substances Hazardous to Health) Regulations operative in the UK, a hazard appraisal of the list has been carried out. The following codes are used where relevant.

C = corrosive substance
F = highly flammable substance
H = harmful or irritating substance
O = oxidizing substance
T = toxic substance

Laboratory Conditions

Adequate bench space (more than 1m x 1m for each student)
Water supply – not necessarily mains supply
Gas supply (for heating) - mains/cylinder
Electrical supply – mains/batteries/generator
Secure area for preparation and storage of items made for practical lessons and tests

Apparatus and materials

Safety equipment appropriate to the work being planned, but at least including eye protection such as safety spectacles or goggles

Chemical reagents

- hydrogen carbonate indicator (bicarbonate indicator)
- iodine in potassium iodide solution (iodine solution)
- Benedict's solution (or an alternative such as Fehling's)
- [**C**] biuret reagent(s) (sodium or potassium hydroxide solution and copper sulphate solution)
- [**F**] ethanol/methylated spirit
- cobalt chloride paper
- pH indicator paper or universal indicator solution or pH probes
- litmus paper
- glucose
- sodium chloride
- aluminium foil or black paper

Instruments

- rulers capable of measuring to 1 mm
- mounted needles or seekers or long pins with large heads
- means of cutting biological materials e.g. scalpels, solid-edged razor blades or knives
- scissors
- forceps
- means of writing on glassware (e.g. wax pencil, water-resistant marker, small self-adhesive labels and pencils)

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Glassware and similar (some of which may be glass, plastic or metal)

- beakers or other containers
- test-tubes, test-tube racks and test-tube holders
- funnels
- droppers or teat pipettes or plastic or glass dispensing bottles
- dishes such as Petri dishes or tin lids
- means of measuring small and larger volumes such as syringes, graduated pipettes or measuring cylinders
- glass rod
- capillary tube

Thermometers (covering at least the range 0 – 100°C (any range starting below 0 and ending above 100°C is suitable)
Means of heating such as Bunsen or other gas burner or spirit burner
Glass slides and coverslips
White tile or other suitable cutting surface
Visking tube or other selectively permeable membrane material
Hand lens (at least X6)

Desirable apparatus and materials

Microscope with mirror and lamp or with built in light, at least low-power (X10) objective, optional high-power (X40) objective will greatly increase the range of cellular detail that can be resolved.
Chemical reagents in addition to those listed above

- copper sulphate (blue crystals)
- dilute (1 mol dm^{-3}) hydrochloric acid
- a source of distilled or deionised water
- eosin/red ink
- limewater
- methylene blue
- [**C**]potassium hydroxide
- sodium hydrogen carbonate (sodium bicarbonate)
- Vaseline/petroleum jelly (or similar)

Mortar and pestle or blender

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ASSESSMENT CRITERIA FOR PRACTICALS

PRACTICAL ASSESSMENT - PAPERS 4 OR 5 OR 6

Scientific subjects are, by their nature, experimental. It is, accordingly, important that an assessment of a student's knowledge and understanding of Biology should contain a component relating to practical work and experimental skills (as identified by assessment objective C). In order to accommodate, within IGCSE, differing circumstances - such as the availability of resources - three alternative means of assessing assessment objective C objectives are provided, namely, school-based assessment, a formal practical test, and a written alternative to practical paper, as outlined in the scheme of assessment.

Paper 4, Coursework (School-based assessment of experimental skills and abilities)

Teachers may not undertake school-based assessment without the written approval of CIE. This will only be given to teachers who satisfy CIE requirements concerning moderation and they will have to undergo special training in assessment before entering candidates.

The general Coursework regulations published in the *Handbook for Centres* should be followed.

Paper 5, Practical Test

Exercises may be set requiring the candidates to:

- follow carefully a sequence of instructions;
- use familiar, and unfamiliar, techniques to record observations and make deductions from them;
- perform simple physiological experiments, e.g. tests for food substances and the use of hydrogencarbonate indicator, litmus and Universal Indicator paper;
- use a scalpel or a razor blade, forceps, scissors and mounted needles skilfully;
- use a hand lens of not less than x6 magnification to recognise, observe and record familiar, and unfamiliar, biological specimens;
- make a clear line drawing of a specimen provided, indicate the magnification of the drawing and label, as required;
- perform simple arithmetical calculations.

It is expected that glassware and instruments normally found in a laboratory, e.g. beakers, test-tubes, test-tube racks or other holders, funnels, thermometers, specimen tubes, Petri dishes, syringes, droppers, glass rods, means of heating the equipment referred to above, x6 (at least) hand lenses and so on, should be available for these experiments, along with reagents (e.g. for food tests), hydrogencarbonate indicator, litmus paper and Universal Indicator paper.

When planning practical work, teachers should make sure that they do not contravene any school, education authority or government regulations that restrict the sampling, in educational establishments, of saliva, blood, urine or other bodily secretions and tissues.

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Paper 6, Alternative to Practical

This paper is designed to test candidates' familiarity with laboratory practical procedures.

Questions may be set requiring the candidates to:

- follow carefully a sequence of instructions;
- use familiar, and unfamiliar, techniques to record observations and make deductions from them;
- recall simple physiological experiments, e.g. tests for food substances, the use of a potometer and the use of hydrogencarbonate indicator, litmus and Universal Indicator paper;
- recognise, observe and record familiar, and unfamiliar, biological specimens;
- make a clear line drawing from a photograph (or other visual representation) of a specimen, indicate the magnification of the drawing and label, as required;
- perform simple arithmetical calculations.

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COURSEWORK (SCHOOL-BASED ASSESSMENT (PAPER 4))

Experimental work forms an integral part of the IGCSE Biology course. The practical aspects to be assessed are outlined in assessment objective C. It is important that these skills are covered during the teaching programme. The following scheme has been devised to enable teachers to develop, assess and record positive achievement in experimental skills. Four practical skills have been identified in order that assessment may be carried out as precisely as possible. The skills are discrete but should not be regarded as being performed in isolation.

It is assumed that there has been a background of practical work carried out during the first three years of secondary education. Thus, it is reasonable to suppose that any single assessment is a representative measure of a given candidate's ability. This could be, but may not necessarily be, related to their previous practical experiences.

The experimental skills and abilities, C1 to C4, to be assessed are given below.

C1 Using and organising techniques, apparatus and materials

C2 Observing, measuring and recording

C3 Interpreting and evaluating experimental observations and data

C4 Planning, carrying out and evaluating investigation

The four skills carry equal weighting.

All assessments must be based upon experimental work carried out by the candidates.

It is expected that the teaching and assessment of experimental skills and abilities will take place throughout the course.

Teachers must ensure that they can make available to the Moderator evidence for two assessments of each skill for each candidate. For skills C1 to C4 inclusive, information about the tasks set and how the marks were awarded will be required. In addition, for skills C2, C3 and C4, the candidate's written work will also be required.

The assessment scores finally recorded for each skill must represent the candidate's best performances.

For candidates who miss the assessment of a given skill through no fault of their own, for example because of illness, and who cannot be assessed **on another occasion**, the CIE procedure for special consideration should be followed. However, candidates who for no good reason absent themselves from an assessment of a given skill should be awarded a mark of zero for that assessment.

CRITERIA FOR ASSESSMENT OF EXPERIMENTAL SKILLS AND ABILITIES

Each skill must be assessed on a 6 point scale, level 6 being the highest level of achievement. Each of the skills is defined in terms of three levels of achievement at scores of 2, 4 and 6.

A score of 0 is available if there is no evidence of positive achievement for a skill.

For candidates who do not meet the criteria for a score of 2, a score of 1 is available if there is some evidence of positive achievement.

A score of 3 is available for candidates who go beyond the level defined for 2, but who do not meet fully the criteria for 4.

Similarly, a score of 5 is available for those who go beyond the level defined for 4, but do not meet fully the criteria for 6.

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SKILL C1 USING AND ORGANISING TECHNIQUES, APPARATUS AND MATERIALS

1

2 - Follows written, diagrammatic or oral instructions to perform a single practical operation.

Uses familiar apparatus and materials adequately, needing reminders on points of safety.

3

4 - Follows written, diagrammatic or oral instructions to perform an experiment involving a series of step-by-step practical operations.

Uses familiar apparatus, materials and techniques adequately and safely.

5

6 - Follows written, diagrammatic or oral instructions to perform an experiment involving a series of practical operations where there may be a need to modify or adjust one step in the light of the effect of a previous step.

Uses familiar apparatus, materials and techniques methodically, correctly and safely.

SKILL C2 OBSERVING, MEASURING AND RECORDING

1

2 - Makes observations or readings, given detailed instructions.

Records results in an appropriate manner, given a detailed format.

3

4 - Makes relevant observations or measurements, given an outline format or brief guidelines.

Records results in an appropriate manner, given an outline format.

5

6 - Makes relevant observations or measurements to a degree of accuracy appropriate to the instruments or techniques used.

Records results in an appropriate manner, given no format.

SKILL C3 INTERPRETING AND EVALUATING EXPERIMENTAL OBSERVATIONS AND DATA

1

2 - Processes results in an appropriate manner, given a detailed format.

Draws an obvious qualitative conclusion from the results of an experiment.

3

4 - Processes results in an appropriate manner, given an outline format.

Recognises and comments on anomalous results.

Draws qualitative conclusions that are consistent with obtained results, and deduces patterns in data.

5

6 - Processes results in an appropriate manner, given no format.

Deals appropriately with anomalous or inconsistent results.

Recognises and comments on possible sources of experimental error.

Expresses conclusions as generalisations or patterns, where appropriate.

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SKILL C4 PLANNING, CARRYING OUT AND EVALUATING INVESTIGATIONS

1

2 - Suggests a simple experimental strategy to investigate a given practical problem.

Attempts 'trial and error' modification in the light of the experimental work carried out.

3

4 - Specifies a sequence of activities to investigate a given practical problem.

In a situation where there are two variables, recognises the need to keep one of them constant while the other is being changed.

Comments critically on the original plan, and implements appropriate changes in the light of the experimental work carried out.

5

6 - Analyses a practical problem systematically and produces a logical plan for an investigation.

In a given situation, recognises that there are a number of variables, and attempts to control them.

Evaluates chosen procedures, suggests/implements modifications, where appropriate, and shows a systematic approach in dealing with unexpected results.

NOTES FOR GUIDANCE

The following notes are intended to provide teachers with information to help them to make valid and reliable assessments of the skills and abilities of their candidates.

The assessments should be based on the principle of positive achievement; candidates should be given opportunities to demonstrate what they understand and can do.

It is expected that candidates will have had opportunities to acquire a given skill before assessment takes place.

It is **not** expected that all of the practical work undertaken by a candidate will be assessed.

Assessments can be carried out at any time during the course. However, at whatever stage assessments are done, the standards applied must be those expected at the end of the course, as exemplified in the criteria for the skills.

Assessments should normally be made by the person responsible for teaching the candidates.

It is recognised that a given practical task is unlikely to provide opportunities for all aspects of the criteria at a given level for a particular skill to be satisfied, for example, there may not be any anomalous results (Skill C3). However, by using a range of practical work, teachers should ensure that opportunities are provided for all aspects of the criteria to be satisfied during the course.

The educational value of extended experimental investigations is widely recognised. Where such investigations are used for assessment purposes, teachers should make sure that the candidates have ample opportunity for displaying the skills and abilities required by the scheme of assessment.

It is not necessary for all candidates in a Centre, or in a teaching group within a Centre, to be assessed on exactly the same practical work, although teachers may well wish to make use of work that is undertaken by all of their candidates.

When an assessment is carried out on group work, the teacher must ensure that the individual contribution of each candidate can be assessed.

Skill C1 may not generate a written product from the candidates. It will often be assessed by watching the candidates carrying out practical work.

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Skills C2, C3 and C4 will usually generate a written product from the candidates. This product will provide evidence for moderation.

Raw scores for individual practical assessments should be recorded on the Individual Candidate Record Card. The final, internally moderated total score should be recorded on the Coursework Assessment Summary Form. Examples of both forms, plus the Sciences Experiment Form, are shown at the back of this syllabus.

Raw scores for individual practical assessments may be given to candidates as part of the normal feedback from the teacher. The final, internally moderated, total score, should **not** be given to the candidate.

MODERATION

(a) Internal Moderation

When several teachers in a Centre are involved in internal assessments, arrangements must be made within the Centre for all candidates to be assessed to a common standard.

It is essential that, within each Centre, the marks for each skill assigned within different teaching groups (e.g. different classes) are moderated internally for the whole Centre entry. The Centre assessments will then be subject to external moderation.

(b) External Moderation

Individual Candidate Record Cards and Coursework Assessment Summary Forms are to be submitted to CIE to arrive no later than 30 April (for the June examination) and 31 October (for the November examination). For external moderation, CIE will require evidence that must include, for skills C1 to C4 inclusive, information about the tasks set and how the marks were awarded. In addition, for skills C2, C3 and C4, Centres must send three examples of a high mark, three examples of an intermediate mark and three examples of a low mark, i.e. 27 pieces of work, that contribute to the final mark, chosen from ten different candidates, must be submitted by the Centre. If there are ten or fewer candidates, all the Coursework that contributed to the final mark must be sent. A further sample may be required. All records and supporting written work should be retained until after the publication of results.

Centres may find it convenient to use loose-leaf A4 file paper for assessed written work, to reduce the cost when samples are sent through the post for moderation. Original work is preferred but authenticated photocopies may be sent, if absolutely necessary.

The samples sent to CIE should be arranged separately for skills C2, C3 and C4, the skill suitably identified and in some mark order, e.g. high to low. The pieces of work for each skill should **not** be stapled together. Each piece of work should be labelled with the skill being assessed, the Centre number and candidate name and number, title of the experiment, a copy of the mark scheme used and the mark awarded. This information should be attached securely, mindful that adhesive labels tend to peel off some plastic surfaces.

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GRADE DESCRIPTIONS

The scheme of assessment is intended to encourage positive achievement by all candidates.

Grade F candidates must show competence in answering questions based on the Core curriculum.

Grade C candidates must show mastery in answering questions based on the Core curriculum, plus some ability to answer questions that are pitched at a higher level.

Grade A candidates must show mastery of the Core curriculum and of the Extended curriculum.

Criteria for the standard of achievement likely to have been shown by candidates awarded Grades F, C and A are shown below.

The standard of achievement required for the award of Grade C includes the criteria for Grade F. Similarly, the standard of achievement required for the award of Grade A includes the criteria for Grade C.

A **Grade A** candidate should be able to:

- relate facts to principles and theories and vice versa;
- state why particular techniques are preferred for a procedure or operation;
- select and collate information from a number of sources and present it in a clear, logical form;
- solve problems in situations that may involve a wide range of variables;
- process data from a number of sources to identify any patterns or trends;
- generate a hypothesis to explain facts, or find facts to support a hypothesis.

A **Grade C** candidate should be able to:

- link facts to situations not specified in the syllabus;
- describe the correct procedure(s) for a multi-stage operation;
- select a range of information from a given source and present it in a clear, logical form;
- identify patterns or trends in given information;
- solve a problem involving more than one step, but with a limited range of variables;
- generate a hypothesis to explain a given set of facts or data.

A **Grade F** candidate should be able to:

- recall facts contained in the syllabus;
- indicate the correct procedure for a single operation;
- select and present a single piece of information from a given source;
- solve a problem involving one step, or more than one step if structured help is given;
- identify a pattern or trend where only minor manipulation of data is needed;
- recognise which of two given hypotheses explains a set of facts or data.

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MATHEMATICAL REQUIREMENTS

Calculators may be used in all parts of the examination.

Candidates should be able to:

1. add, subtract, multiply and divide;
2. understand averages, decimals, fractions, percentages, ratios and reciprocals;
3. recognise and use standard notation;
4. use direct and inverse proportion;
5. use positive, whole number indices;
6. draw charts and graphs from given data;
7. interpret charts and graphs;
8. select suitable scales and axes for graphs;
9. make approximate evaluations of numerical expressions;
10. recognise and use the relationship between length, surface area and volume and their units, on metric scales;
11. use usual mathematical instruments (ruler, compasses);
12. understand the meaning of radius, diameter, square, rectangle.

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TERMINOLOGY, UNITS, SYMBOLS AND PRESENTATION OF DATA FOR BIOLOGY

These terms will be used by Principal Examiners during the setting of papers. Students, should be made aware of the terminology during teaching and practical work.

This section follows the practice laid down in the documents:
Association for Science Education, *Signs, Symbols and Systematics: The ASE Companion to 5-16 Science* (1995)
Institute of Biology, *Biological Nomenclature, Standard terms and expressions used in the teaching of biology* (2000)

1. Numbers

The decimal point will be placed on the line, e.g. 52.35.

Numbers from 1000 to 9999 will be printed without commas or spaces.

Numbers greater than or equal to 10 000 will be printed without commas. A space will be left between each group of three whole numbers, e.g. 4 256 789.

2. Units

The International System of units will be used (SI units). Units will be indicated in the singular not in the plural, e.g. 28 kg.

(a) **SI units commonly used in Biology are listed below.**

N.B. Care should be taken in the use of *mass* and *weight.* In most biological contexts, the term mass is correct, e.g. dry mass, biomass.

Quantity	*Name of unit*	*Symbol for unit*
length	kilometre	km
	metre	m
	centimetre	cm
	millimetre	mm
	micrometre	μm
mass	tonne (1000 kg)	(no symbol)
	kilogram	kg
	gram	g
	milligram	mg
	microgram	μg
time	year	y
	day	d
	hour	h
	minute	min
	second	s
amount of substance	mole	mol

(b) **Derived SI units are listed below.**

energy	kilojoule	kJ
	joule	J
	(calorie is obsolete)	

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(c) **Recommended units for area, volume and density are listed below.**

area	hectare = 10^4 m^2		ha
	square metre		m^2
	square decimetre		dm^2
	square centimetre		cm^2
	square millimetre		mm^2
volume	cubic kilometre		km^3
	cubic metre		m^3
	cubic decimetre (preferred to litre)		dm^3
	litre		dm^3 (**not** l)
	cubic centimetre		cm^3 (**not** ml)
	cubic millimetre		mm^3
density	kilogram per cubic metre	*or*	kg m^{-3}
	gram per cubic centimetre	*or*	g cm^{-3}

(d) **Use of Solidus**

The solidus (/) will **not** be used for a quotient, e.g. m/s for metres per second.

3. Presentation of data

The solidus (/) is to be used for separating the quantity and the unit in tables, graphs and charts, e.g. time/s for time in seconds.

(a) **Tables**

(i) Each column of a table will be headed with the physical quantity and the appropriate unit, e.g. time/s.

There are three acceptable methods of stating units, e.g. metres per sec or m per s or m s^{-1}.

(ii) The column headings of the table can then be directly transferred to the axes of a constructed graph.

(b) **Graphs**

(i) The independent variable should be plotted on the x-axis (horizontal axis) and the dependent variable plotted on the y-axis (vertical axis).

(ii) Each axis will be labelled with the physical quantity and the appropriate unit, e.g. time/s.

(iii) The graph is the whole diagrammatic presentation. It may have one or several curves plotted on it.

(iv) Curves and lines joining points on the graph should be referred to as 'curves'.

(v) Points on the curve should be clearly marked as crosses (x) or encircled dots (⊙). If a further curve is included, vertical crosses (+) may be used to mark the points.

(c) **Pie Charts**

These should be drawn with the sectors in rank order, largest first, beginning at 'noon' and proceeding clockwise. Pie Charts should preferably contain no more than six sectors.

(d) **Bar Charts**

These are drawn when one of the variables is not numerical, e.g. percentage of vitamin C in different fruits. They should be made up of narrow blocks of equal width that do **not** touch.

(e) **Column Graphs**

These are drawn when plotting frequency graphs from discrete data, e.g. frequency of occurrence of leaves with different numbers of prickles or pods with different numbers of seeds. They should be made up of narrow blocks of equal width that do **not** touch.

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(f) **Histograms**

These are drawn when plotting frequency graphs with continuous data, e.g. frequency of occurrence of leaves of different lengths. The blocks should be drawn in order of increasing or decreasing magnitude and they **should** be touching.

4. Taxonomy

Taxonomy is the study of the principles of the organisation of taxa into hierarchies. There are seven levels of taxon - kingdom, phylum, class, order, family, genus and species. These may be used when teaching the concept and use of a classificatory system, the variety of organisms, and the binomial system. The following should apply:

(a) Five Kingdoms are now recognised as

prokaryotes	(Prokaryotae), including bacteria and blue-green bacteria
protoctists	(Protoctista), including green, red and brown algae and protozoans
fungi	(Fungi)
plants	(Plantae)
animals	(Animalia)

The viruses cannot be fitted into this classificatory system.

(b) The binomial system of naming gives each organism a two-word name. The first word is the generic name and the second word is the trivial name, e.g. *Homo sapiens*. The trivial name should never be used by itself.

(c) Generic and trivial names are distinguished from the rest of the text either by underlining (when written or typed) or by being set in italics (in print).

(d) The generic name always takes an initial capital letter. It can be accepted as a shorthand for the species name where the intent is obvious, e.g. *Plasmodium,* and in these circumstances can stand alone.

(e) The common name should not normally be written with an initial capital letter, e.g. cat and dog. The exception is Man, where it is the common name for a species where the two sexes are distinguished by the terms man and woman.

(f) A species is not easy to define but an acceptable general definition is as follows.

'A group of organisms capable of interbreeding and producing fertile offspring.'

5. Genetics

(a) The terms *gene* and *allele* are not synonymous.

A gene is a specific length of DNA occupying a position called a locus. A specific function can be assigned to each gene. An allele is one of two or more different forms of a gene.

(b) A standard form of presenting genetic crosses should be adopted. The following symbols should be used as shown.

P designates the cross of pure-breeding (homozygous) individuals.
F1 designates the offspring of homozygous parents.
F2 designates the offspring produced by crossing F1 parents.

(c) The format for the course of a genetic cross should be labelled as shown.

parental phenotypes
parental genotypes
gametes
offspring genotypes
offspring phenotypes
etc.

(d) The gene should be designated by a letter or letters so that upper and lower case versions are easily distinguishable, e.g. B and b. The upper case letter indicates the dominant allele and the lower case letter indicates the recessive allele.

(e) The symbols for gametes should be circled to indicate the discrete nature of each gamete.

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(f) Some form of checkerboard should be used to demonstrate genotypes that can result from random fusion of gametes. Students should understand that genotypes are only possible combinations and that only a very large number of offspring can result in all combinations being achieved.

(g) The term *incomplete dominance* should be discontinued and in the particular case where alleles are equally dominant it should be called *codominance.* Thus codominance should be used where the influence of both alleles is shown in the phenotype, e.g. the AB blood group in humans.

6. Terminology

(a) Wherever possible, English terms should be used in preference to Latin or Greek terms, e.g. the term red blood cell should be used and **not** erythrocyte.

(b) Generalised terms should be stated in English, e.g. small intestine.

(c) Where no suitable English terms exist, latinised terms are unavoidable and will need to be used, e.g. atrium, bronchi, villi.

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GLOSSARY OF TERMS USED IN BIOLOGY PAPERS

It is hoped that the glossary (which is relevant only to Science subjects) will prove helpful to candidates as a guide, i.e. it is neither exhaustive nor definitive. The glossary has been deliberately kept brief not only with respect to the number of terms included but also to the descriptions of their meanings. Candidates should appreciate that the meaning of a term must depend in part on its context.

1. *Define* (the term(s) ...) is intended literally, only a formal statement or equivalent paraphrase being required.

2. *What do you understand by/What is meant by* (the term(s) ...) normally implies that a definition should be given, together with some relevant comment on the significance or context of the term(s) concerned, especially where two or more terms are included in the question. The amount of supplementary comment intended should be interpreted in the light of the indicated mark value.

3. *State* implies a concise answer with little or no supporting argument, e.g. a numerical answer that can readily be obtained 'by inspection'.

4. *List* requires a number of points, generally each of one word, with no elaboration. Where a given number of points is specified, this should not be exceeded.

5. (a) *Explain* may imply reasoning or some reference to theory, depending on the context. It is another way of asking candidates to give reasons for. The candidate needs to leave the examiner in no doubt **why** something happens.

   (b) *Give a reason/Give reasons* is another way of asking candidates to explain **why** something happens.

6. (a) *Describe*, the data or information given in a graph, table or diagram, requires the candidate to state the key points that can be seen in the stimulus material. Where possible, reference should be made to numbers drawn from the stimulus material.

   (b) *Describe*, a process, requires the candidate to give a step by step written statement of what happens during the process.

   Describe and *explain* may be coupled, as may *state* and *explain*.

7. *Discuss* requires the candidate to give a critical account of the points involved in the topic.

8. *Outline* implies brevity, i.e. restricting the answer to giving essentials.

9. *Predict* implies that the candidate is not expected to produce the required answer by recall but by making a logical connection between other pieces of information. Such information may be wholly given in the question or may depend on answers extracted in an earlier part of the question.

   Predict also implies a concise answer, with no supporting statement required.

10. *Deduce* is used in a similar way to *predict* except that some supporting statement is required, e.g. reference to a law or principle, or the necessary reasoning is to be included in the answer.

11. (a) *Suggest* is used in two main contexts, i.e. either to imply that there is no unique answer (e.g. in Biology, there are a variety of factors that might limit the rate of photosynthesis in a plant in a glasshouse),

    (b) *Suggest* may also be used to imply that candidates are expected to apply their general knowledge and understanding of biology to a 'novel' situation, one that may be formally 'not in the syllabus' – many data response and problem solving questions are of this type.

12. *Find* is a general term that may variously be interpreted as *calculate, measure, determine*, etc.

13. *Calculate* is used when a numerical answer is required. In general, working should be shown, especially where two or more steps are involved.

14. *Measure* implies that the quantity concerned can be directly obtained from a suitable measuring instrument, e.g. length, using a rule, or mass, using a balance.

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15. *Determine* often implies that the quantity concerned cannot be measured directly but is obtained by calculation, substituting measured or known values of other quantities into a standard formula, e.g. relative molecular mass.

16. *Estimate* implies a reasoned order of magnitude statement or calculation of the quantity concerned, making such simplifying assumptions as may be necessary about points of principle and about the values of quantities not otherwise included in the question.

17. *Sketch,* when applied to graph work, implies that the shape and/or position of the curve need only be qualitatively correct, *but* candidates should be aware that, depending on the context, some quantitative aspects may be looked for, e.g. passing through the origin, having an intercept, asymptote or discontinuity at a particular value.

    In diagrams, *sketch* implies that a simple, freehand drawing is acceptable; nevertheless, care should be taken over proportions and the clear exposition of important details.

In all questions, the number of marks allocated are shown on the examination paper, and should be used as a guide by candidates to how much detail to give. In describing a process the mark allocation should guide the candidate about how many steps to include. In explaining why something happens, it guides the candidate how many reasons to give, or how much detail to give for each reason.

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RESOURCE LIST

The following books have been endorsed by CIE for use with this syllabus.

Hayward, D.	*IGCSE Study Guide for Biology* (2005) Hodder Murray http://www.hoddereducation.co.uk ISBN 071957904X
Jones, M	*Biology for IGCSE* (New edition 2002) Heinemann http://www.heinemann.co.uk ISBN: 0435966782
Jones, M & Jones, G	*Biology: International Edition* (2002) Cambridge University Press http://www.cambridge.org/education/international ISBN: 0521891175
Mackean, D G	*IGCSE Biology* (2002) Hodder Murray http://www.hoddermurray.co.uk ISBN: 0719580536

Other textbooks that will be found helpful:

Bradfield, P, Potter, S,	Longman GCSE Biology (2002) Pearson Education Ltd. http://www.longman.co.uk ISBN: 0582504694
Dawson, B & Honeysett, I	*Revise GCSE Study Guide in Biology* (2001) Letts Educational www.letts.education.com/ ISBN 1858059291
Jenkins, M	*Biology Lives* (Edition 2 2001) Hodder & Stoughton Educational www.hodderheadline.co.uk ISBN 0340790512
Parsons (Ed)	*GCSE Biology Revision Guides and Workbooks* Co-ordination Group Publications www.cgpbooks.co.uk
Pickering, W R	*Complete Biology* (2000) Oxford University Press www4.oup.co.uk ISBN 0199147396
Pickering, W R	*Oxford Revision Guide for Biology* (1998) Oxford University Press www4.oup.co.uk ISBN 0199147116

A resource for teachers to support the delivery of the syllabus

Hayward, D	*Teaching and Assessing Practical Skills in Science* (2003) Cambridge University Press http://www.cambridge.org/education/international ISBN: 0521753597

CD-ROM

BIOSCOPE biological microscope simulation (Edition 2004) ISBN 1845650263 Cambridge-Hitachi, Shaftesbury Road, Cambridge, CB2 2BS, UK, www.cambridge-hitachi.com
Includes 56 slide sets of plant and animal specimens, with features that give the feeling of a real microscope. Paper-based tasks (in Word and PDF format), each of 45 to 60 minutes duration, accompany the slides meeting the needs of the IGCSE Biology syllabus.

Experiment Simulator (Edition 2005) ISBN 1845651405 Cambridge-Hitachi, Shaftesbury Road, Cambridge, CB2 2BS, UK, www.cambridge-hitachi.com.
Like the bioscope developed by Cambridge Assessment, and providing six simulated science experiments to inspire and support pupil learning. Includes excellent worksheets and teacher notes.

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Useful websites available at the time of writing

http://www.lungusa.org/diseases/lungemphysem.html American Lung Association
http://www.cellsalive.com CELLS alive
http://www.bbc.co.uk/schools/gcsebitesize/biology GCSE BITESIZE revision in biology
http://www.middleschoolscience.com Middleschoolscience
http://www-saps.plantsci.cam.ac.uk SAPS (Science and Plants for Schools)
http://www.schoolscience.co.uk Schoolscience
http://www.sciencespot.net The Science Spot

Copies of syllabuses, past papers and Examiners' reports are available on CD-ROM and can be ordered using the Publications Catalogue, which is available at www.cie.org.uk under 'Qualifications & Diplomas' – 'Order Publications'.

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SCIENCES
Experiment Form
IGCSE

Please read the instructions printed on the next page.

Centre Number		Centre Name	
Syllabus Code	0610	Syllabus Title	**BIOLOGY**
Component Number	04	Component Title	**COURSEWORK**
June/November	2008		

Experiment Number	Experiment	Skill(s) Assessed

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INSTRUCTIONS FOR COMPLETING SCIENCES EXPERIMENT FORM

1. Complete the information at the head of the form.

2. Use a separate form for each syllabus.

3. Give a brief description of each of the experiments your students performed for assessment in the IGCSE Biology Syllabus. Use additional sheets as necessary.

4. Copies of the Experiment Forms and the corresponding Worksheets/Instructions and Mark Schemes will be required for each assessed task sampled, for each of skills C1 to C4 inclusive.

IGCSE/BIOLOGY/CW/EX/08

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SCIENCES
Individual Candidate Record Card
IGCSE

Please read the instructions printed on the next page and the General Coursework Regulations before completing this form.

Centre Number		Centre Name		June/November	2008
Candidate Number		Candidate Name		Teaching Group/Set	
Syllabus Code	0610	Syllabus Title	BIOLOGY	Component Number	04	Component Title	COURSEWORK

Date of Assessment	Experiment Number from Sciences Experiment Form	Assess at least twice: ring highest two marks for each skill (max 6 for each assessment)				Relevant comments (for example, if help was given)
		C1	C2	C3	C4	
Marks to be transferred to Coursework Assessment Summary Form		(max 12)	(max 12)	(max 12)	(max 12)	TOTAL (max 48)

35

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INSTRUCTIONS FOR COMPLETING INDIVIDUAL CANDIDATE RECORD CARDS

1. Complete the information at the head of the form.

2. Mark each item of Coursework for each candidate according to instructions given in the Syllabus and in the Distance Training Pack.

3. Enter marks and total marks in the appropriate spaces. Complete any other sections of the form required.

4. Ensure that the addition of marks is independently checked.

5. **It is essential that the marks of candidates from different teaching groups within each Centre are moderated internally.** This means that the marks awarded to all candidates within a Centre must be brought to a common standard by the teacher responsible for coordinating the internal assessment (i.e. the internal moderator), and a single valid and reliable set of marks should be produced that reflects the relative attainment of all the candidates in the Coursework component at the Centre.

6. Transfer the marks to the Coursework Assessment Summary Form in accordance with the instructions given on that document.

7. Retain all Individual Candidate Record Cards and Coursework, **which will be required for external moderation.** Further detailed instructions about external moderation will be sent in late March of the year of the June examination and early October of the year of the November examination. See also the instructions on the Coursework Assessment Summary Form.

Note: These Record Cards are to be used by teachers only for students who have undertaken Coursework as part of their IGCSE.

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SCIENCES
Coursework Assessment Summary Form
IGCSE

Please read the instructions printed on the next page and the General Coursework Regulations before completing this form.

Centre Number					Centre Name			June/November	2008
Syllabus Code	0610	Syllabus Title	BIOLOGY	Component Number	04	Component Title	COURSEWORK		

Candidate Number	Candidate Name	Teaching Group/Set	C1 (max 12)	C2 (max12)	C3 (max 12)	C4 (max 12)	Total Mark (max48)	Internally Moderated Mark (max 48)

Name of teacher completing this form		Signature		Date	
Name of internal moderator		Signature		Date	

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UNIVERSITY of CAMBRIDGE International Examinations

A. INSTRUCTIONS FOR COMPLETING COURSEWORK ASSESSMENT SUMMARY FORMS

1. Complete the information at the head of the form.
2. List the candidates in an order that will allow ease of transfer of information to a computer-printed Coursework mark sheet MS1 at a later stage (i.e. in candidate index number order, where this is known; see item B.1. below). Show the teaching group or set for each candidate. The initials of the teacher may be used to indicate the group or set.
3. Transfer each candidate's marks from his or her Individual Candidate Record Card to this form as follows.
   (a) In the columns headed C1, C2, C3 and C4, enter the marks initially awarded (i.e. before internal moderation took place).
   (b) In the column headed Total Mark, enter the total mark awarded before internal moderation took place.
   (c) In the column headed Internally Moderated Mark, enter the total mark awarded *after* internal moderation took place.
4. Both the teacher completing the form and the internal moderator (or moderators) should check the form and complete and sign the bottom portion.

B. PROCEDURES FOR EXTERNAL MODERATION

1. University of Cambridge International Examinations (CIE) sends a computer-printed Coursework mark sheet MS1 to each Centre (in late March for the June examination and in early October for the November examination) showing the names and index numbers of each candidate. Transfer the total internally moderated mark for each candidate from the Coursework Assessment Summary Form to the computer-printed Coursework mark sheet MS1.
2. The top copy of the computer-printed Coursework mark sheet MS1 must be despatched in the specially provided envelope to arrive as soon as possible at CIE but no later than 30 April for the June examination and 31 October for the November examination.
3. Send samples of the candidates' work covering the full ability range with the corresponding Individual Candidate Record Cards, this summary form and the second copy of MS1, to reach CIE by 30 April for the June examination and 31 October for the November examination.
4. Experiment Forms, Work Sheets and Mark Schemes must be included for each assessed task for each of skills C1 to C4 inclusive.
5. For each of skills C2, C3 and C4, Centres must send three examples of a high mark, three examples of an intermediate mark and three examples of a low mark- i.e. 27 examples in total. The examples must be from at least ten candidates and **must have contributed to the final mark of those candidates.**
6. If there is more than one teaching group, the sample should include examples from each group.
7. If there are 10 or fewer candidates submitting Coursework, send all the Coursework **that contributed to the final mark** for every candidate.
8. Photocopies of the samples may be sent **but** candidates' original work, with marks and comments from the teacher, is preferred.
9. (a) The samples should be arranged separately, by tasks, for each of skills C2, C3 and C4, the skill suitably identified and in some mark order, e.g. high to low.
   (b) The pieces of work for each skill should not be stapled together, nor should individual sheets be enclosed in plastic wallets.
   (c) Each piece of work should be clearly labelled with the skill being assessed, Centre name, candidate name and index number and the mark awarded. For each task, supply the information requested in B.4. above.
10. CIE reserves the right to ask for further samples of Coursework.

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