UNIVERSITY of CAMBRIDGE
International Examinations

Cambridge IGCSE

SYLLABUS

Cambridge IGCSE®
Biology (US)
0438

For examination in June and November 2014

This syllabus is available only to Centers taking part in the Board Examination Systems (BES) Pilot.

If you have any questions about this syllabus, please contact Cambridge at international@cie.org.uk quoting syllabus code 0438.

Note

The subject content of this syllabus is the same as the international version. The alternative to practical paper is not included to ensure that coursework or the practical paper is a mandatory part of the syllabus.

Please read the *Cambridge Glossary* alongside this syllabus. This is available from our website. Administration materials appear in UK English and are standard for all our international customers.

Contents

1. Introduction

1.1 Why Choose Cambridge?

University of Cambridge International Examinations is the world's largest provider of international education programs and qualifications for 5 to 19 year olds. We are part of the University of Cambridge, trusted for excellence in education. Our qualifications are recognized by the world's universities and employers.

Recognition

Every year, hundreds of thousands of learners gain the Cambridge qualifications they need to enter the world's universities.

Cambridge IGCSE® (International General Certificate of Secondary Education) is internationally recognized by schools, universities, and employers as equivalent to UK GCSE. Learn more at **www.cie.org.uk/recognition**

Excellence in Education

We understand education. We work with over 9,000 schools in over 160 countries that offer our programs and qualifications. Understanding learners' needs around the world means listening carefully to our community of schools, and we are pleased that 98% of Cambridge schools say they would recommend us to other schools.

Our mission is to provide excellence in education, and our vision is that Cambridge learners become confident, responsible, innovative, and engaged.

Cambridge programs and qualifications help Cambridge learners to become:

- **confident** in working with information and ideas—their own and those of others
- **responsible** for themselves, responsive to and respectful of others
- **innovative** and equipped for new and future challenges
- **engaged** intellectually and socially, ready to make a difference.

Support in the Classroom

We provide a world-class support service for Cambridge teachers and exams officers. We offer a wide range of teacher materials to Cambridge schools, plus teacher training (online and face-to-face), expert advice, and learner support materials. Exams officers can trust in reliable, efficient administration of exams entry and excellent, personal support from our customer services. Learn more at **www.cie.org.uk/teachers**

Nonprofit, Part of the University of Cambridge

We are a part of Cambridge Assessment, a department of the University of Cambridge and a nonprofit organization.

We invest constantly in research and development to improve our programs and qualifications.

1.2 Why Choose Cambridge IGCSE?

Cambridge IGCSE helps your school improve learners' performance. Learners develop not only knowledge and understanding, but also skills in creative thinking, inquiry, and problem solving, helping them perform well and prepare for the next stage of their education.

Cambridge IGCSE is the world's most popular international curriculum for 14 to 16 year olds, leading to globally recognized and valued Cambridge IGCSE qualifications. It is part of the Cambridge Secondary 2 stage.

Schools worldwide have helped develop Cambridge IGCSE, which provides an excellent preparation for Cambridge International AS and A Levels, Cambridge Pre-U, Cambridge AICE (Advanced International Certificate of Education), and other education programs, such as the US Advanced Placement Program and the International Baccalaureate Diploma. Cambridge IGCSE incorporates the best in international education for learners at this level. It develops in line with changing needs, and we update and extend it regularly.

1.3 Why Choose Cambridge IGCSE Biology?

Cambridge IGCSE Biology is accepted by universities and employers as proof of real ability and knowledge. As well as a subject focus, the biology syllabus enables students to:

- better understand the technological world with an informed interest in scientific matters
- recognize the usefulness (and limitations) of scientific method and how to apply this to other disciplines and in everyday life
- develop relevant attitudes, such as a concern for accuracy and precision, objectivity, integrity, inquiry, initiative, and inventiveness
- further interest in, and care for, the environment
- better understand the influence and limitations placed on scientific study by society, economy, technology, ethics, the community, and the environment
- develop an understanding of the scientific skills essential for both further study at Cambridge International A Level and in everyday life.

1.4 Cambridge International Certificate of Education (ICE)

Cambridge ICE is the group award of Cambridge IGCSE. It gives schools the opportunity to benefit from offering a broad and balanced curriculum by recognizing the achievements of learners who pass examinations in at least seven subjects. Learners take subjects from five subject groups, including two languages, and one subject from each of the other subject groups. The seventh subject can be taken from any of the five subject groups.

Biology falls into Group III, Science.

Learn more about Cambridge IGCSE and Cambridge ICE at **www.cie.org.uk/cambridgesecondary2**

1.5 How Can I Find Out More?

If You Are Already a Cambridge School

You can make entries for this qualification through your usual channels. If you have any questions, please contact us at **international@cie.org.uk**

If You Are Not Yet a Cambridge School

Learn about the benefits of becoming a Cambridge school at **www.cie.org.uk/startcambridge**.
Email us at **international@cie.org.uk** to find out how your organization can become a Cambridge school.

2. Assessment at a Glance

Candidates are awarded grades ranging from A* to G.

Candidates expected to achieve grades D, E, F, or G study the Core Curriculum only and are eligible for grades C to G.

Candidates expected to achieve grade C or higher should study the Extended Curriculum, which consists of the Core and Supplement content; these candidates are eligible for all grades from A* to G.

All candidates must enter for **three** papers.

<table>
<tr><th colspan="2">All candidates take:</th></tr>
<tr><td colspan="2">Paper 1 45 minutes
Multiple-choice question paper
Weighted at 30% of total available marks</td></tr>
<tr><th>and either:</th><th>or:</th></tr>
<tr><td>Paper 2 1 hour, 15 minutes
Core theory paper
Weighted at 50% of total available marks</td><td>Paper 3 1 hour, 15 minutes
Extended theory paper
Weighted at 50% of total available marks</td></tr>
<tr><th>and either:</th><th>or:</th></tr>
<tr><td>Paper 4
Coursework
Weighted at 20% of total available marks</td><td>Paper 5 1 hour, 15 minutes
Practical Test
Weighted at 20% of total available marks</td></tr>
</table>

Availability

This syllabus is examined in the May/June examination series and the October/November examination series.

Combining This with Other Syllabi

Candidates can combine this syllabus in an examination series with any other Cambridge syllabus, except:

- syllabi with the same title at the same level
- 0653 Cambridge IGCSE Combined Science
- 0654 Cambridge IGCSE Coordinated Sciences (Double Award)

3. Syllabus Goals and Objectives

3.1 Goals

The goals of the syllabus, listed below, are the same for all candidates. They are not listed in order of priority.

1. to provide a worthwhile educational experience for all candidates, through well-designed studies of experimental and practical science, whether or not they go on to study science beyond this level
2. to enable candidates to acquire sufficient understanding and knowledge to:
   - become confident citizens in a technological world, to take or develop an informed interest in scientific matters
   - recognize the usefulness, and limitations, of scientific method and to appreciate its applicability in other disciplines and in everyday life
   - be suitably prepared for studies beyond the Cambridge IGCSE in pure sciences, in applied sciences, or in science-dependent vocational courses
3. to develop abilities and skills that:
   - are relevant to the study and practice of biology
   - are useful in everyday life
   - encourage efficient and safe practice
   - encourage effective communication
4. to develop attitudes relevant to biology such as:
   - concern for accuracy and precision
   - objectivity
   - integrity
   - inquiry
   - initiative
   - inventiveness
5. to stimulate interest in, and care for, the environment
6. to promote an awareness that:
   - scientific theories and methods have developed, and continue to do so, as a result of the cooperative activities of groups and individuals
   - the study and practice of science is subject to social, economic, technological, ethical, and cultural influences and limitations
   - the applications of science may be both beneficial and detrimental to the individual, the community, and the environment
   - science transcends national boundaries and that the language of science, correctly and rigorously applied, is universal

Cambridge IGCSE Biology places considerable emphasis on understanding and use of scientific ideas and principles in a variety of situations, including those that are well-known to the candidate and those that are new to them. It is anticipated that programs 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 candidates 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.

3.2 Assessment Objectives

The three assessment objectives in Cambridge IGCSE Biology are:

A: Knowledge with understanding
B: Handling information and problem solving
C: Experimental skills and investigations

A description of each assessment objective follows.

A: Knowledge with Understanding

Candidates should be able to demonstrate knowledge and understanding of:

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.

Syllabus content defines the factual material that candidates may be required to recall and explain. Candidates will also be asked questions that require them to apply this material to unfamiliar contexts and to apply knowledge from one area of the syllabus to knowledge of a different syllabus area.

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 Glossary of Terms Used in Science Papers).

B: Handling Information and Problem Solving

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

1. locate, select, organize, 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.

Questions testing these skills may be based on information that is unfamiliar to candidates, requiring them to apply the principles and concepts from the syllabus to a new situation, in a logical, reasoned, or deductive way.

Questions testing these objectives will often begin with one of the following words: *discuss, predict, suggest, calculate, explain,* or *determine* (see Glossary of Terms Used in Science Papers).

C: Experimental Skills and Investigations

Candidates should be able to:

1. know how to 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 investigations, evaluate methods, and suggest possible improvements (including the selection of techniques, apparatus, and materials).

3.3 Scheme of Assessment

All candidates must enter for three papers: Paper 1; one from either Paper 2 or Paper 3; and one from either Paper 4 or Paper 5.

Candidates who have studied only 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 either Paper 4 (Coursework) or Paper 5 (Practical Test).

<table>
<tr><th colspan="2">All candidates take:</th></tr>
<tr><td colspan="2">Paper 1 45 minutes
A multiple-choice paper consisting of 40 items of the four-choice type.
Questions will be based on the Core Curriculum and will be of a difficulty appropriate to grades C to G.
This paper will test skills mainly in Assessment Objectives A and B.
This paper will be weighted at 30% of the final total available marks.</td></tr>
<tr><th>and either:</th><th>or:</th></tr>
<tr><td>Paper 2 1 hour, 15 minutes
Written paper consisting of 80 marks of short-answer and structured questions.
Questions will be based on the Core Curriculum and will be of a difficulty appropriate to grades C to G.
Questions will test skills mainly in Assessment Objectives A and B.
This paper will be weighted at 50% of the final total available marks.</td><td>Paper 3 1 hour, 15 minutes
Written paper consisting of 80 marks of short-answer and structured questions.
Questions will be based on the Extended Curriculum and will be of a difficulty appropriate to the higher grades.
Questions will test skills mainly in Assessment Objectives A and B.
At least 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.</td></tr>
<tr><th>and either:</th><th>or:</th></tr>
<tr><td>Paper 4 *
Coursework
Internal assessment of practical skills **
This paper will be weighted at 20% of the final total available marks.</td><td>Paper 5 * 1 hour, 15 minutes
Practical Test
Questions covering experimental skills.
This paper will be weighted at 20% of the final total available marks.</td></tr>
</table>

* 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.

** At least one teacher in each Center offering a subject including coursework must be accredited by Cambridge.

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

3.4 Weightings

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

Teachers should 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. Teachers' schemes of work (unit lesson plans) and the sequence of learning activities should reflect this balance so that the goals of the syllabus may be met and the candidates fully prepared for the assessment.

Assessment objective	Paper 1 (marks)	Papers 2 or 3 (marks)	Papers 4 or 5 (marks)	Whole assessment (%)
A: Knowledge with understanding	25–30	48–52	0	47–54
B: Handling information and problem solving	10–15	27–32	0	26–33
C: Experimental skills and investigations	0	0	40	20

3.5 Conventions (e.g., Signs, Symbols, Terminology, and Nomenclature)

This syllabus and question papers conform with generally accepted international practice.

In particular, attention is drawn to the following documents, published in the UK, which 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 16–19 Science (2000)

(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).

Liter/dm^3
To avoid any confusion concerning the symbol for liter, **dm^3** will be used in place of *l* or liter.

Decimal markers
In accordance with current ASE convention, decimal markers in examination papers will be a single dot on the line. Candidates are expected to follow this convention in their answers. See Section 6.2.1 for more details.

4. Curriculum Content

The Curriculum content below is a guide to the areas on which candidates are assessed.

It is important that, throughout this course, teachers should make candidates aware of the relevance of the concepts studied to everyday life, and to the natural and made worlds.

Specific content has been limited in order to encourage this approach and to allow flexibility in the design of teaching programs.

Cambridge also provides schemes of work (unit lesson plans), which can be found on the Cambridge Teacher Support website.

Candidates may follow the **Core Curriculum** only **or** they may follow the **Extended Curriculum**, which includes both the Core and the Supplement.

Candidates will be expected to give biologically correct definitions of any of the terms printed in italics.

Section I: Characteristics and Classification of Living Organisms (5% of teaching time)	
1. Characteristics of Living Organisms	

Core
• List and describe the characteristics of living organisms
• Define the terms:
  • *nutrition* as taking in of nutrients which are organic substances and mineral ions, containing raw materials or energy for growth and tissue repair, absorbing and assimilating them
  • *excretion* as removal from organisms of toxic materials, the waste products of metabolism (chemical reactions in cells including respiration), and substances in excess of requirements
  • *respiration* as the chemical reactions that break down nutrient molecules in living cells to release energy
  • *sensitivity* as the ability to detect or sense changes in the environment (stimuli) and to make responses
  • *reproduction* as the processes that make more of the same kind of organism
  • *growth* as a permanent increase in size and dry mass by an increase in cell number or cell size or both
  • *movement* as an action by an organism or part of an organism causing a change of position or place	

2. Classification and Diversity of Living Organisms	
2.1 Concept and Use of a Classificatory System **Core** • Define and describe the *binomial system* of naming species as a system in which the scientific name of an organism is made up of two parts showing the genus and species • List the main features of the following vertebrates: bony fish, amphibians, reptiles, birds, and mammals	**Supplement** • Know that there are other classification systems, e.g., cladistics (based on RNA/DNA sequencing data) • 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)* **Core** • List the main features used in the classification of the following groups: flowering plants (monocotyledons and eudicotyledons (dicotyledons)), arthropods (insects, crustaceans, arachnids, and myriapods), annelids, nematodes, and molluscs	
3. Simple Keys	
Core • Use simple dichotomous keys based on easily identifiable features	

Section II: Organization and Maintenance of the Organism (50% of teaching time)	
1. Cell Structure and Organization	
Core • State that living organisms are made of cells • 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	**Supplement** • Relate the structures seen under the light microscope in the plant cell and in the animal cell to their functions
2. Levels of Organization	

Core
• 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:
  • *tissue* as a group of cells with similar structures, working together to perform a shared function
  • *organ* as a structure made up of a group of tissues, working together to perform specific functions
  • *organ system* as a group of organs with related functions, working together to perform body functions
using examples covered in Sections II and III	

3. Size of Specimens	
Core • Calculate magnification and size of biological specimens using millimeters as units	

4. Movement In and Out of Cells	
4.1 Diffusion **Core** • Define *diffusion* as the net movement of molecules from a region of their higher concentration to a region of their lower concentration down a concentration gradient, as a result of their random movement • Describe the importance of diffusion of gases and solutes and of water as a solvent	
4.2 Active Transport	**Supplement** • Define *active transport* as movement of ions in or out of a cell through the cell membrane, from a region of their lower concentration to a region of their higher concentration against a concentration gradient, using energy released during respiration • Discuss the importance of active transport 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 **Core** • Define *osmosis* as the diffusion of water molecules from a region of their higher concentration (dilute solution) to a region of their lower concentration (concentrated solution), through a partially permeable membrane • Describe the importance of osmosis in the uptake of water by plants, and its effects on plant and animal tissues	**Supplement** • Describe and explain the importance of a water potential gradient in the uptake of water by plants

5. Enzymes	
Core • Define the term *catalyst* as a substance that speeds up a chemical reaction and is not changed by the reaction • Define *enzymes* as proteins that function as biological catalysts • Investigate and describe the effect of changes in temperature and pH on enzyme activity	**Supplement** • Explain enzyme action in terms of the "lock and key" model • Explain 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 laundry detergents and in the food industry (including pectinase and fruit juice) • Outline the use of microorganisms and fermenters to manufacture the antibiotic penicillin and enzymes for use in laundry detergents • Describe the role of the fungus *Penicillium* in the production of antibiotic penicillin
6. Nutrition	
Core • Define *nutrition* as taking in of nutrients that are organic substances and mineral ions, containing raw materials or energy for growth and tissue repair, absorbing and assimilating them	

6.1 Nutrients
Core
• 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)
  • fiber (roughage)
  • water
• Describe the deficiency symptoms for:
  • vitamins (C and D only)
  • mineral salts (calcium and iron only)
	• Describe the use of microorganisms in the food industry, with reference to yogurt and single cell protein
	• Describe the uses, benefits, and health hazards associated with food additives, including colorings

6.2 Plant Nutrition	
6.2.1 Photosynthesis **Core** • Define *photosynthesis* as the fundamental process by which plants manufacture carbohydrates from raw materials using energy from light • State the word equation for the production of simple sugars and oxygen • Investigate the necessity for chlorophyll, light, and carbon dioxide for photosynthesis, using appropriate controls • Describe the intake of carbon dioxide and water by plants • Explain that chlorophyll traps light energy and converts it into chemical energy for the formation of carbohydrates and their subsequent storage	**Supplement** • State the balanced equation for photosynthesis in symbols $6CO_2 + 6H_2O \xrightarrow[\text{chlorophyll}]{\text{light}} C_6H_{12}O_6 + 6O_2$ • Investigate and state the effect of varying light intensity, carbon dioxide concentration, and temperature on the rate of photosynthesis (e.g., in submerged aquatic plants) • Define the term *limiting factor* as something present in the environment in such short supply that it restricts life processes • Explain the concept of limiting factors in photosynthesis • Explain the use of carbon dioxide enrichment, optimum light, and optimum temperatures in greenhouse systems

6.2.2 Leaf Structure **Core** • Identify and label the cuticle, cellular, and tissue structure of a dicotyledonous leaf, as seen in cross-section under the light microscope, and describe the significance of these features in terms of functions, to include: • distribution of chloroplasts—photosynthesis • stomata and mesophyll cells—gas exchange • vascular bundles (xylem and phloem)—transport and support	

6.2.3 Mineral Requirements
Core
• Describe the importance of:
  • nitrate ions for protein synthesis
  • magnesium ions for chlorophyll synthesis
• Describe the uses, and the dangers of overuse, of nitrogen fertilizers
	Supplement
	• Explain the effects of nitrate ion and magnesium ion deficiency on plant growth

6.3 Animal Nutrition	
6.3.1 Diet **Core** • State what is meant by the term *balanced diet* and describe a balanced diet related to age, sex, and activity of an individual • Describe the effects of malnutrition in relation to starvation, coronary heart disease, constipation, and obesity	
6.3.2 Food Supply **Core** • Discuss ways in which the use of modern technology has resulted in increased food production (to include modern agricultural machinery, chemical fertilizers, pesticides and herbicides, artificial selection)	**Supplement** • Discuss the problems of world food supplies • Discuss the problems that contribute to famine (unequal distribution of food, drought and flooding, and increasing population)

6.3.3 Human Alimentary Canal **Core** • Define *ingestion* as taking substances (e.g., food, drink) into the body through the mouth • Define *egestion* as passing out of food that has not been digested, as feces, through the anus • Identify the main regions of the alimentary canal and associated organs including mouth, salivary glands, esophagus, stomach, small intestine: duodenum and ileum, pancreas, liver, gall bladder, large intestine: colon and rectum, anus • Describe the functions of the regions of the alimentary canal listed above, in relation to ingestion, digestion, absorption, assimilation, and egestion of food (cross reference 6.3.4, 6.3.5, 6.3.6 and 6.3.7)	
6.3.4 Mechanical and Physical Digestion **Core** • Define *digestion* as the break-down of large, insoluble food molecules into small, water-soluble molecules using mechanical and chemical processes • Identify the types of human teeth and describe their structure and functions • State the causes of dental decay and describe the proper care of teeth • Describe the process of chewing • Describe the role of longitudinal and circular muscles in peristalsis • Outline the role of bile in emulsifying fats, to increase the surface area for the action of enzymes	**Supplement** • Describe how fluoride reduces tooth decay and explain arguments for and against the addition of fluoride to public water supplies
6.3.5 Chemical Digestion **Core** • State the significance of chemical digestion in the alimentary canal in producing small, soluble molecules that can be absorbed • State where, in the alimentary canal, amylase, protease, and lipase enzymes are secreted • State the functions of a typical amylase, a protease, and a lipase, listing the substrate and end-products	

6.3.6 Absorption **Core** • Define *absorption* as movement of digested food molecules through the wall of the intestine into the blood or lymph • Identify the small intestine as the region for the absorption of digested food • Describe the significance of villi in increasing the internal surface area of the small intestine	**Supplement** • Describe the structure of a villus, including the role of capillaries and lacteals • State the role of the hepatic portal vein in the transport of absorbed food to the liver • Identify the role of the small intestine and colon in absorption of water (the small intestine absorbs 5–10 dm^3 per day, the colon 0.3–0.5 dm^3 per day)
6.3.7 Assimilation **Core** • Define *assimilation* as movement of digested food molecules into the cells of the body where they are used, becoming part of the cells • Describe the role of the liver in the metabolism of glucose (glucose → glycogen) and amino acids (amino acids → proteins and destruction of excess amino acids) • Describe the role of fat as an energy storage substance	**Supplement** • Define *deamination* as removal of the nitrogen-containing part of amino acids to form urea, followed by release of energy from the remainder of the amino acid • State that the liver is the site of breakdown of alcohol and other toxins
7. Transportation	
7.1 Transport in Plants **Core** • State the functions of xylem and phloem • Identify the positions of xylem and phloem tissues as seen in transverse sections of unthickened, herbaceous, dicotyledonous roots, stems, and leaves	
7.1.1 Water Uptake **Core** • Identify root hair cells, as seen under the light microscope, and state their functions • State the pathway taken by water through root, stem, and leaf (root hair, root cortex cells, xylem, mesophyll cells) • Investigate, using a suitable stain, the pathway of water through the above-ground parts of a plant	**Supplement** • Relate the structure and functions of root hairs to their surface area and to water and ion uptake

7.1.2 Transpiration **Core** • Define *transpiration* as evaporation of water at the surfaces of the mesophyll cells followed by loss of water vapor from plant leaves, through the stomata • Describe how water vapor loss is related to cell surfaces, air spaces, and stomata • Describe the effects of variation of temperature, humidity, and light intensity on transpiration rate • Describe how wilting occurs	**Supplement** • 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 **three** contrasting environments, to include pond, garden, and desert, with emphasis on local examples (where appropriate) and the factors described in the core

7.1.3 Translocation
Core
• Define *translocation* in terms of the movement of sucrose and amino acids in phloem;
  • from regions of production
  • to regions of storage OR to regions of utilization in respiration or growth
	Supplement
	• 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 **Core** • Describe the circulatory system as a system of tubes with a pump and valves to ensure one-way flow of blood • Describe the double circulation in terms of a low-pressure circulation to the lungs and a high-pressure circulation to the body tissues and relate these differences to the different functions of the two circuits	
7.2.1 Heart **Core** • Describe the structure of the heart including the muscular wall and septum, chambers, valves, and associated blood vessels • Describe the function of the heart in terms of muscular contraction and the working of the valves • Investigate, state, and explain the effect of physical activity on pulse rate • Describe coronary heart disease in terms of the blockage of coronary arteries and state the possible causes (diet, stress, and smoking) and preventive measures	

7.2.2 Arteries, Veins, and Capillaries **Core** • Name the main blood vessels to and from the heart, lungs, liver, and kidney • Describe the structure and functions of arteries, veins, and capillaries	**Supplement** • Explain how structure and function are related in arteries, veins, and capillaries • Describe the transfer of materials between capillaries and tissue fluid

7.2.3 Blood
Core
• Identify red and white blood cells as seen under the light microscope on prepared slides and in diagrams and photomicrographs
• List the components of blood as red blood cells, white blood cells, platelets, and plasma
• State the functions of blood:
  • red blood cells—hemoglobin and oxygen transport
  • white blood cells—phagocytosis and antibody formation
  • platelets—causing clotting (no details)
  • plasma—transport of blood cells, ions, soluble nutrients, hormones, carbon dioxide, urea, and plasma proteins
	Supplement
	• Describe the immune system in terms of antibody production, tissue rejection, and phagocytosis
	• Describe the function of the lymphatic system in circulation of body fluids and the production of lymphocytes
	• Describe the process of clotting (fibrinogen to fibrin only)

8. Respiration	
Core • Define *respiration* as the chemical reactions that break down nutrient molecules in living cells to release energy • State the uses of energy in the body of humans: muscle contraction, protein synthesis, cell division, active transport, growth, the passage of nerve impulses, and the maintenance of a constant body temperature	
8.1 Aerobic Respiration **Core** • Define *aerobic respiration* as the release of a relatively large amount of energy in cells by the breakdown of food substances in the presence of oxygen • State the word equation for aerobic respiration	**Supplement** • State the equation for aerobic respiration using symbols ($C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$)

8.2 Anaerobic Respiration **Core** • Define *anaerobic respiration* as the release of a relatively small amount of energy by the breakdown of food substances in the absence of oxygen • State the word equation for anaerobic respiration in muscles during hard exercise (glucose → lactic acid) and the microorganism yeast (glucose → alcohol + carbon dioxide) • Describe the role of anaerobic respiration in yeast during brewing and bread-making • Compare aerobic respiration and anaerobic respiration in terms of relative amounts of energy released	**Supplement** • State the balanced 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 • Describe the effect of lactic acid in muscles during exercise (include oxygen debt in outline only)
8.3 Gas Exchange **Core** • List the features of gas exchange surfaces in animals • Identify on diagrams and name the larynx, trachea, bronchi, bronchioles, alveoli, and associated capillaries • State the differences in composition between inspired and expired air • Use lime water as a test for carbon dioxide to investigate the differences in composition between inspired and expired air • Investigate and describe the effects of physical activity on rate and depth of breathing	**Supplement** • 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 role of mucus and cilia in protecting the gas exchange system from pathogens and particles • Explain the link between physical activity and rate and depth of breathing in terms of changes in the rate at which tissues respire and therefore of carbon dioxide concentration and pH in tissues and in the blood

9. Excretion in Humans	
Core	**Supplement**
• Define *excretion* as the removal from organisms of toxic materials, the waste products of metabolism (chemical reactions in cells including respiration), and substances in excess of requirements. Substances should include carbon dioxide, urea, and salts	

• Describe the function of the kidney in terms of the removal of urea and excess water and the reabsorption of glucose and some salts (details of kidney structure and nephron are **not** required)	• Outline the structure of a kidney (cortex, medulla, and the start of the 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
	  • 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 and salts

• State the relative positions of ureters, bladder, and urethra in the body	
• State that urea is formed in the liver from excess amino acids	• Explain dialysis in terms of maintenance of glucose and protein concentration in blood and diffusion of urea from blood to dialysis fluid
• State that alcohol, drugs, and hormones are broken down in the liver	• Discuss the application of dialysis in kidney machines • Discuss the advantages and disadvantages of kidney transplants, compared with dialysis

10. Coordination and Response	
10.1 Nervous Control in Humans **Core** • 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 which together serve to coordinate and regulate body functions • Identify motor (effector), relay (connector), and sensory neurons from diagrams • Describe a simple reflex arc in terms of sensory, relay, and motor neurons, and a reflex action as a means of automatically and rapidly integrating and coordinating stimuli with responses • State that muscles and glands can act as effectors • Describe the action of antagonistic muscles to include the biceps and triceps at the elbow joint • Define sense *organs* as groups of receptor cells responding to specific stimuli: light, sound, touch, temperature, and chemicals • Describe the structure and function of the eye, including accommodation and pupil reflex	**Supplement** • Distinguish between voluntary and involuntary actions • Distinguish between rods and cones, in terms of function and distribution
10.2 Hormones **Core** • Define a *hormone* as a chemical substance, produced by a gland, carried by the blood, which alters the activity of one or more specific target organs and is then destroyed by the liver • State the role of the hormone adrenaline in chemical control of metabolic activity, including increasing the blood glucose concentration and pulse rate • Give examples of situations in which adrenaline secretion increases • Compare nervous and hormonal control systems	**Supplement** • Discuss the use of hormones in food production
10.3 Tropic Responses **Core** • Define and investigate *geotropism* (as a response in which a plant grows toward or away from gravity) and *phototropism* (as a response in which a plant grows toward or away from the direction from which light is coming)	**Supplement** • 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

10.4 Homeostasis **Core** • Define *homeostasis* as the maintenance of a constant internal environment • Identify on a diagram of the skin: hairs, sweat glands, temperature receptors, blood vessels, and fatty tissue • Describe the maintenance of a constant body temperature in humans in terms of insulation and the role of temperature receptors in the skin, sweating, shivering, vasodilation and vasoconstriction of arterioles supplying skin-surface capillaries, and the coordinating role of the brain	**Supplement** • Explain the concept of control by negative feedback • Describe the control of the glucose content of the blood by the liver, and by insulin and glucagon from the pancreas
10.5 Drugs **Core** • Define a drug as any substance taken into the body that modifies or affects chemical reactions in the body • Describe the medicinal use of antibiotics for the treatment of bacterial infection • Describe the effects of the abuse of heroin: a powerful depressant, problems of addiction, severe withdrawal symptoms, and associated problems such as crime and infection, e.g., HIV/AIDS • Describe the effects of excessive consumption of alcohol: reduced self-control, depressant, effect on reaction times, damage to liver, and social implications • Describe the effects of tobacco smoke and its major toxic components (tar, nicotine, carbon monoxide, smoke particles) on the gas exchange system	**Supplement** • Explain why antibiotics kill bacteria but not viruses

Section III: Development of the Organism and the Continuity of Life (25% of teaching time)	
1. Reproduction	
1.1 Asexual Reproduction **Core** • Define *asexual reproduction* as the process resulting in the production of genetically identical offspring from one parent • Describe asexual reproduction in bacteria, spore production in fungi, and tuber formation in potatoes	**Supplement** • Discuss the advantages and disadvantages to a species of asexual reproduction
1.2 Sexual Reproduction **Core** • Define *sexual reproduction* as the process involving the fusion of haploid nuclei to form a diploid zygote and the production of genetically dissimilar offspring	**Supplement** • Discuss the advantages and disadvantages to a species of sexual reproduction
1.2.1 Sexual Reproduction in Plants **Core** • Identify and draw, using a hand lens if necessary, the sepals, petals, stamens, anthers, carpels, ovaries, and stigmas of one, locally available, named, insect-pollinated, dicotyledonous flower, and examine the pollen grains under a light microscope or in photomicrographs • State the functions of the sepals, petals, anthers, stigmas, and ovaries • Use a hand lens to identify and describe the anthers and stigmas of one, locally available, named, wind-pollinated flower, and examine the pollen grains under a light microscope or in photomicrographs • Candidates should expect to apply their understanding of the flowers they have studied to unfamiliar flowers	**Supplement**

• Define *pollination* as the transfer of pollen grains from the male part of the plant (anther of stamen) to the female part of the plant (stigma) • 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 its entry into the ovule followed by fertilization (production of endosperm and details of development are **not** required) • Investigate and describe the structure of a non-endospermic seed in terms of the embryo (radicle, plumule, and cotyledons) and testa, protected by the fruit • Outline the formation of a seed (limited to embryo, cotyledons, testa, and role of mitosis) and fruit (produced from the ovary wall) • State that seed and fruit dispersal by wind and by animals provides a means of colonizing new areas • Describe, using named examples, seed and fruit dispersal by wind and by animals	• Distinguish between self-pollination and cross-pollination • Discuss the implications to a species of self-pollination and cross-pollination

1.2.2 Sexual Reproduction in Humans **Core** • Identify on diagrams of the male reproductive system, the testes, scrotum, sperm ducts, prostate gland, urethra, and penis, and state the functions of these parts • Identify on diagrams of the female reproductive system, the ovaries, oviducts, uterus, cervix, and vagina, and state the functions of these parts • Describe the menstrual cycle in terms of changes in the uterus and ovaries • Outline sexual intercourse and describe fertilization in terms of the joining of the nuclei of male gamete (sperm) and the female gamete (egg) • Outline early development of the zygote simply in terms of the formation of a ball of cells that becomes implanted in the wall of the uterus • Outline the development of the fetus • Describe the function of the placenta and umbilical cord in relation to exchange of dissolved nutrients, gases, and excretory products (no structural details are required) • Describe the prenatal care of pregnant women including special dietary needs and maintaining good health • Outline the processes involved in labor and birth	**Supplement** • Compare male and female gametes in terms of size, numbers, and mobility • Explain the role of hormones in controlling the menstrual cycle (including FSH, LH, progesterone, and estrogen) • Indicate the functions of the amniotic sac and amniotic fluid • Describe the advantages and disadvantages of breast-feeding compared with bottle-feeding using formula milk
1.3 Sex Hormones **Core** • Describe the roles of testosterone and estrogen in the development and regulation of secondary sexual characteristics at puberty	**Supplement** • Describe the sites of production and the roles of estrogen and progesterone in the menstrual cycle and in pregnancy (cross reference 1.2.2)

1.4 Methods of Birth Control
Core
• Outline the following methods of birth control:
  • natural (abstinence, rhythm method)
  • chemical (contraceptive pill, spermicide)
  • mechanical (condom, diaphragm, female condom, IUD)
  • surgical (vasectomy, female sterilization)
	Supplement
	• Outline artificial insemination and the use of hormones in fertility drugs, and discuss their social implications

1.5 Sexually Transmissible Diseases **Core** • Describe the symptoms, signs, effects, and treatment of gonorrhea • Describe the methods of transmission of human immunodeficiency virus (HIV), and the ways in which HIV/AIDS can be prevented from spreading	**Supplement** • Outline how HIV affects the immune system in a person with HIV/AIDS
2. Growth and Development	
Core • Define *growth* in terms of a permanent increase in size and dry mass by an increase in cell number or cell size or both • Define *development* in terms of increase in complexity • Investigate and state the environmental conditions that affect germination of seeds: requirement for water and oxygen, suitable temperature	
3. Inheritance	
Core • Define *inheritance* as the transmission of genetic information from generation to generation	

3.1 Chromosomes
Core
• Define the terms:
  • *chromosome* as a thread of DNA, made up of a string of genes
  • *gene* as a length of DNA that is the unit of heredity and codes for a specific protein. A gene may be copied and passed on to the next generation
  • *allele* as any of two or more alternative forms of a gene
  • *haploid nucleus* as a nucleus containing a single set of unpaired chromosomes (e.g., sperm and egg)
  • *diploid nucleus* as a nucleus containing two sets of chromosomes (e.g., in body cells)
• Describe the inheritance of sex in humans (XX and XY chromosomes)	

3.2 Mitosis **Core** • Define *mitosis* as nuclear division giving rise to genetically identical cells in which the chromosome number is maintained by the exact duplication of chromosomes (details of stages are **not** required) • State the role of mitosis in growth, repair of damaged tissues, replacement of worn out cells, and asexual reproduction	
3.3 Meiosis **Core** • Define *meiosis* as reduction division in which the chromosome number is halved from diploid to haploid (details of stages are **not** required) • State that gametes are the result of meiosis • State that meiosis results in genetic variation so the cells produced are not all genetically identical	

3.4 Monohybrid Inheritance
Core
• Define the terms:
  • *genotype* as genetic makeup of an organism in terms of the alleles present (e.g., Tt or GG)
  • *phenotype* as the physical or other features of an organism due to both its genotype and its environment (e.g., tall plant or green seed)
  • *homozygous* as having two identical alleles of a particular gene (e.g., TT or gg). Two identical homozygous individuals that breed together will be pure-breeding
  • *heterozygous* as having two different alleles of a particular gene (e.g., Tt or Gg), not pure-breeding
  • *dominant* as an allele that is expressed if it is present (e.g., T or G)
  • *recessive* as an allele that is only expressed when there is no dominant allele of the gene present (e.g., t or g)
• Calculate and predict the results of monohybrid crosses involving 1 : 1 and 3 : 1 ratios
	Supplement
	• Explain codominance by reference to the inheritance of ABO blood groups—phenotypes, A, B, AB, and O blood groups and genotypes I^A, I^B, and I^O

3.5 Variation **Core** • State that continuous variation is influenced by genes and environment, resulting in a range of phenotypes between two extremes, e.g., height in humans • State that discontinuous variation is caused by genes alone and results in a limited number of distinct phenotypes with no intermediates e.g., A, B, AB, and O blood groups in humans • Define *mutation* as a change in a gene or chromosome • Describe mutation as a source of variation, as shown by Down syndrome • Outline the effects of ionizing radiation and chemicals on the rate of mutation	**Supplement** • Describe sickle cell anemia, and explain its incidence in relation to that of malaria
3.6 Selection **Core** • Describe the role of artificial selection in the production of varieties of animals and plants with increased economic importance • Define *natural selection* as the greater chance of passing on of genes by the best adapted organisms	**Supplement** • 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 **Core** • Define *genetic engineering* as taking a gene from one species and putting it into another species	**Supplement** • Explain why, and outline how, human insulin genes were put into bacteria using genetic engineering

Section IV: Relationships of Organisms with One Another and with Their Environment (20% of teaching time)

1. Energy Flow

Core

- State that the Sun is the principal source of energy input to biological systems
- Describe the noncyclical nature of energy flow

2. Food Chains and Food Webs (Emphasis on Examples Occurring Locally)

Core

- Define the terms:
  - *food chain* as a chart showing the flow of energy (food) from one organism to the next beginning with a producer (e.g., mahogany tree → caterpillar → song bird → hawk)
  - *food web* as a network of interconnected food chains showing the energy flow through part of an ecosystem
  - *producer* as an organism that makes its own organic nutrients, usually using energy from sunlight, through photosynthesis
  - *consumer* as an organism that gets its energy by feeding on other organisms
  - *herbivore* as an animal that gets its energy by eating plants
  - *carnivore* as an animal that gets its energy by eating other animals
  - *decomposer* as an organism that gets its energy from dead or waste organic matter
  - *ecosystem* as a unit containing all of the organisms and their environment, interacting together in a given area, e.g., decomposing log or a lake
  - *trophic level* as the position of an organism in a food chain, food web, or pyramid of biomass, numbers, or energy
- Describe energy losses between trophic levels
- Draw, describe, and interpret pyramids of biomass and numbers

Supplement

- Explain why food chains usually have fewer than five trophic levels
- Explain why 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	

Core
• Describe the carbon and the water cycles
	Supplement
	• 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 oxygen and carbon dioxide concentrations in the atmosphere

4. Population Size	
Core • Define *population* as a group of organisms of one species, living in the same area at the same time • State the factors affecting the rate of population growth for a population of an organism (limited to food supply, predation, and disease), and describe their importance • Identify the lag, exponential (log), stationary, and death phases in the sigmoid population growth curve for a population growing in an environment with limited resources • Describe the increase in human population size and its social implications • Interpret graphs and diagrams of human population growth	**Supplement** • Explain the factors that lead to the lag phase, exponential (log) phase, and stationary phase in the sigmoid curve of population growth making reference, where appropriate, to the role of limiting factors

5. Human Influences on the Ecosystem	
Core • Outline the effects of humans on ecosystems, with emphasis on examples of international importance (tropical rain forests, oceans, and important rivers)	
5.1 Agriculture **Core** • List the undesirable effects of deforestation (to include extinction, loss of soil, flooding, carbon dioxide build up) • Describe the undesirable effects of overuse of fertilizers (to include eutrophication of lakes and rivers)	

5.2 Pollution
Core
• Describe the undesirable effects of pollution to include:
  • water pollution by sewage and chemical waste
  • air pollution by sulfur dioxide
  • air pollution by greenhouse gases (carbon dioxide and methane) contributing to global warming
  • pollution due to pesticides including insecticides and herbicides
  • pollution due to nuclear fall-out
	Supplement
	• Discuss the effects of nonbiodegradable plastics in the environment
	• Discuss the causes and effects on the environment of acid rain and the measures that might be taken to reduce its incidence
	• Explain how increases in greenhouse gases (carbon dioxide and methane) are thought to cause global warming

5.3 Conservation
Core
• Describe the need for conservation of:
  • species and their habitats
  • natural resources (limited to water and nonrenewable materials including fossil fuels)
	Supplement
	• Explain how limited and nonrenewable resources can be recycled (including recycling of paper and treatment of sewage to make the water that it contains safe to return to the environment or for human use)

5. Practical Assessment

Scientific subjects are, by their nature, experimental. So it is important that an assessment of a candidate's knowledge and understanding of biology should contain a practical component (see Assessment Objective C).

Centers' circumstances (e.g., the availability of resources) differ greatly, so two alternative ways of examining the relevant assessment are provided. The two alternatives are:

- Paper 4—Coursework (internal assessment)
- Paper 5—Practical Test

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

- the same assessment objectives apply
- the same practical skills are to be learned and developed
- the same benefits to theoretical understanding come from all practical work
- the same motivational effect, enthusiasm, and enjoyment should be experienced
- the same sequence of practical activities is appropriate
- teachers should not contravene any school, education authority, or government regulations that restrict the sampling of saliva, blood, urine, or other bodily secretions and tissues.

5.1 Paper 4: Coursework

At least one teacher in each Center offering a subject including coursework must be accredited by Cambridge.

The experimental skills and abilities to be assessed are:

C1 Using and organizing techniques, apparatus, and materials

C2 Observing, measuring, and recording

C3 Handling experimental observations and data

C4 Planning and evaluating investigations

The four skills carry equal weighting.

All assessments must be based on 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 Cambridge evidence of 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, Cambridge 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 given a mark of zero for that assessment.

Criteria for Assessing Experimental Skills and Abilities

Each skill must be assessed on a six-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 by 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.

Score	Skill C1: Using and Organizing Techniques, Apparatus, and Materials
0	No evidence of positive achievement for this skill.
1	Some evidence of positive achievement, but the criteria for a score of 2 are not met.
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	Is beyond the level defined for 2, but does not meet fully the criteria for 4.
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	Is beyond the level defined for 4, but does not meet fully the criteria for 6.
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 safely, correctly, and methodically.
Score	**Skill C2: Observing, Measuring, and Recording**
0	No evidence of positive achievement for this skill.
1	Some evidence of positive achievement, but the criteria for a score of 2 are not met.
2	Makes observations or readings given detailed instructions. Records results in an appropriate manner given a detailed format.
3	Is beyond the level defined for 2, but does not meet fully the criteria for 4.
4	Makes relevant observations, measurements, or estimates given an outline format or brief guidelines. Records results in an appropriate manner given an outline format.
5	Is beyond the level defined for 4, but does not meet fully the criteria for 6.
6	Makes relevant observations, measurements, or estimates to a degree of accuracy appropriate to the instruments or techniques used. Records results in an appropriate manner given no format.

Score	Skill C3: Handling Experimental Observations and Data
0	No evidence of positive achievement for this skill.
1	Some evidence of positive achievement, but the criteria for a score of 2 are not met.
2	Processes results in an appropriate manner given a detailed format. Draws an obvious qualitative conclusion from the results of an experiment.
3	Is beyond the level defined for 2, but does not meet fully the criteria for 4.
4	Processes results in an appropriate manner given an outline format. Recognizes and comments on anomalous results. Draws qualitative conclusions that are consistent with obtained results and deduces patterns in data.
5	Is beyond the level defined for 4, but does not meet fully the criteria for 6.
6	Processes results in an appropriate manner given no format. Deals appropriately with anomalous or inconsistent results. Recognizes and comments on possible sources of experimental error. Expresses conclusions as generalizations or patterns where appropriate.
Score	**Skill C4: Planning and Evaluating Investigations**
0	No evidence of positive achievement for this skill.
1	Some evidence of positive achievement, but the criteria for a score of 2 are not met.
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	Is beyond the level defined for 2, but does not meet fully the criteria for 4.
4	Specifies a sequence of activities to investigate a given practical problem. In a situation where there are two variables, recognizes 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	Is beyond the level defined for 4, but does not meet fully the criteria for 6.
6	Analyzes a practical problem systematically and produces a logical plan for an investigation. In a given situation, recognizes 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.

Guidance on Candidate Assessment

The following notes are intended to provide teachers with information to help them 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.
- 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.
- Extended experimental investigations are of great educational value. If 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 within a teaching group, or within a Center, to be assessed on exactly the same practical work, although teachers can use work that is undertaken by all of their candidates.
- When assessing group work, teachers must ensure that each candidate's individual contribution is 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.
- Skills C2, C3, and C4 will usually generate a written product from the candidates; this 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 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

Internal Moderation

When several teachers in a Center are involved in internal assessment, arrangements must be made within the Center for all candidates to be assessed to the same standard. It is essential that the marks for each skill assigned within different teaching groups (or classes) are moderated internally for the whole Center entry. The Center assessments will then be moderated externally by Cambridge.

External Moderation

External moderation of internal assessment is carried out by Cambridge. Centers must submit candidates' internally assessed marks to Cambridge. The deadlines and methods for submitting internally assessed marks are in the *Cambridge Administrative Guide* available on our website.

Once it has received the marks, Cambridge will draw up a list of sample candidates whose work will be moderated (a further sample may also be requested) and will ask the Center to immediately send every piece of work which has contributed toward these candidates' final marks. Individual Candidate Record Cards and Coursework Assessment Summary Forms must also be sent with the coursework. All remaining coursework and records should be kept by the Center until results are published.

Ideally, Centers should use loose-leaf letter-size filler paper for practical written work, as this is cheaper to send by mail. Original work is preferred for moderation, but authenticated photocopies can be sent if absolutely necessary.

Pieces of work for each skill should **not** be stapled together. Each piece of work should be clearly and securely labeled with:

- the skill being assessed
- the Center number
- the candidate's name and number
- the title of the experiment
- a copy of the mark scheme used
- the mark awarded.

5.2 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 hydrogen carbonate 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 recognize, 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.

Candidates may be required to do the following:

- record readings from apparatus
- describe, explain, or comment on experimental arrangements and techniques
- complete tables of data
- draw conclusions from observations and/or from information given
- interpret and evaluate observations and experimental data
- plot graphs and/or interpret graphical information
- identify sources of error and suggest possible improvements in procedures
- plan an investigation, including suggesting suitable techniques and apparatus.

Candidates will not be required to carry out weighing for the practical test.

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), hydrogen carbonate indicator, litmus paper, and Universal Indicator paper.

5.3 Laboratory Equipment

The following is a list of the conditions, materials, and equipment that are considered appropriate for the teaching of Cambridge 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
N = hazardous to the environment

Laboratory Conditions

Adequate bench space (more than 1m × 1m for each candidate)

Water supply—not necessarily tap water

Gas supply (for heating)—mains/cylinder

Electrical supply—domestic power/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 glasses.

Chemical reagents

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

Instruments

- rulers capable of measuring to 1 mm
- mounted needles or seekers or long pins with large head
- 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)

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
- dishes such as Petri dishes or tin lids
- means of measuring small and larger volumes of liquids such as syringes, volumetric pipettes, or graduated 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 (dialysis tubing) or other partially 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:

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

Mortar and pestle or blender

6. Appendix A

6.1 Grade Descriptions

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

Grade A	**Candidate must show mastery of the Core curriculum and the Extended curriculum**
A **Grade A** candidate will 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
Grade C	**Candidate must show mastery of the Core curriculum, plus some ability to answer questions that are pitched at a higher level.**
A **Grade C** candidate will be able to:	• link facts to situations not specified in the syllabus • describe the correct procedure(s) for a multistage 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
Grade F	**Candidate must show competence in answering questions based on the Core curriculum.**
A **Grade F** candidate will 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 • recognize which of two given hypotheses explains a set of facts or data

6.2 Terminology, Units, Symbols, and Presentation of Data for Biology

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

This section follows the practice laid down in the documents:

(a) Association for Science Education (ASE)
Signs, Symbols and Systematics: The ASE Companion to 16–19 Science (2000)

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

6.2.1 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 10000 will be printed without commas. A space will be left between each group of three whole numbers, e.g., 4256789.

6.2.2 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

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***
length	kilometer	km
	meter	m
	centimeter	cm
	millimeter	mm
	micrometer	µm
mass	tonne (1000 kg)	
	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		
energy	kilojoule	kJ
	joule (calorie is obsolete)	J
(c) Recommended units for area, volume, and density		
area	hectare = 10^4 m^2	ha
	square meter	m^2
	square decimeter	dm^2
	square centimeter	cm^2
	square millimeter	mm^2
volume	cubic kilometer	km^3
	cubic meter	m^3
	cubic decimeter (preferred to liter)	dm^3
	liter	dm^3 (**not** *l*)
	cubic centimeter	cm^3 (**not** m*l*)
	cubic millimeter	mm^3
density	kilogram per cubic meter	kg m^{-3}
	gram per cubic centimeter	g cm^{-3}

Use of Solidus

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

6.2.3 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

- 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., meters per sec or m per s or m s^{-1}.
- The column headings of the table can then be directly transferred to the axes of a constructed graph.

(b) Graphs

- Each axis will be labeled with the physical quantity and the appropriate unit, e.g., time/s.
- The graph is the whole diagrammatic presentation. It may have one or several curves plotted on it.
- Curves and lines joining points on the graph should be referred to as "curves."
- 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) 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.

6.2.4 Taxonomy

Taxonomy is the study of the principles of the organization 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 recognized 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, e.g., *Homo sapiens*. The first word is the generic name (genus) and the second word is the specific name (species).

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

(d) The generic name always takes an initial capital (uppercase) letter. It can be accepted as a shorthand for the specific name where the intent is obvious, e.g., *Plasmodium,* and in these circumstances can stand alone. The specific name always has an initial small (lowercase) letter when following the generic name, e.g., *Escherichia coli*.

(e) The scientific name should generally be written in full when it is first used, but may then be abbreviated when subsequently used, e.g., *Escherichia coli* becomes *E. coli*.

(f) 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.

(g) 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."

6.2.5 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 labeled 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 lowercase versions are easily distinguishable, e.g., B and b. The uppercase letter indicates the dominant allele and the lowercase letter indicates the recessive allele.

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

(f) Some form of checkerboard should be used to demonstrate genotypes that can result from random fusion of gametes. Candidates 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.

6.2.6 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) Generalized terms should be stated in English, e.g., small intestine.

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

6.3 Glossary of Terms Used in Science Papers

This glossary (which is relevant only to Science subjects) will prove helpful to candidates as a guide, but 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 greenhouse).

    (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).

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.

6.4 Mathematical Requirements

Calculators may be used in all parts of the examination.

Candidates should be able to:

- add, subtract, multiply, and divide
- understand averages, decimals, fractions, percentages, ratios, and reciprocals
- recognize and use scientific notation
- use direct and inverse proportion
- use positive, whole number indices
- draw charts and graphs from given data
- interpret charts and graphs
- select suitable scales and axes for graphs
- make approximate evaluations of numerical expressions
- recognize and use the relationship between length, surface area, and volume and their units, on metric scales
- use usual mathematical instruments (ruler, compasses)
- understand the meaning of radius, diameter, square, rectangle.

7. Appendix B: Forms

SCIENCES
Experiment Form
IGCSE

Please read the instructions printed overleaf.

Centre number						Centre name	
Syllabus code		**0**	**4**	**3**	**8**	Syllabus title	**Biology**
Component number		**0**		**4**		Component title	**Coursework**
June/November	**2**	**0**	**1**	**4**			

Experiment number	Experiment	Skill(s) assessed

WMS616

UNIVERSITY of CAMBRIDGE
International Examinations

IGCSE/BIOLOGY/CW/EX/14

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 candidates performed for assessment in the Cambridge 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.

UNIVERSITY *of* CAMBRIDGE
International Examinations

IGCSE/BIOLOGY/CW/EX/14

SCIENCES

Individual Candidate Record Card

IGCSE 2014

Please read the instructions printed on the previous page and the General Coursework Regulations before completing this form.															
Centre number						Centre name						June/November	**2**	**0**	**1**	**4**
Candidate number						Candidate name						Teaching group/set				
Syllabus code	**0**	**4**	**3**	**8**		Syllabus title	**BIOLOGY**	Component number	**0**	**4**		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 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)

UNIVERSITY of CAMBRIDGE International Examinations

IGCSE/BIOLOGY/CW/S/

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 Training Manual.
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 co-ordinating the internal assessment (i.e. the internal moderator), and a single valid and reliable set of marks should be produced which 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.** The deadlines and methods for submitting internally assessed marks are in the *Cambridge Administrative Guide* available on our website.

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

SCIENCES

Coursework Assessment Summary Form

IGCSE 2014

Please read the instructions printed overleaf and the General Coursework Regulations before completing this form.

Centre number						Centre name		June/November	2	0	1	4
Syllabus code	**0**	**4**	**3**	**8**	Syllabus title	**BIOLOGY**	Component number	**0**	**4**	Component title	**COURSEWORK**	

Candidate number	Candidate name	Teaching group/ set	C1 (max 12)	C2 (max 12)	C3 (max 12)	C4 (max 12)	Total mark (max 48)	Internally moderated mark (max 48)

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

UNIVERSITY of CAMBRIDGE International Examinations

IGCSE/BIOLOGYCW/S/

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 which will allow ease of transfer of information to a computer-printed Coursework mark sheet MS1 at a later stage (i.e. in candidate 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 group or set.
3. Transfer each candidate's marks from his or her Individual Candidate Record Card to this form as follows:
   (a) Where there are columns for individual skills or assignments, 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 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 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. The deadlines and methods for submitting internally assessed marks are in the *Cambridge Administrative Guide* available on our website.
3. Cambridge will select a list of candidates whose work is required for external moderation. As soon as this list is received, send candidates' work, with the corresponding Individual Candidate Record Cards, this summary form and the second copy of MS1, to Cambridge.
4. Experiment Forms, Work Sheets and Marking Schemes must be included for each task **that has contributed to the final mark of these candidates**.
5. Photocopies of the samples may be sent **but** candidates' original work, with marks and comments from the teacher, is preferred.
6. (a) The pieces of work for each skill should **not** be stapled together, nor should individual sheets be enclosed in plastic wallets.
   (b) Each piece of work should be clearly labelled with the skill being assessed, Centre name, candidate name and number and the mark awarded. For each task, supply the information requested in B.4 above.
7. Cambridge reserves the right to ask for further samples of Coursework.

8. Appendix C: Additional Information

8.1 Guided Learning Hours

Cambridge IGCSE syllabi are designed with the assumption that candidates have about 130 guided learning hours per subject over the duration of the course. ("Guided learning hours" include direct teaching and any other supervised or directed study time. They do not include private study by the candidate.)

However, this figure is for guidance only, and the number of hours required may vary according to local curricular practice and the candidates' prior experience with the subject.

8.2 Recommended Prerequisites

We recommend that candidates who are beginning this course should have previously studied a science curriculum such as that of the Cambridge Lower Secondary Programme or equivalent national educational frameworks. Candidates should also have adequate mathematical skills for the content contained in this syllabus.

8.3 Progression

Cambridge IGCSE Certificates are general qualifications that enable candidates to progress either directly to employment, or to proceed to further qualifications.

Candidates who are awarded grades C to A* in IGCSE Biology are well prepared to follow courses leading to Cambridge International AS and A Level Biology, or the equivalent.

8.4 Component Codes

Because of local variations, in some cases component codes will be different in instructions about making entries for examinations and timetables from those printed in this syllabus, but the component names will be unchanged to make identification straightforward.

8.5 Grading and Reporting

Cambridge IGCSE results are shown by one of the grades A*, A, B, C, D, E, F, or G, indicating the standard achieved, Grade A* being the highest and Grade G the lowest. "Ungraded" indicates that the candidate's performance fell short of the standard required for Grade G. "Ungraded" will be reported on the statement of results but not on the certificate.

8.6 Access

Reasonable adjustments are made for disabled candidates in order to enable them to access the assessments and to demonstrate what they know and what they can do. For this reason, very few candidates will have a complete barrier to the assessment. Information on reasonable adjustments is found in the *Cambridge Handbook*, which can be downloaded from the website **www.cie.org.uk**

Candidates who are unable to access part of the assessment, even after exploring all possibilities through reasonable adjustments, may still be able to receive an award based on the parts of the assessment they have taken.

8.7 Support and Resources

Copies of syllabi, the most recent question papers, and Principal Examiners' reports for teachers are on the Syllabus and Support Materials CD-ROM, which we send to all Cambridge International Schools. They are also on our public website—go to **www.cie.org.uk/igcse**. Click the **Subjects** tab and choose your subject. For resources, click "Resource List."

You can use the "Filter by" list to show all resources or only resources categorized as "Endorsed by Cambridge." Endorsed resources are written to align closely with the syllabus they support. They have been through a detailed quality-assurance process. As new resources are published, we review them against the syllabus and publish their details on the relevant resource list section of the website.

Additional syllabus-specific support is available from our secure Teacher Support website **http://teachers.cie.org.uk**, which is available to teachers at registered Cambridge schools. It provides past question papers and examiner reports on previous examinations, as well as any extra resources such as schemes of work (unit lesson plans) or examples of candidate responses. You can also find a range of subject communities on the Teacher Support website, where Cambridge teachers can share their own materials and join discussion groups.

University of Cambridge International Examinations
1 Hills Road, Cambridge, CB1 2EU, United Kingdom
Tel: +44 (0)1223 553554 Fax: +44 (0)1223 553558
Email: international@cie.org.uk www.cie.org.uk

3530039344