Singapore Examinations and Assessment Board

CAMBRIDGE International Education

Singapore–Cambridge General Certificate of Education Advanced Level Higher 1 (2027)

Biology (Syllabus 8876)

CONTENTS

PREAMBLE

This preamble sets out the approach, objectives, directions and philosophy of the H1 Biology syllabus.

In Singapore, Biology education from Primary to A-Level has been organised as a continuum in the following manner:

(a) from Primary 3 to Primary 6, students learn about how life works at the systems level

(b) from Lower Secondary Science to O-Level Biology, students learn about how life works at the physiological level

(c) at A-Level, students learn about how life works at the cellular and molecular levels while understanding the implications of these at the macro level.

At A-Level, students have the choice of offering Biology at H1 or H2 levels. The H1 Biology curriculum is designed as a subset of H2 Biology. While H2 Science develops in our students the disciplinary understanding, skills and attitudes necessary for further studies in the subject and related fields, H1 Science is designed to broaden students' learning in a way that will support the development of scientific literacy. It is especially important for future citizens in an increasingly digital and technology-driven world to be equipped to make informed decisions, based on sound scientific knowledge and principles, about current and emerging science-related issues which are important to self, society and the world at large (for example, in understanding the impacts of climate change and what can be done to reduce the impact). The H1 Biology syllabus is distilled from the H2 Biology syllabus and key changes to the H1 Science curriculum are in tandem with the changes in the H2 Science curriculum.

The Biology syllabus is developed as a seamless continuum from O-Level to A-Level, without the need for topics to be revisited at A-Level. The O-Level syllabus is foundational and thus should provide the necessary background for study at A-Level.

Many new and important fields of biology have emerged through recent advancements in life sciences. Vast amounts of knowledge have been generated, as evident from the sprouting of scientific journals catering to niche areas of research. As such, this syllabus refines and updates the content knowledge of the previous syllabus (8876) so that students can keep up to date with knowledge that is relevant for their participation in a technology-driven economy and as a global citizen cognisant of the impacts of climate change.

INTRODUCTION

Candidates will be assumed to have knowledge and understanding of O-Level Biology, either as a single subject or as part of a balanced science course.

The syllabus has been arranged in the form of Core and Extension content to be studied by all candidates. The syllabus places emphasis on the applications of biology and the impact of recent developments on the needs of contemporary society.

Experimental work is an important component and should underpin the teaching and learning of biology.

The value of learning H1 Biology ultimately hinges on the development of a scientific mind and disposition while addressing the broader questions of what life is and how life is sustained. The Science Curriculum Framework developed by the Ministry of Education elaborates on the development of the scientific mind and disposition. Through the study of the H1 Biology course, students should become scientifically literate citizens who are well prepared for the challenges of the 21st century.

AIMS

The *Aims* of a course based on this syllabus should be to:

1 provide students with an experience that develops their interest in biology and builds the knowledge, skills and attitudes necessary for them to become scientifically literate citizens who are well prepared for the challenges of the 21st century

2 develop in students the understanding, skills, ethics and attitudes relevant to the *Practices of Science*, including the following:

   2.1 demonstrating ways of thinking and doing

   2.2 understanding the nature of scientific knowledge

   2.3 relating science, technology, society and environment

3 address the broader questions of what life is and how life is sustained, including:

   3.1 understanding life at the cellular and molecular levels, and making connections to how these micro-systems interact at the physiological and organismal levels

   3.2 recognising the evolving nature of biological knowledge

   3.3 stimulating interest in and demonstrating care for the local and global environment.

PRACTICES OF SCIENCE

Science as a discipline is more than the acquisition of a body of knowledge (e.g. scientific facts, concepts, laws and theories); it is a way of knowing and doing. It includes an understanding of the nature of scientific knowledge and how this knowledge is generated, established and communicated. Scientists rely on a set of established procedures and practices associated with scientific inquiry to gather evidence and test their ideas on how the natural world works. However, there is no single method and the real process of science is often complex and iterative, following many different paths. While science is powerful, generating knowledge that forms the basis for many technological feats and innovations, it has limitations.

The *Practices of Science* are explicitly articulated in the syllabus to allow teachers to embed them as learning objectives in their lessons. Students' understanding of the nature and limitations of science and scientific inquiry are developed effectively when the practices are taught in the context of relevant science content. Attitudes relevant to science such as *inquisitiveness*, *concern for accuracy* and *precision*, *objectivity*, *integrity* and *perseverance* should be emphasised in the teaching of these practices where appropriate. For example, students learning science should be introduced to the use of technology as an aid in practical work or as a tool for the interpretation of experimental and theoretical results.

The *Practices of Science* comprise three components:

1 Demonstrating Ways of Thinking and Doing (WOTD)

The Ways of Thinking and Doing in Science illustrate a set of established procedures and practices associated with scientific inquiry to gather evidence and test ideas on how the natural world works. There are three broad, iterative domains of scientific activity: investigating, evaluating and reasoning, and developing explanations and solutions.

1.1 Posing questions and defining problems

1.2 Designing investigations

1.3 Conducting experiments and testing solutions

1.4 Analysing and interpreting data

1.5 Communicating, evaluating and defending ideas with evidence

1.6 Making informed decisions and taking responsible actions

1.7 Using and developing models[1]

1.8 Constructing explanations and designing solutions

2 Understanding the Nature of Scientific Knowledge (NOS)

Science is an epistemic endeavour to build a better understanding of reality.

2.1 Science is an evidence-based, model-building enterprise to understand the real world.

2.2 Science assumes natural causes, order and consistency in natural systems.

2.3 Scientific knowledge is generated through established procedures and critical debate.

2.4 Scientific knowledge is reliable, durable and open to change in light of new evidence.

3 Relating Science-Technology-Society-Environment (STSE)

Science is not done completely independently of the other spheres of human activity. The relationships and connections to these areas are important as students learn science in context.

3.1 There are risks and benefits associated with the applications of science in society.

3.2 Applications of science often have ethical, social, economic and environmental implications.

3.3 Applications of new scientific discoveries often drive technological advancements while advances in technology enable scientists to make new or deeper inquiry.

[1] *A model is a representation of an idea, an object, a process or a system that is used to describe and explain phenomena that cannot be experienced directly. Models exist in different forms from the concrete, such as physical, scale models to abstract representations, such as diagrams or mathematical expressions. The use of models involves the understanding that all models contain approximations and assumptions limiting their validity and predictive power.*

CURRICULUM FRAMEWORK

The A-Level Biology Curriculum Framework (Figure 1) guides the design and implementation of the A-level Biology curriculum.

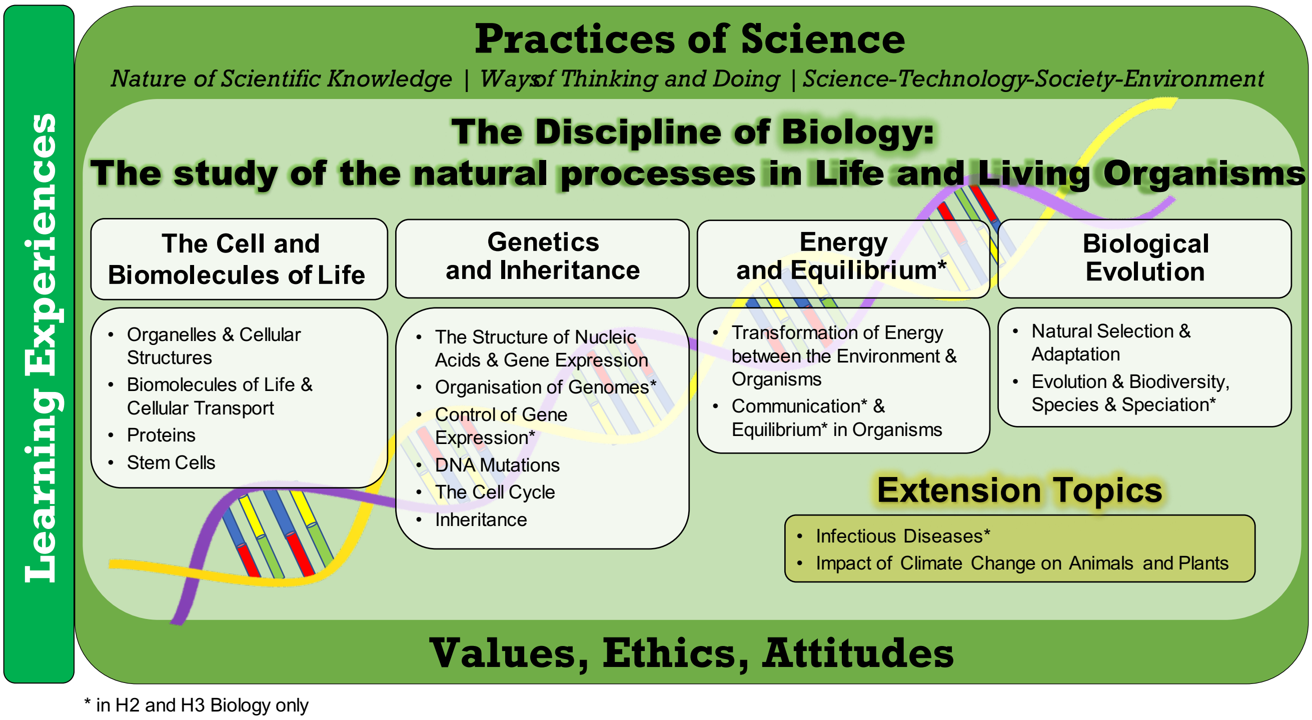

Figure 1: A-Level Biology Curriculum Framework

The *Practices of Science* highlight the ways of thinking and doing that are inherent in the scientific approach, with the aim of equipping students with the understanding, skills, and attitudes shared by the scientific disciplines, including an appropriate approach to ethical issues.

The *Values, Ethics, Attitudes* undergird the study of science and the use of related knowledge and skills to make a positive contribution to humanity.

The *Learning Experiences (LEs)*[2] refer to a range of learning opportunities that enhance students' learning of Biology. Real-world contexts can help illustrate the application of Biology concepts and bring the subject to life. These *LEs* would include experimental (practical work) activities and ICT tools that can be used to build students' understanding.

The *Disciplinary Content* of the Biology syllabuses is organised around four *Core Ideas* of Biology. Besides the *Core Ideas*, the H1 Biology syllabus features an *Extension Topic*, (A) Impact of Climate Change on Animals and Plants. The *Extension Topic* is based on important emerging biological issues impacting both the local and global contexts. It requires students to demonstrate assimilation of the *Core Ideas* and extend their knowledge and understanding to real-world challenges. Furthermore, the *Extension Topic* will equip students with the necessary knowledge and process skills to make informed decisions about scientific issues. The *Extension Topic* takes up about 15 per cent of the total H1 Biology curriculum.

Students are expected to study all four *Core Ideas* and the *Extension Topic*.

[2] *Learning Experiences* can be found in the Teaching and Learning Syllabus.

ASSESSMENT OBJECTIVES

The *Assessment Objectives* listed below reflect those parts of the *Aims and Practices of Science* that will be assessed.

A Knowledge with understanding

Candidates should be able to demonstrate knowledge with understanding in relation to:

1 scientific phenomena, facts, laws, definitions, concepts and theories

2 scientific vocabulary, terminology and conventions (including symbols, quantities and units)

3 scientific instruments and apparatus, including techniques of operation and aspects of safety

4 scientific quantities and their determination

5 scientific and technological applications with their social, economic and environmental implications.

The syllabus content defines the factual knowledge that candidates may be required to recall and explain. Questions testing these objectives will often begin with one of the following words: *define, state, name, describe, explain or outline* (see the *Glossary of Terms*).

B Handling, applying and evaluating information

Candidates should be able (in words or by using symbolic, graphical and numerical forms of presentation) to:

1 locate, select, organise, interpret and present information from a variety of sources

2 handle information, distinguishing the relevant from the extraneous

3 manipulate numerical and other data and translate information from one form to another

4 present reasoned explanations for phenomena, patterns, trends and relationships

5 make comparisons that may include the identification of similarities and differences

6 analyse and evaluate information to identify patterns, report trends, draw inferences, report conclusions and construct arguments

7 justify decisions, make predictions and propose hypotheses

8 apply knowledge, including principles, to novel situations

9 use skills, knowledge and understanding from different areas of Biology to solve problems

10 organise and present information, ideas and arguments clearly and coherently, using appropriate language.

These *Assessment Objectives* above cannot be precisely specified in the syllabus content because questions testing such skills are often based on information which is unfamiliar to the candidate. In answering such questions, candidates are required to use principles and concepts that are within the syllabus and apply them in a logical, reasoned or deductive manner to a novel situation. Questions testing these objectives will often begin with one of the following words: *discuss, predict, suggest, calculate* or *determine* (see the *Glossary of Terms*).

SCHEME OF ASSESSMENT

All candidates are required to enter for Papers 1 and 2.

Paper	Type of Paper	Duration	Weighting (%)	Marks
1	**Multiple Choice**	1 h	33	30
2	**Structured and Free-response Questions**	2 h	67	60

Paper 1 (1 h, 30 marks)

This paper will consist of 30 compulsory multiple choice questions. All questions will include four options.

Paper 2 (2 h, 60 marks)

This paper will comprise two sections. Paper 2 will include questions that assess the higher-order skills of analysing, making conclusions and evaluating information and require candidates to integrate knowledge and understanding from different areas of the syllabus.

Section A (45 marks) will consist of a variable number of structured questions, all compulsory, including at least one data-based or comprehension-type question. The data-based question(s) will constitute 10–15 marks of the paper.

Section B (15 marks) will consist of two free-response questions, from which candidates will choose **one**. The quality of scientific argumentation and written communication will be given a percentage of the marks available.

Weighting of Assessment Objectives

Assessment Objective		Weighting (%)	Assessment Components
A	**Knowledge with understanding**	45	Papers 1, 2
B	**Handling, applying and evaluating information**	55	Papers 1, 2

ADDITIONAL INFORMATION

Modern biological sciences draw extensively on concepts from the physical sciences. It is desirable therefore that, by the end of the course, students should have knowledge of the following topics, sufficient to aid understanding of biological systems. No questions will be set directly on them except where relevant to the assessment of a Learning Outcome.

- The electromagnetic spectrum
- Energy changes (potential energy, activation energy, chemical bond energy)
- Molecules, atoms, ions, electrons
- Acids, bases, pH, buffers
- Isotopes, including radioactive isotopes
- Oxidation and reduction
- Hydrolysis, condensation

Nomenclature

Candidates will be expected to be familiar with the nomenclature used in the syllabus. The proposals in '*Signs, Symbols and Systematics*' (The Association for Science Education Companion to 16–19 Science, 2000) and the recommendations on terms, units and symbols in '*Biological Nomenclature*' (2009) published by the Institute of Biology, in conjunction with the ASE, will generally be adopted although the traditional names sulfate, sulfite, nitrate, nitrite, sulfurous acid and nitrous acid will be used in question papers. Sulfur (and all compounds of sulfur) will be spelt with f (not with ph) in question papers. However, candidates can use either spelling in their answers.

Disallowed Subject Combinations

Candidates may not simultaneously offer Biology at H1 and H2 levels.

Mathematical Requirements

Questions set in the examination may involve the basic processes of mathematics for the calculation and use of decimals, means, ratios and percentages.

Candidates may be required to (i) construct graphs or present data in other suitable graphical forms, and (ii) calculate rates of processes. Candidates should be aware of the problems of drawing conclusions from limited data.

Calculators

Any calculator used must be on the Singapore Examinations and Assessment Board list of approved calculators.

Units and Significant Figures

Candidates should be aware that misuse of units and/or significant figures, e.g. failure to quote units where necessary, the inclusion of units in quantities defined as ratios or quoting answers to an inappropriate number of significant figures, is liable to be penalised.

STRUCTURE OF SYLLABUS

The syllabus is divided into two parts: *Core Ideas* and *Extension Topic*, to be studied by all candidates.

I Core Ideas. There are **4 Core Ideas**:

1. The Cell and Biomolecules of Life
2. Genetics and Inheritance
3. Energy
4. Biological Evolution.

II Extension Topic. There is **1 Extension Topic**:

A Impact of Climate Change on Animals and Plants.

I CORE IDEAS

1 The Cell and Biomolecules of Life

Content

- The cell theory
- Outline functions of membrane systems and organelles in cells
- The structure of a typical bacterial cell
- The structures of biomolecules and their functions
- The fluid mosaic model of membrane structure
- Mode of action of enzymes
- Stem cells

Learning Outcomes

Candidates should be able to:

(a) outline the cell theory with the understanding that cells are the smallest unit of life, all cells come from pre-existing cells and living organisms are composed of cells

(b) interpret and recognise drawings, photomicrographs and electron micrographs of the cytoplasm (cytosol) and cellulose cell wall, and the following membrane systems and organelles: rough and smooth endoplasmic reticulum, Golgi body, mitochondria, ribosomes, lysosomes, chloroplasts, cell surface membrane, nuclear envelope, centrioles, nucleus and nucleolus

(c) outline the functions of the cell structures listed in (b)

(d) describe the structure of a typical bacterial cell (small and unicellular, peptidoglycan cell wall, circular DNA, 70S ribosomes and lack of membrane-bound organelles)

(e) describe the structure and properties of the following monomers:

i α-glucose and β-glucose (in carbohydrates)

ii glycerol and fatty acids (in lipids)

iii amino acids (in proteins) (knowledge of chemical formulae of specific R-groups of different amino acids is not required)

(f) describe the formation and breakage of the following bonds:

i glycosidic bond

ii ester bond

iii peptide bond

(g) describe the structures and properties of the following biomolecules and explain how these are related to their roles in living organisms:

- i starch (including amylose and amylopectin)
- ii cellulose
- iii triglyceride
- iv phospholipid

(h) explain the fluid mosaic model and the roles of the constituent biomolecules (including phospholipids, proteins, glycolipids, glycoproteins and cholesterol) in cell membranes

(i) outline the functions of membranes at the surface of cells and membranes within the cell

(j) explain how and why different substances move across membranes through simple diffusion, osmosis, facilitated diffusion, active transport, endocytosis and exocytosis

(k) explain primary structure, secondary structure, tertiary structure and quaternary structure of proteins, and describe the types of bonds that hold the molecule in shape (hydrogen, ionic and disulfide bonds, and hydrophobic interactions)

(l) explain the effects of temperature and pH on protein structure

(m) describe the molecular structure of the haemoglobin protein and explain how its structure relates to its function in transport (knowledge of details of the number of amino acids and types of secondary structures present is not required)

(n) explain the mode of action of enzymes in terms of an active site, enzyme–substrate complex, lowering of activation energy and enzyme specificity using the lock-and-key and induced-fit hypotheses

(o) investigate and explain the effects of temperature, pH, enzyme concentration and substrate concentration on the rate of an enzyme-catalysed reaction by measuring rates of formation of products (e.g. measuring gas produced using catalase) or rate of disappearance of substrate (e.g. using amylase, starch and iodine)

(p) describe the unique features of stem cells, including zygotic stem cells, embryonic stem cells and blood stem cells, correctly using the terms:

- i totipotency (e.g. zygotic stem cells)
- ii pluripotency (e.g. embryonic stem cells)
- iii multipotency (e.g. blood stem cells)

(q) explain the normal functions of stem cells in a living organism, including embryonic stem cells and blood stem cells.

Use the knowledge gained in this section in new situations or to solve related problems.

2 Genetics and Inheritance

Content

- DNA – structure and function
- Central Dogma – DNA to RNA, RNA to protein
- Mutations
- Replication and division of nuclei and cells
- Understanding of chromosome number and variation
- Effect of meiosis on chromosome number and variation
- The molecular biology of cancer
- The passage of information from parents to offspring
- The effect of environment on phenotype
- Genotypes and phenotypes
- Dihybrid crosses

Learning Outcomes

Candidates should be able to:

(a) describe the structure and roles of DNA and RNA (tRNA, rRNA and mRNA) (knowledge of the structure and roles of mitochondrial DNA and chloroplast DNA is not required)

(b) describe the process of DNA replication

(c) describe how the information on DNA is used to synthesise polypeptides (description of the processes of transcription, formation of mRNA from pre-mRNA and translation is required)

(d) explain what is meant by the terms *gene mutation* and *chromosomal aberration*. For gene mutation, knowledge of how substitution, addition and deletion could change the amino acid sequence (including frameshift) is required. For chromosomal aberration, knowledge of numerical aberration (including aneuploidy, as in the case of trisomy 21, i.e. Down syndrome) and structural aberration (including translocation, duplication, inversion and deletion) is required

(e) explain how gene mutations can result in diseases (including sickle cell anaemia)

(f) discuss the bioethics of genetic maternal screening for mutations, including trisomy–21

(g) describe the events that occur during the mitotic cell cycle and the main stages of mitosis (including the behaviour of chromosomes, nuclear envelope, cell surface membrane and centrioles)

(h) explain the significance of the mitotic cell cycle (including growth, repair and asexual reproduction) and the need to regulate it tightly (knowledge that dysregulation of checkpoints of cell division can result in uncontrolled cell division and cancer is required, but details of the mechanism are not required)

(i) identify the causative factors, including genetic, chemical carcinogens and ionising radiation, which may increase the chances of cancerous growth

(j) describe the development of cancer as a multi-step process that includes accumulation of mutations (details of tumour suppressor genes and proto-oncogenes are not required), angiogenesis and metastasis

(k) explain the significance of the meiotic cell cycle (reduction division prior to fertilisation and cells not genetically identical) and that meiosis and random fertilisation can lead to variation (detailed description of the behaviour of chromosomes during meiosis is not required. Information about the stages and associated behaviour of the nuclear envelope, cell surface membrane and centrioles is not required.)

(l) explain the terms: *locus, allele, dominant, recessive, codominant, incomplete dominance, homozygous, heterozygous, phenotype, genotype* and *sex linkage*

(m) explain how genes are inherited from one generation to the next via the germ cells or gametes

(n) explain how the environment may affect the phenotype, using examples including the effect of diet on differentiation of honeybees

(o) use genetic diagrams to solve problems in dihybrid crosses, including those involving codominance, incomplete dominance, multiple alleles and sex linkage

(p) use genetic diagrams to solve problems involving test crosses.

Use the knowledge gained in this section in new situations or to solve related problems.

3 Energy

Content

- The need for energy in living organisms
- Photosynthesis as an energy-trapping process
- Respiration as an energy-releasing process
- Aerobic respiration
- Anaerobic respiration

Learning Outcomes

Candidates should be able to:

(a) state that photosynthesis occurs in chloroplasts

(b) identify the initial reactants and final products of the light-dependent and light-independent stages (details of the intermediate molecules, enzymes, names of complexes in the ETC and detailed mechanism of action of ATP synthase are not required)

(c) outline briefly that photosynthesis involves conversion of light energy to chemical energy and this energy is stored in the form of carbohydrates

(d) identify the initial reactants and final products for each of the main stages of respiration under aerobic conditions (glycolysis, link reaction, Krebs cycle and oxidative phosphorylation) (details of the intermediate molecules, enzymes, detailed mechanism of action of ATP synthase and calculation of total yield of ATP in each biochemical pathway are not needed)

(e) state that glycolysis occurs in the cytoplasm and that the link reaction, Krebs cycle and oxidative phosphorylation occur in the mitochondria

(f) identify the initial reactants and final products for respiration under anaerobic conditions in yeast and mammalian muscle tissue (details of the intermediate molecules and enzymes in each biochemical pathway are not needed)

(g) state that respiration under aerobic conditions releases more energy than respiration under anaerobic conditions.

Use the knowledge gained in this section in new situations or to solve related problems.

4 Biological Evolution

Content

- Variation, natural selection and evolution

Learning Outcomes

Candidates should be able to:

(a) explain why variation (as a result of mutation, meiosis and sexual reproduction) is important in natural selection

(b) explain, with examples, how environmental factors act as forces of natural selection

(c) explain the role of natural selection in evolution

(d) explain how genetic variation (including harmful recessive alleles) may be preserved in a natural population.

(e) explain the biological concept of the species.

Use the knowledge gained in this section in new situations or to solve related problems.

II EXTENSION TOPIC

A Impact of Climate Change on Animals and Plants

Content

- Human activities that contribute to climate change
- Effects of climate change
- Viral dengue disease in humans and how global warming affects its spread

Learning Outcomes

Candidates should be able to:

(a) identify and explain the human activities over the last few centuries that have contributed to climate change through accumulation of greenhouse gases (limited to CO_2 and methane), including burning of fossil fuels linked to increasing energy usage, clearing of forests and food choices (increasing consumption of meat)

(b) explain the effects of climate change as a result of greenhouse gas emissions, including melting of polar ice caps, rising sea levels, increase in frequency of extreme weather events, stress on fresh water supplies, migration of fishes and insects, stress to coral reef, seagrass and mangrove ecosystems, and release of greenhouse gases from frozen organic matter

(c) explain how mangrove ecosystems help to mitigate the impacts of climate change

(d) explain the relative differences between the carbon footprints of a range of anthropogenic activities, including deforestation, energy production (including fossil fuels, solar power, nuclear power and bioethanol) and food production (meat and plant-based)

(e) discuss the consequences to the sustainable food supply of increased environmental stress resulting from climate change, including the effects on plants and animals of increased temperature and more extreme weather events

(f) explain how temperature changes impact insects as a result of increased temperature leading to increased metabolism and the narrow temperature tolerance of insects, including how temperature affects the life cycle of *Aedes aegypti* as an example of a typical mosquito disease vector

(g) explain how global warming affects the spread of mosquito-borne infectious diseases, including malaria and dengue, beyond the tropics.

Use the knowledge gained in this section in new situations or to solve related problems.

TEXTBOOKS AND REFERENCES

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GLOSSARY OF TERMS

It is hoped that the glossary (which is relevant only to science subjects) will prove helpful to candidates as a guide; 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 *Analyse* is a context-specific term involving the identification of the constituent parts of a complex situation or result, an assessment of their individual implications and a consideration of how these relate to one another and to scientific knowledge and understanding. Analysis may require further processing of mathematical data to reveal underlying trends and patterns.

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

3 *Classify* requires candidates to group things based on common characteristics.

4 *Comment* is intended as an open-ended instruction, inviting candidates to recall or infer points of interest relevant to the context of the question, taking account of the number of marks available.

5 *Compare* requires candidates to provide both the similarities and differences between things or concepts.

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

7 *Define* (the term(s) ...) is intended literally. Only a formal statement or equivalent paraphrase is required.

8 *Describe* requires candidates to state in words (using diagrams where appropriate) the main points of the topic. It is often used with reference either to particular phenomena or to particular experiments. In the former instance, the term usually implies that the answer should include reference to (visual) observations associated with the phenomena.

In other contexts, *describe and give an account of* should be interpreted more generally, i.e. the candidate has greater discretion about the nature and the organisation of the material to be included in the answer. *Describe and explain* may be coupled in a similar way to *state and explain*.

9 *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.

10 *Discuss* requires candidates to give a critical account of the points involved in the topic.

11 *Draw* is often used in the context of drawing biological specimens. This is an instruction to make a freehand diagram to show the structures observed, as accurately as possible with respect to shape and proportion. Lines delimiting distinct regions should be continuous.

In other contexts, this will require an accurate representation of the required subject according to the applicable conventions and criteria, e.g. draw the structure of a molecule of glucose

12 *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.

13 *Evaluate* is a context-specific term requiring a critical use of information to make a judgement or determination of a particular value or quality (e.g. accuracy). Evaluation of the validity of an experimental procedure, a set of results or a conclusion involves an assessment of the extent to which the procedures, results or conclusions are likely to obtain or represent a ‘true’ outcome. This will require consideration of the advantages and disadvantages, strengths and weaknesses, and limitations of the underlying approach, as well as other relevant criteria as applicable, and their relative importance.

14 *Explain* may imply reasoning or some reference to theory, depending on the context.

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

16 *Justify* requires candidates to give reasoning in support of an answer (for example, a decision, conclusion, explanation or claim), based on a consideration of available evidence, including experimental data, together with relevant scientific knowledge and understanding.

17 *Label* requires candidates to use an appropriate label (and labelling line, where necessary) to accurately show the position of a structure, region or point within a diagram or graph, according to the requirements of the assessment.

18 *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.

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

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

21 *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 early part of the question.

22 *Recognise* is often used to identify facts, characteristics or concepts that are critical (relevant/appropriate) to the understanding of a situation, event, process or phenomenon.

23 *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.

24 *State* implies a concise answer with little or no supporting argument, e.g. a numerical answer that can be obtained ‘by inspection’.

25 *Suggest* is used in two main contexts, i.e. either to imply that there is no unique answer (e.g. in chemistry, two or more substances may satisfy the given conditions describing an ‘unknown’), or to imply that candidates are expected to apply their general knowledge to a ‘novel’ situation, one that may be formally ‘not in the syllabus’.

26 *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.