

Biology (Senior Secondary)

1 Introduction

Biology is a branch of science devoted to the study of living things. At HKUGAC, the study of biology aims to help students in understanding the nature of life and appreciate the wonders of the living world. Through providing biology-related learning experiences, students are fostered to develop scientific literacy, so that they can participate actively in our rapidly changing knowledge-based society, prepare for further studies or careers in the fields related to life science, and become lifelong learners in science and technology. In addition, students are being prepared to sit for the Hong Kong Diploma of Secondary Education (HKDSE) examination in biology at the end of S6.

1.1 Teaching methods

Appropriate learning and teaching approaches will be adopted by teachers to meet the different learning targets and outcomes of individual lessons, as well as the varied need and learning styles of our students.

1.1.1 Historical approach

The work of famous biologists will be revisited, so that students can discover how they went about exploring biological phenomena and solving problems through systematic inquiry. Science articles will be given to help students in understanding the past and promote students' independent learning.

1.1.2 Contextual approach

Inquiry activities that link biology to technological applications, societal issues and students' daily experiences will be given to enable students to acquire the relevant concepts, skills and attitudes in a step-wise manner.

1.1.3 Practical work and scientific investigation

As biology is a practical subject, students are guided to gain personal experience of science through hands-on practical activities, and to develop the skills and scientific thinking with the processes of problem-solving, decision-making and evaluation of evidence.

1.1.4 Problem-based learning

Students are challenged to solve real problems by applying thinking skills and working cooperatively in a group. Students are fostered with the skills to find and use appropriate learning resources, and to think critically and analytically. In this approach, students actively engage in the learning process and allow them to take responsibility for their own learning, training to become lifelong learners.

1.1.5 E-learning

E-learning has been implemented in the curriculum of Biology. It is broadly inclusive of different forms of educational technology in learning and teaching, such as multimedia learning, computer-aided instruction, internet-based training, web-based training, online education, virtual education, etc. E-learning is a valuable way for interactive learning which complements strategies for learning both inside and outside the classroom.

Through computer animations or simulations, students can visualize abstract concepts and processes. It also allows students to work at their own pace, and gives them more time to pursue creative activities. In addition, e-learning may extend students' learning through the internet, which is an extremely

valuable source of scientific information and resources. The internet may also provide opportunities for students to learn, sometimes collaboratively, with students in another part of the world. Through the use of electronic media, we aim to provide students with an enriched and more efficient learning environment, enhance self-directed learning and meet their varied learning needs – and to gradually become lifelong learners.

1.2 Assessment

Internal assessment will be carried out from S4 to S6. Both formative and summative assessments will be used in promoting learning and monitoring students' progress. Formative assessment is carried out in various ways including within practical work, projects, oral presentation, class discussions, assignments, lab reports and written quizzes and tests. Summative assessment takes place at the end of each term to review the standard of achievement reached by each student. As for students sitting in the HKDSE Biology examination, school-based assessment (SBA) will also be done starting from S4.

2 Aims and objectives

The curriculum is designed to enable students to:

1. develop and maintain an interest in biology, a sense of wonder and curiosity about the living world, and a respect for all living things and the environment;
2. construct and apply knowledge of biology, understand the nature of science, and appreciate the relationships between biological science and other disciplines;
3. develop skills in carrying out scientific investigations individually and collaboratively;
4. be aware of the social, ethical, economic, environmental and technology implications of biology, and be able to make informed decisions and judgments on biology-related issues;
5. develop an attitude of responsible citizenship, and a commitment to promote personal and community health.

3 Curriculum

The curriculum is based on the New Senior Secondary Biology and emphasizes to strengthen students' understanding of:

1. the nature of scientific inquiry in biology;
2. the interconnections between science, technology, society and the environment;
3. biology as a dynamic body of knowledge and is a human endeavour.

3.1 Curriculum framework

		Topics
Compulsory Part	S4	<u>Cells and Cell Activities</u> Students should be able to: <ul style="list-style-type: none"> ➤ recognize the scientific methods to study biology ➤ describe the significance of organic and inorganic substances to life ➤ test for the biomolecules using chemical tests ➤ appreciate the contribution of the technological development of the microscope to the discovery and the understanding of cells and organelles

		<ul style="list-style-type: none"> ➤ describe and appreciate the levels of organisation in multicellular organisms ➤ distinguish among the different types of transport processes and their essence to cell functioning ➤ distinguish between catabolic and anabolic processes ➤ recognize the properties of enzyme and its roles in metabolism and everyday life application <p><u>Nutrition, Gas Exchange and Transport of Substances in Humans</u> Students should be able to:</p> <ul style="list-style-type: none"> ➤ identify the sources and functions of different food substances required by human ➤ describe the main processes of human nutrition and state their significance ➤ describe how gas exchange takes place in human breathing system ➤ recognize the purpose of having a circulatory system in human ➤ identify the constituents and the functions of the lymphatic system <p><u>Nutrition, Gas Exchange and Transport of Substances in Plants</u> Students should be able to:</p> <ul style="list-style-type: none"> ➤ recognize the essential materials needed by plants ➤ relate autotrophic nutrition to photosynthesis in plants ➤ describe the structural adaptation of roots to the function of water and mineral absorption ➤ state the parts of plants that carry out gas exchange ➤ describe the process of transpiration and its significance ➤ identify turgidity and rigidity of xylem as means of support to plants <p><u>Reproduction, Growth and Development</u> Students should be able to:</p> <ul style="list-style-type: none"> ➤ outline the major events of cell cycle and appreciate the importance of cell division in growth and reproduction ➤ define asexual and sexual reproduction ➤ identify the structures and the functions of male/female reproductive systems ➤ identify and describe the stages of growth and development in plants and humans
Compulsory Part	S5	<p><u>Responses to Stimuli and Coordination in Humans</u> Students should be able to:</p> <ul style="list-style-type: none"> ➤ classify irritability, stimulus, receptor, response, effector and coordination ➤ identify functions of various parts of the human eye and ear ➤ describe how the nervous system brings about voluntary actions ➤ compare and contrast reflex actions and voluntary actions ➤ contrast hormonal and nervous coordination ➤ describe how muscles and bones work together to bring about movement ➤ identify the roles of nervous and endocrine systems in homeostasis <p><u>Photosynthesis and Respiration</u> Students should be able to:</p> <ul style="list-style-type: none"> ➤ outline the major steps in photosynthesis and respiration ➤ recognize the significance of photosynthesis and respiration <p><u>Organisms and Environment</u> Students should be able to:</p> <ul style="list-style-type: none"> ➤ identify the living and non-living components of an ecosystem and how they will affect each other in the ecosystem ➤ describe how carbon and nitrogen is cycled in an ecosystem ➤ state the major types of ecosystems in Hong Kong

	<p>➤ appreciate the biodiversity and understand the importance of biodiversity</p>
	<p><u>Genetics and Evolution</u> Students should be able to:</p> <ul style="list-style-type: none"> ➤ state how genes determine an organism's body characteristics ➤ explain the occurrence of phenotypic and genotypic variations ➤ identify the stages in protein synthesis ➤ state the major steps and applications of recombinant DNA technology ➤ classify different organisms based on the modern classification system ➤ define evolution and describe how it happens
	<p><u>Health and diseases</u> Students should be able to:</p> <ul style="list-style-type: none"> ➤ describe how infectious and non-infectious diseases occurs and treated ➤ define and state non-specific and specific defense mechanisms ➤ describe the biological principle behind vaccination

Elective Part	S6	<u>Human Physiology – Regulation and Control</u> Students should be able to: <ul style="list-style-type: none"> ➤ state the importance and principle of osmoregulation, regulating body temperature, regulating gas content in blood and hormonal control of the menstrual cycle
		<u>Applied Ecology</u> Students should be able to: <ul style="list-style-type: none"> ➤ appreciate the importance of population control and good management of natural resources ➤ state the effects of urbanization and industrialization ➤ know the biological principles of sewage treatment ➤ appreciate the need to preserve biodiversity ➤ know how resources are managed in a sustainable way in Hong Kong
		<u>Biotechnology (optional)</u> Students should be able to: <ul style="list-style-type: none"> ➤ understand the principles of different techniques in modern biotechnology, including recombination DNA technology, polymerase chain reaction, genetically modification of organisms, plant and animal cloning ➤ familiarize with the applications of biotechnology in the area of medicine and agriculture ➤ be aware of the ethical, legal, social, economic and environmental implications of biotechnology

3.2 Delivery schedule

	S4 Biology	S5 Biology	S6 Biology
1st Term	<ul style="list-style-type: none"> ◆ Cells and cell activities ◆ Cellular energetics (I): enzymes ◆ Nutrition, gas exchange and transport of substances in humans 	<ul style="list-style-type: none"> ◆ Responses to stimuli and coordination in humans ◆ Cellular energetics (II): photosynthesis and respiration 	<ul style="list-style-type: none"> ◆ Human physiology - regulation and control ◆ Applied ecology ◆ Consolidation
2nd Term	<ul style="list-style-type: none"> ◆ Nutrition, gas exchange and transport of substances in plants ◆ Reproduction, growth and development 	<ul style="list-style-type: none"> ◆ Organisms and environment ◆ Genetics and evolution ◆ Health and diseases 	<ul style="list-style-type: none"> ◆ Consolidation

4 Assessing students

4.1 Internal assessment in HKUGAC

4.1.1 Assessment criteria

4.1.1.1 Assessment of knowledge and understanding

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

1. phenomena, facts and concepts in science;
2. scientific vocabulary and terminology;
3. application of concepts to familiar and unfamiliar situations;
4. application of science in society and students' everyday life.

Oral questioning, class assignments, module tests and examination can be used to allow students to demonstrate their understanding and creative ideas.

4.1.1.2 Application of scientific processes

Students should be able to

1. ask relevant questions, identify problems and formulate hypotheses for investigations;
2. select and apply facts and concepts learnt to solve problems;
3. plan scientific investigations individually and collaboratively with appropriate instruments and methods;
4. collect and analyse data, make further predictions, draw conclusions and present scientific information effectively.

Project work provides excellent opportunities for students to apply what they have learnt. Investigative projects, in particular, are suitable for assessing enquiry skills such as identifying problems, formulating hypotheses and designing strategies to solve problems scientifically and creatively.

4.1.1.3 Assessment of experimental skills

Students should be able to

1. handle apparatus and chemicals safely and properly;
2. carry out instructions for experiments;
3. observe and describe objects and experimental results accurately;
4. select appropriate apparatus and suggest experimental procedures.

The most suitable methods for assessing science skills are practical assessment. Students are required to perform numbers of practical tasks. They are expected to make use of their knowledge and understanding of science in performing these tasks. Through these practical tasks, students' practical, process and generic skills will be developed and assessed.

4.1.1.4 Assessment of attitudes

Students should

1. develop curiosity and interest in science;
2. be aware of the importance of the safety of oneself and others in the laboratory and be committed to safe practices in daily life;
3. develop personal integrity through honest recording of experimental data;
4. develop an awareness of scientific advancement and its social, economic, environmental and technological implications;
5. be willing to communicate and comment on issues related to science and respect the decisions of others;
6. develop a positive attitude in enhancing personal and community health;
7. show concern for the care of the environment and a willingness to contribute to it.

Attitudes such as curiosity, perseverance, care and concern for living things, and co-operation with others are important in science learning. As these attitudes take time to develop, their assessment should take place over a period of time to show the progress that students have made. Some common means of assessing attitudes include observing behaviour, asking students to write essays, and using questionnaires.

4.1.2 Weighting of component parts

Component	Weighting
Continuous assessments ➤ Scientific investigations ➤ Experimental skills ➤ Quizzes and tests ➤ Assignments ➤ Preparation task before lesson	40%
Examinations	60%

4.1.3 Grading system

The performance is reported in five levels (level 1 to 5), with 5 being the highest. The level 5 candidates with the best performance are awarded a 5**, and the next top group of candidates are awarded a 5*.

Level 5	<ul style="list-style-type: none"> • demonstrate comprehensive knowledge and understanding of facts, concepts and principles in the Biology curriculum • apply the concepts of biology to unfamiliar situations • analyse, synthesise and critically evaluate information from multiple perspectives and in an in-depth manner • effectively communicate ideas in a succinct, logical and coherent manner with accurate use of scientific terminology and in appropriate formats • design and conduct scientific investigations, evaluate procedures, handle and analyse data collected, and draw valid conclusions
Level 4	<ul style="list-style-type: none"> • demonstrate sound knowledge and understanding of facts, concepts and principles in the Biology curriculum • apply the concepts of biology to unfamiliar situations • analyse, synthesise and evaluate information from several perspectives • communicate ideas in a logical and coherent manner using scientific terminology and in appropriate formats • design and conduct scientific investigations, handle and interpret data collected, and draw conclusions
Level 3	<ul style="list-style-type: none"> • demonstrate adequate knowledge and understanding of facts, concepts and principles in the Biology curriculum • apply the concepts of biology to unfamiliar situations with guidance • construct relationships and analyse information • communicate ideas in a clear, structured manner using scientific terminology and in appropriate formats

	<ul style="list-style-type: none"> • design and conduct scientific investigations, handle and interpret data collected, and draw conclusions with guidance
Level 2	<ul style="list-style-type: none"> • demonstrate basic knowledge and understanding of facts, concepts and principles in the Biology curriculum • apply the concepts of biology to familiar situations • describe relationships and handle information • communicate ideas using appropriate scientific terms • conduct practical work by following instructions, handle and interpret data collected, and draw simple conclusions
Level 1	<ul style="list-style-type: none"> • recall elementary facts and principles in the Biology curriculum • apply the concepts of biology to simple and familiar situations • handle simple information presented in a straightforward manner • communicate simple ideas using scientific terms • conduct simple practical work by following instructions and collect the required

4.2 School-based assessment for the HKDSE Biology examination

Students sitting for the HKDSE Biology examination will be required to take part in the SBA starting from S5. For practical related tasks, students are required to perform practical work or investigations which integrated closely with the curriculum content and form a part of the normal learning and teaching process.

For students sitting for the current HKDSE Biology examination, the mark of SBA in practical related tasks will contribute to 20% of the final subject mark, which the public examination contributes to 80%.

5 Role of parents at home and homework

Efficient time management is essential for students to be successful in the subject. Students are encouraged to prepare each lesson based on the guided task given and bring with them questions to be asked during the lesson as a means to promote effective learning. Homework consolidates, reinforces and strengthens concepts learnt in class and helps teachers assess the performance of students. Parents are encouraged to talk to their son or daughter about the work done in class and the current learning topics in order to have a better understanding of the learning situation in the subject. Zero mark will be given to homework in late submission.

6 Guidelines for using Artificial Intelligence (AI)

Guideline on AI-assisted Learning

Artificial intelligence (AI), including Generative AI, could serve as an effective tool for assisting science learning. This section provides examples of using AI to assist learning in science and general reminders.

Examples of AI-assisted learning in science

1. Research and organization of information

Information such as scientific concepts, real-life examples, and data, could be obtained from generative AI. AI could also be used to organize large amounts of information for clear presentation.

2. Feedback

Generative AI could provide feedback on student work based on given criteria to improve the quality of work and assess the accuracy.

3. Language support

By inputting the work in generative AI, the grammar and clarity of the work could be checked.

4. Exploration and brainstorming

Exploration of topics and generation of ideas for project work could be achieved using generative AI.

General reminders for using AI in science

1. Verification of information

Students should assess the accuracy of scientific concepts and the reliability of examples/data with their judgment and other sources. Information obtained from generative AI may not always be correct.

2. Learning effectiveness

There are multiple ways of learning. AI is not the only way for students to learn. Students should consider different learning styles and make good use of different learning strategies, instead of solely relying on AI. Moreover, information obtained from AI should be processed cognitively by students, instead of simply performing “copy and paste”.

3. Quality of prompts

Prompts inputted into generative AI should be specific. More details and conditions allow responses that better suit your needs to be generated.

Guideline on ethical use of AI (Important)

General guideline

Respect Intellectual Property

Students must observe copyright laws and understand the importance of giving proper credit to the original creators of any content they use or modify. When using AI-generated text or other content, students must properly **cite the source** and **acknowledge the use of the AI tool**.

Avoid Misinformation

Students should recognize the potential dangers of AI-generated content, including the spread of **misinformation**. Students should **cross-reference** AI-generated content with reliable sources and think critically about the information's validity.

Privacy and Security

Students must be aware of **privacy** and **security** concerns when using AI tools. Students need to protect their **personal information** and use secure platforms when accessing these tools. Students should be informed about the data collection and use practices of AI tool providers and be mindful of the potential risks associated with sharing personal data.

AI policy in science

Penalty will be given to students with inappropriate use of AI in their work including assignments, projects, etc.

- Students are suggested to keep the original work before being modified by AI. The original work may be requested to be submitted to verify the originality of the submitted work.
- Mark penalty could be given for work with content generated by AI without proper citation and acknowledgment. A zero mark could be given in serious cases. Follow-ups and further disciplinary actions could be taken.
- Students may be asked to redo and resubmit their work if the AI policy is violated.

AI and School-based Assessment (SBA)

This section summarizes the information about SBA related to AI.

- Students should not copy works generated by AI tools and present them as their own as such an act is considered plagiarism.
- Students should acknowledge the use of AI in SBA properly.
- Severe penalties could be given to students for proven plagiarism. A candidate may be disqualified from the subject concerned or the whole HKDSE Examination, or receive a mark or grade penalty.

Other Reminders

- Students should consult their subject teachers for anything uncertain about the use of AI in science subjects.