

# Biology

## Introduction

1. Biology is one of the elective subjects in the Key Learning Area (KLA) of Science Education<sup>1</sup>. The Biology Curriculum serves as a continuation of the Science (S1-3) Curriculum and builds on the strength of current Biology curricula. It will provide a range of balanced learning experiences through which students develop the necessary scientific knowledge and understanding, skills and processes, values and attitudes embedded in the ‘Life and Living’ strand and other strands of science education for personal development and for contributing towards a scientific and technological world. The curriculum will prepare students for entering tertiary courses, vocation-related courses or the workforce in various fields of life science.

## Rationale

2. The emergence of a highly competitive and integrated economy, rapid scientific and technological innovation, and a growing knowledge base will continue to have a profound impact on our lives. In order to meet these challenges, the Biology Curriculum, like other science electives, will provide a platform for developing scientific literacy and building up essential scientific knowledge and skills for life-long learning in science and technology. Through the learning of biology, students will acquire relevant procedural and conceptual knowledge to help them to understand many of today’s contemporary issues, and they will become aware of the interconnections between science, technology and society. In addition, students will develop a respect for the living world, an attitude of responsible citizenship and a commitment to promote personal and community health.

3. Biology is a rapidly advancing science with huge amounts of information about living organisms. It is always confused as a subject of memorizing numerous unrelated facts. In this curriculum, it is hoped that students will acquire a limited body of facts and at the same time develop a broad, general understanding of biology principles and concepts. In order to make the study of biology exciting and relevant, it is suggested to introduce the learning of biology in real life contexts. The adoption of diverse learning and teaching strategies, and assessment practices is intended to stimulate interest and create motivation for learning among students with a range of abilities and aspirations.

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<sup>1</sup> Please refer to the appendix on p.225 for the overall curriculum framework of science education and the proposed elective subjects in the Key Learning Area of Science Education.

## Curriculum Aims

4. The overarching aim of the Biology Curriculum is to provide biology-related learning experiences for students 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 life-long learners in science and technology.

The broad aims of the curriculum are to enable students to:

- ✧ develop and maintain an interest in biology, a sense of wonder and curiosity towards the living world, and a respect for all living things and the environment;
- ✧ construct and apply knowledge of biology, understand the nature of science in biology-related contexts, and appreciate the relationship between biological science and other disciplines;
- ✧ develop the abilities to make scientific inquiries; think scientifically, critically and creatively; and solve problems individually and collaboratively in biology-related contexts;
- ✧ understand the language of science and communicate ideas and views on biology-related issues;
- ✧ be aware of the social, ethical, economic, environmental and technological implications of biology, and be able to make informed decisions and judgements on biology-related issues; and
- ✧ develop an attitude of responsible citizenship, and a commitment to promote personal and community health.

## Curriculum Framework

*(This part should be read in conjunction with the section “Curriculum Framework” of the Main Document. It should be noted that the curriculum framework suggested below is for initial consultation only. Feedback from the public will be taken into account and further details will be provided in the next stage of consultation.)*

5. The learning targets of the Biology Curriculum are categorised into three domains: knowledge and concepts, skills and processes, and values and attitudes. Through the learning embodied in the Biology Curriculum, students will acquire the relevant learning targets in various biology-related contexts.

### Knowledge and Concepts

Students are expected to:

- ✧ acquire knowledge and develop understanding of biological principles, concepts, terms and facts;
- ✧ develop biological practical techniques and process skills;
- ✧ apply biological knowledge and concepts to familiar and unfamiliar situations;
- ✧ show understanding of the applications and uses of biological knowledge in daily life; and
- ✧ develop an understanding of current issues and developments in biology.

### Skills and Processes

Students are expected to:

- ✧ develop abilities to think scientifically and creatively;
- ✧ acquire an analytical mind to critically evaluate biology-related issues;
- ✧ identify the pros and cons of the applications of biological knowledge for informed decision-making;
- ✧ realise the importance of evidence in supporting, modifying or refuting proposed scientific theories;
- ✧ make careful observations, ask relevant questions, identify problems and formulate hypotheses for investigation;
- ✧ plan and conduct scientific investigations individually or collaboratively with appropriate instruments and methods, collect quantitative and qualitative information with accuracy, analyse data and draw conclusions for problem-solving;
- ✧ use information technology to process and present scientific information; and
- ✧ communicate ideas and views effectively with others, using the language of science.

### Values and Attitudes

Students are expected to:

- ✧ show an interest in the study of biology, appreciate the wonders and complexity of Nature, and show respect for all living things and the environment;
- ✧ be aware of the applications of biological knowledge in society and their social, ethical, economic and environmental implications;
- ✧ be aware of the dynamic nature of the body of biological knowledge, and appreciate the role of science and technology in understanding the living world;

- ✧ recognise their responsibility for conserving, protecting and maintaining the quality of the environment for future generations; and
- ✧ develop positive values and attitudes and a healthy lifestyle.

6. The curriculum will consist of compulsory and elective parts. The compulsory part will cover a range of content that enables students to develop understanding of fundamental biological principles and concepts, and the scientific process skills. Topics suggested are: “Cells and Molecules of life”, “Genetics and Evolution”, “Organisms and Environment”, and “Health, Defence and Diseases”.

7. To cater for the diverse interests, abilities and needs of students, an elective part will be included in the curriculum. The elective part aims to provide an in-depth treatment of some of the topics in the compulsory part, or an extension of certain areas of study. The choices are “Human Physiology: Regulation and Control”, “Applied Ecology”, “Microorganisms and Human” and “Biotechnology”.

Compulsory Part (Total 189 hours)		Suggested lesson time (hrs)
1. Cells and Molecules of Life	<ul style="list-style-type: none"> <li>• Molecules of life</li> <li>• Cellular organisation</li> <li>• Cellular energetics</li> <li>• Movement of substances across membrane</li> <li>• Cell cycle and replication</li> </ul>	44
2. Genetics and Evolution	<ul style="list-style-type: none"> <li>• Basic genetics</li> <li>• Molecular basis of genetics</li> <li>• Biodiversity and evolution</li> </ul>	40
3. Organisms and Environment	<ul style="list-style-type: none"> <li>• Essential life processes – flowering plants and human (nutrition, gas exchange, transport and excretion)</li> <li>• Reproduction, growth and development (asexual reproduction, sexual reproduction in flowering plants, human reproduction, growth and development)</li> <li>• Response to the environment (stimuli and receptors, coordination and response, homeostasis)</li> <li>• Ecosystem (levels of organization, major types of ecosystem, abiotic components, biotic community and conservation)</li> </ul>	80
4. Health, Defence and Diseases	<ul style="list-style-type: none"> <li>• Personal health</li> <li>• Body defence mechanisms</li> <li>• Infectious and non-infectious diseases</li> </ul>	25

Elective Part (Total 66 hours, any 2 out of 4)		Suggested lesson time (hrs)
1. Human Physiology: Regulation and Control	<ul style="list-style-type: none"> <li>• Thermoregulation</li> <li>• Osmoregulation</li> <li>• Control of exchange of materials</li> <li>• Control of movement</li> </ul>	33
2. Applied Ecology	<ul style="list-style-type: none"> <li>• Field ecology</li> <li>• Resources exploitation</li> <li>• Conservation</li> </ul>	33
3. Microorganisms and Human	<ul style="list-style-type: none"> <li>• Microbiology</li> <li>• Uses of microorganisms</li> <li>• Harmful microorganisms</li> </ul>	33
4. Biotechnology	<ul style="list-style-type: none"> <li>• Applications of molecular biology</li> <li>• Cloning of organisms</li> <li>• Biotechnology in food production</li> <li>• Biotechnology in medicine</li> <li>• Bioethics</li> </ul>	33
Total lesson time:		255

## Learning and Teaching

8. The curriculum has an in-built flexibility to cater for the interests, abilities and needs of students. This flexibility also provides a means to bring about a balance between the quantity and quality of learning. Teachers should provide ample opportunities for students to engage in a variety of learning experiences, such as investigations, discussions, demonstrations, practical work, projects, field studies, model-making, case-studies, oral reports, assignments, debates, information search and role-play. Teachers should give consideration to the range of experiences that would be most appropriate for their students. The context for learning should be made relevant to daily life, so that students will experience biology as interesting and important to them.

9. Practical work and investigations are essential components of the curriculum. They enable students to gain personal experience of science through hands-on activities, and to enhance the skills and thinking processes associated with the practice of science. Participation in these activities encourages students to bring scientific thinking to the processes of problem-solving, decision-making and evaluation of evidence. Engaging in scientific investigations enables students to gain an understanding of the nature of science and the limitations of scientific inquiry.

## Assessment

*(This part should be read in conjunction with the section “Assessment” of the Main Document.)*

### Aims of assessment

10. Assessment is an integral part of the learning and teaching cycle. It is the practice of collecting evidence of student learning. The aims of assessment are to improve learning and teaching as well as to recognize the achievement of students. Therefore, the design of assessment should be aligned with the learning targets, the curriculum design and the learning progression.

### Internal Assessment

11. Internal assessment refers to the assessment practices that schools will employ as part of the learning and teaching strategies during the three years of study in Biology. These practices should be aligned with curriculum planning, teaching progression, student abilities and the local school contexts. Internal assessment includes both formative and summative assessment practices. The information collected will help to motivate and promote student learning. The information will also help teachers to find ways of promoting more effective learning and teaching. A range of assessment practices, such as, written tests, oral questioning, observation, project work, practical work and assignments, should be used to promote the attainment of various learning outcomes.

### Public Assessment

12. Public assessment of the Biology subject refers to the assessment measures that lead to a qualification in the subject to be offered by the Hong Kong Examinations and Assessment Authority (HKEAA). Public assessment of the Biology subject will comprise two components: a Written Examination and School-based Assessment (SBA). The written examination will consist of various types of item to assess students' performance in a broad range of skills and abilities. Students will be assessed continuously through the SBA component. This will comprise a variety of assessment modes, such as practical work, investigations, assignments and oral reports.

13. In the public assessment, a standards-referenced approach will be adopted for grading and reporting student performance. The purpose of this approach is to recognise the learning outcomes that the students have attained in the subject at the end of the 3-year senior secondary education. Each student's performance will be matched against a set of performance standards, rather than compared to the performance of other students. Standards-referenced Assessment (SRA) makes the implicit standards explicit by providing

specific indication of individual student's performance. Descriptors will be provided for the set of standards at a later stage.

14. The proposed weighting of the SBA component will be 20-25% of the total weighting of the public assessment of senior secondary biology. The merits of adopting SBA are as follows:

- (i) SBA provides a more valid assessment than an external written examination, since it can cover a more extensive range of learning outcomes, through employing a wider range of assessment modes that are not all possible in written examinations.
- (ii) SBA enables the sustained work of students to be assessed. It provides a more comprehensive picture of student performance throughout the period of study rather than their performance in a one-off examination alone.

15. It should be noted that SBA is not an “add-on” element in the curriculum. Assessing student performance through practices such as class discussion and class observation is a normal in-class and out-of-class activity. The modes of SBA selected in the Biology will be appropriate to the learning objectives and processes to be assessed. The design and implementation of SBA should make reference to the nature of the subject and avoid unduly increasing the workload of both teachers and students.

### **Supporting Measures**

16. A subject curriculum and assessment guide will be published to support learning and teaching. The Guide will provide stakeholders with information on the rationale, aims, curriculum framework, learning and teaching strategies and assessment. In addition, it is anticipated that quality textbooks and related learning and teaching materials, aligned with the rationale and recommendations of the curriculum, will be available on the market.

17. Resource materials that facilitate learning will be developed by the Education and Manpower Bureau to support the implementation of this curriculum. Tertiary institutions and professional organizations will be invited to contribute to the development of resource materials. The “Biology Learning and Teaching Resource Kit” already developed will be further updated to meet with the latest curriculum developments. Schools are encouraged to adapt these resources or to develop their own learning and teaching materials to meet the needs of their students as necessary. Schools are also advised to adopt a wide variety of suitable learning resources such as school-based curriculum projects, useful information from the Internet, the media, relevant learning packages and educational software. Last but not the least, experiences from various collaborative research and development projects, such as “Informed Decisions in Science Education”, “Assessment for Learning in Science”,

“Infusing Process and Thinking Skills into Science lessons” and “Collaborative Development of Assessment Tasks and Assessment Criteria to Enhance Learning and Teaching in Science Curriculum” are good sources of information for teachers.

18. To facilitate the implementation of the curriculum, professional development programmes will be organized for biology teachers. Listed below are the major domains of the professional development programmes to be provided.

- ✧ Understanding the rationale and the implementation of the Biology Curriculum;
- ✧ Sharing of learning and teaching strategies and good practices;
- ✧ Latest developments in the field of biology (science update programmes);
- ✧ Curriculum management and leadership (curriculum leadership courses); and
- ✧ Internal assessment, School-based Assessment and Standards-referenced Assessment

19. In addition, teacher networks and learning communities will be formed to facilitate reflection and discussion on various aspects related to the curriculum. Further information on support materials can be obtained from the CDI homepage: <http://www.emb.gov.hk/cd>.