IB WORLD SCHOOL

Biology

syllabus & course of study

(based on Biology guide first assessment 2025)

A. COURSE AIMS

Biology is a study of life. Of all the sciences, biology is a study that takes more of a pragmatic view than a theoretical approach. The earliest evidence of life on Earth dates from at least 3.5 billion years ago, since then life has diversified tremendously, occupying a wide variety of niches. This diversity makes biology both a deeply fascinating and significantly challenging study. Unifying themes provide frameworks for interpretation and help us make sense of living world: Form and function, Unity and diversity, Continuity and change, and Interaction and interdependence.

The scale of life in biology ranges from the molecules and cells of organisms to ecosystems and the biosphere. At each level of biological organization, different properties exist. Living systems are based on interactions, interdependence and integration of components between all levels of biological organization.

A student of biology should gain not only a conceptual understanding of subject, but also an awareness of how biologists construct knowledge claims and the limitations of these methods.

B. Structure of the syllabus and conceptual understanding

The biology syllabus comprises four themes, each made up of two concepts. Each theme is a lens through which the syllabus content can be viewed.

Theme A: Unity and diversity

Theme B: Form and function

Theme C: Interactions and interdependence

Theme D: Continuity and change

The arrangement of syllabus content follows four levels of biological organization, which also serve as conceptual lenses.

Level 1: Molecules

Level 2: Cells

Level 3: Organisms

Level 4: Ecosystems

C. COURSE OBJECTIVES

The course enables students, through the overarching theme of the Nature of Science, to:

1. Develop conceptual understanding that allows connections to be made between different areas of the subject, and to other Diploma Programme sciences subjects.
2. Acquire and apply a body of knowledge, methods, tools and techniques that characterize science.
3. Develop the ability to analyse, evaluate and synthesize scientific information and claims.
4. Develop the ability to approach unfamiliar situations with creativity and resilience.
5. Design and model solutions to local and global problems in a scientific context.
6. Develop an appreciation of the possibilities and limitations of science.
7. Develop technology skills in a scientific context.

8. Develop the ability to communicate and collaborate effectively.
9. Develop awareness of the ethical, environmental, economic, cultural and social impact of science.

D. COURSE OVERVIEW

D.1 Course content

Theme A Unity and diversity

Common ancestry has given living organisms many shared features while evolution has resulted in the rich biodiversity of life on Earth.

1. Molecules: water, nucleic acids
2. Cells: origin of cells *(HL only)*, cell structure, viruses *(HL only)*
3. Organisms: diversity of organisms, classification and cladistics *(HL only)*
4. Ecosystems: evolution and speciation, conservation and biodiversity

Theme B Form and function

Adaptations are forms that correspond to function. These adaptations persist from generation to generation because they increase the chances of survival.

1. Molecules: carbohydrates and lipids, proteins
2. Cells: membranes and membrane transport, organelles and compartmentalization, cell specialization
3. Organisms: gas exchange, transport, muscle and motility *(HL only)*
4. Ecosystems: adaptation to environment, ecological niches

Theme C Interaction and interdependence

Systems are based on interactions, interdependence and integration of components. Systems result in emergence of new properties at each level of biological organization.

1. Molecules: enzymes and metabolism, cell respiration, photosynthesis
2. Cells: chemical signalling *(HL only)*, neural signalling
3. Organisms: Integration of body systems, defence against disease
4. Ecosystems: populations and communities, transfer of energy

Theme D Continuity and change

Living things have mechanisms for maintaining equilibrium and for bringing about transformation. Environmental change is a driver for evolution by natural selection.

1. Molecules: DNA replication, protein synthesis, mutation and gene editing
2. Cells: cell and nuclear division, gene expression *(HL only)*, water potential
3. Organisms: reproduction, inheritance, homeostasis
4. Ecosystems: natural selection, stability and change, climate change

D.2 Other requirements

Experimental programme: practical work 20 hours SL/ 40 hours HL; collaborative science project both SL/HL 10 hours; scientific investigation both SL/HL 10 hours

D.3 Textbook & reference book

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E. COURSE OF STUDY

Themes	Content – topics and guiding questions		Time provision
Unity and diversity - molecules	Water	What physical and chemical properties of water make it essential for life? What are the challenges and opportunities of water as habitat?	2 hours AHL 1 hour

	Nucleic acids	How does the structure of nucleic acids allow hereditary information to be stored? How does the structure of DNA facilitate accurate replication?	3 hours AHL 2 hours
Unity and diversity - cells	Origin of cells	What plausible hypothesis could account for the origin of life? What intermediate stages could there have been between non-living matter and the first living cells?	2 hours
	Cell structure	For what reasons is heredity an essential feature of living things? What is needed for structures to be able to evolve by natural selection?	4 hours AHL 1 hour
	Viruses	What explains the use of certain molecular building blocks in all living cells? What are the features of a compelling theory?	AHL 2 hours
Unity and diversity - organisms	Diversity of organisms	What is a species? What patterns are seen in the diversity of genomes within and between species?	3 hours AHL 2 hours
	Classification and cladistics	What tools are used to classify organisms into taxonomic groups? How do cladistic methods differ from traditional taxonomic methods?	AHL 3 hours
Unity and diversity – ecosystems	Evolution and speciation	What is evidence for evolution? How do analogous and homologous structures exemplify commonality and diversity?	4 hours AHL 1 hour
	Conservation of biodiveristy	How does the theory of evolution by natural selection predict and explain the unity and diversity of life on Earth? What counts as strong evidence in biology?	3 hours
Form and function - molecules	Carbohydrates and lipids	In what ways do variations in form allow diversity of function in carbohydrates and lipids? How do carbohydrates and lipids compare as energy storage compounds?	4 hours
	Proteins	What is the relationship between amino acid sequence and the diverisity in form and function of proteins?	2 hours AHL 2 hours
Form and function - cells	Membranes and membrane transport	How do molecules of lipid assemble into biological membranes? What determines whether a substance can pass through a biological	4 hours AHL 2 hours

		membrane?	
	organelles and compartmentalization	How are organelles in cells adapted to their functions? What are the advantages of compartmentalization in cells?	1 hour AHL 2 hours
	cell specialization	What are the roles of stem cells in multicellular organisms? How are differentiated cells adapted to their specialized functions?	2 hours AHL 1 hour
Form and function - organisms	gas exchange	How are multicellular organisms adapted to carry out gas exchange? What are the similarities and differences in gas exchange between a flowering plant and a mammal?	3 hours AHL 1 hour
	transport	What adaptations facilitate transport of fluids in animals and plants? What are the differences and similarities between transport in animals and plants?	3 hours AHL 2 hour
	muscle and motility	How do muscles contract and cause movement? What are the benefits to animals of having muscle tissue?	AHL 3 hours
Form and function - ecosystems	adaptation to environment	How are the adaptations and habitats of species related? What causes the similarities between ecosystems within a terrestrial biome?	3 hours
	ecological niches	What are the advantages of specialized modes of nutrition to living organisms? How are the adaptations of a species related to its niche in an ecosystem?	4 hours
Interaction and interdependence - molecules	Enzymes and metabolism	In what ways do enzymes interact with other molecules? What are the interdependent components of metabolism?	SL 3 hours AHL 2 hours
	Cell respiration	What are the roles of hydrogen and oxygen in the release of energy in cells? How is energy distributed and used inside cells?	SL 2 hours AHL 3 hours
	Photosynthesis	How is energy from sunlight absorbed and used in photosynthesis? How do abiotic factors interact with photosynthesis?	SL 3 hours AHL 3 hours
Interaction and interdependence -	Chemical signalling	How do cells distinguish between the many different signals that they receive? What interactions occur inside animal cells in response to chemical signals?	AHL only 4 hours

cells	Neural signalling	How are electrical signals generated and moved within neurons? How can neurons interact with other cells?	SL 3 hours AHL 3 hours
Interaction and interdependence - organisms	Integration of body systems	What are the roles of nerves and hormones in integration of body systems? What are roles of feedback mechanisms in regulation of body systems?	SL 5 hours AHL 2 hours
	Defence against disease	How do body systems recognize pathogens and fight infections? What factors influence the incidence of disease in populations?	SL 5 hours
Interaction and interdependence - ecosystems	Populations and communities	How do interactions between organisms regulate sizes of populations in a community? What interactions with a community make its populations interdependent?	SL 5 hours
	Transfer of energy and matter	What is the reason matter can be recycled in ecosystems but energy can not? How is energy that is lost by each group of organisms in an ecosystem replaced?	SL 5 hours
Continuity and change - molecules	DNA replication	How is DNA produced? How has knowledge of DNA replication enabled applications in biotechnology?	SL 2 hours AHL 2 hours
	Protein synthesis	How does a cell produce a sequence of amino acids from a sequence of DNA bases? How is the reliability of protein synthesis ensured?	SL 3 hours AHL 3 hours
	Mutation and gene editing	How do gene mutation occur? What are the consequences of gene mutation?	SL 3 hours AHL 2 hours
Continuity and change - cells	Cell and nuclear division	How can large numbers of genetically identical calls be produced? How do eukaryotes produce genetically varied cells that can develop into gametes?	SL 3 hours AHL 1 hour
	Gene expression	How is gene expression changed in a cell? How can patterns of gene expression be conserved through inheritance?	AHL 3 hours
	Water potential	What factors affect the movement of water into or out of cells?	SL 2 hours

		How do plant and animal cells differ in their regulation of water movement?	AHL 2 hours
Continuity and change - organisms	Reproduction	How does asexual reproduction exemplify themes of change or continuity? What changes within organisms are required for reproduction?	AL 5 hours AHL 3 hours
	Inheritance	What pattern of inheritance exist in plants and animals? What is the molecular basis of inheritance pattern?	SL 5 hours AHL 3 hours
	Homeostasis	How are constant internal conditions maintained in humans? What are the benefits to organisms of maintaining constant internal conditions?	SL 2 hours AHL 2 hours
Continuity and change - ecosystems	Natural selection	What processes can cause changes in allele frequencies within a population? What is the role of reproduction in the process of natural selection?	SL 2 hours AHL 2 hours
	Stability and change	What features of ecosystem allow stability over unlimited time periods? What changes caused by humans threaten the stability of ecosystems?	SL 4 hours AHL 2 hours
	Climate change	What are the drivers of climate change? What are the impacts of climate change on ecosystems?	SL 3 hours AHL 1 hour

F. ASSESSMENT

F.1 Assessment outline SL

External assessment 80%
Paper 1 – 1 hour and 30 minutes: multiple-choice questions; data-based questions
Paper 2 – 1 hour and 30 minutes: data-based and short answer questions; extended-response questions

Internal assessment 20 %
The internal assessment consists of one task: scientific investigation. This component is internally assessed by the teacher and externally moderated by the IB at. The end of the course.

F.2 Assessment outline HL

External assessment 80%
Paper 1 – 2 hours: multiple-choice questions; data-based questions
Paper 2 – 2 hour and 30 minutes: data-based and short answer questions; extended-response questions

Internal assessment 20 %

The internal assessment consists of one task: scientific investigation. This component is internally assessed by the teacher and externally moderated by the IB at. The end of the course.