GCSE Biology Guide (9-1) (adapted from Pearson Edexcel (4BI1) Specification)

Assessment: untiered, written examinations with questions designed to be accessible to students of all abilities.

Content: this is arranged as five topics in *2: Biology content*. A summary of sub-topics is included at the start of each topic. As a minimum, all the bullet points in the content must be taught. The word 'including' in the content helps specify the detail of what must be covered.

Paper overview

Biology Paper 1B	*Paper code 4BI1/1B
Content summary Assesses core content that is **not** in bold and does not have a 'B' reference. Questions may come from any topic area across the specification. 1 The nature and variety of living organisms 2 Structures and functions in living organisms 3 Reproduction and inheritance 4 Ecology and the environment 5 Use of biological resources	
Assessment • The paper is assessed through a 2-hour written examination paper • The total number of marks is 100. • A mixture of different question styles, including multiple-choice questions, short-answer questions, calculations and extended open-response questions. • A calculator may be used in the examinations.	

Biology content

1 The nature and variety of living organisms

2 Structure and functions in living organisms

3 Reproduction and inheritance

4 Ecology and the environment

5 Use of biological resources

1. The nature and variety of living organisms

The following sub-topics are covered in this section.

(a) Characteristics of living organisms

(b) Variety of living organisms

(a) Characteristics of living organisms
Students should:
1.1 understand how living organisms share the following characteristics: • they require nutrition • they respire • they excrete their waste • they respond to their surroundings • they move • they control their internal conditions • they reproduce • they grow and develop.

(b) Variety of living organisms
Students should:
1.2 describe the common features shown by eukaryotic organisms: plants, animals, fungi and protoctists Plants: these are multicellular organisms; their cells contain chloroplasts and are able to carry out photosynthesis; their cells have cellulose cell walls; they store carbohydrates as starch or sucrose. Examples include flowering plants, such as a cereal (for example, maize), and a herbaceous legume (for example, peas or beans). Animals: these are multicellular organisms; their cells do not contain chloroplasts and are not able to carry out photosynthesis; they have no cell walls; they usually have nervous co-ordination and are able to move from one place to another; they often store carbohydrate as glycogen. Examples include mammals (for example, humans) and insects (for example, housefly and mosquito). Fungi: these are organisms that are not able to carry out photosynthesis; their body is usually organised into a mycelium made from thread-like structures called hyphae, which contain many nuclei; some examples are single-celled; their cells have walls made of chitin; they feed by extracellular secretion of digestive enzymes onto food material and absorption of the organic products; this is known as saprotrophic nutrition; they may store carbohydrate as glycogen. Examples include *Mucor*, which has the typical fungal hyphal structure, and yeast, which is single-celled. Protoctists: these are microscopic single-celled organisms. Some, like *Amoeba*, that live in pond water, have features like an animal cell, while others, like *Chlorella*, have chloroplasts and are more like plants. A pathogenic example is *Plasmodium*, responsible for causing malaria.
Students should:

1.3	describe the common features shown by prokaryotic organisms such as bacteria Bacteria: these are microscopic single-celled organisms; they have a cell wall, cell membrane, cytoplasm and plasmids; they lack a nucleus but contain a circular chromosome of DNA; some bacteria can carry out photosynthesis but most feed off other living or dead organisms. Examples include *Lactobacillus bulgaricus*, a rod-shaped bacterium used in the production of yoghurt from milk, and *Pneumococcus*, a spherical bacterium that acts as the pathogen causing pneumonia.
1.4	understand the term pathogen and know that pathogens may include fungi, bacteria, protoctists or viruses Viruses: these are not living organisms. They are small particles, smaller than bacteria; they are parasitic and can reproduce only inside living cells; they infect every type of living organism. They have a wide variety of shapes and sizes; they have no cellular structure but have a protein coat and contain one type of nucleic acid, either DNA or RNA. Examples include the tobacco mosaic virus that causes discolouring of the leaves of tobacco plants by preventing the formation of chloroplasts, the influenza virus that causes 'flu' and the HIV virus that causes AIDS.

2. Structure and functions in living organisms

The following sub-topics are covered in this section.

(a) Level of organisation

(b) Cell structure

(c) Biological molecules

(d) Movement of substances into and out of cells

(e) Nutrition

(f) Respiration

(g) Gas exchange

(h) Transport

(i) Excretion

(j) Co-ordination and response

(a)	**Level of organisation**
Students should:	
2.1	describe the levels of organisation in organisms: organelles, cells, tissues, organs and systems

(b)	**Cell structure**
Students should:	
2.2	describe cell structures, including the nucleus, cytoplasm, cell membrane, cell wall, mitochondria, chloroplasts, ribosomes and vacuole
2.3	describe the functions of the nucleus, cytoplasm, cell membrane, cell wall, mitochondria, chloroplasts, ribosomes and vacuole
2.4	know the similarities and differences in the structure of plant and animal cells
(c)	**Biological molecules**

Students should:	
2.7	identify the chemical elements present in carbohydrates, proteins and lipids (fats and oils)
2.8	describe the structure of carbohydrates, proteins and lipids as large molecules made up from smaller basic units: starch and glycogen from simple sugars, protein from amino acids, and lipid from fatty acids and glycerol
2.9	*practical: investigate food samples for the presence of glucose, starch, protein and fat*
2.10	understand the role of enzymes as biological catalysts in metabolic reactions
2.11	understand how temperature changes can affect enzyme function, including changes to the shape of active site
2.12	*practical: investigate how enzyme activity can be affected by changes in temperature*
2.13	understand how enzyme function can be affected by changes in pH altering the active site

(d)	**Movement of substances into and out of cells**
Students should:	
2.15	understand the processes of diffusion, osmosis and active transport by which substances move into and out of cells
2.16	understand how factors affect the rate of movement of substances into and out of cells, including the effects of surface area to volume ratio, distance, temperature and concentration gradient
2.17	*practical: investigate diffusion and osmosis using living and non-living systems*
(e)	**Nutrition**
Students should:	
Flowering plants	
2.18	understand the process of photosynthesis and its importance in the conversion of light energy to chemical energy
2.19	know the word equation and the balanced chemical symbol equation for photosynthesis
2.20	understand how varying carbon dioxide concentration, light intensity and temperature affect the rate of photosynthesis
2.21	describe the structure of the leaf and explain how it is adapted for photosynthesis
2.22	understand that plants require mineral ions for growth, and that magnesium ions are needed for chlorophyll and nitrate ions are needed for amino acids
2.23	*practical: investigate photosynthesis, showing the evolution of oxygen from a water plant, the production of starch and the requirements of light, carbon dioxide and chlorophyll*
Humans	
2.24	understand that a balanced diet should include appropriate proportions of carbohydrate, protein, lipid, vitamins, minerals, water and dietary fibre
2.25	identify the sources and describe the functions of carbohydrate, protein, lipid (fats and oils), vitamins A, C and D, the mineral ions calcium and iron, water and dietary fibre as components of the diet
2.26	understand how energy requirements vary with activity levels, age and pregnancy

2.27	describe the structure and function of the human alimentary canal, including the mouth, oesophagus, stomach, small intestine (duodenum and ileum), large intestine (colon and rectum) and pancreas
2.28	understand how food is moved through the gut by peristalsis
2.29	understand the role of digestive enzymes, including the digestion of starch to glucose by amylase and maltase, the digestion of proteins to amino acids by proteases and the digestion of lipids to fatty acids and glycerol by lipases
2.30	understand that bile is produced by the liver and stored in the gall bladder
2.31	understand the role of bile in neutralising stomach acid and emulsifying lipids
2.32	understand how the small intestine is adapted for absorption, including the structure of a villus
(f)	**Respiration**
Students should:	
2.34	understand how the process of respiration produces ATP in living organisms
2.35	know that ATP provides energy for cells
2.36	describe the differences between aerobic and anaerobic respiration
2.37	know the word equation and the balanced chemical symbol equation for aerobic respiration in living organisms
2.38	know the word equation for anaerobic respiration in plants and in animals
2.39	*practical: investigate the evolution of carbon dioxide and heat from respiring seeds or other suitable living organisms*

(g)	**Gas exchange**
Students should:	
Humans	
2.46	describe the structure of the thorax, including the ribs, intercostal muscles, diaphragm, trachea, bronchi, bronchioles, alveoli and pleural membranes
2.47	understand the role of the intercostal muscles and the diaphragm in ventilation
2.48	explain how alveoli are adapted for gas exchange by diffusion between air in the lungs and blood in capillaries
2.49	understand the biological consequences of smoking in relation to the lungs and the circulatory system, including coronary heart disease
2.50	*practical: investigate breathing in humans, including the release of carbon dioxide and the effect of exercise*
(h)	**Transport**
Students should:	
2.51	understand why simple, unicellular organisms can rely on diffusion for movement of substances in and out of the cell
2.52	understand the need for a transport system in multicellular organisms
Flowering plants	
2.53	describe the role of phloem in transporting sucrose and amino acids between the leaves and other parts of the plant

2.54	describe the role of xylem in transporting water and mineral ions from the roots to other parts of the plant
Humans	
2.59	describe the composition of the blood: red blood cells, white blood cells, platelets and plasma
2.60	understand the role of plasma in the transport of carbon dioxide, digested food, urea, hormones and heat energy
2.61	understand how adaptations of red blood cells make them suitable for the transport of oxygen, including shape, the absence of a nucleus and the presence of haemoglobin
2.62	understand how the immune system responds to disease using white blood cells, illustrated by phagocytes ingesting pathogens and lymphocytes releasing antibodies specific to the pathogen
2.65	describe the structure of the heart and how it functions
2.66	explain how the heart rate changes during exercise and under the influence of adrenaline
2.67	understand how factors may increase the risk of developing coronary heart disease
2.68	understand how the structure of arteries, veins and capillaries relate to their function
2.69	understand the general structure of the circulation system, including the blood vessels to and from the heart and lungs, liver and kidneys
(i)	**Excretion**
Students should:	
Flowering plants	
2.70	understand the origin of carbon dioxide and oxygen as waste products of metabolism and their loss from the stomata of a leaf
Humans	
2.71	know the excretory products of the lungs, kidneys and skin (organs of excretion)

(j)	**Co-ordination and response**
Students should:	
2.80	understand how organisms are able to respond to changes in their environment
2.81	understand that homeostasis is the maintenance of a constant internal environment, and that body water content and body temperature are both examples of homeostasis
2.82	understand that a co-ordinated response requires a stimulus, a receptor and an effector
Flowering plants	
2.83	understand that plants respond to stimuli
2.84	describe the geotropic and phototropic responses of roots and stems
2.85	understand the role of auxin in the phototropic response of stems
Students should:	
Humans	
2.86	describe how nervous and hormonal communication control responses and understand the differences between the two systems

2.87	understand that the central nervous system consists of the brain and spinal cord and is linked to sense organs by nerves
2.88	understand that stimulation of receptors in the sense organs sends electrical impulses along nerves into and out of the central nervous system, resulting in rapid responses
2.89	understand the role of neurotransmitters at synapses
2.90	describe the structure and functioning of a simple reflex arc illustrated by the withdrawal of a finger from a hot object
2.91	describe the structure and function of the eye as a receptor
2.92	understand the function of the eye in focusing on near and distant objects, and in responding to changes in light intensity
2.93	describe the role of the skin in temperature regulation, with reference to sweating, vasoconstriction and vasodilation
2.94	understand the sources, roles and effects of the following hormones: adrenaline, insulin, testosterone, progesterone and oestrogen

3. Reproduction and inheritance

The following sub-topics are covered in this section.

(a) Reproduction

(b) Inheritance

(a)	**Reproduction**
Students should:	
3.1	understand the differences between sexual and asexual reproduction
3.2	understand that fertilisation involves the fusion of a male and female gamete to produce a zygote that undergoes cell division and develops into an embryo
Flowering plants	
3.3	describe the structures of an insect-pollinated and a wind-pollinated flower and explain how each is adapted for pollination
3.4	understand that the growth of the pollen tube followed by fertilisation leads to seed and fruit formation
3.5	*practical: investigate the conditions needed for seed germination*
3.6	understand how germinating seeds utilise food reserves until the seedling can carry out photosynthesis
3.7	understand that plants can reproduce asexually by natural methods (illustrated by runners) and by artificial methods (illustrated by cuttings)
Humans	
3.8	understand how the structure of the male and female reproductive systems are adapted for their functions
3.9	understand the roles of oestrogen and progesterone in the menstrual cycle
3.11	describe the role of the placenta in the nutrition of the developing embryo
3.12	understand how the developing embryo is protected by amniotic fluid
3.13	understand the roles of oestrogen and testosterone in the development of secondary sexual characteristics

(b)	**Inheritance**
Students should:	
3.14	understand that the genome is the entire DNA of an organism and that a gene is a section of a molecule of DNA that codes for a specific protein
3.15	understand that the nucleus of a cell contains chromosomes on which genes are located
3.19	understand how genes exist in alternative forms called alleles which give rise to differences in inherited characteristics
3.20	understand the meaning of the terms: dominant, recessive, homozygous, heterozygous, phenotype, and genotype
3.22	understand that most phenotypic features are the result of polygenic inheritance rather than single genes
3.23	describe patterns of monohybrid inheritance using a genetic diagram
3.24	understand how to interpret family pedigrees
3.25	predict probabilities of outcomes from monohybrid crosses
3.26	understand how the sex of a person is controlled by one pair of chromosomes, XX in a female and XY in a male
3.27	describe the determination of the sex of offspring at fertilisation, using a genetic diagram
3.28	understand how division of a diploid cell by mitosis produces two cells that contain identical sets of chromosomes
3.29	understand that mitosis occurs during growth, repair, cloning and asexual reproduction
3.30	understand how division of a cell by meiosis produces four cells, each with half the number of chromosomes, and that this results in the formation of genetically different haploid gametes
3.31	understand how random fertilisation produces genetic variation of offspring
3.32	know that in human cells the diploid number of chromosomes is 46 and the haploid number is 23
3.33	understand that variation within a species can be genetic, environmental, or a combination of both
3.34	understand that mutation is a rare, random change in genetic material that can be inherited
Students should:	
3.38	explain Darwin's theory of evolution by natural selection
3.39	understand how resistance to antibiotics can increase in bacterial populations, and appreciate how such an increase can lead to infections being difficult to control

4. Ecology and the environment

The following sub-topics are covered in this section.

(a) The organism in the environment

(b) Feeding relationships

(c) Cycles within ecosystems

(d) Human influences on the environment

(a)	**The organism in the environment**
Students should:	
4.1	understand the terms population, community, habitat and ecosystem
4.2	*practical: investigate the population size of an organism in two different areas using quadrats*
4.5	understand how abiotic and biotic factors affect the population size and distribution of organisms

(b)	**Feeding relationships**
Students should:	
4.6	understand the names given to different trophic levels, including producers, primary, secondary and tertiary consumers and decomposers
4.7	understand the concepts of food chains, food webs, pyramids of number, pyramids of biomass and pyramids of energy transfer
4.8	understand the transfer of substances and energy along a food chain
4.9	understand why only about 10% of energy is transferred from one trophic level to the next

(c)	**Cycles within ecosystems**
Students should:	
4.10	describe the stages in the carbon cycle, including respiration, photosynthesis, decomposition and combustion
(d)	**Human influences on the environment**
Students should:	
4.12	understand the biological consequences of pollution of air by sulfur dioxide and carbon monoxide
4.13	understand that water vapour, carbon dioxide, nitrous oxide, methane and CFCs are greenhouse gases
4.14	understand how human activities contribute to greenhouse gases
4.15	understand how an increase in greenhouse gases results in an enhanced greenhouse effect and that this may lead to global warming and its consequences
4.16	understand the biological consequences of pollution of water by sewage
4.17	understand the biological consequences of eutrophication caused by leached minerals from fertiliser

5. Use of biological resources

The following sub-topics are covered in this section.

(a) Food production

(b) Selective breeding

(c) Genetic modification (genetic engineering)

(a)	**Food production**
Students should:	
Crop plants	
5.1	describe how glasshouses and polythene tunnels can be used to increase the yield of certain crops
5.2	understand the effects on crop yield of increased carbon dioxide and increased temperature in glasshouses
5.3	understand how the use of fertiliser can increase crop yield
5.4	understand the reasons for pest control and the advantages and disadvantages of using pesticides and biological control with crop plants
Micro-organisms	
5.5	understand the role of yeast in the production of food including bread
5.6	*practical: investigate the role of anaerobic respiration by yeast in different conditions*
5.7	understand the role of bacteria (*Lactobacillus*) in the production of yoghurt
5.8	understand the use of an industrial fermenter and explain the need to provide suitable conditions in the fermenter, including aseptic precautions, nutrients, optimum temperature and pH, oxygenation and agitation, for the growth of micro-organisms

(b)	**Selective breeding**
Students should:	
5.10	understand how selective breeding can develop plants with desired characteristics
5.11	understand how selective breeding can develop animals with desired characteristics
(c)	**Genetic modification (genetic engineering)**
Students should:	
5.12	understand how restriction enzymes are used to cut DNA at specific sites and ligase enzymes are used to join pieces of DNA together
5.13	understand how plasmids and viruses can act as vectors, which take up pieces of DNA, and then insert this recombinant DNA into other cells
5.14	understand how large amounts of human insulin can be manufactured from genetically modified bacteria that are grown in a fermenter
5.15	understand how genetically modified plants can be used to improve food production
5.16	understand that the term transgenic means the transfer of genetic material from one species to a different species

Assessment requirements

Paper number	Assessment information	Number of marks allocated in the paper
Paper 1B	Assessed through a 2-hour written examination The paper is weighted at 61.1% of the full qualification. A mixture of different question styles, including multiple-choice questions, short-answer questions, calculations and extended open-response questions.	100

Grade Boundaries
The total available marks for Paper 1B is 100 marks The grade boundaries are obtained by scaling up the 100 marks to the 180 marks normally available in the full IGCSE and benchmarking against these IGCSE grade boundaries

The grades available range from 9 to 1, where 9 is the highest grade

Assessment objectives and weightings

		International GCSE
AO1	Knowledge and understanding of biology	38–42%
AO2	Application of knowledge and understanding, analysis and evaluation of biology	38–42%
AO3	Experimental skills, analysis and evaluation of data and methods in biology – questions could be asked about the practicals outlined in the learning material	19–21%
		100%