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

(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
2.5B	**explain the importance of cell differentiation in the development of specialised cells**
2.6B	**understand the advantages and disadvantages of using stem cells in medicine**

(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
2.14B	***practical: investigate how enzyme activity can be affected by changes in pH***

(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*

(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:	
Flowering plants	
2.40B	**understand the role of diffusion in gas exchange**
2.41B	**understand gas exchange (of carbon dioxide and oxygen) in relation to respiration and photosynthesis**
2.42B	**understand how the structure of the leaf is adapted for gas exchange**
2.43B	**describe the role of stomata in gas exchange**
2.44B	**understand how respiration continues during the day and night, but that the net exchange of carbon dioxide and oxygen depends on the intensity of light**
2.45B	***practical: investigate the effect of light on net gas exchange from a leaf, using hydrogen-carbonate indicator***

(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

(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
2.55B	**understand how water is absorbed by root hair cells**
2.56B	**understand that transpiration is the evaporation of water from the surface of a plant**
2.57B	**understand how the rate of transpiration is affected by changes in humidity, wind speed, temperature and light intensity**
2.58B	***practical: investigate the role of environmental factors in determining the rate of transpiration from a leafy shoot***

5 Use of biological resources

The following sub-topics are covered in this section.

(a) Food production

(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