Structure and function of living organisms

Cells and organisation

1. A cell is the basic structural unit of a living organism.
2. Cells are the fundamental unit because all living organisms are made of one or more cells, and cells carry out the processes needed for life.
3. A unicellular organism is an organism made of only one cell.
4. A multicellular organism is an organism made of many cells.
5. A light microscope uses lenses to magnify cells so that they can be seen.
6. A cell image can be recorded by drawing a labelled biological drawing or by taking a photograph through the microscope.
7. The cell wall supports and strengthens a plant cell and helps it keep its shape.
8. The cell membrane controls what substances enter and leave the cell.
9. The cytoplasm is where many of the chemical reactions needed for life take place.
10. The nucleus contains the genetic material and controls the activities of the cell.
11. The vacuole contains cell sap and helps maintain pressure inside a plant cell, helping it stay firm.
12. Mitochondria are where aerobic respiration takes place, releasing energy for the cell.
13. Chloroplasts contain chlorophyll and are where photosynthesis takes place.
14. Plant and animal cells both contain a cell membrane, cytoplasm, nucleus and mitochondria.
15. Plant cells have a cell wall, chloroplasts and a large permanent vacuole, which animal cells do not have.
16. Diffusion is the net movement of particles from an area of higher concentration to an area of lower concentration.
17. Particles move from a higher concentration to a lower concentration during diffusion.
18. Diffusion allows substances such as oxygen and carbon dioxide to move into and out of cells.
19. Unicellular organisms can have structures or features that help them obtain food, remove waste, move or exchange substances efficiently.
20. A structural adaptation is a physical feature of an organism that helps it survive in its environment.

21. A tissue is a group of similar cells working together to carry out a particular function.
22. An organ is a group of different tissues working together to carry out a particular function.
23. An organ system is a group of organs working together to perform a major function.
24. An organism is an individual living thing.
25. The correct order is cells → tissues → organs → organ systems → organism.

The skeletal and muscular systems

1. The human skeleton is the framework of bones that supports and protects the body.
2. The four main functions are support, protection, movement and blood cell production.
3. The skeleton supports the body by providing a strong framework that holds the body upright.
4. Bones protect important internal organs, such as the skull protecting the brain and the ribs protecting the heart and lungs.
5. The skeleton provides attachment points for muscles, allowing muscles to move bones at joints.
6. Blood cells are made in bone marrow inside some bones.
7. A joint is a place where two or more bones meet.
8. Joints allow bones to move relative to each other.
9. Cartilage is a smooth, tough tissue found at the ends of bones at many joints.
10. Cartilage reduces friction and cushions the ends of bones as they move.
11. Ligaments are strong bands of connective tissue that join bones to other bones.
12. Ligaments hold bones together and help stabilise joints.
13. Tendons are strong connective tissues that attach muscles to bones.
14. Tendons transmit the force of a contracting muscle to a bone, causing movement.
15. Biomechanics is the study of how forces and movements affect living organisms, including how muscles and bones produce movement.
16. Muscles contract and pull on tendons, which pull on bones to produce movement at joints.
17. When a muscle contracts, it becomes shorter and usually thicker.
18. The force exerted by a muscle can be measured using a force meter or other suitable measuring device.
19. An antagonistic pair is two muscles that work together to move a joint in opposite directions.
20. Muscles work in antagonistic pairs because muscles can pull but cannot push.

21. When one muscle contracts, it pulls the bone in one direction.
22. The other muscle relaxes and is stretched as its partner contracts.
23. The biceps and triceps are an example of an antagonistic pair of muscles.
24. One muscle contracts to pull a bone in one direction, while the opposing muscle contracts to pull it back in the other direction.
25. Muscles are needed because bones cannot move themselves; muscles provide the forces that move bones.

Nutrition and digestion

1. The seven components are carbohydrates, lipids, proteins, vitamins, minerals, dietary fibre and water.
2. Carbohydrates provide energy for activities and chemical reactions in the body.
3. Lipids provide energy, form part of cell membranes and help insulate the body.
4. Proteins are needed for growth and repair and are used to make important substances such as enzymes.
5. Vitamins are needed in small amounts to keep the body healthy and allow important processes to occur.
6. Minerals are needed in small amounts for healthy growth and normal body functions.
7. Dietary fibre helps food move through the digestive system and helps prevent constipation.
8. Water is needed for chemical reactions, transport of substances and many other processes in the body.
9. A person's energy requirement is the amount of energy their body needs from food to maintain normal activities and body functions.
10. The body needs energy for movement, maintaining body temperature, growth, repair and other life processes.
11. Energy requirements can be affected by age, body size, sex and level of physical activity.
12. Energy requirements can be estimated by calculating the energy needed for the person's body functions and activities, using information such as body size, age and activity level.
13. An imbalance in the diet occurs when a person's diet contains too much or too little of one or more nutrients or energy.
14. Obesity is a condition in which a person has an unhealthy amount of body fat, often caused by taking in more energy than the body uses over time.
15. Starvation is a severe lack of food or nutrients that prevents the body from getting enough energy and nutrients.
16. A deficiency disease is a disease caused by not getting enough of a particular nutrient.

17. If the body does not receive enough of a nutrient it needs, a deficiency can prevent normal body processes and cause disease.
18. The main organs include the mouth, oesophagus, stomach, small intestine, large intestine, rectum and anus.
19. The mouth begins digestion by mechanically breaking food into smaller pieces and mixing it with saliva, which contains digestive enzymes.
20. The stomach stores and churns food and contains acid and enzymes that help digest proteins.
21. The small intestine completes much of digestion and absorbs soluble digested nutrients into the blood.
22. The large intestine absorbs water from the remaining material and forms faeces.
23. An enzyme is a biological catalyst that speeds up chemical reactions without being used up.
24. Digestive enzymes break large, insoluble food molecules into smaller, soluble molecules that can be absorbed into the blood.
25. Bacteria in the human digestive system help break down some substances in food and can produce useful substances for the body.

Nutrition and digestion — Plant nutrition

1. Plants use photosynthesis to make carbohydrates.
2. Carbohydrates are made mainly in the leaves, inside chloroplasts.
3. Photosynthesis needs light energy, carbon dioxide and water.
4. Plants use carbohydrates for energy, growth and making other substances needed by the plant.
5. Water enters plant roots from the soil by osmosis.
6. Mineral nutrients enter plant roots from the soil, often by active transport.
7. Plants need mineral nutrients for healthy growth and to make important substances.
8. Water is needed for photosynthesis, transport of substances and keeping plant cells firm.
9. Roots have many root hair cells, giving them a large surface area for absorbing water and mineral nutrients.
10. Plants use carbohydrates for respiration, growth and making substances such as cellulose and starch.
11. Leaves absorb light and carbon dioxide and contain chloroplasts where photosynthesis takes place.
12. Leaves are broad and thin, giving them a large surface area for absorbing light and a short distance for gases to diffuse.
13. The water used in photosynthesis comes from the soil and is absorbed by the roots.
14. Mineral nutrients come from the soil and are absorbed by the plant roots.

15. Mineral nutrients are needed to make substances required for healthy growth and normal plant functions.
16. Roots provide a large surface area for absorbing water and mineral nutrients from the soil.
17. Without enough water, a plant may wilt and photosynthesis and growth will be reduced.
18. Without enough mineral nutrients, a plant may grow poorly and develop deficiency symptoms.
19. Plants need water for photosynthesis and other processes, while mineral nutrients are needed to make important substances and support growth.
20. Water and mineral nutrients are transported from the roots to other parts of the plant through xylem vessels.
21. Photosynthesis uses light energy to convert carbon dioxide and water into glucose, which is a carbohydrate.
22. Carbohydrates provide energy and are used to build materials needed for plant growth and storage.
23. Leaves make carbohydrates by photosynthesis, while roots absorb water and mineral nutrients needed by the plant.
24. Plants obtain carbon dioxide from the air, water and mineral nutrients from the soil, and light energy from the Sun.
25. Photosynthesis provides carbohydrates, while roots supply water and mineral nutrients, allowing the plant to grow, carry out life processes and survive.

Structure and function of living organisms

Gas exchange systems

1. Gas exchange is the movement of gases, such as oxygen and carbon dioxide, between an organism and its surroundings.
2. The human gas exchange system takes oxygen into the body and removes carbon dioxide.
3. The main structures are the nose or mouth, trachea, bronchi, bronchioles and lungs containing alveoli.
4. The trachea carries air into and out of the lungs.
5. The bronchi are two tubes that carry air from the trachea into each lung.
6. The bronchioles are smaller airways that carry air through the lungs to the alveoli.
7. The alveoli are tiny air sacs where oxygen and carbon dioxide are exchanged between the air and blood.

8. Alveoli have a large surface area, thin walls and a good blood supply, allowing gases to diffuse quickly.
9. Oxygen moves from the alveoli into the blood, while carbon dioxide moves from the blood into the alveoli.
10. Inhalation is the process of breathing air into the lungs.
11. During inhalation, the diaphragm contracts and flattens.
12. The volume of the chest increases during inhalation.
13. The pressure inside the lungs decreases during inhalation.
14. Exhalation is the process of breathing air out of the lungs.
15. During exhalation, the diaphragm relaxes and becomes domed-shaped.
16. The volume of the chest decreases during exhalation.
17. The pressure inside the lungs increases during exhalation.
18. Air moves from areas of higher pressure to areas of lower pressure, so changes in lung pressure cause air to enter or leave the lungs.
19. Lung volume is the amount of air contained in the lungs.
20. Lung volume can be measured using a spirometer.
21. Exercise increases breathing rate and usually increases the depth of breathing because muscles need more oxygen and produce more carbon dioxide.
22. Asthma can narrow the airways, making it harder for air to move into and out of the lungs.
23. Smoking can damage the lungs and reduce the efficiency of gas exchange.
24. Smoking can damage the alveoli and increase the risk of lung diseases such as lung cancer.
25. Stomata are tiny openings in plant leaves that allow gases such as carbon dioxide and oxygen to move into and out of the leaf.

Reproduction

Human reproduction

1. Reproduction is the process by which living organisms produce offspring of their own species.
2. The main male reproductive organs include the testes, sperm ducts, penis and glands that add fluid to sperm.
3. The main female reproductive organs include the ovaries, oviducts, uterus, cervix and vagina.
4. The testes produce sperm and the male sex hormone testosterone.
5. The sperm ducts carry sperm from the testes towards the urethra.
6. The penis transfers sperm into the female reproductive system during sexual intercourse.
7. The ovaries produce eggs and female sex hormones.

8. The oviducts carry eggs from the ovaries towards the uterus and are usually where fertilisation occurs.
9. The uterus is where a fertilised egg develops into a foetus during pregnancy.
10. The vagina is a muscular passage that receives sperm during sexual intercourse and forms the birth canal.
11. Gametes are reproductive cells that contain genetic information and can fuse during fertilisation.
12. The male gamete is the sperm cell and the female gamete is the egg cell.
13. During the menstrual cycle, an egg matures and is released from an ovary. The lining of the uterus thickens and is later shed if pregnancy does not occur.
14. Fertilisation is the fusion of a sperm cell and an egg cell to form a fertilised egg cell.
15. Fertilisation normally occurs in an oviduct.
16. Gestation is the period during which a developing baby grows inside the uterus before birth.
17. The foetus develops in the uterus during pregnancy.
18. The placenta allows substances such as oxygen and nutrients to pass from the mother's blood to the foetus and waste substances such as carbon dioxide to pass back.
19. A mother's lifestyle can affect the development and health of the foetus because substances taken into the mother's body can reach the foetus.
20. Smoking during pregnancy can reduce the oxygen supply to the foetus and increase the risk of poor growth and other health problems.
21. Alcohol consumption during pregnancy can damage the developing foetus and affect its growth and development.
22. The placenta allows useful substances such as oxygen and nutrients to pass from the mother's blood to the foetus.
23. The mother's and foetus's blood are kept separate, although substances can move between them across the placenta.
24. During birth, muscles in the uterus contract, the cervix widens and the baby passes through the vagina.
25. The main stages are fertilisation → development of the embryo and foetus in the uterus → birth.

Plant reproduction

1. The main reproductive structures of a flower are the anther, filament, stigma, style, ovary and ovules.
2. The anther produces and releases pollen grains containing the male reproductive cells.
3. The stigma receives pollen and is often sticky so pollen can attach to it.
4. The ovary contains the ovules and develops into the fruit after fertilisation.

5. The ovule contains the female reproductive cell and develops into a seed after fertilisation.
6. Pollination is the transfer of pollen from an anther to a stigma of a flower of the same species.
7. Insect pollination occurs when insects transfer pollen between flowers.
8. Wind pollination occurs when pollen is carried from one flower to another by the wind.
9. Insect-pollinated flowers often have bright petals, scent and nectar, while wind-pollinated flowers often have exposed anthers and feathery stigmas.
10. Insect-pollinated flowers may have brightly coloured petals, scent, nectar and sticky pollen to attract insects and help pollen stick to them.
11. Wind-pollinated flowers often have exposed anthers, large feathery stigmas and produce large amounts of small, light pollen.
12. When pollen lands on a suitable stigma, it can grow a pollen tube down towards an ovule.
13. Fertilisation in flowering plants is the fusion of the male reproductive cell from pollen with the female reproductive cell in an ovule.
14. Fertilisation takes place inside an ovule in the ovary.
15. After fertilisation, an ovule develops into a seed.
16. After fertilisation, the ovary develops into a fruit.
17. A seed contains a young plant embryo and stored food, surrounded by a protective seed coat.
18. A fruit is a structure that develops from the ovary and contains or protects seeds.
19. Seeds are dispersed away from the parent plant to reduce competition for resources such as light, water and minerals.
20. Seeds can be dispersed by wind, animals, water or explosive mechanisms.
21. Wind can carry lightweight seeds or seeds with structures such as wings or parachutes away from the parent plant.
22. Animals can disperse seeds by eating fruits and later passing the seeds out, or by carrying seeds attached to their bodies.
23. Water can carry seeds that float from one place to another.
24. Measurements could include the distance travelled by seeds, the number of seeds dispersed and the proportion dispersed by each method.
25. Different mechanisms can be compared by measuring factors such as the distance seeds travel, the number dispersed and how effectively they move away from the parent plant.

Health

1. A drug is a substance that changes the way the body works.
2. A recreational drug is a drug taken for enjoyment or its effects rather than to treat a medical condition.

3. Substance misuse means using a substance in a way that can cause harm to a person's health or wellbeing.
4. A medicinal drug is used to prevent, diagnose or treat illness, while a recreational drug is generally taken for its effects rather than medical treatment.
5. Recreational drugs can change behaviour by affecting mood, alertness, judgement and reactions.
6. Recreational drugs can harm physical health and may damage organs or increase the risk of illness and injury.
7. Recreational drugs can affect the brain by changing the activity of nerve cells and altering mood, thinking and behaviour.
8. Recreational drugs can change how the nervous system sends and processes signals around the body.
9. Some recreational drugs can reduce coordination by affecting the brain and nervous system.
10. Recreational drugs can affect decision-making by changing judgement and how a person responds to risks.
11. Some recreational drugs can increase or decrease heart rate.
12. Some recreational drugs can change breathing rate or make breathing slower and less effective.
13. Recreational drugs can interfere with normal body functions by changing how the brain, nervous system and organs work.
14. Drug dependence is when a person becomes reliant on a drug and finds it difficult to stop taking it.
15. Repeated use of some drugs can cause changes in the brain that lead to dependence and a strong desire to keep using the drug.
16. Dependence can make stopping difficult because a person may experience strong cravings or withdrawal symptoms.
17. Taking too much of a recreational drug can cause poisoning, serious harm or even death.
18. Recreational drugs can cause short-term changes such as altered mood, reduced coordination, poor judgement or changes in alertness.
19. Long-term misuse can lead to dependence, damage to organs and an increased risk of serious diseases.
20. Substance misuse can affect school or work, relationships, finances and a person's physical and mental wellbeing.
21. Some recreational drugs can alter the senses, causing changes in how a person sees, hears or feels things.
22. Recreational drugs can affect movement and coordination by changing the activity of the brain and nervous system.
23. Recreational drugs can affect judgement, making a person more likely to take risks or make unsafe decisions.
24. Different drugs contain different chemicals that act on different parts of the brain and body, so their effects can differ.

25. Understanding the effects and risks of recreational drugs helps people make informed decisions and reduce the risk of harm.

Material cycles and energy

Photosynthesis

1. Photosynthesis is the process by which plants, algae and some microorganisms use light energy to make organic molecules from carbon dioxide and water.
2. The reactants are carbon dioxide and water.
3. The products are glucose and oxygen.
4. Carbon dioxide + water → glucose + oxygen.
5. The energy comes from light, mainly from the Sun.
6. Plants, algae and some microorganisms carry out photosynthesis.
7. Plants absorb light energy using chlorophyll in their chloroplasts.
8. Organic molecules are carbon-containing molecules made by living organisms, such as glucose.
9. Organic molecules provide materials and stored energy needed for growth and life processes.
10. Photosynthesis converts light energy into chemical energy stored in glucose.
11. Animals depend on photosynthetic organisms because they obtain energy by eating plants, algae or organisms that depend on them.
12. Almost all living organisms depend on photosynthesis because it provides the organic molecules and energy that form the basis of most food chains.
13. Photosynthesis releases oxygen into the atmosphere.
14. Photosynthesis removes carbon dioxide from the atmosphere.
15. Plants and algae help maintain the balance of oxygen and carbon dioxide in the atmosphere.
16. A leaf is the main organ where photosynthesis takes place.
17. Leaves are broad and contain many chloroplasts, allowing them to absorb large amounts of light.
18. Stomata allow carbon dioxide to enter the leaf.
19. Water is transported to photosynthesising cells through the plant's transport tissues.
20. Most leaves are broad to provide a large surface area for absorbing light and thin to provide a short distance for gases to diffuse.
21. Chlorophyll absorbs light energy needed for photosynthesis.
22. Chloroplasts contain chlorophyll and provide the structures where photosynthesis takes place.

23. The arrangement of cells allows light to reach photosynthesising cells while providing spaces for carbon dioxide to move through the leaf.
24. Stomata allow carbon dioxide to enter and oxygen to leave the leaf.
25. Broad, thin leaves, chloroplasts containing chlorophyll, suitable cell arrangements and stomata all help maximise the efficiency of photosynthesis.

Cellular respiration

1. Cellular respiration is the chemical process in which cells break down organic molecules to release energy.
2. Cellular respiration provides energy needed for life processes such as movement, growth and keeping the body warm.
3. Organic molecules are broken down during cellular respiration, releasing energy.
4. The released energy is used to power life processes.
5. Aerobic respiration is respiration that uses oxygen.
6. The reactants are glucose and oxygen.
7. The products are carbon dioxide, water and energy.
8. Glucose + oxygen → carbon dioxide + water + energy.
9. Anaerobic respiration is respiration that releases energy without using oxygen.
10. Anaerobic respiration occurs in human muscles when there is not enough oxygen for aerobic respiration, such as during vigorous exercise.
11. The products of anaerobic respiration in humans are lactic acid and energy.
12. Glucose → lactic acid + energy.
13. Fermentation is anaerobic respiration carried out by microorganisms such as yeast.
14. Microorganisms such as yeast and some bacteria can carry out fermentation.
15. In yeast, the products are ethanol, carbon dioxide and energy.
16. Humans produce lactic acid during anaerobic respiration, whereas yeast produces ethanol and carbon dioxide.
17. Aerobic respiration requires oxygen, while anaerobic respiration does not.
18. Aerobic respiration produces carbon dioxide and water, while anaerobic respiration produces different products depending on the organism.
19. Anaerobic respiration releases less energy because glucose is not completely broken down.
20. Muscles produce lactic acid when there is not enough oxygen for aerobic respiration.
21. Vigorous exercise increases the muscles' demand for energy faster than oxygen can be supplied.

22. Anaerobic respiration allows cells to continue releasing some energy but can lead to the build-up of lactic acid in muscles.
23. Aerobic respiration requires oxygen, whereas anaerobic respiration occurs without oxygen.
24. Anaerobic respiration allows cells to release some energy from organic molecules when oxygen is limited.
25. Respiration is essential because cells need the released energy to carry out life processes.

Interactions and interdependencies

Relationships in an ecosystem

1. An ecosystem is a community of organisms interacting with each other and with their physical environment.
2. Interdependence means organisms depend on other organisms for things such as food, pollination, shelter or reproduction.
3. Organisms depend on one another for resources, food, reproduction and survival.
4. A food web shows how several food chains are linked together in an ecosystem.
5. Arrows in a food web show the direction of energy transfer from the organism being eaten to the organism that eats it.
6. A change in one population can cause the populations of other organisms in the food web to increase or decrease.
7. Insects pollinate many flowering plants, allowing them to reproduce and produce seeds and fruits.
8. Insect pollination is the transfer of pollen from one flower to another by insects.
9. Insect-pollinated crops depend on insects to transfer pollen between flowers so that fertilisation can occur.
10. Insect pollination is important for food security because many food crops depend on insect pollinators to produce fruits and seeds.
11. A decline in insect pollinators could reduce the pollination and production of many crops.
12. Organisms can change their environment through activities such as feeding, burrowing, growing and producing waste.
13. An organism's environment provides conditions and resources that affect its ability to survive and reproduce.
14. Environmental conditions are the physical and chemical conditions surrounding organisms, such as temperature, light and water availability.

15. Changes in environmental conditions can cause population sizes and distributions to change.
16. Toxic materials are substances that can harm living organisms.
17. Toxic materials can enter ecosystems through pollution, waste, pesticides and other human activities.
18. Toxic materials can accumulate when organisms take them in faster than they can remove them.
19. Toxic materials can become more concentrated at higher levels of a food web because predators consume many contaminated organisms.
20. Toxic materials can damage organisms, reduce their ability to reproduce and may cause illness or death.
21. Removing one species can disrupt food webs and affect the populations of other species that depend on it.
22. Changes in food availability can cause populations that rely on that food to increase or decrease.
23. Organisms are interconnected, so changes affecting one population can spread through feeding relationships and other interactions.
24. Human activities such as pollution and habitat destruction can reduce populations, remove food sources or destroy habitats, disrupting relationships between organisms.
25. Understanding interdependence helps people predict the effects of environmental changes and manage ecosystems more effectively.

Genetics and evolution

Inheritance, chromosomes, DNA and genes

1. Heredity is the passing of genetic information and characteristics from parents to their offspring.
2. Genetic information is passed from parents to offspring through genes carried in reproductive cells.
3. A chromosome is a long, coiled molecule of DNA containing many genes.
4. Chromosomes are found in the nucleus of cells.
5. DNA is the molecule that carries genetic information.
6. DNA is mainly found in the nucleus of a cell.
7. A gene is a section of DNA that contains genetic information.
8. Genes are sections of DNA that provide information for characteristics.
9. Genes are sections of DNA found along chromosomes.
10. Genetic information influences characteristics by providing instructions that affect how an organism develops and functions.
11. A species is a group of organisms that can reproduce with one another to produce fertile offspring.

12. Organisms belong to different species when they cannot normally reproduce with each other to produce fertile offspring.
13. Variation is the difference in characteristics between individuals of the same species.
14. Continuous variation is variation that can have any value within a range, such as height.
15. Discontinuous variation has distinct categories with no intermediate values, such as blood group.
16. Continuous variation can be measured using numerical measurements such as height, mass or length.
17. Variation can be represented using graphs such as histograms or scatter graphs, depending on the type of data.
18. Individuals of the same species vary because they inherit different genetic information and may experience different environmental conditions.
19. Some organisms have characteristics that make them better suited to their environment, allowing them to survive and reproduce more successfully.
20. Variation can cause some individuals to have advantageous characteristics, which may allow them to survive and reproduce more successfully.
21. If the environment changes, characteristics that were previously advantageous may become less useful or disadvantageous.
22. Poor adaptation may reduce survival and reproduction, causing a population to decrease and potentially become extinct.
23. Biodiversity is the variety of different living organisms in an area or on Earth.
24. Maintaining biodiversity helps ecosystems remain healthy and provides resources such as food, medicines and genetic material.
25. Gene banks store genetic material such as seeds, sperm or DNA and can help preserve genetic diversity for future use.