PEARSON

Science

STUDENT BOOK | WESTERN AUSTRALIA

8

Topic 1 Cells in plants and animals

Prior knowledge

Cells are the basic unit of living things

1 **a** dogs – living
b tables - non-living
c people - living
d bacteria – living
e grass – living
f soil - non-living
g insects – living
h viruses - non-living

2 Living things have growth, reproduction, respond to stimuli, movement, excretion, require nutrients.

3 The different kingdoms of life include: Fungi, Plantae, Animalia, Protista, Monera

Types of cells

4

Similarities	Differences
use energy excrete waste require nutrients grow reproduce	Plants are heterotrophs and animals are autotrophs

5 Students could provide any two of the below body systems:
The respiratory system – to take in and release gases
The excretory system – to remove wastes
The cardiovascular system – to transport materials
The immune system – to protect the body from infection
The musculoskeletal system – to allow the body to move
The nervous system – to respond to stimuli
The digestive system – to break down and absorb nutrients

6 They can absorb sunlight for use in photosynthesis.

Observing cells

7 a single bacteria, and e an atom

1.1 Cells as the building blocks of living things

Check your understanding

SC1: I can describe cells as microscopic units of living things

- All living things are made up of one or more cells.
- Cells are the basic building blocks of all living things.
- New cells are produced from existing cells.

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SC2: I can explain the difference between unicellular and multicellular organisms

Unicellular (organisms made up of only one cell); multicellular (organisms that are made up of many cells)

Lesson review

1 muscle cell → muscle tissue → heart → circulatory system → human

2 An organ system is a group of organs that work together to perform an overall function within the body.

3 A group of different types of cells working together is known as a tissue.

4 **a** multicellular

b unicellular

c multicellular

d multicellular

5 Ralph is likely to have seen unicellular organisms as they were not visible to the naked eye and most unicellular organisms cannot be seen without a microscope.

1.2 Cells in humans

Check your understanding

SC1: I can state the function of different types of cells in humans

Any two from:

- Cheek cells help to start the digestion process and protect from bacterial infection.
- Nerve cells relay information around the body.
- Skin cells protect the body from infection and the outside environment.
- White blood cells protect the body from infection and disease.
- Red blood cells carry and deliver oxygen around the body.

SC2: I can compare the scale of different types of cells in humans

a A microscope is required to observe objects that are smaller than 100 µm.

b Macroscopic is the term used to describe objects that are larger than 1000 µm.

SC3: I can describe some features that are common to most types of cells

People often refer to the nucleus as the 'control centre' of the cell as it contains all of the genetic instructions that decide the cells functions.

Lesson review

1 mitochondrion, nucleus, the DNA/genetic material inside the nucleus, ribosomes, cytoplasm, cell membrane

2 **a** Red blood cells are responsible for transporting oxygen around the body.

b Nerve cells (also known as neurons) are responsible for sending messages around the body so that it can move.

c White blood cells (or you could also say skin cells) are responsible for protecting the body against infection.

3 The cell membrane is a vital part of the cell, as it holds the cell together and controls what can enter or exit the cell.

4 Having many mitochondria is useful to muscle cells in the body, as muscles require a lot of energy and mitochondria are responsible for creating energy within the cell.

5 From smallest to largest: 20 µm, 1 cm, 1.8 cm, 25 mm, 30 000 µm, 80 mm

6 It would most likely be a human cheek cell, as each human cheek cell is approximately 60 µm in length and there are eight lined up. This makes 480 µm in total length.

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1.3 The development of microscopes

Check your understanding

SC1: I can outline the key developments in microscope technology from the first microscope to present day

The first microscopes used were a simple microscope that contained two lenses and gave magnification up to 30×.

SC2: I can outline the key discoveries about cells from Hooke's first description of cells to present day

Antonie van Leeuwenhoek saw single celled organisms such as protozoa in pond water.

SC3: I can describe how specific improvements in microscope technologies lead to new discoveries about the structure and function of cells

A stereo microscope is able to observe specimens as a more three-dimensional view.

Lesson review

1 A micrograph is an image produced by taking a picture through a microscope.

2 Transmission electron microscopes can be used to see finer structures found within the mitochondria.

3 A light microscope would be most appropriate for viewing pond water. Students would be able to see the images like Antonie van Leeuwenhoek did and it is also light weight so can be moved.

4 Scientists would be able to take photos of what they observe to share with other scientists to collaborate and communicate their findings.

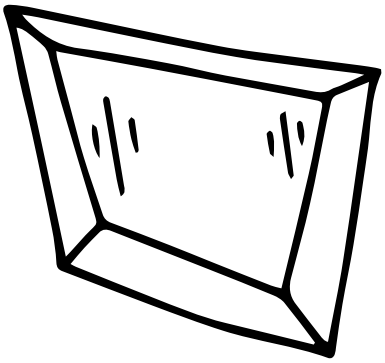
5 Galileo Galilei's microscope was able to see object 30× magnification, so these would appear 3 mm long.

1.4 Practical investigation: Using a microscope

Results

Diagrams should be clear, labelled and include the magnification used.

1 Sample answer:

Specimen	salt crystal	**Sketch** 
Magnification	100×	
Microscopic observations	crystal has a rough square shape	

Evaluation

1 Sample answers:

- Eyepiece – to place the eye on and view the specimen. Also has 10× magnification.
- Objective lens – to magnify the specimen at different levels.
- Stage – where the specimen is placed.
- Mirror / lamp – to allow light to enter the specimen.
- Coarse focus knob – to allow large scale movement of the specimen on the stage up and down; this allows the specimen to be seen better.

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- Fine focus knob – to allow very small movement of the specimen on the stage up and down allowing the specimen to be seen better.
- Handle – to allow the microscope to be moved to another location safely.

2 In a light microscope, when the magnification of the lens increases, the field of view of the specimen decreases.

3 It is important to know the total magnification to understand how much the specimen has been enlarged, which helps in accurately observing and analysing the specimen's details.

4 When calculating the magnification of a specimen viewed under a light microscope the eye piece magnification is multiplied by the objective lens magnification.

5 Using a 10× eyepiece with a 4× objective lens gives a total magnification of 40×, while using the same eyepiece with a 40× objective lens gives a total magnification of 400×. The latter provides a much higher magnification, allowing for more detailed observation of the specimen.

6 You would note the magnification used, draw or photograph the specimen, and describe its features, including any changes observed at different magnifications.

1.5 The functions of the nucleus in cells

Check your understanding

SC1: I can identify the nucleus from a visual representation of a cell

Eukaryotic cells have a distinct nucleus located in the central part of the cell.

SC2: I can explain the function of the nucleus of a cell

The main function of the nucleus is to store and protect the cell's genetic material (DNA) and provide instructions for cell functions. Students may also comment on the nucleolus (inside the nucleus) which produces ribosomes.

Lesson review

1 The nucleus typically appears as a large, round or oval structure within the cell, often centrally located and darker than the surrounding cytoplasm.

2 The key cell functions that the nucleus controls include: chemical reactions in the cell, how the cell develops and how it reproduces.

3 Eukaryotic cells store their DNA within the nucleus. Prokaryotic cells do not have a nucleus, so the DNA is found simply floating in the cytoplasm.

4 Red blood cells lack a nucleus so that they can store more oxygen that can be delivered to different parts of the body.

1.6 Practical investigation: Observing cells

Results

Answers should include a clearly labelled diagram, and the correct magnification used.

Conclusion

1 The following should be visible: cell wall, nucleus and possibly cytoplasm.

2 Some parts of the cell (organelles) may be too small to be seen with a light microscope. Some others may be transparent, making them difficult to see (because the light passes through them).

3 The onion and rhubarb cells have a similar size, shape and structure. Their colouring is different: onion cells are colourless, while rhubarb cells are red.

4 The onion cells contain no pigment and would be difficult to see without a stain, whereas the rhubarb cells contain red pigment and are easy to see without a stain.

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1.7 The roles of the cell wall and cell membrane

Check your understanding

SC1: I can identify the cell membrane and cell wall of a cell from a photomicrograph, model or other visual representation

In a plant cell, the cell wall is located on the exterior of the cell and the cell membrane sits inside of this.

SC2: I can describe the functions of cell membranes and cell walls

A semi-permeable membrane is a thin layer of material that only certain particles can pass through.

SC3: I can compare the functions of cell membranes and cell walls

The cell membrane is semi-permeable and will only allow certain substances in and out of the cell, the cell wall is also semi-permeable but cannot control what can enter or exit the cell.

Lesson review

1. The cell wall provides structural support for plant cells.
2. Osmosis describes the movement of water in and out of the cell.
3. The cell wall is a thick layer found on the outside of the cell and the cell membrane is a thinner layer found inside the cell wall.
4. In plant cells, the cell membrane controls the movement of substances in and out of the cell, and the cell wall provides additional structural support and protection.
5. Water is more likely to move out of a cell placed in a beaker of sugary water solution, as water moves from an area with higher water to an area of lower water.

1.8 Practical investigation: Investigating the action of a cell membrane

Prediction

Sample answer:

The egg in salt water will get larger because there will be a higher concentration of chemicals (salt) inside the egg than in the egg in distilled (pure) water.

Results

Sample results:

Table 1.8.1 Changes in the mass of eggs in salt water and distilled water

Treatment	Mass of egg (g)				
	Day 0	Day 1	Day 2	Day 3	Total change in mass (g)
distilled water	51.0	54.4	58.1	63.9	+12.9
salt water	52.4	50.4	47.1	46.5	–5.9

Table 1.8.2 Changes in the volume of salt water and distilled water

Treatment	Volume of water (mL)		
	Day 0	Day 3	Total change in volume (g)
distilled water	200	187	–13
salt water	200	207	+4

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Conclusion

1 Distilled water: the egg gained mass.

Salt water: the egg lost mass.

2 Distilled water: a small loss of water volume.

Salt water: a gain in water volume.

3 Answers will vary based on the predictions and observations.

4 Distilled water: the increase in mass of the egg occurred because some water entered the egg through the membrane as the water was moving from an area of pure water to an area of water with chemicals dissolved in it (the egg).

Salt water: the loss of mass of the egg occurred because some water left the egg through the membrane, as the concentration of chemicals in the salt water was higher than that inside the egg.

The membrane controlled what entered and left the egg.

Evaluation

Answers should include how well the variables were controlled and measured, the reliability of results and a comment on how accurate the measurements of mass and volume were.

1.9 The functions of the cytoplasm in cells

Check your understanding

SC1: I can identify the cytoplasm of a cell from a photomicrograph, model or other visual representation

When observing cells, the cytoplasm would include all of the internal contents of the cell, except the nucleus.

SC2: I can describe the components that are contained in the cytoplasm of a cell

Organelles that are found within the cytoplasm include:

- ribosomes, used to make proteins for the cell
- mitochondria, used to create energy for the cell
- chloroplasts, used in plant cells to make nutrients through the process of photosynthesis.

SC3: I can describe the functions of the cytoplasm of a cell

Sample answer: One function of the cytoplasm within the cell is to move materials and organelles that allow the cell to function more effectively.

Lesson review

1 The cytoplasm is everything contained within a cell membrane except the nucleus.

2 The mitochondria, ribosomes, chloroplast or other organelles not including the nucleus.

3 The cytoplasm usually looks like empty space between cell structures, but also includes the organelles seen, which may look like small dots, except for the nucleus.

4 **a** The cytosol is a liquid-like substance that contains mainly water, proteins and salts.

b The cytoskeleton is a network of proteins that provides structure to hold organelles in place.

5 The cytoplasm contains different substances since each organelle carries out a specific job, meaning that many different chemical reactions are happening in separate parts of a cell at one time.

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1.10 The functions of mitochondria and chloroplasts in cells

Check your understanding

SC1: I can identify the mitochondria and chloroplasts of a cell from a photomicrograph, model or other visual representation

Chloroplast are easier to view as they are larger in size being approximately 5–7 µm long, whereas mitochondria are very small in size (0.5–3 µm long).

SC2: I can describe the functions of the mitochondria and chloroplasts of a cell

Chloroplasts use carbon dioxide, water and energy from the sun to make glucose for the cell through a process known as photosynthesis. Students may also say that they make oxygen (which is a waste product).

SC3: I can compare and contrast the presence and functions of the mitochondria and chloroplasts in cells

The mitochondria can use the glucose and oxygen produced by photosynthesis in the chloroplast for cellular respiration. The carbon dioxide and water produced by cellular respiration in the mitochondria can be used for photosynthesis in the chloroplast.

Lesson review

1. The electron microscope is needed to view mitochondria, whereas a light microscope can view chloroplast.
2. Chloroplasts appear green when viewed under a microscope.
3. Chloroplasts are found in plants and many protists.
4. Cellular respiration occurs in mitochondria, it converts chemical energy (glucose) and oxygen to ATP energy.

   Photosynthesis occurs in the chloroplast, it uses sunlight, carbon dioxide and water to make glucose.
5. The nerve cells that Emad viewed would have contained more mitochondria than the skin cells because muscle cells require more energy to function and the mitochondria is responsible for creating ATP energy for the cell.

1.11 The functions of vacuoles in cells

Check your understanding

SC1: I can identify the vacuoles of a cell from a photomicrograph, model or other visual representation

When viewing plant cells under a microscope, the vacuole would be a region that does not contain any organelles, whereas the cytoplasm would have organelles present.

SC2: I can describe the functions of vacuoles in plant and animal cells

When the plant cell vacuoles are full the cell becomes turgid giving the plant an up-right appearance.

Lesson review

1. Plant vacuoles contain water, wastes and nutrients.
2. Plants usually have one large central vacuole, whereas animal cells have many smaller vacuoles.
3. Vacuoles can take in and store nutrients for cells to use later in functions. They can also store waste products to excrete from the cell rather than them building up in the cytoplasm.
4. Plants start to become wilted during the heat as there is less water available to take into their large vacuole. This reduces the size of the vacuole resulting in the cells losing their turgor pressure to maintain their rigid shape.

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1.12 Comparing plant and animal cells

Check your understanding

SC1: I can distinguish animal and plant cells in a photomicrograph, model or other visual representation based on their appearance and organelles present

The visible features of plant cells that distinguish them from animal cells includes; the presence of cell walls, chloroplasts and a single large vacuole.

SC2: I can compare and contrast animal and plant cells based on the functions of their organelles

Answers could include: nucleus, ribosomes, mitochondria, cytoplasm and cell membranes.

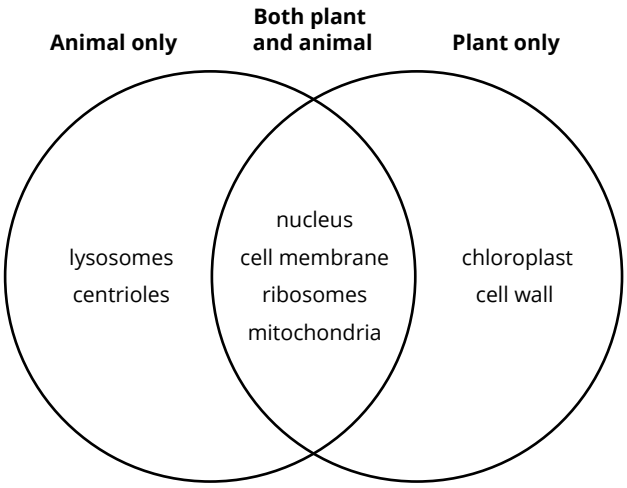
Lesson review

1 Plant cells have a large vacuole and cell wall present whereas animal cells have a small vacuole and no cell wall.

2 Plant and animal cells both require mitochondria as they both need energy to survive, grow and reproduce.

3 Plant cells use their vacuole to remove wastes, whereas animal cells can use both their lysosomes and vacuole to remove waste products.

4



5 Ebony was most likely viewing plant cells as plant cells have a more rectangular shape that is not flexible and if the large vacuole was turgid would be pushing the organelles to the exterior parts of the cell.

1.13 Practical investigation: Organisms under the microscope

Results

Sample results table:

Organism name	*Euglena*	**Observations**
Unicellular or multicellular	unicellular	green chloroplasts red spot (eyespot) hair-like structures (flagella) for movement (may be one or many) small unicellular organism
Magnification	400×	
Organism name	*Paramecium*	**Observations**
Unicellular or multicellular	unicellular	vacuoles hair-like structures (cilia) around cell for movement large unicellular organism
Magnification	100× or 400×	

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Organism name	*Spirogyra*	**Observations**
Unicellular or multicellular	multicellular	cell wall green chloroplasts arranged in spirals many large rectangular cells (multicellular)
Magnification	100× or 400×	

Conclusion

1 *Euglena* and *Spirogyra* are green because they have chloroplasts, which contain the green pigment chlorophyll. The chloroplasts are where photosynthesis takes place.

2 Sample answer: *Euglena* use tail-type structures (flagella), *Paramecia* use hair-like structures (cilia) and *Amoeba* use extensions of the cell (pseudopods) to move. *Amoeba* usually move more slowly than *Euglena* and *Paramecia*.

3 Vacuoles are used to store materials such as water and waste.

Evaluation

1 Sample answer: The organisms move around, and they are difficult to observe because they can quickly move out of the field of view.

2 Sample answer: Cotton wool fibres were used to contain the organisms so they couldn't move around as much. The fibres also had the added benefit of indicating the size of the organisms.

3 Answers may include:

- having pond water that contains more specimens
- having another way to contain the microorganisms
- microscopes with wider fields of view
- microscopes with higher magnification.

1.14 Inquiry activity: Modelling cells

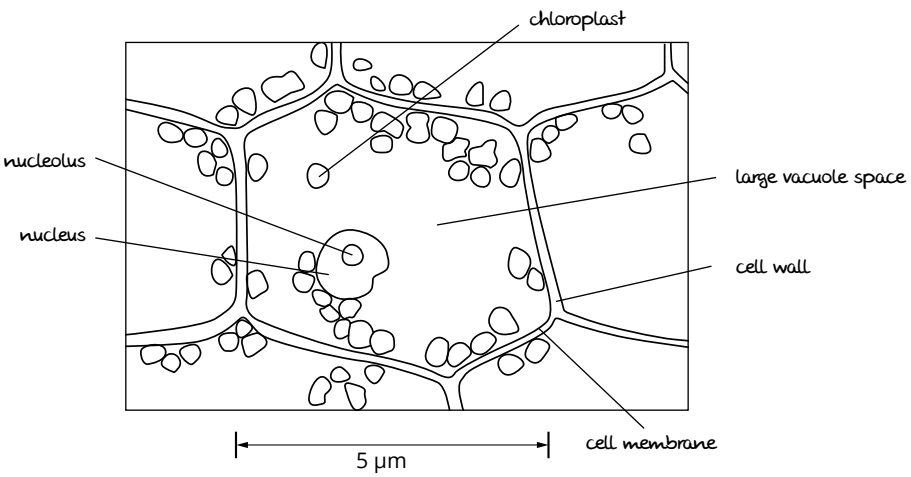
Part A: Drawing cells

Conduct

1 The diagram of the *Elodea* cell should be similar to that shown below, with or without colours to enhance the diagram, and should include the following labels. The scale at a magnification of 3000× should be 5 mm for 2 cm on the diagram.

***Elodea* cell**

magnification 3000×



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2 The diagram of the animal cell based on the description should have a title and include the following labelled cell structures:
   - a central nucleus with a nucleolus inside
   - five mitochondria shown as small oval-shaped organelles
   - several labelled vacuoles, some with visible material inside the vacuole
   - a cell membrane
   - small ribosomes, positioned along structures labelled as cytoskeleton or microtubes
   - the cytoplasm.

Evaluate

1 Sample answer: The light microscope used darkfield and polarisation to show the different organelles that can be seen in the elodea cell more clearly.
2 Sample answer: The diagram has the organelles and structures labelled, and the scale allows the size of the cell and organelles to be estimated and compared to other cells.
3 Sample answer: The diagram shows the relative position and scale of the organelles and relations between the organelles that are not clear from the written information. The diagram makes it easier to compare this cell with other cells.
4 Sample answer: The diagrams effectively differentiate between plant and animal cells because the organelles are clearly labelled and the structure of the cells, for example, the presence of a cell wall in the plant cell and the multiple vacuoles in the animal cell, are easy to identify.

Part B: Modelling cells

Evaluate

1 Sample answer: The answer should focus on the colour, texture, porosity and strength of the materials used. For example, a rigid material should be used for the cell wall, a flexible porous material for the cell membrane and the vacuoles, and green materials for chloroplasts in a plant cell.
2 Answers may focus on the smaller components of the cells, such as ribosomes and mitochondria, especially if internal structures of organelles are represented.
3 Sample answer: Dynamic features or functions of the cell, such as the flow of food and oxygen to the mitochondria, can be represented with arrows. Moveable cell membranes or expanding/contracting vacuoles can be represented with more innovative options.
4 Answers may focus on the substances that make up the organelles and structures. Students might also need more information about the positional and structural relationships between organelles within the cells so that the model can represent these accurately.

1.15 Inquiry activity: Implications of stem cell research

Plan

1 Summary notes should include some or all of the following points.
   - Stem cells can develop into many different types of cells.
   - Stem cells are unspecialised (unlike most other cells in the body, which are specialised and can perform only specific functions).
   - Stem cells have the capacity to renew themselves and to give rise to different types of cells (valuable for medical research and treatment).
   - There are two main types of stem cells:
     – embryonic stem cells (derived from early-stage embryos; can develop into any type of cell)
     – adult stem cells (found in various tissues in the body; can develop into specific types of cells).

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- Stem cells function by dividing and producing more stem cells, as well as differentiating into specialised cells. This process of differentiation allows stem cells to repair and replace damaged or diseased cells in the body.
- In a laboratory setting, stem cells can be cultured and manipulated to produce large numbers of specialised cells, which can then be used to treat a variety of medical conditions.
- Stem cells play a critical role in the functioning of the body and have the potential to revolutionise medicine through their ability to repair and replace damaged or diseased cells. Further research in this field holds great promise for the development of new and effective treatments for a variety of medical conditions.

2 Sample answer:

Positive social implications	**Negative social implications**
Potential for new and effective treatments for a variety of medical conditions	Concerns about access to treatments and distribution of treatments in a fair and equitable manner
Longer life expectancy due to more therapies	False hope of treatment possibilities
Advancements in medical research and technology	Religious and cultural objections to stem cell research
Increased understanding of the biology of stem cells and how they can be used to treat disease	Privacy and informed consent concerns, particularly when it comes to the use of patient tissue and personal information in research
Reduction in sex-linked diseases with the ability to choose the biological sex of embryos	Ability to choose the biological sex of embryos being used for unscientific or cultural reasons, leading to an imbalance in the sex ratio in a population
Creation of new jobs and economic opportunities in the biotech and pharmaceutical industries	

3 Sample PNI chart:

Ethical implications of stem cell research

Positive	**Negative**	**Interesting**
• could lead to new treatments for diseases that currently have no cure • may help replace damaged or diseased cells or tissues with healthy ones • can aid in drug testing and research, which could improve patient outcomes • reduction in sex-linked diseases with the ability to choose the biological sex of embryos	• creation of embryonic stem cells involves destruction of embryos • can be expensive, making it inaccessible to those who need it most • may lead to a 'slippery slope' of creating human clones or genetic engineering • ability to choose the biological sex of embryos being used for unscientific or cultural reasons, leading to an imbalance in the sex ratio in a population • privacy and informed consent concerns, particularly when it comes to the use of patient tissue and personal information in research	• use of embryonic cells raises many issues • use of stem cells for non-medical purposes • potential abuses will need to be monitored and policed • how to ensure that access and affordability do not lead to inequality • many treatments from stem cells yet to be proven

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Design

1 An infographic is considered informative and engaging when it effectively communicates information and data in a visually appealing and easy-to-understand format. The following elements contribute to making an infographic effective.

- Simplicity: An effective infographic should present complex information in a clear and simple manner.
- Visual hierarchy: The information should be arranged in a way that guides the viewer's attention to the most important points.
- Colour: Colour can be used to help guide the viewer's attention and create visual interest. The colours used should be appropriate for the subject matter and consistent throughout the infographic.
- Typography: The typefaces used in an infographic should be easy to read and suitable for the subject matter.
- Icons and illustrations: Icons and illustrations can help make abstract information more concrete and easier to understand.
- Data representation: The data and information should be presented in a way that is easy to understand and visually appealing, such as in charts, graphs and maps.
- Consistency: The overall design of the infographic should be consistent and have a clear visual style that helps tie all the elements together.

  By combining these elements, an infographic can be both informative and engaging, helping to communicate information in a memorable and effective way.

2 An infographic about stem cell research could include the following information.

- Definition of stem cells: A clear and concise definition of what stem cells are, including their unique properties and potential.
- Types of stem cells: An overview of the different types of stem cells, including embryonic stem cells, adult stem cells and induced pluripotent stem cells.
- Sources of stem cells: Information on where stem cells can be found, such as in embryos, cord blood and adult tissues.
- Potential applications of stem cell research: A brief overview of the potential applications of stem cell research, including regenerative medicine, disease modelling and drug discovery.
- Advancements in stem cell research: Highlight the major breakthroughs and advancements in stem cell research, such as the discovery of induced pluripotent stem cells and the development of new techniques for growing and manipulating stem cells.
- Ethical considerations: A discussion of the ethical concerns surrounding stem cell research, such as the use of embryonic stem cells and the potential for misuse.
- Social considerations: You could consider topics such as access to health care, public opinion and policy, medical advancements and ethical considerations.
- Future prospects: A look at the future prospects for stem cell research, including the ongoing development of new therapies and treatments and the potential for continued breakthroughs in this field.

3 Remember that infographics should use clear and concise language and have supporting illustrations, diagrams and graphs to help convey the information effectively.

Improve

1 Answers will vary.

2 Sample answer: I could consider feedback from my teacher and peers about the presentation and information within my infographic.

3 Sample answer: I could consider whether my infographic was clear and straightforward and arranged in a way that guides viewers' attention to the most important points. I might ask: Were the colours used appropriate for the subject matter? Was the data and information visually appealing? Was the overall design consistent with a clear visual style?

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4 Sample answer: I could consider whether any key information was missing, whether the information could have been presented in a different way to make it clearer and whether the data was easy to understand. I might ask: Should I change the headings? Did I represent both positive and negative implications equally?

Evaluate

1 The ethical and social implications of the discovery and application of stem cell technology.

2 Answers may include considering accuracy of data, identifying bias in data sources, summarising complex situations, choosing engaging and clear presentation methods, providing a balanced and objective account, and considering the interaction between science and society.

Topic review

Remember

1 A cell is the building block of all living things.

2 The cell structures that were the first to be seen using a microscope are the cell wall and the nucleus.

3 A prokaryotic cell or a mature red blood cell do not contain a nucleus.

4 The cell membrane is responsible for controlling what can enter or exit the cell.

5 Key features of a plant cell include: chloroplast – the site of photosynthesis; cell wall – provides structural support to the cell; large vacuole – takes in water and nutrients to make the cell turgid.

Understand

6 Eukaryotic (animal and plant) cells are generally larger than prokaryotic (such as bacterial) cells.

7 Multicellular organisms consist of multiple cells that work together and often have specialised functions, whereas a unicellular organism performs all life processes within one cell.

8 Cells found in the respiratory system would need to be able to allow oxygen to enter the blood stream and carbon dioxide to exit.

9 Scientists can use an electron microscope to observe finer details of organelles and some small cell features such as mitochondria that cannot be observed with a stereo microscope.

10 Both plant and animal cells need a nucleus to contain the genetic material for providing instructions to the cell. They would also both need mitochondria because they generate ATP through cellular respiration, providing the energy required for various cellular processes. Plants do not directly use the glucose (sugar) from photosynthesis without mitochondria.

Apply

11 The cytoplasm would be surrounding the nucleus and contain all the organelles and clear fluid within the cell.

12 10× eyepiece magnification multiplied by 40× objective lens magnification would produce a 400× magnification image

13 Ben should explain to the student that the cell wall surrounds the cell membrane, so is found outside of it. He should also explain that the cell wall will look thicker.

Analyse

14 A unicellular organism must perform all functions necessary for survival within one cell and in a changing environment this may not be possible. A multicellular organism can have specialized cells for different functions, allowing for more complex and efficient survival strategies when the environment changes.

15 In plant cells, vacuoles primarily store water and maintain turgor pressure, while also storing nutrients and waste products. In animal cells, vacuoles are smaller and serve various storage, transport, and waste disposal functions, but they do not play a significant role in maintaining the structure of the cell.

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Extension

16 Diagrams should be approximately 6 cm in diameter and contain features such as cell membrane, nucleus, cytoplasm, mitochondria, lysosomes and centrioles.

17 Answers may include: scientists creating blood stem cells; scientists using donor stem cells to repair damaged knee and spinal cords; scientists creating artificial kidneys using stem cells to study diseases; ideas about ethics surrounding the use of human or animal materials; costs and other social and ethical impacts that relate to the topic.

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