Chapter 6: Cells

6.1 All living things are made up of cells

Student book answers (pages 96–97)

Check your learning 6.1

Remember and understand

1 Who invented the first microscope?

Robert Hooke invented the first microscope.

2 Why are cells called ‘cells’?

Cells have their name because when Hooke put thin slices of cork under the microscope, it looked like honeycomb. He thought these holes and their boundaries (cell wall) looked like the rooms in which monks stayed, which were called ‘cells’.

3 What does ‘multicellular’ mean?

‘Multicellular’ means many cells.

4 Name five multicellular organisms.

Student answers will vary; any five animals or plants are acceptable.

5 What do all unicellular organisms have in common?

All unicellular organisms are made up of only one cell.

6 What are the three principles of the combined cell theory?

The three principles of the combined cell theory are:

• All organisms are composed of one or more cells.

• Cells are the basic unit of life and structure.

• New cells are created from existing cells.

Apply and analyse

7 The common house dust mite is a microorganism. Could you see this animal without a microscope? Explain how you came to your answer.

House dust mites have a translucent body and are typically 0.2–0.3 millimetres in size. Hence, they can only be seen under the microscope.

8 Would a cell with a bigger surface area to volume ratio be able to meet its requirements for nutrients more effectively? Why or why not?

Yes. With a larger surface area to volume ratio the cell would find it easier for nutrients to reach the centre of the cell.

9 Why are unicellular organisms always very small?

As cells get larger, it becomes harder for nutrients to reach the centre of the cell and for wastes to get out. Unicellular organisms are always very small in order to maximise their surface area to volume ratio and hence be better able to survive.

6.2 Microscopes are used to study cells

Student book answers (pages 98–99)

Check your learning 6.2

Remember and understand

1 What type or types of microscopes are in your science laboratory?

Students should have compound light microscopes and stereomicroscopes in their science laboratory.

2 Why do you look from the side when you adjust the coarse focus knob?

Always look from the side of the microscope when adjusting the coarse focus knob to ensure the objective lens does not touch the slide.

3 Why must very thin samples be used under a light microscope?

Very thin samples must be used under a light microscope because the light emitted must be able to pass through the specimen.

4 What is ‘microscopy’?

‘Microscopy’ is the science of investigating small objects.

Apply and analyse

5 Explain why it is important to label and date your specimen drawings. Give three different reasons.

It is important to label and date your specimen drawings because: they are like a summary of what was seen and when; results are dependent on the drawings; and they help people understand the drawing.

6 Complete the following magnification table for a compound light microscope by working out the missing values.

| Eyepiece | Objective lens magnification | Total magnification |
| --- | --- | --- |
| × 5 | × 20 | × 100 |
| × 15 | × 20 | × 300 |
| × 10 | × 50 | × 500 |

6.3 Plant and animal cells have organelles

Student book answers (pages 100–103)

Check your learning 6.3

Remember and understand

1 Name three organelles that are surrounded by a membrane.

The nucleus, chloroplasts and mitochondria are membrane-bound organelles.

2 What is the function of the cell membrane? In other words, why does a cell need a membrane?

The function of the cell membrane is to control the entry and exit of substances into and out of the cell. It also helps cells identify each other.

3 What are some of the roles of proteins in organisms?

Proteins are involved in the structure of cells, organelles and larger organs. They may also be involved in transporting messages around the body, helping chemical reactions occur, fighting disease or carrying substances.

4 In which organelle does cellular respiration occur?

Cellular respiration occurs in mitochondria.

5 What is stored in a vacuole?

Vacuoles store water, nutrients and waste products.

6 What is photosynthesis?

Photosynthesis is a chemical process in which the Sun’s light energy enables carbon dioxide and water to become glucose (a sugar) and oxygen.

Apply and analyse

7 What features of cells mean they are classified as living things? Remember MRNGREWW from Year 7?

Cells move, respire, respond to stimuli, grow, reproduce, excrete wastes and require nutrition. This makes them living things.

8 Where would you be more likely to find large numbers of mitochondria, in a muscle cell or a bone cell? Explain your reasoning.

Large numbers of mitochondria are most likely to be found in a muscle cell because they are responsible for energy production in a cell and ensure the muscle has enough energy to perform.

6.4 All organisms have cells that specialise

Student book answers (pages 104–105)

Check your learning 6.4

Remember and understand

1 Give an example of a unicellular organism and a multicellular organism.

A unicellular organism is a single-celled organism, such as bacteria. A multicellular organism has multiple cells, such as plants and animals.

2 Describe the two main differences between eukaryotic and prokaryotic organisms.

Student answers will vary. Any two of the following are correct: prokaryotes are unicellular, primitive and do not have many organelles, such as a nucleus, whereas eukaryotes are multicellular, more complex and have many organelles, such as a nucleus.

3 Where is the genetic material found in a prokaryotic cell?

In a prokaryotic cell the genetic material (DNA) is located in the cytoplasm.

4 Table 6.2 shows that plant cells contain chloroplasts. Although a typical plant cell contains chloroplasts, chloroplasts are not found in all plant cells.

a Suggest why some cells in a plant root may lack chloroplasts.

A plant’s roots are not involved in photosynthesis and so they have no need for chloroplasts.

b In which part of a plant would you expect cells to contain many chloroplasts?

A plant’s leaves would contain many chloroplasts.

5 Look back at Table 6.2, then suggest which kingdom is often referred to as ‘the rest’.

Monera as known as ‘the rest’.

6.5 Bacteria are single-celled organisms

Student book answers (pages 106–107)

Check your learning 6.5

Remember and understand

1 What type of microorganism does our digestive system rely on? What does this organism do?

Our digestive systems rely on microorganisms to digest food, remove wastes and make essential vitamins.

2 What is natural flora?

Natural flora is the term used to describe the microorganisms that live in the human body naturally.

3 Can natural flora ever be harmful to our bodies?

Natural flora can be harmful to the human body. For example, some drugs used to treat cancer can suppress the immune system and, under these conditions, normally harmless natural flora may cause serious disease. In addition, if natural flora escapes from its usual location it may cause serious illness (e.g. *Escherichia coli* from the gut invading the bladder can cause urinary tract infections).

4 What is a pathogen? What are the four main groups of pathogens?

A pathogen is a microbe that can potentially cause a disease. The four main groups of pathogens are bacteria, fungi, protists and viruses.

5 Why is a virus not considered to be living?

A virus is not considered to be living because it cannot survive and reproduce outside a host cell.

Apply and analyse

6 It is not recommended that food be left out of the fridge for more than 3 hours. Use binary fission to explain why.

Bacteria reproduce by binary fission, which can take as little as 20 minutes to get started. Bacterial growth is stopped at temperatures below 4°C and above 60°C, so food left on the bench provides ideal conditions for bacteria to grow.

6.6 Eukaryotic cells undergo mitosis

Student book answers (pages 108–109)

Check your learning 6.6

Remember and understand

1 List three reasons why new cells need to be made.

New cells need to be made to replace old cells, damaged cells or grow specific cells to carry out specialised functions.

2 On a sheet of paper, draw diagrams to describe the steps involved in mitosis. Label the parent cells and daughter cells.

Students should draw and label a diagram similar to Figure 6.28.

3 What is the name of the substance that provides instructions for the cell and where is it found?

DNA is the substance that provides instructions for the cell. It is found in the nucleus.

4 What is apoptosis? When does it occur?

Apoptosis is the programmed death of a cell. It occurs if DNA is damaged or the cell is old.

5 Where is DNA found in your skin cells?

DNA is found in the nucleus of our skin cells.

6 Red blood cells do not have a nucleus. Explain why this makes it impossible to for them to undergo mitosis.

The nucleus plays a major role in mitosis, so without a nucleus it is impossible for red blood cells to undergo mitosis.

Apply and analyse

7 Cigarette smoke is considered a carcinogen. What does this mean?

A ‘carcinogen’ is a cancer-causing substance.

8 Explain why a single cancer drug cannot destroy all types of cancer.

Student answers will vary. Typically, there are many different types of cancer (more than 200) so different drugs are needed to treat the different types.

6.7 Fungal cells can save lives

Student book answers (pages 110–111)

Extend your understanding 6.7

1 What is the difference between fungi and bacteria?

Student answers will vary. Typically, fungi are eukaryotes, they have a nucleus and membrane-bound organelles, they are multicellular and reproduce both sexually and asexually. Bacteria are prokaryotes, have no nucleus, are unicellular and reproduce by binary fission.

2 Fungi usually grow best at 22°C. How did leaving the agar plate on the bench accidentally help Fleming make his discovery?

When Fleming returned after leaving his agar plate on the bench with bacteria in it, he found that the fungi mould that had started growing on the plate at the ideal room temperature had stopped the bacteria from growing.

3 Why did Florey and his group of scientists not give penicillin to four of their mice?

The four mice that went without penicillin served as a control group. These mice could be compared with those that were given the penicillin.

4 Many of our medicines today originate from the molecules made in nature. How does the purity of penicillin prepared in a laboratory compare with the fermented materials used in 1000 bce?

Student answers will vary, but should mention the ideal and sterile conditions used in modern laboratories to grow penicillin.

5 ‘The most exciting phrase to hear in science, the one that heralds discoveries, is not “Eureka” but “that’s funny …”’ Use Fleming’s discovery to explain this quote from Isaac Asimov.

Student answers will vary. The phrase ‘that’s funny …’ is logically followed by ‘what if …’ as part of the scientific method of investigation.

Review 6

Student book answers (pages 112–113)

Remember and understand

1 Who was the first person to describe cells? What cells did they draw?

Robert Hooke was the first person to describe cells. Plant cells were the first cells to be drawn.

2 What is the benefit of using a stain when viewing some specimens?

The benefit of using a stain when viewing some specimens is to make the structures of a cell more readily visible.

3 Explain two key ideas presented in the cell theory.

Cell theory states: all organisms are composed of one or more cells, cells are the basic unit of life and structure, and new cells are created from existing cells.

4 Explain why programmed cell death is necessary.

Programmed cell death is necessary to ensure damaged or old cells are replaced by new cells. This aids in growth and the maintenance of overall health.

5 Why does a specimen need to be really thin to be viewed under a light microscope?

Very thin samples must be used under a light microscope because the light emitted must be able to pass through the specimen.

6 What is the cell theory?

The cell theory describes the main ideas about the importance of cells and their role in living things.

7 Explain at least one similarity and one difference between a mitochondrion and a chloroplast.

Any one of the following:

Similarities: energy source for cell, many of them in the cell

Differences: chloroplasts are only in plants and absorb the Sun’s energy to convert it to usable energy, whereas mitochondria are membrane-bound and use cellular respiration to convert energy

8 How are fungal cells different from bacterial cells?

Student answers will vary. Typically, fungi are eukaryotes, they have a nucleus and membrane-bound organelles, they are multicellular and reproduce both sexually and asexually. Bacteria are prokaryotes, have no nucleus, are unicellular and reproduce by binary fission.

9 Define the following words:

a mitosis

Process of cell division to provide growth or repair

b cancer

Group of diseases that result from uncontrolled cell division

c mutagen

Substance that may damage a cell’s genetic material (DNA)

d binary fission

Form of asexual reproduction used by bacteria; the splitting of a parent cell into two equal daughter cells

e pathogen

Microbe that can potentially cause a disease

Apply and analyse

10 A cell membrane is ‘partially permeable’. This means that only certain substances are able to cross the membrane. List some substances that would need to get into the cell and some that would need to get out.

Oxygen, nutrients and water need to get into a cell. Carbon dioxide and other waste products need to get out of a cell.

11 Explain why unicellular organisms are always tiny and why multicellular organisms are made up of so many cells.

Unicellular organisms are tiny because they consist of only one cell specialised to carry out the functions required. Multicellular organisms require many cells to carry out many different functions.

12 Ribosomes are found in every cell on Earth. What function do ribosomes perform in cells? Why is it so important?

Ribosomes are where proteins are made in the cells. Proteins are small molecules with different roles.

13 If you were sick with a cold or flu, a doctor might prescribe antibiotics. But antibiotics are quite useless against viruses, the pathogens responsible for colds and flu. So why would a doctor prescribe antibiotics?

Antibiotics are ineffective for viruses, so if an antibiotic were prescribed it would be to help the immune system fight a bacterial infection.

14 Light microscopes allow you to view living cells. Electron microscopes view either dead cells or cells that have been killed in the process of viewing them. In what situations might light microscopes be preferable to electron microscopes?

Light microscopes are preferable to electron microscopes when wanting to view a wide range of biological activity, such as the uptake of food, cell division and movement.

15 Identify the microscope most likely to have created the images in Figure 6.37.

a Scanning electron microscope

b Transmission electron microscope

c Stereomicroscope

d Light microscope

16 Two students prepare slides from different sections of a spring onion under a light microscope in their school laboratory. James views a section of the green leafy part and observes many chloroplasts within each cell, but has difficulty identifying a nucleus in each cell. Emily views a section of the white stem of the plant. She comments that a nucleus is clearly visible in most of the cells, but does not identify any chloroplasts.

a Suggest why James identified many chloroplasts within each cell when they appeared to be absent from the cells viewed by Emily.

James identified chloroplasts because he was viewing the leaf, where chloroplasts are mostly found and photosynthesis occurs. Emily, however, was viewing the stem, where photosynthesis doesn’t occur and therefore chloroplasts aren’t found.

b Emily commented that she could identify a nucleus in most cells. If a nucleus is not visible in a particular cell, does this mean that the cell does not contain a nucleus?

If the nucleus is not visible in a cell it doesn’t mean the cell doesn’t contain one. It may mean that the nucleus is masked by other organelles or blends into the cell membrane or cell wall.

Evaluate and create

17 Similes are often used in creative writing to compare two things using the words ‘like’ or ‘as’. Explain the similarities that allow these similes to be used.

a Cells are like building blocks.

Cells are often considered to be the building blocks of life, because most living things are composed of a large number of cells, similar to how large numbers of building blocks are used to create a model building.

b The nucleus is like a control centre.

The nucleus of a cell controls all the functions of the cell, just as a control centre would control all the functions of a large factory or power plant.

c The mitochondrion is like a power station.

The mitochondria are the site of energy production for the cell, much like a power station is the site of energy production for a town or city.

18 Write a very short creative story about a virus. Your story needs to be from the point of view of a cell. The first line of your story is: ‘Once upon a time, a virus arrived for an uninvited visit’.

Student answers will vary.

19 How has our understanding of how living things function changed with the development of the microscope?

Student answers will vary. Typically, our understanding of how living things function improved dramatically with the development of the microscope. Scientists were able to work out a reliable way of determining a living thing from a non-living thing. The microscope showed that all living things are made up of cells and, in turn, what the cells themselves are made up of.

20 Use the lenses from an old pair of reading glasses or a magnifying glass to create a model of a microscope. Describe how your model is similar and different to Hooke’s microscope and modern compound microscopes.

Student answers will vary.