ARCHBISHOP ILSLEY CATHOLIC SCHOOL

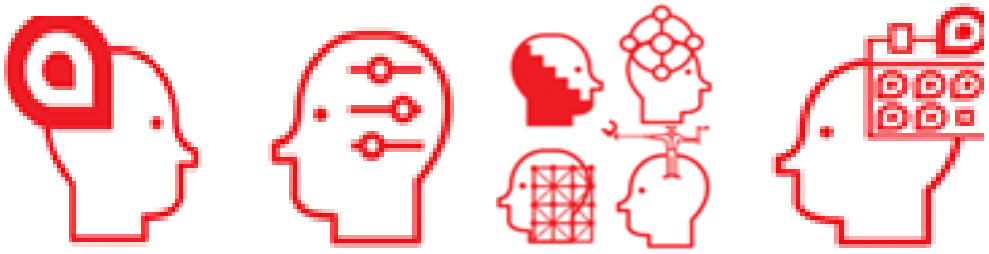
Justus et Tenax Propositi - Just and Firm of Purpose

AQA GCSE Combined/Triple Science

Biology

B1 Cell Biology

Knowledge and Mastery Book



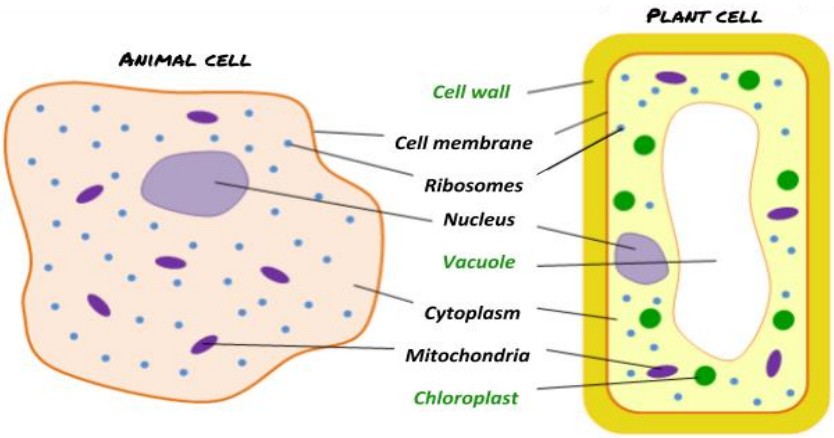
Do not write in this booklet

ALL answers to be written in your exercise book

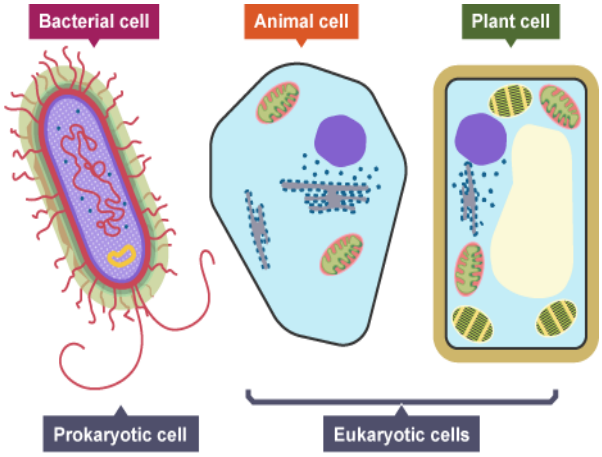
Contents

Lesson 1: Cells

Cells are the basic unit of life. Cells are needed to reproduce, therefore, all living things are made of cells. The basic structure of animal and plant cells is shown below. However, this is just a basic plan. Most cell types in multicellular organisms are specialised. This means that have different structures that allow them to preform different functions in the organism. Both plant and animal cells have a nucleus which makes them eukaryotic cells.



Bacterial, or **prokaryotic,** cells are much, much, much smaller than plant and animal cells. In fact, they are even smaller than the nucleus of an animal or plant cell. Bacteria do not have a nucleus. Instead, their DNA is free in the cytoplasm. It consists of a single loop of DNA. They may also have extra small rings of DNA called plasmids. These plasmids can hold genes for traits such as antibiotic resistance.



Cell Structure (organelle)	Function (job in the cell)
Nucleus	Contains DNA/chromosomes
Cytoplasm	Site of some reactions, fills out the cell
Cell membrane	Controls what enters and exits cell
Ribosome	Makes (synthesises) protein
Mitochondria	Aerobic respiration to release energy
Cell wall	Strength, structure, protection
Chloroplast	Photosynthesis
Vacuole	Structure and storage of water and carbohydrates

Lesson 1 Mastery Questions

1. **What is the function of the nucleus?**
2. **What is the function of the cell membrane?**
3. **What is the function of the ribosome?**
4. **What is the function of the chloroplast?**
5. **Which part of the cell is responsible for some chemical reactions?**
6. **Which part of the cell is responsible for aerobic respiration?**
7. **Which part of the cell provides strength, structure and protection to a plant cell?**
8. **Which part of the cell stores water to help with structure?**
9. **What is a eukaryotic cell?**
10. **What is a prokaryotic cell?**
11. **What does a prokaryotic cell have that eukaryotic cells doesn't?**
12. **What do plant cells have that animal cells do not?**
13. **What controls the activities of the cell?**
14. **What is the function of the vacuole?**
15. **What controls what enters and exits a cell?**
16. **What is the function of the mitochondria?**
17. **What makes proteins?**
18. **What is the function of the cell wall?**
19. **What part of the cell is responsible for photosynthesis?**
20. **What is the function of the cytoplasm?**

Q1.

Living organisms are made of cells.

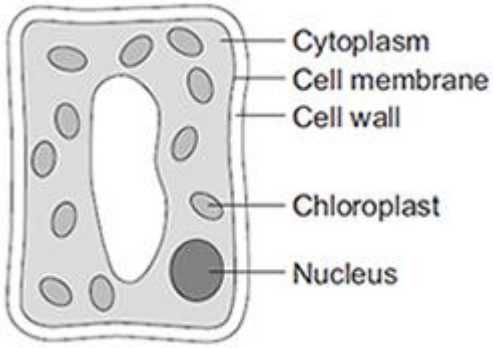
(a) Animal and plant cells have several parts. Each part has a different function.

Match the part of the cell to it's function.

Cell part	Function
Cell membrane	Where most energy is released in respiration
Mitochondria	Controls the movement of substances into and out of the cell
Nucleus	Controls the activities of the cell
	Where proteins are made

(3)

(b) The diagram below shows a cell from a plant leaf.



Which **two** parts in the diagram above are **not** found in an animal cell?

(2)

(Total 5 marks)

Q2.

Cells are the basic units of all forms of life.

(a) Describe **four** differences between a bacterial cell and a plant cell.

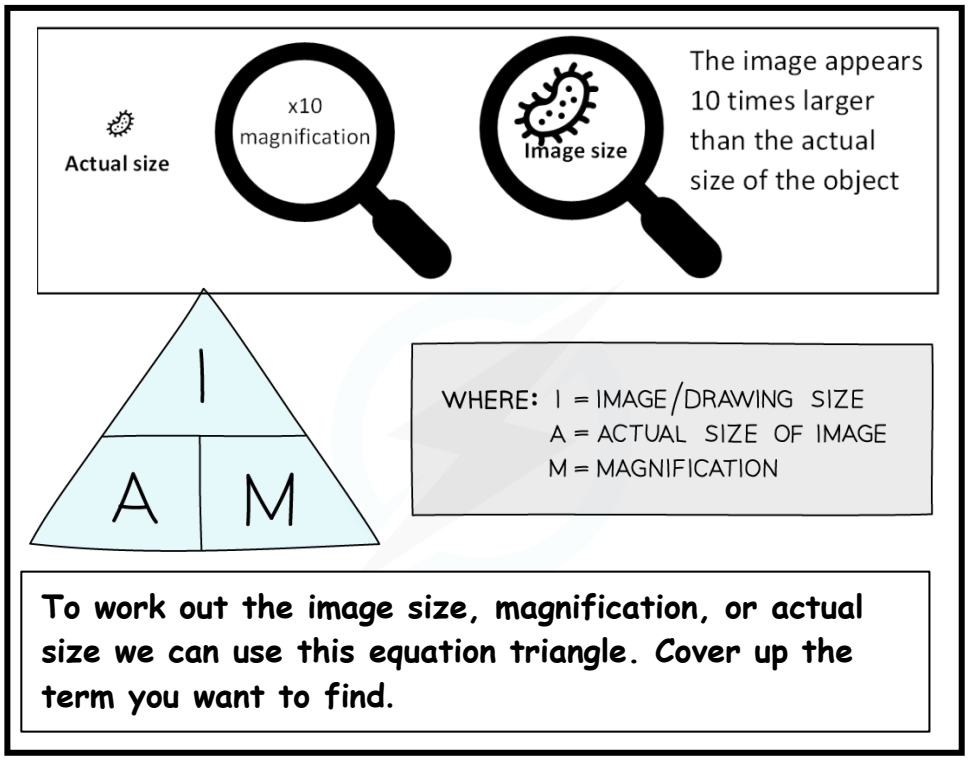
(4)

Lesson 2: Magnification and Types of Microscope

Calculating Magnification

If the cell in the image is 10mm long, it will be 0.025mm in real life. This is because in real life it is 400 times smaller.

$$10 \div 40 = 0.025 \textbf{ mm}$$



Standard form allows us to write really long numbers in a short way that takes up less space.

$0.000001 = 1 \times 10^{-6}$

$1.000.000.000 = 1 \times 10^{9}$

Lesson 2: Mastery Questions

1. What is magnification?
2. What is resolution?
3. A microscope has an objective lens with a magnification of 40x and an eyepiece lens with a magnification of 10x. What is the total magnification?
4. If an object appears 10 times larger under a microscope, what is the magnification?
5. A student observes a specimen under a microscope with a total magnification of 400x. If the objective lens has a magnification of 40x, what is the magnification of the eyepiece lens?
6. What is the magnification of a microscope if the objective lens has a magnification of 20x and the eyepiece lens has a magnification of 15x?
7. An image under a microscope has a magnification of 200x. If the actual size of the specimen is 2 mm, what is the size of the image?
8. A cell is observed under a microscope with a total magnification of 600x. If the actual size of the cell is 20 micrometers, what is the size of the image?
9. A microscope has an objective lens with a magnification of 10x and an eyepiece lens with a magnification of 20x. If the specimen is 5 mm in size, what is the size of the image?
10. A student wants to observe a specimen under a microscope and achieve a total magnification of 400x. If the objective lens has a magnification of 40x, what should be the magnification of the eyepiece lens? A microscopic image of a cell has a magnification of 400x. If the measured size of the cell in the image is 0.2 mm, what is the actual size of the cell?
11. A photograph of a microscopic organism is taken at a magnification of 1000x. If the length of the organism in the image is measured to be 2 cm, what is the true length of the organism?
12. A microscopic image of a mineral crystal has a magnification of 500x. If the measured width of the crystal in the image is 0.5 mm, what is the real width of the crystal?
13. A microscope is set to a magnification of 200x, and a microscopic image of a leaf is obtained. If the measured length of the leaf in the image is 1.5 cm, what is the actual length of the leaf?
14. A photograph of a microscopic organism is taken at a magnification of 800x. If the measured diameter of the organism in the image is 0.2 mm, what is the true diameter of the organism?
15. Copy and complete the table.

Number	**Standard Form**
0.000056	
6748000	
	3.4×10^6
	1.45×10^8

Lesson 2 Cells Exam Questions

Q1.

This question is about cell structures.

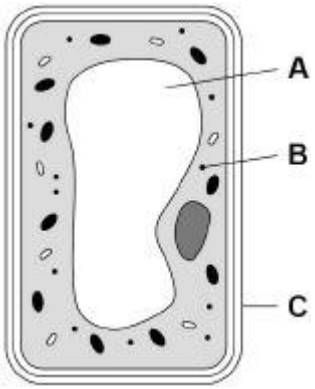
(a) Draw **one** line from each cell structure to the type of cell where the structure is found.

Cell Structure	Type of cell where the structure is found
Nucleus	Prokaryotic cells
Permanent vacuole	Plant cells only
Plasmid	Eukaryotic cells

(2)

(b) **Figure 1** shows a plant cell.

Figure 1



What are the names of structures **A**, **B** and **C**?

Tick **one** box.

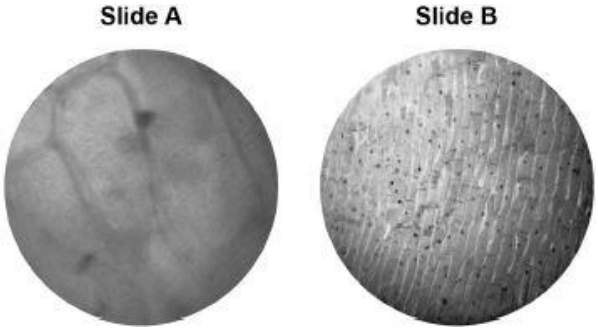
Structure A	Structure B	Structure C	
Chloroplast	Vacuole	Cell wall	☐
Nucleus	Chloroplast	Cell membrane	☐
Vacuole	Mitochondrion	Cell membrane	☐
Vacuole	Ribosome	Cell wall	☐

(1)

A student observed slides of onion cells using a microscope.

Figure 2 shows two of the slides the student observed.

Figure 2



The cells on the slides are **not** clear to see.

(c) Describe how the student should adjust the microscope to see the cells on Slide A more clearly.

(1)

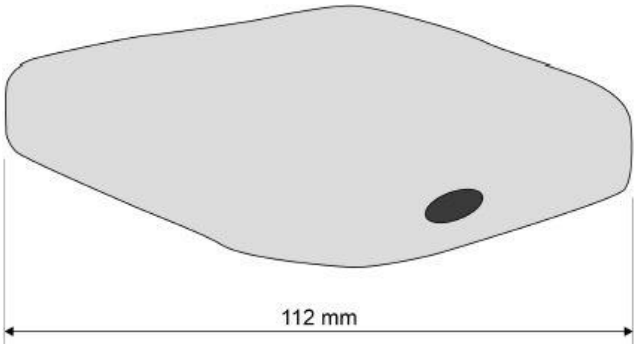
(d) Describe how the student should adjust the microscope to see the cells on Slide B more clearly.

(2)

(e) The student made the necessary adjustments to get a clear image.

Figure 3 shows the student's drawing of one of the cells.

Figure 3



The real length of the cell was 280 micrometres (µm).

Calculate the magnification of the drawing.

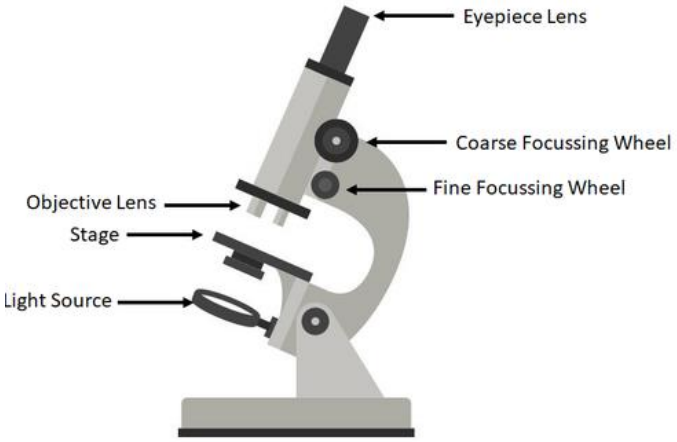
(3)

(Total 9 marks)

Lesson 3: Using a Microscope

Keywords

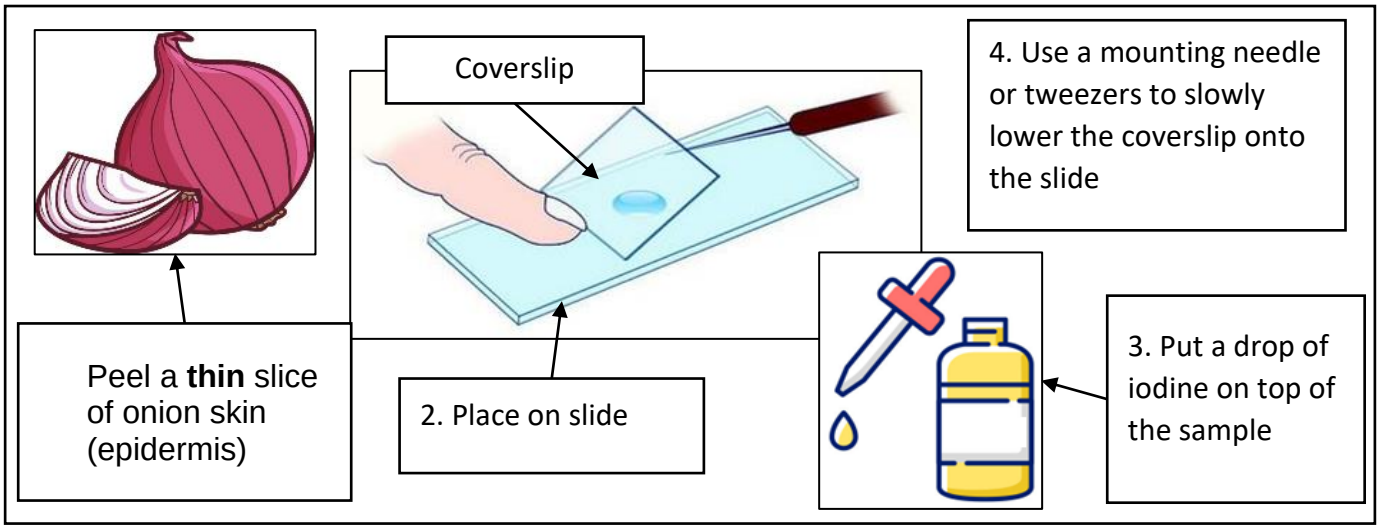
- **Magnification: making an image bigger**
- **Resolution: seeing 2 points on an image as separate**
- **Focus: enable to see more clearly**
- **Specimen: biological sample you are investigating**



Using a Microscope

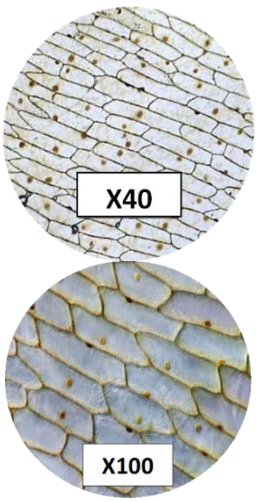
Cells are too small to be seen with the naked eye. The first light microscopes were made in the 17th century. They pass a beam of light **through** a specimen and a set of lenses which magnify the specimen before the light reaches your eye.

Making a slide of onion skin epidermis



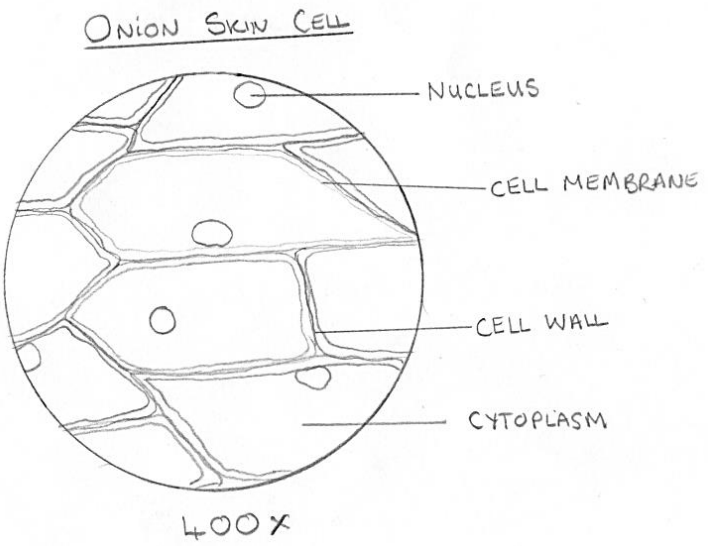
Viewing cells under a light microscope

1. Place slide on stage and secure with clips
2. Turn on light and select the lowest power objective lens.
3. Use coarse focus to move stage as close to slide as possible without touching it
4. Look down eyepiece lens and use coarse focus to move stage slowly away from objective until you see blurry image of cells.
5. Use fine focus to make image sharper.
6. Change objective lens to higher power magnification and repeat step 5.



Drawing Cells

1. **Use a pencil.**
2. **Clean lines, no sketching or shading.**
3. **Label with straight label lines, the lines must touch the structure you're labelling.**
4. **Include total magnification (eyepiece x objective).**



Mastery Questions

1. What is the function of the coarse focus?
2. What is the function of the stage?
3. What is the function of the light?
4. What is the function of the eyepiece and objective lenses?
5. Write a definition for magnification.
6. Outline the method that a student would need to follow in order to prepare an onion slide. Include the following terms: Iodine, Onion, Upper Layer, tweezers, Glass slide, Cover Slip, Pipette
7. State the function of each of the following:
    a. Iodine
    b. Onion
    c. Tweezers
    d. Glass slide
    e. Cover slip
    f. Pipette
8. A student says in high resolution images, the objects are further apart. The student is wrong. Can you explain why and correct their answer?
9. Why do we need to use microscopes to view cells?
10. A sample of food infected with bacteria is viewed under the microscope. The bacteria are 0.0005mm long. How big will they look when using a light microscope which has a magnification of x1500? Explain if this is a good use of the microscope.

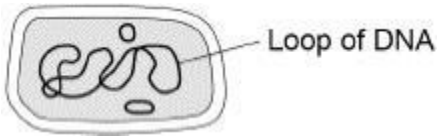
Exam Question

Q1.

This question is about cells.

(a) **Figure 1** shows a cell.

Figure 1



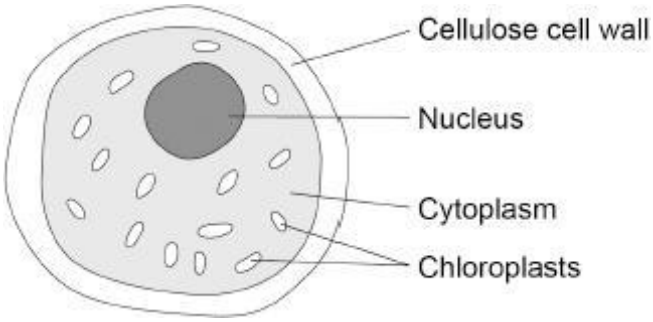
What type of cell is shown in **Figure 1**? **(1)**

Choose **one** .

Animal Bacterium Plant

Figure 2 shows an algal cell.

Figure 2



(b) What is the function of the cell wall? **(1)**

Choose **one**.

To contain the genetic material | To stop the chloroplasts leaking out | To strengthen the cell

(c) The algal cell is green. Which part of the algal cell makes it green in colour? **(1)**

Choose **one**.

Cellulose Cytoplasm Chloroplast Nucleus

(d) Cells contain sub-cellular structures. Match each structure to **one** function.

Structure	Function
Cell membrane	Controls transport of substances into the cell
Mitochondria	Where energy is released
Ribosomes	Where glucose is made
	Where photosynthesis takes place
	Where proteins are made

(3)

A student prepared a microscope slide of cheek cells.

The student looked at one cell using a microscope.

Figure 3 shows the image the student saw.

Figure 3

(e) What should the student do to get a clear image? **(1)**

Choose **one**.

Adjust the focus knob

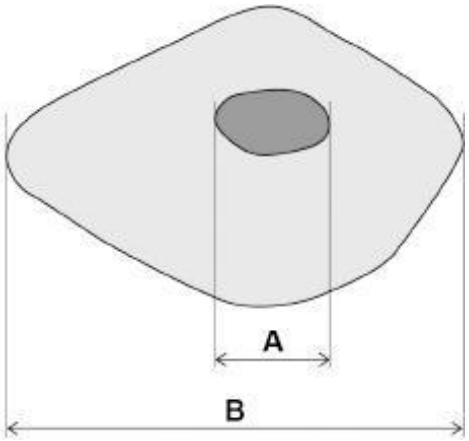
Make the light dimmer

Put water on the slide

The student then obtained a clear image.

Figure 4 shows the clear image.

Figure 4



(f) Measure the length of the nucleus (**A**) and the length of the cell (**B**) in millimetres (mm). **(2)**

(g) How many times longer is the cell (**B**) than the nucleus (**A**)? **(1)**

(h) The student looked at another cell. The image width of the cell was 40 mm

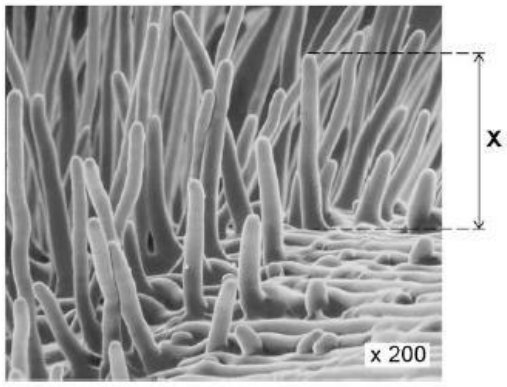
The real width of the cell was 0.1 mm Calculate the magnification of the cell. Use the equation:

$$\text{magnification} = \frac{\text{size of image}}{\text{size of real object}}$$

(2)

Q2.

The image shows part of a root from a cress plant.



(a) What type of microscope was used to create the image?

(1)

(b) The magnification of the cress root in the image above is × 200.

There are 1000 micrometres (μm) in a millimetre (mm).

Calculate the real length of the root hair, **X**.

Give your answer in micrometres (μm).

(2)

Lesson 4: Cell Division and the Cell Cycle

The function and organisation of DNA

The function of the nucleus is to enclose the genetic information. Genetic information is the code that controls the activities of the cell. The chemical that makes up this code is DNA. A gene is a short sequence of DNA that codes for a protein. Proteins are made by the ribosomes in the cytoplasm. Proteins affect cell activity and therefore the characteristics of an organism.

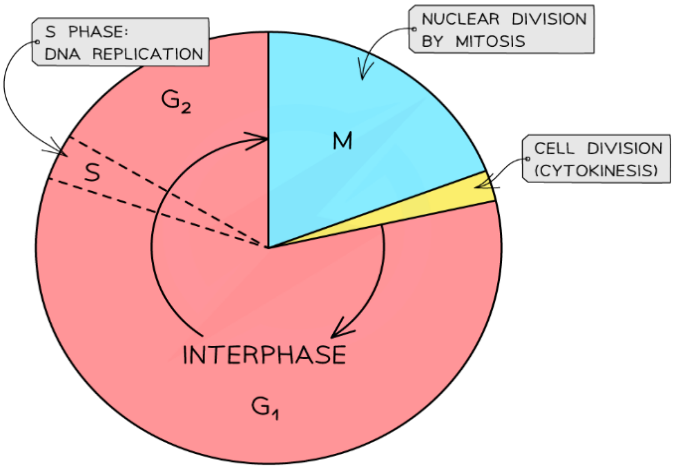
DNA → Protein → Cell activity → Characteristics

DNA is like a long thread. In each cell in your body this thread is about 2 metres long, broken up into 46 sections called chromosomes. Each chromosome is part of a pair. It has another chromosome which contains the same genes in the same order, although they may be different versions. During fertilisation, you inherit 1 copy of each pair from your mother and 1 copy from your father. The chromosomes are not usually visible. This is because they are all tangled, like a ball of string. Before the cell divides the chromosomes become condensed and organised making them visible under a light microscope.

Cell Division and the Cell Cycle

Cells are the basic unit of life. All living things are either made of cells or require cells to survive. All cells undergo the cell cycle. To make a new cell, the original cell splits to form 2 cells. There are some important things the cell must do before this happens, these are described by the cell cycle. Each cycle ends with one cell dividing to form 2 identical cells.

- **Interphase**
  The cell grows
  Mitochondria and ribosomes multiply
  DNA replicates
- **Mitosis**
  Chromosomes pulled to opposite sides of the cell.
  Nucleus divides
- **Cell division (Cytokinesis)**
  Cytoplasm and cell membrane divide



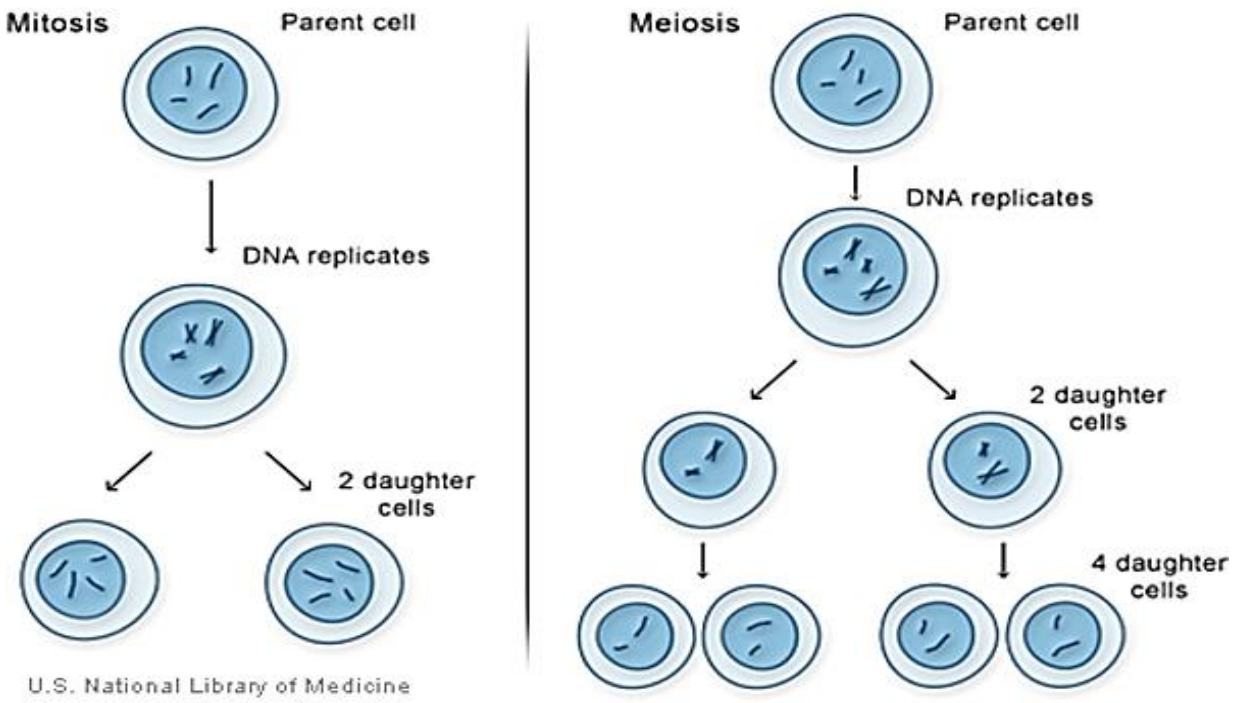
Mitosis

For an organism to reproduce asexually it must divide by mitosis. First the chromosomes and cell organelles are copied, then the chromosomes are pulled to opposite sides of the cell (**mitosis**) and the nucleus divides. Finally, the cytoplasm and cell membrane divides. Two identical 'daughter cells' are produced. Because they have identical genetic information to the parent cell, they are called clones. Mitosis happens in multicellular organisms, such as animals and plants, when they grow and when they repair damaged tissues, but we do not use it to reproduce.

Meiosis

Sperm and egg cells are made by a process called ***meiosis***. Sexual reproduction is defined by the fusion of gametes. This means the offspring will have a unique combination of genes from both parents. This leads to variation (differences) within the population.

Meiosis is a special form of cell division that occurs in the sexual organs. Meiosis follows the same steps as mitosis to start (cell division 1), but once the daughter cells have formed, they undergo a second division. This results in 1 parent cell forming 4 gametes, each with **half** the number of chromosomes as an adult cell.



Mastery Questions

Define / describe Questions: State, give an account, say what you see!

1. Copy and complete the table.

	Mitosis	Meiosis
Do the chromosomes and organelles replicate at the start?	***Yes***	***Yes***
Do they chromosomes line up and get pulled apart?		
How many times does the cell divide		
How many daughter cells are produced?		
What is the number of chromosomes in the daughter cells		
Are the cells clones?		

2. How many chromosomes are in a human body cell?
3. How many chromosomes are in a gamete (sex cell)?
4. Name the organelle where chromosomes are found.
5. Name the organelle where proteins are made?
6. Why do you have 2 copies of each chromosome?
7. What are the 2 types of cell division?
8. Without mitosis, multicellular organisms wouldn't be able to grow. What else would multicellular organisms not be able to do?
9. What are the 3 phases of the cell cycle?
10. What is the definition of variation?
11. State some types of variation you can see between the dogs in the picture.
12. What type of cell division creates variation in genes?
13. What is a clone?

Compare Questions: similarities AND differences!

14. Compare mitosis and meiosis using a Venn diagram.
15. Compare mitosis and meiosis **(6)**

Explain Questions: Say why, make links from one idea to another!

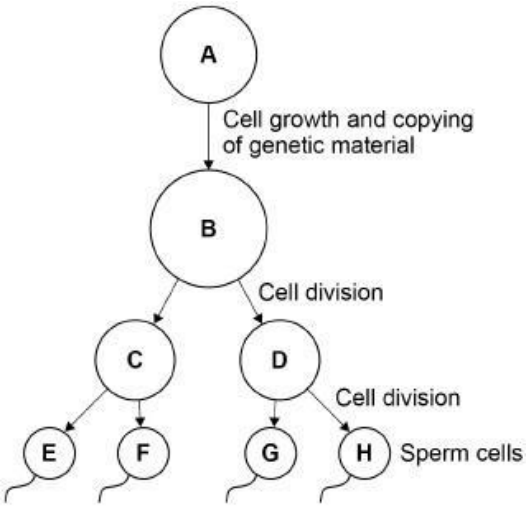
16. Why is cell division important?
17. A clone was made from one of your body cells. Suggest what that individual would be like. What would be the same as you and what might be different?
18. Explain how variation in genes can lead to variation in characteristics.
19. If there are 54 cells in cell growth, 90 cells total, and the total cycle length is 2.5 hours, how long does cell growth take?
20. If a cell takes 3 hours to completely form a new cell, 18 cells are splitting, 19 cells are in mitosis, and 140 cells are growing, how long does the growth stage take?

Exam Questions

Q1.

Figure 1 shows the production of sperm cells in humans.

Figure 1



(a) Cell **A** is a normal body cell. How many chromosomes are there in cell **A**? **(1)**

(b) What is the mass of DNA in cell **E**? **(1)** Choose **one**.

A quarter of the mass of the DNA in cell **A**

Half the mass of the DNA in cell **A**

The same mass as the DNA in cell **A**

Twice the mass of the DNA in cell **A**

(c) What type of cell division produces sperm cells? **(1)** Choose **one**.

Binary fission

Differentiation

Meiosis

(d) Sometimes there are errors in copying the genetic material.

What term describes an error in the genetic material? Choose **one**. **(1)**

Absorption

Fertilisation

Mitosis

Mutation

In sexual reproduction, a sperm cell fuses with an egg cell to form a new single cell.

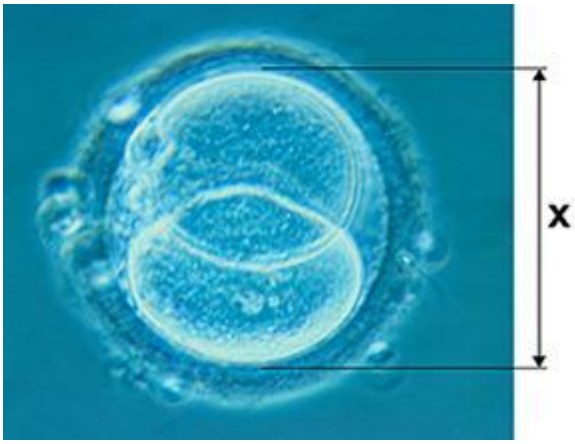
An embryo develops from the single cell.

The cell divides three times to produce the embryo.

(e) How many cells are there in the embryo after three cell divisions? **(1)**

Figure 2 shows a different human embryo.

Figure 2



(g) Measure image length **X** on **Figure 2**. Give your answer in millimetres (mm).

(1)

(h) The image in **Figure 2** has been magnified × 500 Calculate the real length of the embryo.

Use the equation:

$$\text{real length of the embryo} = \frac{\text{image length}}{\text{magnification}}$$

Give your answer in micrometres (µm).

1 mm = 1000 µm

(3)

(i) The embryo may **not** implant in the lining of the uterus.

The embryo will then be lost from the woman's body several days later.

Explain why the woman may **not** notice this has happened.

(2)

Q2.

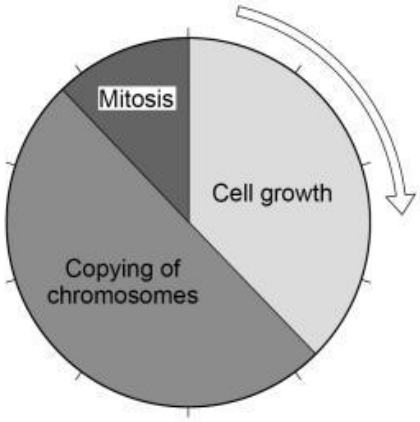
This question is about the cell cycle.

(a) Chromosomes are copied during the cell cycle. Where are chromosomes found? **(1)**

(b) What is the name of a section of a chromosome that controls a characteristic? **(1)**

Figure 1 shows information about the cell cycle.

Figure 1

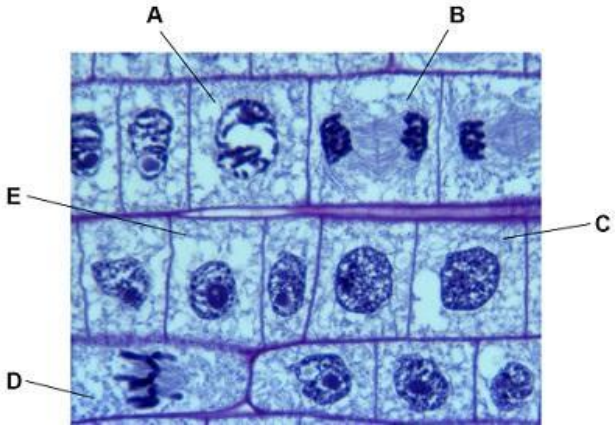


(c) Which stage of the cell cycle in **Figure 1** takes the most time? **(1)**

(d) During mitosis cells need extra energy. Which cell structures provide most of this energy? **(1)**

(e) The cell cycle in **Figure 1** takes two hours in total. The cell growth stage takes 45 minutes. Calculate the time taken for mitosis. **(2)**

Figure 2 shows some cells in different stages of the cell cycle.



(f) Which cell is **not** dividing by mitosis? **(1)** Choose **one** letter**. A B C D**

(g) Cell **E** in **Figure 2** contains 8 chromosomes. Cell **E** divides by mitosis.
How many chromosomes will each new cell contain? **(1)**

(h) Why is mitosis important in living organisms? (**1)**

Q3.

The table shows the number of chromosomes found in each body cell of some different organisms.

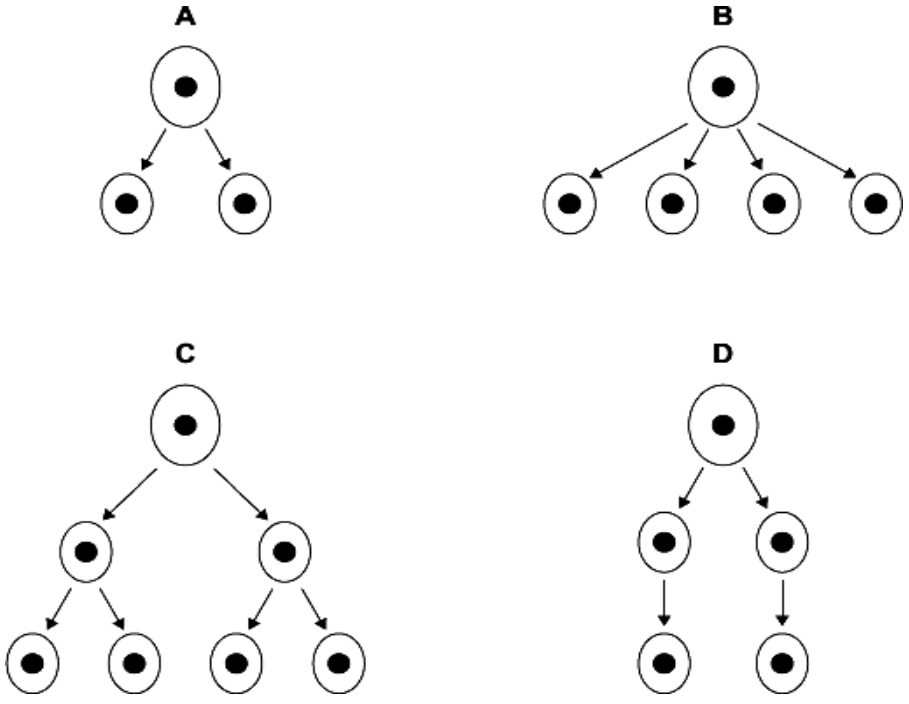
Animals		Plants	
Species	**Number of chromosomes in each body cell**	**Species**	**Number of chromosomes in each body cell**
Fruit fly	8	Tomato	24
Goat	60	Potato	44
Human	46	Rice	24

(a) Nearly every organism on earth has an even number of chromosomes in its body cells. Suggest why. **(1)**

(b) Chromosomes contain DNA molecules. Describe the function of DNA. **(2)**

(c) Gametes are made in the testes by meiosis.

(i) Look at the diagrams.



(i) Which diagram, A, B, C or D, represents how cell division by meiosis produces gametes in the testes? **(1)**

(ii) How many chromosomes will each goat gamete contain? **(1)**

Chapter 5: Specialised Cells and Differentiation

Multicellular organisms are organised into organ systems which are responsible for major processes that keep us alive.

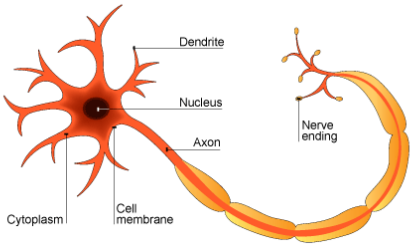
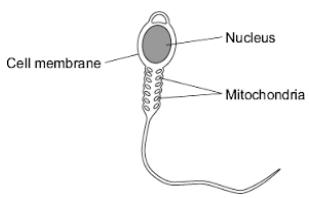
- immune system which fights off harmful microorganisms,
- the nervous system which allows us to respond to our environment.
- the cardiovascular which transports vital chemicals around our body
- the reproductive system which allows us to make more humans

These organ systems are divided into separate organs that all work together to perform this role. For example, in the cardiovascular system we have a heart to pump blood and blood vessels to carry blood.

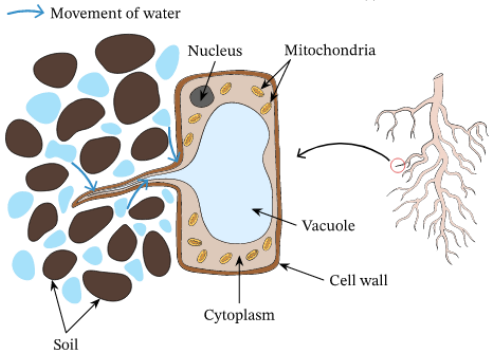
Our organs are further divided into different tissues. Tissues are groups of the same kind of cell. For example, in the heart there are groups of muscle cells creating the heart contraction and also groups of nerve cells that tell the heart when the contractions need to happen – these are different tissues but both vital to the working of the heart.

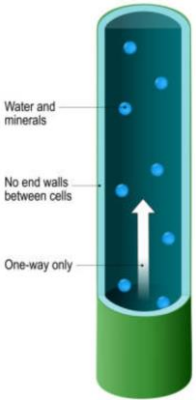
These tissues are made up of individual specialised cells. A muscle cell and a nerve look very different because their jobs are very different. Unspecialised cells are called stem cells and can turn into any type of cell.

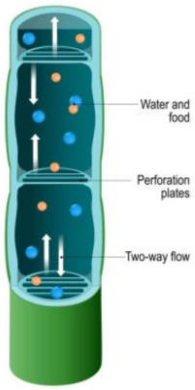
Three different specialised cells in animals

Specialised cell	Function	Adaptations
Nerve cell 	Carry electrical impulses around the body	• Lots of dendrites to make connections to other cells • A very long axon that carries the electrical impulse from one place to another • Synapses to pass the impulse between nerve cells • Synapses contain lots of mitochondria to provide the energy needed to make special transmitter molecules
Muscle cells	Contract and relax to allow movement	• Contain special fibres that can slide over one another to allow the fibres to contract • Contain lots of mitochondria to provide energy for contraction • Store glycogen which can be converted into glucose for respiration
Sperm cells 	Fertilise an egg cell	• A tail for movement • Middle section full of mitochondria to provide energy for tail to move • Digestive enzymes in *acrosome* to break through egg • A large nucleus containing half the genetic information needed to make a human.

Three different specialised cells in plants

Specialised cell	Function	Adaptations
Root hair cell 	• Absorb water and minerals	• Large surface area available for water to move into cell by osmosis • Large permanent vacuole that speeds up osmosis • Lots of mitochondria that carry out respiration to provide the energy needed for active transport
Palisade Cell	• Carry out photosynthesis	• Contain lots of chloroplasts containing chlorophyll that trap light • Usually found in outer layers of leaf and stem to absorb as much light as possible
Xylem cells	• Transports water and mineral ions from the roots to the leaves	• When first formed xylem cells are alive but due to build-up of lignin the cells dies and form long hollow tubes that allow water and mineral ions to travel up the plants • The lignin makes the xylem cells very strong and help them withstand the pressure of water moving up the plant
Phloem cells	• Transports glucose around the plant	• Cell walls between cells break down to form sieve plates that allow water carrying dissolved glucose to move up and down the phloem • Supported by companion cells that keep them alive. Phloem cells don't have cell structures like mitochondria instead they rely on companion cells for their energy needs





How are specialised cells formed?

Special cells in embryos called stem cells have the ability to turn into any type of specialised cell. This process is called cell differentiation. However, once a cell has differentiated it can no longer turn back into a stem cell.

Plants have stem cells present throughout the life of the plant. This is why if a plant loses a branch, it can grow it back. At the growing tips of shoots and roots are meristems. These are specialised tissues containing stem cells.

The only stem cells found in adult humans are bone marrow stem cells. These are not as potent as embryonic stem cells. They are only able to turn into different types of blood cells.

Chapter 5 Mastery Questions

1. Why does the nerve cell have lots of dendrites?
2. What is a specialised cell?
3. What is the function of the cell membrane?
4. What do muscle cells contain a store of?
5. What does *differentiate* mean?
6. What is the function of the nucleus?
7. Why do muscle cells contain a store of glycogen?
8. What is the function of a nerve cell?
9. Give two adaptations of a nerve cell.
10. What is the function of root hair cells, xylem cells and phloem cells
11. A palisade cell of a leaf is viewed under x400 magnification. The image is 1.2cm long. How big is the cell in μm?
12. The build-up of what chemical causes xylem cells to die?
13. Why do root hair cells have lots of mitochondria?
14. What cell structure do photosynthetic cells have lots of?
15. Why do nerve cells contain lots of mitochondria?
16. If you are in your exam and are unsure of an adaptation of an animal cell, what one do they all share?
17. Complete the sentences below:
    a) *The sperm has a tail because……*
    b) *The sperm has 23 chromosomes so……*
    c) *The sperm has a middle section which….*
18. A student is asked how a muscle cell is adapted to its function. She writes:

    A muscle cell is a specialised animal cell. It has lots of mitochondria to help it move. It also stores glycogen for energy.

    This answer got her 2 marks out of 4. Rewrite this sentence using key scientific terminology and adding more detail so that she can get 4 marks.
19. What does the number of mitochondria tell you about a cell?
20. What does the presence of flagella tell you about a cell?
21. Why must xylem cells be strong?
22. What is the purpose of sieve plates?
23. What is the name given to the type of cells that keep phloem cells alive?
24. Complete the sentences below

    The phloem has companion cells because….

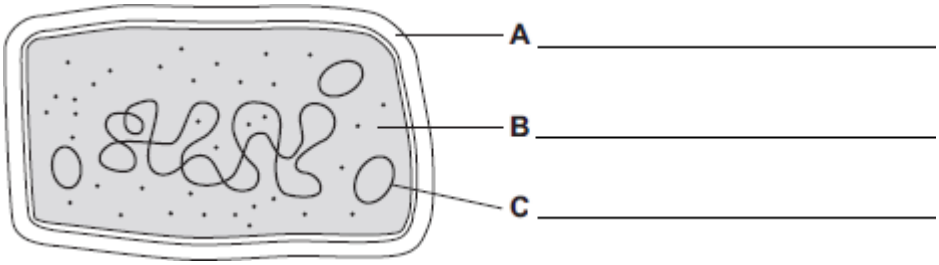
    The phloem transports sugar in 2 directions so

    The phloem has sieve plates for….
25. Suggest why root hair cells don't contain chloroplasts (Hint: think about their location)
26. A whale's sperm is roughly 75μm long.
    a) What is its length in m? use standard form
    b) If a human sperm is roughly 40μm long what is the percentage increase in length from a human to a whale sperm cell?

Chapter 5 Exam Questions

Q1.

(a) The diagram shows the structure of a bacterial cell.



(i) On the diagram use words from the box to label structures **A**, **B** and **C**.

cell membrane	**cell wall**	**chloroplast**	**cytoplasm**	**plasmid**

(3)

(ii) Give **one** difference between the structure of the bacterial cell and an animal cell.

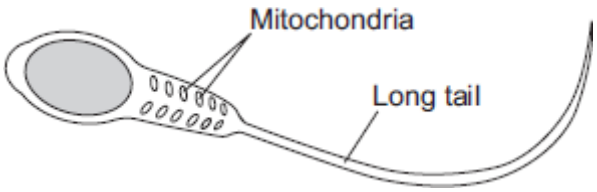
(1)

(iii) Name **one** structure that is found in a plant cell but is **not** found in a bacterial or an animal cell.

(1)

(b) Cells can be specialised for a particular job.

The diagram shows the structure of a human sperm cell.



Describe how the long tail and the mitochondria help the sperm to do its job.

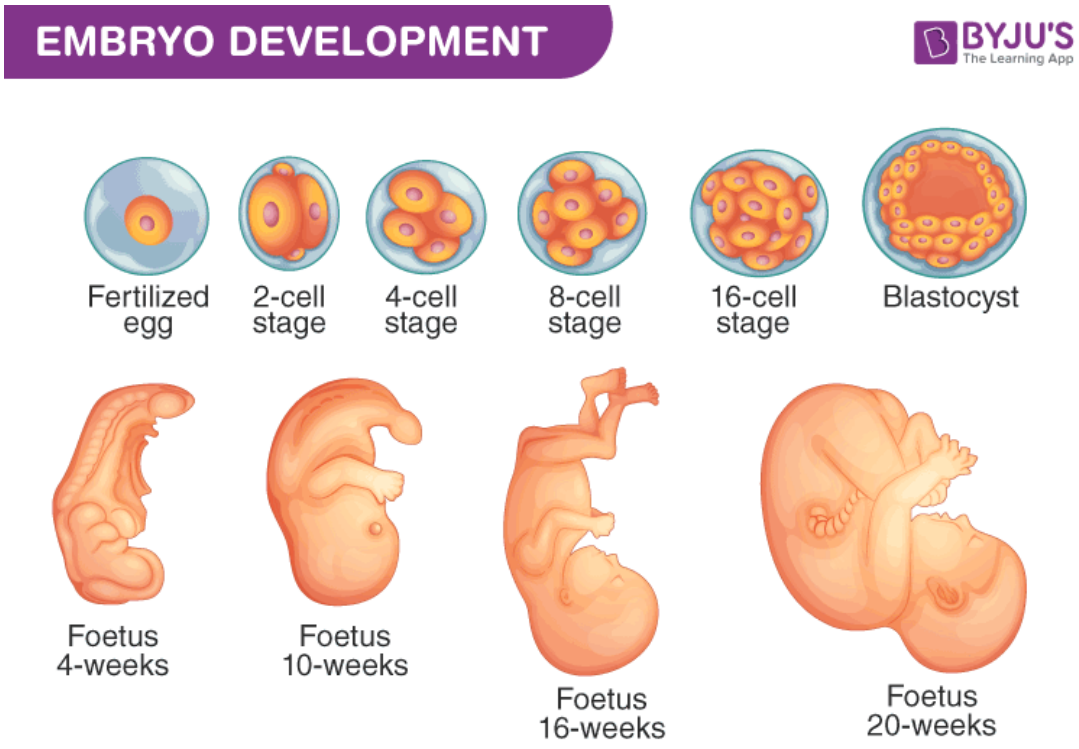
Long tail

Mitochondria

(4)

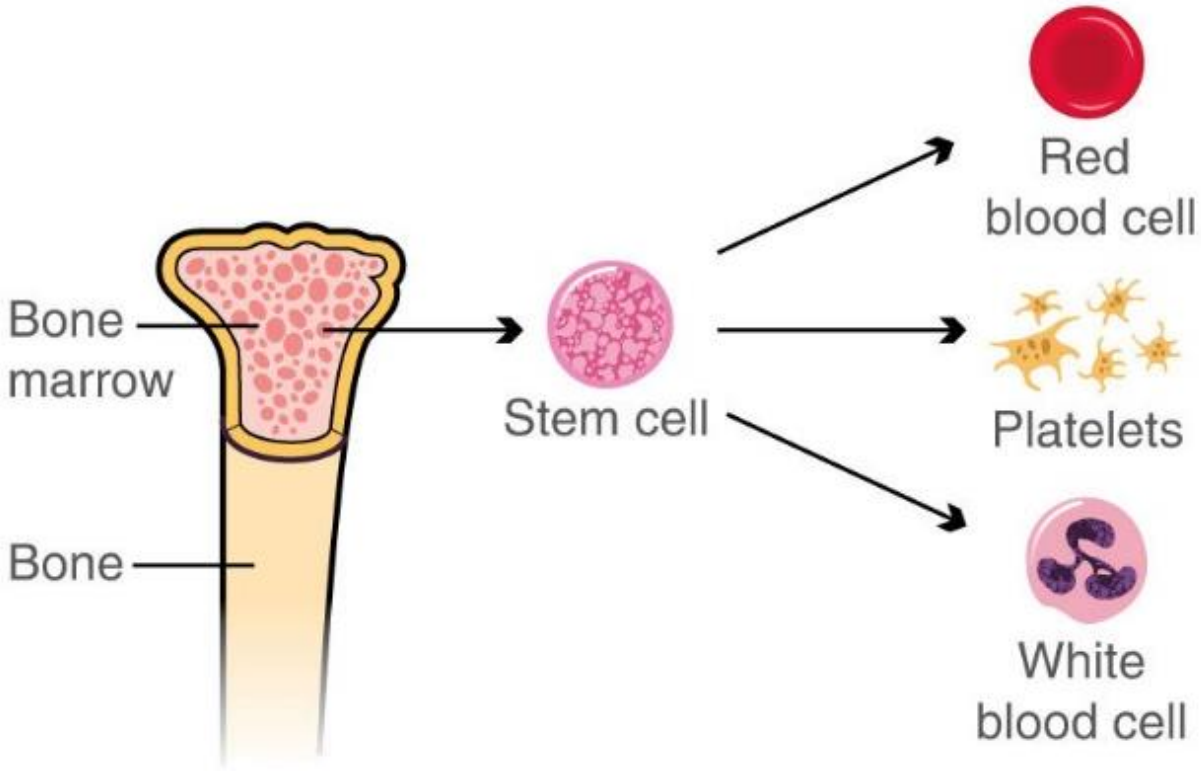
Chapter 6: Stem Cell Therapy

Stem cells are the undifferentiated (non-specialised) cells that can become any type of specialised cell. They are incredibly important to multicellular organisms, living things made of more than 1 cell. Stem cell's ability to make any kind of cell has made them an potential way to treat health problems. Currently stem cell therapy is a new technique which has two main approaches.



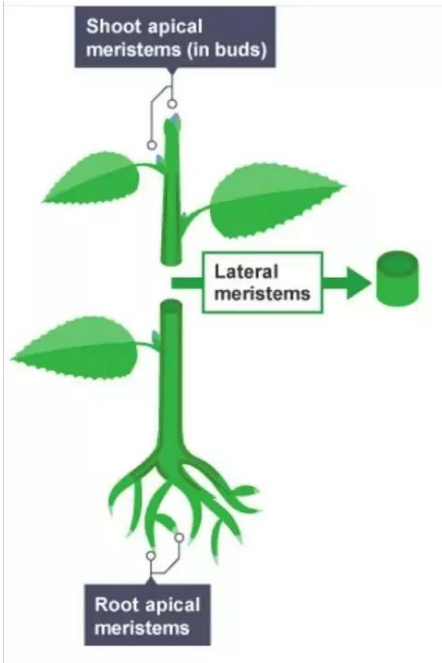
Embryonic stem cells

Embryonic stem cells are stem cells that are taken from embryos. Embryos is the name for developing offspring between 2 and 16 cell stage. Scientists can create many embryos in a lab. It is a painless technique and because they are able to become any type of cells, they can treat a wide range of diseases. For example, if they become nerve cells, they can treat Parkinson's or paralysis and if they become insulin producing cells they can cure type I diabetes. However, there are disadvantages to using embryonic stem cells. It is an unreliable technique which may not work, even if it has worked in patients before. Stem cells like to divide, a bit like cancerous cells. Stem cell treatments may increase the risk of getting cancer later on in life. It also has ethical concerns of using fertilised egg cells to produce embryos which some people believe should not be produced if they are not given the opportunity to produce life. All scientific studies go through a rigorous ethics evaluation before they are given permission to go ahead.



Adult stem cells

Adult stem cells are another way to treat disease. An example of these are bone marrow stem cells, these can also be used for treating diseases. There are no ethical issues with this method as the patient can give permission. It has been successfully used many times to treat a range of blood diseases and is very safe and reliable with a quick recovery time. However, there is a risk of infection being transferred with the new cells and the procedure can be very painful for the recipient and the donor. This method can **only** treat blood diseases.



Plant Stem Cells

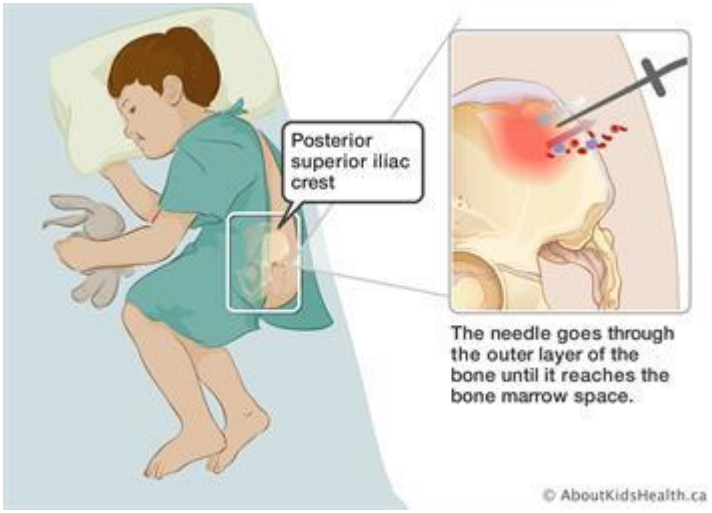
Most plants keep all their stem cells where they are growing. This means they are often found at the tips of the roots or at the meristems (the tip of the shoots). The stem cells from plant meristems can be used to make clones of the mature plant. This is important as it allows us to produce a large number of plants quickly. This could help us save plants from extinction or produce large amounts of identical plants for scientific research. It can also be used in horticulture to create identical plants to sell.

Chapter 6 Mastery Questions

1. What is a stem cell?
2. What is a specialised cell?
3. What is differentiation?
4. What things about the cell are different before and after differentiation?
5. What are the 2 types of stems cells found in animals?
6. When are embryonic stem cells found in animals?
7. When are bone marrow stem cells found in animals?
8. When are stem cells found in plants?
9. What are embryonic stem cells?
10. A student argues that stem cells shouldn't be used in scientific research.
    "It is wrong to use embryonic stem cells because it harms the embryo and embryos can't give consent! It's not even a reliable technique to you might be causing the death of an embryo for no reason!" Another student wants to argue back that that using embryonic stem cells in research has lots of advantages. What could he say?
11. Copy and complete the layout below to **evaluate** the use of embryonic stem cells.

Advantages	Disadvantages
Conclusion	

12. Where are adult stem cells found?
13. List 3 advantages of using adult stem cells.
14. Copy and complete the sentence: Using adult stem cells is beneficial because… However,…

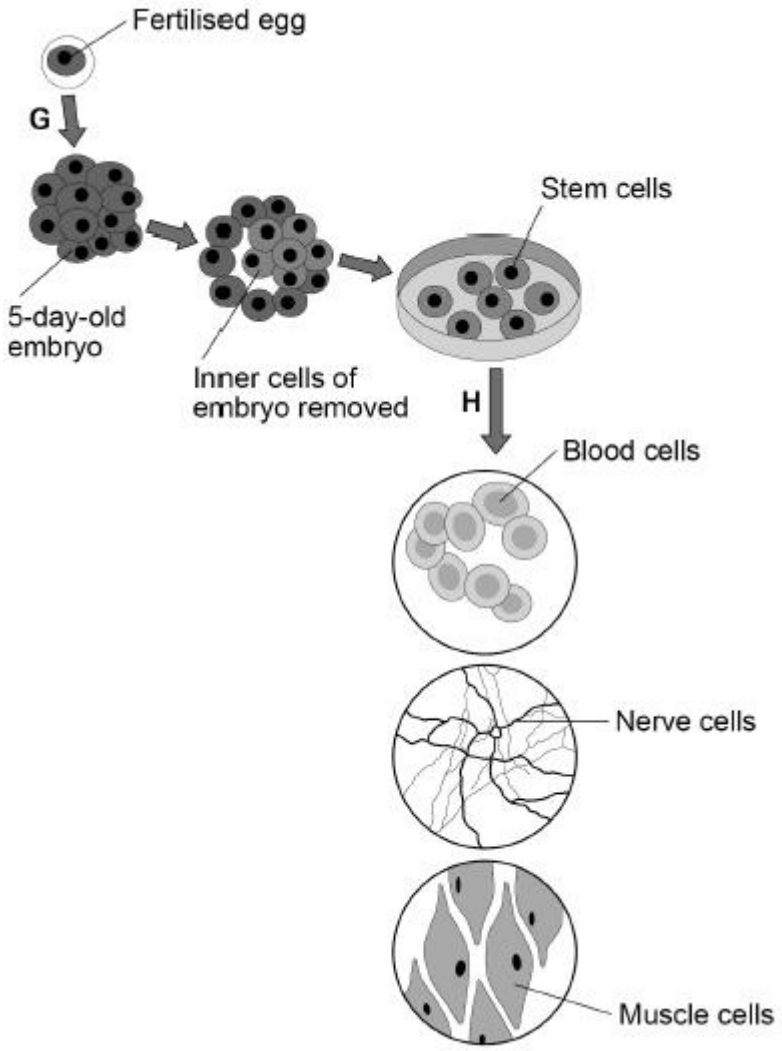


15. The diagram above shows the procedure to collect and transplant bone marrow stem cells. Why does this have a risk of infection?
16. Where can meristems be found in a plant?
17. Why are meristems important?
18. Explain the use of meristems in plants for human benefits (hint: agriculture).
19. Understanding meristem tissue is important because…
20. Understanding meristem tissue is important therefore…

Chapter 6 Exam Questions

Q1.

The diagram shows how cells from human embryos can be used to grow 'replacement body parts' for humans.



(a) How many chromosomes are in a **fertilised** human egg? **(1)**

(b) What is the process labelled **G**? **(1)**

(c) When the embryo is three days old, it contains eight cells. How many times has the fertilised egg cell divided by day three? **(1)**

(d) Stem cells become specialised in the process labelled **H** in the diagram. What is the process labelled **H**? **(1)**

(e) Which **two** parts would be found in all the cells in the diagram. Choose **two**. **(2)**

Cell membrane	Cytoplasm	Chloroplasts
Cell wall	Plasmids	

(f) Why might stem cells from human embryos be more useful than stem cells from adults? **(1)**

(g) Some parents have stem cells from the umbilical cord of their baby collected and stored.

These stem cells can be used to treat diseases in the child later in life.

Why might stem cells from their own umbilical cord be used rather than stem cells from another embryo? Choose **one**. **(1)**

Less risk of rejection of umbilical cord stem cells.

Stem cells from another embryo can treat more diseases.

Umbilical cord stem cells are older.

(h) Some medical uses of stem cells are still experimental.

Why do some scientists have concerns about the use of stem cells? **(1)**

(i) Some people object to the use of embryonic stem cells because of religious beliefs.

Give **one** other ethical concern about the use of embryonic stem cells? **(1)**

Q2.

This question is about stem cells.

(a) Give **one** place in a plant where stem cells are found. **(1)**

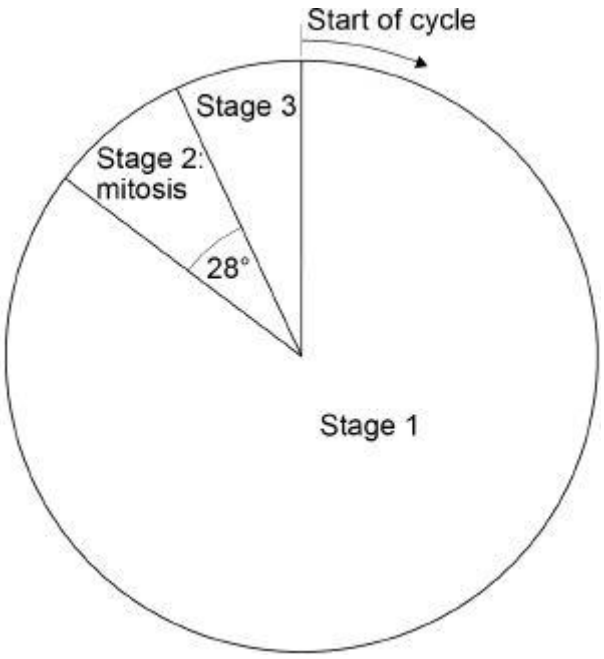
(b) What is **one** economic use of plant stem cells? Choose **one**. **(1)**

To create genetically modified crops	To increase variation in plants
To create new species of plants	To produce large numbers of identical plants

Embryonic stem cells divide by mitosis.

Figure 1 represents a cell cycle for a human embryonic stem cell.

Figure 1



(c) The mass of DNA in the cell at the start of the cycle is 6 picograms.

A picogram is 10^{-3} nanograms.

Convert 6 picograms to grams.

Give your answer in standard form. **(1)**

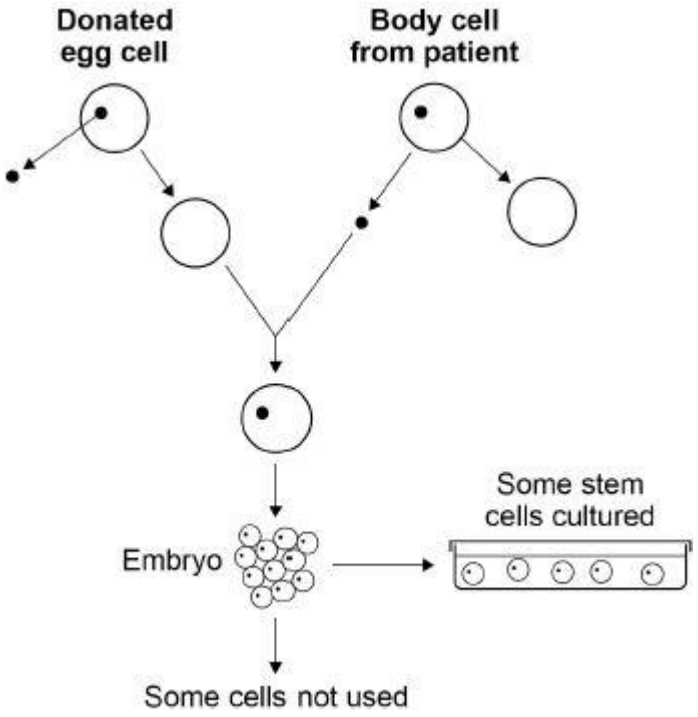
(d) The time taken for this complete cell cycle is 15 hours.

Calculate how many hours the cell spent in mitosis.

Give your answer to 3 significant figures. **(2)**

(e) Describe what happens in each of the three stages of the cell cycle. **(5)**

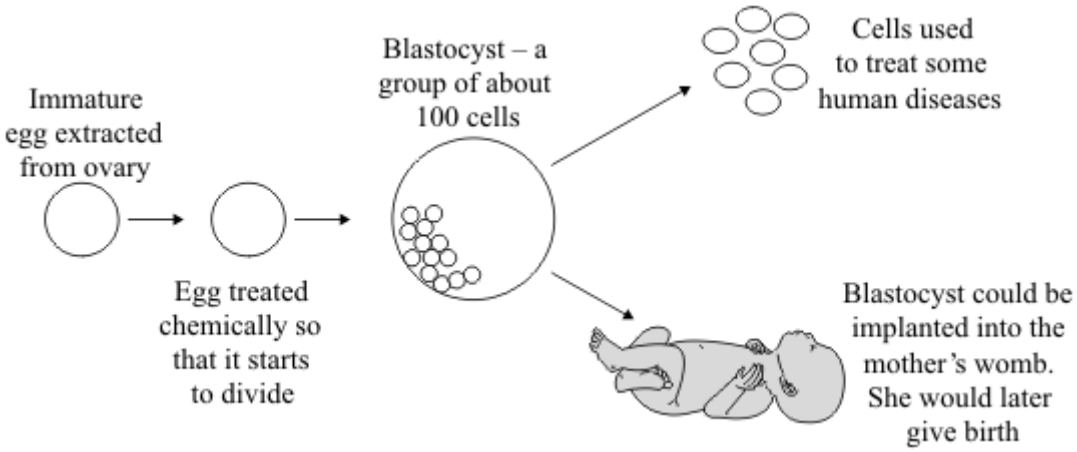
Figure 2 shows how embryonic stem cells are produced in therapeutic cloning for use in patients. **Figure 2**



(f) Give **two** advantages and **two** disadvantages of therapeutic cloning in medical treatments. Use **Figure 2** to help you. **(4)**

Q3.

The diagram shows how an immature egg could be used either to produce cells to treat some human diseases or to produce a baby.



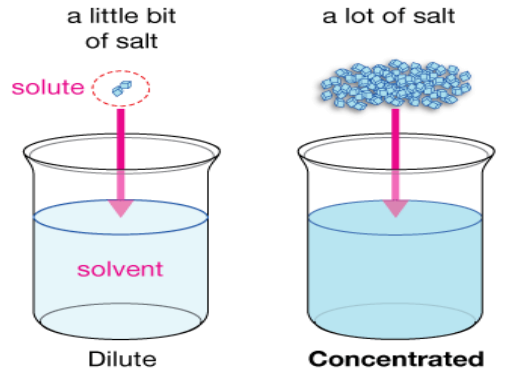
Scientists may be allowed to use this technique to produce cells to treat some human diseases, but not to produce babies.

Using information from the diagram, suggest an explanation for this. **(4)**

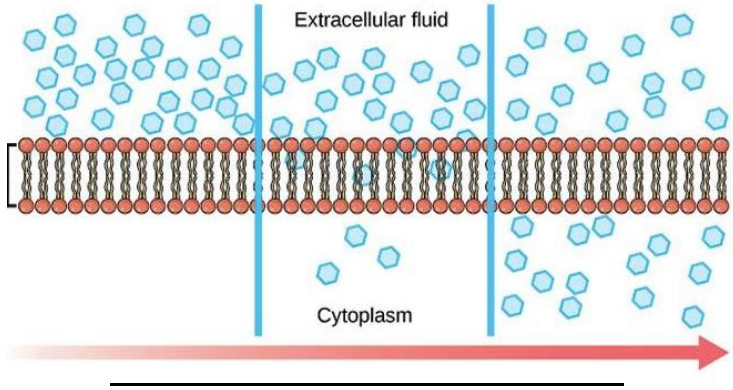
Lesson 7: Diffusion and Exchange Surfaces

Keywords

- **Solution: mixture of solvent with dissolved solute i.e., salty water**
- **Diffusion: the spreading out of particles from a higher to lower concentration, until all the particles are evenly distributed.**
- **Active transport: active movement of particles from a lower to a higher concentration using energy.**
- **Concentration: amount of a substance in a given volume i.e., how much salt per litre of water.**
- **Exchange surface: Surface where nutrients enter the body.**



Dilute vs concentrated solutions



Exchange surfaces in Animals

To survive, cells need to take in nutrients and remove waste. They do this by letting substances diffuse across their cell membranes. Multicellular organisms need specialised exchange surfaces to take in enough nutrients to feed the trillions of cells that make them up. Those trillions of cells also produce a lot of waste that needs to be removed. A network of blood vessels transports nutrients between exchange surfaces and every cell of the body.

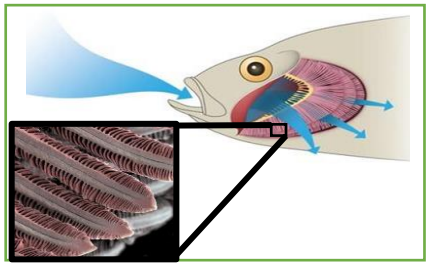
The **lungs** take in **oxygen** that is needed by cells for respiration. Respiration is a reaction which releases energy. The lungs are made up of **alveoli** which are specialised for rapid **diffusion** of oxygen and carbon dioxide. Gills in fish also perform this function.

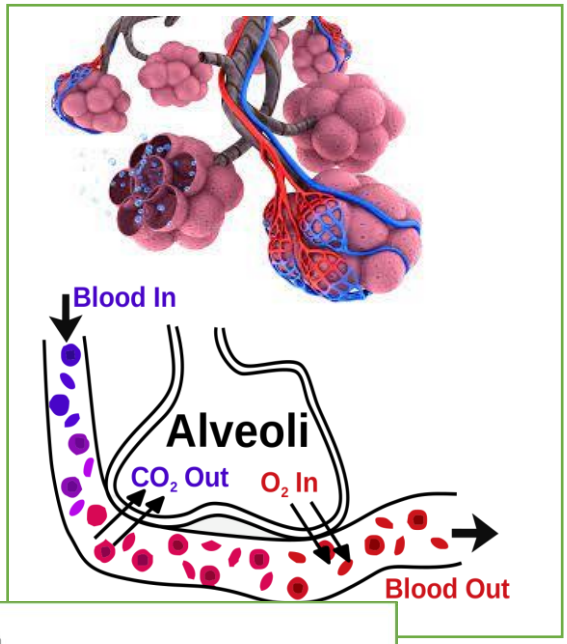
The **small intestines** absorb nutrients from the food broken down by the digestive system. Carbohydrates are broken down into glucose which then diffuse across the lining and into blood vessels to be transported to cells. Glucose is also essential for respiration. To make sure we absorb all the nutrition we can from our food sometimes glucose and amino acids need to move into the blood even when their concentration is lower in the small intestine. This can't be done by diffusion and needs **active transport**. Active transport uses energy and a protein in the cell membrane to push the nutrients up the concentration gradient (low to high) and into the blood.

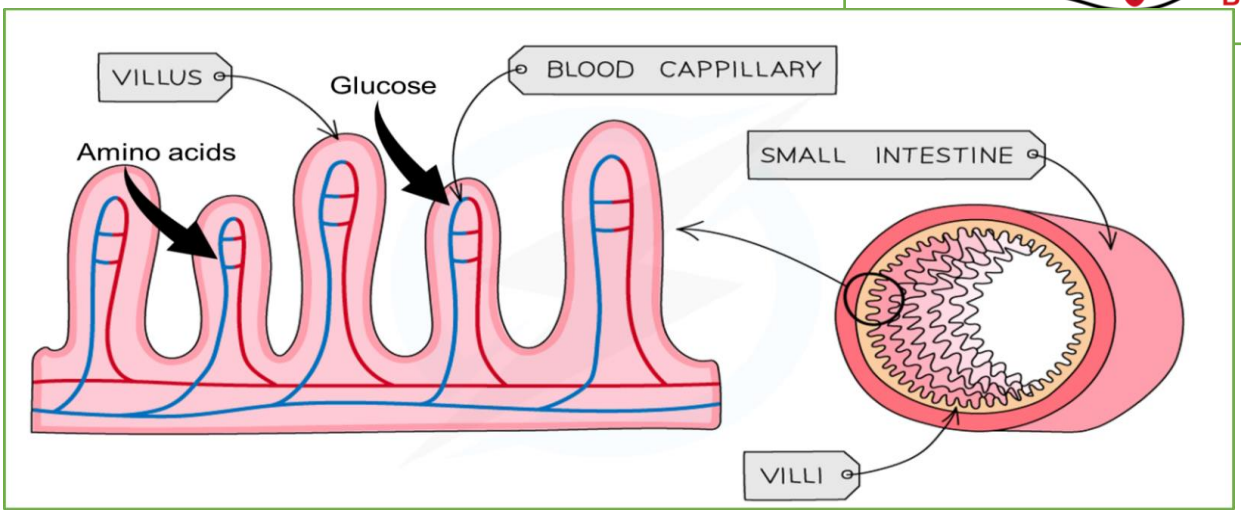
Adaptations of Exchange Surfaces

Exchange surfaces need to be as efficient as possible. This means the rate of diffusion needs to be quick so lots of nutrients and waste can be exchanged. There are 3 main adaptations to increase the rate of diffusion in living organisms.

1. Folded membranes: villi create a large surface area meaning more surface to exchange across
2. Good blood supply: The constant blood flow stops the concentration becoming equal on both sides, keeping the concentration gradient high.
3. The lining of the alveoli and villi as well as the capillaries are only one cell thick creating a short diffusion pathway .







Lesson 7 Mastery Questions

Define / describe Questions: State, give an account, say what you see!

1. What substances commonly enter cells?
2. Name a substance which is a common waste product in cells.
3. Define diffusion.
4. What is meant by the word rate?
5. What is the function of the cell membrane?
6. State two factors that can affect the rate of diffusion.
7. How are the villi adapted to increase the rate of diffusion?
8. What is active transport?
9. What 2 things are needed for active transport that are not needed for diffusion?

Compare Questions: similarities AND differences!

10. How is active transport similar to diffusion?
11. How is active transport different to diffusion?
12. Compare the villi and the alveoli.

Explain Questions: Say why, make links from one idea to another!

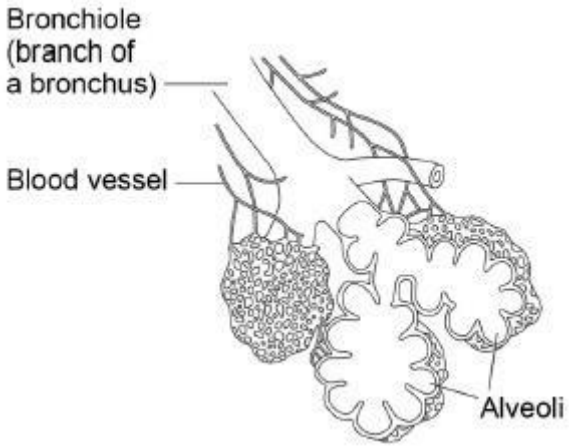
13. Oxygen enters the blood of fish through the gills. Why is oxygen important to fish?
14. Finish this sentence. The lining of the villi are only one cell thick because…
15. Finish this sentence. Alveoli have a good blood supply so that …
16. Explain why villi have a folded membrane.
17. Active transport is used in the transport of glucose from the small intestine to the blood. Explain why.
    Suggest
18. Suggest how the villi might be adapted to increase the rate of active transport.
19. Frogs can absorb oxygen through their skin. Based on the adaptations other exchange surfaces have, suggest some adaptations their skin might have to ensure diffusion is fast and efficient.

Exam Questions

Q1.

Figure 1 shows part of the lungs.

Figure 1



(a) Give **two** ways the lungs are adapted for efficient exchange of gases.

Describe how each adaptation helps to maintain efficient gas exchange. **(4)**

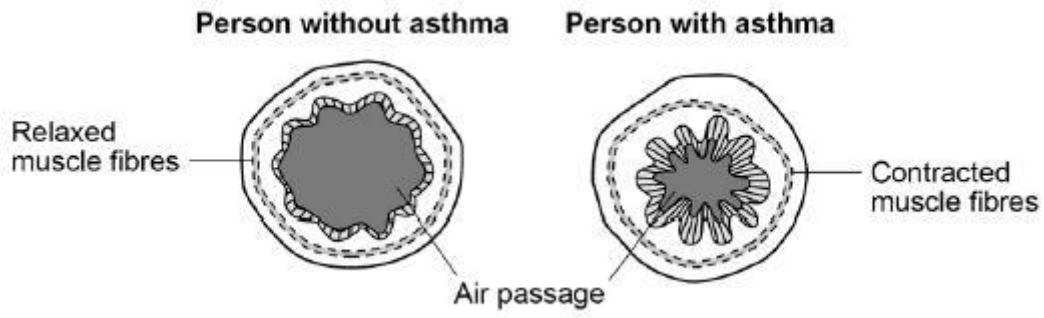
(b) There are 5.4 million people with asthma in the UK. What type of disease is asthma? **(1)**

Choose **one**.

An allergy	A cancer
A bacterial infection	A viral infection

(c) **Figure 2** shows cross-sections of bronchioles of two people.

Figure 2

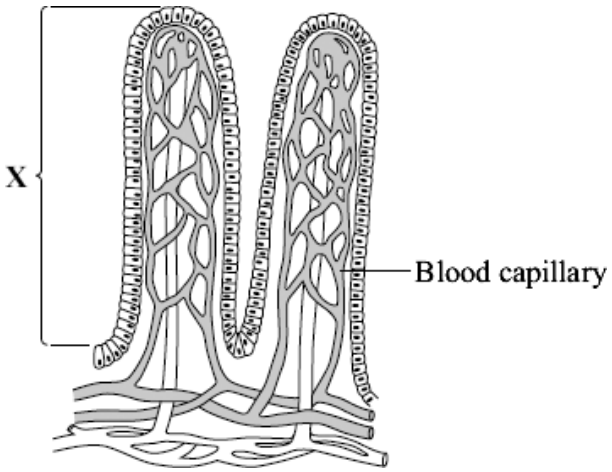


Suggest why people with asthma often find it difficult to breathe.

(1)

Q2.

The diagram shows part of the lining of the small intestine.



(a) (i) Name structure **X**. Choose **one**. **(1)**

alveolus **thorax** **villus**

(ii) Choose **three** ways in which structure **X** is adapted to help the absorption of soluble food. **(3)**

It is ventilated.

It contains a layer of muscle.

Its outer surface is one cell thick.

It has a good blood supply.

It has a large surface area.

Its cells contain haemoglobin.

(b) Name the process by which soluble food enters the blood. Choose **one**. **(1)**

diffusion **fermentation** **transpiration**

Q3.

Read the following information about how the small intestine absorbs sugars.

- The blood absorbs glucose and some other sugars, like xylose, from the small intestine.
- Glucose molecules are the same size as xylose molecules, but glucose is absorbed more quickly than xylose.
- Experiments with pieces of intestine show that the uptake of oxygen by the intestine is 50 % higher in the presence of glucose than in the absence of glucose. Xylose does not have this effect on the uptake of oxygen.
- The cells lining the small intestine have many mitochondria.

Explain how this information provides evidence that glucose is absorbed by the small intestine using *active transport*.

Lesson 8-9 Osmosis Practical

Keywords

- **Accuracy: cell with a nucleus**
- **Reliability: long strand of DNA with many cells, found in nucleus**
- **Precision: cells split to form 2 cells (mitosis or meiosis in eukaryotes)**

Osmosis Required Practical

By putting pieces of a potato into different concentration solutions we can estimate the concentration inside the cells.

- Placed in pure water, the water would move into the potato cells by osmosis and the piece of potato would get heavier. This is because the water concentration is higher outside the cells.
- Placed into a very concentrated solution the potato cells would lose water and get lighter. This is because the water concentration is higher inside the potato.
- If the potato stays the same mass, it has not lost or gained water. This mean the concentration outside the potato is the same as the concentration inside the potato.

Equipment

- Test tubes x5 + test tube rack
- 4 concentrations of glucose solution
- Distilled water
- Potato cylinder, identical size
- Mass balance
- Paper towel

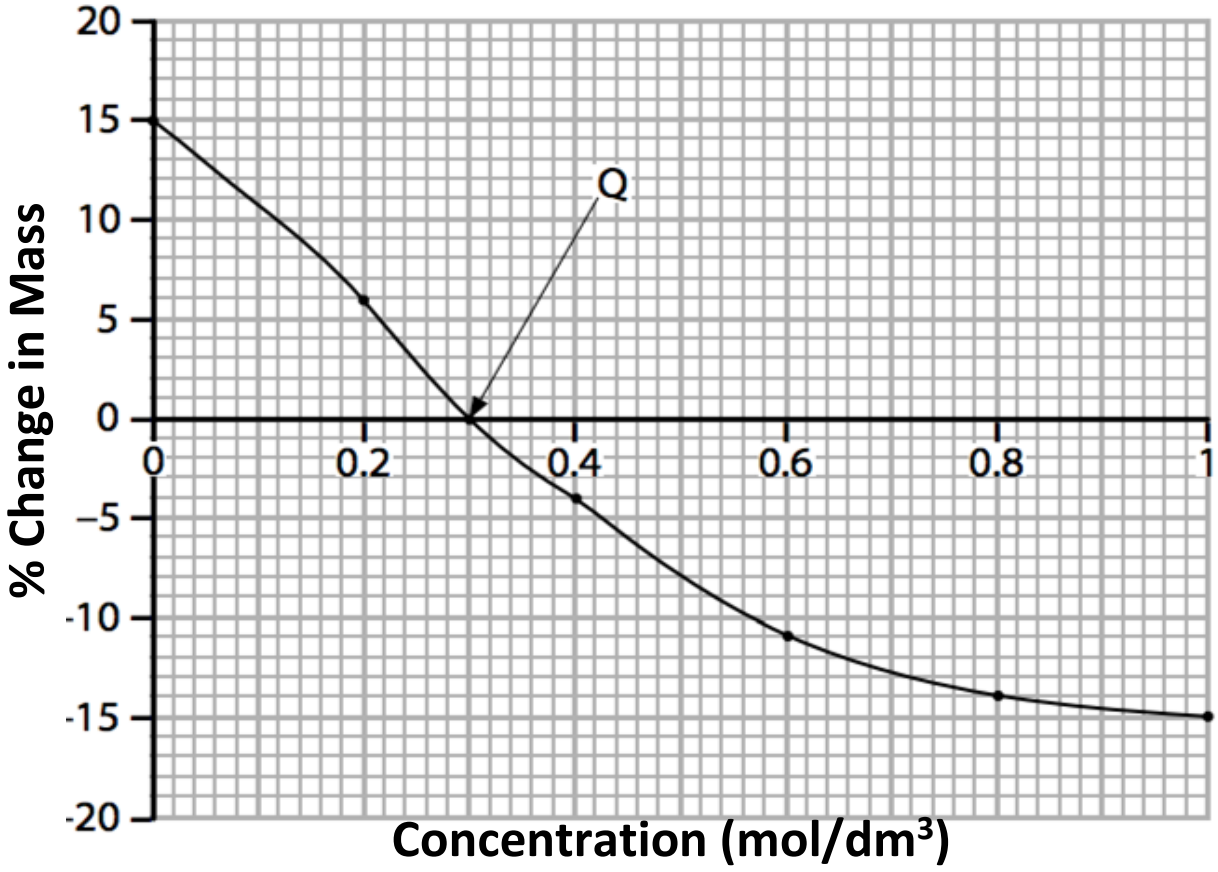
Method

1. Place 4 different glucose solutions in 4 test tubes and distilled water in the 5th test tube.
2. Weigh each potato and place in each tube. Record which mass went in which concentration. Leave for 3 hours.
3. Remove each potato cylinder and blot dry with paper towel to remove excess water from the outside
4. Weigh each potato cylinder again and calculate the change in mass.

Results

Concentration (mol/dm^3)	Initial mass (g)	Final mass (g)	Change in mass (g)	% Change in mass
0.0	4.6	5.3	+0.7	+15
0.2	4.7	5.0	+0.3	+6
0.4	3.9	3.7	-0.2	-4
0.6	4.4	3.9	-0.5	-11
0.8	4.9	4.2	-0.7	-14
1.0	4.1	3.5	-0.6	-15

Analysis



Conclusion

The concentration in side the potato was about 0.3 mol/dm^3. This is because we can extrapolate from the graph that at 0.3 mol/dm^3 there was 0% change in mass. If water did not move in or out of the potato cells then the waterr concentration on either side of the cell membrane must have been equal.

We can't be too sure of this result because we never actually tested a concentration of 0.3 mol/dm^3. It is better to say the concentration inside the potato cells is between 0.2 and 0.4 mol/dm^3.

To improve accuracy we could repeat the experiment using values between 0.2 and 0.4 mol/dm^3. We could also improve reliability by repeating each concentration 3 times to identify anomalies and calculate a mean. To improve the precision or our experiment we need to increase the resolution. This means are measurements are made in smaller increments. For example, we could use concentrations such as 0.32 or 0.325 mol/dm^3.

Lesson 8-9 Mastery Questions

1. What is osmosis?
2. A potato is made of plant cells. Draw and label what a potato cell might look like.
3. State the equipment needed to investigate osmosis in potato cells.
4. What are the 6 solution concentrations used in the experiment?
5. What is distilled water?
6. What do we use to measure the length and the mass?
7. What are the independent, dependent and control variables in this experiment?
8. What goes on the *y* axis of the graph, the independent or dependent variables?
9. Why do we blot the potato cylinders dry?
10. Why do we need to record the initial mass accurately?
11. Why do we calculate the percentage change rather than just the change?
12. Explain why the potato cylinder lost mass in 0.4 mol/dm3 sugar solution.
13. Explain why the potato cylinder gained mass in 0.2 mol/dm3 sugar solution.
14. How do you calculate the percentage change in mass?
15. Copy and complete the table

Initial mass (g)	Final mass (g)	Change in mass (g)	% Change in mass
5	6	+ 1	
4.8	5..0		
7.3	6.8		
5.6	4.2		
3.9	3.8		

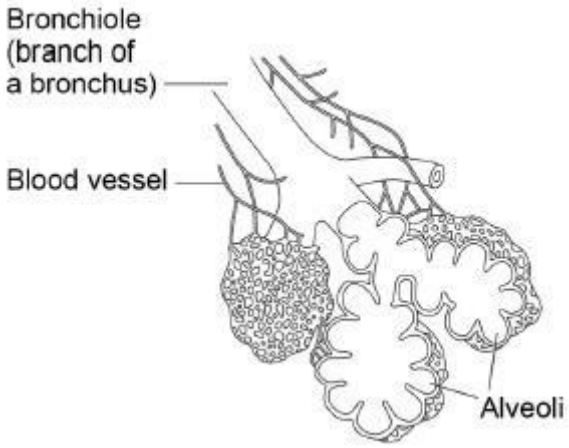
16. Estimate what the concentration of the potato cells is. Why can we not be certain of this?
17. Why is it important the potato cylinders are the same size?
18. Suggest what future investigations can we do to determine a more accurate value for potato cell concentration?
19. Suggest how we could make our results more reliable and more precise?

Lesson 8-9 Exam Questions

Q1.

Figure 1 shows part of the lungs.

Figure 1



(a) Give **two** ways the lungs are adapted for efficient exchange of gases.

Describe how each adaptation helps to maintain efficient gas exchange. **(4)**

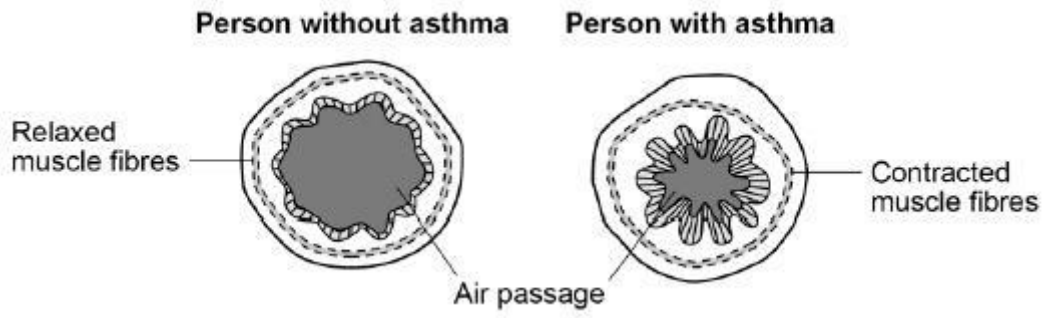
(b) There are 5.4 million people with asthma in the UK. What type of disease is asthma? **(1)**

Choose **one**.

An allergy	A cancer
A bacterial infection	A viral infection

(c) **Figure 2** shows cross-sections of bronchioles of two people.

Figure 2

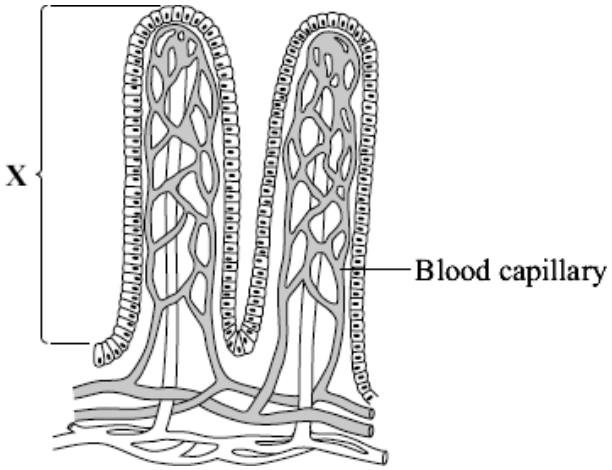


Suggest why people with asthma often find it difficult to breathe.

(1)

Q2.

The diagram shows part of the lining of the small intestine.



(a) (i) Name structure **X**. Choose **one**. **(1)**

alveolus **thorax** **villus**

(ii) Choose **three** ways in which structure **X** is adapted to help the absorption of soluble food. **(3)**

It is ventilated.	It contains a layer of muscle.
Its outer surface is one cell thick.	It has a good blood supply.
It has a large surface area.	Its cells contain haemoglobin.

(b) Name the process by which soluble food enters the blood. Choose **one**. **(1)**

diffusion **fermentation** **transpiration**

Q3.

Read the following information about how the small intestine absorbs sugars.

- The blood absorbs glucose and some other sugars, like xylose, from the small intestine.
- Glucose molecules are the same size as xylose molecules, but glucose is absorbed more quickly than xylose.
- Experiments with pieces of intestine show that the uptake of oxygen by the intestine is 50 % higher in the presence of glucose than in the absence of glucose. Xylose does not have this effect on the uptake of oxygen.
- The cells lining the small intestine have many mitochondria.

Explain how this information provides evidence that glucose is absorbed by the small intestine using *active transport*.

Lesson 10 Exchange Surfaces in Plants

Keywords

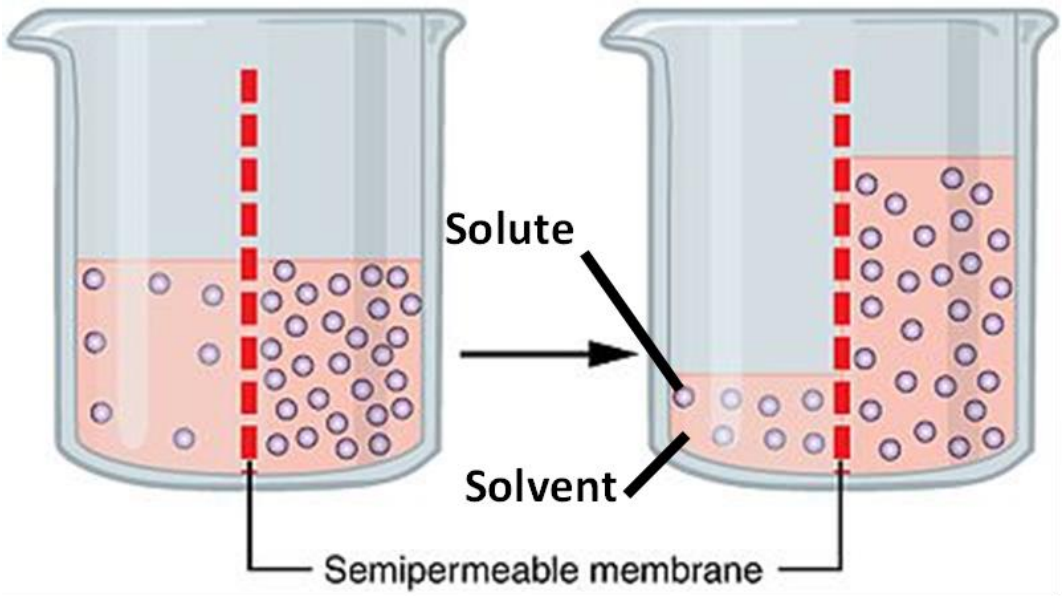
- **Osmosis: mixture of solvent with dissolved solute i.e., salty water**
- **Cell membrane: the spreading out of particles from a higher to lower concentration, until all the particles are evenly distributed.**
- **Water concentration: how many water molecules per area, i.e., per cell. High water concentration is dilute solution.**
- **Solute concentration: how many solute molecules per area, i.e., per litre. High solute concentration is a concentrated solution.**

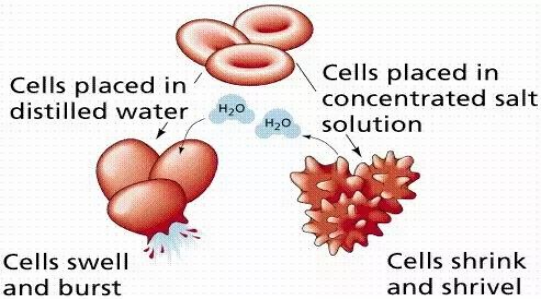
Exchange surfaces in plants

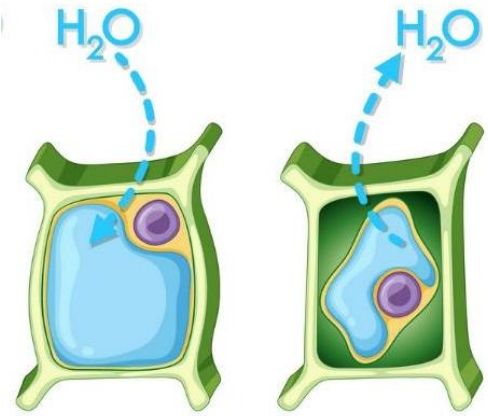
All multicellular organisms need specialised exchange surfaces to take in enough nutrients to feed the trillions of cells that make them up. Leaves and roots are both specialised exchange surfaces in plants.

- Oxygen and carbon dioxide diffuse between the leaf and surrounding air. The leaves are not folded because they also have to catch the light and folds would produce patches of shade.
- Roots are covered in millions of microscopic hairs. These are called root hair cells and increase the surface area of the root for diffusion.

Osmosis happens because not all dissolved substances can cross the cell membrane. This is why we say the cell membrane is semi-permeable. In the diagram the solute particles cannot cross the semipermeable membrane. There is a higher **water concentration** on the left-hand side, and a higher **solute concentration** on the right, so water moves across the membrane from left to right.







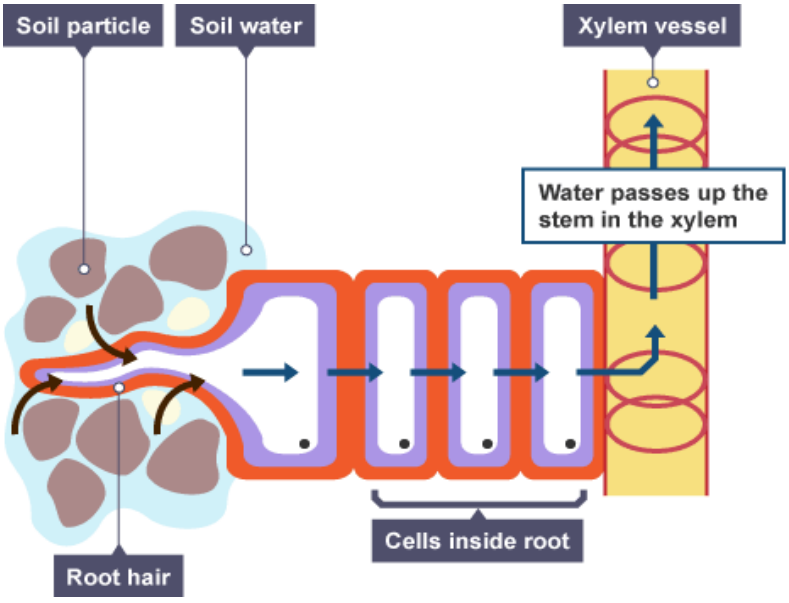
Changes in solute concentration inside cells can cause cells to shrivel, expand and even burst.

Plant cells rarely burst from taking in too much water because they are protected by their cell wall. The excess water fills up the vacuole and helps the plant to stand up tall. In times of low water, the vacuole empties, and the plant wilts.

Root hair cells

Osmosis

Root hair cells absorb water by osmosis. To keep water flowing into the root they keep the solute concentration in the cell high. Once water reaches the xylem it is transported up the stem to the leaves where it evaporates or is used in photosynthesis.



Active Transport

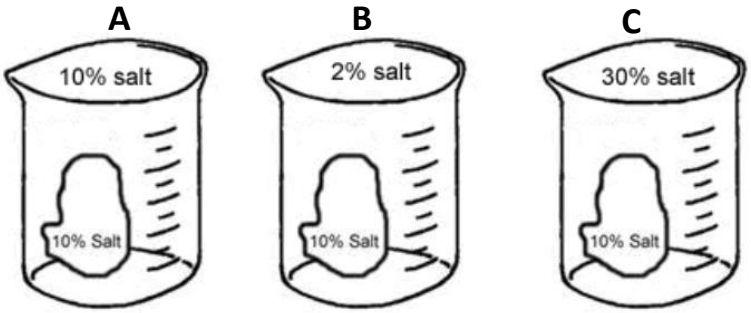
Root hair cells also need to absorb mineral from the soil such as nitrogen and magnesium. All of these minerals are essential for healthy plants. Nitrogen is needed to make proteins and magnesium is needed to make chlorophyll which is essential for photosynthesis.

There is usually a higher concentration of these minerals inside the cell and therefore require energy to push them up the concentration gradient from a lower to a higher concentration by active transport.

Mastery Questions

Define / describe Questions: State, give an account, say what you see!

1. Name 2 exchange surfaces found in plants and the nutrients that are exchanged.
2. Name 2 exchange surfaces found in animals and the nutrients that are exchanged.
3. Name the 3 ways substances move around organisms.
4. Osmosis is the movement of … across …
5. Where does osmosis occur in plants?
6. Define diffusion.
7. Define active transport.
8. Where do plants store water?
9. Give a definition for exchange surfaces.
10. What apparatus is used to measure mass?
11. What is the function of the cell membrane?
12. For each picture state whether water will move into or out of the cell.



13. If there is a higher water concentration outside the cell, which way will water move?
14. What will happen if too much water moves into an animal cell?
15. Name 2 minerals needed by plants and their function.
16. If there is a higher solute concentration outside the cell, which way will water move?
17. What will happen to the mass of the cell if water moves in?
18. What will happen to the mass of the cell if water moves out?

Explain Questions: Say why, make links from one idea to another!

19. Which has a higher water concentration, distilled water, or salty water? Why?
20. Why is active transport needed to absorb minerals into root hair cells?
21. Inside the cell has a salt concentration of 0.5 mol/dm^3. Outside the cell has a salt concentration of 0.2 mol/dm^3. Overtime the cell will lose mass. Why?
22. Inside the cell has a salt concentration of 1.5 mol/dm3. Outside the cell has a salt concentration of 0.2 mol/dm^3. Overtime the cell will lose mass. Will this happen more quickly or more slowly that question 18? Why?
23. Inside the cell has a salt concentration of 0.8 mol/dm3. Outside the cell has a salt concentration of 1.0 mol/dm^3. What will happen to the mass of cell? Explain why?

Suggest Questions: Use your scientific knowledge to make a reasonable conclusion!

24. In the digestive system in animals the large intestine is where water is absorbed from things you eat and drink into the blood. By what transport method, diffusion, osmosis, or active transport, do you think this water moves?

Exam Questions

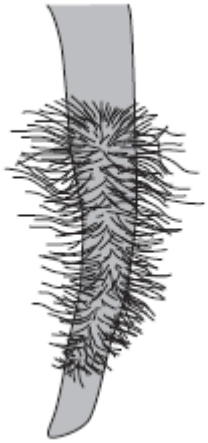
Q1.

Plant roots absorb water from the soil by osmosis.

(a) What is osmosis?

(3)

(b) The image below shows part of a plant root.



The plant root is adapted for absorbing water from the soil.

Use information from the diagram to explain how this plant root is adapted for absorbing water.

(3)

(Total 6 marks)

Q2.

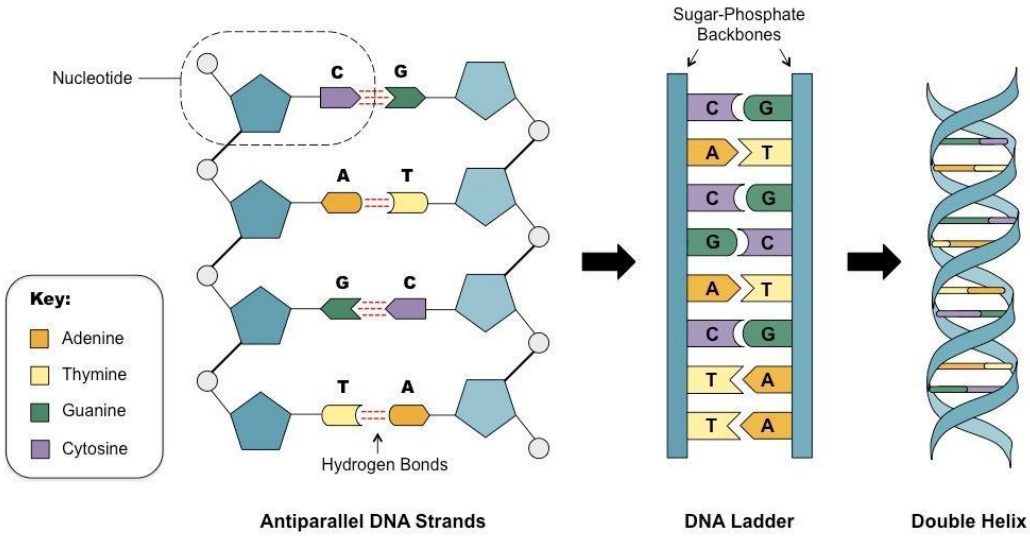
Plant roots obtain some of their mineral salts from the soil by active transport.

What is involved in *active transport*?

(Total 4 marks)

Lesson 11: DNA and the Genome

DNA is often described as the molecule of life. It is responsible for the instructions to make proteins and therefore all of life's variation and complexity is coded in its' sequence..
A DNA strand is a polymer. A long chain molecule made of 4 similar repeating units. We call them A, T, C and G, also known as bases. It exists as a double helix, formed of two strands which twist round each other.
A DNA strand is a sequence of these 4 letters tells the ribosomes which order to place certain amino acids when making a protein. Remember proteins are long chains of amino acids and are made by ribosomes. By changing the order of amino acids, different proteins are made that have unique shapes and functions.



An organisms complete set of genetic material is called its genome. It is stored in the nucleus in eukaryotic cells but is free in the cytoplasm in prokaryotic cells.
In eukaryotes the DNA is organised as long, tightly wound strands called chromosomes. On each chromosome are 100's of genes.
A gene is a section of DNA, 50-1000 bases, which codes for a single protein.

We have now developed the technology to sequence an entire genome. This allows us to know the sequences of bases (letters) on each chromosome in an individual's nucleus. The human genome is over 3 billion base pairs long. So far we have used it to improve our understanding of certain diseases, to trace the movement of early humans across the globe from their starting point in Africa over 1 million years ago and there is hope that this technology will lead to even more medical diagnosis and treatments in the future. Although as we learn more about the human genome, we begin to realise how complex it is and how much more we need to learn.

Changes in DNA can lead to **mutations**. These are changes in the DNA sequence of bases that means an individual might have a new characteristic, e.g., blue eyes or ginger hair.

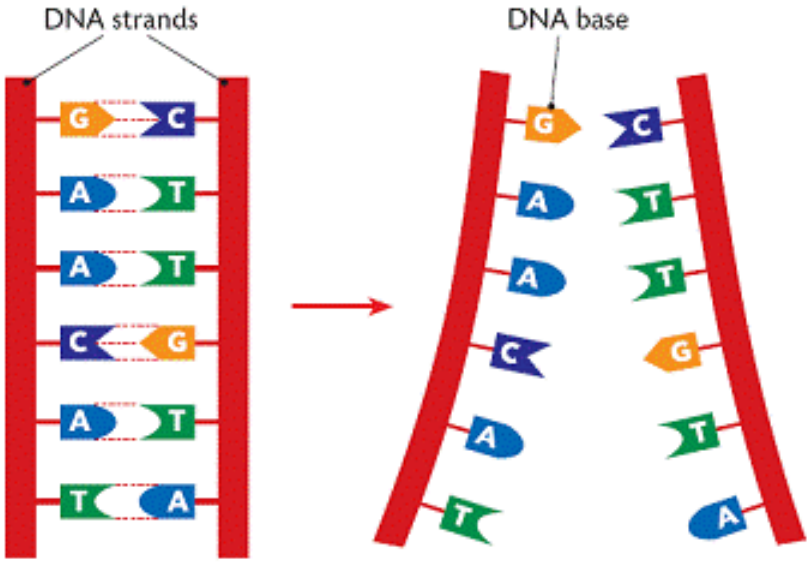
These mutations are one source of **variation-** differences between organisms. If an organism has different DNA, then they nay have different characteristics. At the same time, if an organism lives in a different environment, this may lead to them having different characteristics. All of this means that even between organisms of the same species, there are differences.

Protein Synthesis

The two strands of the DNA molecule bond together in a specific way called complimentary base pairing.

C always bonds to G

T always bonds to A



Protein synthesis starts with a template being made of the desired gene. This template is called mRNA. The template travels out of the nucleus and into the cytoplasm. The template meets ribosomes. The ribosomes allow carrier molecules to bring in the specific amino acid that corresponds to the three bases in the template. As the ribosome moves along the template more amino acids are added, and the protein is formed with the correct sequence of amino acids. When the protein molecule is complete it folds up to form a unique 3D shape. This enables it to perform a specific task. It may be an enzyme, a hormone or form structural proteins like collagen.

Lesson 11 Mastery Questions

1. Name the genetic material enclosed in a nucleus of a eukaryotic cell.
2. Where is genetic material found in prokaryotic cells?
3. Describe the structure of double helix.
4. How is DNA organised in the cell?
5. Define ‘gene’.
6. Define ‘genome’.
7. Define ‘DNA’.
8. How many different bases are there?
9. Name 3 uses for the sequenced human genome?
10. How many base pairs make up the human genome?
11. What is a polymer?
12. What organelle makes proteins from amino acids?
13. Put the following structures in order of increasing size: **Organism, cell, nucleus, organ, tissue, chromosome, gene, organ system**
14. What is a mutation?
15. What is variation?
16. What two things lead to variation?

Triple Only

17. How does mRNA compare to DNA?
18. Where is mRNA read to make a protein?
19. What is the process where DNA is converted into mRNA?
20. What is the process where mRNA is converted into a protein?

Lesson 11 Exam Questions

Q1.

The genetic material in cells is made of DNA.

(a) Which **two** of the following describe the structure of DNA?
Pick **two.**
A double helix A monomer A polymer A protein A single strand

(2)

(b) Complete the sentences.
Choose answers from the box.

clone	**disorder**	**gene**
genome	**mutation**	

A small section of DNA which codes for one protein is called a _____ .
All the genetic material of an organism is called its _____ .

(2)

(c) Gametes (sex cells) contain half the amount of DNA compared to body cells.
Give the names of the **two** types of gametes in humans.

(1)

(d) What is the process called when the gametes join?

(1)

Q2.

Variation in individual organisms can be caused by:

- genes
- the environment
- a combination of both genes and the environment.

(a) What is the cause of each variation in the table below?
Copy and complete the table below:

Variation	**Cause of variation**		
	Genes only	**Environment only**	**Both genes and the environment**
Brown eyes			
Light brown skin colour			
Short hair			

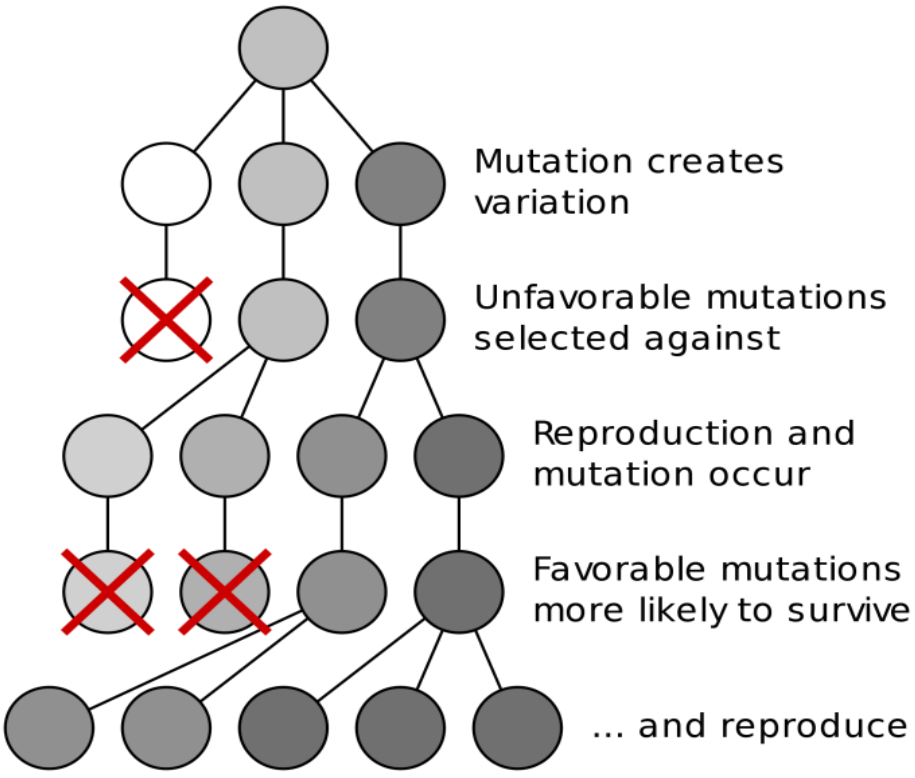
(3)

Lesson 12 Evolution by Natural Selection

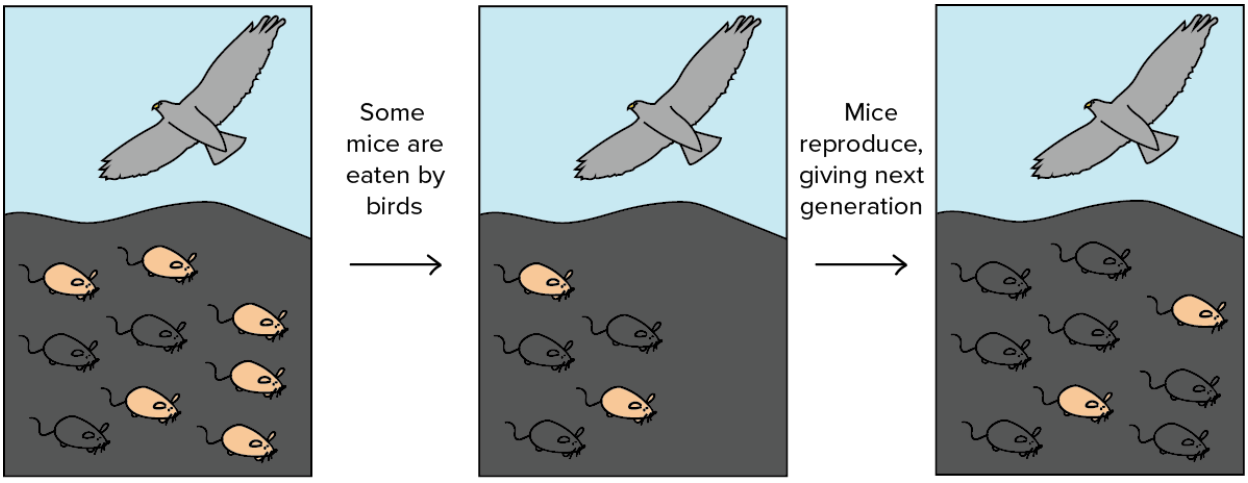
The organisms that exist nowadays are very different from those billions of years ago. Over time it appears that organisms have become more complex. This is due to evolution by natural selection.

Natural selection is the process where nature selects what characteristics (controlled by genes) are best for organisms to survival in that specific environment and hence allows it to reproduce. In simple terms, this is the survival of the fittest, where "fittest" refers to those best adapted to their environment, but not necessarily the strongest. **Evolution** occurs after natural selection occurs over many generations. This is the process:

- Individual organisms in a species have a range of pre-existing genetic variation due to random mutation.
- Certain individuals have favourable mutations. These alleles that give them a survival advantage are called adaptations.
- They're more likely to survive and reproduce, passing on the favourable alleles.
- Overtime, these variations accumulate,
- They may eventually evolve into a new species (speciation), where they can no longer interbreed to form fertile offspring.



Be careful: Avoid saying "organisms adapt to their environment" in your answer. Organisms cannot (choose to) adapt to a certain environment within their lifetime. Evolution must happen over many generations! And it is not by choice, but by natural selection.



A population of mice has moved into a new area where the rocks are very dark. Due to natural genetic variation, some mice are black, while others are tan.

Tan mice are more visible to predatory birds than black mice. Thus, tan mice are eaten at higher frequency than black mice. Only the surviving mice reach reproductive age and leave offspring.

Because black mice had a higher chance of leaving offspring than tan mice, the next generation contains a higher fraction of black mice than the previous generation.

Students find it hard to write answers to evolution question as there is a lot to remember. To help you, always remember the mnemonic…

My Very Angry Sister Really Annoys Grandad

- **Variation** which might result in …
- **Advantageous** **characteristic** which could help an organism…
- **Survive** and…
- **Reproduce** which means advantageous…
- **Alleles** are passed on to the next …
- **Generation**

Lesson 12 Mastery Questions

1. What causes genetic variation?
2. Explain how the cause above can lead to variation in phenotype.
3. State the theory of evolution by natural selection.
4. What is a 'species'?
5. Define 'natural selection'.
6. What is evolution?
7. Why can genetic mutation be beneficial to organisms in a changing environment?
8. Which would be the most successful organism within a species and why?
9. The strongest?
10. The one which reproduces the fastest?
11. The one which is best adapted to the environment?
12. List 3 things organisms compete for.
13. A lion is living in the dense jungle, the climate change and the jungle starts to become a desert. What adaptations could help the lion survive in order to pass on its genes?
14. A disease wipes out 75% of all male wildebeest. What kind of adaptations could ensure the surviving male wildebeest will be able to mate and pass on their genes?
15. Cacti live in the desert and are able to store water in their thick waxy leaves. Describe the process of evolution that lead to this species.
16. Suggest how giraffes having long necks may be a result from evolution by natural selection.

My Very Angry Sister Really Annoys Grandad

M...
V...
A...
S...
R...
A...
G...

Lesson 12 Exam Questions

Q1.

The figure to the right shows flamingos. Flamingos are birds.
They have long legs.
They can walk in deep water and use their long necks to reach food in the mud.

How would Darwin have explained the evolution of the flamingo's long neck?
Use the correct answer from the box to **copy and** complete each sentence.

mutation	**natural selection**	**sexual reproduction**	**variation**

In a population of flamingos there are birds with different lengths of neck.
This range of differences in neck length is called _____ .
The flamingos with longer necks are better adapted to feed in deeper waters.
They are more likely to survive than flamingos with shorter necks.
This is an example of _____ .
The surviving flamingos pass on their genes for a longer neck to their offspring during _____ .

(Total 3 marks)

Q2.

A particular species of snail has a shell which may be pink, yellow or brown. It may also be plain or have bands running round it.
The snails are eaten by song thrushes.
Explain why snails with plain brown shells are the most common in hedgerows.

(Total 4 marks)

Q3.

Moose are animals that eat grass.
Figure 1 shows a moose.

Figure 1

Moose have distinct characteristics such as antlers.
Describe how moose may have evolved to have large antlers.

(5)

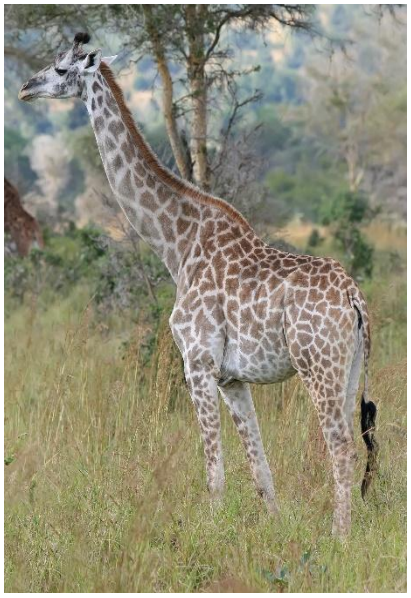
Lesson 13 Adaptations

Adaptations are features or characteristics of an organism or cell that allows it to either survive (e.g., giraffe has a long neck for access to food) or to do a certain role (sperm cells having tails, or **flagella**, to swim towards the egg). Natural selection allows the evolution of these traits.

There are multiple types:

Structural

These are features of an organism's body structure for example shape, colour or size.. For example, land based arctic animals tend to be white for camouflage from predators and prey, and have either a thick layer of fur or fat to keep warm, or a giraffe with a long neck to reach food that is higher up, or a wolf with fangs and claws to aid in hunting.



Behavioural

These are ways an organism behaves. Some species of organisms may seek warm shelter in the cold, or shade in the heat. Some may even leave for warmer climates completely, like birds or fish when they migrate.

Interestingly hibernation is **not** an example of behavioural- while it may seem like the animal is merely sleeping, it needs to undergo various bodily functions to allow it to enter this state.

Functional (Physiological)

These are things going on inside the organisms' body that can be related to processes like reproduction and metabolism. Examples include organisms like reptiles or mammals

in hot environments not sweating, bears hibernating, and even examples of things like thermoregulation in mammal.

Lesson 13 Mastery Questions

1. What is an adaptation?
2. What process allows adaptations to occur?
3. What is a structural adaptation?
4. Give an example of a structural adaptation.
5. What is a behavioural adaptation?
6. Give an example of a behavioural adaptation.
7. What is a functional (physiological) adaptation?
8. Give an example of a functional (physiological) adaptation
9. Name the kind of adaptation for each one you have discussed above?How is a bear adapted to the cold?
10. Name the kind of adaptation for each one you have discussed above?How is a shark adapted to living underwater?
11. Name the kind of adaptation for each one you have discussed above?How is a polar bear adapted to living in the cold?
12. Name the kind of adaptation for each one you have discussed above?How is a lion adapted to being a predator?
13. Name the kind of adaptation for each one you have discussed above?
14. How is a deer adapted to being a prey?
15. Name the kind of adaptation for each one you have discussed above?How is a human adapted to using tools?
16. Name the kind of adaptation for each one you have discussed above?

Lesson 13 Exam Questions

Q1.

Animals have adaptations to survive in their environment.

These adaptations may be structural, behavioural or functional.

(a) Draw **one** line from each animal adaptation to the type of adaptation it is.

Animal adaptation	Type of adaptation
 Male palm cockatoos use sticks to beat on hollow branches to attract females.	Structural
 The harmless hornet moth has black and yellow stripes to look like a bee or wasp.	Behavioural
 Sea spiders have automatic muscle contractions that move oxygen around their bodies.	Functional

(2)

Plants also have adaptations.

Orchid plants have adaptations which make them one of the most successful plant groups.

Orchids rely on insects for pollination.

The photograph shows an orchid.

(b) Which **two** features help orchids survive?

Copy out the **two** correct answers

Brightly coloured flowers Large quantities of pollen

No scent Oval shaped leaves Small leaves

(2)

Many orchid species grow in tropical rainforest ecosystems.

(c) What name describes the variety of all the different species found in an ecosystem?

Copy out the **one** right answer

(1)

(d) Some species of orchid may become extinct because of deforestation.

Give **one** reason why tropical rainforests are being cut down.

(1)

(e) Give **one** factor that might cause a species of orchid to become extinct.

Do **not** refer to deforestation in your answer.

(1)

Scientists have analysed the entire genetic material of one species of orchid.

(f) What chemical is the genetic material made from?

(1)

(g) What is the name for the entire genetic material of an organism?

(1)

(Total 9 marks)

Q2.

Some animals are adapted to survive in very cold conditions such as the Arctic.

Explain how the adaptations of Arctic animals help them to survive in cold conditions.

(Total 6 marks)