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GCSE Biology

AQA Topic – Cell Biology

Overview
Cell Biology

Cell structure

- Eukaryotes and prokaryotes
- Animal and plant cells
- Cell specialisation
- Cell differentiation
- Microscopy
- Culturing microorganisms (biology only)

Cell division

- Chromosomes
- Mitosis and the cell cycle
- Stem cells

Transport in cells

- Diffusion
- Osmosis
- Active transport

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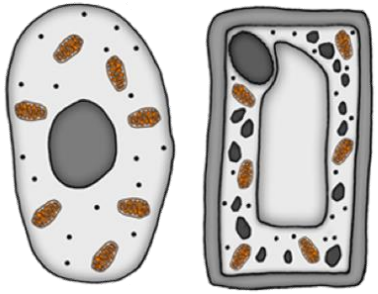
Cell structure
Part 1

- Eukaryotes and prokaryotes
- Animal and plant cells

Cell structure part 1 - Eukaryotes and prokaryotes

All living things are **made** of **cells**, they are the **basic unit** of all **life.**

Eukaryotic cells



Have a cell membrane, cytoplasm and genetic material (DNA) enclosed in a nucleus.

Animal and plant cells are eukaryotic cells

Prokaryotic cells

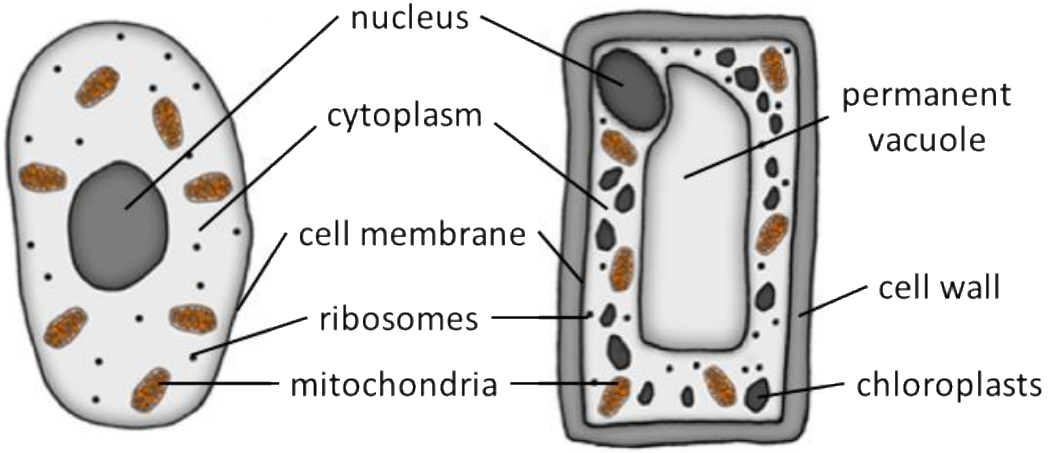
These are **smaller** than eukaryotic cells. The genetic material is not enclosed in a nucleus. The DNA is a single loop and there may be one or more rings of DNA called plasmids.

Bacterial cells are prokaryotic cells

Prefixes are used in science to make very small numbers more manageable. You need to learn the ones in the table and be able to convert to and from standard form.

Prefix	Multiple	Standard form
centi (cm)	1 cm = 0.01 m	$\times 10^{-2}$
milli (mm)	1 mm = 0.001 m	$\times 10^{-3}$
micro (µm)	1 µm = 0.000 001 m	$\times 10^{-6}$
nano (nm)	1 nm = 0.000 000 001 m	$\times 10^{-9}$

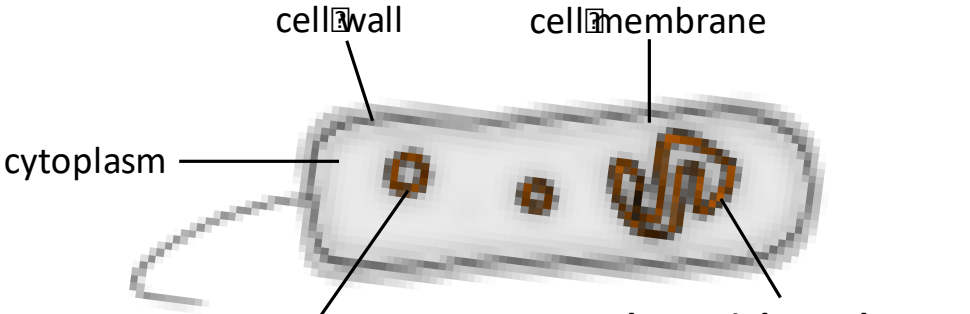
Cell structure part 1 - Animal, plant cells and bacterial cells



animal cell

plant cell

You will need to know the differences between plant, animal and bacterial cells.



bacterial cell

Bacterial cells are much smaller than plant and animal cells.

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Cell structure part 1 - Animal, plant cells and bacterial cells

Cell part	Function	Animal	Plant	Bacteria
Nucleus	Contains genetic material, which controls the activities of the cell	✓	✓	
Cytoplasm	Most chemical processes take place here, controlled by enzymes	✓	✓	✓
Cell membrane	Controls the movement of substances into and out of the cell	✓	✓	✓
Mitochondria	Most energy is released by respiration here	✓	✓	
Ribosomes	Protein synthesis happens here	✓	✓	
Cell wall	Strengthens the cell – made of cellulose (not bacteria) (algal cells also have a cell wall)		✓	✓
Chloroplasts	Contain chlorophyll, absorbs light energy for photosynthesis		✓	
Permanent vacuole	Filled with cell sap to help keep the cell turgid		✓	
Bacterial DNA	Loop of DNA NOT found in a nucleus			✓
Plasmid (DNA)	Small ring of DNA often used as a vector in genetic modification			✓

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QuestionIT!

Cell structure
Part 1

- Eukaryotes and prokaryotes
- Animal and plant cells

Cell structure part 1 – QuestionIT

1. Where is the genetic material in a prokaryotic cell?

2. Where is the genetic material in a eukaryotic cell?

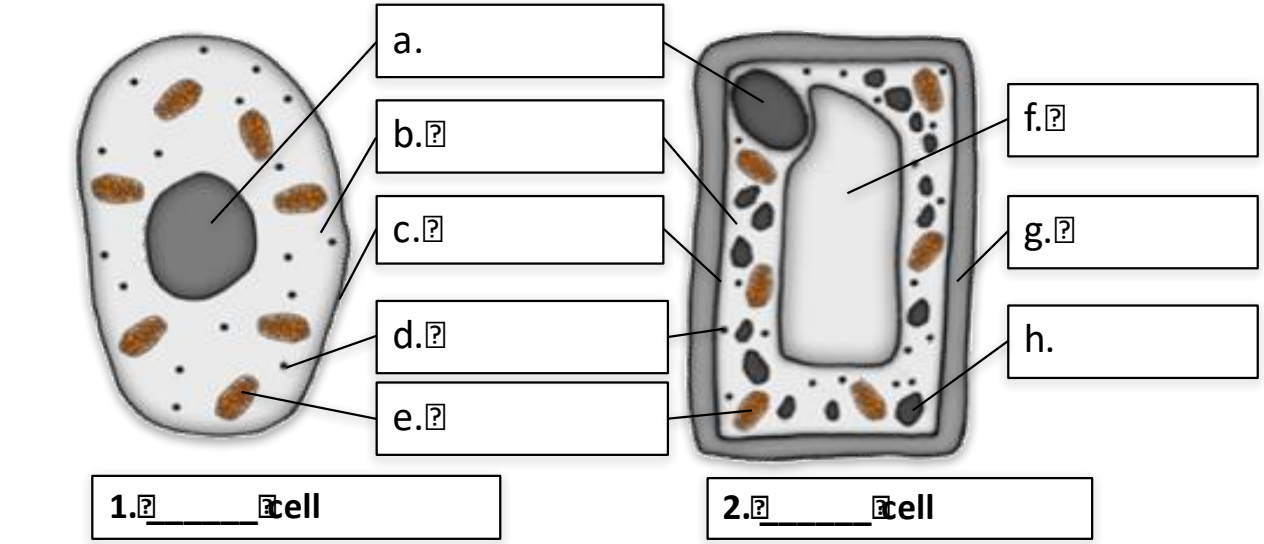
3. Copy and complete the table.

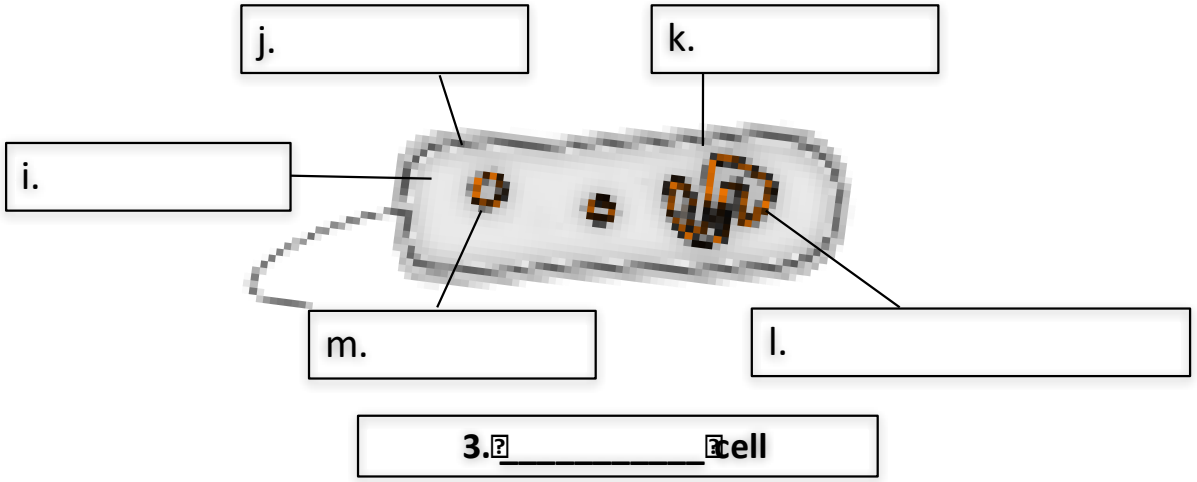
Prefix	Multiple	Standard form
centi (cm)		$\times 10^{-2}$
	1 mm = 0.001 m	$\times 10^{-3}$
micro (µm)	1 µm = 0.000 001 m	
nano (nm)		$\times 10^{-9}$

4. Why do scientists use prefixes?

Cell structure part 1 – QuestionIT

5. Name the structures **A to L** on the diagrams below and label cells 1, 2 and 3.





Cell structure part 1 – QuestionIT

6. Copy and complete the table and tick the correct column for each one.

Cell part	Function	Animal	Plant	Bacteria
	Contains genetic material, which controls the activities of the cell			
Cytoplasm				
	Controls the movement of substances into and out of the cell			
	Most energy is released by respiration here			
Ribosomes	Protein synthesis happens here			
	Strengthens the cell – made of cellulose			
Chloroplasts				
	Filled with cell sap to help keep the cell turgid			
	Loop of DNA NOT found in a nucleus			
Plasmid (DNA)				

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AnswerIT!

Cell structure
Part 1

- Eukaryotes and prokaryotes
- Animal and plant cells

Cell structure – AnswerIT

1. Where is the genetic material in a prokaryotic cell?

In a bacterial DNA loop and there may be one or more plasmid rings.

2. Where is the genetic material in a eukaryotic cell?

The DNA is in chromosomes enclosed in a nucleus.

3. Copy and complete the table.

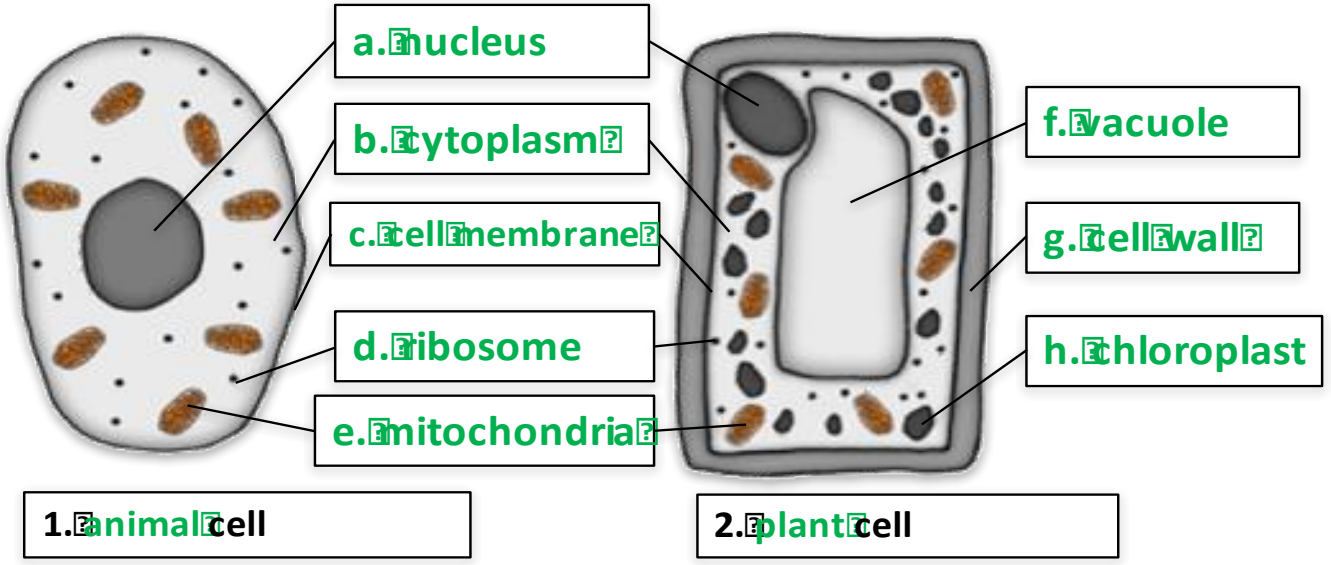
Prefix	Multiple	Standard form
centi (cm)	**1 cm = 0.01 m**	x 10^{-2}
milli (mm)	1 mm = 0.001 m	x 10^{-3}
micro (µm)	1 µm = 0.000 001 m	**x 10^{-6}**
nano (nm)	**1 nm = 0.000 000 001 m**	x 10^{-9}

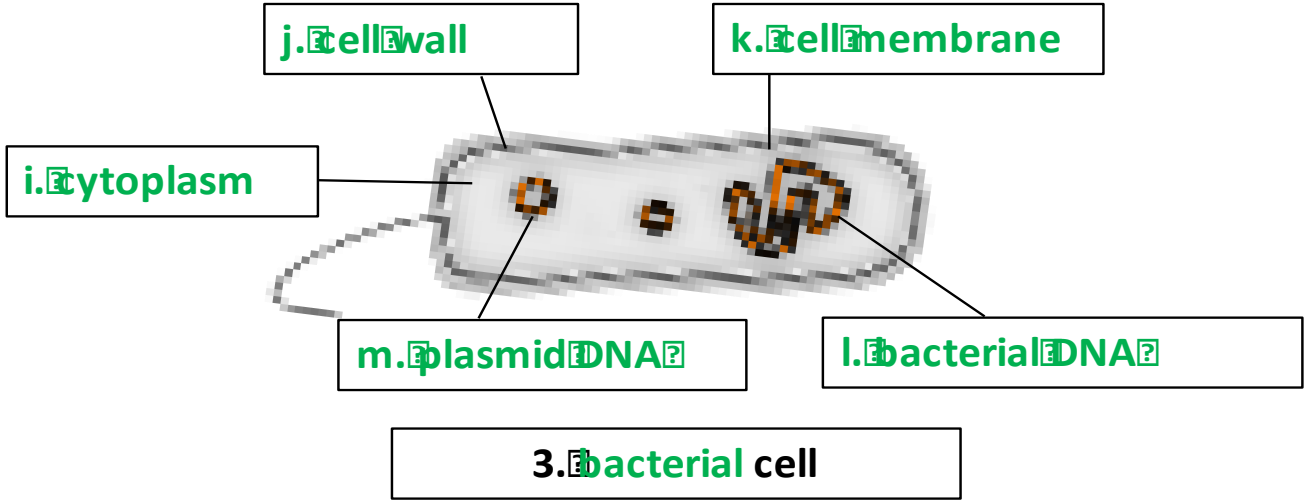
4. Why do scientists use prefixes?

To make very small numbers more manageable

Cell structure – AnswerIT

5. Name the structures **A to L** on the diagrams below and label cells 1, 2 and 3.





Cell structure – AnswerIT

6. Copy and complete the table and tick the correct column for each one.

Cell part	Function	Animal	Plant	Bacteria
Nucleus	Contains genetic material, which controls the activities of the cell	✓	✓	
Cytoplasm	Most chemical processes take place here, controlled by enzymes	✓	✓	✓
Cell membrane	Controls the movement of substances into and out of the cell	✓	✓	✓
Mitochondria	Most energy is released by respiration here	✓	✓	
Ribosomes	Protein synthesis happens here	✓	✓	
Cell wall	Strengthens the cell – made of cellulose		✓	✓
Chloroplasts	Contain chlorophyll, absorbs light energy for photosynthesis		✓	
Permanent vacuole	Filled with cell sap to help keep the cell turgid		✓	
Bacterial DNA	Loop of DNA NOT found in a nucleus			✓
Plasmid (DNA)	Small ring of DNA often used as a vector in genetic modification			✓

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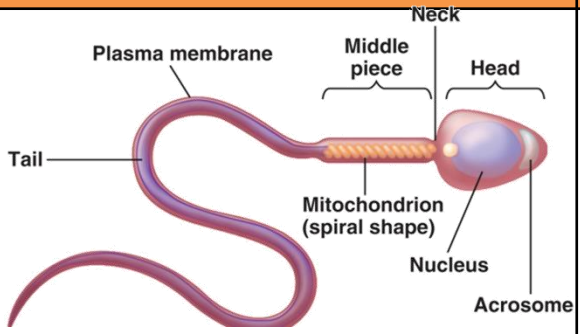
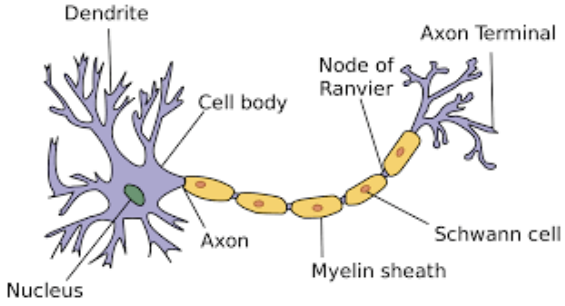
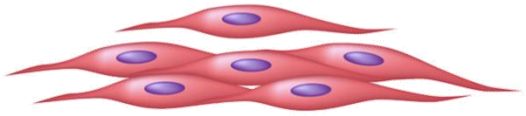
Cell structure
Part 2

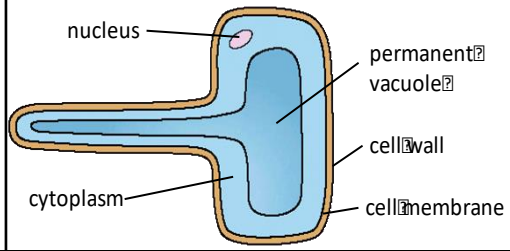
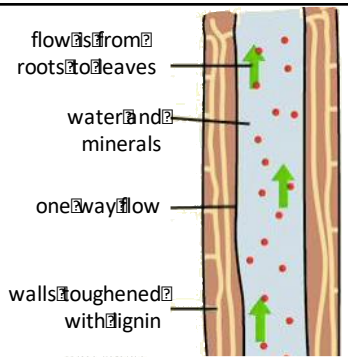
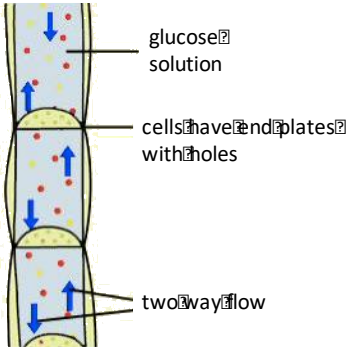
- Cell specialisation
- Cell differentiation

Cell structure part 2 - Animal cell specialisation

The **structure** of different cells helps them to carry out a **particular function** within the organism. These cells are called **specialised cells**.

Name of animal cell	Diagram	Structure and function
Sperm		**Function is to fertilise an egg.** • Streamlined with a long tail to swim to the egg. • Acrosome in the head containing enzymes to digest the egg cell membrane. • Large number of mitochondria in the mid section to release energy for movement.
Nerve		**Function is to carry electrical signals.** • Long to carry signals long distances. • Branched connections to connect to other nerve cells and form a network around the body. • Insulating sheath to enhance transmission of electrical signals.
Muscle	 Smooth muscle cells	**Function is .** • Contain a large number of mitochondria to release energy from respiration for movement. • Long so that there is enough space to contract.

Cell structure part 2 - Plant cell specialisation

Name of plant cell	Diagram	Structure and function
Root hair		**Function is to absorb water and minerals from the soil.** • Hair like projections to increase the surface area. (Note that root hair cells have no chloroplasts this is because they do not need them as they are in the soil)
Xylem		**Function is to carry water and minerals in plants.** • Form hollow xylem tubes made of dead tissue. • Long cells with walls toughened by lignin. • Water and minerals flow from the roots towards the leaves only in one direction in a process called **TRANSPIRATION**.
Phloem		**Function is to carry glucose around the plant.** • Form phloem tubes made of living tissue. • Cells have end plates with holes in them. • Glucose in solution moves from the leaves to growth and storage tissues in a process called **TRANSLOCATION**.

Cell structure part 2 - Cell differentiation

Cell **differentiation** occurs as organisms develop, the cell changes and becomes **specialised**. As the cell **differentiates,** it forms different sub-cellular structures, e.g. the tail on a sperm cell or the hairs on a root hair cell.

Most types of **ANIMAL** cells **differentiate** in the early stage of development.

Most types of **PLANT** cells can **differentiate throughout their life** cycle.

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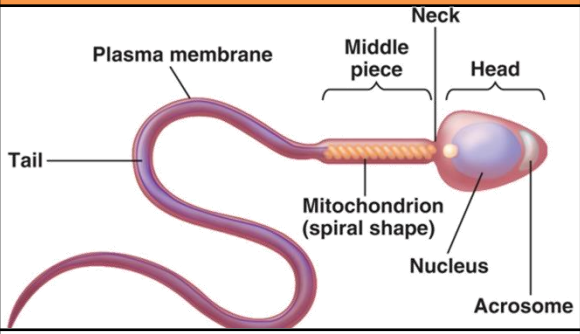
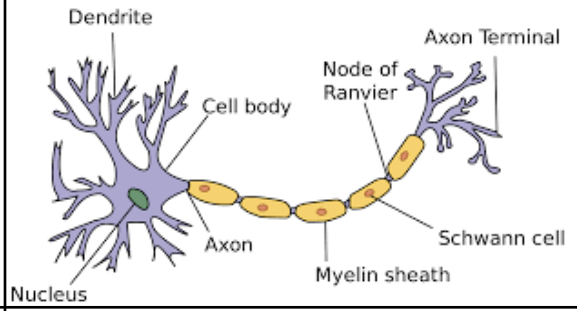
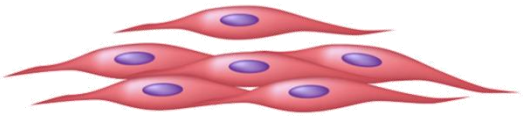
QuestionIT!

Cell structure
Part 2

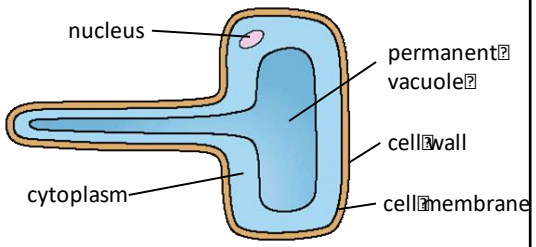
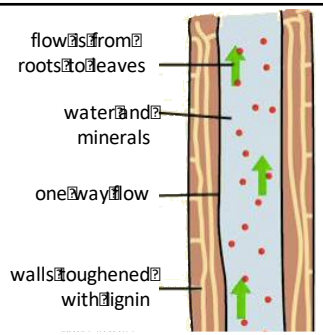
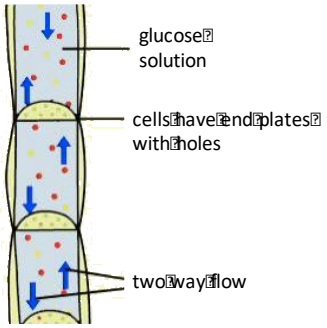
- Cell specialisation
- Cell differentiation

Cell structure part 2 – QuestionIT

1. Name animal cells A, B and C and describe their structure and function.

Name of animal cell	Diagram	Structure and function
A.		
B.		
C.	 Smooth muscle cells	

2. Name plant cells A, B and C and describe their structure and function.

Name of plant cell	Diagram	Structure and function
A.		
B.		
C.		

Cell structure – QuestionIT

3. What does cell differentiation mean?

4. In what stage of an animal's life cycle do most cells differentiate?

5. In mature animals when do cells still need to differentiate?

6. In what stage of their life cycle do plant cells differentiate?

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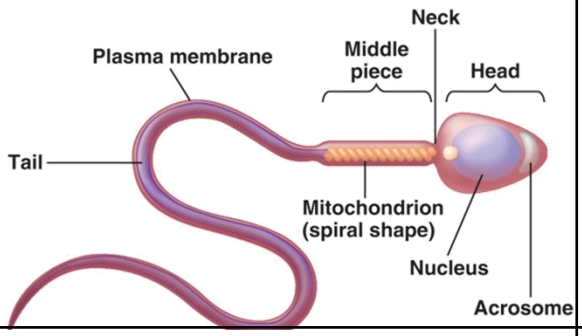
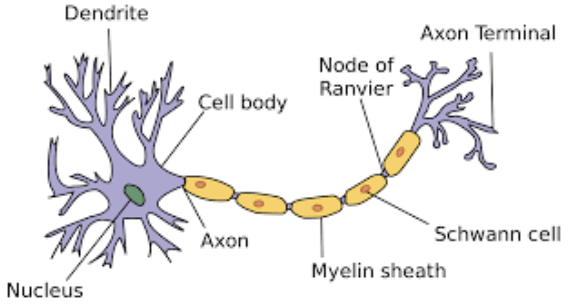
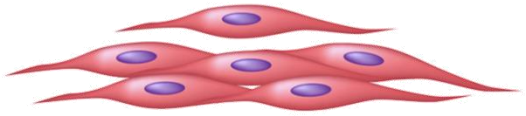
AnswerIT!

Cell structure
Part 2

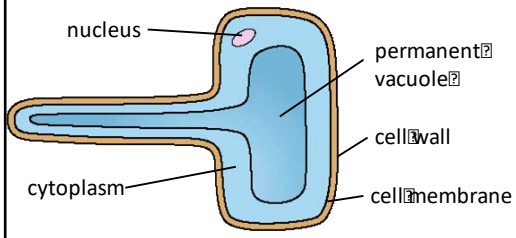
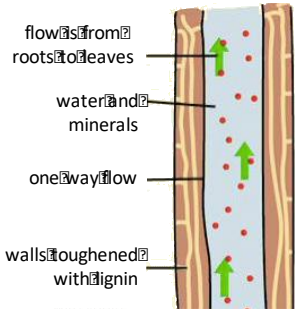
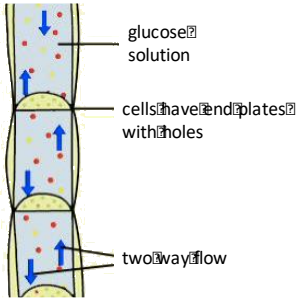
- Cell specialisation
- Cell differentiation

Cell structure – AnswerIT

1. Name animal cells A, B and C and describe their structure and function.

Name of animal cell	Diagram	Structure and function
A. Sperm		**Function is to fertilise an egg.** • Streamlined with a long tail to swim to the egg. • Acrosome in the head containing enzymes to digest the egg cell membrane. • Large number of mitochondria in the mid section to release energy for movement.
B. Nerve		**Function is to carry electrical signals.** • Long to carry signals long distances. • Branched connections to connect to other nerve cells and form a network around the body. • Insulating sheath to enhance transmission of electrical signals.
C. Muscle	 Smooth muscle cells	**Function is to contract to allow movement.** • Contain a large number of mitochondria to release energy from respiration for movement. • Long so that there is enough space to contract.

2. Name plant cells A,B and C and describe their structure and function.

Name of plant cell	Diagram	Structure and function
A. Root hair		**Function is to absorb water and minerals from the soil.** • Hair like projections to increase the surface area. (Note that root hair cells have no chloroplasts this is because they do not need them as they are in the soil)
B. Xylem		**Function is to carry water and minerals in plants.** • Form hollow xylem tubes made of dead tissue. • Long cells with walls toughened by lignin. • Water and minerals flow from the roots towards the leaves only in one direction in a process called **TRANSPIRATION**.
C. Phloem		**Function is to carry glucose around the plant.** • Form phloem tubes made of living tissue. • Cells have end plates with holes in them. • Glucose in solution moves from the leaves to growth and storage tissues in a process called **TRANSLOCATION**.

3. What does cell differentiation mean?

When a cell changes to become specialised.

4. In what stage of an animal's life cycle do most cells differentiate?

In the early stages.

5. In mature animals when do cells still need to differentiate?

For repair and replacement of cells.

6. In what stage of their life cycle do plant cells differentiate?

They differentiate throughout their lifecycle.

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LearnIT!
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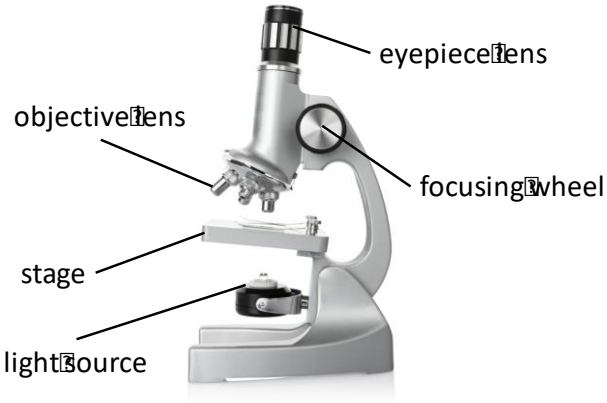
Cell structure
Part 3

- Microscopy
- Culturing microorganisms (biology only)

Cell structure - Microscopy



light microscope

First ones used in 1590's

electron microscope

First ones used in 1960's

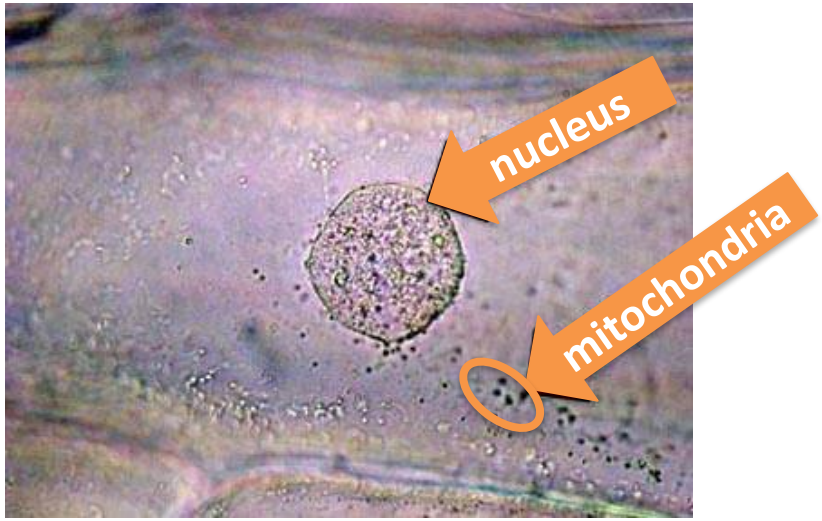
Feature	Light (optical) microscope	Electron microscope
Radiation used	Light rays	Electron beams
Max magnification	~ 1500 times	~ 2 000 000 times
Resolution	200nm	0.2nm
Size of microscope	Small and portable	Very large and not portable
Cost	~£100 for a school one	Several £100,000 to £1 million plus

Resolution: The **shortest distance** between **two objects** that can be seen clearly.

Video - Types of microscopes

Cell structure - Microscopy

Electron microscopes have a **higher** magnification and resolution than **light microscopes**. This means that scientists can see more sub- cellular structures (structures within the cells).



Light microscopes image can let us see **structures** like nuclei and mitochondria.

Electron microscopes image can let us see the **internal structures** of a chloroplast and mitochondrion.

Cell structure - Microscopy

You can calculate the magnification of an image by using the equation:

$$\text{magnification M} = \frac{\text{size of image I}}{\text{real size of the object A}}$$

MAGNIFICATION: the number of times bigger the image looks compared to the object
IMAGE: what is viewed through the microscope lenses
OBJECT: the **ACTUAL** specimen under the microscope

WORKED EXAMPLE 1:

A magnified animal cell structure has a diameter of 6 mm. ← IMAGE

The actual diameter of the structure is 0.15mm. ← OBJECT

Calculate how many times the structure has been magnified.

$$M = \frac{I}{A} \qquad M = \frac{6}{0.15} \qquad M = 40$$

You may need to to write your answers in **standard form.**

You may need to be able rearrange to change the **subject** of the equation.

Cell structure - Microscopy

$$\text{magnification } M = \frac{\text{size of image } I}{\text{real size of the object } A}$$

WORKED EXAMPLE 2:

The actual length of a cell structure is 30µm. ← OBJECT (A)

It is magnified 40 times. ← MAGNIFICATION (M)

Calculate the length of the magnified cell structure in mm.

Rearrange the equation to make I the subject

$$A \times M = \frac{I \times A}{A}$$

Multiply both sides by A

Cancel out the As

$$I = M \times A$$

Put I on the left of the equation

$$I = 40 \times 30$$

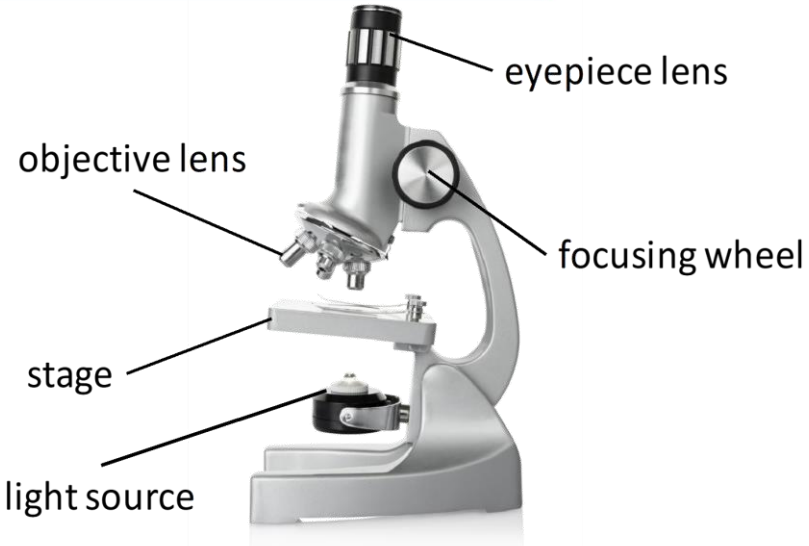
$$I = 1200\ \mu m$$

$$I = 1.2mm$$

To convert to mm you need to divide by 1000

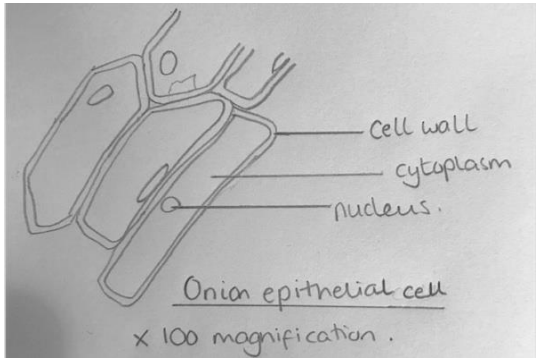
You may need to to write your answers in **standard form.**

Cell structure – Microscopy



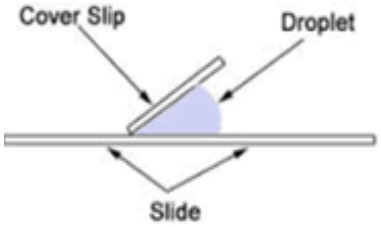
Drawing what you see

- **Clear line drawing – no shading**
- **Label main cell structures**
- **Add a title and the magnification.**



Making a wet mount slide e.g. onion cells

- Place a thin section of the **specimen** onto slide.
- Place a drop of water in the middle of the slide or stain the specimen.
- Gently lower cover slip onto the specimen without trapping air bubbles.

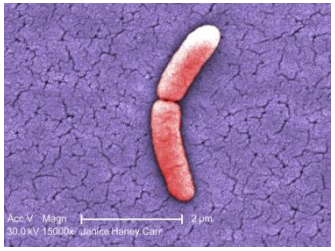


- Soak up any excess liquid with a paper towel.
- Switch on the light source and place your slide on the stage.
- Use the lowest objective lens and turn the focusing wheel to move the lens close to the slide.
- Slowly adjust the focusing wheel until you can see a clear image.
- Increase the magnification by changing the objective lens and re-focus.

See GCSE Practical Guide - Biology – Microscopy on Huddle - Microscopy Practical guide

Cell structure - Culturing microorganisms (biology only)

Bacteria multiply by binary fission (a cell division where two identical cells are formed). In the right conditions cells can divide as often as every 20 minutes.



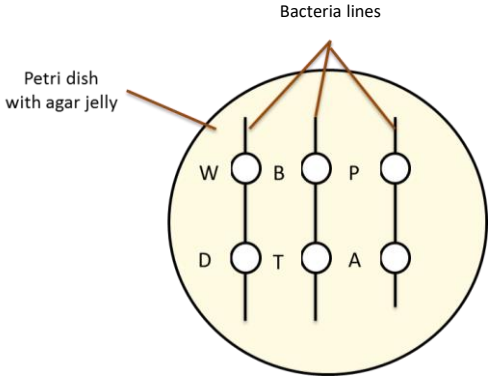
Bacteria can be grown in the lab

- A ***culture medium (agar)*** used containing an *energy* source (carbohydrate) and minerals.
- Petri dishes and agar must be **sterilised before use to kill microorganisms.**
- **Inoculating loops** used to transfer bacteria after being heated in a Bunsen flame.
- The lid of the Petri dish should be **sealed** with **tape to stop other microorganisms** getting in (must **not be fully sealed so oxygen** can get in)
- In school, Petri dishes are **incubated at 25°C to reduce risk** of growth of **pathogens** that might be **harmful to humans.**

Effectiveness of disinfectants and antibiotics on bacteria experiment

- Agar inoculated with **BACTERIA**.
- **Paper discs** containing **antiseptics** and **antibiotics** placed on **bacteria** and **left to grow.**

  Water disc used as a CONTROL.
- If **bacteria don't grow** around the disc then the chemical is **effective** at killing bacteria.
- **Area** where **bacteria don't grow** is called **ZONE OF INHIBITION**.



See GCSE Practical Guide - Practical guide - Microbiology

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QuestionIT!

Cell structure
Part 3

- Microscopy
- Culturing microorganisms (biology only)

Cell structure part 3 – QuestionIT

1. Define the term ‘resolution’.

2. Copy and complete the table below.

Feature	Light (optical) microscope	Electron microscope
Radiation used		
Max magnification		
Resolution		
Size of microscope		
Cost		

3. What are the advantages of the electron microscope?

4. Name the smallest cell structures that can be seen by the light microscope?

5. What are the smallest cell structures that can be seen by the electron microscope?

Cell structure part 3 – QuestionIT

6. Write down the magnification equation.

7. Rearrange the equation to change the subject for the two other factors.

8. A magnified cell structure has a diameter of 375µm.

   The actual diameter of the structure is 2.5µm.

   Calculate how many times the structure has been magnified.

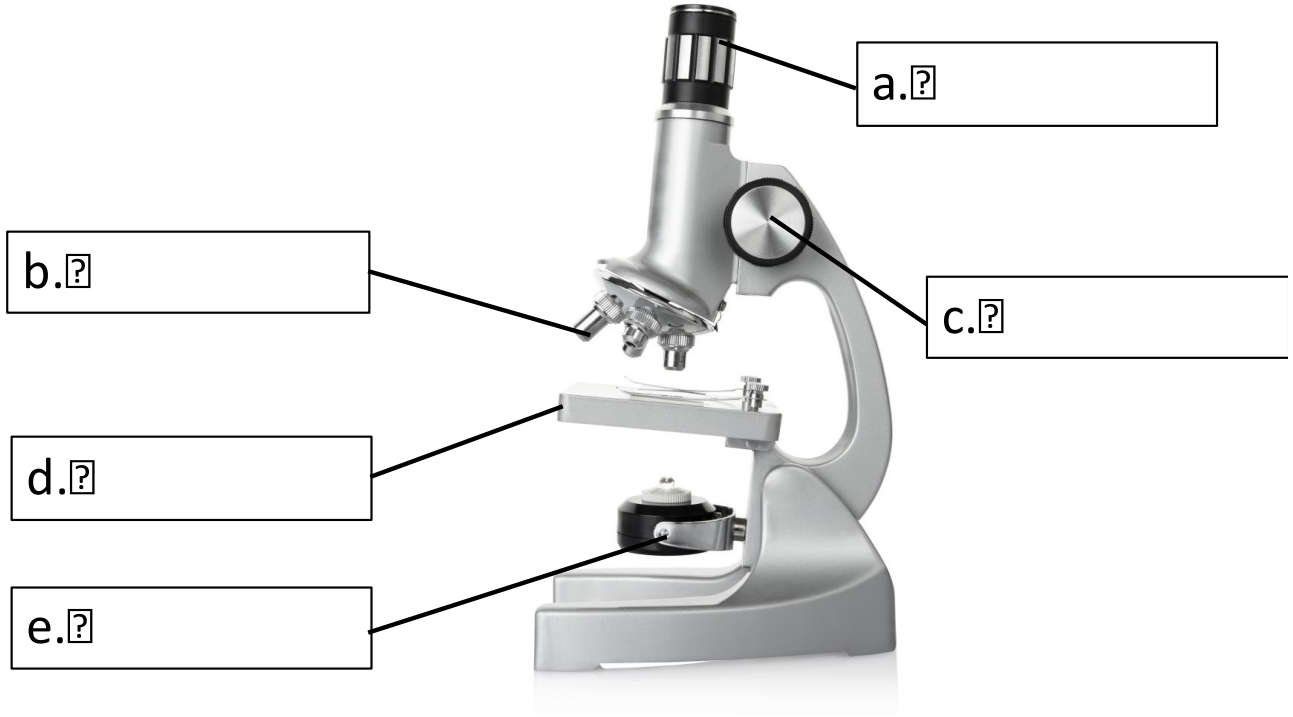
9. The actual length of a cell structure is 3µm.

   It is magnified 1,500 times.

   Calculate the length of the magnified cell structure in mm.

Cell structure part 3 – QuestionIT

10. Name the parts of the light microscope in the diagram below.



11. How would you make an onion cell slide?

12. How would you use the light microscope to view onion cells?

Cell structure part 3 – QuestionIT (Biology ONLY)

13. What is ‘binary fission’?

14. Why do you need to sterilise Petri dishes and culture mediums before use?

15. What would you use an inoculating loop for?

16. How do you sterilise an inoculating loop?

17. How would you secure the lid of the Petri dish?

18. What temperature would you incubate the samples at in a school and why should you use this temperature?

19. How can you test the effectiveness of antibiotics and disinfectants on bacteria?

20. What is the zone of inhibition?

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AnswerIT!

Cell structure
Part 3

- Microscopy

- Culturing microorganisms (biology only)

Cell structure part 3 – QuestionIT

1. Define the term resolution.

The shortest distance between two objects that can be seen clearly.

2. Copy and complete the table below.

Feature	Light (optical) microscope	Electron microscope
Radiation used	**Light rays**	**Electron beams**
Max magnification	**~ 1500 times**	**~ 2 000 000 times**
Resolution	**200nm**	**0.2nm**
Size of microscope	**Small and portable**	**Very large and not portable**
Cost	**~£100 for a school one**	**Several £100,000 to £1 million plus**

3. What are the advantages of the electron microscope? **Electron microscopes have a higher magnification and resolution than light microscopes; scientists can see more sub-cellular structures.**

4. Name the smallest cell structures that can be seen by the light microscope?

Nuclei and mitochondria

5. What are the smallest cell structures that can be seen by the electron microscope? **Internal structures of mitochondria and chloroplasts.**

Cell structure part 3 – AnswerIT

6. Write down the magnification equation.

$$\text{magnification (M)} = \frac{\text{size of image (I)}}{\text{real size of the object (A)}}$$

7. Rearrange the equation to change the subject for the two other factors.

$$\text{size of image (I)} = \text{magnification (M)} \times \text{real size of the object (A)}$$

$$\text{real size of the object (A)} = \frac{\text{size of image (I)}}{\text{magnification (M)}}$$

8. A magnified cell structure has a diameter of 375µm.
The actual diameter of the structure is 2.5µm.
Calculate how many times the structure has been magnified.

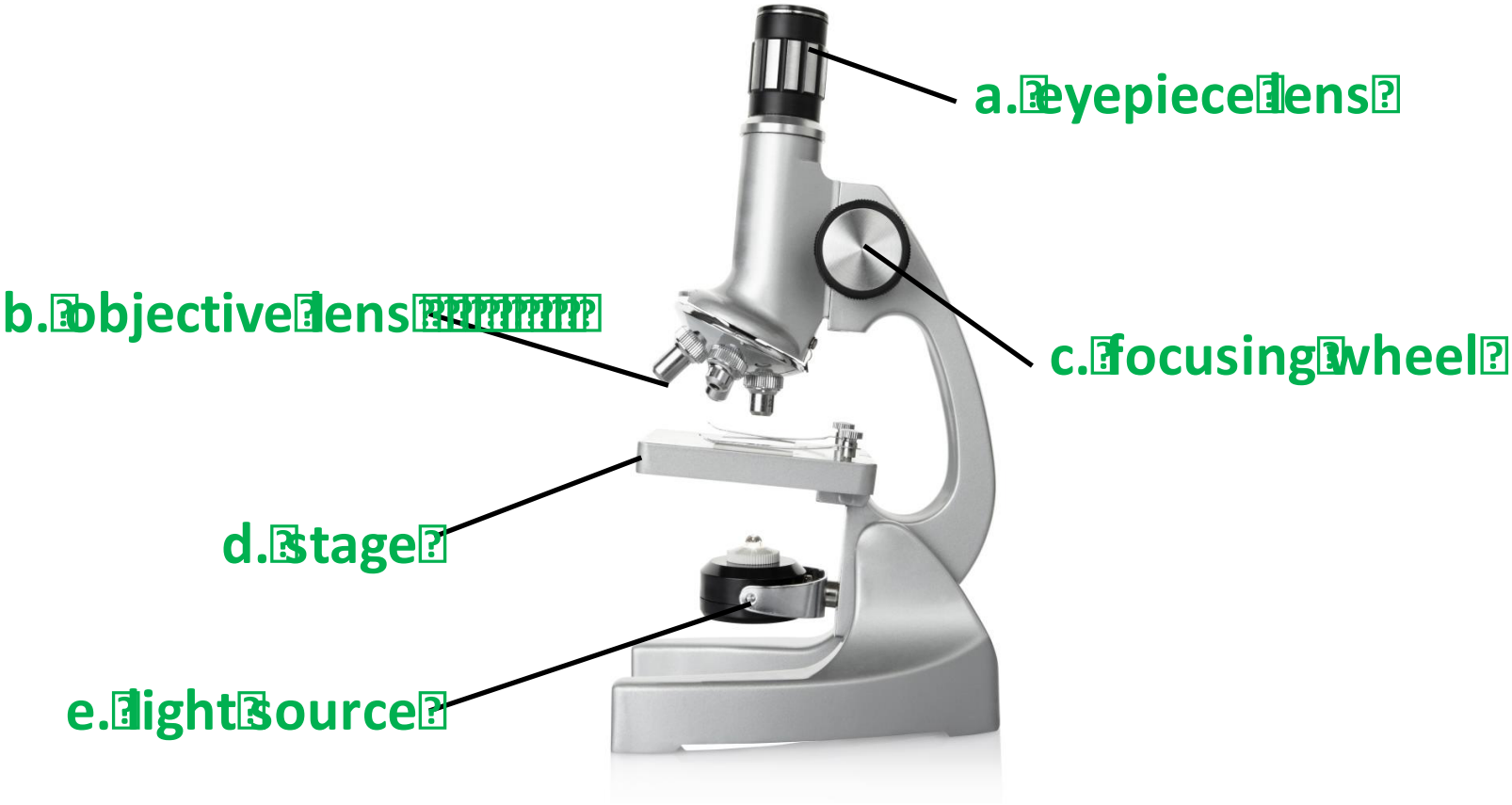
M = I/A M = 375/2.5 = 150 M = 150 times

9. The actual length of a cell structure is 3µm.
It is magnified 1,500 times.
Calculate the length of the magnified cell structure in mm.

I = M x A I = 1500 x 3 I = 4500 µm 4500 / 1000 = 4.5mm

Cell structure part 3 – QuestionIT

10. Name the parts of the light microscope in the diagram below.



Cell structure part 3 – QuestionIT

11. Describe how you would make an onion cell slide.

- **Place thin section of onion epidermis onto slide.**
- **Place a drop of iodine in the middle of the slide to stain the onion.**
- **Gently lower cover slip onto the onion without trapping air bubbles.**
- **Soak up any excess liquid with a paper towel.**

12. Describe how you would use the light microscope to view onion cells.

- **Switch on the light source and place your slide on the stage.**
- **Use the lowest objective lens and turn the focusing wheel to move the lens close to the slide.**
- **Slowly adjust the focusing wheel until you can see a clear image.**
- **Increase the magnification by changing the objective lens and re-focus.**

Cell structure part 3 – QuestionIT (Biology ONLY)

13. What is 'binary fission'? Cell division where two identical cells to the parent cell are formed.
14. Why do you need to sterilise Petri dished and culture mediums before use? To kill any unwanted microorganisms.
15. What would you use an inoculating loop for? To transfer bacteria onto the agar.
16. How do you sterilise an inoculating loop? By heating in a Bunsen flame.
17. How would you secure the lid of the Petri dish? With tape but not sealed all the way around.
18. What temperature would you incubate the samples at in a school and why should you use this temperature? 25^{o}C, to prevent the growth of pathogens harmful to humans.
19. How can you test the effectiveness of antibiotics and disinfectants on bacteria? Inoculate agar with bacteria, place discs soaked in the solutions (water as a control) and place the discs on the agar containing bacteria. Incubate at 25^{o}C.
20. What is the zone of inhibition? An area where bacteria don't grow.

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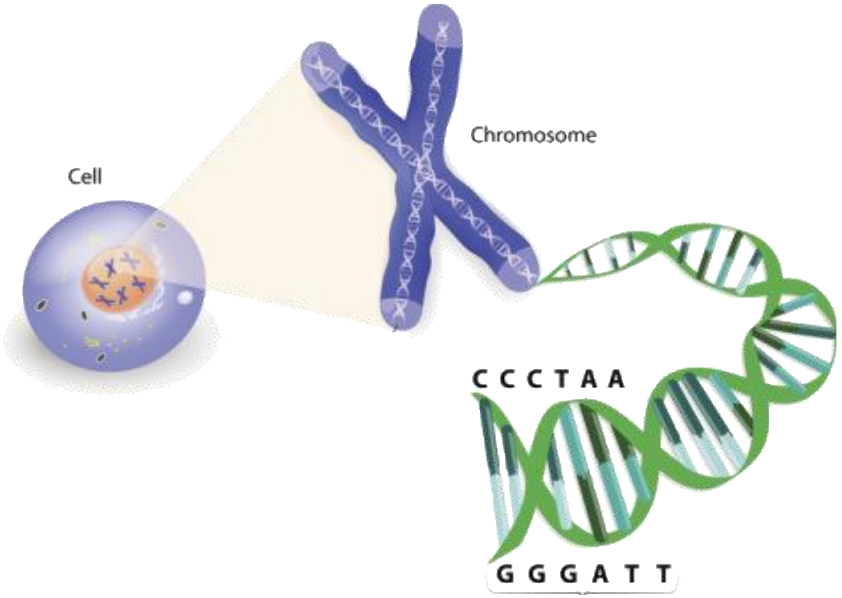
LearnIT!
KnowIT!

Cell division

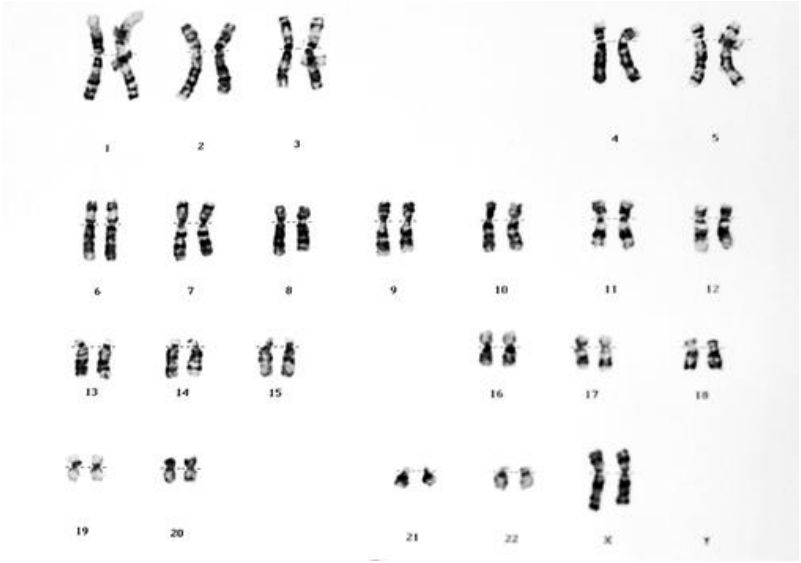
- Chromosomes
- Mitosis and the cell cycle
- Stem cells

Cell division - Chromosomes



The **nucleus** of a cell contains the **instructions** for **making proteins** and new cells. In the nucleus there are structures called **chromosomes**. The chromosomes are made of coiled strands of **DNA** molecules. A section of DNA that codes for a specific protein or characteristic is called a **gene**.

In **human body cells** the **chromosomes** are normally found in **pairs**. The karyotype diagram below shows the **23 chromosome pairs** for a female human.



Human have are around **24,000 genes** and there are up to **2,000 genes** in **one** human chromosome.

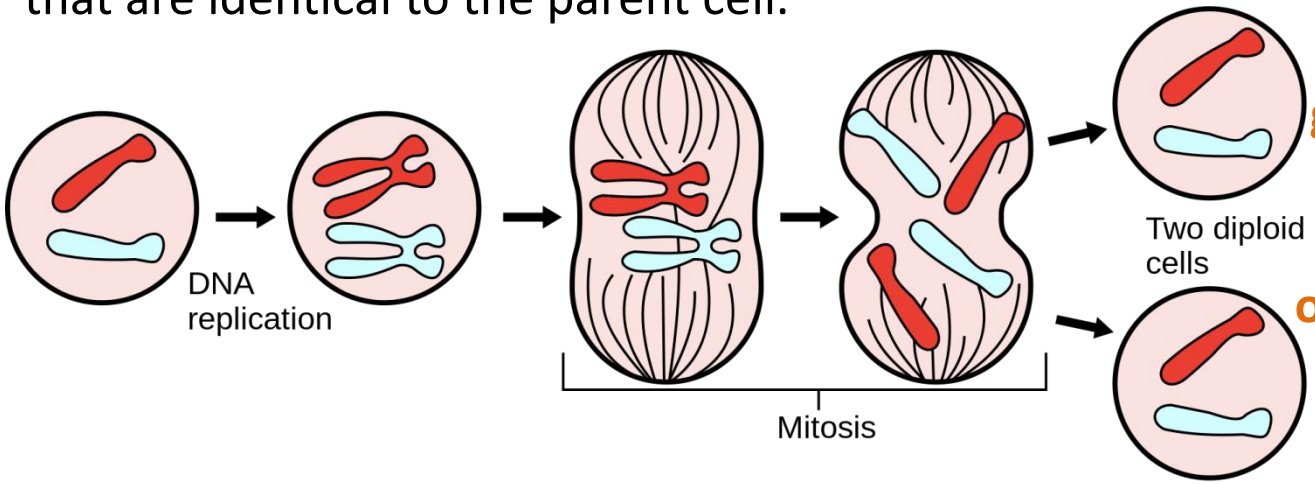
Cell division - Mitosis and the cell cycle

In the **cell cycle,** cells divide in a series of **stages**. The **genetic material** is **doubled** and then **divided** into **two identical cells**.

Stage 1 – Growth: Before a cell can divide it needs to grow and increase the number of sub-cellular structures such as ribosomes and mitochondria.

Stage 2 - DNA synthesis: The DNA replicates to form two copies of each chromosome.

Stage 3 – Mitosis: One set of chromosomes is pulled to each end of the cell and the nucleus divides. Then the cytoplasm and cell membranes divide to form two cells that are identical to the parent cell.

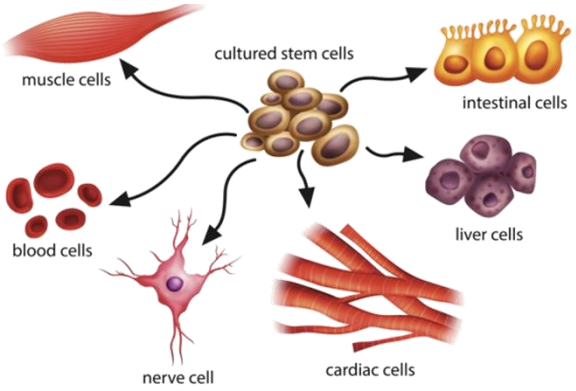


Mitosis occurs during growth and to repair or replace damaged cells. Asexual reproduction occurs by mitosis in both plants and simple animals.

Cell division - Stem Cells - animals

Stem cells are undifferentiated cells within an organism. They can produce other stem cells that can then differentiate into many different types of cells.

Human embryo stem cells: can be cloned and made to **differentiate** into **most** different types of human cells.
Human adult stem cells: can form **many** (but not all) types of cells including blood cells.
Human stem cells can be used to help treat diseases like diabetes and paralysis.



Embryos produced by **therapeutic cloning** have the **same genes as the patient**. This means stem cells from the embryo are **not rejected by the patient's body.** This is why they can be used for medical treatments.

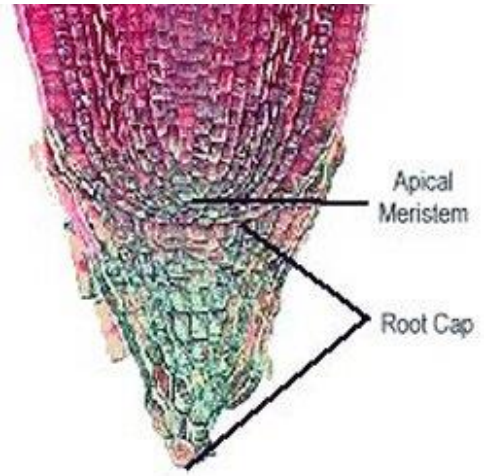
The **risks** of using stem cells risks such as **transfer** of **viral infections**.

Some people have objections to stem cell use for **ethical** and **religious** reasons.

During Fertility treatment doctors usually fertilise many more eggs than are going to be used. The **embryos** then formed are used to **obtain** stem cells. In the UK **scientists** can use these embryos for **research** but only under **very strict guidelines**.

Cell division- Stem Cells - plants

Most types of **PLANT** cells can **differentiate throughout their life** cycle.
Undifferentiated stem cells in **plants** are grouped together in **structures called meristems.** The undifferentiated cells can then specialise e.g. root hair cell, xylem or phloem cells.



Stem cells from **meristems in plants** can be used to produce **clones of plants** quickly and economically.

- **Rare species:**
  can be cloned to protect from extinction.
- **Crop plants:**
  with special features such as disease resistance can be cloned to produce large numbers of identical plants for farmers.
  e.g. potatoes, strawberries and dates

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QuestionIT!

Cell division

- Chromosomes
- Mitosis and the cell cycle
- Stem cells

Cell Division– QuestionIT

1. What are chromosomes?
2. What is a gene?
3. What is DNA?
4. Where in a cell do you find chromosomes?
5. How many chromosome pairs do you find in a human body cell?
6. What are the three stages of the cell cycle?
7. What is mitosis and what is it used for in animals and plants?
8. What is a stem cell?
9. Which type of human stem cell can differentiate into any human cell?

10. What is therapeutic cloning?

11. What are the risks of therapeutic cloning?

12. State two reasons why people may object to the use of stem cells in therapeutic cloning.

13. What are meristems?

14. State two reasons that plants are cloned.

AnswerIT!

Cell division

- Chromosomes
- Mitosis and the cell cycle
- Stem cells

Cell Division– AnswerIT

1. What are chromosomes? **Coiled strands of DNA molecules.**
2. What is a gene? **A section of DNA that codes for a protein.**
3. What is DNA?

A genetic material found in the nucleus that codes for proteins.

4. Where in a cell do you find chromosomes?

In the nucleus of cells.

5. How many chromosome pairs do you find in a human body cell?

23 pairs

6. What are the three stages of the cell cycle? **Growth, DNA synthesis and mitosis.**
7. What is mitosis and what is it used for in animals and plants?

Growth, repair and asexual reproduction.

8. What is a stem cell? **An undifferentiated cell.**
9. Which type of human stem cell can differentiate into any human cell?

Embryo stem cells.

10. What is therapeutic cloning? **Where patients are given stem cells containing the same genes as theirs.**

11. What are the risks of therapeutic cloning? **Viral infections.**

12. State two reasons why people may object to the use of stem cells in therapeutic cloning.

Ethical and religious reasons.

13. What are meristems? **Structures in plants that contain stem cells.**

14. State two reasons that plants are cloned? **To clone rare species of plants and to clone crop plants with useful characteristics.**

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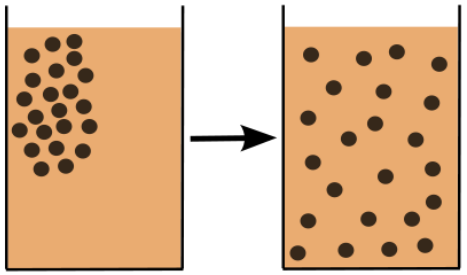
LearnIT!
KnowIT!

Transport in cells

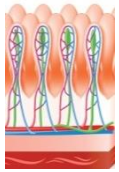
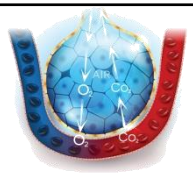
- Diffusion
- Osmosis
- Active transport

Transport in cells - Diffusion

Diffusion is the spreading of the **particles of a gas or substances in solution**, resulting in a **net movement** of particles from a region where they are of a **higher concentration *to an area of* lower concentration.**



Diffusion can occur in: Air – smells from perfume etc.
Solution – tea from a tea bag, dye in water etc.
Through membranes – small intestines, blood cells etc.

Substances that are transported in and out of cells in humans			
Location	Particles move	From	To
Small Intestine 	**Digested food e.g. glucose, amino acids**	**Small intestine**	**Blood in capillary of villus**
Lungs 	**Oxygen**	**Alveolar air space**	**Blood circulating around the lungs**
Kidneys 	**Urea**	**Cells**	**Blood plasma**

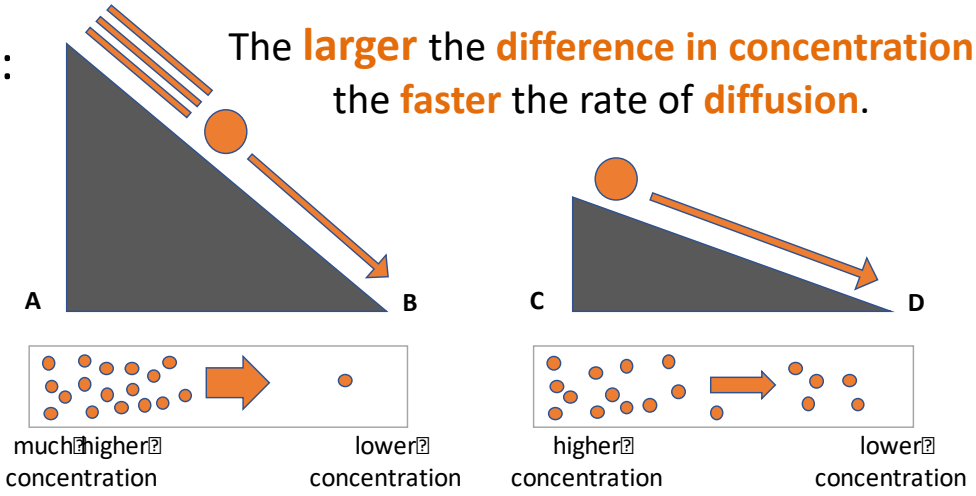
Transport in cells - Diffusion

Factors which affect the rate of diffusion:

The concentration gradient:

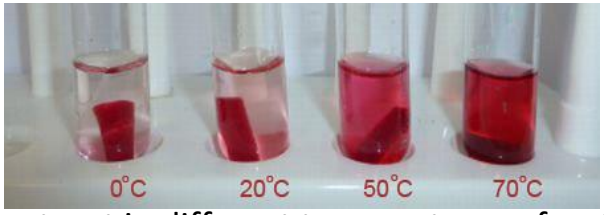
A **difference** in **concentration** between two **areas next** to each other. Particles will move **down** the concentration **gradient from high to low**.

The **larger** the **difference in concentration** the **faster** the rate of **diffusion**.



The temperature:

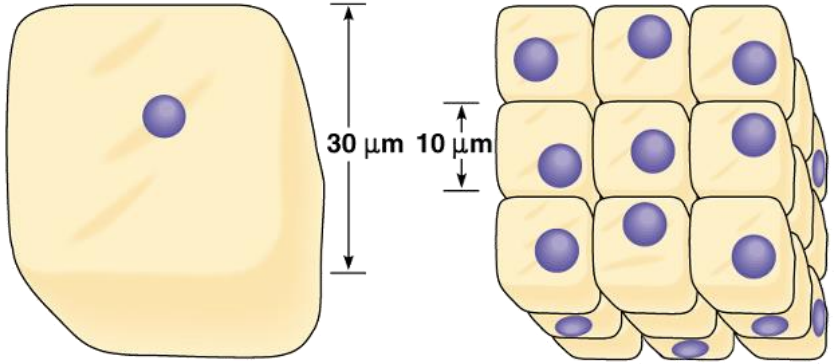
As the **temperature** increases the particles in a gas or liquid gain **more energy** so they move **faster**. The **hotter** it is the **faster** the rate of diffusion.



Beetroot in different temperatures of water

The surface area of the membrane:

A **single-celled organism** has a large surface area compared to its volume. This allows sufficient **transport** of molecules into and out of the cell to meet the **needs** of the organism.



Transport in cells – Surface area to volume ratio

The surface area to volume ratio can be calculated by dividing an object's surface area (SA) by its volume

Cube A represents a small animal like a mouse the sides are 1 cm each and there are 6 sides.

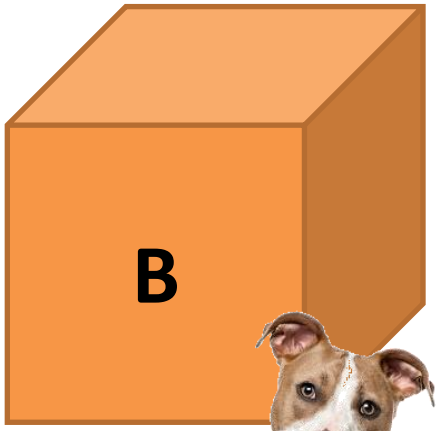
To calculate the **volume**:
volume A = length x width x height
volume A = 1 x 1 x 1
volume A = 1cm ^{3}

To calculate the **area** of **one** surface:
area = height x width
area = 1 x 1 = 1cm^2

To calculate the **SA** of **A**:
area of **one surface** x the **number** of surfaces
surface area = 1 x 6 = 6cm^2

SA:V ratio = 6/1 = 6

Cube B represents a larger animal like a dog the sides are 6cm each and there are 6 sides.



To calculate the **volume**:
volume B = length x width x height
volume B = 6 x 6 x 6
volume A = 216cm ^{3}

To calculate the **area** of **one** surface:
area = height x width
area = 6 x 6 = 36cm^2

To calculate the **surface area** of **B**:
area of **one surface** x the **number** of surfaces
surface area = 36 x 6 = 216cm^2

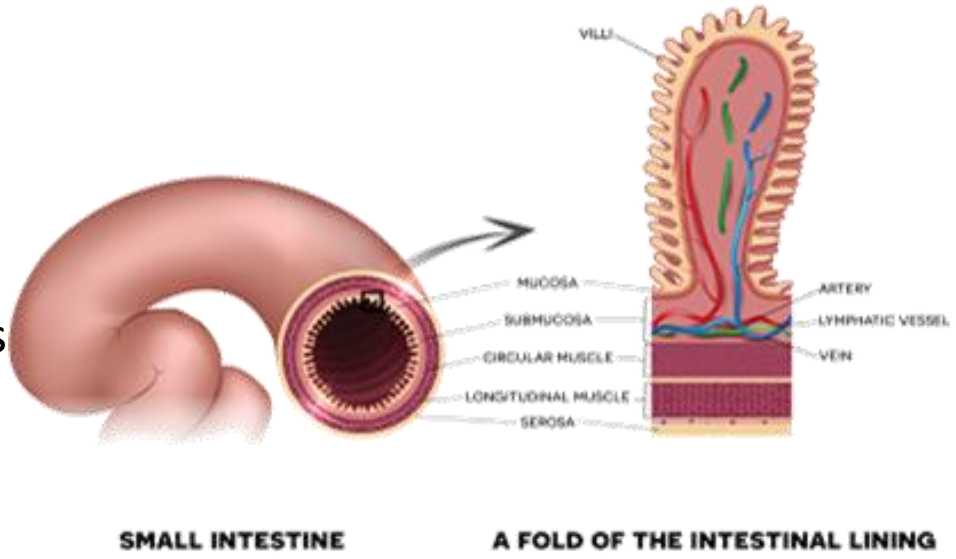
SA:V ratio = 216/216 = 1

So as you can see the mouse has a much larger surface area compared to its volume.

Transport in cells – Adaptations in animals

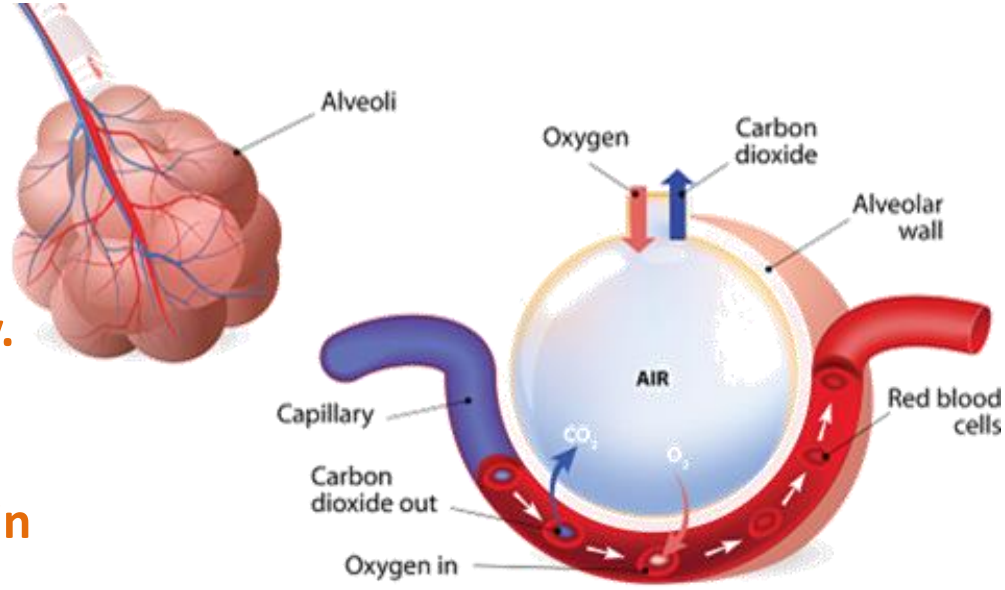
Adaptations of the small intestines:

- Internal surface is covered in millions of **folds** called **villi.**
- Villi **increase** the **surface area**.
- Villi have a very **good blood supply.** This **maintains** the **concentration gradient.**
- **Membranes** of the villi are **very thin** to allow for a **short diffusion distance.**



Adaptations of the lungs:

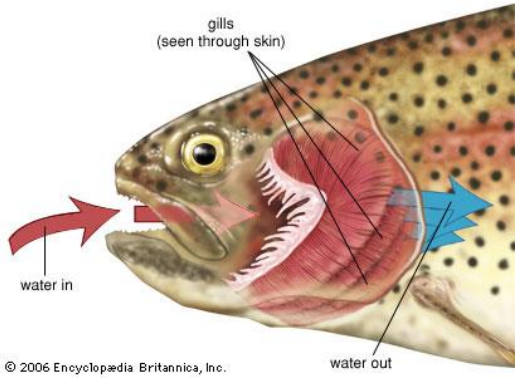
- Lungs contain millions of tiny air sacs called **alveoli.**
- Alveoli **increase** the **surface area**.
- Alveoli have a very **good blood supply.** This **maintains** the **concentration gradient.**
- **Membranes** of the alveoli are **very thin** to allow for a **short diffusion distance.**

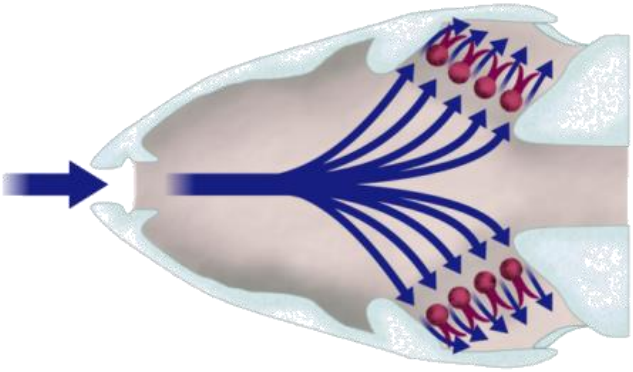


Transport in cells – Adaptations in animals

Adaptations of gills in fish:

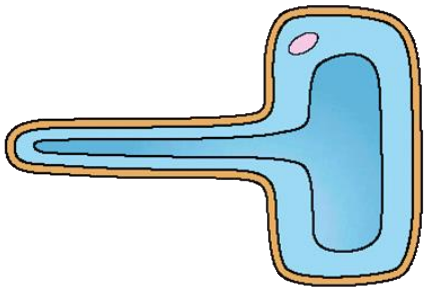
- Each gill is made of lots of thin plates called **gill filaments, water with low oxygen flows** over **them** (however, the oxygen in the blood surrounding the gills is lower) .
- Gill filaments **increase** the **surface area**.
- Gill filaments are covered with **lamella** that increase the surface area more.
- Lamella have a very **good blood supply.** This **maintains** the **concentration gradient as water flows** in the **opposite direction.**
- **Membranes** of the lamellae are **very thin** to allow for a **short diffusion distance.**





http://kids.britannica.com/kids/assembly/view/87782

Transport in cells – Adaptations in plants

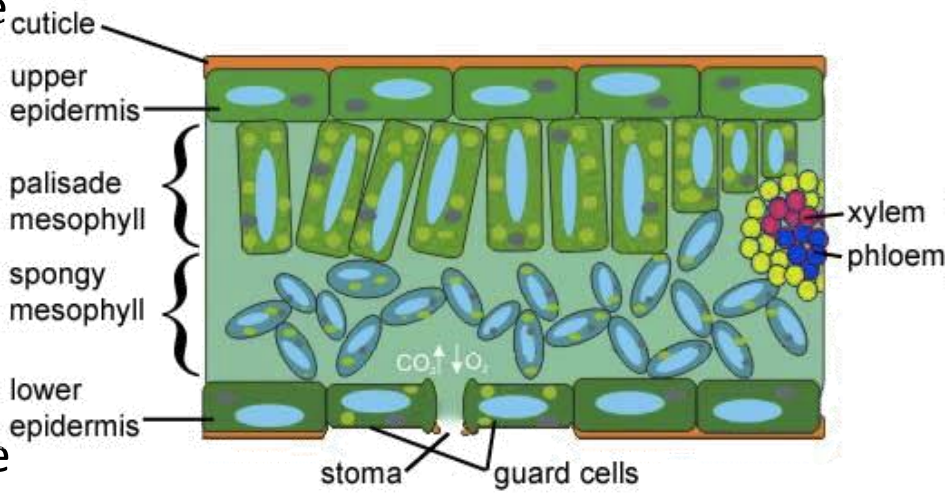


Adaptations of the roots:

- The root surface is covered in millions of **root hair cells.**
- Root hair cells **increase** the **surface area**.
- Present on the **mature** **parts** of the roots.
- Absorb **water** and **minerals** from the soil.

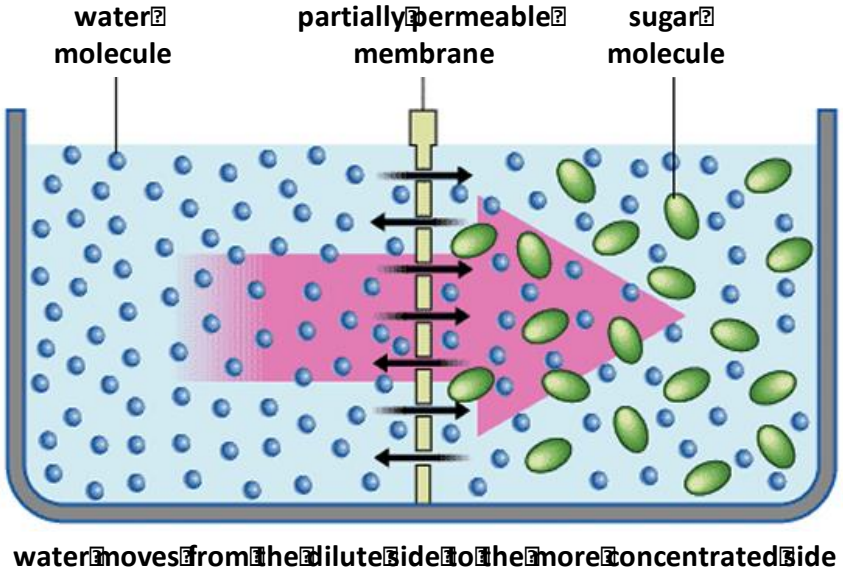
Adaptations of the leaves:

- **Large surface area** to **absorb** more **light.**
- Thin so **short distance** for carbon dioxide to diffuse into leaf cells.
- **Chlorophyll** absorbs **sunlight** for **photosynthesis**.
- **Xylem** and **phloem** to **support** the leaf and **transport water** and **glucose**.
- **Stomata** on the **lower side** of the leaf to allow **gases** to **diffuse** into and out of the leaf.



Transport in cells - Osmosis

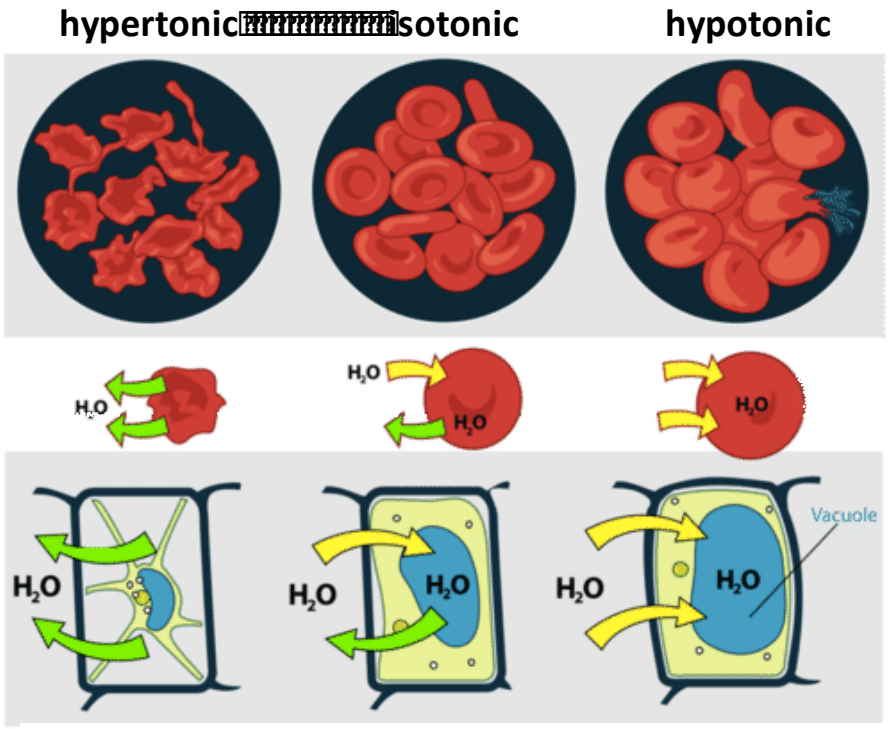
Osmosis is the diffusion of water from a dilute solution to a concentrated solution through a partially permeable membrane.



The rate of osmosis changes depending on the concentration gradient and temperature.

Partially permeable membrane – a membrane that lets some but not all substances through.

Osmosis in plant and animal cells:



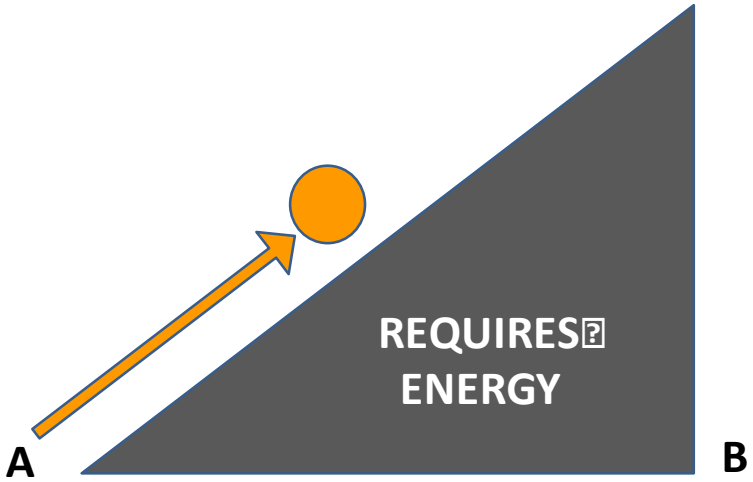
Hypertonic – more concentrated solution than in the cells.

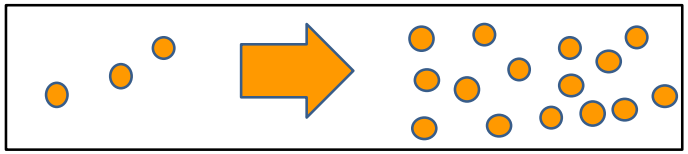
Isotonic – same concentration as the solution in the cell.

Hypotonic – more dilute than the solution in the cells.

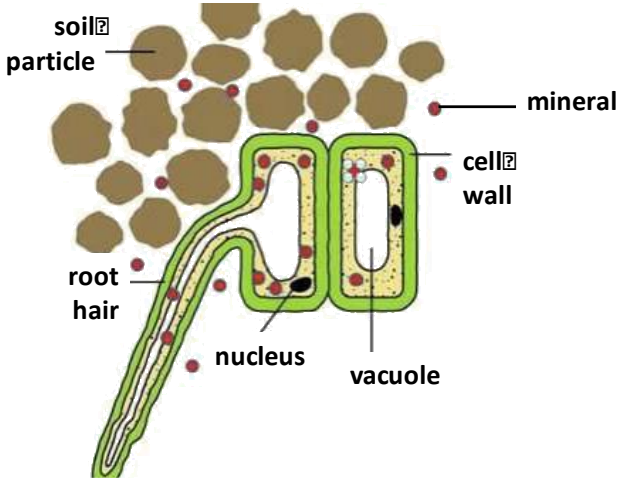
Transport in cells – Active transport

Active transport moves substances from a more dilute solution to a more concentrated solution (against a concentration gradient). The energy is provided by respiration.





Active transport occurs in **root hair cells**.



The **minerals** are at a **higher concentration** in the **root hair** cell than in the soil. So the **minerals** move **into** the **cell against** the concentration gradient.

Active transport also occurs in the **gut** (small intestines) **sugar** (glucose) molecules are absorbed from lower concentrations in the gut into the blood which has a higher sugar concentration.

The glucose is used for respiration.

QuestionIT!

Transport in cells

- Diffusion
- Osmosis
- Active transport

Transport in cells – QuestionIT

1. Define ‘diffusion’.

2. State three places where diffusion occurs in the body.

3. What is a concentration gradient?

4. What three factors affect the concentration gradient?

5. What is surface area to volume ratio?

6. Which has the largest surface area to volume ratio, an elephant or a meerkat?

7. State how the following are adapted for diffusion:

    a. The small intestines
    b. The lungs
    c. Gills in fish
    d. Root
    e. Leaves

Transport in cells – QuestionIT

8. Define ‘osmosis’.

9. What is a ‘partially permeable membrane’?

10. What happens to an animal cell in a hypertonic solution?

11. What happens to an animal cell in a hypotonic solution?

12. Define ‘active transport’.

13. Why does active transport need to occur in root hair cells?

14. Why does active transport need to occur in the gut?

AnswerIT!

Transport in cells

- Diffusion
- Osmosis
- Active transport

Transport in cells – QuestionIT

1. Define 'diffusion'?

The spreading of the particles from a region where they are of a higher concentration to an area of lower concentration.

2. State three places where diffusion occurs in the body. Small intestines, lungs, kidneys

3. What is a concentration gradient? The difference in concentration between two areas next to each other.

4. What three factors affect rate of diffusion? Concentration gradient, temperature, surface area.

5. What is surface area to volume ratio? The size of a surface compared to its volume.

6. Which has the largest surface area to volume ratio an elephant or a meerkat? The meerkat.

7. State how the following are adapted for diffusion:

a. The small intestines. Have villi to increase surface area, good blood supply, thin membranes.
b. The lungs. Have alveoli to increase surface area, good blood supply, thin membranes, they are ventilated.
c. Gills in fish. Have gill filaments and lamella to increase surface area, good blood supply, thin membranes.
d. Roots. Have root hair cells to increase surface area.
e. Leaves. Large surface area, thin and stomata.

8. Define osmosis? Osmosis is the diffusion of water from a dilute solution to a concentrated solution through a partially permeable membrane.
9. What is a partially permeable membrane? A membrane that lets some but not all substances through.

Transport in cells – QuestionIT

10. What happens to an animal cell in a hypertonic solution? It will lose water by osmosis and shrivel.
11. What happens to an animal cell in a hypotonic solution? It will absorb water by osmosis and get bigger/burst.
12. Define active transport. Active transport moves substances from a more dilute solution to a more concentrated solution (against a concentration gradient) using energy from respiration.
13. Why does active transport need to occur in root hair cells? Because the minerals are at a higher concentration in the roots than in the soil.
14. Why does active transport need to occur in the gut? Because the glucose in the blood is at a higher concentration than in the gut.