

GCSE Biology

Edexcel Topic – Key Concepts in Biology

Cell structure

- Eukaryotes and prokaryotes
- Animal, plant and bacterial cells
- Number, size and scale (including quantitative units)
- Cell specialisation
- Microscopy

Enzymes

- Enzyme action
- Factors affecting enzyme action
- Rate calculations

Transport in cells

- Diffusion
- Osmosis
- Active transport

Food

- Food tests (Biology ONLY)
- Calorimetry (Biology ONLY)



Cell structure

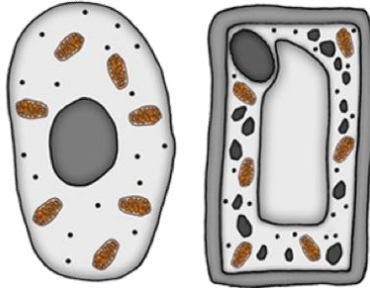
Part 1 (1.1&1.5)

- Eukaryotes and prokaryotes
- Animal and plant cells
- Number, size and scale

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.

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.

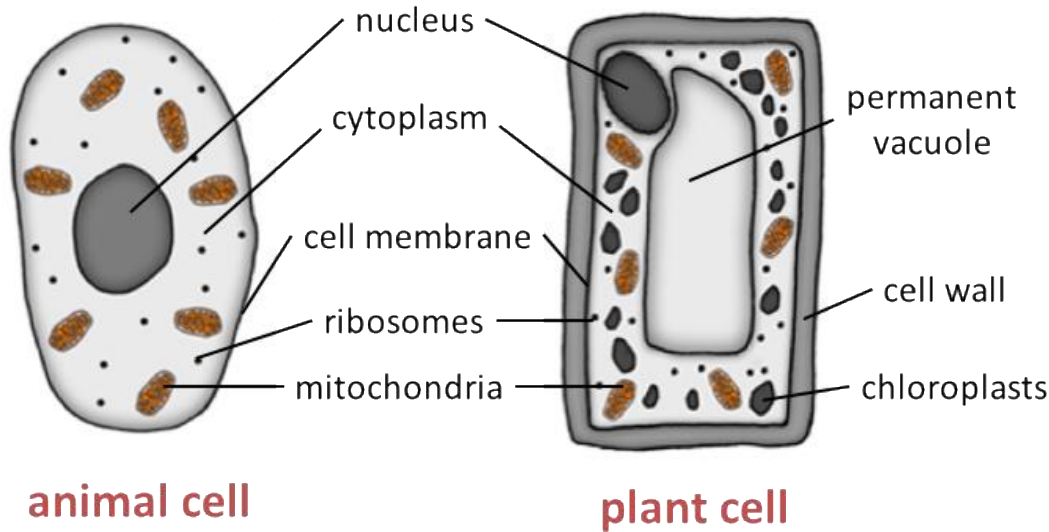
Bacterial cells are prokaryotic cells

Animal and plant cells are eukaryotic cells

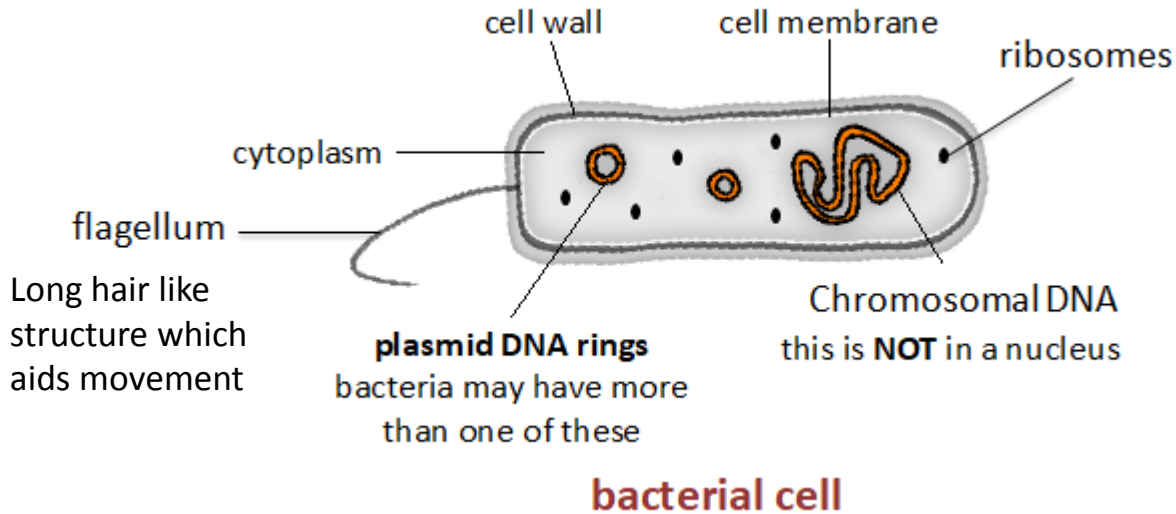
Prefixes are used in science to make very small numbers more manageable. You need to learn the ones in the table and be able to convert to and from standard form.

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	$\times 10^{-9}$
pico (pm)	1 pm = 0.000 000 000 001m	$\times 10^{-12}$

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



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



Bacterial cells are much smaller than plant and animal cells.

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 movement of substances into and out of 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		✓	
Chromosomal DNA	Loop of DNA NOT found in a nucleus			✓
Plasmid (DNA)	Small ring of DNA often used as a vector in genetic modification			✓

Questions !

Cell structure Part 1

- Eukaryotes and prokaryotes
- Animal and plant cells
- Number, size and scale



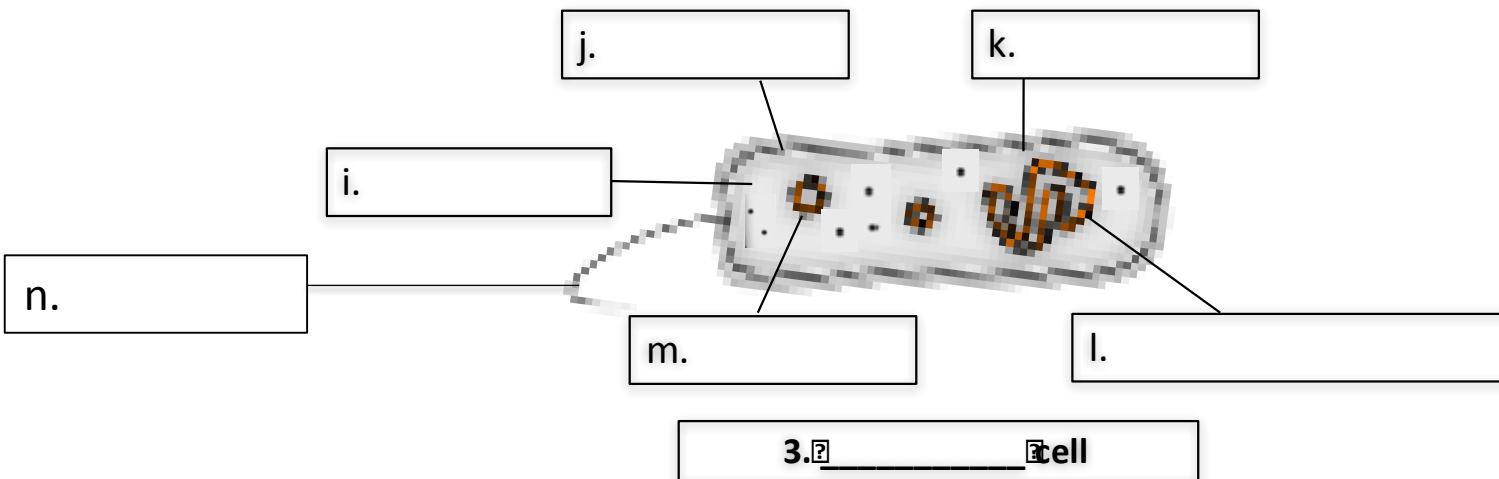
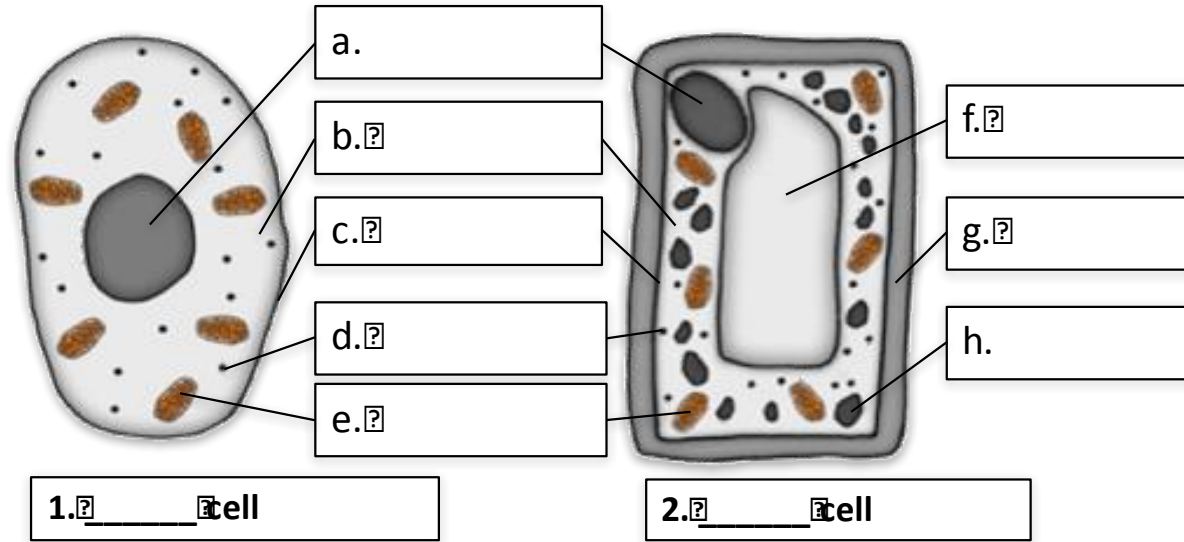
1. Where is the genetic material in a prokaryotic cell?
2. Where is the genetic material in a eukaryotic cell?
3. Copy and complete the table.

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 – Question 1

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)				

Answers !

Cell structure Part 1

- Eukaryotes and prokaryotes
- Animal and plant cells
- Number, size and scale



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.

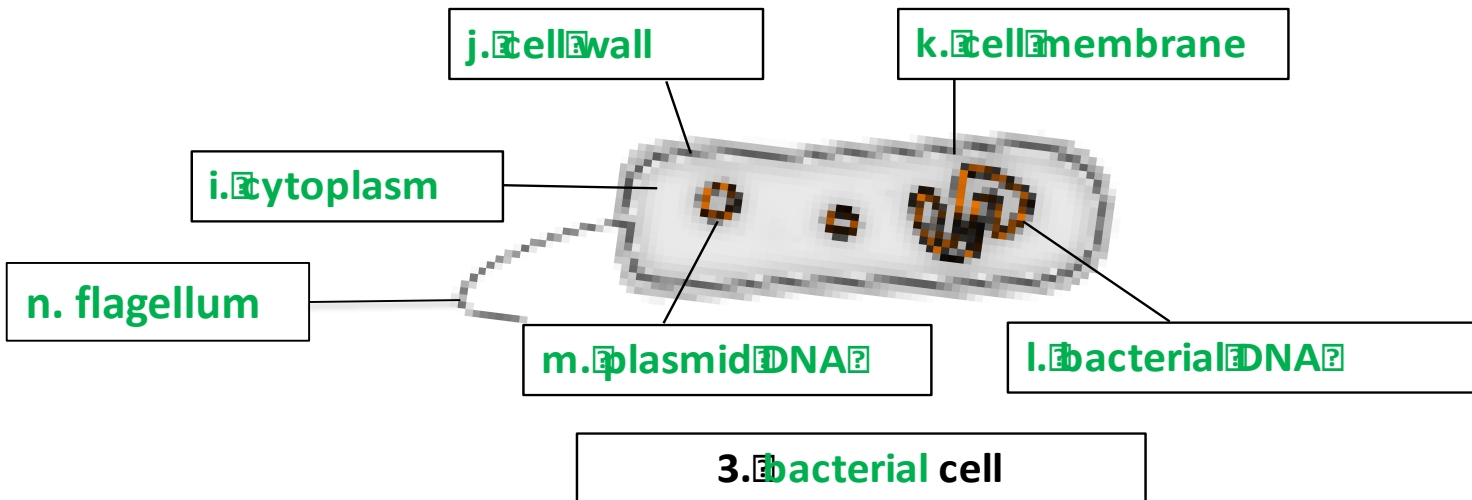
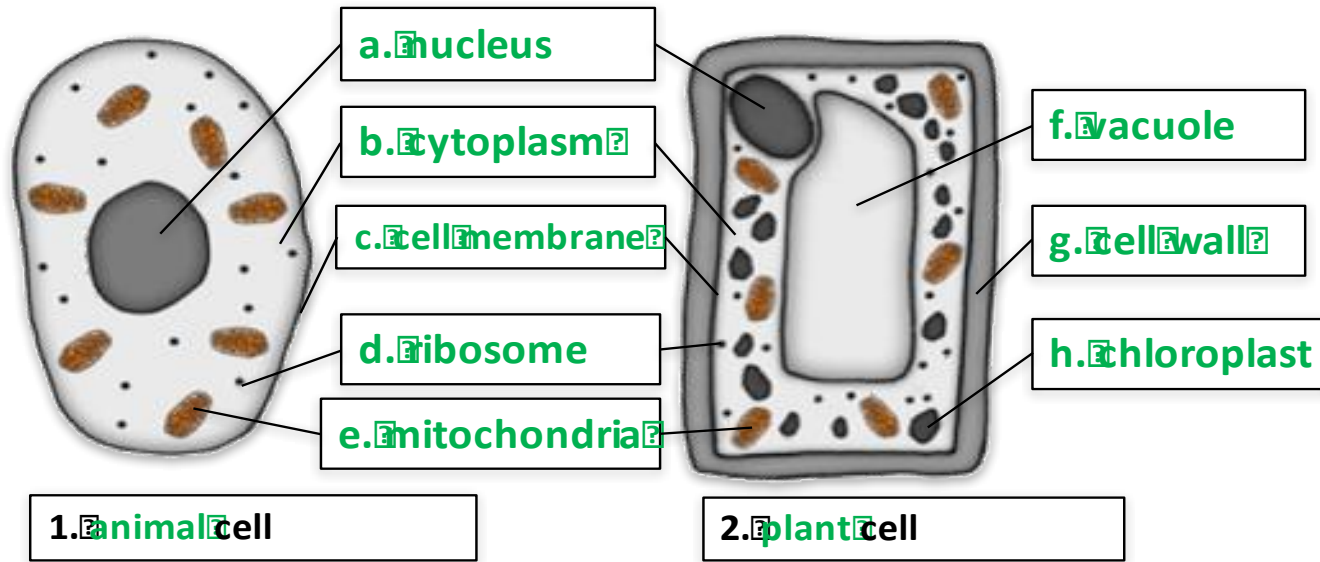
3. Copy and complete the table.

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4. Why do scientists use prefixes?

To make very small numbers more manageable

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



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

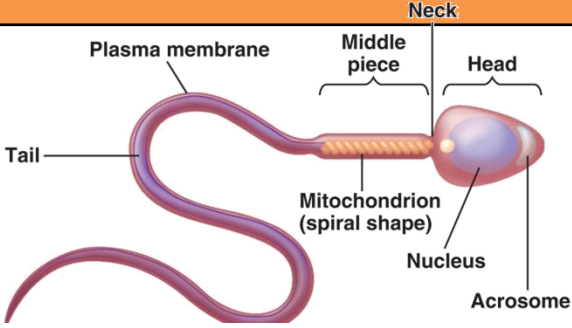
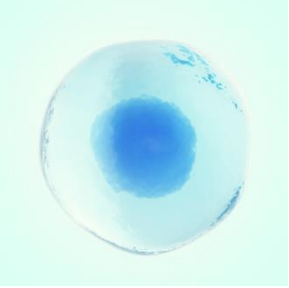
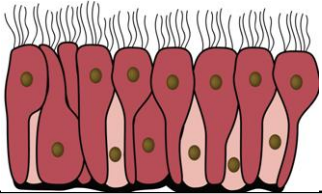
Cell part	Function	Animal	Plant	Bacteria
Nucleus	Contains genetic material which controls the activities of the cell	✓	✓	
Cytoplasm	Most chemical processes take place here, controlled by enzymes	✓	✓	✓
Cell membrane	Controls the movement of substances into and out of the cell	✓	✓	✓
Mitochondria	Most energy 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			✓

Cell structure Part 2 (1.2)

- Cell specialisation

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	Adaptation to function
<p>Sperm</p>	 <p>The diagram illustrates the structure of a sperm cell. It features a long, wavy tail at the back, followed by a middle piece containing several mitochondria in a spiral arrangement. The head at the front contains a nucleus and an acrosome. The entire cell is enclosed by a plasma membrane.</p>	<p>Function is to fertilise an egg</p> <ul style="list-style-type: none"> • 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 • Ribosomes for protein synthesis
<p>Egg</p>	 <p>The micrograph shows a single, large, spherical egg cell. It has a prominent, dark blue nucleus in the center and a lighter, translucent cytoplasm surrounding it.</p>	<p>Function is to fuse with sperm and develop into embryo</p> <ul style="list-style-type: none"> • Nutrients in the cytoplasm for respiration and cell division • Haploid nucleus • Cell membrane changes to prevent further sperm entry
<p>Ciliated epithelium</p>	 <p>The diagram shows a layer of cuboidal epithelial cells. Each cell has a large, central nucleus. On the apical surface of the cells, there are numerous fine, hair-like structures called cilia, which are used for moving substances across the surface.</p>	<p>Function is movement of substances</p> <ul style="list-style-type: none"> • Surface contains cilia (microscopic hairs) to sweep substances e.g. mucus • Large number of mitochondria to release energy

Question !

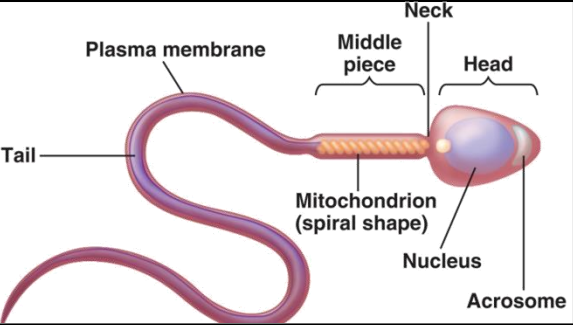
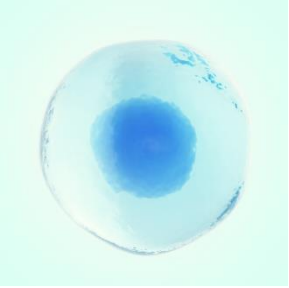
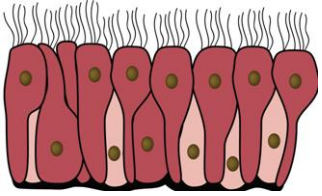
Cell structure Part 2

- Cell specialisation



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.	 <p>The diagram shows a sperm cell with a long, wavy tail. The head is at the right end, containing a nucleus and an acrosome. A neck connects the head to the middle piece, which contains a spiral-shaped mitochondrion. The plasma membrane covers the entire cell.</p>	
B.	 <p>A single, roughly spherical animal cell is shown. It has a large, dark blue nucleus in the center and a lighter blue cytoplasm. The cell membrane is visible as a thin, light blue outer layer.</p>	
C.	 <p>A row of columnar epithelial cells is shown. Each cell is taller than it is wide, with a rectangular shape. They have cilia (small hair-like structures) on their apical surface. The cells are arranged in a single layer, and their nuclei are located near the base.</p>	

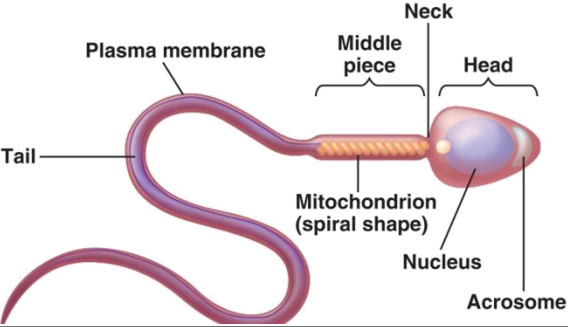
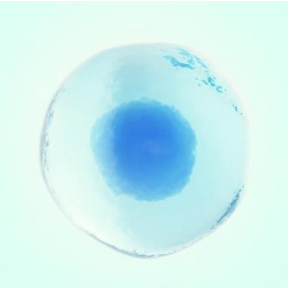
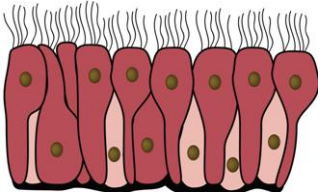
AnswerIT!

Cell structure Part 2

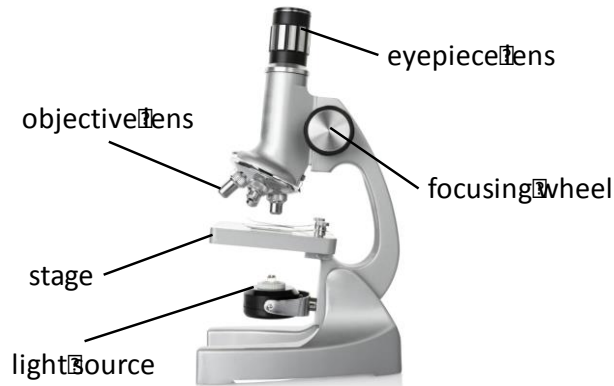
- Cell specialisation



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

Name of animal cell	Diagram	Structure and function
<p>A. Sperm</p>	 <p>The diagram illustrates the structure of a sperm cell. It is elongated and consists of several distinct regions: a long, wavy tail at the back; a middle piece containing a spiral-shaped mitochondrion; a narrow neck; and a head at the front. The head contains a large nucleus and an acrosome. The entire cell is covered by a plasma membrane.</p>	<p>Function is to fertilise an egg.</p> <ul style="list-style-type: none"> 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. Ribosomes for protein synthesis
<p>B. Egg</p>	 <p>The image shows a single, roughly spherical egg cell. It has a clear, light blue cytoplasm and a prominent, darker blue nucleus in the center. The cell membrane is visible as a thin, dark outer boundary.</p>	<p>Function is to fuse with sperm and develop into embryo.</p> <ul style="list-style-type: none"> Nutrients in the cytoplasm for respiration and cell division Haploid nucleus Cell membrane changes after fertilisation to prevent second sperm from fertilising egg
<p>C. Ciliated epithelial</p>	 <p>The diagram shows a layer of ciliated epithelial cells. Each cell is roughly rectangular and has a row of fine, hair-like cilia extending from its apical surface. Inside each cell, a nucleus is visible near the base, and numerous small, dark organelles (mitochondria) are scattered throughout the cytoplasm.</p>	<p>Function is movement of substances.</p> <ul style="list-style-type: none"> Surface contains cilia to sweep substance e.g. mucus Large number of mitochondria to release energy

Cell structure part 3- Microscopy



light microscope

First used in 1590's



electron microscope

First used in 1960's

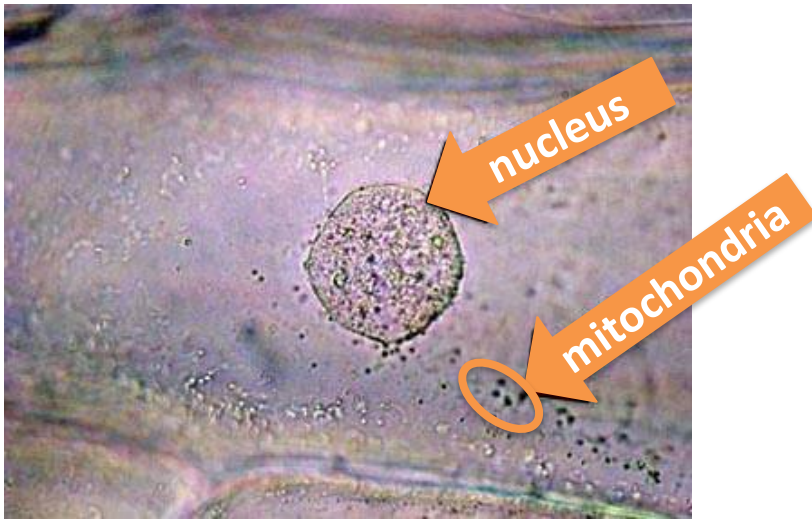
Feature	Light (optical) microscope	Electron microscope
Radiation used	Light rays	Electron beams
Max magnification	~ 1500 times	~ 2 000 000 times
Resolution	200nm	0.2nm
Size of microscope	Small and portable	Very large and not portable
Cost	~£100 for a school one	Several £100,000 to £1 million plus

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

[Video - Types of microscopes](#)

Cell structure part 3 - 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) with greater clarity.



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 part 3 - 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 microscope. Make sure the image and object size have the same units.

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.

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

$$M = \frac{6}{0.15}$$

$$M = 40$$

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

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

Cell structure part 3- 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 $30\mu\text{m}$. ← 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

$$I = 40 \times 30$$

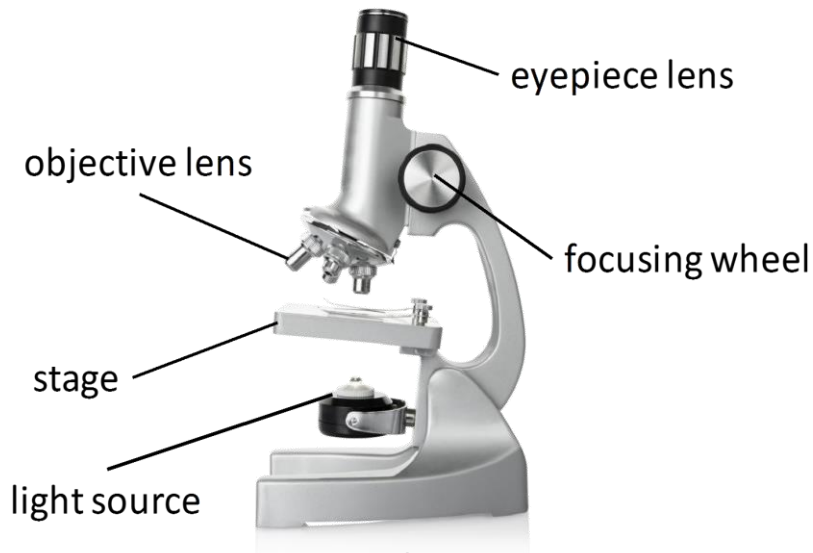
$$I = 1200 \mu\text{m}$$

$$I = 1.2\text{mm}$$

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

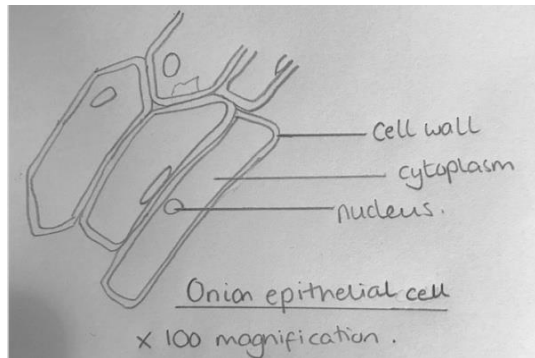
To convert to mm you need to divide by 1000

Cell structure part 3 – Microscopy



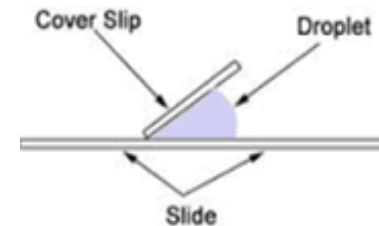
Drawing what you see

- **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.

QuestionIT!

Cell structure Part 3

- Microscopy



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 – Question 17

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 $375\mu\text{m}$.

The actual diameter of the structure is $2.5\mu\text{m}$.

Calculate how many times the structure has been magnified.

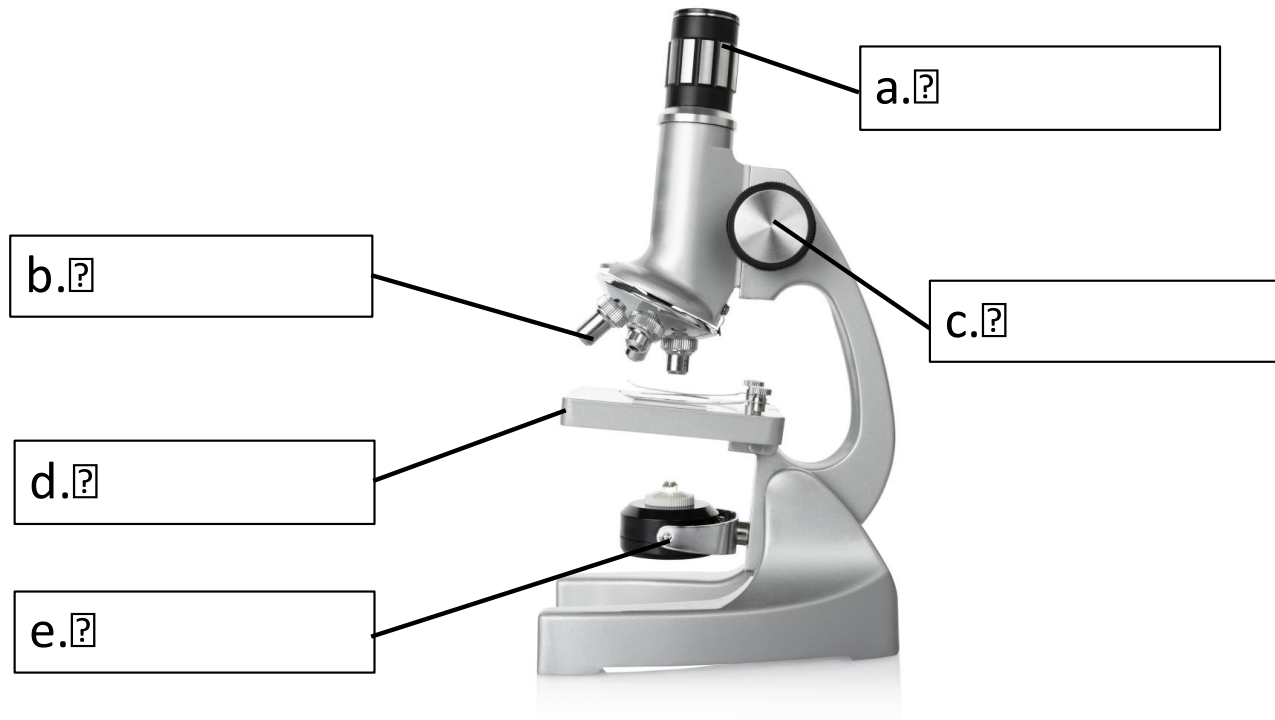
9. The actual length of a cell structure is $3\mu\text{m}$.

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?

AnswerIT!

Cell structure Part 3

- Microscopy



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 $375\mu\text{m}$.

The actual diameter of the structure is $2.5\mu\text{m}$.

Calculate how many times the structure has been magnified.

$$M = I/A$$

$$M = 375/2.5 = 150$$

$$\underline{M = 150 \text{ times}}$$

9. The actual length of a cell structure is $3\mu\text{m}$.

It is magnified 1,500 times.

Calculate the length of the magnified cell structure in mm.

$$I = M \times A$$

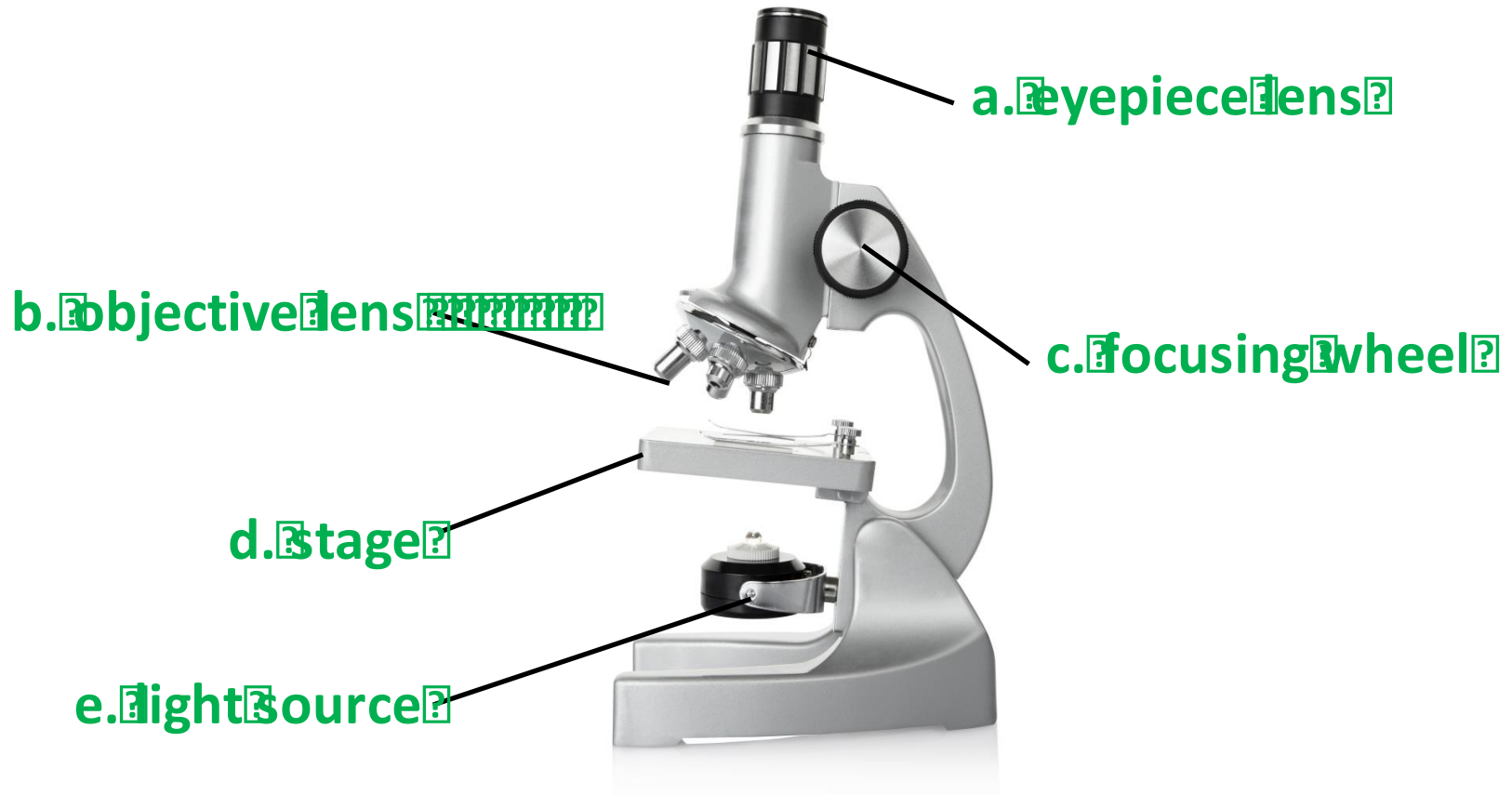
$$I = 1500 \times 3$$

$$I = 4500 \mu\text{m}$$

$$4500 / 1000 = 4.5\text{mm}$$

Cell structure part 3 – Question 10

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.

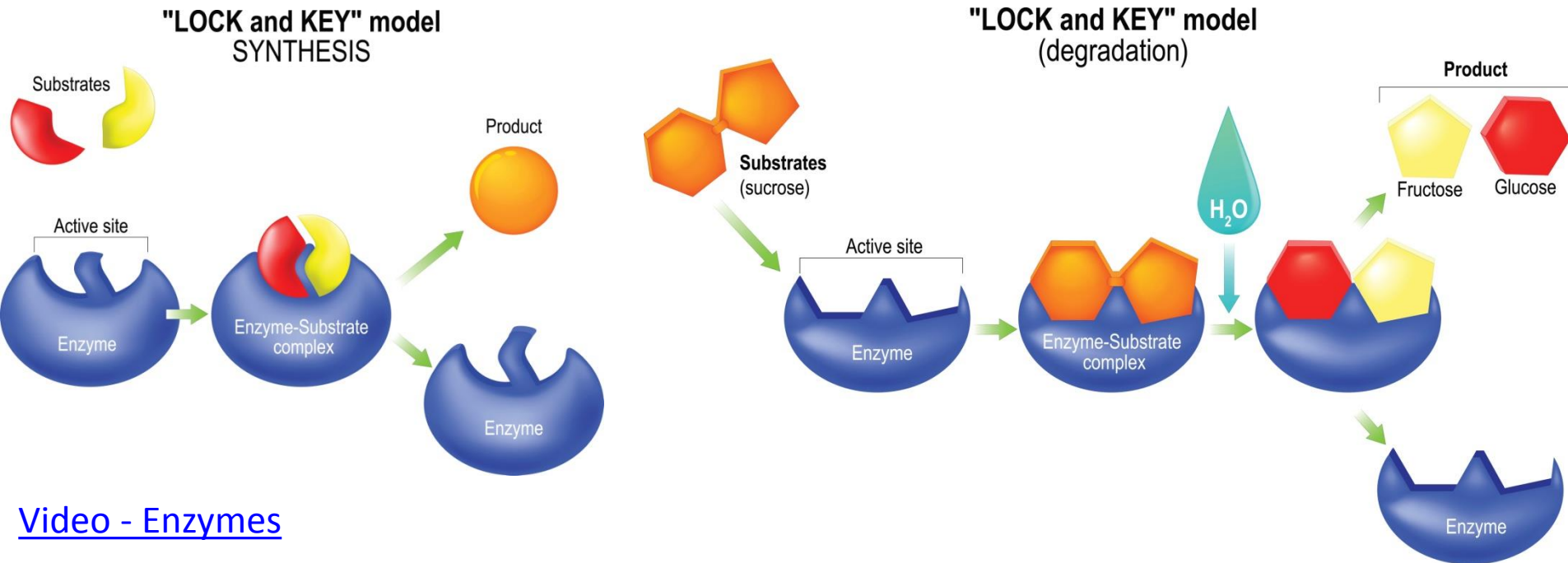
12. Describe how you would use the light microscope to view onion cells.

- 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.

Key Concepts in biology part 4- Enzymes

'**Lock and Key theory**' is a **model** to explain **enzyme action**.

Enzymes are made of **proteins** and are **biological catalysts** - substances that **increase** the rate of **chemical reactions** without being **used up**. The shape of the **active site** of the enzyme is specific for each substrate (substance the enzyme acts on).



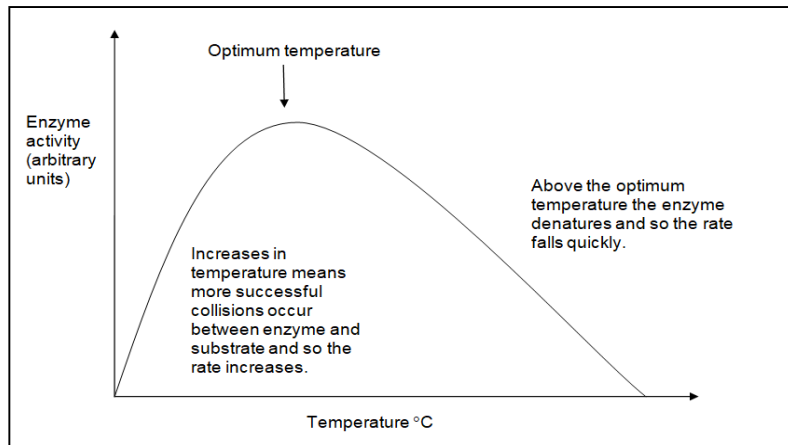
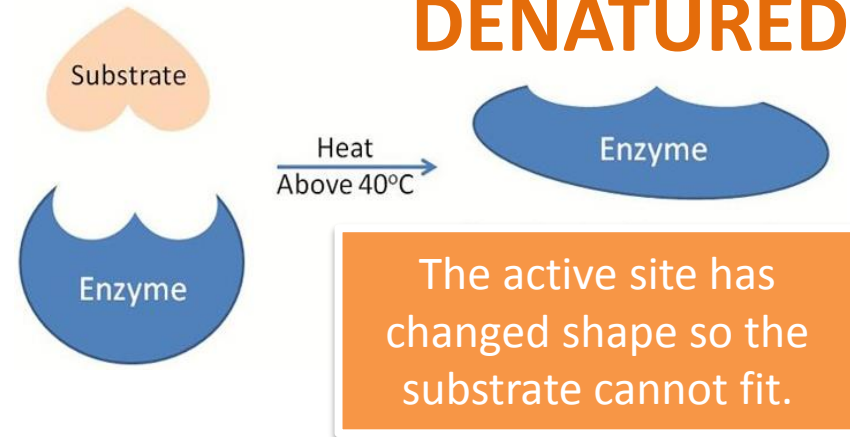
[Video - Enzymes](#)

The **products** of digestion are used to **build** new **carbohydrates**, **lipids** and **proteins** in the body. Some **glucose** is used in **respiration**.

Key Concepts in biology part 4- Enzymes

Enzyme activity is affected by **temperature** and by **pH**. Specific conditions are needed to keep enzymes working at their best. **OPTIMUM CONDITIONS!** Enzymes **control** the chemical reactions in the body, this is known as **metabolism**.

In enzyme reactions, **increasing the temperature** will initially increase the **rate of reaction** due to increased **collisions** between the enzyme and substrates. **BUT** if the **temperature is too high** the **enzyme will denature** (NB: denature, NOT die/killed) because some of the bonds in the protein break so changing its shape.

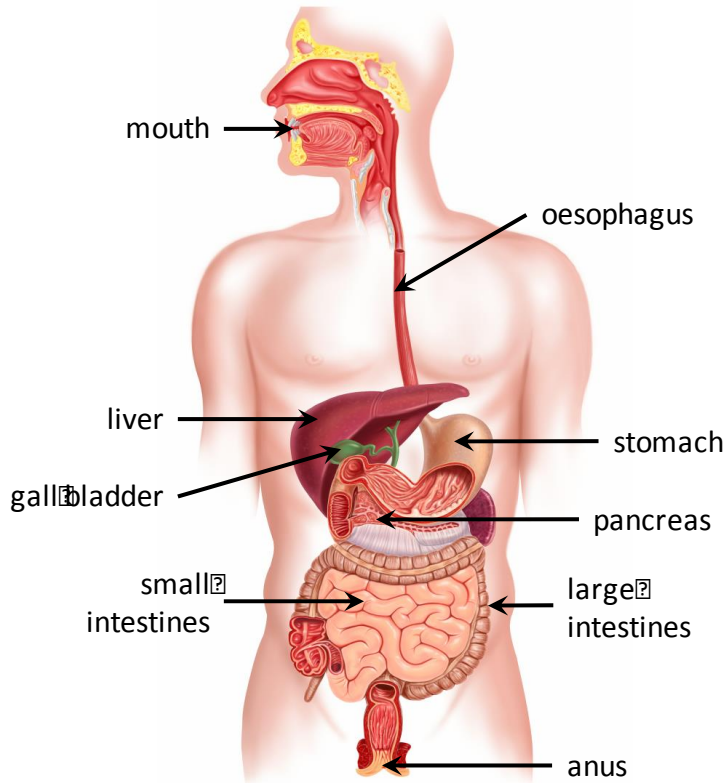


If the temperature is too low then enzymes do not work effectively. If the metabolic rate of an organism falls too low then the organism may die. The enzymes become inactive but they are not killed.



Key Concepts in biology part 4- Enzymes

The **digestive system** is an example of an **organ system** where **different** organs **work together** to digest and absorb food.



[Video - Digestion and Enzymes](#)

Digestion is where **large insoluble molecules** are **broken down** into **smaller soluble ones that can be absorbed into the bloodstream.**

Digestion occurs in the **GUT** (tube from the mouth to the anus) and it relies on **ENZYMES** (biological catalysts).

[Activity - Digestive Enzymes](#)

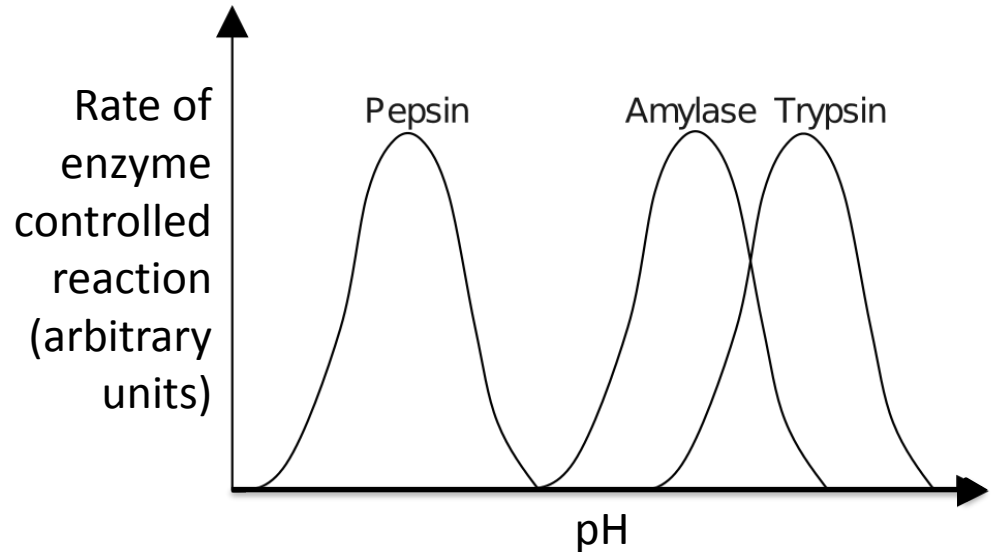
Digestive Enzyme	Where released?	Breakdown what?
Carbohydrase (amylase)	Salivary glands and pancreas	Carbohydrates into simple sugars (maltose)
Protease	Stomach and pancreas	Proteins into amino acids
Lipase	Pancreas	Fats and oils (lipids) into fatty acids and glycerol

[PiXL - Required Practical Guide Food Tests](#)

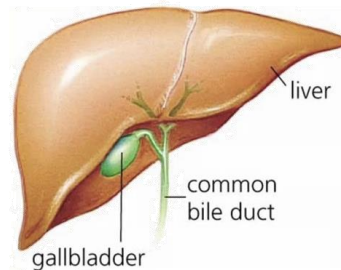
Key Concepts in biology part 4- Enzymes

Digestion and pH. The **stomach** releases acid. The enzymes made in the **stomach** work best in **acidic** conditions. The **enzymes** made in the **pancreas** and small **intestine** work best in **alkaline** conditions.

Bile is **made** in the **liver** and **stored** in the **gall bladder**. It is alkaline to **neutralise** hydrochloric **acid** from the **stomach**. It also **emulsifies fat** to form small droplets which **increases** the **surface area**. The alkaline conditions and large surface area **increase the rate of fat breakdown** by lipase.



This sketch graph shows that different enzymes have a different optimum pH.



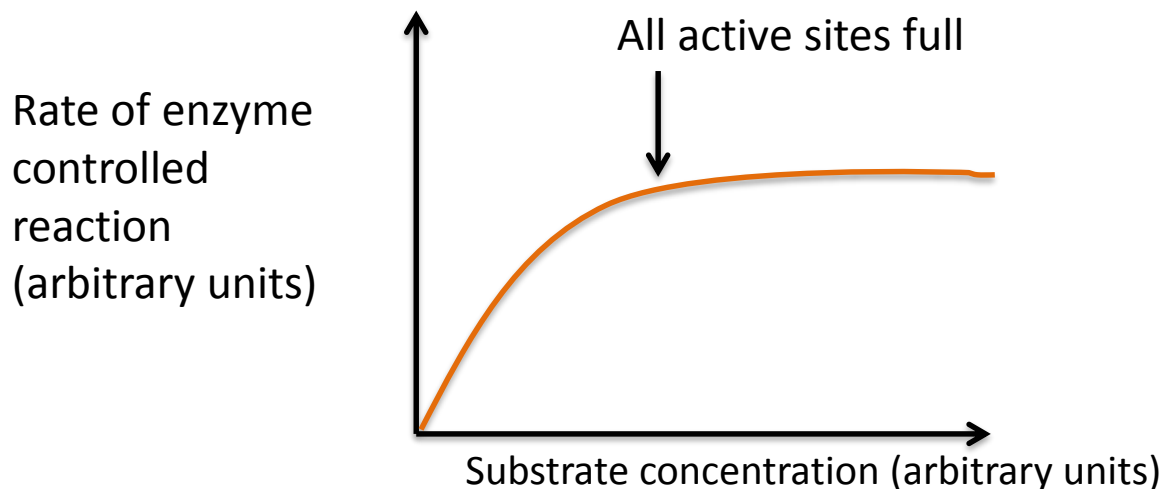
Substrate concentration will affect the rate of enzyme activity. The higher the amount of substrate present, the faster the reaction will occur until all active sites are full and vice versa.

Key Concepts in biology part 4- Enzymes

Substrate concentration will affect the **rate** of enzyme activity.

The **higher** the **amount of substrate** present the **faster** the **reaction** will occur **until** **all active sites are full**.

Once all the active sites are full the reaction cannot proceed any faster.



Practical procedure: Amylase and pH



Video 1

Video 2

Amylase is an enzyme which breaks down starch into maltose.
Starch can be detected using iodine solution.
If starch is present, the iodine solution turns from a browny red colour to a blue black colour.

Key Concepts in biology part 4- Enzymes

Rate is a measurement of how something **changes over a period of time**.

We can calculate the rate of reaction for an enzyme experiment using the formula:

$$\frac{1}{\text{time}}$$

The units are s^{-1} .

Buffer pH	Time taken for amylase to break down starch (s)	Rate of reaction $\frac{1}{\text{time}}$ (s^{-1})
9	180	$1 \div 180 = 0.006$
7	90	$1 \div 90 = 0.011$
4	150	$1 \div 150 = 0.007$
1	210	$1 \div 210 = 0.005$

Practical procedure: Food tests (biology)



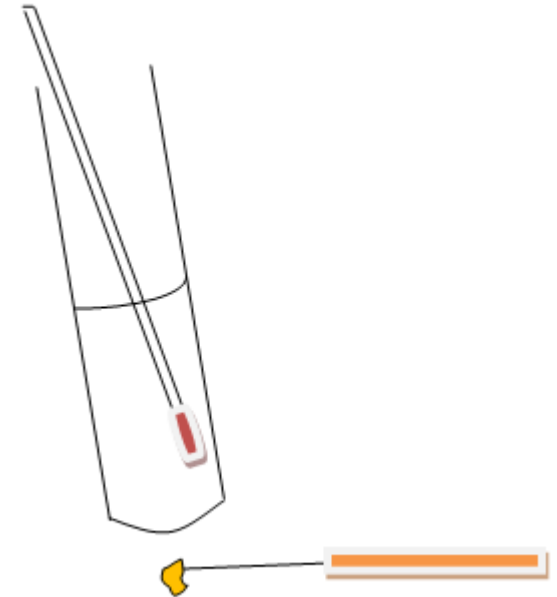
Video 1

Video 2

Key Concepts in biology part 4- Food calorimetry (biology)

Food **calorimetry** can be used to see how much energy certain foods contain.

1. Weigh a small amount of the food and place on the mounted needle.
2. Measure out 25cm³ of water and place it in a boiling tube.
3. Measure the temperature of the water.
4. Set the food alight using a Bunsen burner.
5. Hold the burning food under the water until it goes out.
6. Try to relight the food and hold it under the water.
7. Measure the final temperature of the water.



Calculate how many joules of energy the food contained:

$$\text{Energy in food (J)} = \text{Mass of water (g)} \times \text{temperature change of water (}^{\circ}\text{C)} \times 4.2$$

1 g of water is the same as 1 cm³ of water.

In order to compare the energy values of different food you must calculate how many joules are in each gram of food.

$$\text{Energy per gram of food} = \text{energy in food (J)} \div \text{mass of food (g)}$$

QuestionIT!

Key concepts in biology
Part 4 (1.7-1.14B)

- Enzymes
- Food tests (biology)
- Food calorimetry (biology)



Key concepts in biology part 4 – QuestionIT

1. What is digestion?
2. What is an enzyme?
3. Complete the table below:

Digestive Enzyme	Where released?	Breakdown what?
Amylase		
Protease		
Lipase		

4. What biological molecule are enzymes made of?
5. What is the active site of an enzyme?
6. What is a substrate?

Key concepts in biology part 4 – QuestionIT

7. What are the products of digestion used for in the body?
8. What does denatured mean?
9. How does increasing the temperature affect enzyme activity?
10. How does pH affect enzyme activity?
11. What is the role of bile in digestion?
12. Enzymes are also required to catalyse the synthesis of larger molecules.

Complete the table to show what complex molecules are being made:

Monomers	Polymers synthesised with the aid of enzymes.
Amino acids	
Fatty acids and glycerol	
Glucose	

Biology Only

13. What reagent is used to identify the presence of starch?
14. Which reagent is used to identify the presence of a reducing sugar?
15. Which test is used to identify if protein is present?
16. Which flammable reagent is used in the emulsion test for lipids?
17. List the equipment needed to find out how much energy is in 1g of peanuts.

AnswerIT!

Key concepts in biology
Part 4 (1.7-1.14B)

Enzymes

Food tests (biology)

Food calorimetry (biology)



Key concepts in biology part 4 – AnswerIT

1. What is digestion? **Large insoluble molecules are broken down into smaller soluble ones.**
2. What is an enzyme? **A biological catalyst – they speed up the rate of reaction without being used up.**
3. Complete the table below:

Digestive Enzyme	Where released?	Breakdown what?
Amylase	Salivary glands and pancreas	Carbohydrates into simple sugars
Protease	Stomach and pancreas	Proteins into amino acids
Lipase	Pancreas	Fats and oils (lipids) into fatty acids and glycerol

4. What biological molecule are enzymes made of? **Proteins.**
5. What is the active site of an enzyme? **It is where the substrate binds.**
6. What is a substrate? **Substance (chemical) that the enzyme acts on.**

Key Concepts in biology Part 4 – AnswerIT

7. What are the products of digestion used for in the body? **They are used to synthesize carbohydrates, lipids and proteins in the body. Glucose is used in respiration.**
8. What does denatured mean? **That the active site of the enzyme has changed shape so the substrate cannot fit.**
9. How does increasing the temperature affect enzyme activity? **Initially it increases the rate of reaction due to increased collisions between the enzyme and substrates, but if the temperature is too high the enzyme will denature.**
10. How does pH affect enzyme activity? **Enzymes have optimum pH conditions, if these are too alkaline or acidic the enzyme denatures.**
11. What is the role of bile in digestion? **It neutralises stomach (hydrochloric) acid and emulsifies fats.**

Key Concepts in biology Part 4 – AnswerIT

12. Enzymes are also required to catalyse the synthesis of larger molecules.
Complete the table to show what complex molecules are being made:

Monomers	Polymers synthesised with the aid of enzymes.
Amino acids	Proteins
Fatty acids and glycerol	Lipids (Fats)
Glucose	Carbohydrates (Starch)

Biology Only

13. What reagent is used to identify the presence of starch? **Iodine solution**
14. Which reagent is used to identify the presence of a reducing sugar? **Benedict's solution**
15. Which test is used to identify if protein is present? **Biuret**
16. Which flammable reagent is used in the emulsion test for lipids? **Ethanol**
17. List the equipment needed to find out how much energy is in 1g of peanuts. **Balance, boiling tube, measuring cylinder, mounted needle, Bunsen burner, mat, clamp stand and clamp, thermometer, safety glasses.**

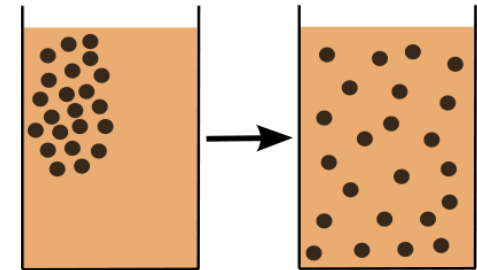
Key concepts in biology part 5 - Diffusion

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**.

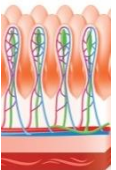
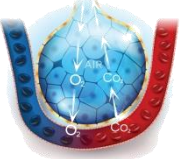
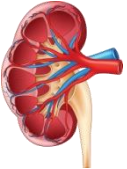
Diffusion can occur in: Air – smells from perfume etc.

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

Key concepts in biology part 5 - Diffusion

Factors which affect the rate of diffusion.

The concentration gradient:

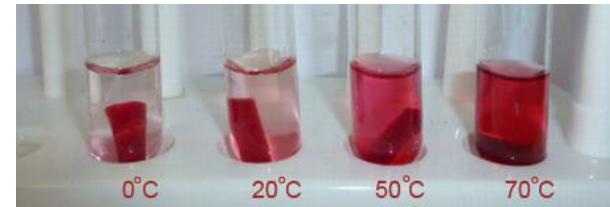
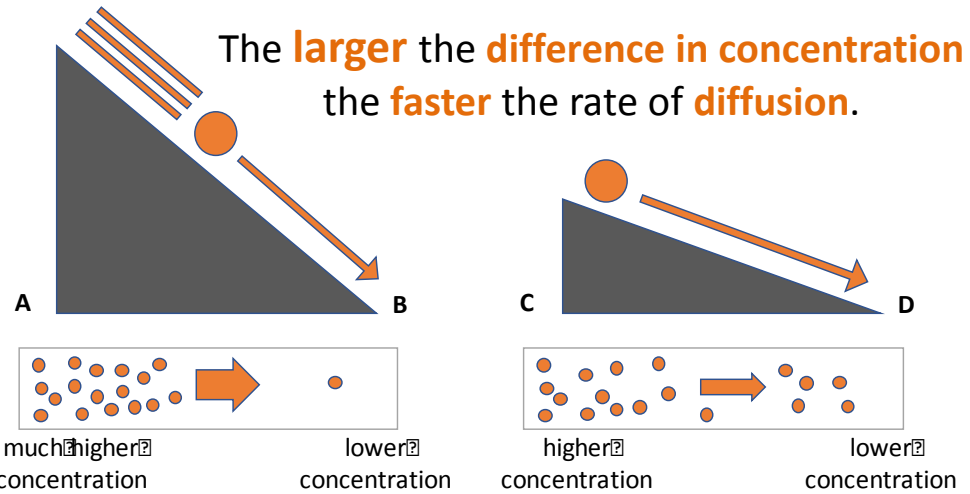
A **difference** in **concentration** between two **areas next** to each other. Particles will move **down** the concentration gradient from **high to low**.

The temperature:

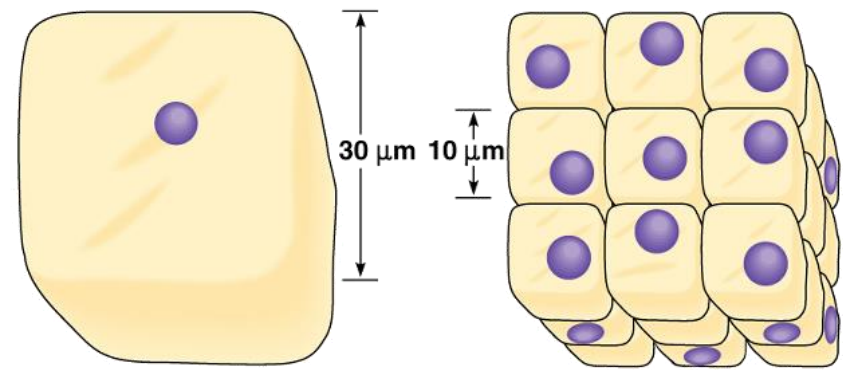
As the **temperature** increases, the particles in a gas or liquid gain **more energy** so they move **faster**. The **hotter** it is the **faster** the rate of diffusion.

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.



Beetroot in different temperatures of water

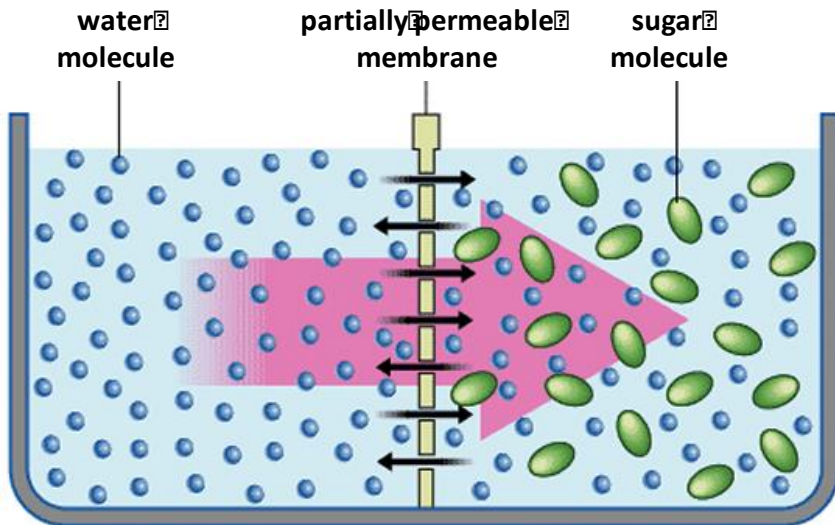


Surface area of one large cube = $5400 \mu\text{m}^2$

Total surface area of 27 small cubes = $16,200 \mu\text{m}^2$

Key concepts in biology part 5 - Osmosis

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



water moves from the dilute side to the more concentrated side

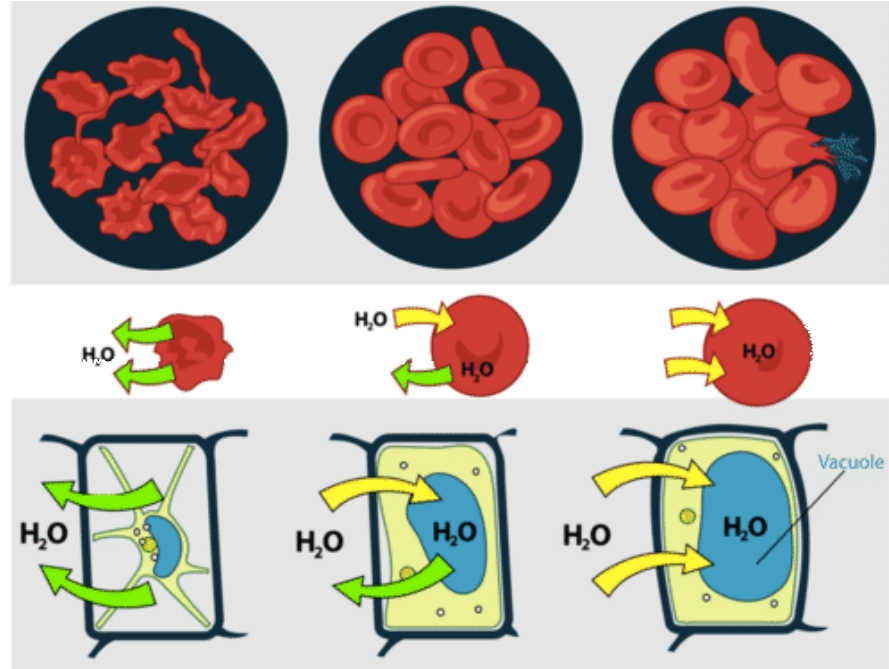
The **rate of osmosis** changes depending on the **concentration gradient** and **temperature**.

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

Osmosis in plant and animal cells:

hypertonic  isotonic

hypotonic



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.

Practical procedure: Osmosis in potato



Video 1

Video 2

Osmosis results:

Work out the percentage change in mass for each chip. This means you can compare the effect of the sucrose concentrations on potato chips which did not have the same initial mass.

To calculate percentage change use the formula:

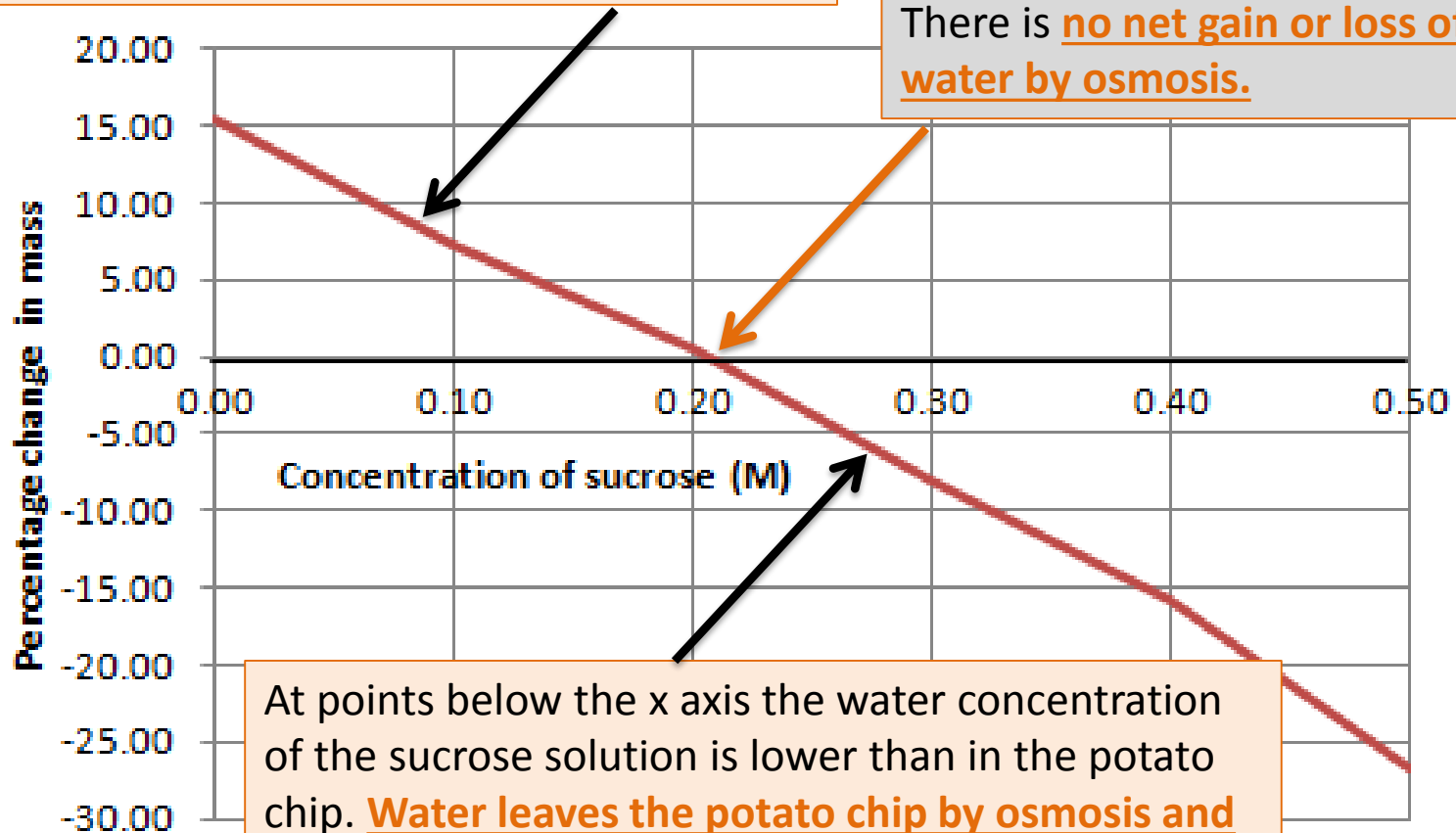
$$\frac{\text{final mass} - \text{initial mass}}{\text{initial mass}} \times 100$$

Concentration of sucrose solution (M)	Initial mass of potato chip (g) A	Final mass of potato chip (g) B	Percentage change in mass (g) $\frac{B - A}{A} \times 100$	Negative numbers mean the potato chip has lost mass.
0.0	1.82	2.10	15.38	
0.1	1.79	1.92	7.26	
0.2	1.78	1.79	0.56	
0.3	1.88	1.73	-7.98	
0.4	1.70	1.43	-15.88	
0.5	1.98	1.45	-26.77	

Transport in cells – Question 1T

At points above the x axis the water concentration of the sucrose solution is higher than in the potato chip. Water enters the potato chip by osmosis and it gains mass.

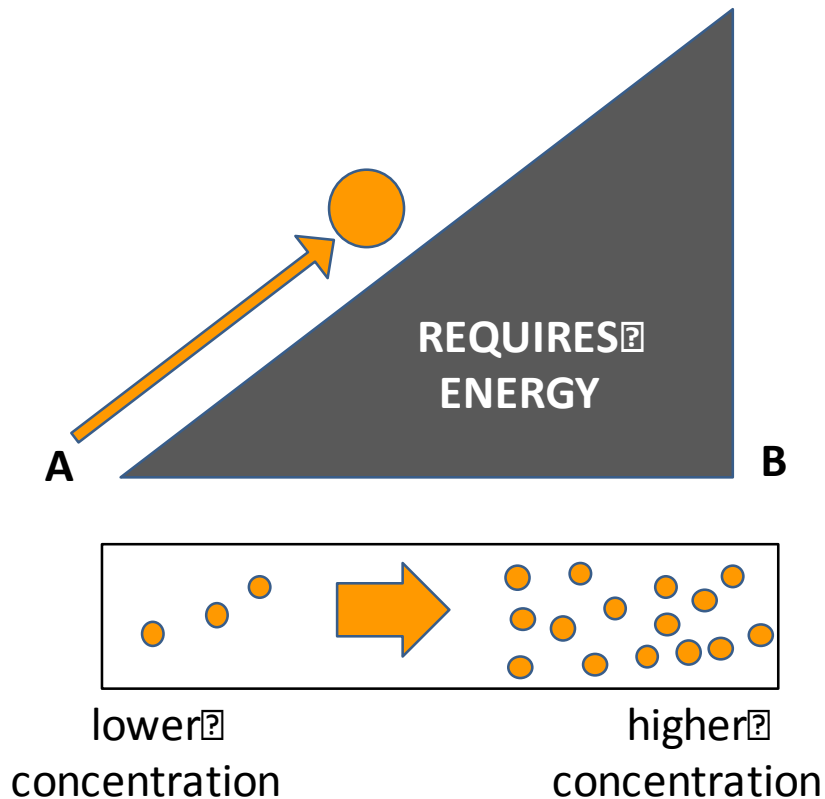
At the point when the line crosses the x axis the sucrose solution and the fluid in the potato chip have the **same** concentration (**isotonic**). There is no net gain or loss of water by osmosis.



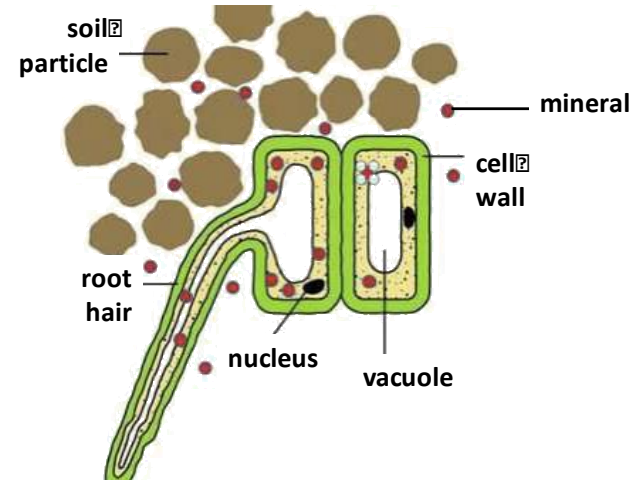
At points below the x axis the water concentration of the sucrose solution is lower than in the potato chip. Water leaves the potato chip by osmosis and it loses mass.

Key concepts in biology part 5 – 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 part 5 – QuestionIT

1. Define 'diffusion'.
2. State two places where diffusion occurs in the body.
3. What is a concentration gradient?
4. What three factors affect the concentration gradient?
5. Define 'osmosis'.
6. What is a 'partially permeable membrane'?
7. What happens to an animal cell in a hypertonic solution?
8. What happens to an animal cell in a hypotonic solution?
9. Define 'active transport'.
10. Why does active transport need to occur in root hair cells?
11. Why is percentage change in mass calculated for osmosis results?

AnswerIT!

Transport in cells

- Diffusion
- Osmosis
- Active transport



Transport in cells part 5 – AnswerIT

1. Define 'diffusion'?

The spreading of 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.**

Transport in cells part 5 – AnswerIT

5. Define osmosis? **Osmosis is the diffusion of water from a dilute solution to a concentrated solution through a partially permeable membrane.**
6. What is a partially permeable membrane? **A membrane that lets some but not all substances through.**
7. What happens to an animal cell in a hypertonic solution? **It will lose water by osmosis and shrivel.**
8. What happens to an animal cell in a hypotonic solution? **It will absorb water by osmosis and get bigger/burst.**
9. 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.**
10. 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.**
11. Why is percentage change in mass calculated for osmosis results? **So that the effect of different sucrose concentrations can be compared for potato chips which did not have the same initial mass.**