

## CB1a Microscopes

What is the most common microscope used today?  
The most common light microscope used today contains 2 lenses and was invented at the end of the sixteenth century. Robert Hook used a microscope like this to discover cells in 1665.

What magnification did Hook's microscope have?  
Hook's microscope had a magnification of about x30 (it made things appear about 30 times bigger).

What does the detail obtained by a microscope depend on?  
The detail obtained by a microscope depends on its resolution. This is the smallest distance between 2 points that can still be seen as 2 points. Van Leeuwenhoek's best microscopes had a resolution of 0.0014 millimetres.

What is an electron microscope?  
Instead of light, beams of electrons pass through a specimen to build up an image. These microscopes can magnify up to x2,000,000 with resolutions down to 0.000002 millimetres. They allow us to see cells with much greater detail and clarity than a normal light microscope.

# CB1 - Key Concepts in Biology (Paper 1 and 2)

## CB1f Enzyme Action

What is an enzyme made from?  
An enzyme is a 3D protein molecule formed from a chain of amino acids. The 3D contains a small pocket called the active site.

What is an active site?  
An active site is where the substrate of the enzyme fits at the start of a reaction. Different substrates have 3D shapes, and different enzymes have active sites of different shapes. This explains why every enzyme can only work with specific substrates that fit the active site. E.g. each key only fits 1 specific lock.

How can enzymes be affected?  
Changes in pH or temperature can affect how the protein folds up and so can affect the shape of the active site. If the shape of the active site changes too much the substrate will no longer fit neatly in. We say that the enzymes has been denatured (key no longer fits in the lock).

## CB1e Enzymes and Nutrition

Why do bacteria release digestive enzymes?  
They release digestive enzymes into their environment and then absorb digested food into their cells.

How do digestive enzymes in humans work?  
Digestive enzymes turn the large molecules in our food into the smaller sub-units they are made of. The digested products are then small enough to be absorbed by the small intestine.

What are proteins broken down into?  
Protein molecules are broken down into amino acids.

What are starch molecules broken down into?  
Starch molecules are broken down into glucose molecules.

What are lipid (oil and fat) molecules broken down into?  
Lipids are broken down into fatty acids and glycerol.

How do living plants and animals use enzymes to speed up reactions?  
Enzymes are biological catalysts that increase the rate of reactions. Enzymes are a special group of proteins found throughout the body.

What does amylase do?  
It is found in the saliva and small intestine and breaks down starch to small sugars. E.g. maltose and glucose.

What does catalase do?  
Found most cells and especially in liver cells and breaks down hydrogen peroxide.

What does starch synthase do?  
It is found in plant cells and makes starch from glucose.

What is DNA polymerase?  
It is found in the nucleus and joins DNA strands from its monomers (building blocks).

## CB1c Specialised Cells

What is a specialised cell?  
A specialised cell has a specific function. There are about 200 specialised cells in humans. Specialised cells are adapted to their functions. E.g. nerve, small intestine, pancreas, gametes, epithelial cells.

How are cells specialised for digestion?  
The cells that line the small intestine absorb small food molecules produced by digestion. They are adapted by having membranes with many tiny folds. These adaptations increase the surface area of the cell for faster absorption of digested food.

Where does fertilisation occur?  
Fertilisation occurs in the oviduct. The cells in the lining of the oviduct transport egg cells towards the uterus. The oviduct cells are adapted for this function by having hair like cilia. These wave from side to side sweeping the egg along.

How is a human egg cell specialised?  
The cell membrane fuses with the sperm cell membrane. After fertilisation the cell membrane and jelly coat become hard to stop other sperm cells entering. The cytoplasm is packed with nutrients to supply the fertilised egg with energy and raw materials.

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The jelly coat protects the egg cell. It also hardens after fertilisation, to ensure that only one sperm cell enters the egg cell.

The cytoplasm is packed with nutrients, to supply the fertilised egg cell with energy and raw materials for the growth and development of the embryo.

haploid nucleus



How are sperm cells specialised for reproduction?

streamlined shape

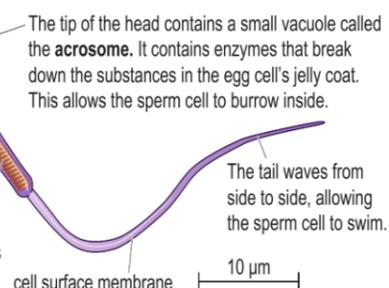
The tip of the head contains a small vacuole called the **acrosome**. It contains enzymes that break down the substances in the egg cell's jelly coat. This allows the sperm cell to burrow inside.

nucleus

A large number of mitochondria are arranged in a spiral around the top of the tail, to release lots of energy to power the tail.

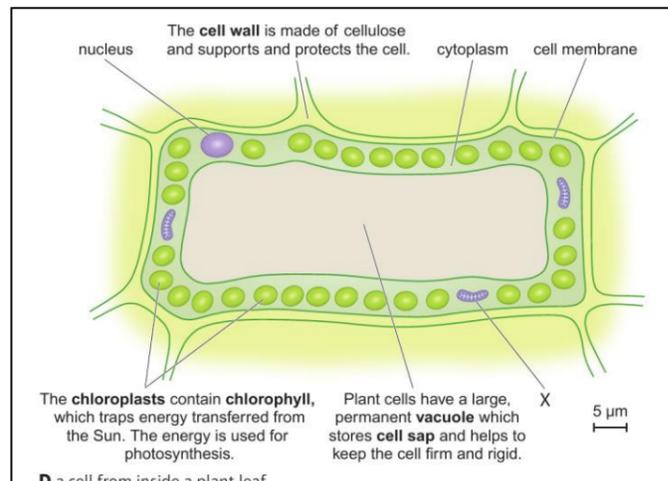
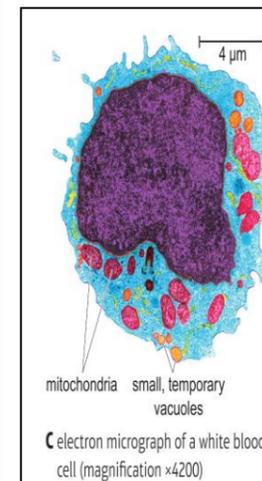
The tail waves from side to side, allowing the sperm cell to swim.

cell surface membrane



## CB1b Plant and Animal Cells

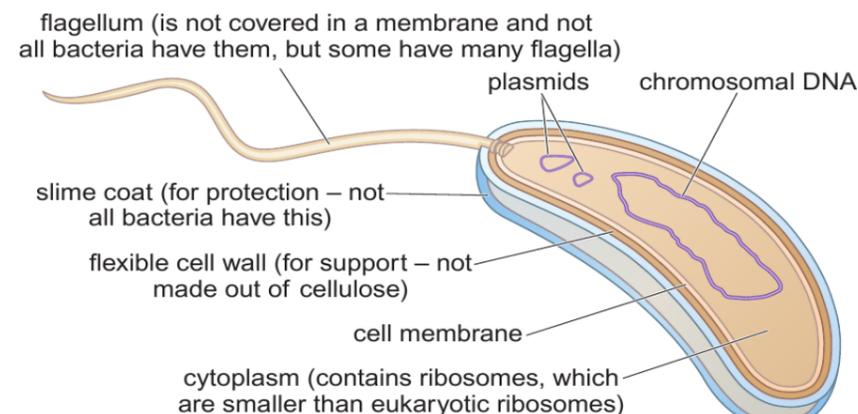
What is an organelle?  
An organelle is a structure inside a cell with a specific function.



## CB1d Inside Bacteria

Why are bacteria difficult to see?  
Bacteria are difficult to see with light microscopes because they are very small and mostly colourless.

Explain the structure of a bacteria.  
Bacteria are prokaryotic, which mean that their cells do not have nuclei or chromosomes or mitochondria or chloroplasts. Instead the cytoplasm contains 1 large loop of chromosomal DNA, which controls most of the cells activities. Smaller loops of DNA are called plasmids. They have a cell wall and a cell membrane.



D Different bacteria are different shapes and sizes but usually have these parts.

## CB1g Enzyme Activity

How are enzymes affected by temperature?  
As the temperature increase, molecules move faster. Higher speeds increase the chance of substrate molecules bumping into enzyme molecules. However when the temperature gets too high, the shape of the enzyme molecule starts to change. The temperature which the enzyme works fastest is called its optimum temperature.

How does pH affect enzymes?  
At pHs below and above the optimum the active site's shape is altered and so the enzymes does not work so well.

What is the optimal temperature of most human enzymes?  
The optimum temperature is around 37°C.

## CB1h Transporting Substances

What is active transport?  
Cells may need to transport molecules against a concentration gradient or transport molecules that are too big to diffuse through the cell membrane. They can do this using active transport. This process is carried out by transport proteins in the cell membrane. The transport proteins capture certain molecules and carry them across the cell membrane. This is an active process and so requires energy.

What is osmosis?  
If there are more water molecules in a certain volume on one side of a membrane than the other, there will be an overall movement of water molecules from the side where there are more water molecules. This diffusion of small molecules of a solvent through a semi permeable membrane is called osmosis.

What is diffusion?  
Diffusion is the movement of gas and liquid particles from a high concentration to a low concentration. A difference between 2 concentrations forms a concentration gradient. The bigger the difference between concentrations, the steeper the concentration gradient and the faster diffusion occurs.

How do small molecules move into and out of cells?  
Small molecules such as oxygen and carbon dioxide move into out of cells by diffusion.

What are passive processes?  
Osmosis and diffusion are passive processes so do not require an input of energy.

## Key Vocabulary Definitions

Adaptations – the features of an organism that enable it to do a certain function (job).

Biological catalyst – a substance found in living organisms that speeds up reactions (an enzyme).

Ciliated epithelial cells – a cell that lines certain tubes in the body and has cilia on its surface.

Cilium – a small hair like structure on the surface of some cells. Plural is cilia.

Concentration Gradient – the difference between 2 concentrations.

Denatured – a denatured enzyme is one where the shape of the active site has changed so much that its substrate no longer fits and the reaction can no longer happen.

DNA – deoxyribonucleic acid. A polymer made of sugar and phosphate groups joined to bases.

Epithelial cells – a cell found on the surfaces of parts of the body.

Eukaryotic – a cell with a nucleus is eukaryotic.

Eye piece lens – organisms that have cells like this are also said to be eukaryotic organisms.

Field of view – the circle of light you see looking down a microscope.

Gametes – a haploid cell produced by meiosis used for sexual reproduction.

Haploid – a cell or nucleus that has 1 set of chromosomes. Gametes are haploid.

Magnification – the number of times larger an image is than the initial object that produced it.

Objective lens – the part of the microscope that is closest to the specimen.

Partially Permeable membrane – describes a membrane that will allow certain particles to pass through it but not others. Another term for this is semi permeable.

Product – a substance formed in a reaction.

Prokaryotic – a cell with no nucleus is prokaryotic. Organisms such as bacteria are said to be prokaryotic.

Resolution – the smallest change that can be measured by an instrument. For example, in a microscope it is the smallest distance between 2 points that can be seen as 2 points and not blurred into 1 point.

Scale bars – a line drawn on a magnified image that shows a certain distance at that magnification.

Specialised cells – a cell that is adapted for a certain specific function (job).

Substrate – a substance that is changed during a reaction.

Synthesis – to build a large molecule from smaller sub units.

## Calculations

To work out a microscope's magnification, you multiply the magnifications of its 2 lenses together. So, the magnification of a microscope with a x5 eye piece lens and a x10 objective lens is  $5 \times 10 = \times 50$ .

To calculate mass change work out the difference between the mass of tissue at the start and at the end (final mass – initial mass) divide this difference by the initial mass and multiply by 100.

Percentage change in mass =  $(\text{Final mass} - \text{initial mass}) \div \text{initial mass} \times 100$

A negative answer is a percentage loss in mass.