CHURCH STRETTON SCHOOL

Triple Science - Biology

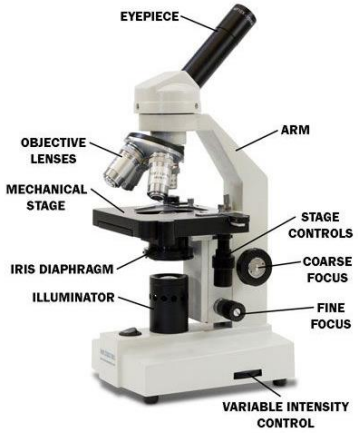
SB1 Knowledge organiser

B1: Biology key concepts

Lesson sequence

1. Microscopes
2. Plant and animal cells
3. Measuring cells
4. Core practical: using microscopes
5. Specialised cells
6. Inside Bacteria
7. Enzymes and Nutrition (Digestive enzymes)
8. Core practical: testing Foods
9. How enzymes work
10. Factors affecting enzymes
11. Core practical: enzymes and pH
12. Transporting Substances
13. Core practical: osmosis in potatoes

1. Microscopes	
Magnification	The number of times bigger something appears under a microscope.
Eyepiece lens	The lens on a microscope that you look through.
Objective lens	The lens at the bottom of a microscope. There are normally three you can choose from.
Total magnification	Eyepiece lens x objective lens.
Resolution	The smallest distance between two points so that they can still be seen as two separate points.
Stains	Dyes added to microscope slides to show the details more clearly.
Milli	Thousandth, $1x10^{-3}$ (a millimetre is a thousandth of a metre).
Micro	Millionth, $1x10^{-6}$ (a micrometre is a millionth of a metre).

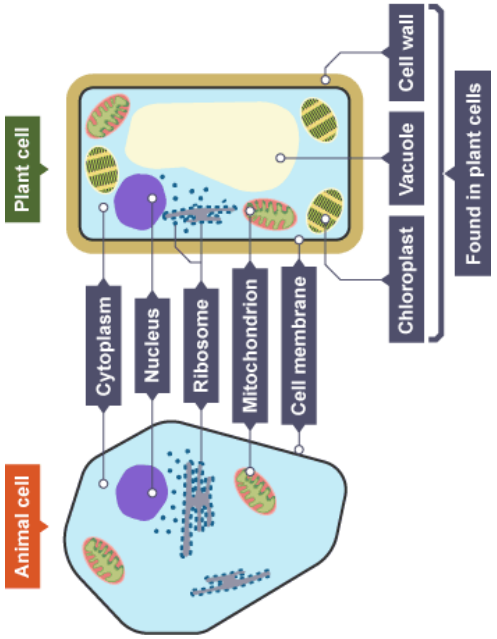


Nano	Billionth, $1x10^{-9}$ (a nanometre is a billionth of a metre).
Pico	Trillionth, $1x10^{-12}$ (a picometre is a trillionth of a metre).

Prefix	Effect on unit	Example
milli-	÷ 1000	millimetres (mm)
micro-	÷ 1 000 000	micrometres (µm)
nano-	÷ 1 000 000 000	nanometres (nm)
pico-	÷ 1 000 000 000 000	picometres (pm)

(× 1000 / ÷ 1000 between each row)

2. Plant and animal cells	
Cell	The basic structural unit of all living things (the building blocks of life).
Parts of an animal cell	Cell membrane, cytoplasm, nucleus, ribosomes, mitochondria.
Parts of a plant cell	Cell membrane, cytoplasm, nucleus, ribosomes, mitochondria, cell wall, permanent vacuole, chloroplasts.
Cell membrane	Controls what enters and leaves the cell.
Cytoplasm	A jelly-like substance where chemical reactions take place.
Nucleus	Contains DNA and controls the cell.
Ribosome	Produces proteins.
Mitochondria	Releases energy by aerobic respiration.
Cell wall	Protects and supports the cell, made of cellulose.
Permanent vacuole	Stores sap and helps to support the cell.
Chloroplast	Where photosynthesis happens, contains chlorophyll.



3. Measuring cells	
Micrograph	A picture produced by a microscope.
Light microscope	A microscope that uses light, can magnify up to 1500 times.
Electron microscope	A microscope that uses electrons to produce an image, can magnify up to 1,000,000 times.
Actual size of a cell	Actual size = measured size / magnification
Convert mm to µm	Micrometres (µm) = millimetres (mm) x 1000

4. Core practical – using microscopes (CP1)	
CP1 – key question	What do cells look like under a light microscope?
CP1 – Prepare the slide	Collect the cells you are studying and place them on the slide. Add a drop of stain and cover with a cover slip.
CP1 – Select lens	Choose between the 4x, 10x and 40x objective lenses.
CP1 – Place slide in microscope	Place slide on microscope stage, adjust the coarse focus until the lens is just touching the slide.
CP1 – Rough focus	Looking through the eyepiece, slowly adjust the coarse focus until you see a rough image.
CP1 – Fine focus	Looking through the eyepiece, slowly adjust the fine focus until you see a sharply focussed image.
CP1 – Record the image	Draw what you see, label any cell parts you can recognise and repeat with different objective lenses.
CP1 - Results	As you increase the magnification of the objective lens, the cells appear larger and more detailed.

5. Specialised cells	
Small intestine cell	**Job:** To absorb small food molecules produced during digestion. **Adaptations:** Tiny folds called microvilli that increase their surface area.
Sperm cell	**Job:** Fertilise an egg and deliver male DNA. **Adaptations:** A tail to swim, mitochondria to give energy for swimming, an acrosome to break through the egg's jelly coat, haploid nucleus with only half the total DNA.

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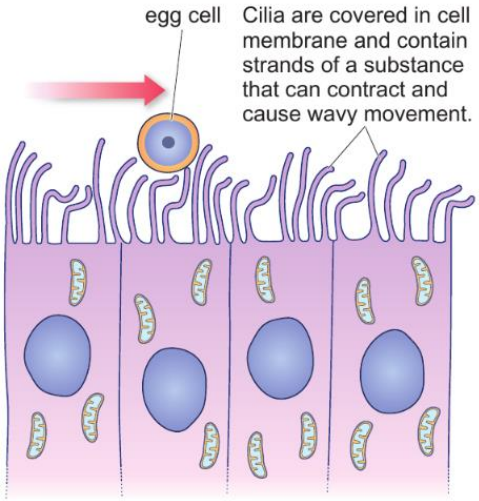
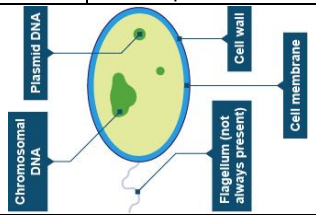
Egg cell	**Job:** To be fertilised by a sperm and then develop into an embryo. **Adaptations:** Jelly coat to protect the cell, many mitochondria and nutrients to provide energy for growth, haploid nucleus with only half the total DNA.
Ciliated epithelial cell	**Job:** To clear mucus out of your lungs (and other internal surfaces). **Adaptations:** Small hairs on the surface – called cilia – which wave to sweep mucus along.

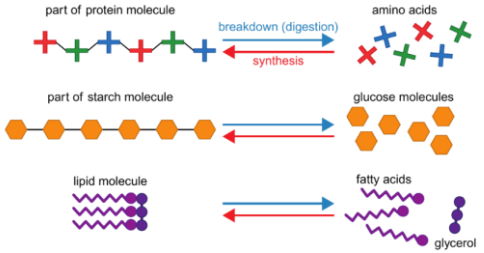


6. Inside bacteria	
Parts of a bacterial cell	**All bacteria:** Cell membrane, cell wall, cytoplasm, ribosomes, chromosomal DNA, plasmid DNA **Some bacteria:** flagellum.
Chromosomal DNA	Large piece of DNA containing most genes.
Plasmid DNA	Small loops of DNA containing a few genes.
Flagellum	A tail used for movement.
Eukaryotic cells	Cells with a nucleus.

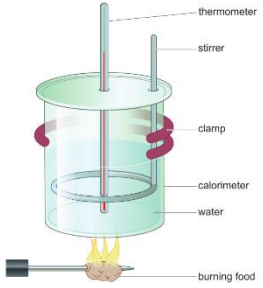
Prokaryotic cells	Cells without a nucleus.
Standard form	A way of writing numbers in terms of powers of ten. E.g. $0.015 = 1.5 \times 10^{-2}$ $0.000458 = 4.56 \times 10^{-4}$ The index of ten (the 'minus' number) tell you which decimal point to start on.



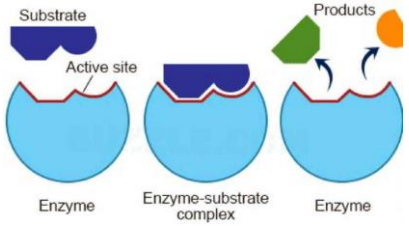
7. Enzymes and nutrition (Digestive enzymes)	
Digestion	Breaking large food molecules down into ones small enough to absorbed by the small intestine.
Catalyst	A substance that speeds up a chemical reaction without being used up.
Enzyme	A protein that works as a catalyst to speed up the reactions in our cells.
Digestive enzymes	Enzymes that break large food molecules down into smaller ones.
Amylase	**Where found:** saliva, small intestine **What it does:** breaks down starch into simple sugars such as maltose
Lipase	**Where found:** small intestine **What it does:** breaks down fats into fatty acids and glycerol
Protease	**Where found:** stomach (pepsin), small intestine (trypsin) **What it does:** breaks down proteins into amino acids



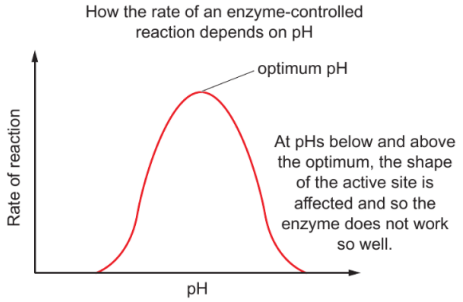
8. Core practical: testing foods (CP2)	
CP2 - Chemical reagents	A compound or mixture used to find out whether or not a specific **chemical** substance is present.
CP2 - Reducing sugars	The smallest sugars (including glucose and fructose)
CP2 - Benedict's solution	A chemical test used to determine if reducing sugars are present The solutions colour changes from Blue -> brick red
CP2 - Biuret solution	A chemical test used to determine if protein is present. The solutions colour changes from blue -> purple
CP2 - Ethanol emulsion test	A test used to determine if fat is present. Food is mixed with ethanol and shaken. Some of the mixture is poured into water. A cloudy emulsion is formed if fats are present.
CP2 - Calorimeter	an apparatus for measuring the amount of heat involved in a chemical reaction or other process.



9. How enzymes work	
Substrate	The chemical(s) that an enzyme works on.
Active site	An area of an enzyme with the same shape as the substrate.
Lock and key mechanism	The substrate moves into the active site and reacts to form the products. The products leave the active site so another substrate can then enter and so on.
Specificity	Each enzyme can only work on one substrate because the shape of the active site has to match.
Denature	When the shape of the active site changes shape so the enzyme stops working.



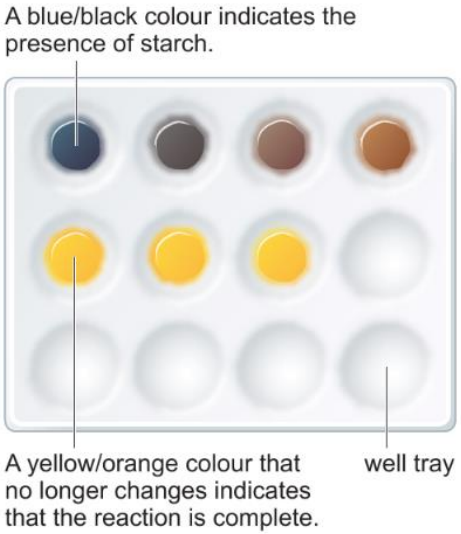
10. Factor affecting enzymes	
Optimum temperature	The temperature when an enzyme works fastest (about 37^{O} for human enzymes).
Changing the temperature	**Increasing to optimum**: rate increases because particles move faster **Increasing past optimum:** rate decreases as enzyme denatures
Optimum pH	The pH when enzymes work fastest (around pH 6-8 for most human enzymes)
Changing pH	Rate decreases as you move away from the optimum because the enzyme denatures.
Increasing substrate concentration	At first the rate increases, but then it levels out as the enzyme is working as fast as possible.



11. Core practical – enzymes and pH (CP3)	
CP3 – key question	How does the rate that amylase works change as you change the pH?
CP3 – Prepare your reactants	Place starch solution, amylase solution and pH 7 buffer into separate test tubes and warm them in a water bath at 40°C
CP3 – Prepare your dropping tile	Place a few drops of iodine solution into each well of a spotting tile.
CP3 – Start the reaction	Mix reactants together, start the stopwatch and keep the mixture warm in the water bath.
CP3 – Test for starch	Remove a small amount of mixture and place in a well on the spotting tile.
CP3 – Record your results	Repeat the test until the mixture does not go black (no starch). Record the time.
CP3 – Vary the pH	Repeat with different pH buffers from pH 3 to pH 10
CP3 – Results	The amylase works fastest around pH 7 and more slowly at pH high or lower than this.

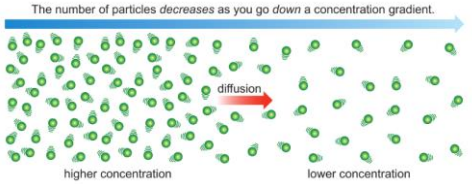
Exam-style question

The enzyme pepsin digests proteins. Pepsin is denatured at pH 8. Explain what this means. *(2 marks)*



12. Transporting substances	
Concentration	The number of particles in a given volume (the strength of a solution).
Concentration gradient	The difference in concentration between two neighbouring areas.
Diffusion	The movement of particles from high to low concentration (down a concentration gradient).
Diffusion examples	**Lungs:** oxygen into blood, carbon dioxide out of blood **Leaf:** carbon dioxide into leaf, oxygen out of leaf.
Partially permeable membrane	A membrane that allows some molecules but not others to pass through it (like a cell membrane).
Osmosis	The movement of water across a partially permeable membrane from high water/low solute conc to low water/high solute conc.
Osmosis examples	Water into plant roots, water in/out of any cells.

Active transport	Using energy to move substances from low to high concentration (up a concentration gradient).
Active transport examples	Minerals being absorbed into plant roots.



13. Core practical – osmosis in potatoes (CP4)	
CP4 – Prepare potatoes	Cut six similar pieces of potato, blot them dry and weigh them.
CP4 – Run the experiment	Place each potato piece in a test tube with sucrose (sugar) solutions with concentrations from 0% to 50%
CP4 – Record results	Blot each potato piece dry and re-weigh it.
CP4 – Calculate percentage mass change	% change = (final value – starting value) / starting value x 100
CP4 – Results	Potato in weaker sucrose solutions gain mass because water enters potatoes by osmosis, those in stronger solutions lose mass as water leaves by osmosis.