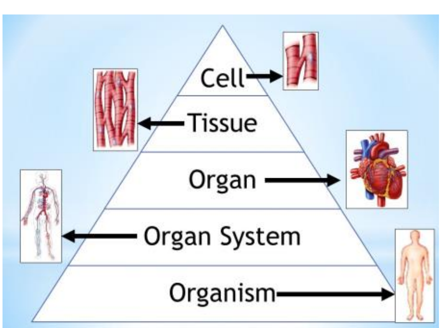
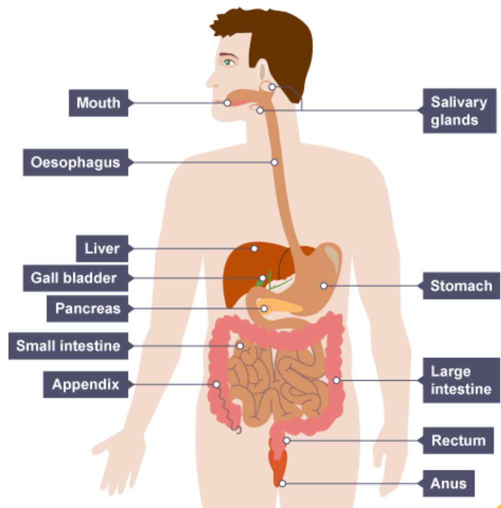
Organisation - Digestion

Keyword	Definition
Cell	The smallest unit of a living organism.
Tissue	A group of cells with a similar structure and function.
Organ	An aggregation of tissues performing specific functions.
Organ system	An aggregation of organs working together to perform an overall function.
Organism	A whole living thing made of collections of organ systems all working together.
Enzyme	A protein molecule which speeds up the rate of chemical reactions within living organisms.
Carbohydrase	An enzyme which breaks down carbohydrates into simple sugars.
Amylase	A carbohydrase enzyme produced by the salivary gland, the walls of the small intestine and the pancreas. Digests starch into glucose.
Protease	An enzyme produced by the walls of the stomach, the walls of the small intestine and the pancreas. Digests protein into amino acids.
Lipase	An enzyme which is produced by the walls of the small intestine and the pancreas. Digests lipids into fatty acids and glycerol.
Acid	Found in the stomach. Two functions: 1. Kills pathogens 2. Provides the optimum low pH required for protease.
Bile	A chemical 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.

Or01 Organisation Principles A



Or02 Human Digestive System B



Or 02 and 08 B

Structure	Function
Mouth	Where food enters the body.
Salivary glands	Produce saliva containing amylase.
Oesophagus	Muscular tube which moves ingested food to the stomach.
Stomach	Muscular organ where digestion continues. Protein is mainly broken down here.
Pancreas	Produces digestive enzymes.
Liver	Produces bile.
Gall bladder	Stores bile before releasing it into the small intestine.
Small intestine	Where food is mixed with digestive enzymes and bile. Digested food is absorbed into the blood here.
Large intestine	Where water is reabsorbed.
Rectum	Where faeces are stored.
Anus	Where faeces leave the body.

Required Practical:

Food Tests

Enzymes

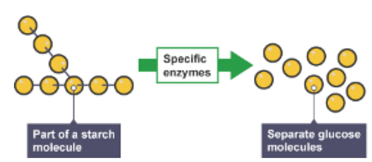
Mathematical Skills:

- *Be prepared to carry out calculations to find the rate of a chemical reaction.*

Relevant Modules: AQA

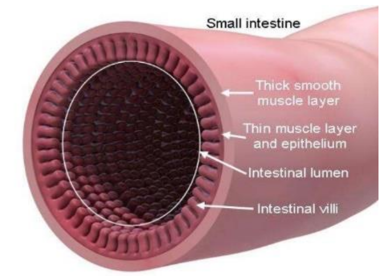
- Cells
- Organisation – metabolism
- Respiration

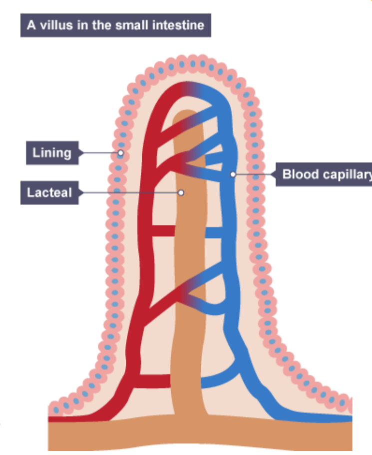
Or05 Enzymes and Digestion C



Enzymes helps to break large food molecules down into pieces small enough to be absorbed through the walls of the small intestine and into the bloodstream.

Or02 Digestive System B



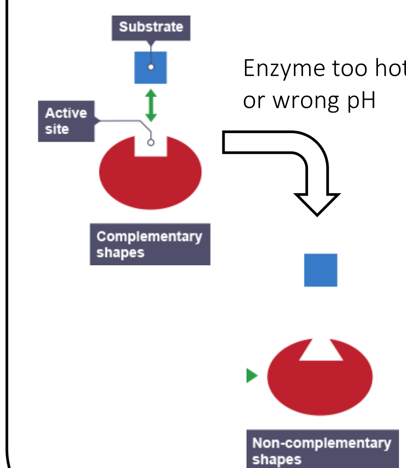


The small intestine isn't just a smooth tube. The villi ensure there is an extremely large surface area for a fast rate of absorption of small soluble nutrients.

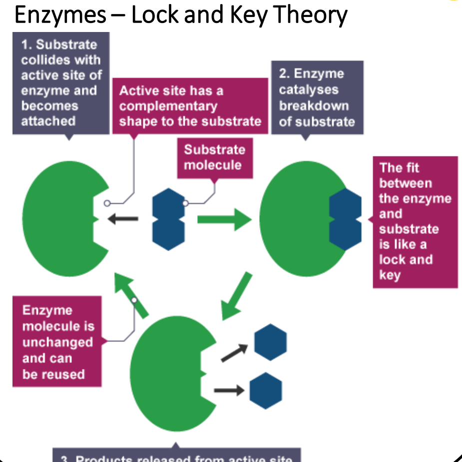
Each villus has a good blood supply to maintain the concentration gradient so that food can diffuse straight into the blood stream.

Key Point

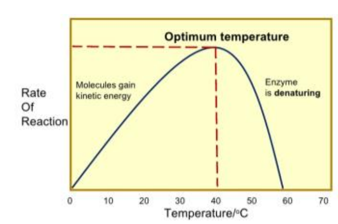
Or07 Denaturation D

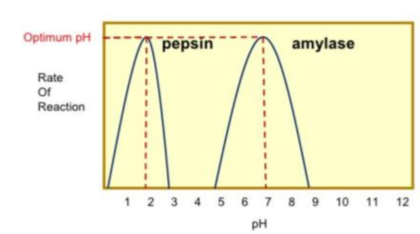


Or05 Enzymes – Lock and Key Theory C



Or07 Factors Affecting Enzymes D





If enzymes get too cold, they work more slowly. If the temperature increases, the rate of reaction increases up to the optimum (best) temperature. If they get too hot (past the optimum temperature) they will denature and stop working.

Enzymes have an optimum pH. If they go too far below or above their optimum pH they denature and stop working.

Or03 and 08 C

Digestive Enzyme	Where it is produced	Where it functions	What food it breaks down	What it breaks down into
Amylase	Salivary gland, small intestine, pancreas.	Mouth and small intestine	Starch →	Glucose
Protease	Stomach, small intestine, pancreas.	Stomach, small intestine	Protein →	Amino acids
Lipase	Small intestine, pancreas.	Small intestine	Lipids (Fat) →	Fatty acids and glycerol

Useful YouTube links:

Digestion

Enzymes

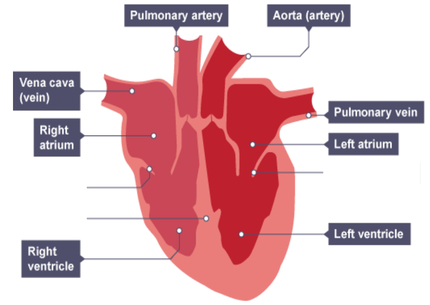
Organisation – Circulatory and Gas Exchange Systems

TPS

Keyword	Definition
Atrium	The upper two chambers of the heart that collect blood from the veins.
Ventricle	The lower two chambers of the heart that pumps blood out through the arteries.
Artery	A type of blood vessel carrying blood away from the heart.
Vein	A type of blood vessel which takes blood into the heart.
Capillary	A type of blood vessel connecting arteries and veins. These surround internal tissues and organs and are the site of exchange of substances between the cells and the blood.
Pulmonary artery	Carries blood from the heart to the lungs.
Pulmonary vein	Carries blood from the lungs to the heart.
Aorta	An artery carrying blood from the heart to the body.
Vena cava	A vein carrying blood from the body into the heart.
Coronary heart disease (CHD)	Layers of fatty material build up inside the coronary arteries, narrowing them. This reduced the flow of blood, resulting in a lack of oxygen for the heart muscle.
Trachea	The windpipe. Air travels down this rigid tube from the mouth/nose into the lungs.
Bronchi	The two branches from the trachea that ensures air can travel into the two lungs.
Alveoli	Small air sacs within the lungs through which gas exchange between the lungs and the blood occurs.
Red blood cells	Small cells which do not contain a nucleus but contain a pigment called haemoglobin. These adaptations allow red blood cells to have a large surface area to carry oxygen.
Plasma	The yellow liquid in blood which all the other components of blood, hormones, nutrients and carbon dioxide travel in.
Platelet	A small fragment of a cell which has the function of helping blood to clot. This is useful if someone is wounded as it stops them bleeding to death.
White blood cell	This is the immune system. These cells kill pathogens by: - Producing antibodies - Producing antitoxins - Phagocytosis

E

Or09 Heart Structure



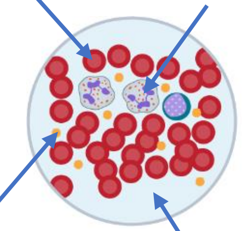
The circulatory system is known as a double pump system because blood is being pumped to the lungs from the right side, at the same time as blood is being pumped to the body from the left side.

F

Or11 Blood

Red blood cells – carry oxygen

White blood cells – kill pathogens

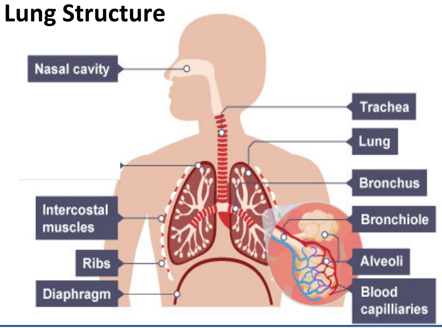


Platelets – clot blood

Plasma – liquid that carries all the blood cells, hormones, nutrient and CO_2

E

Or13 Lung Structure



E

Or09 Pacemaker

Cells in the **right atrium** of the heart which control the heart beats are called the natural pacemaker cells.

Required Practical:

None

Mathematical Skills:

- *Be prepared to calculate the rate of blood flow and rate of transpiration.*
- *Be prepared to calculate the distribution of stomata on a leaf.*
- *Be prepared to calculate surface area and volume.*

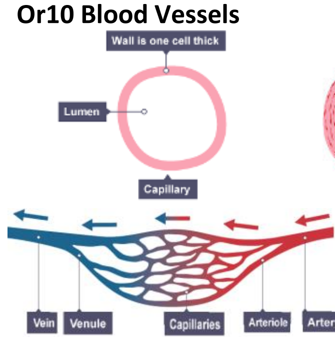
Relevant Modules:

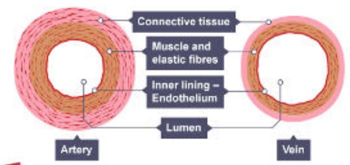
AQA

- Cells
- Infection and Response
- Bioenergetics

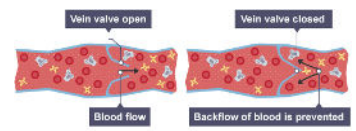
Or10 Blood Vessels

Not to scale





Capillaries are the connection between arteries and veins. They form huge networks around tissues and organs within the body.



Valves are found in veins and stop blood flowing the wrong way.

F

Type of vessel	Walls	Lumen	Blood pressure	Other features
Capillary	One cell thick – short diffusion pathway.	Small	Low	
Artery	Thick – made of elastic and muscle fibres to withstand pressure.	Small	High	
Vein	Thin – made of elastic and muscle fibres.	Large	Low	Valves to stop backflow of blood.

Or12 Treatments for CHD

1. Stents are used to keep the coronary arteries open.

2. Statins are widely used to reduce blood cholesterol levels which slows down the rate of fatty material deposit.

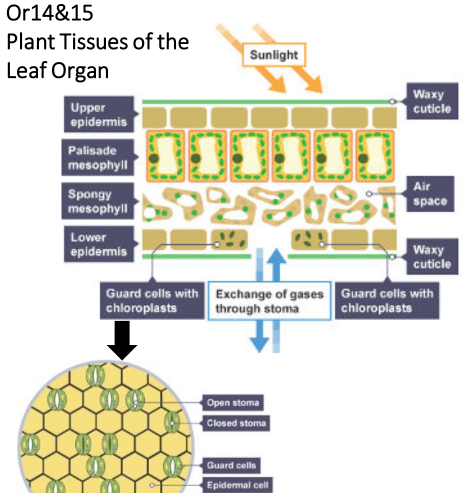
3. Faulty valves: In some people heart valves may become faulty. They can be replaced using biological or mechanical valves.

4. In the case of heart failure a **donor heart**, or **heart and lungs** can be transplanted.

5. Artificial Hearts: Occasionally used to keep patients alive whilst waiting for a heart transplant.

G

Or14&15 Plant Tissues of the Leaf Organ



G

Tissue	Function
Epidermis	Protective layer on the top and bottom of the leaf. Waterproof to avoid water loss.
Palisade Mesophyll	Made of tightly packed, long column shaped cells with lots of chloroplasts in order to carry out photosynthesis.
Spongy Mesophyll	Cells are loosely structured allowing for air spaces for gas exchange.
Xylem	Transports water from the roots to the leaves to give the palisade cells the water they need to do photosynthesis. The movement of water is called transpiration stream.
Phloem	Transports glucose produced in the palisade cells to the rest of the plant. The movement of glucose through the phloem is called translocation.
Guard cells and stomata	The stoma are the holes through which carbon dioxide and oxygen exchange places. The guard cells open and close to control gas exchange and water loss.

G

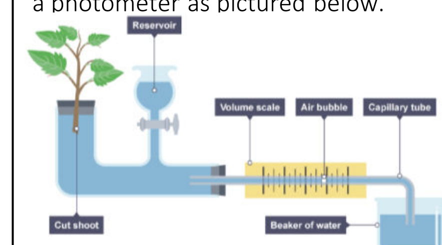
Or15&16 Transpiration

The evaporation of water from the leaves through the stomata.

The rate of transpiration is affected by:

- Temperature – warmer = faster
- Humidity – more humid = slower
- Air movement – more = faster
- Light intensity – higher = faster

Transpiration can be measured using a photometer as pictured below.



As water is absorbed by the plant root hair cells due to losing water via transpiration, the air bubble will move along the capillary tube. The speed at which it moves can be measured and this gives a measurement to the rate of transpiration.

Useful YouTube links:

Circulatory System | Respiratory System | Plant Leaf Structure

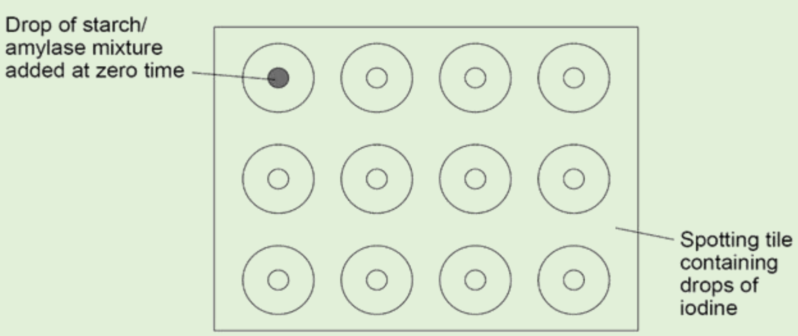
Required Practical - Enzymes

Or06 D

TPS

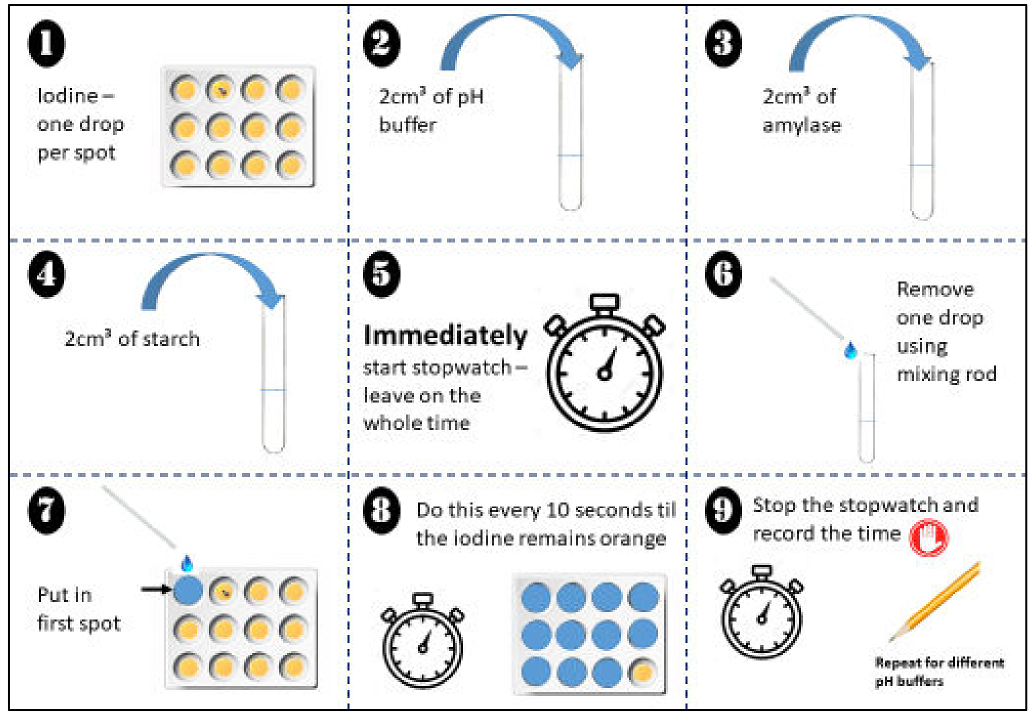
Method

- Place labelled test tubes containing the ***buffered pH solutions***, ***amylase solution*** and ***starch solutions*** in to the water bath. Leave these to allow the solutions to reach 25 °C
- Place one drop of iodine solution into **each** well on the spotting tile.
- Using a pipette, add 2cm^3 of one of the ***buffered pH solutions*** to a test tube.
- Use the pipette to place 2 cm^3 of ***amylase*** into the same test tube.
- Use a different pipette to add 2 cm^3 of the ***starch solution*** to the test tube containing the amylase/buffer solution.
- **Immediately** start the stop clock and leave it on throughout the test.
- Mix using a glass rod / clean pipette.
- After 30 seconds, remove one drop of the mixture with a glass rod.
- Place this drop on the first depression of the spotting tile with the iodine solution. The iodine solution should turn blue-black indicating the presence of starch.
- **Dispose of the excess solution in the pipette and replace the empty pipette into the test solution.**
- Use the pipette to remove one drop of the mixture every 30 seconds. Put each drop onto the iodine solution in the **next** well on the spotting tile. Empty the pipette of excess solution after each drop. Continue until the iodine solution and the amylase/buffer/starch mixture remain orange for 2 consecutive wells.
- Repeat the procedure with solutions of other pHs.

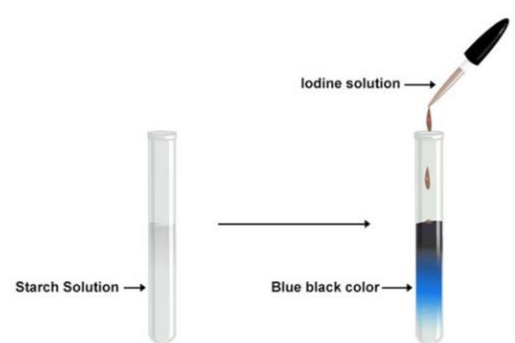


Equipment:

- test tubes
- a test tube rack
- water bath
- spotting tiles
- 5cm^3 measuring cylinder
- pipettes
- a stop clock
- starch solution
- amylase solution
- buffered pH solutions with an allocated pipette
- iodine solution



Testing for the presence of starch



Right at the very start, the solution of amylase, starch and pH buffer turns black with iodine as starch hasn't had time to be broken down by the amylase enzyme.

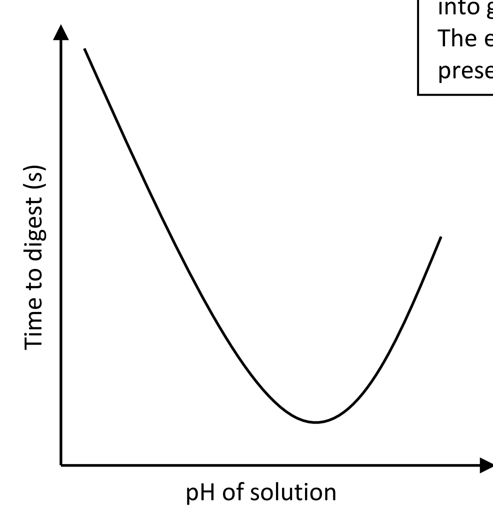
As time progresses, the amylase breaks the starch into glucose. When tested with iodine, if no starch is present due to being fully broken down into glucose, the solution will remain orange.

Key Point

Typical Results

pH of solution	Time taken to completely digest starch (s)
3	300
4	270
5	150
6	90
7	30
8	150

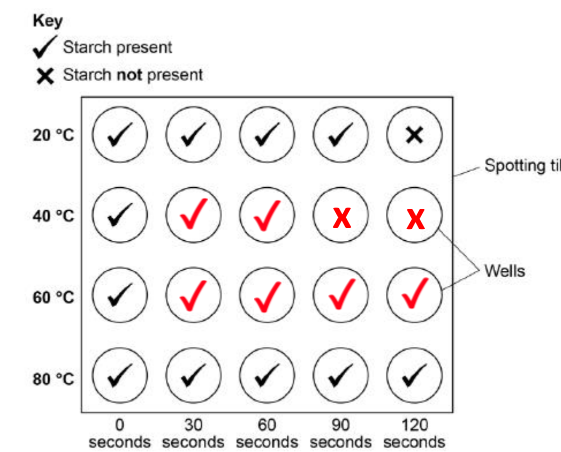
Typical Graph



Typical Exam Question

Even though the required practical investigates how pH affects the rate of enzyme activity, the exam board do sometimes change it in the question to investigate how temperature affects enzyme activity. Here is an example question. The answer is in red.

Q1. The temperature of the human body is 37 °C.
The diagram below shows the results of the investigation at 20 °C and at 80 °C
Complete the diagram to show the results you would expect at 40 °C and at 60 °C
You should write a tick or a cross in each well of the spotting tile.



As 40C is the closest temperature to the optimum of 37C, the starch is digested the quickest here. The reason there are two crosses at the end is due to the fact that all the starch had been broken down into glucose by the enzyme amylase.
The enzyme at 60C has denatured so the starch is present the whole time.

Useful YouTube links:

Practical Demo

Enzymes Theory

Required Practical – Food Tests

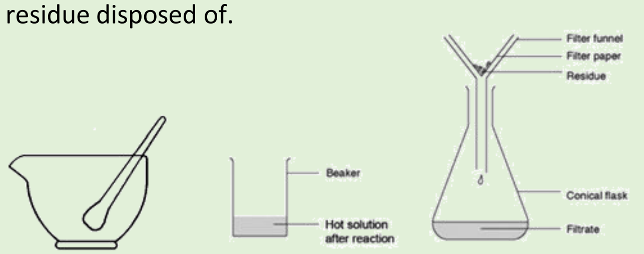
Or04 B

TPS

Methods:

Preparing a sample for testing

- Use a pestle and mortar to grind up a small sample of food to be tested.
- Transfer the ground up food into a small beaker.
- Then add distilled water and stir the mixture so that some of the food dissolves in the water.
- Filter using a funnel with filter paper to obtain as clear a solution as possible (repeat filtration may be required).
- The final solution should be collected in a conical flask and the residue disposed of.



Testing for protein (Option 1)

- Add approximately 2 mL of your test solution to a test tube.
- Add 2 mL of the Biuret solution to the test tube.
- Gently shake the test tube to mix the solutions.

Testing for protein (Option 2)

- Add approximately 2 mL of your test solution to a test tube.
- Add 1 mL copper sulfate solution to the test tube.
- Add 1 mL sodium hydroxide solution to the test tube.
- Gently shake the test tube to mix the solutions.

Testing for Carbohydrates:

1. Starch

- Add approximately 3 mL of your test solution to a test tube.
- Add 5 drops of iodine solution to the test tube and gently mix.

2. Simple sugars

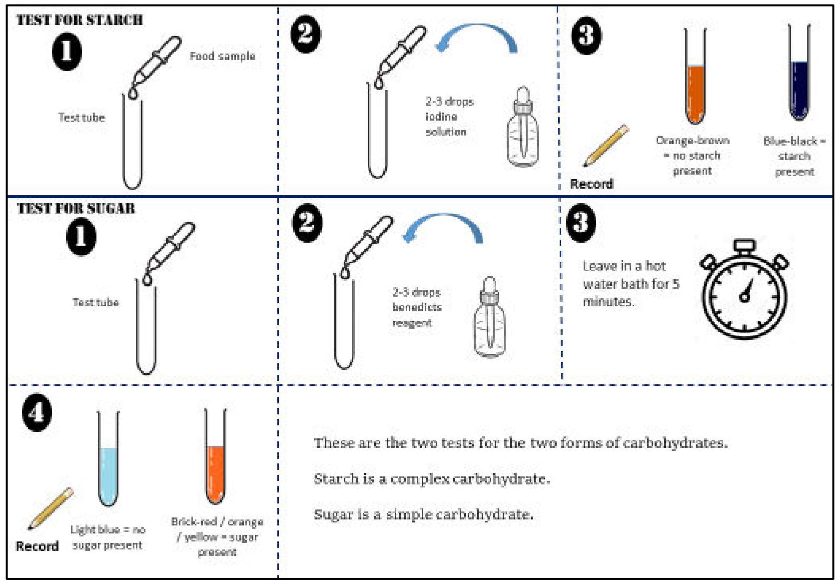
- Add approximately 5 mL of your test solution to a test tube.
- Add 10 drops of the Benedict's solution to the test tube.
- Place the test tube in a water bath set at 70-80 °C
- Leave for 5 minutes

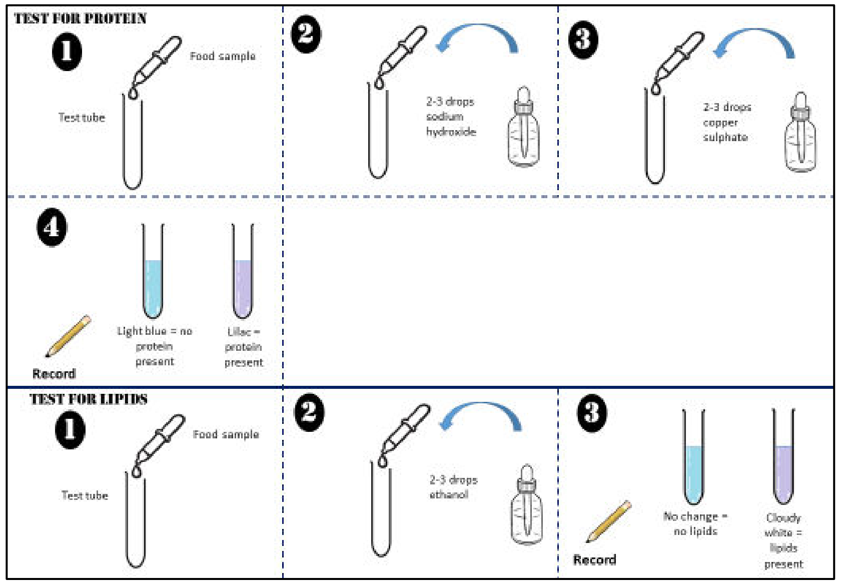
Testing for lipids (Option 1)

- Add approximately 5 mL of your test solution to a test tube.
- Add 3 drops of the Sudan III solution to the test tube.
- Gently shake the tube to mix the solutions.

Testing for lipids (Option 2)

- Add approximately 5 mL of your test solution to a test tube.
- Add 3 drops of ethanol to the test tube.
- Gently shake the tube to mix the solutions.





Food tested	Result of test (positive / Negative)			
	Starch	Simple sugar	Protein	Lipids
Meat	X	X	✓	✓
Egg	X	X	✓	✓
Bread	✓	X	X	X
Milk	X	✓	X	✓
Biscuit	✓	✓	X	X
Haribo	X	✓	X	X

Food Group	Reagent	Negative	Positive
Protein	Biuret	Blue	**Purple**
Protein	Sodium hydroxide + copper sulfate	Colourless	**Purple**
Lipids	Ethanol	Colourless	**Cloudy white**
Starch	Iodine	Orange	**Black**
Sugar	Benedicts	Blue	**Brick red**

Key Point

You must memorise the information in this table to be able to answer any exam questions on testing nutrients in foods.

Useful YouTube links:

Practical Demo