B2 Principles of organisation

Cells are the basic building blocks of all living organisms.

A tissue is a group of cells with a similar structure and function.

Organs are aggregations of tissues performing specific functions.

Organs are organised into organ systems, which work together to form organisms.

Examples of tissue in humans include:

Muscular tissue - to churn the food and other contents of the stomach.

Glandular tissue - to produce digestive juices including acid and enzymes.

Epithelial tissue - to cover the inner and outer surfaces of the stomach.

Cancer

Cancer is the result of changes in cells that lead to uncontrolled growth and division.

Benign tumours are growths of abnormal cells which are contained in one area, usually within a membrane. They do not invade other parts of the body.

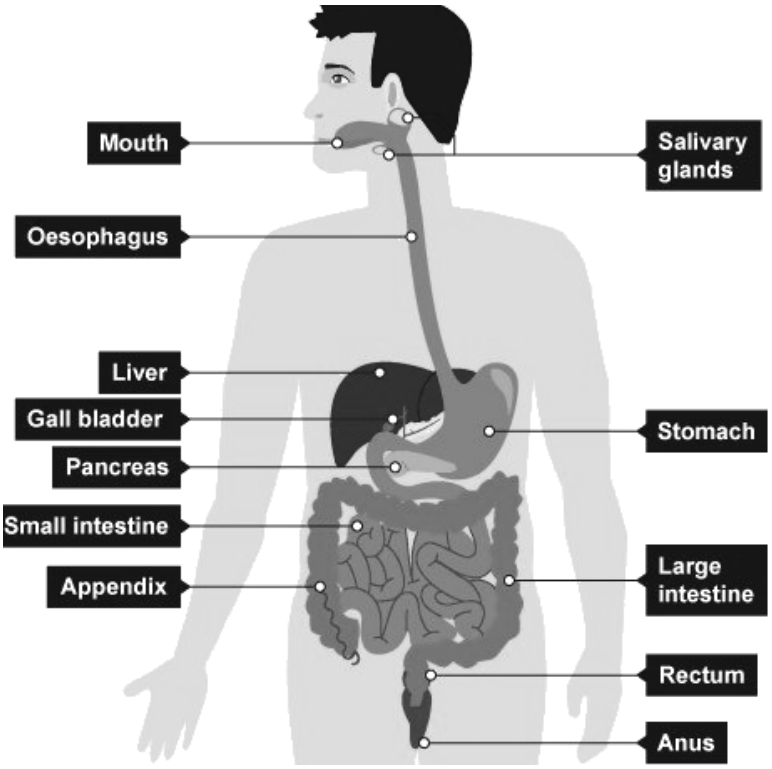
Malignant tumour cells are cancers. They invade neighbouring tissues and spread to different parts of the body in the blood where they form secondary tumours.

Scientists have identified lifestyle risk factors for various types of cancer. There are also genetic risk factors for some cancers.

Treatments for cancer can include chemotherapy and radiotherapy.

B2 The Human Digestive System

The digestive system is an example of an organ system in which several organs work together to digest and absorb food.



Mouth: Food enters the body and mixes with saliva which contains the enzyme amylase. The teeth break down the food into smaller pieces.

Salivary glands: where saliva is made which includes the enzyme amylase.

Oesophagus: Food is moved down this tube by **peristalsis**

Stomach: The food mixes with acid in the stomach to kill bacteria. The food is churned by the muscles. Some enzymes here.

Liver: Bile is made here.

Gall bladder: Bile is stored here.

Pancreas: Enzymes are made here.

Duodenum: Connects the Stomach to the small intestine, bile is added to the food.

Small intestine: Food is mainly digested here, enzymes break down the food and it is absorbed into the blood.

Large intestine: Water is absorbed here.

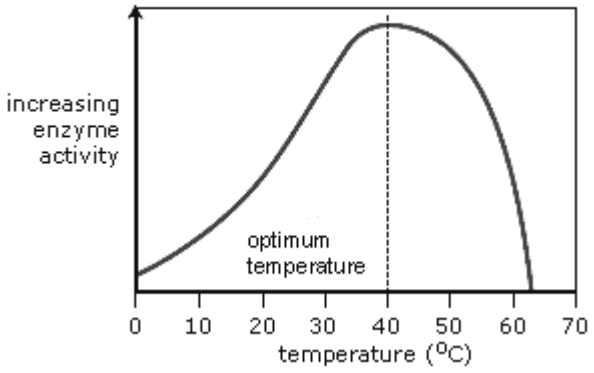
Rectum: Waste is stored here.

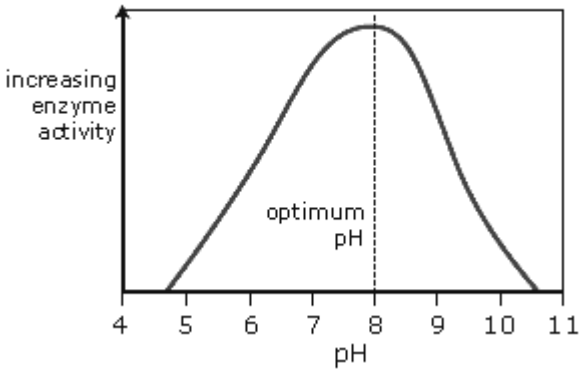
Anus: Waste is expelled from the body through this.

(Note: **Bile is alkaline** to **neutralise the 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.)

B2 The Human Digestive System (Enzymes)

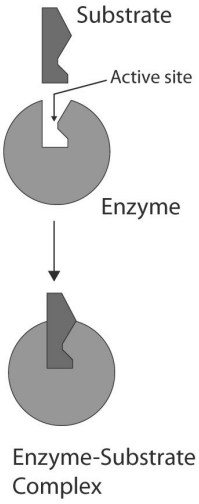
Enzymes are **made from protein**. They are **catalysts** (they speed up a reaction without being used up in that reaction themselves).





Particular enzymes work best at particular values of temperature and pH, different enzymes have different optimum values.

The lock and key model explains how only certain types of food can fit into certain enzymes. (Only certain enzymes can digest certain foods). The area into which a certain food molecule (substrate) fits in an enzyme is called the **active site**. The shape of the active site is the 'lock' and only foods of the correct type will fit into it.



Digestive enzymes convert food into small soluble molecules that can be absorbed into the bloodstream.

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

Enzyme	**Insoluble molecules broken down**	**Enzyme production site**	**Site where enzymes act**	**Small, soluble molecules formed**
Carbohydrase (Amylase)	Carbohydrate (starch)	Salivary gland, pancreas, small intestine	Mouth, small intestine	Simple sugars (Glucose)
Protease	Protein	stomach, pancreas, small intestine	Stomach, small intestine	Amino acids
Lipase	Lipids (Fats)	pancreas, small intestine	Small intestine	Fatty acids and glycerol

B2 Required Practical: Food tests

The Benedict's test for sugars

Method

1. Set up your water bath
2. Put some of the food sample into a test tube.
3. Add a few drops of Benedict's solution to the sample in the test tube.
4. Put the test tube in the water bath at a minimum of 80 °C for about 5 minutes.
5. Note down any colour change in your table of results.

The Iodine test for starch

Method:

1. Put some of the food sample into a test tube.
2. Add a few drops of Iodine solution.
3. Note down any colour change in your table of results.

The Test for Lipids

Method:

1. Put some of the food sample into a test tube.
2. Add a few drops of distilled water.
3. Add a few drops of ethanol.
4. Shake the solution gently.
5. Note what you see in your table of results.

The Biuret's test for protein

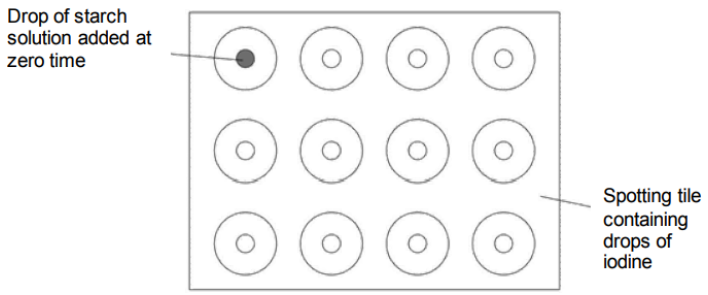
Method:

1. Put some of the food sample into a test tube.
2. Add 1 cm^3 of Biuret solution A and 1 cm^3 of Biuret solution B to the test tube.
3. Shake the tube gently to mix.
4. Note any colour change in your table of results

B2 Required Practical: effect of pH on the rate of reaction of enzyme

Method

1. Heat your water bath to 35^{O}C.
2. Put 2 cm^3 of each buffered solution into individual, separate test tubes. Label each tube with the pH of the solution.
3. Label 5 test tubes 'Starch' and add 4 cm^3 of starch solution into each tube.
4. Put a thermometer in one of the starch test tubes to monitor the temperature. Leave the thermometer in this tube throughout the experiment.
5. Add 10 cm^3 of Amylase solution into another test tube. Label the tube 'amylase'.
6. Put all the test tubes into the water bath.
7. Allow the solutions to reach 35 °C.
8. While the solutions are reaching the required temperature, put one drop of Iodine solution into each depression on your spotting tile.
9. Put a drop of starch solution in the first depression of the tile. This is your 'zero time' mixture. You will use this as a comparison of colour for your test buffers. Starch gives a blue-black colour with iodine, and the iodine stays brown if all the starch has broken down to glucose.
10. When all the tubes have reached 35 °C take one of the tubes of starch from the water bath and add the 2cm^3 of your first pH buffered solution. Stir the mixture with a glass rod.
11. Use the pipette to add 2 cm^3 of amylase solution to the mixture. Start the stopwatch as soon as you add the amylase. Keep stirring the mixture with the glass rod.
12. After 10 seconds, remove one drop of the mixture with a glass rod.
13. Put this drop on the second depression of your spotting tile.



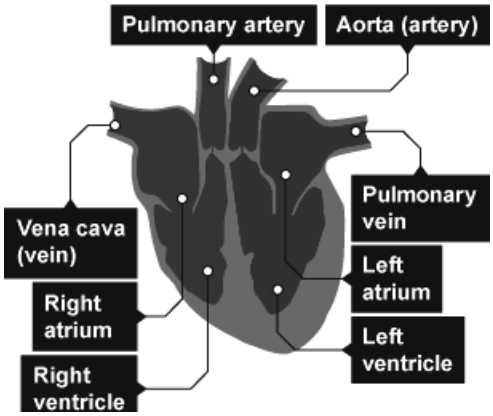
14. Rinse the glass rod with water.
15. Every 10 seconds, use the glass rod to remove one drop of the mixture. Put each drop onto the iodine solution in the next depression on the spotting tile. Remember to rinse the glass rod with water after putting each drop on the spotting tile.
16. Keep sampling every 10 seconds until the iodine does not change colour.
17. Repeat with both of your other buffered solutions.

Results: You should find that the starch breaks down the fastest when it is has a pH of around 5. Higher values of pH will result in it taking longer to break down.

B2 The Heart and Blood Vessels

The heart is an organ that pumps blood around the body in a **double circulatory system** (one side of the heart pumps blood to the lungs, the other side of the heart pumps blood to the rest of the body).
The **right ventricle** pumps blood to the lungs where gas exchange takes place.
The **left ventricle** pumps blood around the rest of the body.

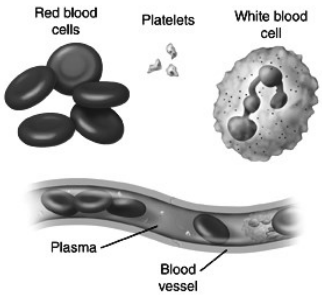
The **coronary artery** is the artery which supplies blood to the muscles of the heart.
The **pulmonary artery** and **pulmonary vein** take blood from the heart to the lungs and back again.
The **aorta** delivers blood from the heart to the rest of the body and the **vena cava** returns blood from the rest of the body to the heart.
The natural resting heart rate is controlled by a group of cells located **in the right atrium** that act as a **pacemaker**.



Artificial pacemakers are **electrical devices** used to **correct irregularities in the heart rate**.

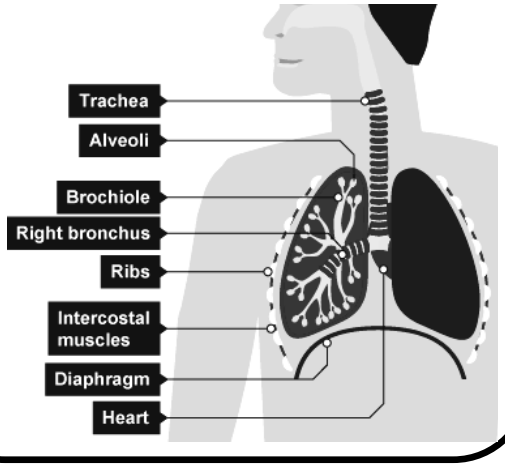
The body contains three different types of blood vessel: arteries, veins and capillaries. **Arteries** carry blood away from the heart and are thick are the blood is under high pressure. **Veins** contain valves to prevent backflow of blood as it is under low pressure. **Capillaries** have thin walls to allow for molecules from the blood to pass through them.

Blood is a tissue consisting of **plasma**, in which the **red blood cells**, **white blood cells** and **platelets** are suspended.



Red blood cells carry oxygen, they have no nucleus to maximize space and a concave shape to increase surface area.
Platelets help your blood to clot in a wound.
White blood cells are part of your immune system.
The **plasma** is the liquid which carries all these (and other) components.

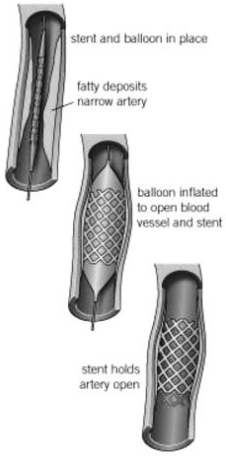
The lungs are adapted for gaseous exchange by having many alveoli to give a **large surface area** to transfer oxygen into the blood and allow carbon dioxide to leave the blood (this is called **gas exchange**).



B2 Coronary heart disease

In coronary heart disease layers of fatty material build up inside the **coronary arteries**, narrowing them. This **reduces the flow of blood** through the coronary arteries, resulting in a **lack of oxygen** for the heart muscle.

Stents are a mesh which is inserted into the patient to open the coronary arteries.



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

In some people **heart valves may become faulty**, preventing the valve from opening fully, or the heart valve might develop a leak. Faulty heart valves can be replaced using **biological or mechanical valves**.

In the case of **heart failure** a **donor heart**, or heart and lungs can be transplanted. **Artificial hearts** are occasionally used to keep patients alive whilst waiting for a heart transplant, or to allow the heart to rest as an aid to recovery.

Treatments for cardiovascular disease	**Advantages**	**Disadvantages**
Drugs (statins)	No surgery	Only slows the rate of build up, doesn't help if build up is already present.
Stent	Only requires local anaesthetic.	Some dangers are always associated with surgery. Can cause a heart attack.
Mechanical device (artificial heart)	Can allow patients to survive to await a donor heart.	Not a permanent solution.
Heart transplant	Can last for many years.	Chance of rejection.

B2 Health Issues and Diseases

Health is the state of physical and mental well-being.
Diseases, both communicable and non-communicable, are major causes of ill health.
Other factors including diet, stress and life situations may have a profound effect on both physical and mental health.
Different types of disease may interact.

- Defects in the immune system mean that an individual is more likely to suffer from infectious diseases (HIV can lead to a weakened immune system).
- Viruses living in cells can be the trigger for cancers.
- Immune reactions initially caused by a pathogen can trigger allergies such as skin rashes and asthma.
- Severe physical ill health can lead to depression and other mental illness.

Lifestyle and Non-communicable Diseases

Diseases can cost individuals money in terms of care and lost earnings if they can't work. Diseases can also cost governments in countries (such as ours) where the government contribute to the cost of caring for those with diseases.

A poor, unbalanced diet, excessive consumption of alcohol and smoking can all increase the incidence (likelihood) of non-communicable diseases.

Risk factors are linked to an increased rate of a disease.
They can be:

- aspects of a person's lifestyle
- substances in the person's body or environment.

A causal mechanism (evidence of a specific factor causing a disease) has been proven for some risk factors, but not in others.

- The effects of diet, smoking and exercise on cardiovascular disease.
- Obesity as a risk factor for Type 2 diabetes.
- The effect of alcohol on the liver and brain function.
- The effect of smoking on lung disease and lung cancer.
- The effects of smoking and alcohol on unborn babies.
- Carcinogens, including ionising radiation, as risk factors in cancer.

Many diseases are caused by the interaction of a number of factors.

Correlation: there appears to be a link between two things.

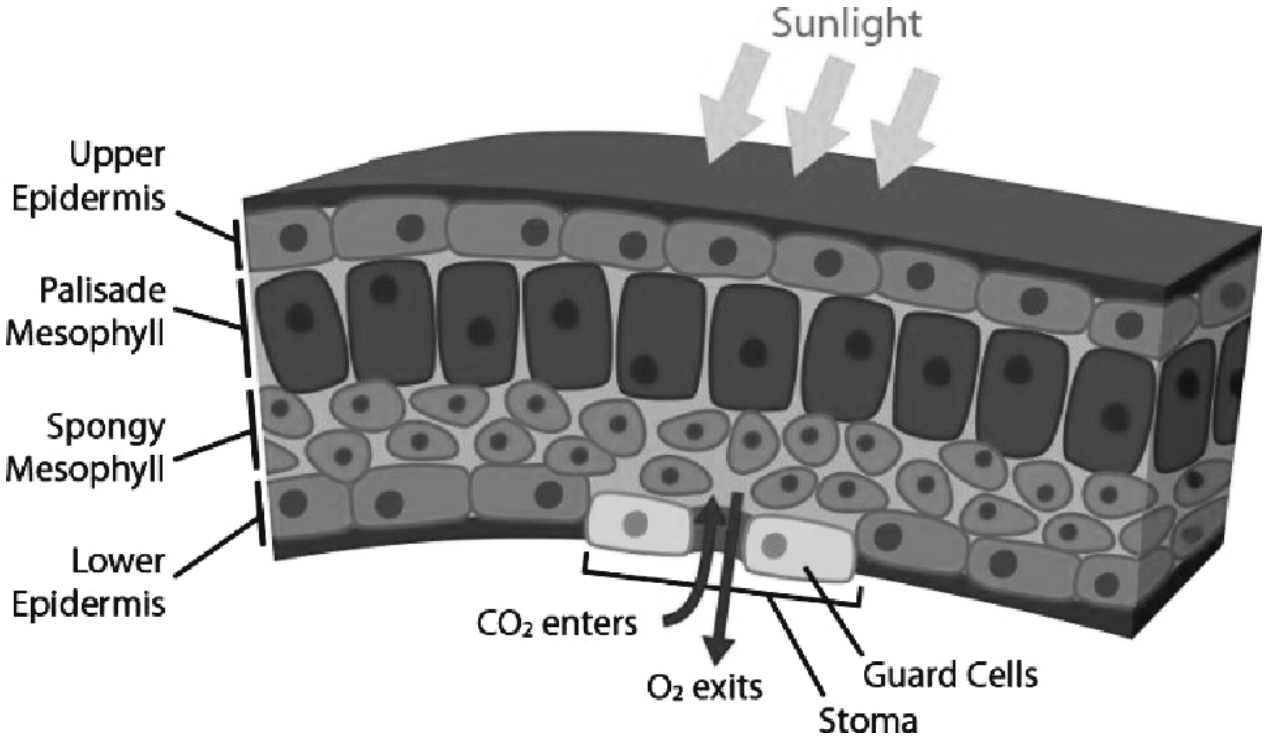
Causation: there is scientific evidence that there is a link between two things.

B2 Plant Tissues

Plant tissues include:

- epidermal tissues - protects the cells underneath.
- palisade mesophyll - where most of the photosynthesis takes place.
- spongy mesophyll - some photosynthesis, many gaps for gases to pass through.
- xylem - transports water and mineral ions around the plant.
- phloem - transports dissolved sugars around the plant.
- meristem tissue found at the growing tips of shoots and roots - makes new cells.

The leaf is a plant organ.



(The lower epidermis contains stomata whose opening and closing are controlled by guard cells)

B2 Plant organ systems

Translocation is the movement of materials from leaves to other tissues throughout the plant.
The roots, stem and leaves form a plant organ system for transport of substances around the plant.

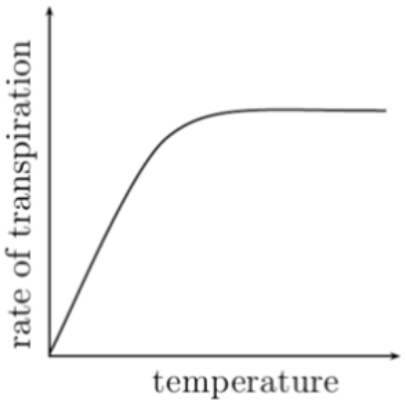
Root hair cells are adapted for the efficient uptake of water by osmosis, and mineral ions by active transport.

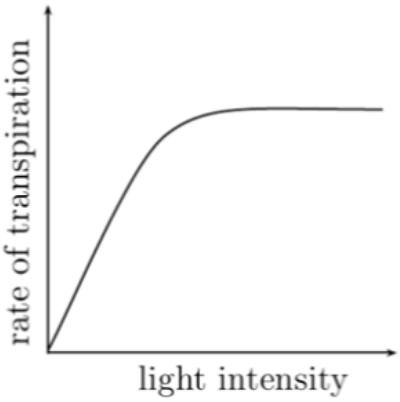
Xylem tissue transports water and mineral ions from the roots to the stems and leaves. It is composed of hollow tubes strengthened by lignin adapted for the transport of water in the transpiration stream.

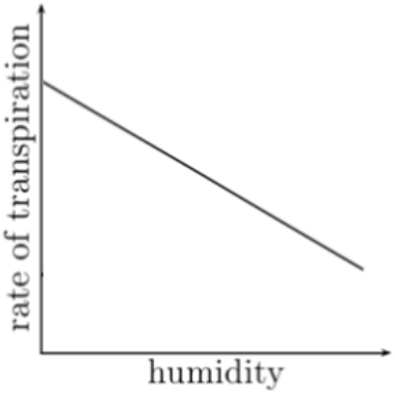
The role of **stomata and guard cells** are to control gas exchange and water loss.

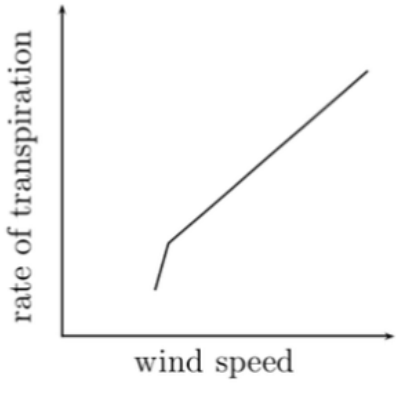
Phloem tissue transports dissolved sugars from the leaves to the rest of the plant for immediate use or storage. The movement of food molecules through phloem tissue is called translocation. Phloem is composed of tubes of elongated cells. Cell sap can move from one phloem cell to the next through pores in the end walls.

Transpiration is the process by which water is lost from a plant by evaporation.









Water is mainly lost from a plant through the stomata.