THE DUSTON SCHOOL
Knowledge itself is power
4-19

Year 9 Science Knowledge Booklet

Term 4

Name:	**Class:**
Homework 1 Due: 1st March	**Homework 2 Due: 15th March**
Homework 3 Due: 29th March	

Science Homework 1

Read all of this knowledge organiser. The work covered will be in the first knowledge quiz of the term.

Big questions:

What are the energy stores and transfers?
How is energy transferred?
How can we calculate work done?
How can we calculate kinetic energy?
How can we calculate gravitational potential energy?
How can we calculate elastic potential energy?
How much energy is needed to heat a substance?
How can we measure specific heat capacity?
How can we determine the specific heat capacity from results?
What is power?
What does efficiency mean?
What are the advantages and disadvantages of different energy stores?

Key vocabulary

Chemical Energy Store	The energy stored in bonds between atoms in a substance e.g. fuels, food, batteries.
Conduction	Heat transfer through a solid.
Convection	Heat transfer through a liquid or gas.
Efficiency	The ratio of useful energy output to the total energy input.
Elastic Potential Energy Store	The energy stored in a stretched or compressed spring or elastic band
Energy Resource	A method of generating electricity e.g. coal power stations, wind turbines, solar panels.
Gravitational Potential Energy Store	The energy stored in an object lifted up in a gravitational field.
Kinetic Energy Store	The energy stored in a moving object.
Nuclear Energy Store	The energy stored in the nucleus of an atom.
Power	The amount of energy transferred per unit time.
Radiation	Heat transfer by waves e.g. infrared radiation.
Specific Heat Capacity	The amount of energy needed to raise the temperature of 1kg of a substance by 1°C.
Thermal Energy Store	The energy stored in an object based on its temperature.
Work Done	Energy transferred when a force moves an object.

What are the energy stores and transfers?

Energy Stores:

Kinetic Energy Store	The energy stored in a moving object.
Gravitational Potential Energy Store	The energy stored in an object lifted up in a gravitational field.
Elastic Potential Energy Store	The energy stored in a stretched or compressed spring or elastic band
Chemical Energy Store	The energy stored in bonds between atoms in a substance e.g. fuels, food, batteries.
Thermal Energy Store	The energy stored in an object based on its temperature.
Nuclear Energy Store	The energy stored in the nucleus of an atom.

Energy Transfers:

Heat	Energy transferred from a hot object to a cooler object.
Mechanical Work (Work Done)	Energy transferred when a force moves an object.
Electric Current	Energy transferred in an electrical circuit.
Radiation	• Energy transferred by waves.

Science Homework 2

Try to answer all of these key knowledge questions. Then check your answers using the last page. These are some of the questions that will be in the knowledge quizzes and the end of term tests.

Key knowledge question	Answer
Write the equation that links kinetic energy, mass and speed	
Write the equation that links gravitational potential energy, mass, gravitational field strength and height	
Write the equation that links elastic potential energy, spring constant and extension	
Write the equation that links power, energy and time	
Write the equation that links work done, force and distance moved	
Write the equation to calculate efficiency	
Which energy store is increased when a person climbs a ladder?	
Which energy store is stored in a hot cup of tea?	
Which energy store is stored in a moving car?	
Which energy store is stored in a stretched spring?	
Which energy store is stored in a battery?	
What happens to dissipated energy?	
State the law of conservation of energy	
Name 3 fossil fuels	
Name 2 non-renewable energy sources	
Name 2 renewable energy sources	

How can we calculate work done?

Work done = force x distance moved $W = Fs$

How can we calculate kinetic energy?

Kinetic energy = 0.5 x mass x speed^2 $E_k = ½ mv^2$

How can we calculate gravitational potential energy?

Gravitational Potential Energy = mass x gravitational field strength x height $E_p = mgh$

How can we calculate elastic potential energy?

Elastic potential energy = 0.5 x spring constant x extension^2 $E_e = ½ ke^2$

How much energy is needed to heat a substance?

Energy transferred = mass x specific heat capacity x temperature change $\Delta E = mc \Delta\Theta$

How can we measure specific heat capacity?

To determine the specific heat capacity we use an electric heater to heat a metal block or a liquid in a beaker.
We need to measure:

- Energy transferred using an energy meter
- Mass of the substance using a balance
- Temperature change (final temperature – starting temperature) using a thermometer

Specific heat capacity can then be calculated using $c = \frac{\Delta E}{m\Delta\theta}$

Limitations:

- Only half of the heater fits in the metal block so energy is transferred to the surroundings.
- Energy will be transferred from the metal block/beaker to the surroundings. Wrapping it in insulation will reduce this.

What is power?

Power is the energy transferred per unit time.

Power = $\frac{Energy}{time}$ $P = \frac{E}{t}$

What does efficiency mean?

Efficiency = $\frac{useful\ energy\ output}{total\ energy\ input}$

What are the advantages and disadvantages of different energy stores?

Energy Resource	Advantages	Disadvantages
Fossil fuels (Coal, Oil and Gas)	Reliable – fossil fuel power stations can run 24 hours a day, 365 days a year to generate electricity.	Non-renewable - fossils fuels will eventually run out. Burning fossil fuels produces carbon dioxide which is a greenhouse gas so increases global warming. Impurities in fossil fuels can produce sulphur dioxide which causes acid rain. Incomplete combustion of fossil fuels produces carbon monoxide which is poisonous and carbon particulates (soot) which causes breathing problems and can make buildings look dirty.
Wind	Renewable. Does not produce carbon dioxide. Can be built out at sea (offshore windfarms). Land around wind turbines can be used for animal grazing.	Not–reliable – does not generate electricity if there is no wind/too windy. Cause noise pollution. Some people argue they spoil views.
Solar	Renewable Does not produce carbon dioxide. Solar panels can be fitted to roofs.	Not – reliable – does not generate electricity at night or if it is too cloudy. Solar farms take up a lot of land.
Nuclear	Does not produce carbon dioxide. Reliable – fossil fuel power stations can run 24 hours a day, 365 days a year to generate electricity. A lot of energy is released from a small amount of fuel.	Produces radioactive waste that needs to be stored for a long time. High profile nuclear disasters e.g. Chernobyl and Fukushima
Hydroelectric	Does not produce carbon dioxide. Reservoirs can provide new habitats. Generally reliable.	Limited locations that are suitable. Reservoirs cause flooding of habitats. Dams disrupt the movement of animals. Can be affected by droughts.
Tidal	Does not produce carbon dioxide. Reliable – two tides per day.	Limited suitable locations on river estuaries. Tidal barrages can disrupt movement of animals.
Wave	Does not produce carbon dioxide.	Expensive to set up.
Geothermal	Does not produce carbon dioxide.	Limited suitable locations with geothermal activity e.g. Iceland.
Biomass	Carbon neutral because the carbon dioxide that is released when plants are burned was taken out of the atmosphere when the plant was growing.	Large amounts of land required to grow plants for biomass fuel.

Key knowledge question	**Answer**
Write the equation that links kinetic energy, mass and speed	$E_k = ½ mv^2$ Kinetic Energy = 0.5 x mass x (speed)^2
Write the equation that links gravitational potential energy, mass, gravitational field strength and height	$E_p = mgh$ Gravitational Potential Energy = mass x gravitational field strength x height
Write the equation that links elastic potential energy, spring constant and extension	$E_e = ½ ke^2$ Elastic Potential Energy = 0.5 x spring constant x (extension)^2
Write the equation that links power, energy and time	E= Pt Energy = Power x time
Write the equation that links work done, force and distance moved	W = Fs Work Done = Force x distance moved
Write the equation to calculate efficiency	Efficiency = useful energy output / total energy input or Efficiency = useful power output / total power input
Which energy store is increased when a person climbs a ladder?	Gravitational potential energy store
Which energy store is stored in a hot cup of tea?	Thermal energy store
Which energy store is stored in a moving car?	Kinetic energy store
Which energy store is stored in a stretched spring?	Elastic potential energy store
Which energy store is stored in a battery?	Chemical energy store
What happens to dissipated energy?	it is transferred to thermal energy store of the surroundings
State the law of conservation of energy	energy cannot be created or destroyed, only transferred from one energy store to another
Name 3 fossil fuels	coal, oil and gas
Name 2 non-renewable energy sources	coal, oil, gas, nuclear
Name 2 renewable energy sources	wind, solar, hydroelectric, geothermal, biomass, wave, tidal

Big questions:

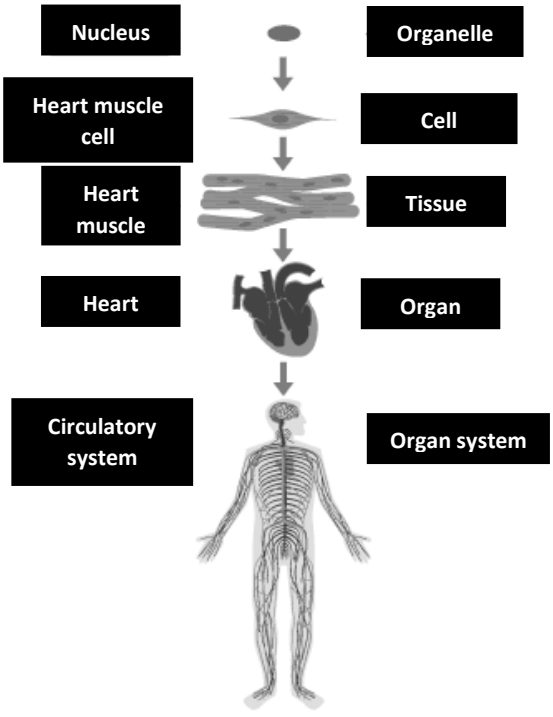
- **How is an organism arranged?**
- **What is the function of the digestive system?**
- **How do we test for biological molecules?**
- **Why are enzymes important?**
- **How can the rate of enzyme reactions be affected?**
- **What are some of the key enzymes?**
- **How are the lungs adapted for their function?**
- **How is the heart adapted for their function?**
- **How are blood vessels adapted for their function?**
- **What is the function of blood?**
- **How does life style affect non-communicable diseases?**
- **How is a plant structured?**
- **What is the function of stomata?**
- **What is translocation?**
- **What is transpiration?**

Key vocabulary

Active site	Region of an enzyme where specific substrate molecules bind and undergo a chemical reaction.
Alveolus **Alveoli (plural)**	A tiny air sac in the lungs, where gas exchange occurs
Amylase	Enzyme that catalyses the breakdown of starch into sugars.
Benign	Normally slow growing tumours that do not spread to other parts of the body.
Blood	Tissue which transports substances around the body in the circulatory system.
Blood vessels	Structures specially adapted to carry blood around the body
Denature	An enzyme's active site permanently changes shape and the enzyme is no longer able to function (substrate no longer fits)
Enzyme	Protein molecule that catalyses (speeds up) chemical reactions inside cells and the body.
Malignant	Tumour that can spread through the body for example via the blood stream (metastasise).
Non-communicable disease	A disease that cannot be transferred from organism to organism.
Organ	Group of similar tissues working together to perform a particular function.
Organ System	Group of organs working together to perform a particular function.

Pacemaker	Group of cells located in the right atria of the heart that regulates the heart rate.
Risk Factor	Something that increases a chance of developing a disease. Risk factors can be caused by lifestyle factors or substances in a person's body or their environment.
Statin	Drug used to reduce cholesterol in the blood. Can be used to treat CHD
Stent	Metal or plastic tubes used to widen the coronary arteries if they have been blocked due to CHD.
Stoma	Pore on the underside of a leaf.
Substrate	The molecule that fits into the active site of an enzyme.
Tissue	Group of similar cells working together to perform a particular function.
Translocation	Movement of sugar produced in photosynthesis to all other parts of the plant for respiration and other processes. Occurs in phloem cells.
Transpiration	Evaporation of water at the surfaces of the spongy mesophyll cells in leaves, followed by loss of water vapour through the stomata.

How is an organism arranged?



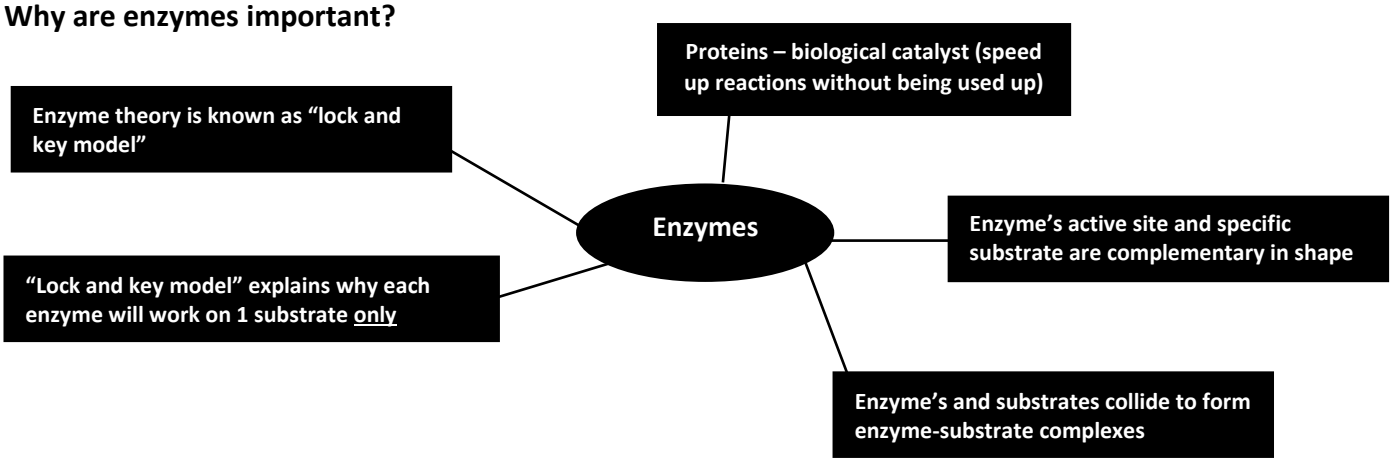
What is the function of the digestive system?

Structure	Function
Mouth	Where food enters the alimentary canal and digestion begins
Salivary glands	Produce saliva containing amylase
Oesophagus	Muscular tube which moves ingested food to the stomach
Stomach	Muscular organ where digestion continues
Pancreas	Produces digestive enzymes
Liver	Produces bile
Gall bladder	Stores bile before releasing it into the duodenum
Gall bladder	Stores bile before releasing it into the duodenum
Small intestine - duodenum	Where food is mixed with digestive enzymes and bile
Small intestine - ileum	Where digested food is absorbed into the blood and lymph
Large intestine - colon	Where water is reabsorbed
Large intestine - rectum	Where faeces are stored

How do we test for biological molecules?

Food sample	Reagent	Method	Initial colour	Colour of positive result
Reducing sugar	Benedict's	Add Benedict's reagent to the food and boil in a water bath.	Blue	Brick red precipitate
Starch	Iodine	Add iodine reagent to the food.	Yellow-brown	Blue-black
Protein/amino acids	Biuret	Add Biuret reagent to the food.	Blue	Lilac/purple
Fat	Ethanol	Add ethanol to the food to dissolve the fat then add water.	Colourless	White emulsion

Why are enzymes important?



Science Homework 3

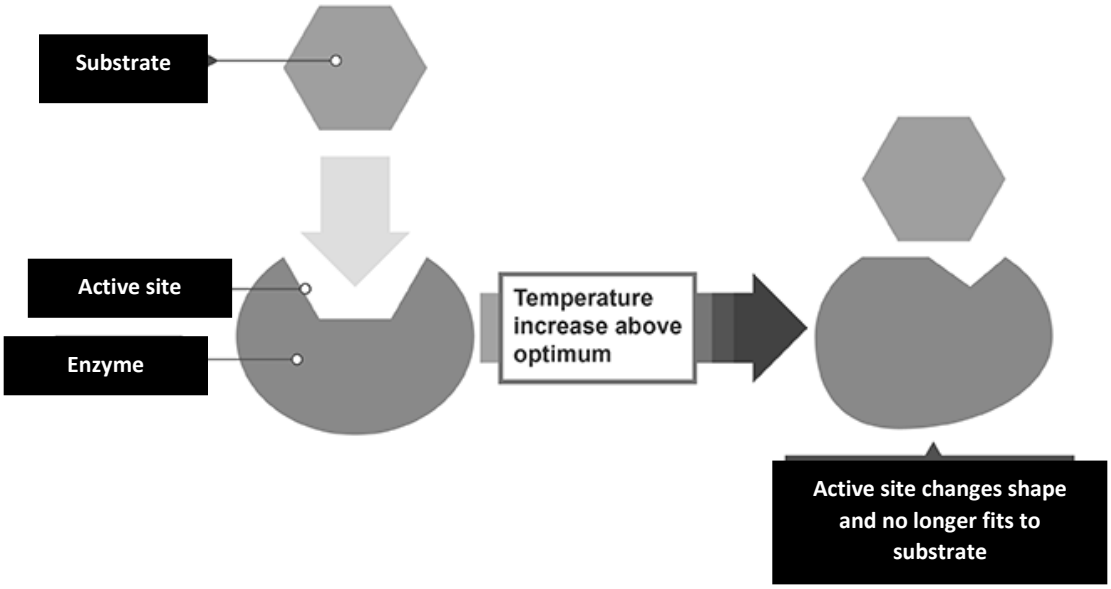
Try to answer all of these key knowledge questions. Then check your answers using the last page. These are some of the questions that will be in the knowledge quizzes and the end of term tests.

Key knowledge question	Answer
Where is the enzyme amylase made and what does is do?	
Where is the enzyme protease made and what does is do?	
Where is the enzyme lipase made and what does is do?	
What is the purpose of digestion?	
What are the products of digestion used for?	
State the function of arteries and describe their adaptations	
State the function of veins and describe their adaptations	
State the function of capillaries and describe their adaptations	
What is the function of red blood cells and how are they adapted?	
What is transpiration?	

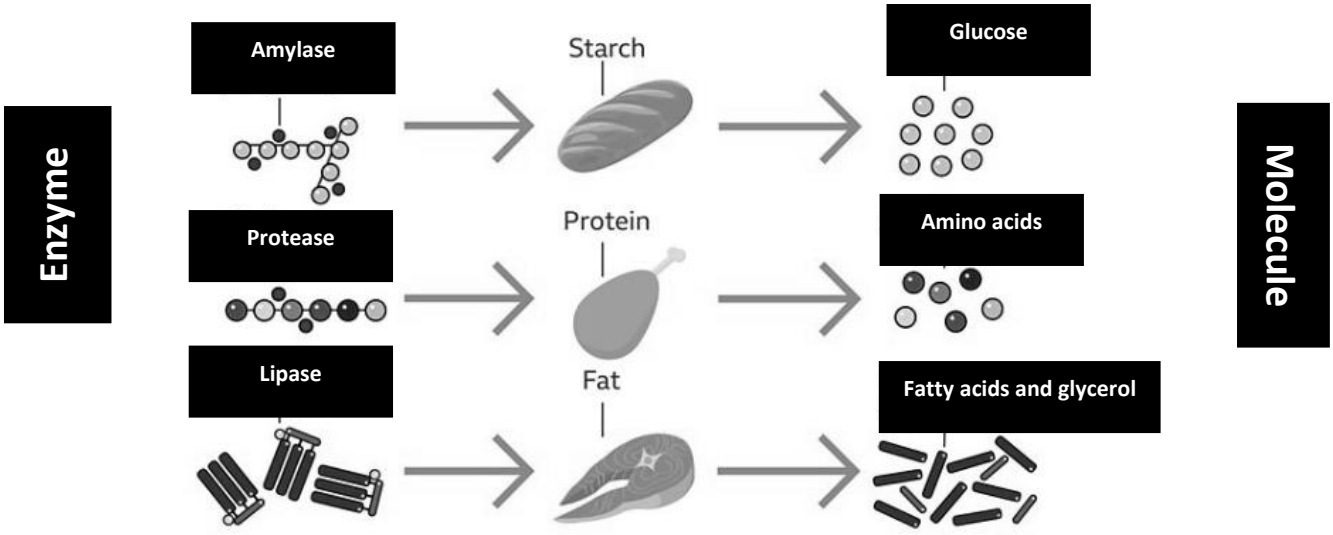
How can the rate of enzyme reactions be affected?

pH	Deviating from the optimum pH (too high or too low) causes the enzyme's active site to become denatured and the active site loses its important shape. It can no longer form enzyme-substrate complexes, leading to a decrease in enzyme activity.
Enzyme concentration	The higher the enzyme concentration, the more enzymes there are to form enzyme-substrate complexes, leading to an increase in enzyme activity. This happens up to a certain point. Enzyme activity then levels off (plateaus) as there are not enough substrate molecules to react with the extra enzymes.
Substrate concentration	The higher the substrate concentration, the more substrate there is to form enzyme-substrate complexes, leading to an increase in enzyme activity.
Temperature	As temperature increases to the optimum, the kinetic energy of the enzyme and substrate increases, causing more collisions between the enzyme and substrate**.** This causes the formation of more enzyme-substrate complexes, leading to an increase in enzyme activity. An increase in temperature beyond the optimum causes the enzyme's active site to become <u>denatured.</u>

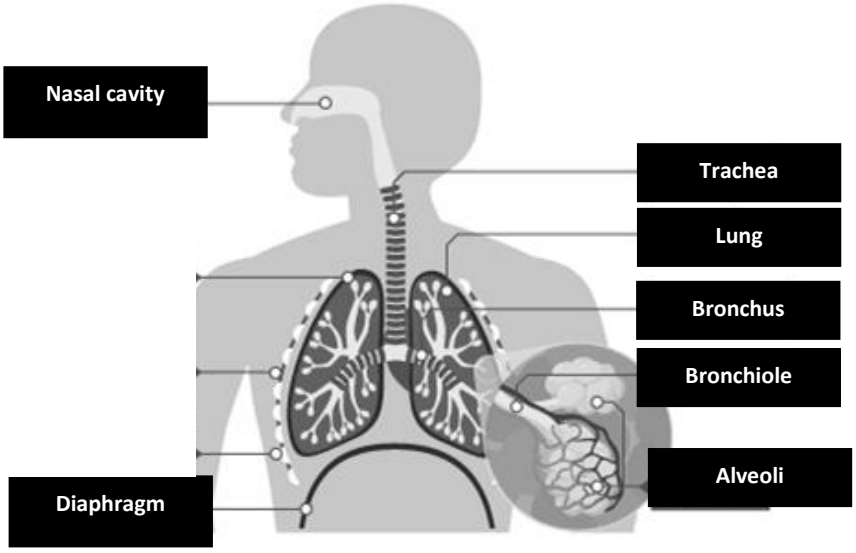
<u>Denaturation</u>



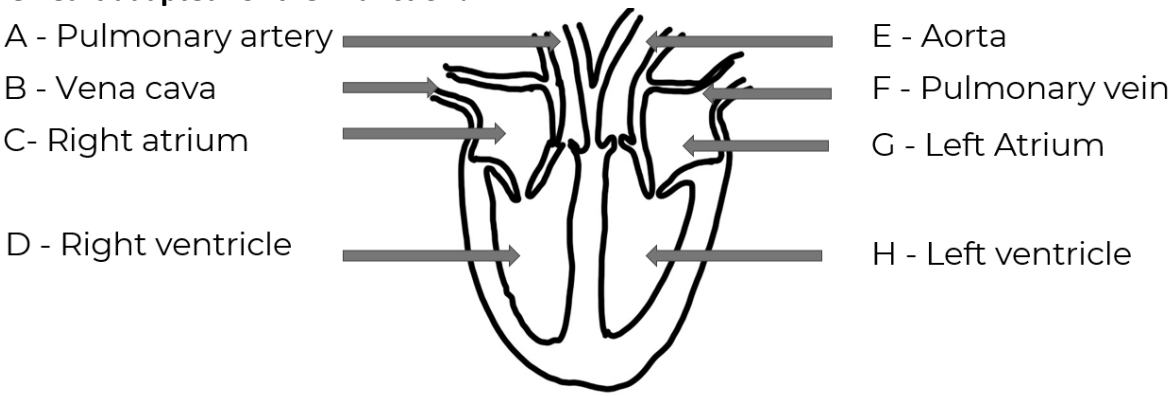
What are some of the key enzymes?



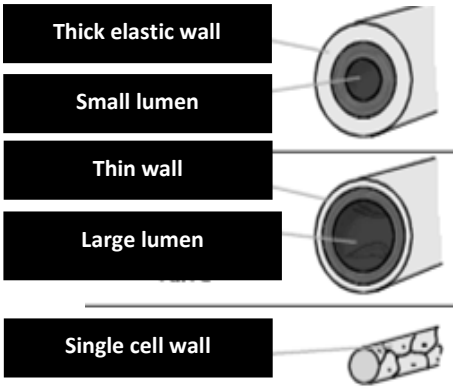
How are the lungs adapted for their function?



How is the heart adapted for their function?



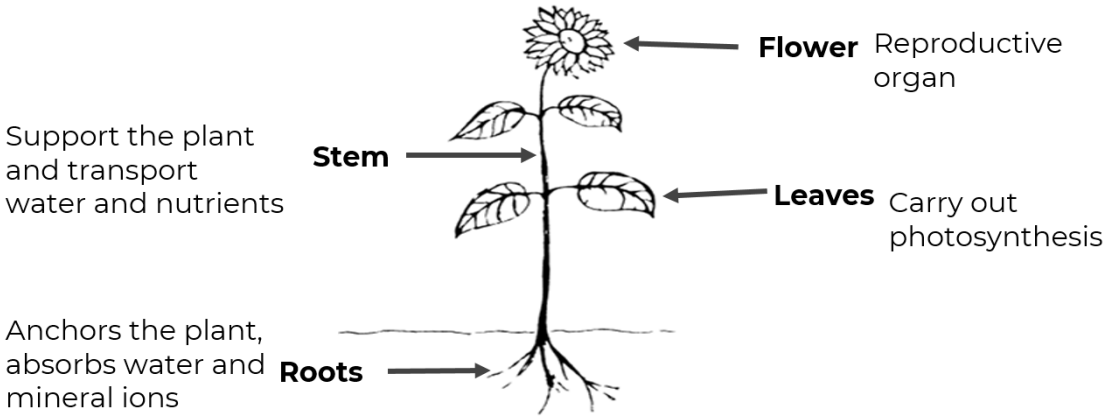
How are blood vessels adapted for their function?



What is the function of blood?

Blood Component	Function
Red Blood Cells	Carries oxygen around the body
White blood cell	Defend the body against pathogens
Platelets	Involved in blood clotting
Red Blood Cells	Carries oxygen around the body

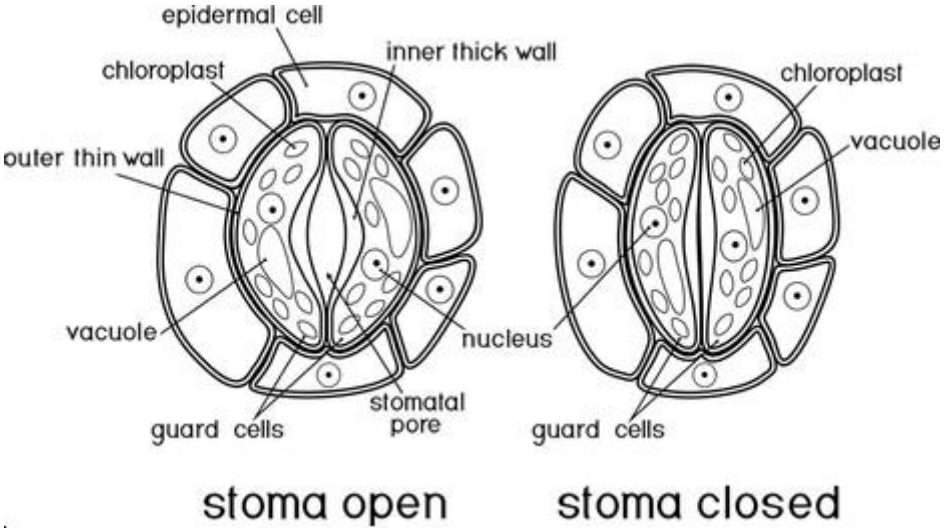
How is a plant structured?



Epidermis	**Cover** the **surfaces** of the leaf; lets **light penetrate**.59	**Palisade mesophyll**	Where **most photosynthesis** takes place. Cells contain **many chloroplasts**. **Absorbs light**.
Xylem	**Carries water** and **minerals** from the roots around the plant.	**Spongy mesophyll**	**Some photosynthesis**. Has **air spaces** for **diffusion** of CO_2 and O_2.
Phloem	**Carries dissolved sugars** made through photosynthesis around the plant. 6	**Guard cells**	Cells that **open** and **close stomata**.

What is the function of stomata?

Stoma	Opening that allows CO_2 and O_2 to diffuse in and out of the leaf.



What are translocation and transpiration?

Transpiration	Translocation
Movement of **water** through the **stomata**	Movement of **sugars** and **nutrients** from **leaves** to other plant parts
Water is transported	**Sucrose** is transported
Water **moves** upwards **only** in the **xylem**	Movement **any direction** by **phloem**
Involves **dead** cells	Involves **living** cells

Key knowledge question	**Answer**
Where is the enzyme amylase made and what does is do?	Made in the salivary glands, pancreas and small intestine -> Amylase digests (breaks down) starch into sugar (glucose)
Where is the enzyme protease made and what does is do?	Made in the stomach, pancreas and small intestine -> Protease digests (breaks down) protein into amino acids
Where is the enzyme lipase made and what does is do?	Made in the pancreas and small intestine -> Lipase digests (breaks down) fats into fatty acids and glycerol
What is the purpose of digestion?	Break down of large insoluble molecules into small soluble molecules so that they can be absorbed into the bloodstream.
What are the products of digestion used for?	To build new molecules and glucose is used in respiration
State the function of arteries and describe their adaptations	Arteries, carry blood away from the heart, thick elastic and muscular walls to withstand high pressure
State the function of veins and describe their adaptations	Veins, carry blood towards the heart, contain valves to prevent back flow
State the function of capillaries and describe their adaptations	Capillaries, exchange of substances, one cell thick (short diffusion path)
What is the function of red blood cells and how are they adapted?	Red blood cells, transport oxygen -> contain haemoglobin, biconcave in shape, no nucleus
What is transpiration?	The movement of water through a plant from the roots to the leaves