



EXAM PAPERS PRACTICE

Revision Booklet 2022-2023 **Edexcel IGCSE(9-1) in Biology**

Part 1: Sections 1 & 2 of the specification

- 1. The nature and variety of living organisms**
- 2. Structure and functions in living organisms**

This revision booklet has been made to follow the specification point by point and it has questions based on each point.

Revision questions based on the specification

Section 1: The Nature and Variety of living things

1.1 – 1.4 Characteristics and Variety of Living Things

List the 8 characteristics of life and give a brief description of each one with an example of a plant or animal carrying it out.

- **Movement** – The ability to move the position of all or part of the organism
- **Respiration** – The process of releasing energy in the form of ATP from glucose
- **Sensitivity** – The ability to sense changes in the environment around the organism

- **Control / homeostasis** – the ability to maintain the internal conditions inside cells i.e solute or mineral ion concentration, water content

- **Growth** – the ability to increase the number of cells, mass, or size over an organism's lifetime
- **Reproduction** – the ability to produce offspring
- **Excretion** – the ability to get rid of waste products from metabolic reactions
- **Nutrition** – the need to obtain the nutrients needed to maintain metabolic reactions

Complete the table about living organisms: yes/no (with description if needed)

	Plants	Animals	Fungi	Bacteria	Protoctists	Viruses
Unicellular or multicellular?	Multi	Multi	Uni and Multi	Uni	Uni and Multi	Not made of cells
Able to photosynthesise? (Do their cells have chloroplasts?)	Yes	No	No	Some can	Some can	No
Cell walls present? Do cells of these organisms have a cell wall? What substance is it made of?	Yes Cellulose	No	Yes Chitin	Yes Peptidoglycan or Murein	No	No



Nucleus present? Is the DNA enclosed in a nucleus in cells?	Yes	Yes	Yes	No	Yes	No
Examples? Name some examples of these organisms	Oak, tobacco plant	Humans, Snakes	Mucor, Yeast	Salmonella, Nitrobacter	Plasmodium, Euglena	HIV, Tobacco mosaic virus

How are carbohydrates stored in plants, animals and fungi?

- Plants: Starch
- Animals: Glycogen
- Fungi: Glycogen

Describe the common features shown by prokaryotic organisms such as bacteria.

- No nucleus (DNA is a circular chromosome called a **nucleoid**)
- Can have **plasmids** (these are smaller circles of DNA)
- No organelles like – mitochondria, chloroplasts, vacuoles
- They have a **cell membrane, cytoplasm, and cell wall made of peptidoglycan**
- Some bacteria have a **slime capsule** covering them
- Some bacteria have **flagella** to help them move
- They are smaller than eukaryotic cells

Why are viruses not considered living organisms as compared to the other 5 kingdoms?

- They not made of cells – no organelles, no cell membrane (only a protein coat)
- The cannot perform any life process except reproduction (and they can only reproduce inside other cells)
- They need to use the cells' mechanisms to replicate new viruses

What are the characteristics of a virus?

- They can have either DNA or RNA as their genetic material
- They do not have a cell membrane (only a protein coat)
- They are smaller than bacterial cells
- They are specific to the type of organism that they infect
- Can only reproduce inside living cells

Define the term 'pathogen'

- A microorganism that can cause disease
- They can be either – bacteria, fungi, protoctist, or viral



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Give an example of each a bacterial, fungal, protocist, and viral pathogen

- Bacterial – *Salmonella*, *E. coli*, *Lactobacillus bulgaricus*
- Fungal – ringworm, athletes foot
- Protocist – *Plasmodium*
- Virus – tobacco mosaic virus, influenza, HIV



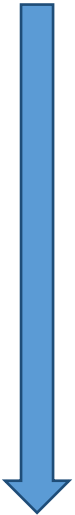
Section 2: Structures and functions in living organisms

2.1 – 2.4 structure of organisms

List the levels of organisation within an organism starting with the smallest and finishing at organism. Give a brief description of their roles

(Use these words: **Organs, Tissues, Systems, Organelles, Cells, Organism**)

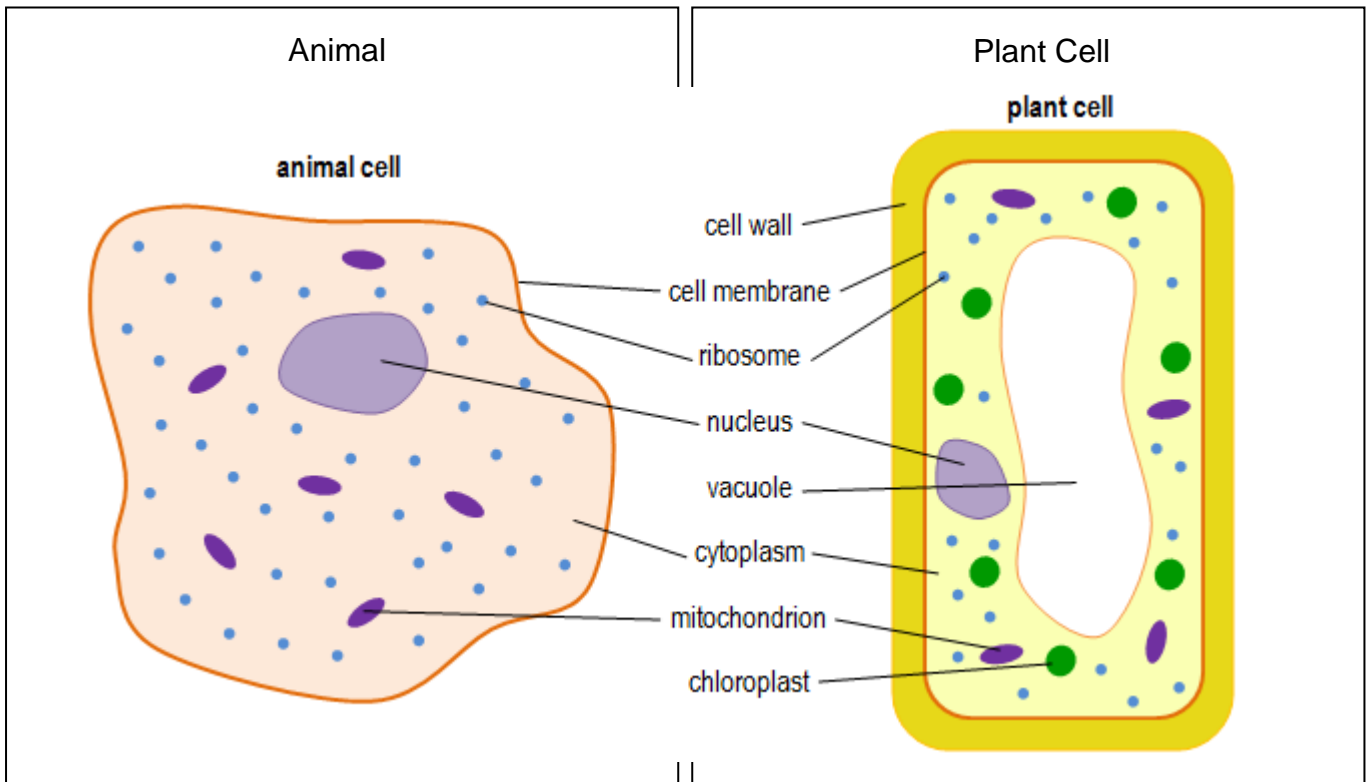
Smallest



Largest

- **Organelles** – Structures inside cells that perform specific functions
- **Cells** – Basic unit of life, they can be adapted to perform a specific function
- **Tissues** – A group of specialised cells that carry out a particular function
- **Organs** - A group of tissues working together to perform a particular function
- **Organ systems** – A group of organs working together to perform a particular function
- **Organism** – A group of organ systems working together to keep an organism alive

Draw and label a plant and an animal cell in the spaces below:





Complete the table below by including descriptions of the functions of cell organelles:

Cell Structure (Organelle)	Plant, Animal or both?	Description and Function of the cell Structure
Nucleus	Both	Controls the metabolic activity inside the cell, contains the genetic material that codes for proteins and is inherited
Cytoplasm	Both	Where chemical reactions take place, This is where organelles are found
Cell Membrane	Both	This controls what can enter and leave the cell, also it separates the contents of the cell from the outside of the cell
Cell Wall	Plant	This provides support to the cells so it can keep its shape as well as stopping it from bursting when there is a lot of water in the cell
Chloroplast	Plant	This is where photosynthesis occurs, where glucose and oxygen are made
Vacuole	Plant	This stores cell sap and helps keep the cell turgid by pushing the cytoplasm outwards towards the cell wall
Mitochondria	Both	This is where aerobic respiration takes place and where ATP is made

2.5 – 2.6 Specialised cells and Stem cells

What is cell differentiation?

- This is when undifferentiated cells become specialised

Why do cells become differentiated?

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- So that they can perform a particular function i.e. neurone sending impulses around the body

What are stem cells?

- Stem cells are undifferentiated cells that can turn into specialised cells

Define:

Embryonic stem cells:

- Undifferentiated cells collected from embryos – These can turn into any type of cell

Adult stem cells:

- Undifferentiated cells collected from adults – These can turn into a limited number of types of cells

Why are stem cells used in medicine?

- Since stem cells are undifferentiated so they can be used to replaced damaged cells/tissue.
- They can turn into the desired cell type and replace lost cells

How can stem cells be used in medicine?

- Stem cells can be used to repair broken nerves in the spine and help cure paralysis,
- They can be used to replace lost brain tissue in diseases like Parkinson's or Alzheimer's,
- They can be used to grow new organs

Complete this table:

Advantages of using stem cells	Disadvantages of using stem cells
<ul style="list-style-type: none">• Embryonic stem cells can turn into most types of cells• Less chance of rejection by the host• Adult stem cells can be collected	<ul style="list-style-type: none">• The embryo is destroyed when collecting embryonic stem cells• The operation is painful when collecting adult stem cells



<p>relatively easily</p> <ul style="list-style-type: none">• Can be used to treat many diseases	<ul style="list-style-type: none">• Can have a risk of causing some forms of cancer
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2.7 – 2.14 Biological molecules

What elements from the periodic table are found in **Carbohydrates**?

Choose from these elements: Sulphur, Carbon, Nitrogen, Hydrogen, Phosphorous, Oxygen.

- Carbon, Hydrogen, Oxygen

What elements from the periodic table are found in **Lipids** (fats and oils)?

Choose from these elements: Sulphur, Carbon, Nitrogen, Hydrogen, Phosphorous, Oxygen.

- Carbon, Hydrogen, Oxygen (there is a much higher ratio of hydrogen to oxygen in lipids than in carbohydrates)

What elements from the periodic table are found in **Protein**?

Choose from these elements: Sulphur, Carbon, Nitrogen, Hydrogen, Phosphorous, Oxygen.

- Carbon, Hydrogen, Oxygen, Nitrogen (plus 2 Amino acids have Sulphur as well)

	Starch	Glycogen	Protein	Lipids
What are the functions of these large molecules?	Store of energy	Store of energy	<ul style="list-style-type: none"> • Structural • biological catalysts – speed up reactions • immune response – antibodies • receptors • hormones 	Structural – cell membranes Store of energy, insulation
What are the subunits/monomers that make up these molecules?	Glucose (simple sugars)	Glucose (simple sugars)	Amino acids	Glycerol and fatty acids
What are the names of the bonds between the monomers/subunits in these molecules?	Glycosidic bonds	Glycosidic bonds	Peptide bonds	Ester bonds
Are these found in plant cells or animal cells or both?	Plant	Animal	Both	Both




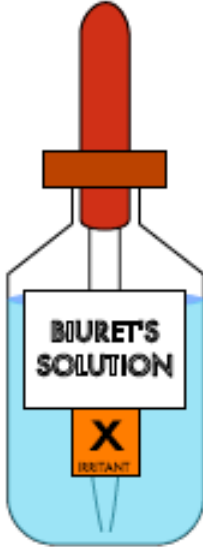

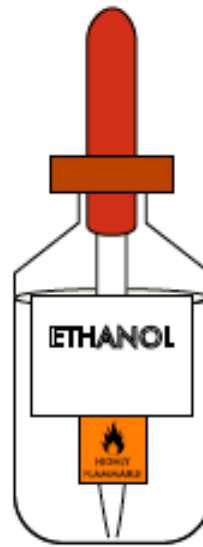
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2.9 Practical:

BIOCHEMICAL (FOOD) TESTS

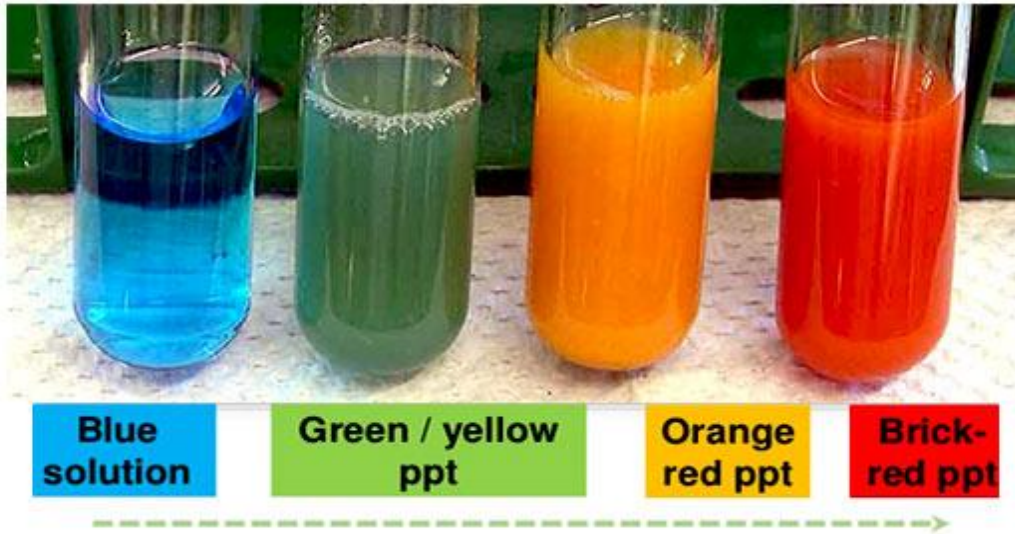
CHEMICAL	TESTS FOR ...?	HOW TO CARRY OUT THE TEST	RESULT	CHEMICAL	TESTS FOR ...?	HOW TO CARRY OUT THE TEST	RESULT
	<p>Iodine test</p> <p>Tests for: starch</p> <p>How to carry out the test: drop iodine onto a (food) sample</p> <p>Result: if starch is present then it will go from brown to very dark blue/black</p> <p>If starch is absent it will remain brown</p>				<p>Biuret test</p> <p>Tests for: Protein</p> <p>How to carry out the test: drop biuret solution onto a (food) sample</p> <p>Result: if protein is present then it will go from light blue to purple</p> <p>If protein is absent it will remain blue</p>		
	<p>Benedict's test</p> <p>Tests for: (reducing) sugars i.e. glucose</p> <p>How to carry out the test: put (food) sample into test tube, add benedict's solution, then heat to a high temperature for 5 minutes using a water bath</p> <p>Result: if glucose is present then it will go from blue to green/yellow/orange/red depending on how much glucose there is</p> <p>If glucose is absent then it will stay blue</p>				<p>Emulsion test</p> <p>Tests for: lipids</p> <p>How to carry out the test: put (food) sample into test tube, add some water, shake, add some ethanol, shake well</p> <p>Result: if lipid is present then it will turn cloudy</p>		



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This is the Benedict's test. What do the colours represent?



- Green/yellow – low concentration of glucose present
- Orange – higher concentration of glucose present
- Red – very high concentration of glucose present

What are enzymes made up of?

- Proteins/amino acids

What do enzymes do?

- Biological catalysts – lower activation energy for metabolic reactions to occur/speed up the rate of metabolic reactions

Explain what is meant by a biological catalyst.

- A biological catalyst is an organic molecule (a protein) that lowers the activation energy of reactions to speed up rates of reaction without getting used up in the reaction themselves.
- Catalysts used in chemistry are inorganic metals.

Why don't enzymes get used up in the reactions they catalyse?

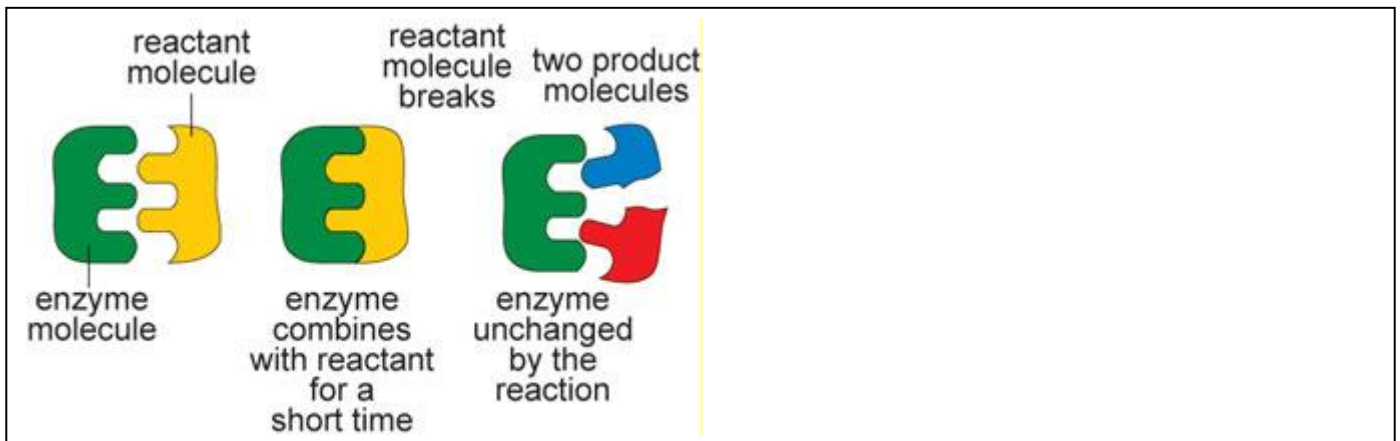
- Enzymes provide an alternative reaction pathway allowing reactions to occur. They allow the substrate to react and make products but are not part of the reaction themselves.



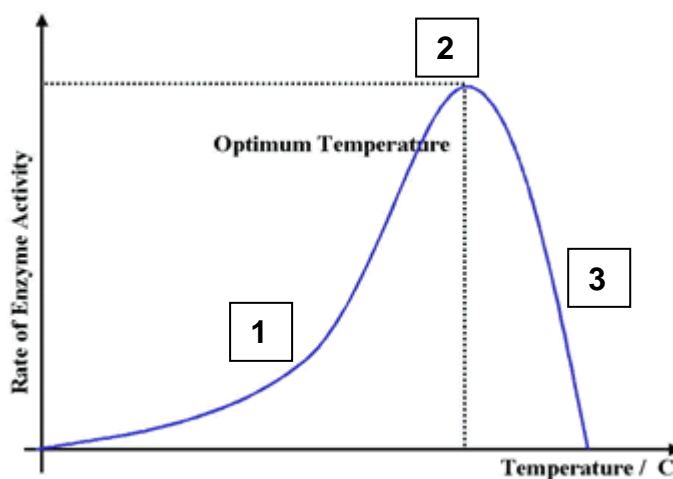
Describe the lock and key theory: (use these words in your answer – **Active site**, **substrate**, **complementary**, **specific shape**, **fit**)

- Enzymes have a specific 3D shape; part of the shape is called the active site where reactions take place. The active site of an enzyme is specific to its substrate, therefore the substrate only has a complementary shape to that enzyme's active site and will fit perfectly in it.

Draw a diagram of the lock and key theory:



Describe and explain what is happening in each part of the graph. Use these words to help you answer: **Collisions**, **quicker**, **increases**, **substrate**, **optimum temperature**, **decreases**, **denature**, **shape**, **active site**, **permanent**



- As temperature increases the rate of enzyme activity also increases until it reaches a maximum rate and then the rate of enzyme activity decreases.
- This is because as temperature increases the enzyme and substrate move quicker and there are more successful collisions between them. This happens until the optimum temperature for the enzyme is reached where the reactions occur at the fastest rate. After this the enzymes begin to denature and change shape. This means that the active site no longer has a complementary shape to the substrate and the reactions can no longer occur. This is a permanent change and cannot be reversed.

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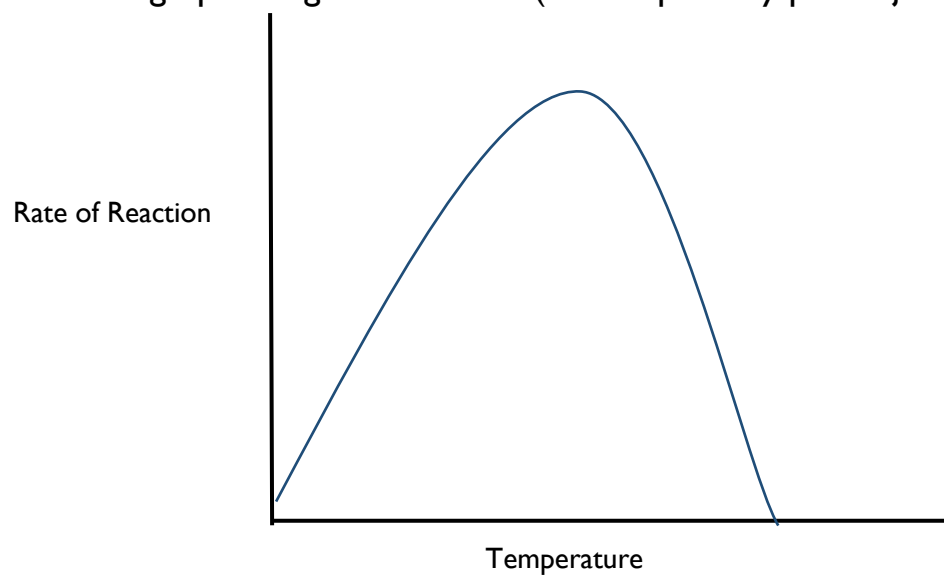
2.12 Practical: Design a simple experiment that shows how temperature affects the rate of reaction of an enzyme.

Equipment	Method
<ul style="list-style-type: none"> • Water baths at 10°C, 20°C, 30°C, 40°C, 50°C, 60°C, 70°C • Amylase • Starch solution • Iodine solution • Spotting tiles • Test tubes • Pipettes 	<ol style="list-style-type: none"> 1. Put starch solution into test tubes, put amylase into different test tubes. 2. Put each test tube of starch and amylase into water bath for 5 minutes. 3. The control will starch with no amylase at each temperature 4. Take a few drops out of each starch test tube and drop onto a spotting tile. Add a few drops of iodine and see if there is starch present. Record results. 5. Add the amylase to the starch test tubes and start the stop clocks. Every 30 seconds repeat step 4. 6. Do this for 10 minutes.

This is an example results table of catalase reacting with hydrogen peroxide producing oxygen. Complete the table for the rate of reaction to 2dp

	Temperature (°C)						
	10	20	30	40	50	60	70
Number of seconds to produce 10cm ³ of oxygen	90	80	50	20	50	100	250
Rate of Reaction (1/time taken)	1/90 = 0.01	1/80 =0.0125	1/50 =0.02	1/20 = 0.05	1/50 =0.02	1/100 =0.01	1/250 =0.004

Sketch a graph using these results (do not plot any points just draw a line of best curve)



What is the optimum temperature for this enzyme? Explain your answer using data

- 40°C, because it was the fastest rate of reaction

How does pH affect the functioning of enzymes? (Use the words – **denature, shape, narrow range, optimum pH**)

- Each enzyme works within a narrow range of pH. If the pH goes beyond either side of the optimum pH then the enzyme will change shape and denature. The optimum pH is the pH that the enzyme works the fastest at.

What would happen to enzymes that work in the acid of the stomach when they go into the small intestine where it is less acidic? Explain your answer

- The pH of the intestine is more alkaline, therefore higher, than the stomach. This means that the enzymes that work in the more acidic conditions of the stomach will no longer work as they will become denatured.



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2.14 Practical: Design a simple experiment that shows how pH affects the rate of reaction of an enzyme using potato chips and hydrogen peroxide.

Equipment

Method

- Different pH buffers: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
- Potato corer
- Hydrogen peroxide solution
- Test tubes

- Make potato chips the same size using the potato corer and ruler.
- In each test tube add a pH buffer and put a potato core in there; leave for 5 minutes
- Add hydrogen peroxide to each test tube and measure the height of the foam produced after a minute.
- For the control, use water instead of hydrogen peroxide at each pH

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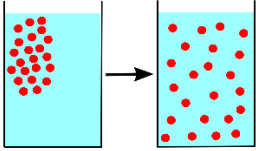
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2.15– 2.17 Movement of Substances into and out of Cells

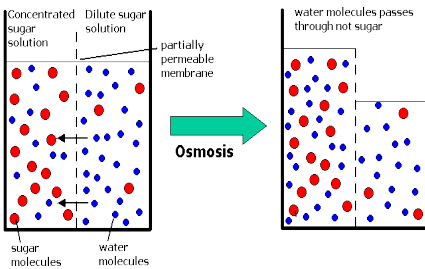
Define: (use these questions to guide you: Does the process require energy? Does it require a membrane? Does the process go with or against the concentration gradient?)

• Diffusion -



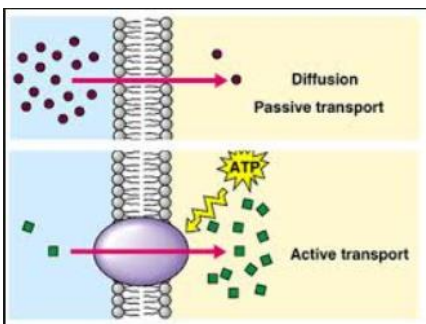
- Requires particles
- Passive (no energy required)
- No membrane required
- Diffusion occurs down a concentration gradient (from an area of high concentration to and area of low concentration)

• Osmosis -



- Special type of diffusion that only happens with **water**
- Passive (no energy required)
- Partially permeable membrane required
- Diffusion occurs down a concentration gradient (from an area of **high water concentration** to and area of **low water concentration**)

• Active Transport - ...



- Involves particles
- Energy (ATP) is required
- Membrane required with carrier proteins
- Active transport occurs up a concentration gradient (from an area of low concentration to and area of high concentration)

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How and why do these factors affect the rate of the movement of substances into and out of cells?

Surface area to volume ratio:

- The larger the surface area to volume ratio the faster the rate of diffusion as there is more surface for diffusion to occur across

Temperature:

- The higher the temperature the faster particles move therefore diffusion can occur faster

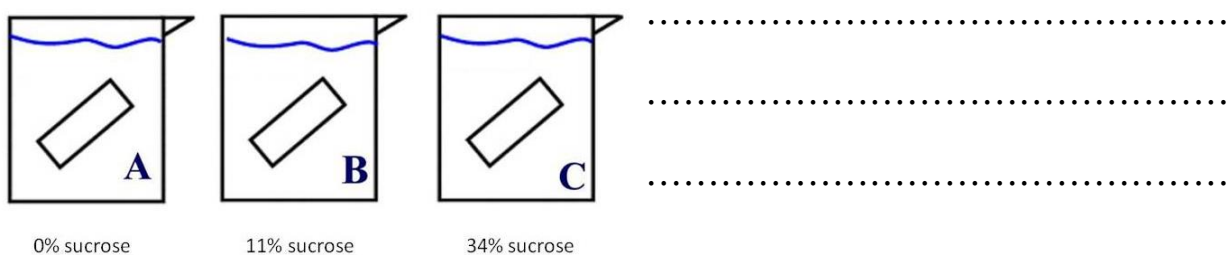
Distance:

- The shorter the distance to travel the faster diffusion can occur

Concentration gradient:

- The larger the difference in concentration between the two areas the faster particles will move across from an area of high concentration to an area of low concentration.

Describe an experiment to show the effect of osmosis on potato chips. Use these words/pieces of equipment in your answer: weighing scales, core borer, different solutions of sugar concentration, potato.

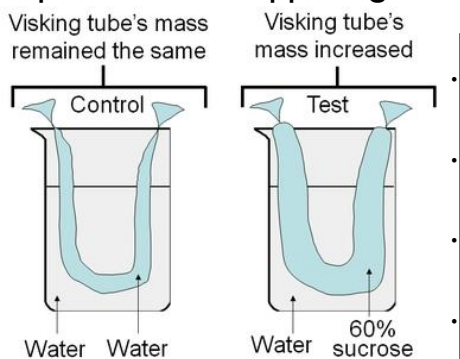


- Cut identically sized potato chips using a core borer
- Rinse and dry the chips then measure the mass and length of each of the identically sized potato chips
- Put the identically sized potato chips into solutions of different concentrations of salt (or sugar)
- After a set amount of time (15 minutes for example) take the potato chips out of the solutions and dry them.
- Then measure the mass and lengths of the potato chips again.

What is visking tubing?

- A type of plastic that can model a partially permeable membrane and osmosis. It allows water through but does not allow any other molecule through

Explain what is happening in this diagram of visking tubing.



- The mass of the visking tubing increased because there was a higher concentration of water outside the visking tubing than inside it. The sucrose could not diffuse across the visking tubing as it was too large therefore water moved from the area of high concentration to the area of low concentration through the partially permeable membrane.
- The mass in the first experiment did not increase as there was no concentration gradient between the inside and out of the visking tubing.

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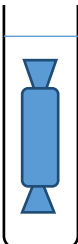

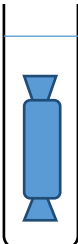
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2.17 Practical: Investigate diffusion and osmosis using living and non-living systems

Potato cylinders in solutions of different concentrations	Visking tubing with solutions of different concentrations
<p>Describe what would happen to the mass and length of this potato chip if it is put into a dilute solution</p>  <ul style="list-style-type: none">The mass and length would increase (because water is entering the potato)	<p>Describe what would happen to this visking tubing if it had a concentrated solution of glucose inside it with a dilute solution surrounding it</p>  <ul style="list-style-type: none">The mass would increase (because water is entering the visking tubing)
<p>Describe what would happen to the mass and length of this potato chip if it is put into a concentrated solution</p>  <ul style="list-style-type: none">The mass and length would decrease (because water is leaving the potato)	<p>Describe what would happen to this visking tubing if it had a dilute solution inside it with a concentrated solution of glucose surrounding it</p>  <ul style="list-style-type: none">The mass would decrease (because water is leaving the visking tubing)

How would you work out the concentration of the inside of potato cells using an experiment similar to this?

- Using the different solutions of sugar and measuring the differences in the lengths and mass of the potato chips a graph would be drawn.
- Then using the line of best fit you could see where there would be no change in the length or mass of the potato chip.
- If the potato chip doesn't increase or decrease in length or mass then there is no net movement of water into or out of the potato since the concentration inside the potato is the same as outside the potato.



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2.18 – 2.23 Nutrition in Flowering plants

What is Photosynthesis? What is needed for it to occur?

- Photosynthesis is the process whereby plants use sun light to convert carbon dioxide and water into glucose and oxygen. This can only occur in the presence of chlorophyll in chloroplasts.

Why is light needed for photosynthesis? (Hint: light energy \Rightarrow chemical energy)

- Light is needed to provide the energy needed to convert carbon dioxide and water into glucose and oxygen. The energy is stored in the glucose molecule as chemical energy.

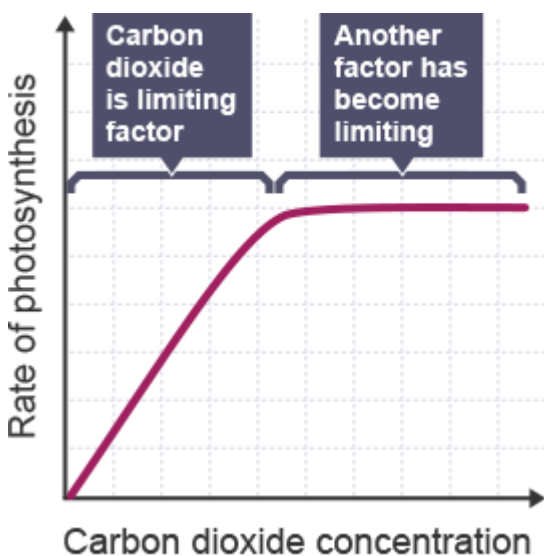
What is the word equation and balanced chemical symbol equation for photosynthesis?

- Carbon dioxide + water \rightarrow Glucose + oxygen
- $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$

What does limiting factors mean?

- The factor that is slowing down the rate of photosynthesis even when there is an excess of other factors.

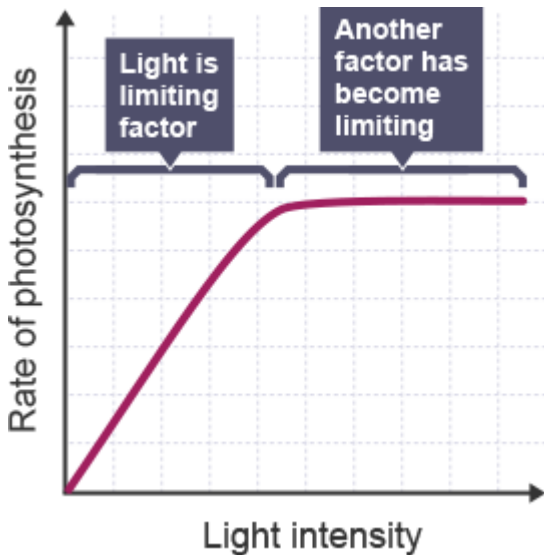
Explain this graph on carbon dioxide and the rate of photosynthesis



- As the carbon dioxide concentration increases the rate of photosynthesis increases. This means that the carbon dioxide concentration is limiting the rate of photosynthesis as when it increases the rate increases. However, there is a point when increasing the carbon dioxide concentration does not affect the rate of photosynthesis as now it is in excess, something else is limiting the rate of photosynthesis e.g. light intensity or temperature.

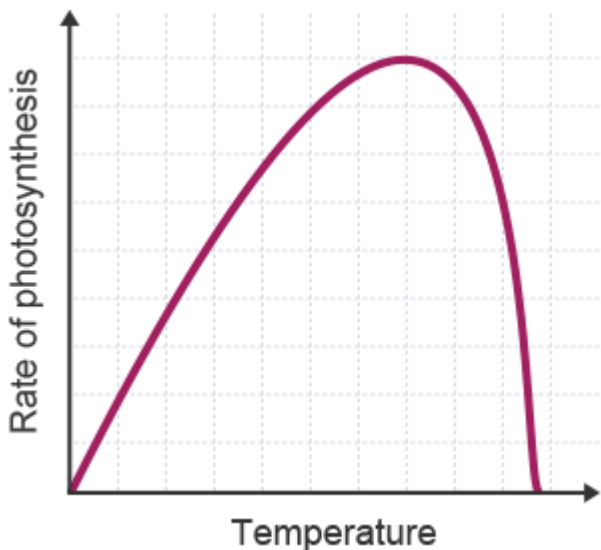


Explain this graph on light intensity and the rate of photosynthesis



- As the light intensity increases the rate of photosynthesis increases. This means that the light intensity is limiting the rate of photosynthesis as when it increases the rate increases. However, there is a point when increasing the light intensity does not affect the rate of photosynthesis as now it is in excess, something else is limiting the rate of photosynthesis e.g. carbon dioxide concentration or temperature.

Explain this graph temperature and the rate of photosynthesis



- As the temperature increases the rate of photosynthesis increases. This means that the temperature is limiting the rate of photosynthesis as when it increases the rate increases. This is because rates of reactions increase as temperature increases. However, as the temperature continues to increase the rate of photosynthesis decreases as the enzymes involved with photosynthesis are becoming denatured which slows down and stops the reaction from occurring.

Describe what this graph is showing you. Use the data in the graph

The effect of carbon dioxide concentration & temperature on the rate of photosynthesis



- As light intensity increases the rate of photosynthesis increases. However, the rate of photosynthesis is higher when there is a higher concentration of carbon dioxide and when there is a higher temperature.

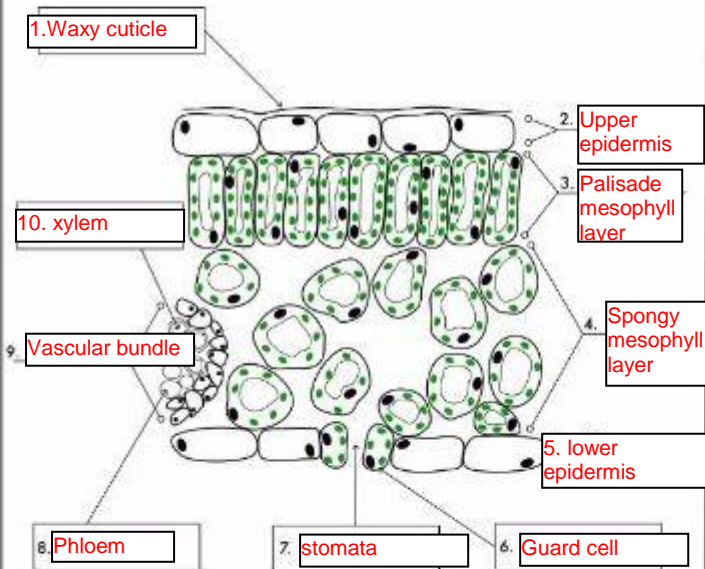


Complete this diagram

ADAPTATION OF THE LEAF TO PHOTOSYNTHESIS

FEATURES OF A LEAF

★ Label the parts of the leaf in the diagram below
Use the table on the right to help you if needed



FUNCTIONS OF THE LEAF PARTS

★ Complete the table below with how each feature of the leaf helps the plant photosynthesise efficiently

Leaf Part	How is it involved in Photosynthesis?
Waxy Cuticle	Prevents too much evaporation
Upper Epidermis	Is transparent to allow light to pass through
Palisade Mesophyll	Cells have many chloroplasts to photosynthesis
Spongy Mesophyll	Full of air spaces to allow gas diffusion in and out
Lower Epidermis	Contains no chloroplasts
Xylem	Carries water and mineral ions for photosynthesis
Phloem	Carries products of photosynthesis away

Explain how the structure of the leaf is adapted for photosynthesis

Use some or all of these words to help you: **flat, vertical cells, air spaces, stomata, vascular bundle, chloroplasts, thin, waxy cuticle**

- Leaves have a large surface area to catch as much sun light as possible
- Leaves are very thin to allow a short diffusion distance for gasses to diffusion faster
- Palisade cells are vertical so that they do not layer on top of each other so that they can absorb as much sun light as possible
- Palisade cells are full of chloroplasts so that they can do more photosynthesis
- Air spaces allow gaseous exchange
- Vascular bundle provides water for photosynthesis
- Stomata allows carbon dioxide to diffusion into and oxygen to diffuse out of the leaf
- Waxy cuticle prevents water loss by evaporation



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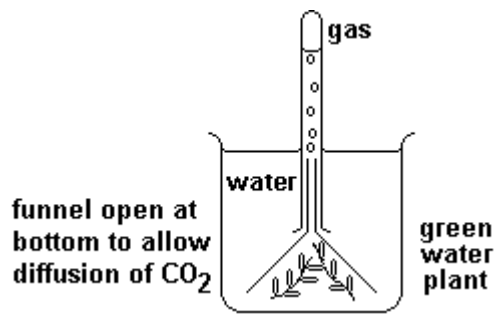
Why do plants need magnesium ions?

- To help make chlorophyll in chloroplasts

Why do plants need nitrate ions?

- To provide the nitrogen needed to make proteins

2.23 Practical: How can you test to see if oxygen is being produced by photosynthesis?



- Put a freshly blown out splint in the gas that is produced. If it is pure oxygen the splint should catch on fire again.

What could you do to this experiment to see how light affects the production of bubbles?

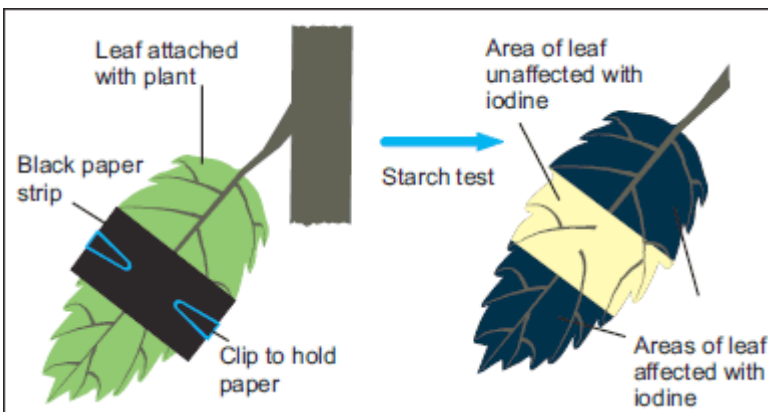
- Change the light intensity and count the number of bubbles per minute or measure the amount of oxygen produced in a set amount of time
- Make sure that the temperature stays the same and that there is an excess of carbon dioxide so that they are not the limiting factors.



The leaf starch test tests for the presence of starch. How can starch show that photosynthesis has taken place?

- During photosynthesis glucose is produced.
- Glucose is converted into starch.
- Therefore, if starch is present then photosynthesis has occurred.

Explain this experiment. How does it show light is needed for photosynthesis?



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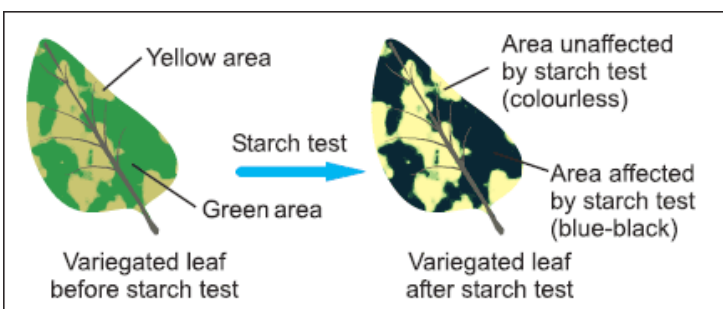
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- Light cannot go through the black paper
- Starch is present in the areas that were uncovered but no starch was present where the leaf was covered
- Therefore, this shows that light is needed to produce starch

Explain this experiment. How does it show chlorophyll is needed for photosynthesis?



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- The green areas of the leaf contain chlorophyll
- Where there is chlorophyll there is starch
- Where there is no chlorophyll there is no starch
- Therefore, chlorophyll is needed for photosynthesis



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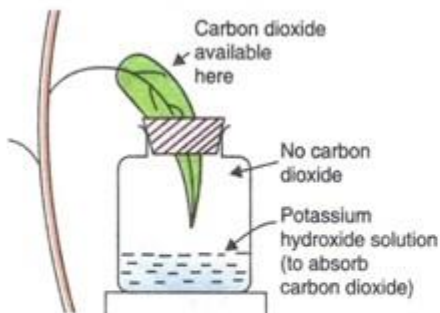
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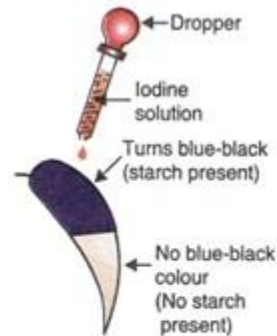
Explain how this experiment shows that carbon dioxide is needed for photosynthesis



(a) The upper part of leaf has carbon dioxide around it but the lower half of the leaf has no carbon dioxide available to it.



(b) Chlorophyll removed leaf (after boiling in alcohol).



(c) Iodine solution being poured on decolourised leaf.

- The area of the leaf that had access to carbon dioxide produced starch
- The area that did not have access to carbon dioxide did not produce starch
- Therefore, this indicates that carbon dioxide is required for photosynthesis



EXAM PAPERS PRACTICE

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2.24 – 2.33 Nutrition & Digestion in Humans

What is a balanced diet?

- A balanced diet is when carbohydrates, lipids, proteins, minerals, vitamins, fibre, and water are consumed in the **correct proportions**

Identify sources and describe functions of:

Nutrient	Sources	Function
Carbohydrate	Pasta, potatoes, rice, cereals	To provide a source of energy
Protein	Meat, fish, nuts	To help the body grow and also help the body repair or replace damaged tissues
Lipids	Meat, vegetable oils, butter, milk	To provide a long term energy store, to make cell membranes, to help nerve impulses move quickly
Vitamin A	Vegetables, carrots	To prevent night blindness
Vitamin C	Oranges, citrus fruits, vegetables, fruits	To prevent scurvy – it helps tissues connect together
Vitamin D	Vegetables, fruits, mushrooms	To help bones stay strong and prevent rickets
Calcium	Milk, cheese, butter	To help bones stay strong
Iron	Red meat, green leafy vegetables like spinach	To help produce haemoglobin in red blood cells, to prevent anaemia
Water	Water, fruit, vegetables, milk	To provide an environment where chemical reactions can occur inside cells
Dietary Fibre	Vegetables, fruit	To help the intestines have something to push against to push food through, prevents constipation and bowel cancer



Why do energy requirements vary with activity levels, age and pregnancy?

- More active people require more energy as they are releasing more energy in respiration, people who are less active are not respiring as much so therefore, need less energy
- Pregnant women require more energy as they need to provide energy to the growing baby
- As children get older they require more energy as they are growing but as they get older past 25 their metabolic rate slows down and so require less energy
- Men generally require more energy than women as they generally have more muscle mass which respire more

Describe the structures and functions of the alimentary canal:

Mouth:

- The teeth and tongue mechanically break down the food
- Saliva lubricates the food
- Saliva also has an enzyme, amylase, that begins to digest starch

Oesophagus:

- The oesophagus is a muscular tube from the mouth to the stomach
- Food passes through it by muscular contractions called peristalsis

Stomach:

- The stomach is a muscular bag that churns the contents.
- It produces hydrochloric acid to provide conditions that kill bacteria
- Also the hydrochloric acid provides the optimum pH for pepsin, a protease enzyme that breaks down protein

Small intestine (*duodenum and ileum*):

- The small intestine is divided into two parts – the **duodenum** and the **ileum**
- **Duodenum** – this is where most digestion occurs, the stomach acid is neutralised and digestive enzymes are produced and released which breaks down the food even further. The pancreatic duct and the bile duct open into the duodenum releasing digestive juices and bile.
- **Ileum** – this is where the **absorption** of the digested food occurs. It has a large surface area created by many villi.



Large intestine (*colon and rectum*):

- **Colon** – Water is absorbed from the undigested food.
- **Rectum** – the waste is stored here until it is expelled through the **anus** and out of the body.

Pancreas:

- The pancreas creates digestive enzymes, like pancreatic **lipase** and **amylase**, that are released into the duodenum to help with the digestion of food.

Write the definitions for:

Ingestion:

- The intake of food

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Digestion:

- The breakdown of food into smaller particles.
- The breakdown of large insoluble molecules into smaller soluble molecules

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Absorption:

- The absorption of the products of digestion into the blood stream

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Assimilation:

- Cells taking in the products of digestion from the blood stream and using them

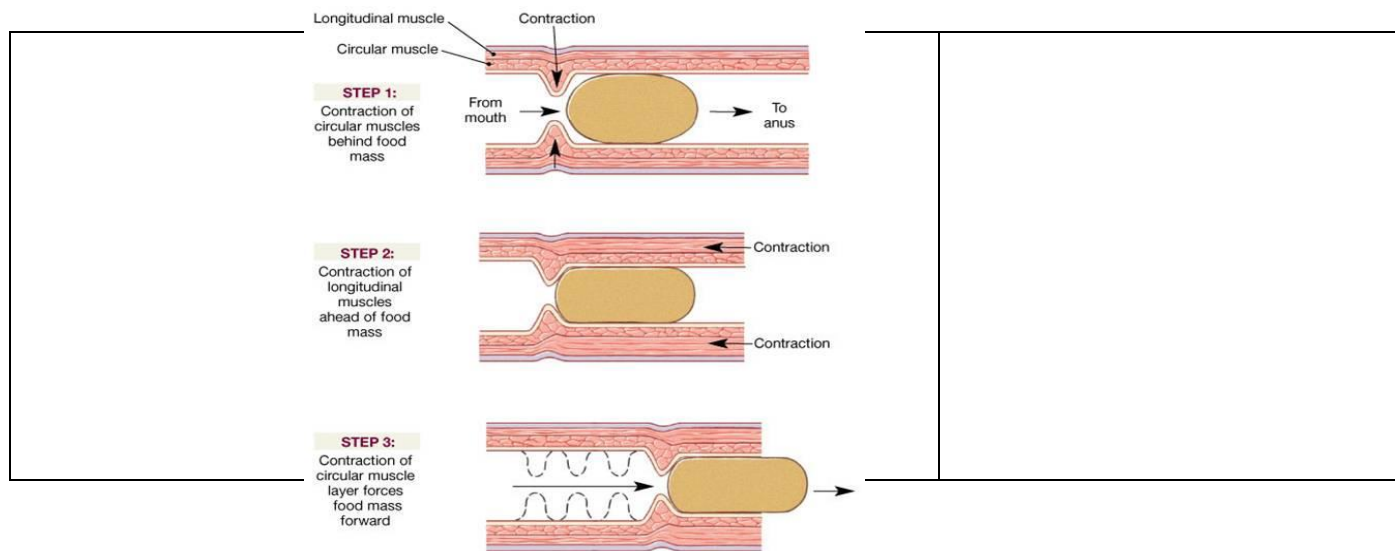
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Egestion:

- The waste that cannot be digested is pushed through the alimentary canal and out of the body without being digested

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Describe peristalsis in the gut using diagrams (like a cartoon):



Explain why peristalsis happens.

- To help push the contents of the intestines along so that digestion and absorption can occur

What do digestive enzymes do?

- Digestive enzymes break down food nutrients into small soluble molecules so that these can be absorbed

Where in the digestive system are digestive enzymes produced?

- Mouth – Amylase (carbohydrase) breaks down starch
- Stomach – Pepsin (protease) breaks down proteins
- Duodenum and pancreas – Lipases, proteases, and carbohydrases like amylase

What do amylase and maltase work on and what are the products?

- Amylase breaks down starch into maltose
- Maltase breaks down maltose into glucose

What do proteases do and what are the products?



- Proteases break down proteins into amino acids

What do lipases do and what are the products?

- Lipases break down lipids (fats and oils) into glycerol and fatty acids

What is the role of the liver and gall bladder in digestion?

- Liver – produces bile
- Gall bladder – stores bile

Describe how bile works.

- Bile neutralises stomach acid to produce the optimum pH for enzymes that work in the duodenum
- Bile also emulsifies lipids so that a larger surface area is produced for lipase to break down fats and oils at a faster rate

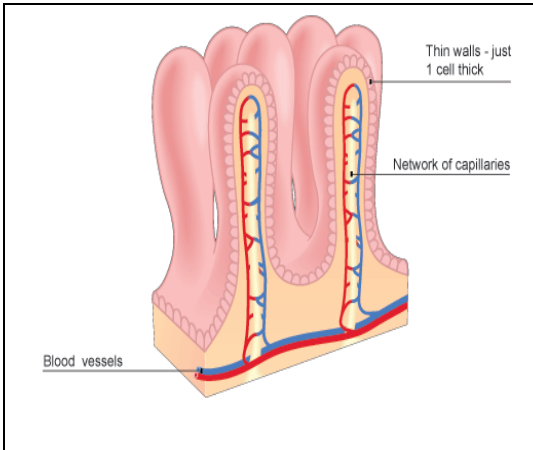
How is the small intestine adapted for absorption?

- The small intestine is long to increase surface area
- The ileum has many villi that increase the surface area to speed up absorption
- There is a close blood supply so that absorbed nutrients can be taken away quickly so a concentration gradient is maintained

Draw and describe the structure of the villus (include: blood supply, thin walls, capillary network)

for more help, p

- The villus has microvilli on it to increase the surface area even more to allow faster absorption
- The villi walls are one cell thick for a short diffusion path to allow faster diffusion
- The capillaries are very close to the villi walls so that the diffusion distance is short
- The capillary walls are one cell thick so that they create a short diffusion distance
- The blood supply helps maintain a diffusion gradient



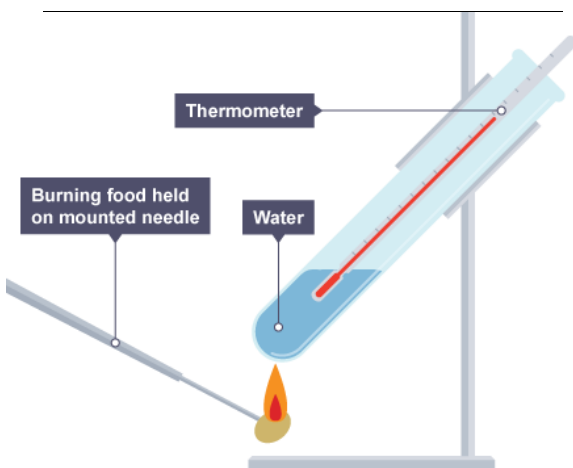
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How does the structure of the villus help with the absorption of the products of digestion in the small intestine?

- The villus has microvilli on it to increase the surface area even more to allow faster absorption
- The villi walls are one cell thick for a short diffusion path to allow faster diffusion
- The capillaries are very close to the villi walls so that the diffusion distance is short
- The capillary walls are one cell thick so that they create a short diffusion distance

2.33 Practical: Describe an experiment you would do to investigate the energy content in a food sample (draw a small diagram to help you)



- Put a set volume/mass of water into a boiling tube.
- Take the initial temperature of the water
- Measure the mass of the piece of food you will be burning.
- Set the piece of food alight and put a set distance from the boiling tube.
- Once the piece of food has finished burning, record the final temperature of the water.
- Work out the temperature difference between the initial temperature and the final temperature
- Do this equation to work out the energy content of food:

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$$\text{Energy released from food per gram (J)} = \frac{\text{mass of water (g)} \times \text{temperature rise (}^\circ\text{C)} \times 4.2}{\text{mass of food sample (g)}}$$

To improve this experiment:

- Use pure oxygen to allow complete combustion of the fuel



EXAM PAPERS PRACTICE

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2.34 – 2.39 Respiration

What is respiration?

- The release of energy from glucose in the form of ATP

What is the role of ATP?

- ATP is the energy currency that cells use to carry out functions.

Compare the differences of aerobic and anaerobic respiration in this handy table provided.

Aerobic	Anaerobic
Uses oxygen for the complete breakdown of glucose	Doesn't use oxygen, glucose is not broken down completely
Produces carbon dioxide and water	Animals, plants, bacteria: produces lactic acid Yeast: produces ethanol and carbon dioxide
Releases a lot of energy / makes a lot of ATP	Releases a little amount of energy / does not produce much ATP

What is the word equation **and** balanced chemical symbol equation for aerobic respiration?

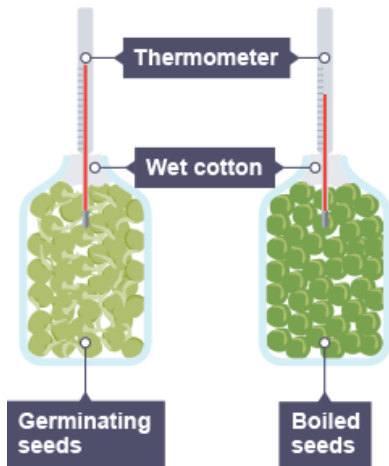
- Glucose + oxygen → Carbon dioxide + water (+ ATP)
- $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O (+ ATP)$

What is the word equation for anaerobic respiration in animals and plants?

- Glucose → Lactic acid (+ ATP)

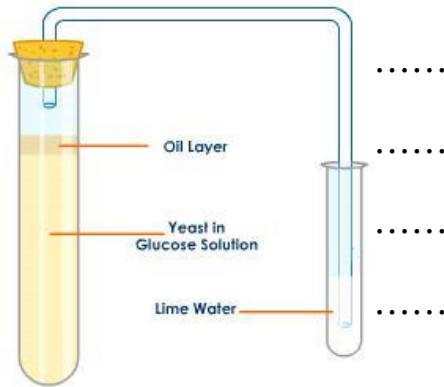


2.39 Practical: (a) How does this experiment show that seeds respire? (Why was the right hand side boiled? What does the difference in temperature mean?)



- Respiration is an exothermic reaction; this means it produces heat
- The germinating seeds have a higher temperature as shown on the thermometer, therefore the seeds are respiring
- The boiled seeds cannot germinate as the enzymes in the seeds have been denatured, therefore germination cannot take place

(b) How would this experiment show carbon dioxide is produced during respiration?



- Respiration creates carbon dioxide
- Limewater turns cloudy in the presence of carbon dioxide
- The glucose gets broken down in respiration
- The carbon dioxide comes from the yeast solution and bubbles through the lime water turning it cloudy

What is the oil layer for?

- To prevent oxygen getting into the yeast and glucose solution so that the yeast can do anaerobic respiration



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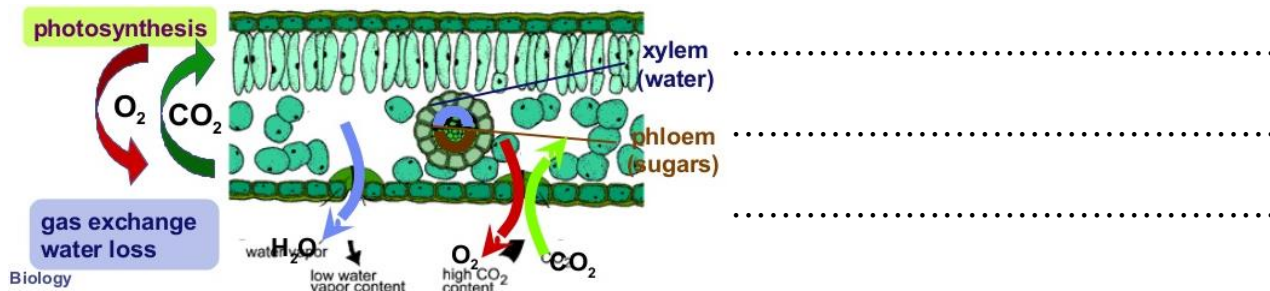


2.40 – 2.45 Gas exchange in flowering plants

Why is diffusion essential for gas exchange in living organisms?

- Diffusion allows oxygen to move into the cells so that aerobic respiration can occur
- Diffusion allows carbon dioxide to move out of the cells so that it does not build up and become toxic

Describe gas exchange in a leaf



- During photosynthesis oxygen is produced to excess. This means there is a higher concentration of oxygen in the leaf than outside it and so oxygen diffuses out through the stomata
- Carbon dioxide is used up during photosynthesis, therefore there is a lower concentration of carbon dioxide inside the leaf compared to the outside so carbon dioxide diffuses in through the stomata.
- Water evaporates inside the leaf. This means there is more water vapour inside the leaf than outside of it so water vapour diffuses out through the stomata.

How is the leaf adapted for gas exchange? (*This is a different question to how it is adapted for photosynthesis; use these words: air spaces, stomata, spongy mesophyll, oxygen, carbon dioxide, water vapour*)

- The stomata allow gas exchange to occur
- The spongy mesophyll has air spaces that allow gases to exchange
- The leaf is thin so that it has a short diffusion pathway for oxygen, carbon dioxide and water vapour to diffuse in and out of the leaf

What is the role of stomata in gas exchange? How do they work?

- Stomata open during the day when the plant is photosynthesising, this allows gas exchange to occur (carbon dioxide to go in and oxygen to go out).
- If the plant is dehydrated the stomata close to prevent further water loss

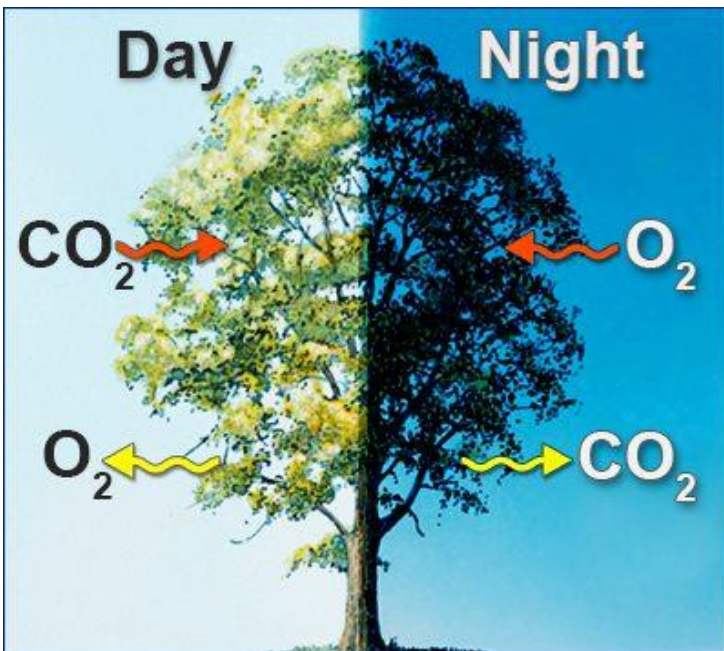


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TRUE or FALSE: if the statement is false correct it

- All plant cells photosynthesise
- All plant cells respire
- Photosynthesising cells do not require oxygen

• Answer: F, T, F

The next few questions will be based on the following diagram. It shows the net flow of gasses in a plant during the day and night.



(i) Describe and explain what is happening to the tree during the night time?

- Plants are living organisms therefore they respire. Respiration needs oxygen and creates carbon dioxide.
- **During the day** plant **also** photosynthesise. They produce more oxygen than they need therefore excess oxygen is released into the atmosphere.
- **During the night** no photosynthesis occurs so therefore oxygen is no produced, but it is still needed for respiration.

(ii) What would happen during the day if there was no carbon dioxide? Explain your answer

- Photosynthesis could not happen as carbon dioxide is needed



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(iii) What would happen to the uptake of carbon dioxide if the light intensity was increased?

- Carbon dioxide uptake would increase
- This is because the stomata open more the higher the light intensity.
- More carbon dioxide would be turned into glucose at a faster rate causing the concentration of carbon dioxide inside the leaf to fall even more.
- This means diffusion will happen faster as there would be a steeper concentration gradient.

(iv) If the plant is still respiring during the day why is there a net flow of carbon dioxide into the plant?

- This is because the rate of photosynthesis is more than the rate of respiration
- This means that more carbon dioxide is needed to be turned into glucose than carbon dioxide being produced in respiration
- Therefore, the concentration of carbon dioxide is still much lower in the leaf than outside
- Therefore, carbon dioxide will still enter the leaf by diffusion

What differences will there be between these limiting factors at different times of the day:
Circle the correct words

	Just after dawn (early morning)	In the mid afternoon
Temperature	HIGHER/ LOWER	HIGHER /LOWER
Carbon dioxide concentration in air	HIGHER /LOWER	HIGHER/ LOWER
Light intensity	HIGHER/ LOWER	HIGHER /LOWER

Explain how the differences of these factors will affect the rate of photosynthesis in the morning compared to the afternoon

- Lower temperature in the morning means slower rates of reaction than in the afternoon, therefore, slower photosynthesis in the morning compared to the afternoon
- There is a higher concentration in the air around the plant in the morning compared to the afternoon as no photosynthesis has taken place during the night. Only respiration has occurred. As the day progresses into afternoon there will be less carbon dioxide surrounding the plant as it is being used up in photosynthesis. This means that the lower concentration of carbon dioxide could slow down the rate of photosynthesis.
- The light intensity is lower in the morning than the afternoon therefore, this means that the rate of photosynthesis would be slower.



EXAM PAPERS PRACTICE

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2.45 Practical: This is what hydrogen carbonate indicator is:

Hydrogencarbonate indicator

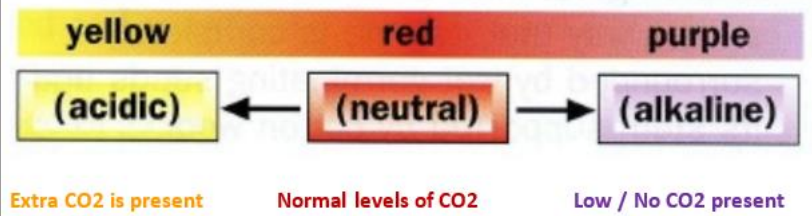
Hydrogen carbonate indicator:

- routinely used to measure CO₂ levels in aquatic systems.
- red in equilibrium with atmospheric air
- becomes more orange/yellow with increased CO₂
- changes from red through magenta to deep purple as CO₂ is removed.

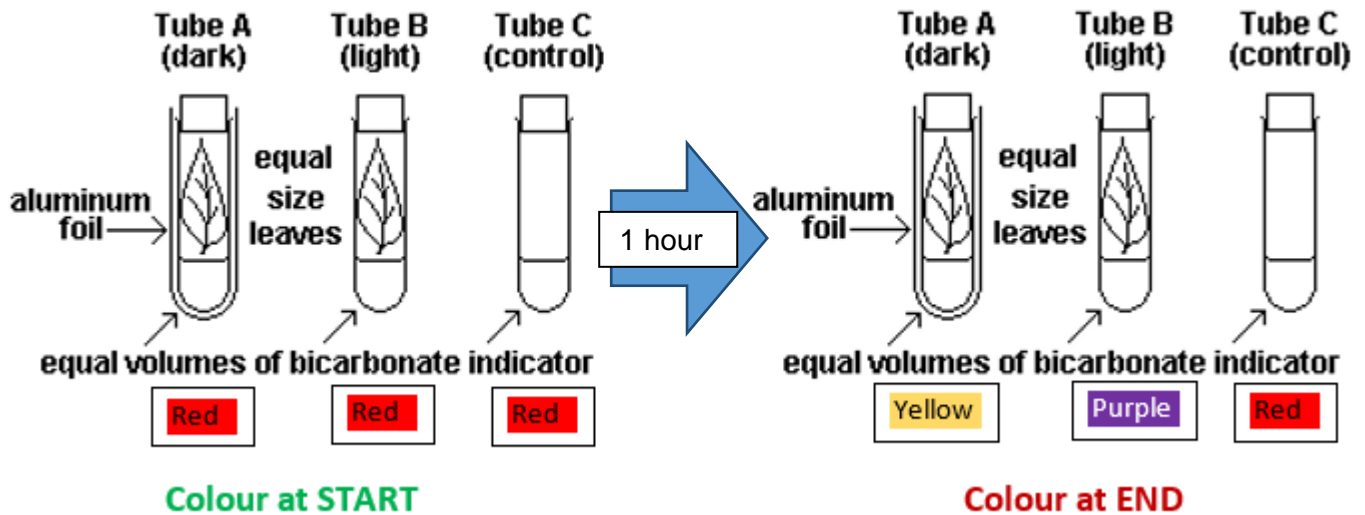


What is hydrogen carbonate indicator?

It is a liquid which reacts with carbon dioxide. It changes colour, depending on whether there is a lot of CO₂ dissolved in it, or not.



Explain the results of this experiment



- At the beginning of the experiment all show normal levels of carbon dioxide
- However, Tube A is in the dark so no photosynthesis can happen, therefore, only respiration occurs, therefore, only carbon dioxide is produced, which turns the indicator yellow as more carbon dioxide means it is more acidic.
- Tube B is in the light so photosynthesis can occur, therefore, carbon dioxide is absorbed more than it is produced so that the indicator turns purple because the lack of carbon dioxide turns it more alkaline.
- Tube C does not change colour. This is because no reactions are taking place, therefore, the colour does not change.

Why is there a control experiment?

- The control is needed to make sure that it is the leaves causing the change in the indicator and not something else.

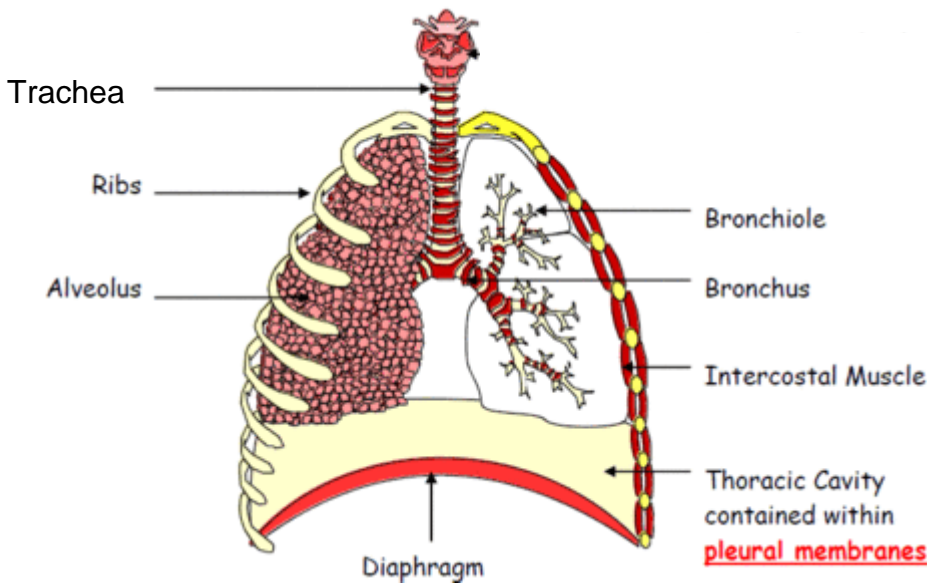


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2.46 – 2.50 Gas exchange in humans

This is a diagram of the human thorax:



Describe these parts of the thorax:

- Trachea (including the cartilage rings):

- Tube lined with C shaped rings of cartilage. It goes from the mouth to the lungs where it splits. The cartilage prevents the trachea from collapsing

- Ribs:

- Bones that protect the lungs from damage. The ribcage can expand or contract with breathing

- Diaphragm:

- This is a dome shaped muscle underneath the lungs that contracts and relaxes helping ventilation

- Bronchi:

- These are the two tubes that the trachea split into. They have cartilage rings to prevent them from collapsing

- Bronchioles:

- These are the small tubes that come from the bronchi and at the end of them there are alveoli



- Alveoli:

- These are small air sacs at the end of the bronchioles

- Intercostal muscles:

- These are muscles in between the ribs and help the ribcage expand and contract

- Pleural membranes:

- These are very slippery to help reduce the friction of the lungs rubbing along the inside of the ribcage

Describe the action of the intercostal muscles when humans:

- Inhale:

- External intercostal muscles contract and make the ribcage lift upwards and outwards

- Exhale:

- External intercostal muscles relax
- Internal intercostal muscles can be contracted consciously to expel air faster

Describe the action of the diaphragm and explain how it helps humans: (*how does it change air pressure inside the lungs?*)

- Inhale:

- The diaphragm contracts
- It flattens out and moves downwards
- This increases the volume of the chest cavity (thorax)
- The air pressure decreases inside the thorax
- The air pressure outside the lungs is higher and so moves into the lungs

- Exhale:

- The diaphragm relaxes
- It forms a dome shape and moves upwards
- This decreases the volume of the chest cavity (thorax)
- The air pressure increases inside the thorax
- The air pressure inside the lungs is higher and so moves out of the lungs

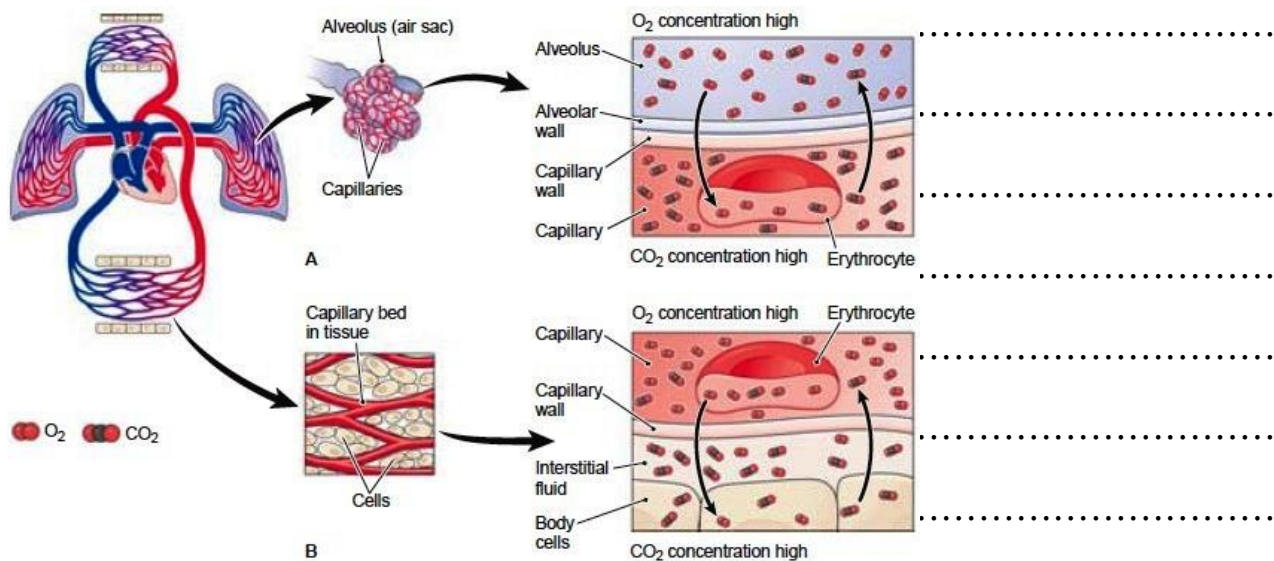


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Describe how gas exchange happens in the lungs and tissues of animals. Use the diagram to help you.



- The concentration of oxygen in the alveoli is high and the concentration of carbon dioxide is low.
- There is a high concentration of carbon dioxide and a low concentration of oxygen in the blood arriving at the alveoli
- Therefore, oxygen moves from the alveolar space into the blood where there is a low concentration of oxygen
- Carbon dioxide moves from the blood, where there is a high concentration to the alveolar space where there is a low concentration

Explain how the alveoli are adapted for gas exchange by diffusion: (include: thin alveoli walls, thin capillary walls, moist surface, large surface area, oxygen & carbon dioxide)

- The alveoli are small and have a large surface area to volume ratio
- The alveoli walls are one cell thick to allow a short diffusion pathway for faster diffusion
- The capillaries are very close to the alveoli to allow a short diffusion pathway for faster diffusion. The capillary walls are one cell thick to allow a short diffusion pathway for faster diffusion
- The inside of the alveoli is lined with a surfactant that stops the alveoli from collapsing and also allows oxygen and carbon dioxide to diffuse through.



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Tar, nicotine, many carcinogens (cancer causing chemicals), and other chemicals can be found in the smoke from cigarettes. What do these chemicals do to the lungs and circulatory system?

- Tar – include how it affects the cilia in the bronchi and bronchioles and how this can lead to bronchitis and chest infections:

- Tar paralyses the cilia so they cannot move mucus up the bronchioles and out of the lungs
- This leads to bacteria having time to multiply in the mucus which could cause a chest infection
- The immune response causes inflammation which cause bronchitis

- Nicotine – include how it affects blood pressure and can contribute to heart disease:

- Nicotine causes the blood pressure to increase
- This can damage the lining of the arteries
- The damaged arteries can start to have fatty deposits build up in the damaged areas
- These can block the arteries leading to the heart causing less oxygen to reach the heart cells so they cannot respire and die

- Carcinogens – what will these chemicals do to the body?

- Tar has many chemicals in it known to cause cancer
- These can change the sequence of bases in DNA and cause mutations
- Some of these mutations can cause uncontrolled cell division with is what cancer is

- Carbon monoxide – how does this affect the ability of the blood to carry oxygen and how will it affect a developing foetus? (use these words: *haemoglobin*, *carboxyhaemoglobin*)

- Carbon monoxide binds to haemoglobin more readily than oxygen
- It forms carboxyhaemoglobin
- If haemoglobin has bound to carbon monoxide, then less oxygen can be carried around the body
- If less oxygen reaches the developing foetus, then it cannot grow as fast and would be born smaller



What is emphysema?

- Emphysema is a disease that affects breathing.
- The lungs cannot get smaller and stay inflated with limited ventilation

How are the alveoli affected by emphysema?

- The elastic fibres in the alveoli breakdown so the alveoli are enlarged
- This reduces the surface area for gas exchange
- The lungs cannot contract so there is less ventilation

How can smoking cause coronary heart disease?

- Nicotine causes the blood pressure to increase
- This can damage the lining of the arteries
- The damaged arteries can start to have fatty deposits build up in the damaged areas
- These can block the arteries leading to the heart causing less oxygen to reach the heart cells so they cannot respire and die

2.50 Practical: (a) The following questions are based on a simple experiment to investigate how exercise affects breathing:

(i) How would you design an experiment to show the effect of exercise on breathing?

- Measure the number of breaths per minute at rest
- Exercise for a set amount of time
- Measure the breathing rate directly after the exercise
- Measure breathing rate every minute after exercise until it reaches back to normal breathing rate

(ii) What would your variables be?

- | | |
|---------------------------|--|
| • Independent variable: | • The time when the breathing rate is measured |
| • Dependent variable: .. | • The number of breaths per minute |
| • Control variables: | • The intensity of the exercise |
| | • The method of counting the breaths |
| | • The temperature of the room |

(iii) Describe the difference in the breathing rates between these two pupils (A and B) after the exercise

Time from start of experiment	Breathing rate / breaths per minute	
	Pupil A	Pupil B
1	13	13
2	14	12
3	13	12
Rate after 3 minutes of vigorous exercise		
7	28	17
8	24	13
9	17	12
10	14	12

- Pupil A has a slightly higher breathing rate than pupil B at rest
- Both pupils' breathing rates increase after the vigorous exercise
- After the vigorous exercise, pupil A has a much higher breathing rate than pupil B at 28 breaths per minute compared to 17.
- Pupil A takes longer to reach their resting breathing rate than pupil B.

(iv) Why does the breathing rate need to rise during exercise?

- Muscle contract more during exercise
- This means more respiration, which means more oxygen is needed
- To supply the extra oxygen, the breathing rate increase

(v) Which of the pupils is more fit? Explain your reasoning

- Pupil B is more fit, this is because their breathing rate went back to resting breathing rate quicker than pupil A's did

(b)

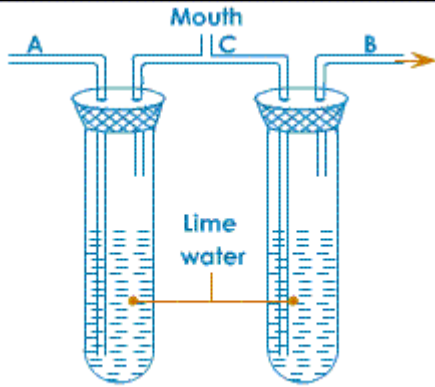


Fig. 5.12 To prove that exhaled air contains more carbon dioxide than inhaled air

Explain how this experiment proves that there is more carbon dioxide in exhaled air than inhaled air.

- The lime water of the inhaled air will not turn cloudy
- The lime water of the exhaled air will go cloudy
- Lime water turns cloudy in the presence of carbon dioxide

2.51 – 2.52 Transport in organisms

What does surface area to volume ratio mean?

- The relative area of surface of an object compared to the volume of that object
- The larger the surface area to volume ratio means there will be more surface area for substances to pass through

How do unicellular organisms get their nutrition and oxygen? (Use the word diffusion in your answer)

- Unicellular organisms have a large surface area to volume ratio.
- Nutrients and oxygen can more easily diffuse into the centre of the cell



How do unicellular organisms get rid of their waste? (Use the word diffusion in your answer)

- Unicellular organisms have a large surface area to volume ratio.
- Carbon dioxide can more easily diffuse out of the centre of the cell

Why is surface area to volume ratio important to the rate of diffusion?

- A large surface area means faster rate of diffusion

Why do multicellular organisms rely on transport systems to transport gases, nutrients, and minerals?

- Large, multicellular organisms have smaller surface area to volume ratios than small unicellular organisms.
- This means that the cells deep inside the organism cannot receive nutrients and oxygen fast enough to survive.
- A transport system allows nutrients and oxygen to reach every cell even if it is deep inside the body
- A transport system also allows waste not to build up as it can take it away before it becomes toxic

2.53 – 2.58 Transport in flowering plants

What is transported in: (use the words: sucrose, amino acids, water, *named* mineral ions/salts, as well as any other substances you can)

- Phloem:
 - Sucrose, amino acids

.....

- Water, nitrates, magnesium ions



- Xylem:
-

What are the differences between Xylem and phloem?

- **Phloem:**
 - Made up of living cells
 - Transports sugars and amino acids made from photosynthesis
 - Can move in either direction up or down the plant from a source to a sink
 - Can require energy to move substances in the phloem
- **Xylem:**
 - Made of dead cells
 - Transports water and mineral ions from the soil to the leaves
 - Can only move in one direction from roots to leaves
 - Does not require energy to transport water



In what direction can the flow of substances in the phloem go?

- Both directions up and down a plant stem

Where does the phloem transport the products of photosynthesis?

- To the parts of the plant that needs nutrients either for growth or for storage

In what direction does the flow of substances in the xylem go?

- From the roots to the leaves

By which process do root hair cells absorb water?

- Osmosis

Why do root hair cells have a higher mineral salt content than the surrounding soil?

- So that water can move into the root hair cells by osmosis from an area of high water concentration to an area of low water concentration



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What would happen if there was a higher mineral salt concentration in the soil surrounding the roots than inside the root hair cells?

- Water would leave the root hair cells by osmosis

What is transpiration?

- The loss of water from the leaves via evaporation from the surface of the leaves

What is the transpiration stream?

- The column of water that moves through the plant from the roots to the leaves to the atmosphere

Transpiration is affected by humidity, wind speed, temperature, and light intensity. Explain how and why transpiration is affected by:

- Changes in humidity:

- The higher the humidity around the leaf the slower the rate of evaporation from the leaf as less water can evaporate into the air
- The lower the humidity around the leaf the faster the rate of evaporation from the leaf as more water can evaporate into the air

- Wind speed:

- The higher the wind speed around the leaf the faster the rate of evaporation from the leaf as the wind blows away the humidity leaving room for more water to evaporate
- The lower the wind speed around the leaf the slower the rate of evaporation from the leaf as the humidity increases around the leaf



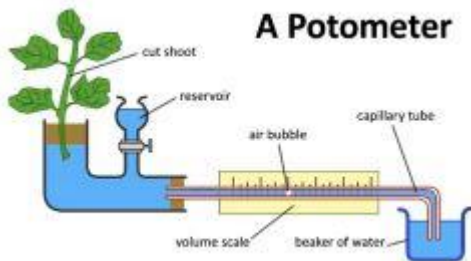
• Temperature:

- The higher the temperature around the leaf the faster the rate of evaporation from the leaf as the higher temperature causes more water to evaporate
- The lower the temperature around the leaf the slower the rate of evaporation from the leaf as the lower temperature slows down the rate of evaporation

• Light intensity:

- The higher the light intensity the faster the rate of photosynthesis, therefore more water is used and needed so more water gets drawn up by transpiration and therefore more water evaporates
- The lower the light intensity the slower the rate of photosynthesis, therefore less water is used and needed so less water gets drawn up by transpiration and therefore less water evaporates

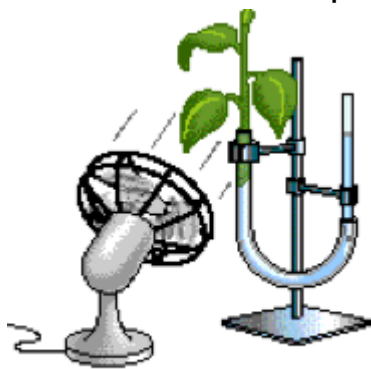
2.58 Practical: What is a potometer and what does it do?



A Potometer

- A potometer measures the rate of water uptake in a plant.
- Water is pulled through the tube and the movement of the air bubble indicates how much water has moved.
- Therefore, it can measure the rate of transpiration and the volume of water lost from the plant by evaporation/transpiration

Describe how this experiment will investigate the rate of transpiration



C. Wind

- The potometer will measure the volume of water lost by the leaves by evaporation
- The wind speed can be change by changing the settings on the fan



How would you change this experiment if you were investigating how temperature, humidity or light intensity affected the rate of transpiration?

- To measure the effect of light intensity, the light intensity on the leaves can be changed and the rate of transpiration can be measured
- The air temperature around the plant can be changed and the rate of transpiration can be measured
- The humidity can be changed by putting a plastic bag over individual leaves and the rate of transpiration can be measured.

- Make sure that all other variables are kept the same except the independent variable to make sure the results are reliable
- Use the same species of plant, the same age of plant, the same part of the plant that the leaves are from, the same number of leaves



2.59 – 2.69 Transport in humans – blood

Describe what blood is made up of:

- Red blood cells
- white blood cells
- plasma
- platelets

Why is plasma such an important part of the blood? (use: carbon dioxide, digested food, urea, hormones, and heat energy)

- Plasma is the medium that transports red blood cells around the body
- Plasma carries carbon dioxide to the lungs
- Plasma carries dissolved digested food to the liver and other parts of the body
- Plasma carries urea to the kidneys
- Plasma carries hormones around the body to their target cells
- Plasma transports heat around the body to distribute heat to warm cooler parts or to take heat away from warmer parts

How are red blood cells adapted to their function? (include: their shape, absence of a nucleus, and presence of haemoglobin)

- Red blood cells have a **biconcave** shape to increase the surface area to volume ratio to help oxygen diffuse more quickly
- Red blood cells have no nucleus to make space for more haemoglobin to carry more oxygen
- Haemoglobin is present to carry oxygen

What 2 ways does the immune system respond to disease?

- There are two types of white blood cells that respond in two ways:
 - Phagocyte – ingests/engulfs pathogens, and uses digestive enzymes to kill them
 - Lymphocyte – produces antibodies that bind to a specific pathogen's antigens. These can kill pathogens or bind to pathogens causing them to clump together so that they can be more easily engulfed by phagocytes.

Draw, label and describe in the boxes below the action of a phagocyte ingesting a pathogen

<p>1.</p>	<p>2.</p> <p style="text-align: center;">Stages of phagocytosis</p>
<p>3.</p>	

Draw, label and describe how lymphocytes and antibodies work in the boxes below:

<p>1.</p>	<p>2.</p>
<p>3.</p>	



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Describe what a vaccination is:

- Vaccination is when a weakened version or disabled pathogen is introduced into the body artificially but does not cause disease. The body's immune system treats the vaccine as a proper infection and produces an immune response which in turn makes the individual immune to that particular disease

Explain how vaccinations work? (Use **memory cells** in your answer)

- Vaccines have the specific antigens present that the immune system recognises and produces a response to.
- Memory cells are created during the immune response so that the immune system can produce antibodies more quickly in larger quantities if the body is introduced to those same antigens again.

Describe what a platelet is

- Platelets are fragments of cells that are in the plasma that makes up blood.
- They are small and do not contain a nucleus or any other real organelle

Explain the role of platelets in blood clotting

- Platelets cause blood to clot if blood vessels are damaged.
- In the presence of air, the platelets produce a chemical that causes the soluble plasma protein – **fibrinogen** – to change into insoluble protein fibres called **fibrin**.
- The fibrin forms a network across the wound which traps red blood cells and causes a clot.
- This prevents further blood loss and helps stop microorganisms gaining entry into the body.
- The clot turns into a scab, under which new tissue grows to replace the damaged tissue

How does blood clotting protect us from microorganisms?

- Microorganisms cannot enter due to the barrier created by the clot and then the scab



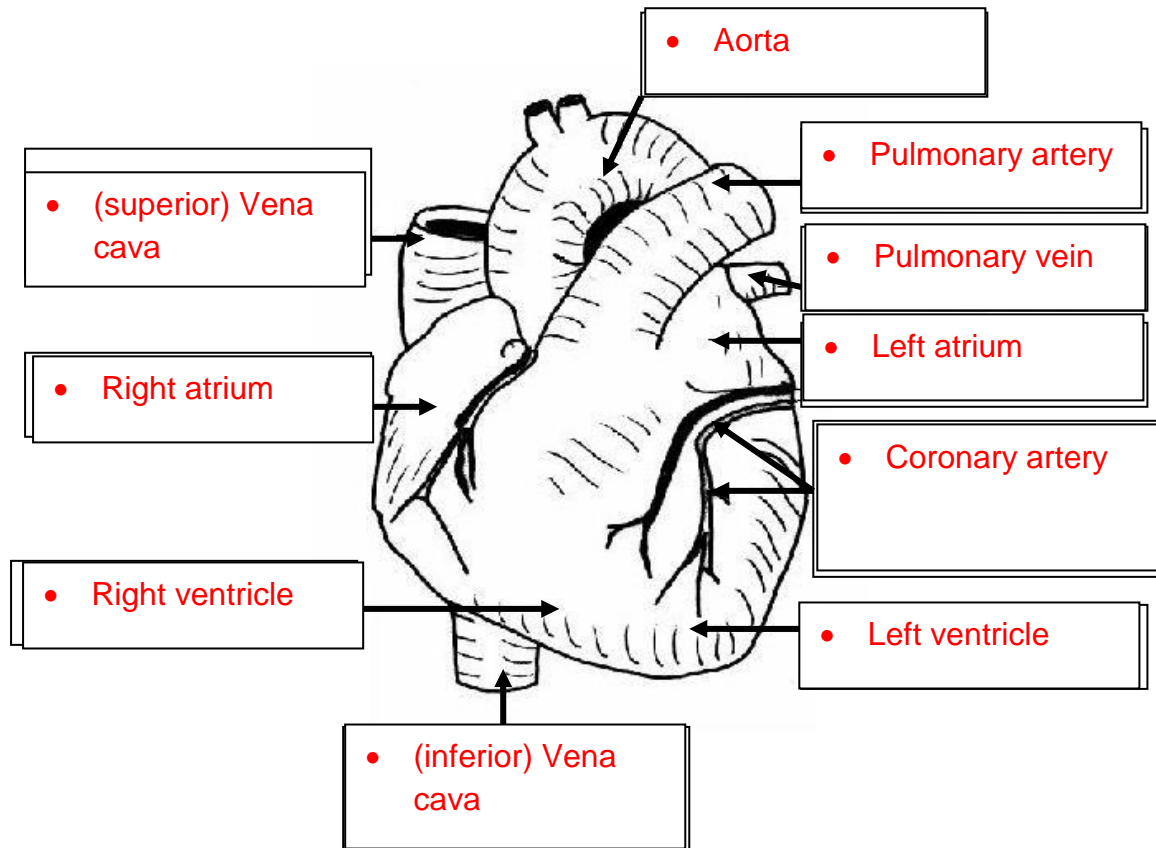
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Label the outline of the heart:

Complete the diagram by adding the following labels

- aorta
- left ventricle
- inferior vena cava
- pulmonary artery
- left atrium
- superior vena cava
- pulmonary vein
- coronary veins and arteries
- right atrium
- right ventricle



Through which blood vessels does:

Oxygenated blood flow through

- Aorta, pulmonary vein, coronary arteries

Deoxygenated blood flow through ..

- Vena cava, pulmonary artery

What do the coronary arteries do?

- Provide oxygenated blood and nutrients to the cardiac muscles

Why is the left ventricle wall thicker than the right?

- The left ventricle wall is thicker so that it produces a higher blood pressure so that it can pump blood further and around the body



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What is the role of the valves in the heart?

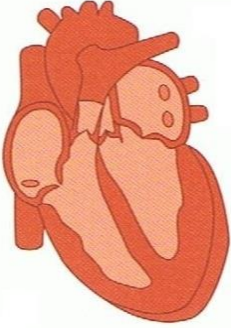
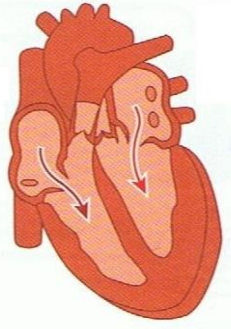
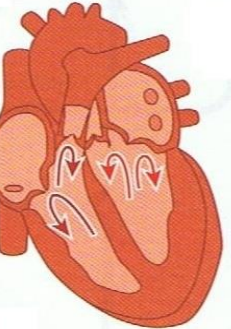
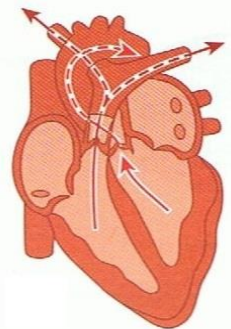
- Valves prevent the backflow of blood so that it can flow in one direction

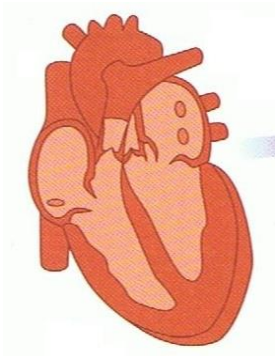
Describe how valves work

- Valves open when the blood flows through them in the correct direction
- As the blood pushes backwards against the valves it causes them to shut, which prevents blood flowing backward



Number the pictures and notes so that they provide a description of the cardiac cycle

<p>A</p> 	<p>Blood enters the atria. However, initially it cannot pass into the ventricles...</p> <p>... because the atrio-ventricular valves (the bicuspid and the tricuspid valves) are closed.</p>
<p>B</p> 	<p>The walls of the atria contract. This raises the pressure of the blood in the atria which....</p> <p>... forces open the atrio-ventricular valves. Blood passes through these valves into the ventricles.</p>
<p>C</p> 	<p>When the ventricles are full, they contract. This increases the pressure of the blood in the ventricles...</p> <p>... which closes the atrio-ventricular valves. This stops blood returning to the atria.</p>
<p>D</p> 	<p>The ventricles continue to contract and the pressure continues to increase. This forces open the semi-lunar valves at the base of the aorta and the pulmonary artery. Blood...</p> <p>... is ejected into these two arteries. The pulmonary artery carries blood to the lungs. The aorta has branches that carry blood to all other parts of the body.</p>
<p>E</p>	<p>When the ventricles are full, they contract. This increases the pressure of the blood in the ventricles...</p>



As the ventricles empty, higher pressure in the aorta and pulmonary artery closes the...

...valves in these blood vessels. The cycle then begins again as the atria start to fill with blood

How does the heart rate change during exercise?

- The heart rate increases during exercise

Why does the heart rate change?

- Muscles contract more meaning that more respiration occurs
- More oxygen is needed so the heart rate increases to supply the extra oxygen to the muscles

What does adrenaline do to the heart rate?

- Adrenaline increases the heart rate

What is the purpose of adrenaline?

- To prepare the body for action by helping supply the muscles with more oxygen by increasing the heart rate and breathing rate.
- Also more blood is diverted to the muscles and less blood goes towards the internal organs.

In the table below draw and describe the structure and role of the blood vessels

	Artery	Vein	Capillary
Draw and label the blood vessel			
Describe how	The artery has thick,	The vein has thinner walls	The capillary's lumen is



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the blood vessel is adapted to do its function	elastic, muscular walls to withstand the high blood pressure. The lumen is smaller to maintain high blood pressure	as there is lower blood pressure. The lumen is larger and veins have valves	only one red blood cell thick. The walls are one cell thick to allow a short diffusion distance
What is the role of the blood vessel in the body	To transport oxygenated blood around the body	To transport deoxygenated blood back to the heart	To allow the exchange of gases in the lungs and in the body



Why do veins have valves?

- Veins have valves to stop blood flowing backwards so it maintains blood in one direction

What is the difference between a single and double circulatory system?

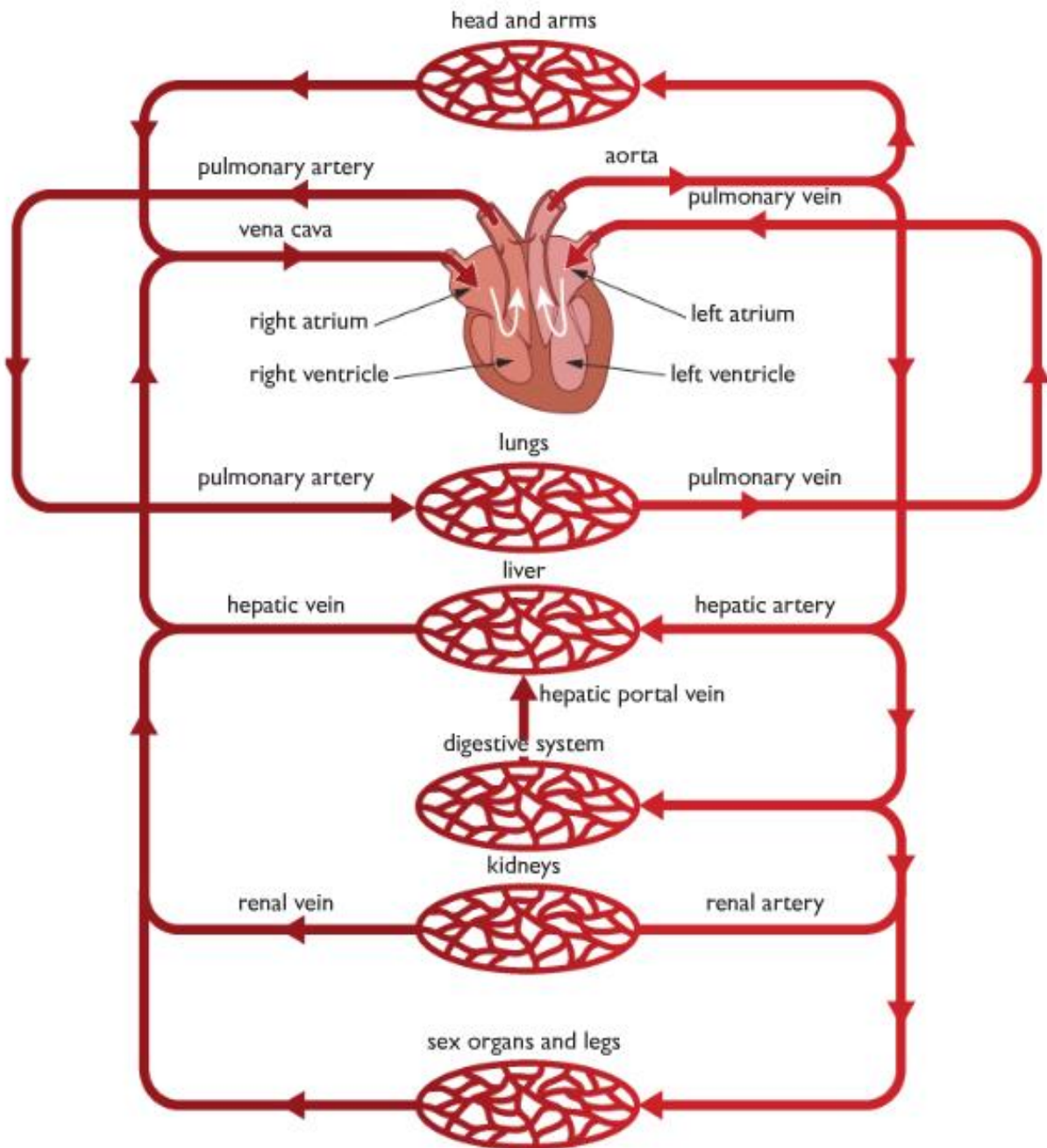
- Single circulatory system goes from the heart to the lungs/gills to the body back to the heart
- Double circulatory system goes from the heart to the lungs back to the heart to the body back to the heart

What are the advantages of having a double circulatory system?

- The double circulatory system is under higher pressure
- This means it can supply oxygenated blood further
- This helps organisms with higher metabolisms and higher rates of respiration by supplying more oxygen faster



Remember this diagram!!! Note which direction the blood flows





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2.70 Excretion in Flowering Plants

Why is carbon dioxide a waste product of metabolic reactions?

- Carbon dioxide is produced during respiration

Why is oxygen considered a waste product of photosynthesis?

- Because oxygen is produced in excess during photosynthesis

How do plants lose these gasses?

- By diffusion out of the stomata

2.71 – 2.79 Excretion in Humans

What are the three main organs of excretion?

- Lungs
- Kidneys
- Skin

What are the excretory products of these three organs?

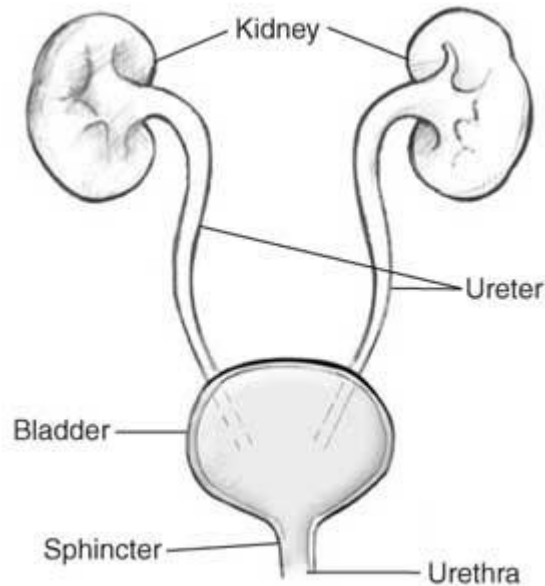
- Lungs – carbon dioxide
- Kidneys – urine
- Skin – sweat

What are the two main roles of the kidney?

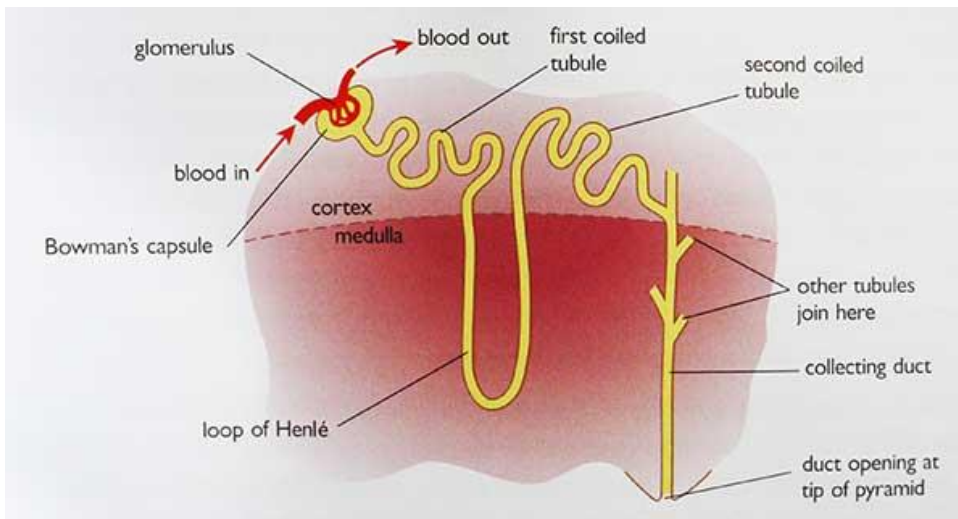
- Production and excretion of urine
- Osmoregulation – how the body helps regulate the levels of water in the blood



Draw the structure of the urinary system (include the kidneys, ureters, bladder and urethra)



Sketch the structure of a nephron (include Bowman's capsule, glomerulus, convoluted tubules, loop of Henlé and collecting duct)



What is ultrafiltration?

- The glomerulus filters the blood so that only filtrate comes through. The filtrate is composed of water and small soluble molecules and ions.

How does ultrafiltration happen in the Bowman's Capsule?

- Due to higher blood pressure in the glomerulus filtrate is pushed into the Bowman's capsule. Larger molecules like proteins as well as red blood cells are too large to fit through into the Bowman's capsule and so stays in the blood.



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How is the glomerular filtrate similar to blood plasma?

- The concentration of small soluble molecules like glucose, amino acids, vitamins is the same
- The concentration of mineral ions like sodium ions is the same
- The water potential is the same

How is the glomerular filtrate different to blood plasma?

- There are no large molecules like proteins in the glomerular filtrate
- There are no red blood cells in the filtrate

Where is water reabsorbed in the nephron?

- The Loop of Henle and the collecting ducts

What is selective reabsorption?

- The reabsorption of glucose from the filtrate back into the blood stream

Where does selective reabsorption occur?

- In the proximal convoluted tubule

Why does selective reabsorption occur?

- So that glucose and other useful molecules are not lost and can be used by the body

What is the role of ADH?

- ADH – Antidiuretic Hormone – helps the kidneys reabsorb more water from urine so that it maintains the water content of the blood



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How does ADH do its role?

- ADH makes the collecting ducts more permeable to water causing water to be reabsorbed into the blood more

What does urine contain?

- Urine contains urea, water, and mineral ions

2.80 – 2.82 Coordination and response in organisms

Give some examples of how organisms, plants and animals, respond to changes in the environment

- Plant roots grow towards the pull of gravity
- Plant shoots grow towards the light
- Animal eyes adjust to different light levels
- Animals start shivering when they are cold

Why do organisms respond to changes in the environment?

- So that they can survive any change to the environment and adapt accordingly

What does homeostasis mean?

- Homeostasis is the maintaining of the internal conditions in the body.
- Maintaining a constant internal environment

What internal conditions in organisms are examples of homeostasis?

- Maintaining the water content of the body
- Maintaining the temperature
- Maintaining the mineral ion content of the body



Define these terms which are required for a coordinated response:

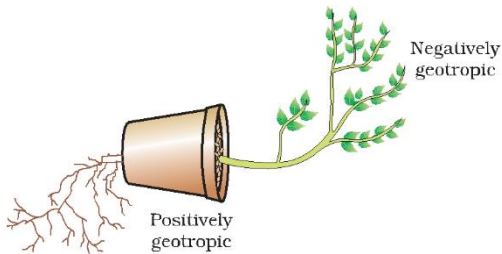
- Stimulus: • A change in the surroundings of an organism that produces a response
- Receptor: • A cell or organ that detects a stimulus
- Effector: • An organ that brings about a response
 - it can either be a **muscle** or **gland**

2.83 – 2.85 Coordination and response in Flowering Plants

What types of stimuli do plants respond to?

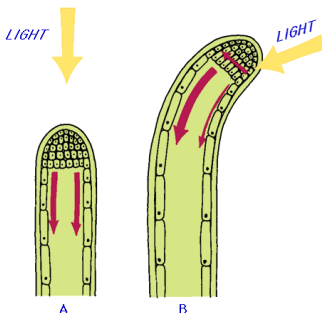
- Light and gravity

Describe what geotropic responses are in shoots and roots



- Roots grow towards the pull of gravity
- Shoots grow away from the pull of gravity

Describe what happens to plant stems in light



- The plant stems grow towards the light by bending towards it

for r



What is the bending towards the light called?

- Phototropisms

How does auxin control the way shoots and stems respond to light?

- The tip of the shoot produces a hormone like chemical called auxin
- Auxin causes cells to elongate
- Light causes auxin to move to the darker less lit side of the shoot
- This causes cells on the darker side to elongate more than the cells in the lighter side.
- This pushes the plant towards the light source

2.86 – 2.95 Coordination and response in humans

What is:

- Nervous communication: (*hint: it's not when you talk if you are scared 😊*)

- Nervous communication when neurones send electrical impulse to each other as well as parts of the body

- Hormonal communication:

- Hormonal communication is when glands produce a hormone and that is transported around the body via the blood. The hormone interacts with its specific receptor

Complete this table

	Nervous communication	Hormonal communication
Similarities	<ul style="list-style-type: none"> • nerves use chemicals (neurotransmitters) between neurones • • • 	<ul style="list-style-type: none"> • Uses chemical called hormones • • •



Differences	<ul style="list-style-type: none">• Very fast and act almost instantaneously• Transmission is electrical impulses• Response is usually short lived• can have a very localised effect on a few cells•	<ul style="list-style-type: none">• Slower and generally take longer to act• chemicals travel through the blood• Response is usually longer lasting• can effect a wide range of cell types•
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What does the central nervous system (CNS) comprise of?

- Brain, spinal cord

Name 5 sense organs: (you can name more than 5 if you like *but don't brag too much about how many you know* 😊)

- Eye
- Ear
- Tongue
- Nose
- Skin

How do these sense organs communicate with the CNS?

- They communicate by electrical impulses

Describe the route of an electrical impulse from a receptor in a sense organ to the CNS and then to an effector

- A receptor receives a stimulus. This stimulus gets changed into an electrical impulse
- The impulse goes to a sensory neurone, the sensory neurone passes along the axon of the sensory neurone
- The impulse then passes to intermediate neurones which passes the impulse to motor neurones
- The motor neurones pass the impulse along to an effector – either a muscle or gland. The connection between the neurone and muscle is called the neuromuscular junction
- The effector responds to the stimulus



Why does the CNS need to respond rapidly to changes in the environment?

- To protect the organism from damage
- The environment can change very quickly needing a quick response

What are reasons for having the myelin sheath surrounding the axons of neurons?

- The myelin sheath is made of fatty materials. The fat is an electrical insulator. This means it helps speed up the electrical impulses along the axon. This helps responses to stimuli happen very quickly.

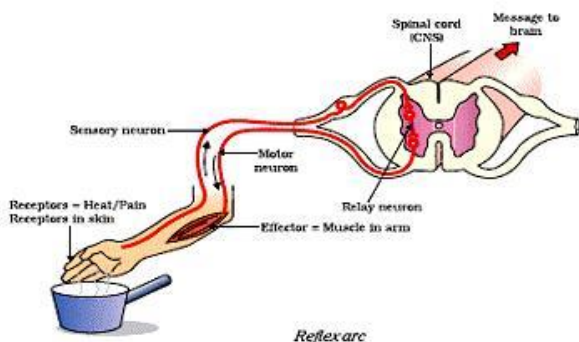
What are synapses?

- Synapses are the small gaps between neurones.
- Neurotransmitters are chemicals that cross over the synapse.

Describe the action of how an electrical impulse is converted to a chemical impulse back to an electrical impulse at a synapse using neurotransmitters

- The electrical impulse reaches the pre-synaptic bulb. This cause the presynaptic bulb to release neurotransmitters into the synapse.
- The neurotransmitters **diffuse** across the synapse.
- The neurotransmitters then bind to the receptors on the membrane of the post-synaptic bulb. This causes an electrical impulse to be created in the post-synaptic neurone.
- The electrical impulse now travels along the post synaptic membrane.

Describe this reflex arc, how is this reflex arc beneficial to humans?



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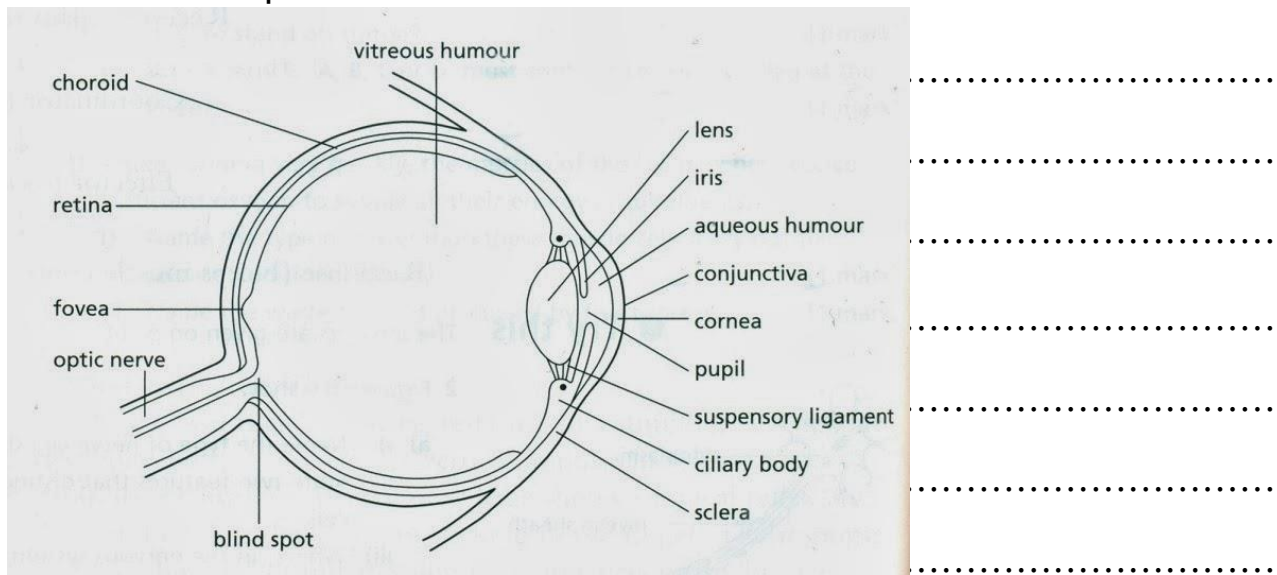
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- A reflex arc is an unconscious reflex which bypasses conscience thought.
- This allows a much quicker response which could protect the body from damage.
- For example:
 - A finger touches a hot object.
 - The receptor detects the stimulus.
 - The impulse travels from the receptor to the sensory neurone.
 - Then the impulse travels to the relay neurone in the spinal cord



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Describe the structure and function of the eye as a receptor using this diagram
What does each part do?



- Retina – contains rod and cone cells that detect light and converts light energy into electrical impulses that travel to the brain via the optic nerve. Cone cells can detect different wavelengths of light so that we can see colour, rod cells detect the presence of light and is mainly useful in low light conditions.
- Optic nerve – takes impulses from the eye to the brain
- Lens – helps focus light onto the retina
- Ciliary muscles and suspensory ligaments – these help change the shape of the lens so that it can focus on close objects and far objects
- Pupil – is the hole that light comes through
- Iris – controls the amount of light going into the eye. If there is a lot of light it makes the



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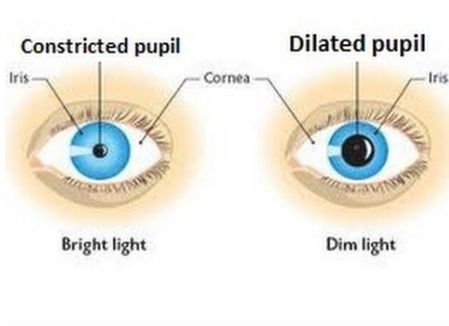
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Why is there a blind spot?

- **Blind spot** – this area has no rods or cones as it is where the optic nerve goes from the eye to the brain.

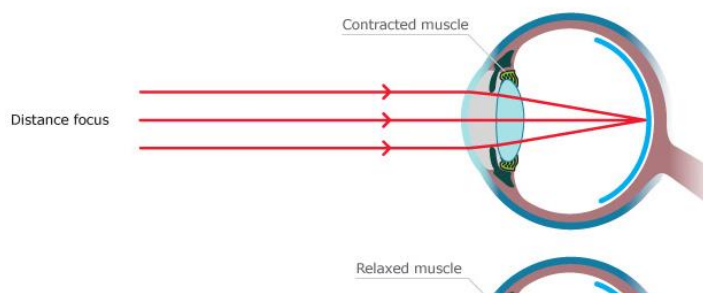
How and why does the eye respond to different light intensities (the iris reflex)? (use: radial muscles, circular muscles, pupils)



- In high level of light intensity, the retina can be damaged so the amount of light entering the eye needs to be controlled.
- In bright light the circular muscles contract, the radial muscles relax, therefore, the pupil constricts
- In dim light the circular muscles relax, the radial muscles contract and the pupil dilates.
- This is a **reflex action**

How does the eye undergo accommodation (focus on near and distant objects)? (use: ciliary muscles, suspensory ligaments, lens)

How the eye focuses light



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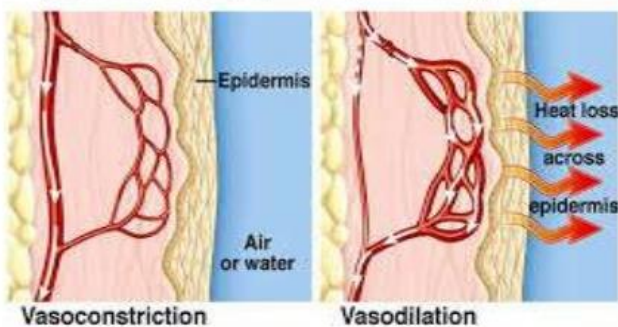
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- When the eye focuses on a far object the lens becomes less rounded and more flat. This is because:
 - The ciliary muscles relax, which makes the suspensory ligaments tighter.
 - The suspensory ligaments pull on the lens.
 - Therefore, lens becomes less rounded and flatter
- When the eye focuses on a near object the lens becomes more rounded (more convex). This is because:
 - The ciliary muscles contract, which makes the suspensory ligaments slack.
 - This means the suspensory ligaments do not pull on the lens as much
 - Therefore, lens becomes more rounded

Skin helps regulate body temperature so that the body stays at the same temperature. How does it do this? Use the diagrams to help explain

Vasoconstriction – arteriole closes

Vasodilation – arteriole opens



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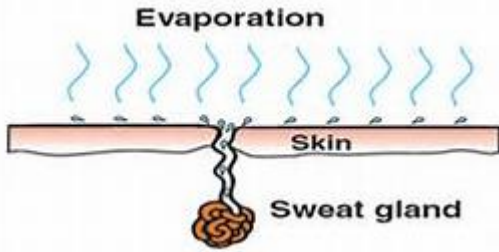
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- As the internal body temperature increases the arteries/arterioles closer to the skin open wider. This is called **vasodilation**. As more blood is directed to the skin more heat can be lost by radiation to the surroundings.
- As the internal body temperature decreases the arteries/arterioles close to the skin become smaller. This is called **vasoconstriction**. As more blood is directed to the body less blood goes to the skin therefore, less heat is lost to the surroundings.



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How does sweating help regulate body temperature?



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- As the body temperature increases the skin starts to release sweat. The extra body heat transfers energy to the sweat causing it to evaporate. This transfers the heat energy to the surroundings

What are the sources, roles and effects of these hormones?

	Source	Role/function	Effects
ADH	Pituitary gland in the brain	Controls the water content of the blood	Causes the kidneys to reabsorb more water by making the collecting ducts more permeable
Adrenaline	Adrenal glands on top of the kidneys	Increases the heart rate and breathing rate	Prepares the body for physical activity



Insulin	Pancreas	Controls the levels of glucose in the blood	Lowers the glucose concentration in the blood by causing cells to take in glucose
Testosterone	Testis	Controls puberty in boys	Helps the male secondary sexual characteristics develop
Progesterone	Ovaries (the corpus luteum) and the placenta	Controls the thickness of the lining of the uterus and regulates the menstrual cycle	High levels of progesterone keeps the lining of the uterus thick
Oestrogen	Ovaries	Controls puberty in girls	Helps the female secondary sexual characteristics develop
FSH	Pituitary gland	Helps egg development and oestrogen secretion in females (and sperm production in males)	Causes the egg to mature inside a follicle in the ovary to be ready for release and fertilisation
LH	Pituitary gland	Stimulates egg release (ovulation) in females (and testosterone production in males)	Causes the ovary to release the egg cell into the fallopian tubes

You are on your way to becoming a BIOLOGY HERO!! 😊