Name: ……..

# Y11 into Y12
# Biology transition work

# What should you know?

Biological molecules

- Recall the definitions of a monomer and polymer
- Describe the concept of ions and identify the charge on different elements and polyatomic ions
- Describe the concept of covalent bonding and use this to identify the number of bonds an element can form (including the specific examples C, H, O, N, S and P)
- Recall what foods contain proteins, carbohydrates and lipids
- State the roles of proteins, carbohydrates and Lipids in the human body.
- Describe the chemical tests needed to determine whether or not proteins, starch, sugars and lipids are present.
- State the role of haemoglobin in the body.
- Explain the process of chromatography.
- Recall the equation for and calculate a RF value.

Enzymes

- Recall the role of enzymes in the body
- Describe the mechanisms for enzyme action
- Explain how different factors affect the rate of enzyme activity

Nucleotides and nucleic acids

- Describe the structure of DNA
- Describe the process for extracting DNA from cells
- Describe the processes of transcription and translation

Cell structure

- Define Magnification and resolution
- Describe how to use a light microscope to view cells
- Describe how to make an onion and cheek cell slide
- Explain why staining is important
- Compare light and electron microscopes
- Recall and use the calculation for magnification
- Define eukaryotic and prokaryotic cells
- Recall the subcellular structures in plant cells
- Describe the roles of the different subcellular structures in plant cells
- Recall the subcellular structures in animal cells
- Describe the roles of the different subcellular structures in animal cells
- Recall the common subcellular structures in bacterial cells
- Describe the roles of the different subcellular structures in bacterial cells

Cell division

- State the importance of mitosis
- Describe the process of mitosis
- State the importance of meiosis
- Describe the process of meiosis
- Describe how different plant and animal cells are adapted to there roles
- Explain how these adaptations allow plant and animal cells to carry out their roles
- Describe how multicellular organisms are organised in terms of cells, tissues, organs and organ systems
- State the definition of a stem cell
- Describe the importance of stem cells in medicine

Biological membranes

- Recall the role of membranes in the cell
- Describe the process of diffusion
- Describe the process of osmosis
- Explain how to calculate the rate of osmosis in a cell
- Recall and use the equation to calculate the rate of osmosis in a cell
- Describe the process of active transport

Exchange and Transport

- Describe the process of diffusion
- Explain why a large surface area to volume ratio is important
- Calculate the surface area to volume ratio
- Explain the importance of exchange systems in multicellular organisms
- Explain how lungs are adapted to be a good exchange system
- Explain how root hair cells are adapted to be a good exchange system

Transport in animals

- Describe the role of the circulatory system
- Recall what makes up the circulatory system in humans
- Explain how the different blood vessels are adapted to function
- Explain how the different parts of the blood are adapted to function
- Label a diagram of the Heart
- Describe the route that blood takes through the Heart
- Explain the role of valves in the heart
- Explain why the right side of the heart is thicker than the left
- Recall and apply the equation for cardiac output

Transport in plants

- Describe the importance of transport in plants
- Explain the process of translocation
- Explain the process of transpiration
- Explain how the xylem and phloem are adapted to their function
- Explain how the rate of transpiration can be measured experimentally
- Describe how light intensity, wind, humidity and temperature affect the rate of transpiration

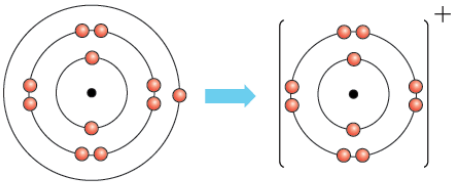
# The Basics

## Biological molecules

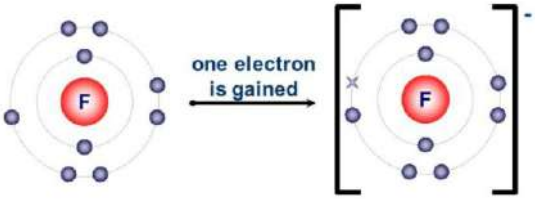
**Ions**

Ions are charged particles created when atoms lose or gain electrons during ionic bonding. The charge on an ion is dependent on the number of electrons gained or lost to get a full outer shell of 8 (or 2 if there is only one shell).

E.g. Sodium has 1 electron on the outer shell (as it is group 1). To get a full outer shell it with lose this electron giving the sodium ion a charge of +1.



Florine has 7 electrons on the outer shell (as it is in group 7) so will gain an electron giving the Fluorine ion a charge of -1.




Polyatomic ions are ions made up of more than 1 atom. Here are some that you should remember.

- $CO_3^{-2}$
- $SO_4^{-2}$
- $NH_4^{+}$
- $NO_3^{-}$
- $OH^{-}$

**Covalent bonding**

Covalent compounds can be monomers (1 molecule) or polymers (many molecules joined together in a chain).

Covalent bonds are made by the sharing of electrons between two molecules, this means that an atom will only make the same amounts of bonds as the number of electrons it needs e.g. carbon has 4 electrons so needs another 4 to have a full outer shell and so will form 4 bonds.

**Proteins, Lipids and carbohydrates**

| Food Group | Use in the body |
|---|---|
| Carbohydrates | Main source of energy |
| Proteins | Growth of muscles, repair of tissues |
| Lipids (Fats) | Insulation and energy source |

Testing starch

1. Place a little of the food sample in a spotting tile well.
2. Add a few drops of iodine, if it turns blue/black then it contains starch.

Testing Fats

1. Place a dry food sample in a test tube containing around 5 $cm^3$ of ethanol.
2. Shake the tube.
3. Pour some of this solution into a test tube containing 10 cm3 of water.
4. If fat is present, the water will become cloudy white.

Testing protein

1. Place small samples of the food in a test tube.
2. Add Biuret solution to the test tube.
3. If protein is present, it will produce a purple colour.

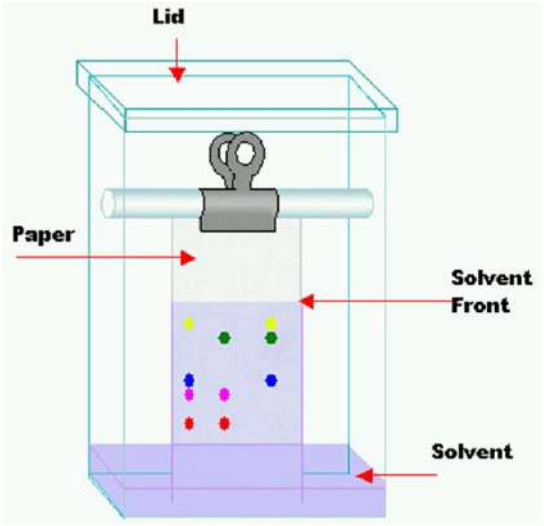
Testing sugar

1. Take a test tube and place a small amount of food in it.
2. Now add about 10 drops of BENEDICTS solution.
3. Place the test tubes in a beaker of hot water
4. If the food contains sugar it will turn red.

**Chromatography**

The method for chromatography is as below it works by the mobile phase (the solvent e.g. water) moving up the stationary phase (the paper) dissolving the substances in the mixture the more soluble substances will move further than the less soluble ones

1. Draw a pencil line of the paper.
2. Dot on the ink along the line.
3. Put a small amount of water in the bottom of a beaker.
4. Make sure the water is below the ink dots.
5. Put the paper into the water.
6. Wait until the solvent front (line of water) is nearly at the top.
7. Remove chromatogram and leave to dry.




$$R_f = \frac{\text{Distance moved by spot}}{\text{Distance moved by solvent}}$$

# Knowledge Tasks

**Ions**

1. What is the charge on a potassium ion?

   _____

2. What is the charge on a chlorine ion?

   _____

3. What is the charge on a calcium ion?

   _____

4. Draw a sodium ion

5. Draw a hydrogen ion

6. What is a hydroxide ion?

   _____

7. What is an ammonium ion?

   _____

8. What is a nitrate ion?

   _____

9. What is a phosphate ion?

   _____

10. What is a hydrogen carbonate ion?

    _____

**Covalent compounds**

1. Define a monomer

   _____

   _____

2. Define a Polymer

   _____

   _____

3. How many bonds can a carbon atom make?

   _____

4. How many bonds can a hydrogen atom make?

   _____

5. How many bonds can an oxygen atom make?

   _____

6. How many bonds can a nitrogen atom make?

   _____

7. How many bonds can a sulphur atom make?

   _____

8. How many bonds can a phosphate atom make?

   _____

9. A methane molecule has 1 carbon how many hydrogens must it have?

   _____

10. An ethene molecules has 2 carbons but only 4 hydrogens. How is this possible?

    _____

**Proteins, Lipids and Carbohydrates**

1. What is the role of proteins in the body?

   _____

2. What is the role of lipids in the body?

   _____

3. What is the role of carbohydrates in the body?

   _____

4. Draw a labelled diagram to show how you would test for protein.

5. Draw a labelled diagram to show how you would test for starch.

6. Draw a labelled diagram to show how you would test for sugar.

7. Draw a labelled diagram to show how you would test for lipids

**Chromatography**

1. Describe how you would carry out a chromatography. (you may include a diagram in your description)

_____
_____
_____
_____

2. Explain how chromatography works

_____
_____
_____
_____

3. What is the equation used to calculate the RF value?

_____
_____

4. Work out the Rf values for the 3 samples on the chromatography paper.

_____ _____
_____

5. Which is the most soluble? How can you tell?

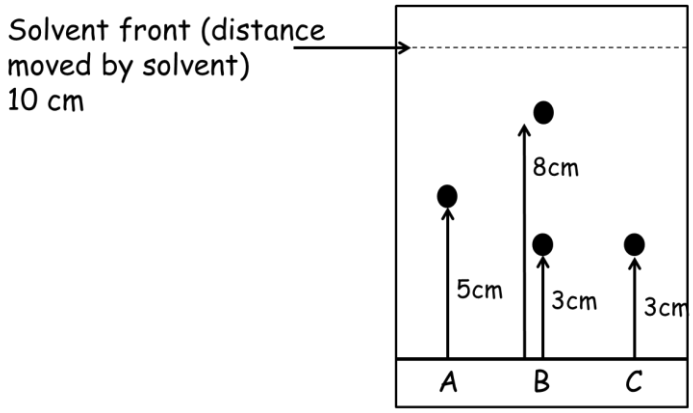
_____
_____
_____
_____

6. Which samples are pure? How can you tell?

_____
_____

7. Which samples are mixtures? How can you tell?

_____
_____

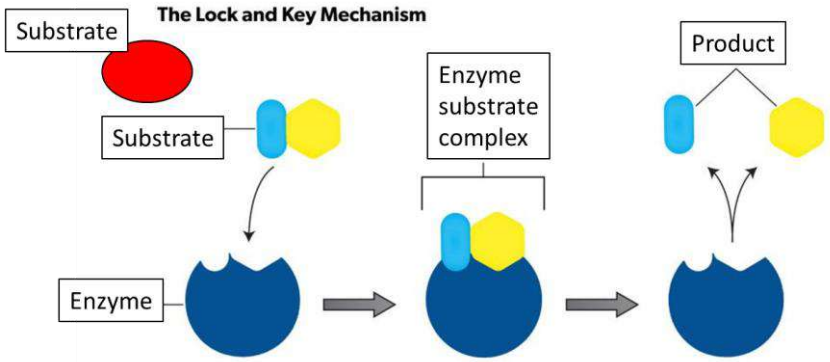


# The Basics

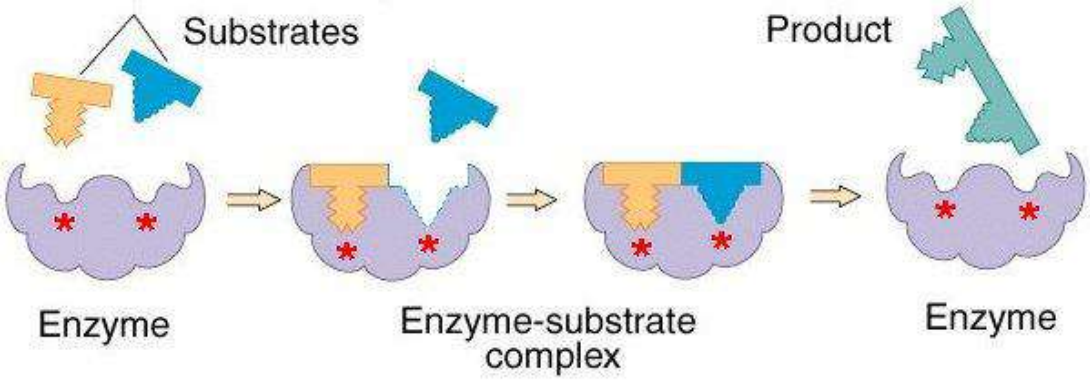
## Enzymes

Enzymes are biological catalyst this means they speed up a reaction without being used up. It does this by decreasing the activation energy but there are two mechanisms for enzyme action

1) The lock and key mechanism – In this mechanism the substrate fits perfectly in the specifically shaped active site, the enzyme then speeds up the reaction and the product leaves.

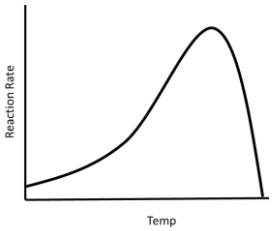



2) The induced fit mechanism – In this mechanism the substrate enters the active site and the enzyme then adjusts slightly so that the substrate fits. The reaction is then catalysed like in the other mechanism and the product leaves.

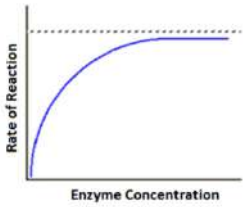



There are 3 main factors impact the rate of enzyme catalysed reactions. These are;

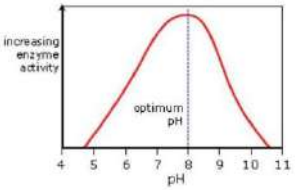
1) Temperature- As temperature increases so does the rate of reaction until it reaches the optimum temperature where the enzyme starts to denature. This is due to the increase in energy increasing the movement of the substrates increasing the rate of collisions and so the number of successful reactions.




2) Concentration – As the concentration increases so does the rate of reaction (due to an increase in collisions) until the reaction is unable to increase in rate further due to another limiting factor.




3) pH – Enzyme activity is fastest at the optimum pH and decreases either side as the enzymes change shape and denature.



# Knowledge Tasks

1. What is the role of enzymes in the body?

   _____

2. Why will enzymes only work on specific reactions?

   _____

3. Describe how enzymes work via the lock and key mechanism (use a diagram to help you with your answer)

   _____
   _____
   _____
   _____
   _____

4. Describe how enzymes work via the induced fit mechanism (use a diagram to help you with your answer)

   _____
   _____
   _____
   _____
   _____

5. How does temperature effect the rate of enzyme catalysed reactions?

   _____
   _____
   _____

6. Why is this?

   _____
   _____
   _____

7. How does concentration effect the rate of enzyme catalysed reactions?

   _____
   _____
   _____

8. Why is this?

   _____
   _____
   _____

9. How does pH effect the rate of enzyme catalysed reactions?

   _____

   _____

   _____

10. Why is this?

    _____

    _____

    _____

11. Design an experiment to test the effect of one of these factors on amylase (the enzyme that catalyses the break down of starch in the body).
    You should include:
    - The equipment you would need
    - The variables
    - The risks and safety procurations you would take to avoid these risks

_____

_____

_____

_____

_____

_____

_____

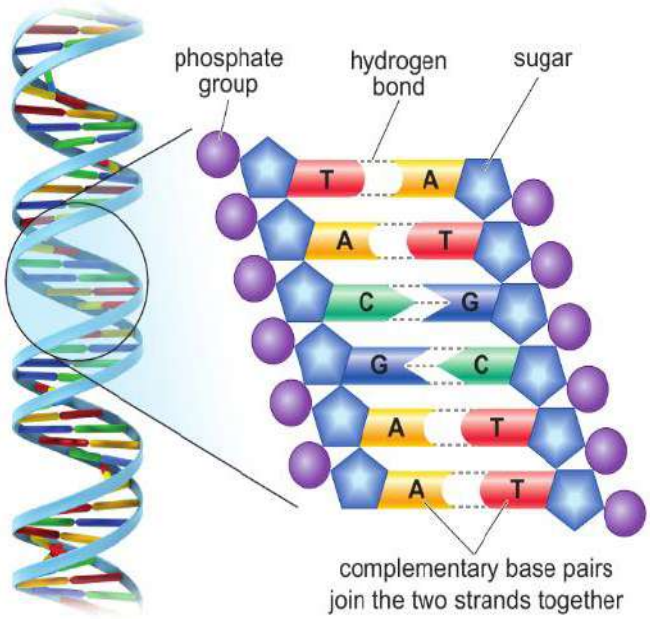
# The Basics

## Nucleotides and nucleic acids

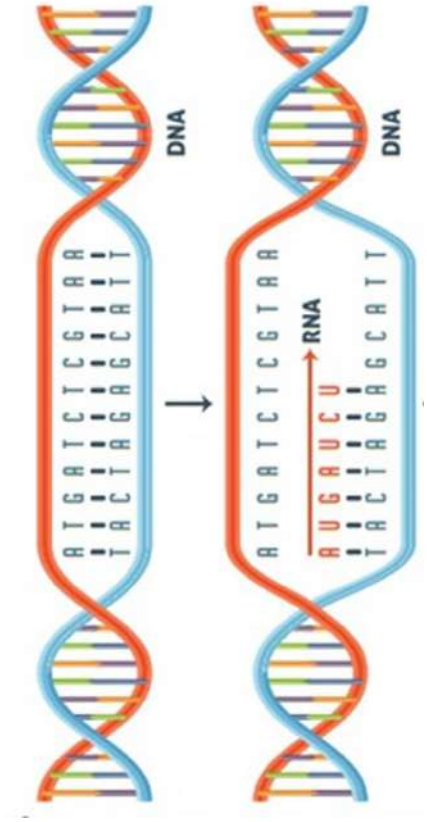
DNA is made up of different bases, these are unique to each person. These bases bond complimentary to each other

1. Adenine (A) will always bond to Thymine (T)
2. Cytosine (C) will always bond to Guanine (G)

These bases code for different proteins which can then code for characteristic




DNA double helix



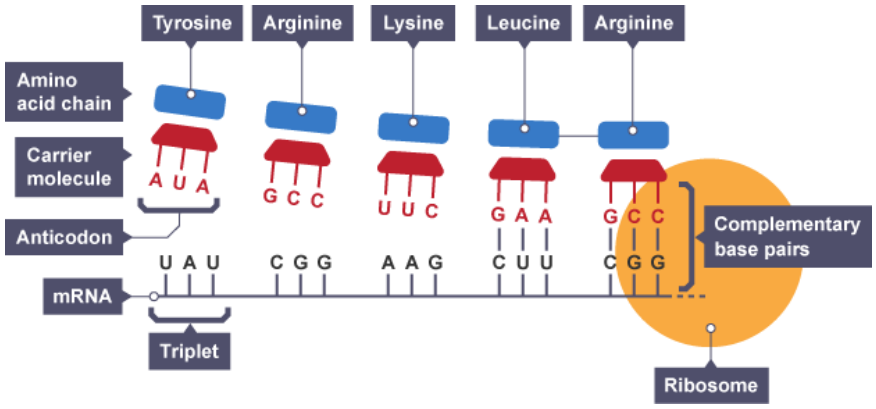

### Transcription

1. The two strands of the DNA helix are unzipped by breaking of the weak Hydrogen bonds between base pairs. This unwinding of the helix is caused by an enzyme (helicase enzyme).
2. The enzyme RNA polymerase attaches to the DNA in a non-coding region just before the gene.
3. RNA polymerase moves along the DNA strand. Free RNA nucleotides form hydrogen bonds with the exposed DNA strand nucleotides by complementary base pairing to form a strand of mRNA (RNA has U instead of T)
4. The newly formed strand of mRNA is now ready to leave the nucleus and travel to the ribosome.

## Translation

1. The mRNA strand travels through the cytoplasm and attaches to the ribosome. The strand passes though the ribosome.
2. For every three mRNA bases the ribosome lines up one complementary molecule of tRNA. We call every three bases a **codon**.
3. tRNA molecules transport specific amino acids to the ribosome which they leave behind shortly after lining up opposite the DNA. Because there are three mRNA bases for each tRNA molecule, we call this the **triplet code**.
4. Used tRNA molecules exit the ribosome and collect another specific amino acid.
5. A chain of several hundred amino acids in the correct order according to the original DNA is then made. This is called a **polypeptide**.

After translation, the polypeptide is finally folded into the correct shape and becomes a protein. Peptide bonds form between the adjacent amino acids to finalise the structure.




Extracting DNA

1. Dissolve 3g sodium chloride in 100ml water and mix in 10ml washing up liquid. Stir it well to dissolve the salt.
2. Mash the peas and add the pulp to the mixture. The detergent will break down the cell membranes and release DNA from inside the nucleus.
3. Stand the beaker in a water bath at 60°C for 15 minutes.
4. Add 2 drops of protease enzyme to 10cm3 of the mixture to help break down the proteins into the measuring cylinder. You only need a very small amount of this enzyme.
5. Pour iced ethanol VERY SLOWLY AND CAREFULLY down the side of the measuring cylinder to form a layer on top of the pea extract. And it must be added slowly to form two separate layers.
6. You can wind the DNA threads onto a cotton bud or a glass rod to see them more clearly.

https://www.youtube.com/watch?v=67KXatgoNKs

# Knowledge Tasks

1. Describe the structure of DNA?

   _____

2. What is DNA made up of?

   _____

3. How are the strands of DNA held together?

   _____

4. Describe complementary pairing

   _____
   _____
   _____

5. A section of DNA has the base sequence ATGGCAT write the complementary sequence for this

   _____

6. For each of the steps of DNA extractions draw a diagram to show the process below

7. Describe the role of the extraction buffer in this process

   _____
   _____
   _____

8. Explain why we filter the solution

   _____
   _____
   _____

9. Explain why a water bath is used in this process

   _____
   _____
   _____

10. Describe the role of Ethanol in this process

_____
_____
_____

11. Describe the process of transcription (Use a diagram to help with your description)

_____
_____
_____
_____
_____
_____
_____
_____
_____

12. Describe the process of translation

_____
_____
_____
_____
_____
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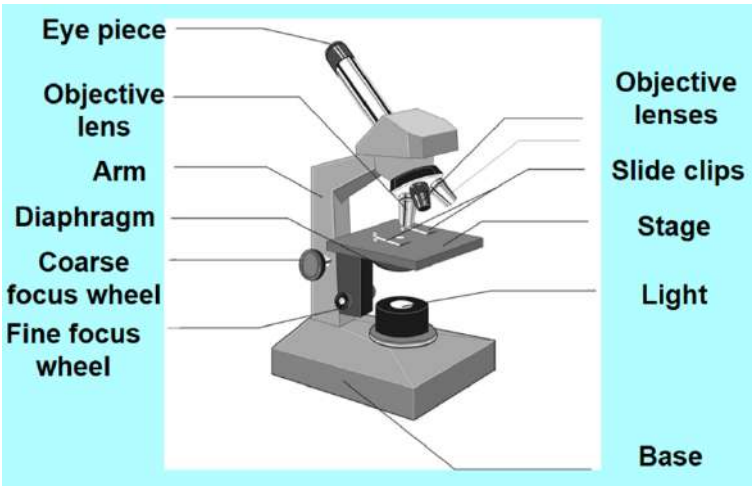
_____
_____
_____

# The Basics

## Cell Structure

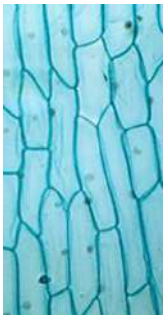


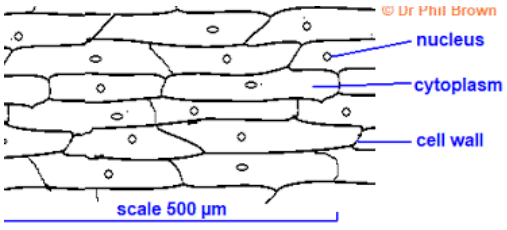

Using a microscope

1. Carry the microscope with two hands (one on the bottom of the microscope one on the handle)
2. Direct the light into the microscope so you can see through the eye piece *(make sure light isn't going directly into your eyes)*
3. Start with the **lowest magnification** moving it as close to the stage as possible without touching it.
4. Move the magnification further away slowly until it comes into focus.
5. Move onto the next magnification up and repeat until you reach the highest magnification

Making an onion cell slide

1. Peel skin of onion.
2. Place carefully and flat on the slide.
3. Put one drop of iodine onto the slide to stain the cells and make them easier to see
4. Place the cover slip over the onion carefully this helps to keep the skin flat and protects it.
5. Push down with paper towel and remove any excess iodine.
6. Your slide is now ready to be viewed






**Magnification -** The number of times bigger an image is compared to the real object calculated by image size / actual size.

**Resolution -** The smallest distance between two points that allows them to be seen as distinct objects.

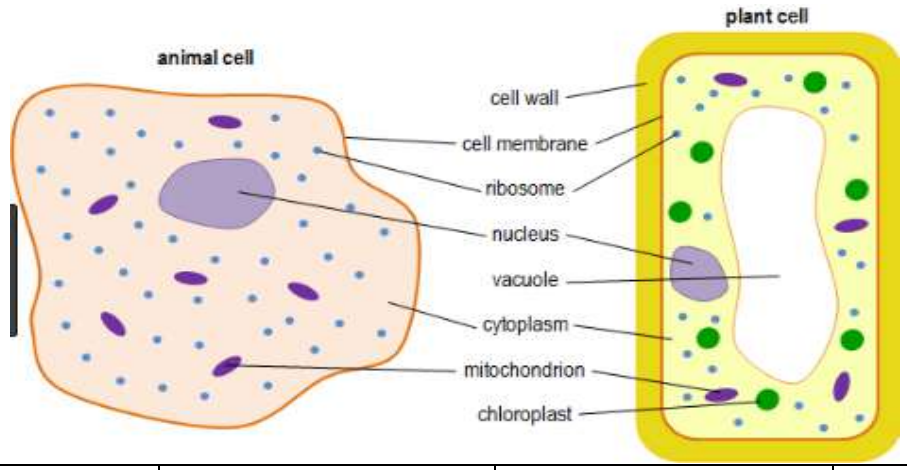
Light vs. election microscopes

Light microscopes can now magnify up to x1500 with a resolution as small as 0.0001mm. But this is still not as good as electron microscopes.

Electron microscopes use a beam of electrons instead of light to build up an image. These microscopes can magnify up to x2,000,000 with a resolution as small as 0.0000002mm this means the structures inside cells can be seen much more clearly. For example a white blood cell is 0.0000025 mm so cant be seen with a light microscope but can be seen clearly with an electron microscope.

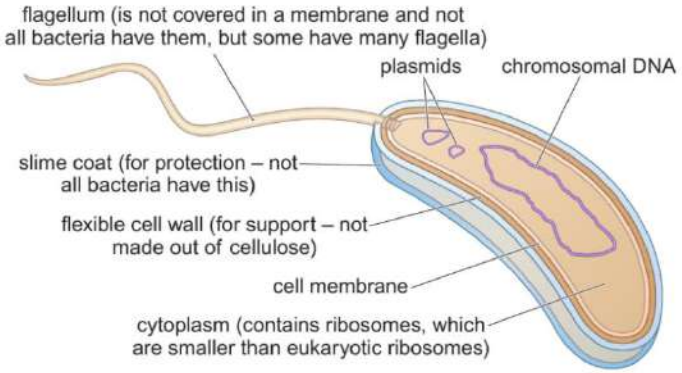
The problem is that electron microscopes are very large and very expensive so are only found in places like universities.

Eukaryotic cells- Eukaryotic cells are cells like animal and plant cells they have membrane bound organelles such as a nucleus and mitochondria.




| | | | |
|---|---|---|---|
| Cell Wall | Made of Cellulose, supports and protects the cell | Cell Membrane | Thin layer, controls what enters and leaves the cell. Separates one cell from another. |
| Ribosome | Tiny round structures, make new proteins for a cell. | Nucleus | Controls the cell and its activities. Inside it are chromosomes, which are made of DNA. |
| Vacuole | A store of cell sap, helps to keep the cell rigid and firm. | Cytoplasm | A watery jelly where most of the cells activities take place. |
| Mitochondrion | Where respiration takes place. | Chloroplast | Where photosynthesis takes place. |

Prokaryotic cells- Prokaryotic cells are cells like bacteria they have no membrane bound organelles such as a nucleus and mitochondria.




Instead of a nucleus, bacterium have Chromosomal DNA, which is a large loop of DNA in the cell that controls most of the cells activities, and Plasmids, these are small loops of DNA that control some of the prokaryotic cells activities.

Bacteria cells also have a cell wall like plants but unlike plant cells these are flexible cell walls which still provide structure but allow movement as they are not as rigid.

Two structures that only Bacteria cells contain are a Flagellum, which is a tail like structure that spins like a propeller allowing the bacteria to move, and a Slime coat which is in only some bacteria and provides protection for the cell.

# Knowledge Tasks

1. What is the meaning of the word magnification?

   _____

2. What is the meaning of the work resolution?

   _____

3. Write a step by step method of how to use a microscope to view cells

   _____

   _____

   _____

   _____

   _____

   _____

4. Write a step by step how to make an onion and cheek cell slide

   _____

   _____

   _____

   _____

   _____

   _____

5. Why do we use a cover slip when making microscope slides?

   _____

   _____

6. Why is staining important?

   _____

   _____

7. Compare light and electron microscopes using a table or Venn diagram in the space below

8. What is the equation for calculating magnification?

   _____

   _____

9. A cell is 100um large but appears to be 10mm under a microscope. What is the magnification of this microscope?

   _____

   _____

10. What is a eukaryotic cell?

_____

11. What is a prokaryotic cell?

_____

12. List 5 cell structures in an animal cell

_____

_____

_____

_____

_____

13. Describe the role of each of these structures

_____

_____

_____

_____

_____

14. List 3 structures that a plant cell has and an animal cell does not

_____

_____

_____

15. Describe the roles of each of these structures

_____

_____

_____

16. List 4 subcellular structures found in bacteria cell that are not found in plant or animal cells

_____

_____

_____

_____

17. Describe the roles of these different subcellular structures

_____

_____

_____

_____

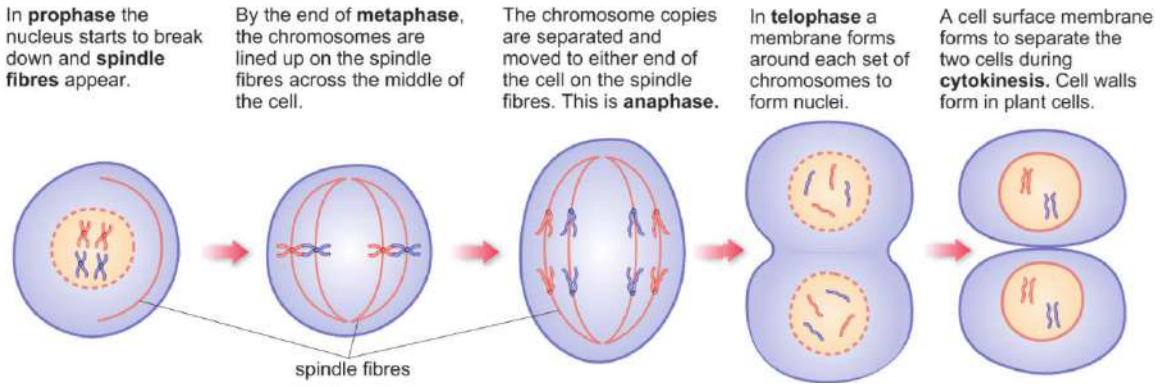
# The Basics

## Cell Division

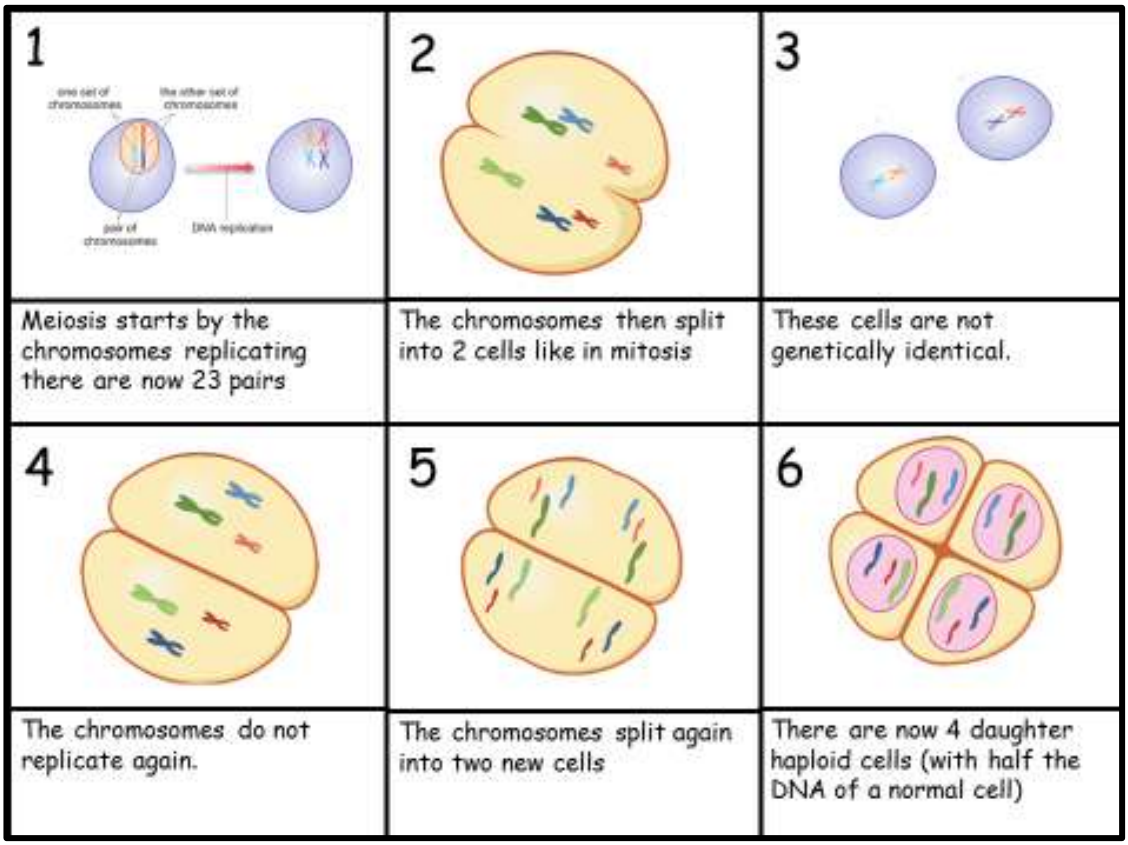
Most of the cells in your body are diploid. Diploid cells have 46 chromosomes of DNA. All the cells (except sex cells) in your body have the same 46 chromosomes.

To get a new cell, cells need to go through a process of cell division called mitosis. Mitosis is essential for growth, repair and asexual reproduction.

Each mitotic division makes 2 diploid cells.



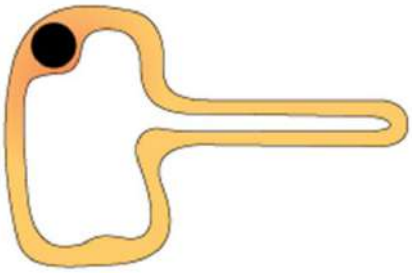

Meiosis is another form of cell division however there are 2 divisions and only one replication of the DNA meaning that there are 4 non identical haploid cells produced (cells with half the amount of information as a normal cells). This process is used to produce gametes like sperm and egg cells ready for fertilisation.



Specialised cells

Cells in the body are not all the same, they are differentiated or specialised to do specific roles. For example:

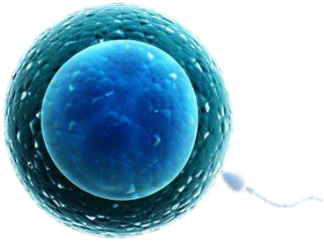
Red blood cells are adapted to carry oxygen by having no nucleus so they have more room for haemoglobin (which carries oxygen) they also have a large surface area (allowing oxygen to diffuse out easily)



Root hair cells take up water and nutrients from the soil and have long tails or hairs to help them do this.

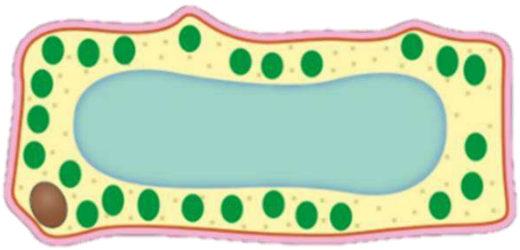
Sperm cells fertilise egg cells to make a baby.

They only have half the information of a normal cell but they do have a special stream lined head and a tail with lots of mitochondria at the top



Egg cells are fertilised by sperm in order to make a baby.

They only have half the information of a normal cell but lots more nutrients and a protective jelly coat around the outside

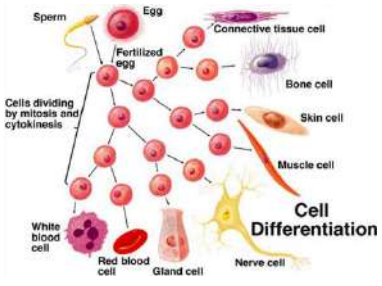


Palisade cells are used to help gather energy for the sun for photosynthesis

They are specialised as they contain lots of chloroplasts and can tessellate easily to absorb maximum sunlight.

**Stem cells**

Stem cells are undifferentiated, unspecialised cells that can turn into any other cell in the body. Plant stem cells these are found in the meristems and can usually produce any kind of specialised cell. Embryonic stem cells are cells that make up an early embryo and can form any kind of specialised cell. Adult animal stem cells are harder to obtain and can only differentiate into a few specialised cells.




Stem cells can be used in many areas of medicine such as replacing damaged cells or even growing organs for transplants however many people think that using stem cells for medicine is unethical.

# Knowledge Tasks

1. State 3 functions of mitosis

   _____

   _____

2. What type of cells are produced during mitosis? How many of them are made?

   _____

3. Describe the process of mitosis (Use a diagram to help you with your answer)

   _____

   _____

   _____

   _____

   _____

   _____

4. State the main use of meiosis in humans

   _____

   _____

5. What type of cells are produced during meiosis? How many of them are made?

   _____

   _____

6. Describe the process of meiosis (Use a diagram to help you with your answer)

   _____

   _____

   _____

   _____

   _____

   _____

7. How are Sperm cells adapted to their role in humans?

   _____

   _____

   _____

8. How are Red blood cells adapted to their role in humans?

   _____

   _____

   _____

9. How are Egg cells adapted to their role in humans?

   _____

   _____

   _____

10. How are guard cells adapted to their role in plants?

_____

_____

_____

11. How are Root hair cells adapted to their role in plants?

_____

_____

_____

12. Explain how these adaptations allow plant and animal cells to carry out their roles

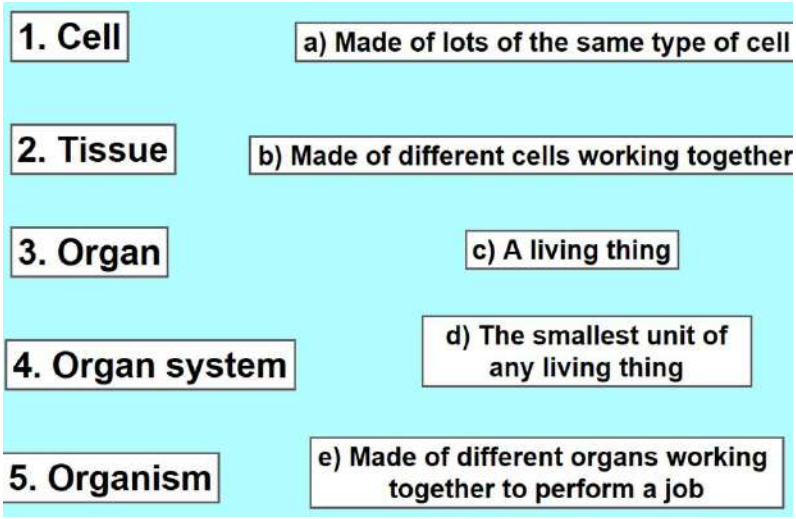
_____

_____

_____

_____

13. Match the word with its definition




14. Put these words in order of size and complexity (Organ, Tissue, Organism, Organ system, Cell)

_____

_____

15. What is a stem cell?

_____

_____

16. What are the 3 types of stem cells? How are they different?

_____

_____

_____

17. What are 3 ways stem cells can be used in medicine? (Do some research to help you with this question)

_____

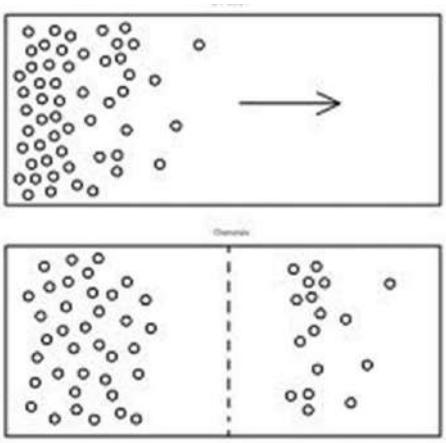
_____

_____

# The Basics

## Biological Membranes

Diffusion is the passive movement of substances (without energy) like oxygen or carbon dioxide down the concentration gradient (high to low concentration).



Osmosis is similar to diffusion however osmosis is the movement of water across a partially permeable membrane. Water moves from a dilute solution to a concentrated solution (high water concentration to low water concentration).

The rate of osmosis can be calculated by working out the % change in mass over time where;

$$\% \text{ change in mass} = \frac{(\text{Final mass} - \text{Initial mass})}{\text{Initial mass}} \times 100$$

Osmosis is the overall movement of water molecules from a region where there are more of them in a particular volume to a region where there are fewer, through a semi-permeable membrane. The cells in a potato contain many substances dissolved in water. The cells are surrounded by cell membranes that are permeable to water. When a strip of potato is placed in a solution, the overall movement of water molecules between the potato cells and the solution will depend on which has the higher concentration of solutes. In this practical you will investigate osmosis in potato strips in terms of the percentage change in mass of potato in different solutions.

## Aim

To investigate how solution concentration affects percentage change in mass of potato strips due to osmosis.

### Prediction

1 For each of the solutions you will use, predict whether the potato strips will gain mass, lose mass or keep the same mass. Explain your predictions.

## Method

**A** Using the waterproof pen, label each tube with the name of one of the solutions. Place the boiling tubes in the rack.

**B** Dry a potato strip carefully by blotting it with a paper towel. Measure its mass on the balance.

**C** Place the potato strip into one of the tubes. Record the label on the tube and the mass of the strip in your results table (see next page).

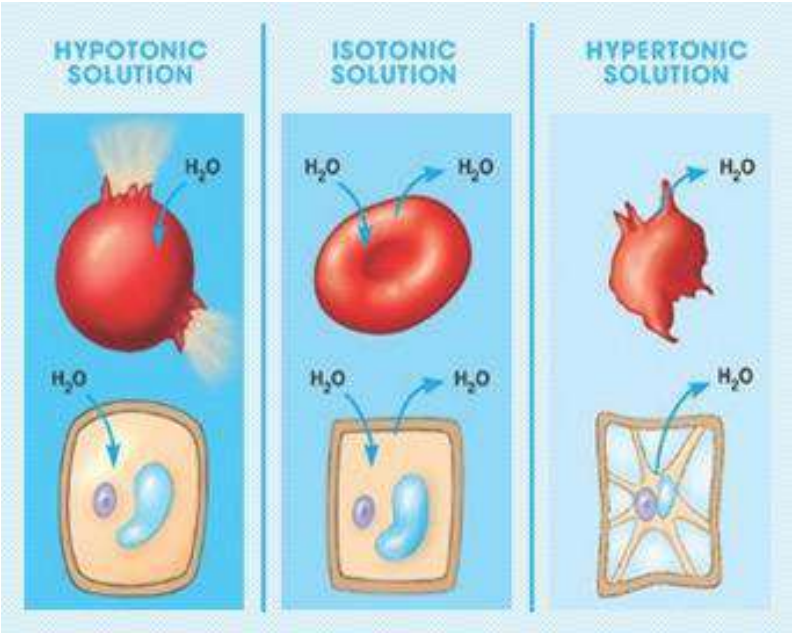
**D** Repeat steps B and C until all strips have been measured and placed in tubes.

**E** Carefully fill each tube with the appropriate solution, so that the potato is fully covered. Leave the tubes for at least 15 minutes.

**F** For each potato strip, use the forceps to remove it from its tube, blot dry on a paper towel and measure its mass again. Record all the masses in the results table.

Example results

| % Sucrose solution | Mass at start | Mass at end | % Change in Mass |
|---|---|---|---|
| 0 | 3.22 | 3.45 | 23 |
| 10 | 3.21 | 3.32 | 11 |
| 20 | 3.26 | 3.28 | 2 |
| 50 | 3.33 | 3.33 | 0 |



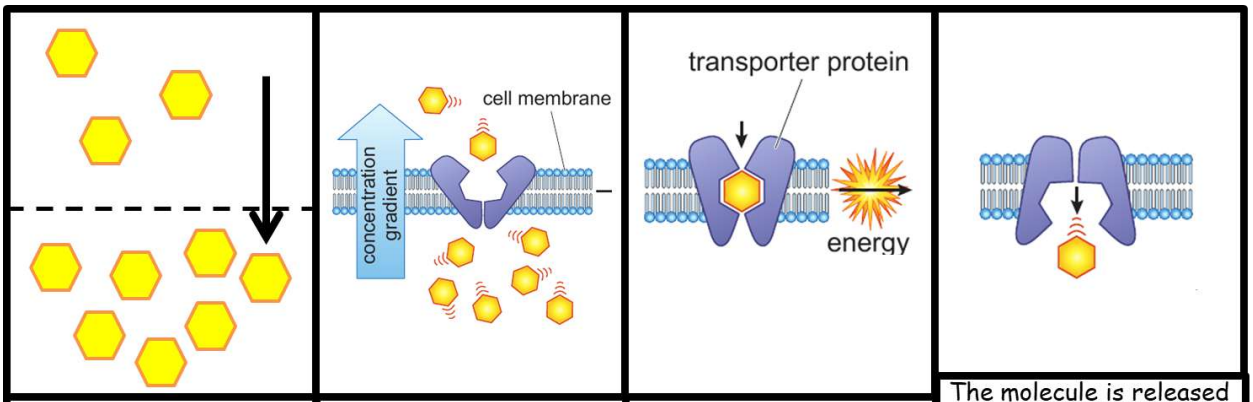

Effect of different solutions on cells

Hypotonic – A very dilute solution

Isotonic – A solution with the same concentration as inside the cell

Hypertonic- A concentrated solution

Active Transport




| | | | |
|---|---|---|---|
| Active transport is the movement of particles against the concentration gradient. This requires energy. | The molecule (for example glucose) binds to a transporter protein. | The transporter protein then uses energy to change shape. | The molecule is released into the other side of the membrane and the transport protein returns to it's original shape ready to start again |

# Knowledge Tasks

1. What is the role of the cell membrane?

   _____

2. What is diffusion?

   _____

   _____

3. What is osmosis?

   _____

   _____

4. What is the equation to calculate the rate of osmosis?

   _____

   _____

5. If you put a piece of potato in distilled water what would you expect to happen to the mass of that potato? Why in terms of osmosis?

   _____

   _____

   _____

   _____

6. If you put a piece of potato in a highly concentrated sugar solution what would you expect to happen to the mass of that potato? Why in terms of osmosis?

   _____

   _____

   _____

7. A potato has a starting mass of 2.18g and a final mass of 2.41g what is the % change in mass?

   _____

   _____

8. If this took 5 minutes what is the rate of osmosis?

   _____

   _____

9. Looking at this data what type of solution do you think the potato was in?

   _____

   _____

10. What happens to an animal and a plant cell if they are put in pure water?

    _____

    _____

    _____

    _____

11. What happens to an animal and plant cell if they are put in a very concentrated solution?

    _____

    _____

    _____

    _____

12. Design an experiment to test the effect of different concentrations of sucrose solution on the rate of osmosis. (Include the equipment and the controls needed for this experiment)

_____
_____
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13. Describe the process of active transport (include a diagram to help you with your answer)

_____
_____
_____
_____
_____

14. Compare active transport, osmosis and diffusion using a table or Venn diagram in the space below

# The Basics

## Exchange and Transport

The surface area to volume ratio is how much of the shape is exposed to the outside for the volume for example a smaller cube would have a larger SA:V ratio as there is more of the shape exposed.

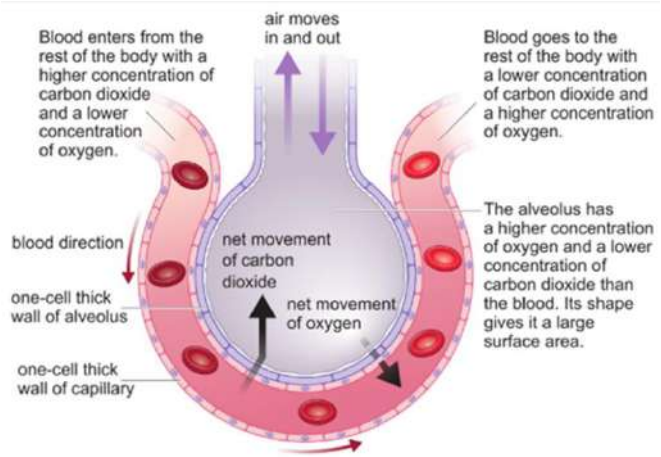
Surface area = (Width x Height) x the number of sides

Volume = Width x Height x Depth

The large this ratio is the more space there is for diffusion to occur so the faster the rate of diffusion. This is important in getting transport as possible. In multicellular organisms like plants and animals exchange systems like the lungs roots and intestines are adapted to increase the SA:V ratio and the rate of diffusion.

### The lungs

The lungs are made of the trachea, two bronchi and then bronchioles that end with many alveoli (a bit like the branches of a tree).

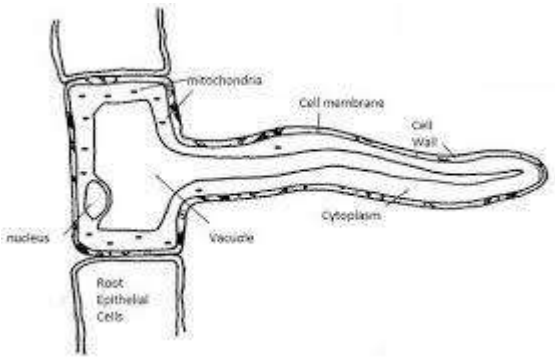



The alveoli increase the surface area massively and are adapted in many ways such as;

- Moist lining for dissolving gases
- Good blood supply – maintains conc. Gradients
- Very thin walls
- Enormous surface area – about 75m$^2$ in humans
- Covered in a network of veins and arteries for increased spread and gas exchange

### The roots

The roots of a plant help absorb minerals and water from the soil for the plant, the roots keep a constant concentration gradient meaning there is less water in the roots than outside so water moves in by osmosis. The roots also contain many root hair cells which are cells with hair like extensions to increase the surface area.



# Knowledge Tasks

1. What is diffusion and how does it work?

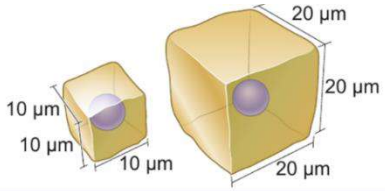
2. Why is diffusion important in animals and plants?

3. What is surface area to volume ratio?

4. Why is having a large surface area to volume ratio is important?

5. What is the equation to calculate the surface area to volume ratio?

6. Calculate the surface are to volume ratio for these two cubes.




| | |
|---|---|
| surface area = = | surface area = = |
| volume = = | volume = = |
| SA:V = = | SA:V = = |

7. Why do multicellular organisms such as plants and animals need gas exchange systems?

8. Explain the role of the lungs in gas exchange and how they adapted to function (you may use a diagram in your answer).

9. Explain the role of the roots in transport and how they are adapted to function (you may use a diagram in your answer).

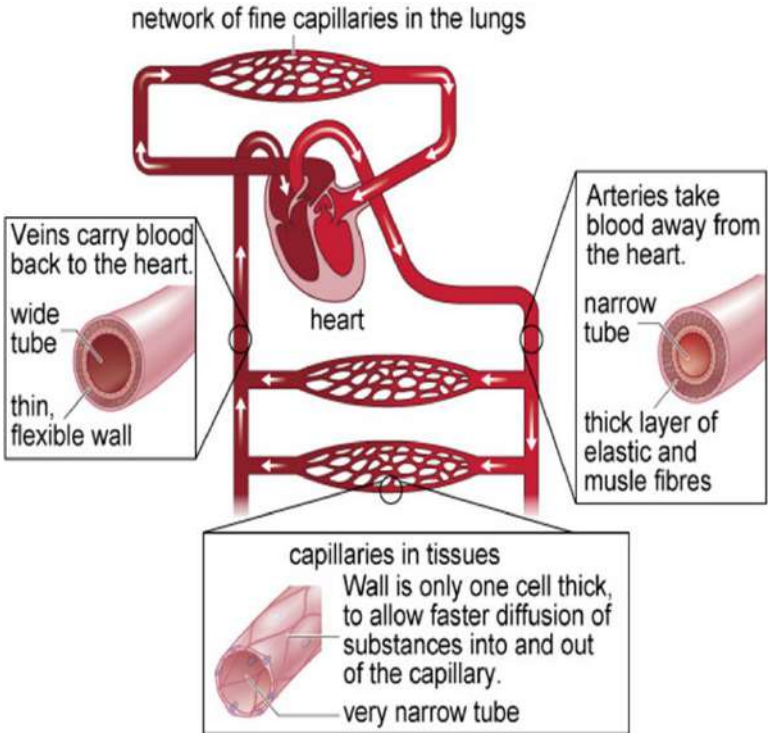
_____
_____
_____
_____
_____
_____

# The Basics

## Transport in animals

The role of the circulatory system is to transport substances around the body. For example oxygen and glucose is transported to respiring tissues and carbon dioxide is transported away from respiring tissues.

The circulatory system is made up of the heart, blood vessels and blood.




### Blood vessels

Arteries

- The arteries always take blood away from the heart.
- In the arteries, the blood is always under high pressure.
- For this reason, the arteries have very stretchy walls containing muscle and elastic fibres.
- Allows them to stretch and spring back

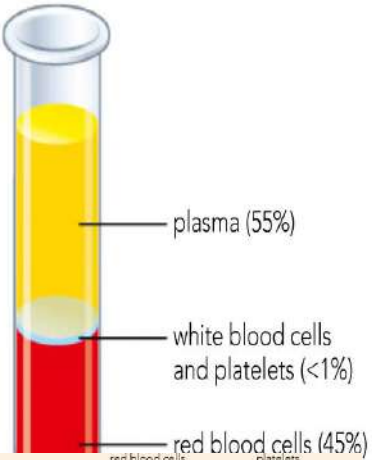
Capillaries

- Arteries branch into capillaries
- Capillaries are the smallest of the blood vessels.
- Their walls are only one cell thick, very narrow
- They are found inside all of our tissues and organs.
- This means they can squeeze in gaps between cells and deliver blood to extremities.
- As their walls are so thin, substances like carbon dioxide and oxygen can diffuse through them easily to get to and from the blood.

Veins

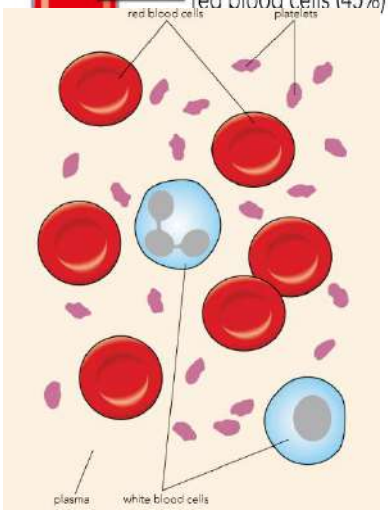
- Capillaries eventually join up to form veins
- Veins have quite thin walls because the blood in them is not under high pressure.
- They have a big lumen (hole) to help blood flow at low pressure
- They also have valves to keep blood flowing in the right direction preventing backflow.

# Blood




Red Blood Cells (Erythrocytes)

- Have a **biconcave disc** structure (looks like a donut!)
- This gives it a **large SA to volume ratio** (lots of space to carry oxygen)
- RBCs have **no nucleus** – leaves more room for more haemoglobin to be in the cell (so it can carry more oxygen)
- Contain red pigment called **Haemoglobin,** (contains iron)
- Can combine **reversibly** (reaction can occur both ways) with oxygen.




Plasma

- A **yellow liquid,** carries everything in blood, including RBCs, WBCs, and platelets
- Also transports dissolved substances such as **carbon dioxide, glucose, amino acids, urea, hormones, antibodies and antitoxins (produced by WBCs)**

White blood cells

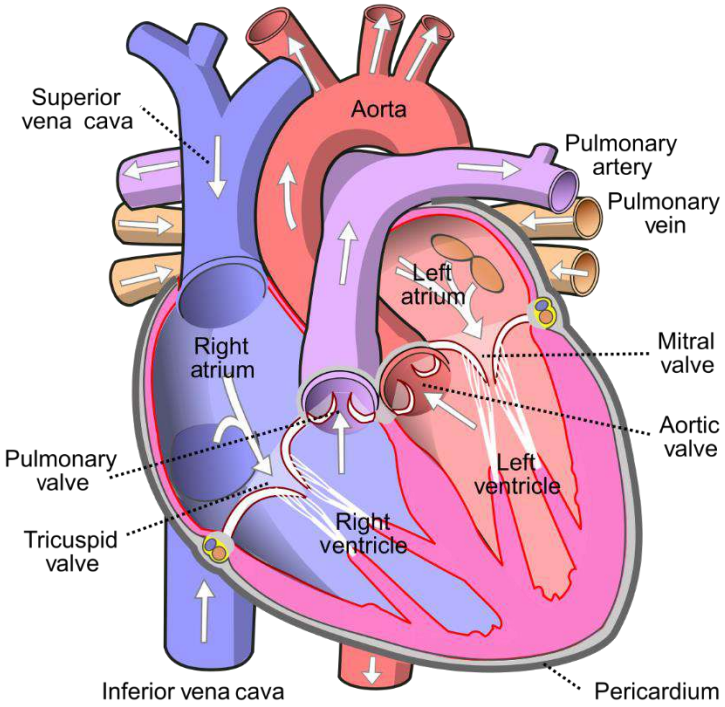
- Defenders against **disease**
- **LYMPHOCYTES** - WBCs that make **antibodies** and some make **antitoxins**
- Antibodies are **proteins** that bind to **microorganisms** and help **destroy** them
- **PHAGOCYTES** – WBCs that change shape and engulf pathogens. This process is called **Phagocytosis**
- All WBCs have a **nucleus**
- When you have an infection, WBCs multiply so a blood test will show high WBC count.

Platelets

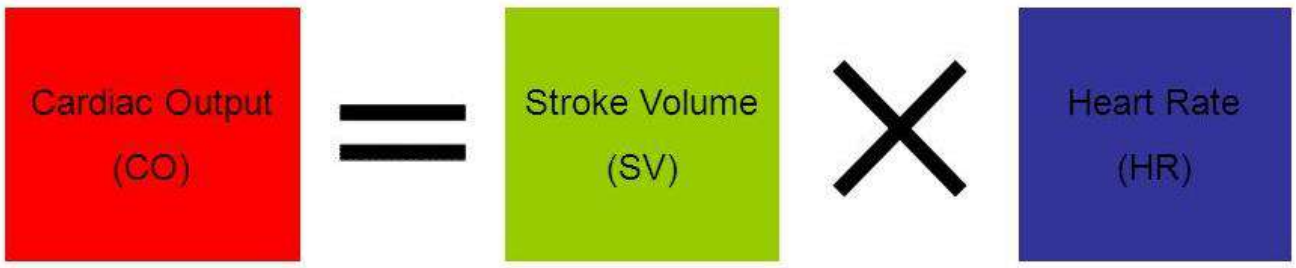
- **Tiny fragments** of cells
- Have **NO nucleus**
- They make your blood **clot** if you cut or damage a blood vessel.
- Clot dries and forms a **scab** – this stops microorganisms getting inside body
- Prevents excessive bleeding and bruising

# The Heart

1. Oxygenated blood returns to the heart via the pulmonary vein and enters the left atrium
2. The valves are flaps of tissue that stop back flow of blood
3. When the atrium is full, muscles contract and force blood passed the valves into the left ventricle
4. Vena cava (superior and inferior) brings blood into right atrium
5. The pulmonary artery carries blood deoxygenated blood to the lungs to pick up oxygen, and remove carbon dioxide
6. When right ventricle is full of blood, muscles contract forcing blood out via the pulmonary artery
7. When right atrium is full, muscles in the wall contract and force blood through valves into right ventricle
8. The aorta is the largest blood vessel in the body and the blood travels from here to the rest of the body
9. When the left atrium is full, it contracts and forces blood passed valves into the aorta.




The total volume of blood per minute is called the cardiac output and can be calculated by;




Where

- HR = Beats per minute
- SV = Volume of blood pumped by a ventricle per contraction

# Knowledge Tasks

1. What is the role of the circulatory system?

2. What is the circulatory system made up of?

3. What are the 3 types of blood vessels?

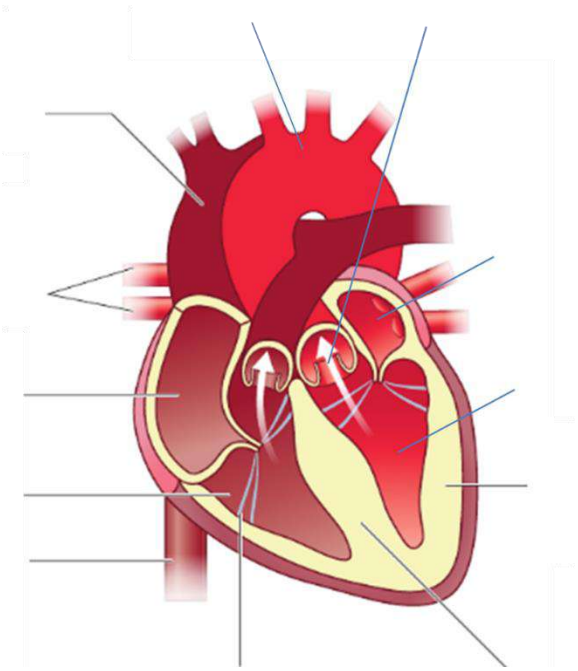
4. How are these blood vessels adapted to function?

5. What components make up the blood?

6. What are the roles of these different parts of the blood?

7. How are these different parts of the blood adapted to function?

8. Label this heart diagram



9. Using a blue (deoxygenated) and a red (oxygenated) pen draw arrows to show the route blood takes through the heart
10. Describe the route blood takes through the heart including the names of all the main structures.

_____
_____
_____
_____
_____
_____
_____
_____

11. What is the role of the valves in the heart?

_____
_____

12. Why is the left side of the heart thicker than the right?

_____
_____

13. What is the equation for cardiac output?

_____
_____

14. If someone's heart pumps 0.0083 litres 59 times a minute what is their cardiac output?

_____
_____

# The Basics

## Transport in Plants

### Translocation

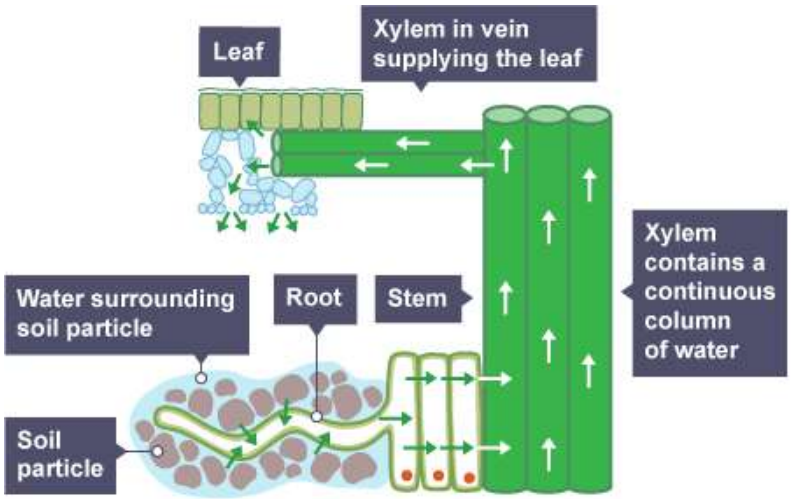
During photosynthesis, plants produce glucose from simple inorganic molecules - carbon dioxide and water - using light energy. Some of the glucose produced by photosynthesis is used for respiration. This releases energy for the seven life processes.

Translocation is the movement of sugar produced in photosynthesis to all other parts of the plant for respiration and the other processes described above. This occurs in phloem vessels.

### Transpiration

Transpiration is the movement of water in a plant and occurs due to water evaporating through the stomata in the leaves which pulls the other water molecules up to replace them because of forces between the water molecules.

This process occurs in the Xylem vessels.

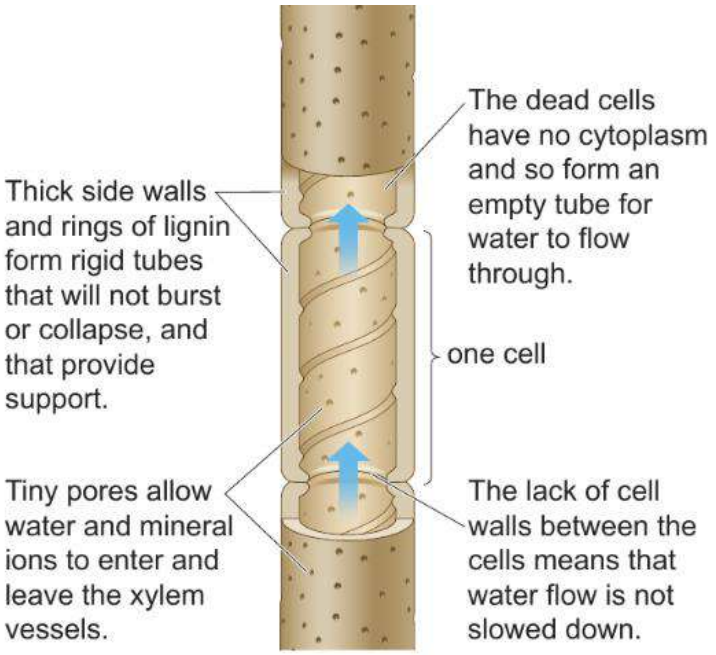



### Xylem

The Xylem is adapted to carry water through the plant by transpiration.

During the differentiation of xylem cells, the cell itself dies causing the bottom and top cell walls to disintegrate forming a long tube empty of cytoplasm to allow water to flow through easily.

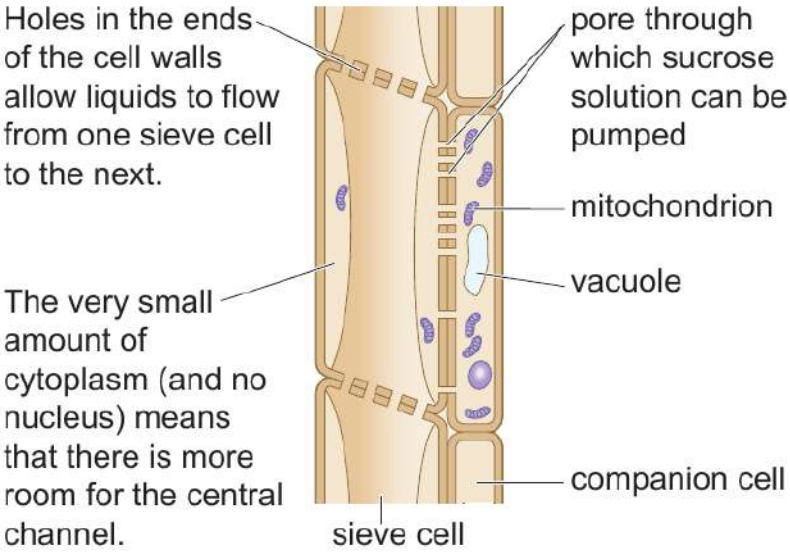
Although the cells are dead the walls of xylem vessels are very thick and have rings of something called lignin. These strong walls are to support the plant and so the water pressure doesn't burst the vessels. Despite these strong walls the xylem vessels do have tiny pores in to allow water and mineral ions to move in and out of the vessel easily.



## Phloem

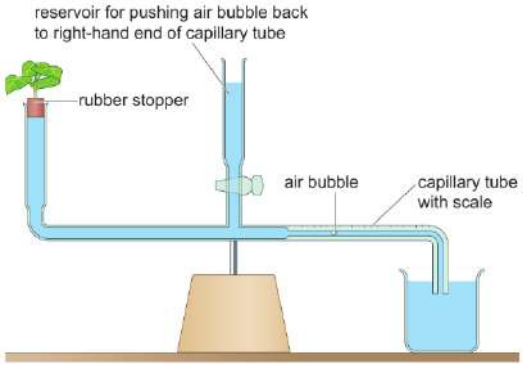
The Phloem contains sieve tubes that allow sucrose (a sugar made from glucose) to be translocated (transported) around the plant.

Unlike the xylem the sieve cells are not dead. They are however long tubes containing little cytoplasm and no nucleus and have holes in the cell walls at the top and bottom of the cell to allow fluid to flow through to the next cell.




The sieve cells have another cell attached to them these are called companion cells and actively pump sucrose into the sieve cells. To help the companion cells do this they are packed full of mitochondria. They also have vacuoles to help support the phloem.

## Measuring transpiration




This is a potometer. Potometers show how much water is taken up by measuring the distance moved by the air bubble. The further the bubble moves the more water is taken up. The more water taken up, the faster the rate of transpiration

By changing different factors, we can see how they affect the rate of transpiration using this equipment. For example, you can change light intensity by changing the distance of the plant from a light source. However, you have to place a beaker of water in front of the light so the heat from the light does not affect the rate.

Some of the factors that affect transpiration are;

- **Temperature** – As temperature increases so does the rate of transpiration as particles diffuse quicker.
- **Light intensity** – The higher the light intensity the higher the rate of transpiration and the wider the stomata so more water evaporates.
- **Wind** – As wind speed increases so does the rate of transpiration as wind moves molecules away from the stoma so more can evaporate.
- **Humidity** – As humidity decreases the rate of transpiration increases this is because the lower the humidity the less water molecules there are around the stoma and so more can evaporate.

# Knowledge Tasks

1. Why is transport in plants important?

   _____

2. What is translocation?

   _____

3. What is transpiration?

   _____

4. Describe the process of transpiration

   _____

   _____

   _____

   _____

5. How is the xylem adapted to function? (you may use a diagram in your answer)

   _____

   _____

   _____

6. How is the phloem adapted to function? (You may use a diagram in your answer)

   _____

   _____

   _____

   _____

7. Fill in the table below to compare the xylem and the phloem

| Part of plant | Xylem | Phloem |
|---|---|---|
| Role | | |
| Are cells dead or alive | | |
| Are other cells needed? | | |
| Adaptation one | | |
| Adaptation two | | |

8. How can the rate of transpiration be measured?

_____
_____
_____
_____

9. Describe how light intensity affects the rate of transpiration

_____
_____
_____
_____

10. Describe how wind affects the rate of transpiration

_____
_____
_____

11. Describe how humidity affects the rate of transpiration

_____
_____
_____
_____

12. Describe how temperature affects the rate of transpiration

_____
_____
_____

13. Explain how you could test the effect that light intensity has on the rate of transpiration including the controls you would use.

_____
_____
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14. Explain how you could change this experiment to test the effect of temperature on the rate of transpiration

_____
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