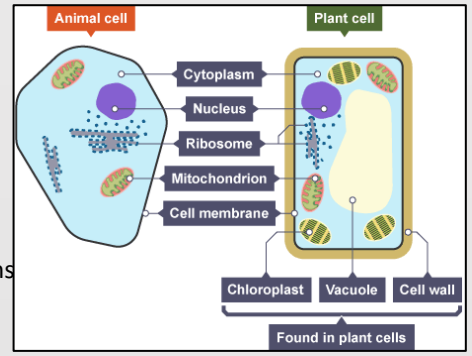
science biology

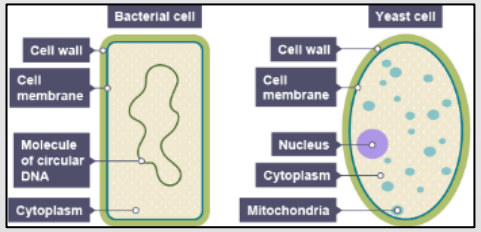
GCSE B1 – Cell Biology

1. Cell Structure

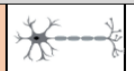
- **Nucleus**
Contains DNA and controls the cell
- **Ribosomes**
Protein synthesis
- **Cell Membrane**
Controls what goes in and out the cell
- **Mitochondria**
Respiration
- **Cytoplasm**
Where chemical reactions occur
- **Chloroplast**
Absorb light for photosynthesis
- **Vacuole**
Stores cell sap
- **Cell Wall**
Made of cellulose to strengthen the cell
- **Plasmid**
Contains additional genes

Eukaryotic cells – larger, more complex cells, with nucleus e.g. animal/plant/fungus
Prokaryotic cells – very small simple cells, no nucleus (loose DNA and plasmids) e.g. bacteria





2. Specialised Cells: They are **differentiated** so they have a modified structure to enable them to carry out a specific function.

specialised animal cells	nerve		*carry electrical signals*	long branched connections and insulating sheath
	sperm		*fertilise an egg*	streamlined with a long tail acrosome containing enzymes large number of mitochondria
	muscle		*contract to allow movement*	contains a large number of mitochondria long
specialised plant cells	root hair		*absorb water and minerals from soil*	hair like projections to increase the surface area
	xylem		*carry water and minerals*	TRANSPIRATION - dead cells cell walls toughened by lignin flows in one direction
	phloem		*carry glucose*	TRANSLOCATION - living cells cells have end plates with holes flows in both directions

3. Microscopes and Magnification:

Microscopes allow us to see greater detail in small samples:
- Adjust the focus (turn the fine focus) - to make the image clearer
- Increase the magnification (change the objective lens) – to make the image larger

Magnification is the number of times larger an image is compared with the real size of the object.

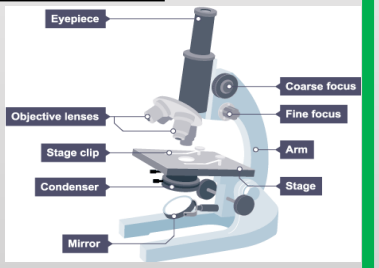
Resolution is the ability to distinguish between 2 separate points.

Types of microscopes

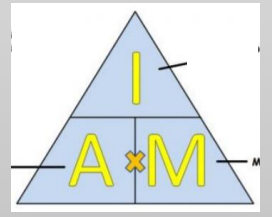
Feature	Light microscope	Electron microscope
Radiation used	Light rays	Electron beams
Max magnification	1500x	2 000 000x
Resolution	200nm	0.2nm
Size of microscope	Small and portable	Very large and not portable
Cost	Low	High

Required Practical 1 – USING A LIGHT MICROSCOPE

1. Use a stain to make organelles visible (e.g. cell wall, nucleus).
2. Get the specimen as flat and thin as possible.
3. Select the lowest objective lens to give the largest field of view.
4. Use the coarse focus to move the stage.
5. Use the fine focus to make the image clearer.
6. Calculate the total magnification = eye piece lens x objective lens



Calculating magnification:



Magnification (M) = Image size (I) / actual size (A)

Calculating actual size
- Use a RULER to measure the image in mm
- Multiply by 1000 to CONVERT mm into µm
- Divide image size by the magnification

REMEMBER there are 1000µm in 1mm and 1000nm in 1µm

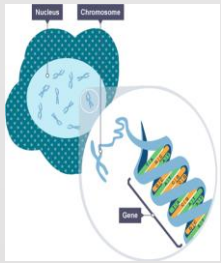
4. Stem Cells

Stem cells are undifferentiated cells that can **clone** to make more stem cells or specialise into any type of body cell by **differentiation**.
+ replace/repair tissue, grow organs, cure disease
- destroys embryo, ethical issues, moral/religious objections

Therapeutic cloning - an embryo is cloned from the patient. Stem cells are taken from the embryo to treat the patient's disease. No rejection issues as genes are the same.

5. Chromosomes and Genes:

Human body cells contain **46** (23 pairs of) chromosomes.



Chromosomes are long, rolled-up strands of **DNA** which carry the genes. **Genes** are sections of DNA that code for characteristics.

Males = 22pairs + XY
Females = 22 pairs + XX

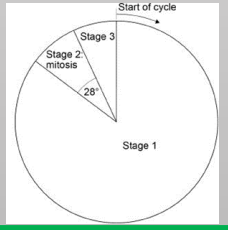
6. Cell Division:

Cells multiply by **Mitosis** to produce genetically identical cells.

Stages of the cell cycle

Stage 1
Cell growth, increase in number of organelles and DNA replicates
stage 2 Mitosis
One set of chromosomes moves to each end of cell, Nucleus divides
Stage 3
Cytoplasm / cell membrane divides to form two (genetically) identical cells

Result = 2 daughter cells, genetically identical to each other and the parent cell



chaseterrace academy

science

biology

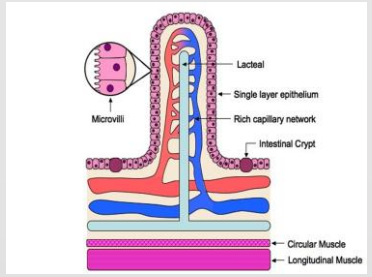
GCSE B1 – Cell biology

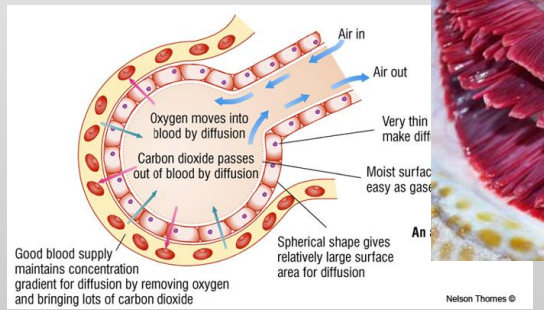
7. Exchanging materials

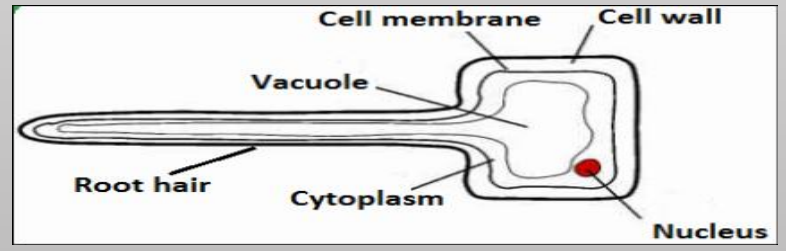
In **multicellular** organisms, surfaces and body organs are specialised for exchanging materials. Some example of specialised exchange surfaces are the villi in the small intestine, the alveoli sacs in the lungs, the gills in fish and leaves in plants.

The effectiveness of exchange surfaces in plants and animals is increased by:

- having a large surface area
- a membrane that is thin, to provide a short diffusion path
- (in animals) having an efficient blood supply
- (in animals, for gaseous exchange) being ventilated





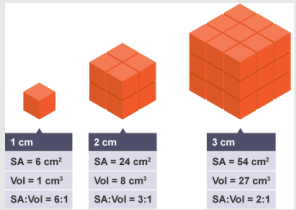


8. Calculating surface area: volume ratio

Large organisms have a small SA:vol so need specialised exchange surfaces (eg. alveoli, villi, gills) with large SA so diffusion is faster.

Surface area= length x width x 6

Volume= length x width x height



9. Active transport- *energy is used to move particles against a concentration gradient*

Examples

- Mineral ions are absorbed into plant root hairs from very dilute solutions in the soil. Plants require ions for healthy growth.
- Sugar molecules are absorbed from the gut to the blood stream

10. Osmosis *the movement of water from a high concentration of water (dilute solution) to a low concentration of water (concentrated solution) across a partially permeable membrane*

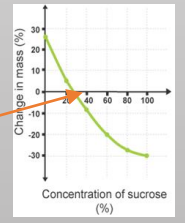
Osmosis Required Practical

IV= Conc of solution. DV = % change in mass

CVs = time, same length potato, solution volume, amount of blotting

1. Cut sections of plant (potato) tissue to 2cm and weigh them
2. Put into different concentrations of sucrose solution
3. Leave for 1 hr, remove from solutions
4. Blot dry using and paper towel and re-weigh the potato
5. Calculate the % change in mass

% change in mass= (change in mass/ starting mass) x 100



x intercept = zero change in mass
= solution must =
concentration of cytoplasm

11. Diffusion *the movement of particles of a gas or a liquid from a high concentration to a low concentration.*

Rate of diffusion is increased by:

- ▲ temperature
- ▲ surface area
- ▲ concentration gradient
- ▼ diffusion distance

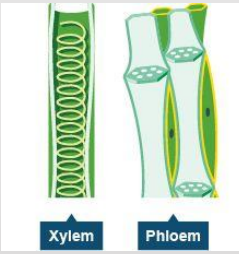
Example

- Oxygen diffusing into the bloodstream and carbon dioxide diffusing into the alveoli sac.

12. Plant Transport Systems

Translocation- movement of dissolved sugars through the **phloem** from the leaves (made) to the roots (store)

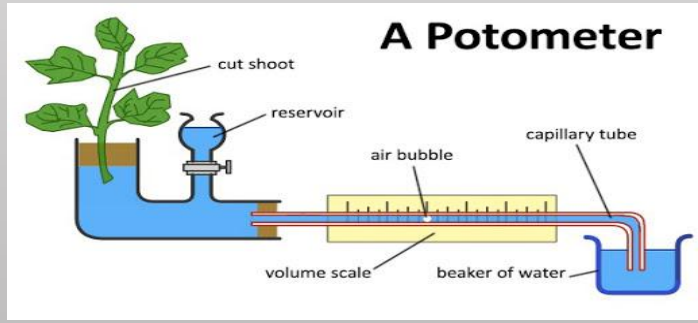
Transpiration- the evaporation of water through the stomata. This causes the movement of water and minerals from the roots to the leaves through the **xylem**.



The rate of transpiration is increased by:

- Warm Temperature
- Wind
- Dry air
- Sunlight

Transpiration can be measured using a **potometer**. As the shoot takes up the water the air bubble moves and this can be timed to give a volume of water per minute.



chaseterrace academy

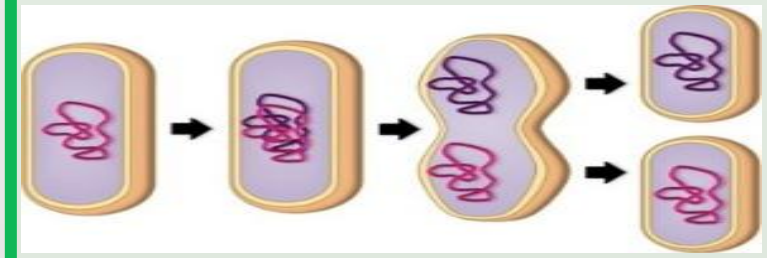
science biology

GCSE B1 SINGLE BIOLOGY ONLY– Cell Biology

chaseterrace academy

13. Culturing Microorganisms

Bacteria multiply by simple cell division (**Binary Fission**) as often as once every 20 minutes if they have enough nutrients and a suitable temperature.



The DNA loop is copied and the cytoplasm separates as the cell wall begins to pinch the cell in half.

Result = 2 genetically identical daughter cells and population growth is **exponential** (1>2>4>8>16>32>64>128….)

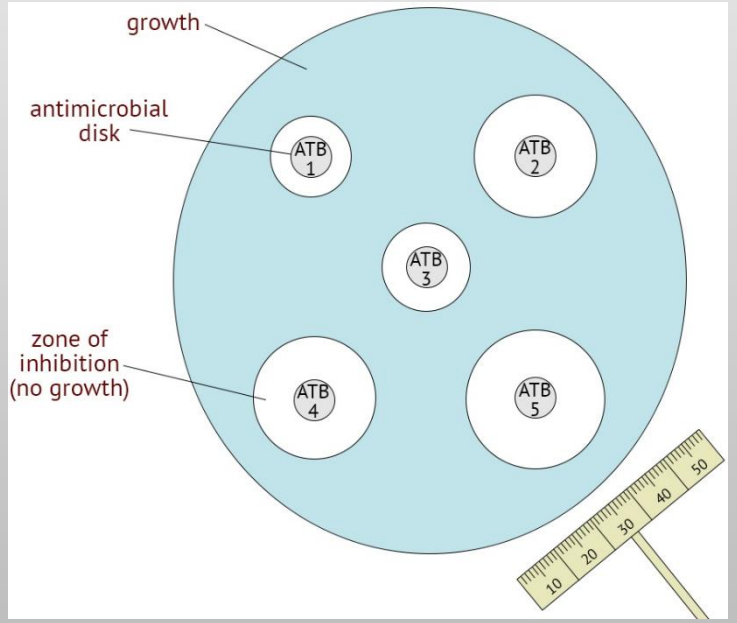
Bacteria can be grown in a nutrient broth solution or as colonies on an agar gel plate.

Sterile cultures of microorganisms are required for investigating the action of disinfectants and antibiotics.

14. PRACTICAL - INVESTIGATING THE EFFECT OF ANTISEPTICS ON BACTERIAL GROWTH

1. Using aseptic technique **inoculate** a petri dish with a **lawn** of *E.coli* bacteria.
2. Place discs of filter paper, soaked in a variety of antiseptics (eg mouthwash, hand-gel, disinfectant, water (control), onto the prepared petri dish.
3. **Incubate** at 25°C for 48h
4. Using a mm scale ruler, measure the diameter of the **zone of inhibition** around each filter paper disc.
5. Calculate area of each clear areas using πr^2.
6. Compare the effectiveness of each antiseptic.

More clear area = more bacteria killed = more effective antiseptic



15. Aseptic Technique

Preparing an uncontaminated culture.

Process	Why is it important?
Petri dishes and **culture media** must be sterilised before use	No unwanted bacterial growth
Lift lid only slightly and away from you	Prevents contamination from airborne bacteria
Inoculating loops used to transfer bacteria to the dish must be sterilised by passing them through a flame	No unwanted bacterial growth
The lid of the Petri dish should be secured with 2 pieces of tape and stored upside down	Air can get in but lid won't come off and no condensation will form on the lid
In school laboratories, cultures should generally be incubated at 25°C	No growth of pathogenic bacteria