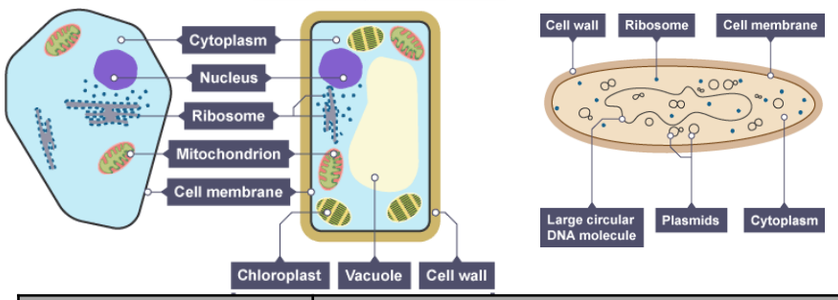
B1

Animal | Plant and algae | Bacteria



Specialised cells
Sperm, nerve, muscle (animal), root hair, xylem, phloem (plants)

Tissue: a group of cells with similar function, **Organs** are aggregations (clusters) of tissues performing similar functions

Sub cellular structure	Function	A	P	B
Nucleus	Controls activities of cell, contains DNA	Y	Y	
Cytoplasm	Site of chemical reactions	Y	Y	Y
Cell membrane	Controls what enters and exits cells	Y	Y	Y
Mitochondria	Site of respiration, where energy is released	Y	Y	
Ribosome	Site of protein synthesis	Y	Y	Y
Cell Wall	Gives cell strength, made of cellulose		Y	Y
Permanent vacuole	Contains cells sap		Y	
Chloroplast	Site of photosynthesis		Y	

Microscopes
Electron microscopes have higher **magnification** and **resolution** than light microscope. This allows us to see sub cellular structures e.g. mitochondria
Magnification = Image size/ Real object size **1000µm in a 1mm**

Cell cycle: DNA and sub-cellular structures are first **replicated,**
Mitosis is for growth and repair of cells. One set of chromosomes moves to each pole of cell. It happens in almost all body cells. You get **2 genetically identical daughter cells** (1 division)

Stem cell are undifferentiated cells that can change to specialised cells
Embryonic stem cells can change into any cell type e.g. nerve, muscle
Adult stem cells can only change to limited cell types (bone marrow → blood cells)
Plant meristem cells (found in root and shoot tip) can change though out their life

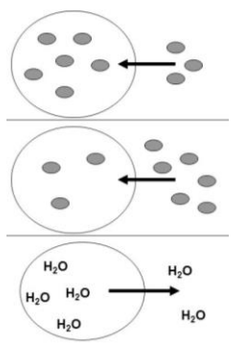
Uses: Therapeutic cloning is when an embryo is produced with the same DNA as patient – can treat paralysis, diabetes, burns. They do not get rejected by patients body.
Plant meristem can be used to make plant clones very quickly – good for rare plants or crops with desirable features such as disease resistance or high yield

Problems: Embryos discarded- ethical or religious objections, some risk of transferring viral infections (viruses sometimes used as a vector)

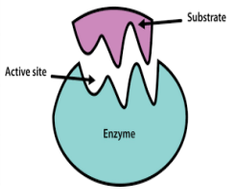
Active Transport - movement of particles from **low → high** concentration requiring **energy** e.g. mineral ion uptake in plant roots or sugar molecules in small intestine

Diffusion – movement of particles from **high→ low** concentration. E.g. oxygen entering cell for respiration.
Greater the **concentration gradient,** higher temperature and larger surface area = faster diffusion

Osmosis is diffusion of water **from high →low concentration OF WATER** through partially permeable membrane



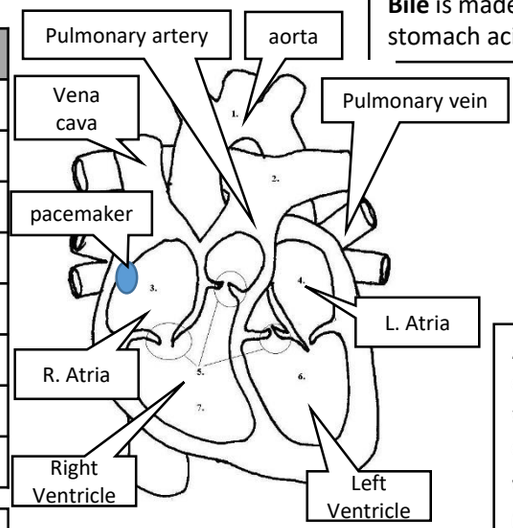
Enzyme	Made in…	Reaction
Amylase	Mouth, Pancreas, Small intestine	Starch → sugar
Protease	Stomach, Pancreas, S. intestine	Protein → aa
Lipase	Pancreas, Small intestine	Fats → fatty acids + glycerol



Small molecules are absorbed into the blood stream and used to build new carbohydrates, lipids and proteins. Glucose is used for Respiration

Bile is made in the liver and stored in the gall bladder. It is alkaline to neutralize stomach acid and breaks down fat into smaller droplets to increase surface area.

Enzymes are **biological catalysts** for **specific** reactions due to the shape of their active site like a "**lock and key**"



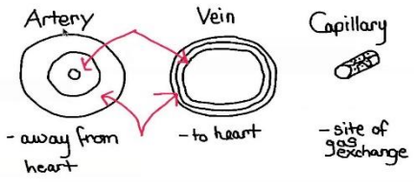
Blood travels from the body organs to the heart through from the **vena cava** vein, **right atrium, right ventricle, pulmonary artery** to the lungs. It returns from the lungs via the **pulmonary vein, left atria, left ventricle** and then is pumped to the body through the **aorta** artery.

The natural heart rate is controlled by the **pacemaker** cells . Artificial pacemakers are electrical devices that correct irregular heart rates

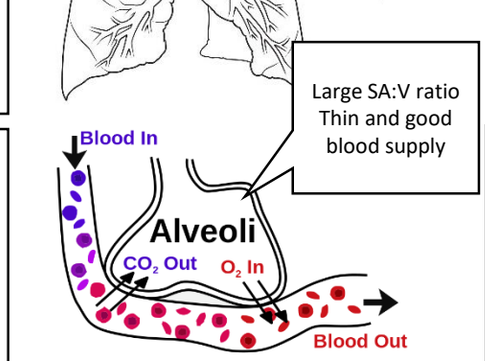
Arteries carry blood away from heart (oxygenated except pulmonary artery), they have thick walls with a layer of muscle to resist high pressures, elastic fibres to allow stretch.

Veins carry blood to the heart at low pressure (deoxygenated except pulmonary vein), they have thin walls and **valves** to prevent back flow.

Capillary walls are only one cell thick to allow fast rate of diffusion



Blood is a tissue that contains red blood cells (to carry oxygen), **white blood cells** (to produce **antibodies**) and **platelets** (clotting) suspended in **plasma** (carries cells, proteins, carbon dioxide, glucose, urea)



Artificial blood products do not need to be refrigerated and does not need to be a blood type match, but is expensive, does not carry as much oxygen and does not mix well with real blood

Biological replacement valves cause less damage to red blood cells but harden after a few years so more operations required.

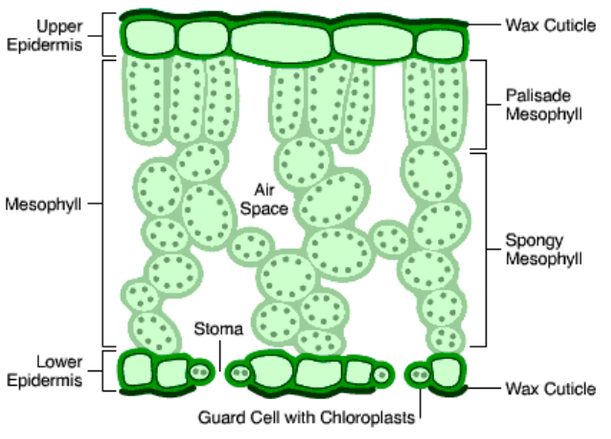
Mechanical valves last a life time but can damage RBC and require the patient to take anti-clotting drugs to thin the blood. **Artificial hearts** can be used for short periods of time

Coronary Heart Disease involves layers of fatty material narrowing the coronary arteries.

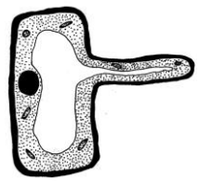
Stents keep the artery open.
Statin drugs reduce blood cholesterol levels which slows the rate of build up but are not suitable for people with liver disease

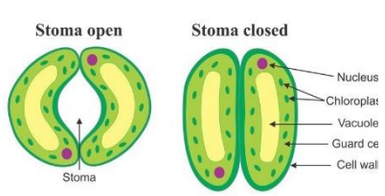
Plant tissue	Function
Epidermal	Covers organ e.g. leaf, stem, root
Meristem	Site of growth in root and shoot tips
Xylem	Transports water and mineral ions
Phloem	Transports sugar
Mesophyll	Site of photosynthesis (spongy and palisade)

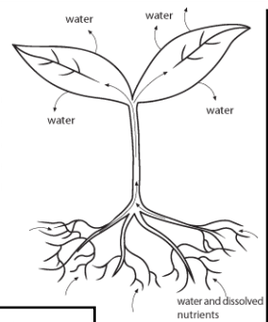
Diffusion examples
The small intestine villi, alveoli in lungs, gills in fish, root hair cells and leaves of plants are all adapted for quick diffusion and exchange of materials by having **large surfaces areas, thin membranes and good blood supply (animals)**



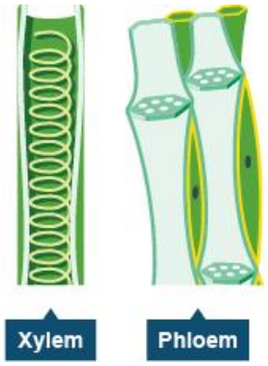
Root hair cells are adapted for efficient uptake of water by osmosis and mineral ions by active transport
Stomata and guard cells are to control gas exchange and water loss
Xylem tissue transports water and mineral ions from the roots to the stems and leaves. It is composed of hollow tubes strengthened by lignin adapted for the transport of water in the **transpiration** stream







Transpiration rate is increased due to high temperatures (particles have more kinetic energy), **low humidity** and **high wind** (greater concentration gradient) and **high light intensity**
(stomata only open when high light levels to conserve water at night)



The movement of food molecules through **phloem** tissue is called **translocation**. Phloem is composed of tubes of elongated cells. Cell sap can move from one phloem cell to the next through pores in the end walls.

Photosynthesis : **Carbon dioxide + Water → Glucose + Oxygen**

$$6CO_2 + 6H_2O \longrightarrow C_6H_{12}O_6 + 6O_2$$

Limiting Factors: Light, carbon dioxide, temperature

Measuring photosynthesis – count bubbles of oxygen or starch test (iodine solution goes black)
Glucose used the make starch, fats and oils for storage, cellulose (for cell wall strength) and amino acids for protein. Nitrates also needed to proteins (absorbed by roots)

Aerobic Respiration: **Glucose + Oxygen → (Energy) + Carbon dioxide + Water**

$$C_6H_{12}O_6 + 6O_2 \rightarrow \text{energy} + 6CO_2 + 6H_2O$$

Energy is used for movement, keeping warming and building molecules (e.g. making starch and cellulose in plants or glycogen in animals, forming lipids or proteins)

Exercise increases the heart rate and rates and depth of breathing, blood flows faster, increasing supply of sugar and oxygen to muscles. Glycogen broken down into glucose.

Anaerobic respiration does not use oxygen. Build up of lactic acid causes muscle fatigue. Less energy released too. **glucose → lactic acid (+ energy)**

Oxygen debt is the amount of extra oxygen the body needs after exercise to react with the lactic acid and remove it from the cells. Blood flowing through the muscles transports the lactic acid to the liver where it is converted back into glucose.

Fermentation is anaerobic respiration in plants and yeast **glucose → ethanol + carbon dioxide**
It is used to make bread and alcoholic drinks

Orders of Magnitude – A leaf is 0.1m long and a cell is 0.0001m long = 0.1/0.0001 = x 1000 = 10^3

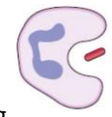
So **3 orders of magnitude**

Health is a state of physical and mental well being.
Different types of **communicable and non-communicable** diseases interact e.g. viruses can cause cancers, physical ill health can lead to depression.

Pathogens are microorganisms that cause infectious disease. Pathogens may be **viruses, bacteria, protists or fungi.**

Bacteria may produce **poisons** (toxins) that damage tissues and make us feel ill. Viruses live and reproduce inside cells, causing cell damage

Non-specific human defences include skin, nose hair, stomach acid, mucus production in the trachea and bronchi



White blood cells have three methods to defend against pathogens: **phagocytosis** (engulfing and destroying the pathogen), **antibodies** and **antitoxins**

Vaccination involves introducing small quantities of dead or inactive forms of a pathogen into the body to stimulate the white blood cells to produce **antibodies.** If the same pathogen re-enters the body the white blood cells respond **quickly** to produce the **many** of the correct antibodies, preventing infection. **Memory cells** created

Antibiotics, such as penicillin, are medicines that help to cure **bacterial disease**, first developed in the 1940s. Antibiotics cannot kill viral pathogens. Penicillin was discovered by **Alexander Fleming** from mould.

Painkillers and other medicines are used to treat the symptoms of disease but do not kill pathogens (from willow trees)

Digitalis heart drug is from fox gloves plant

Molecule	Food Test	Result
Starch	Iodine	+ Black - Orange
Sugar	Benedict with heat	+ Brick red - Blue
Protein	Biuret	+ Purple - Blue
Lipid	Emulsion test – ethanol and shake	+ Cloudy

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

Malignant tumour cells are cancers. They invade neighbouring tissues and spread to different parts of the body in the blood where they form secondary tumours. Cancers are caused by both lifestyles and genetic risk factors

Disease	Symptoms	Transmission
Measles (V)	Fever and red skin rash	Inhalation of droplets from sneezes and coughs
HIV (V)	Flu like initially and the immune system stops working and progresses to AIDs	Exchange of body fluids
TMV (V)	Leaves discoloured in a mosaic pattern – less photosynthesis	Direct contact plant to plant
Salmonella (B)	Fever, abdominal craps vomiting, diarrhea	Food poisoning
Gonorrhoea (B)	Green discharge from vagina or penis and pain when urinating	Sexually transmitted, treated with penicillin
Rose Black Spot (F)	Black and purple leaf spots, leaves turn yellow – less photosynthesis	Spread by water or wind
Malaria (P)	Recurrent fevers, can be fatal	Mosquito vectors

Drug testing Cells → Animals → human volunteers
Check dose, efficacy and toxicity

Preclinical testing is done in a laboratory using cells, tissues and animals. **Clinical** trials use healthy volunteers and patients. Low doses to check safety then extend trials to check for optimum dose.

Double blind trials involve giving some patients a **placebo** (substance with no medicine, all other variables in trial must be kept the same).

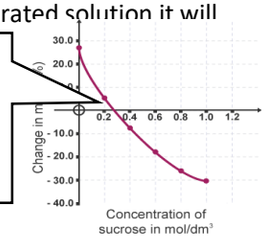
RP1: Microscopes - This sample to allow light through, total magnification = objective lens x eyepiece lens

RP2: Osmosis- IV: Concentration, DV: percentage change in mass, CV: Surface area of potato, temperature, same potato, time
In pure water the potato will gain mass, in concentrated solution it will lose mass due to osmosis

RP3: Food tests

RP4: Enzymes
IV: pH, DV: Time taken for starch To be converted to sugar by Amylase, CV: Temperature, Volumes of starch and enzyme
As the pH moves away from the optimum, the active site loses its shape and can no longer fit the substrate

X intercept: concentration of potato is same as solution



$$Light\ intensity \propto \frac{1}{Distance^2}$$

RP5: Photosynthesis
IV: Light intensity (distance of lamp from pond weed), DV: Number of bubbles of oxygen, CV: Type and length of pondweed, colour of light, carbon dioxide available, temperature