Biology
Paper 1 Knowledge Organisers

AQA Combined Science (Trilogy)

NAME: _____

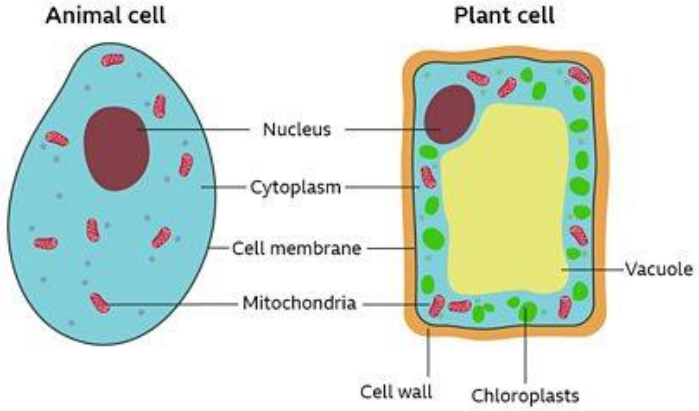
CLASS: _____

TEACHER: _____

B1 – Cell Biology

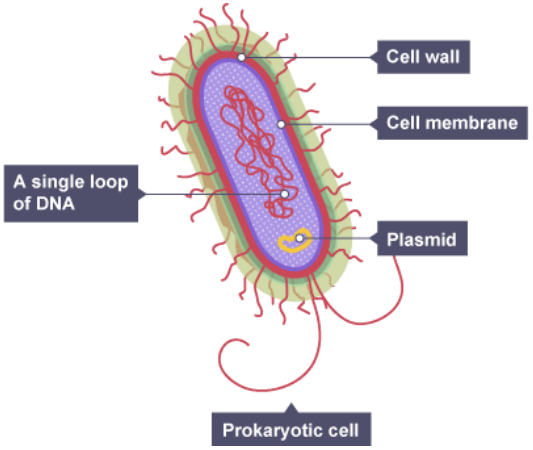
Eukaryotic Cells

They have a nucleus to contain the chromosomes. These can be animal, plant or fungus or protist cells. Animal and plant cells are shown below.



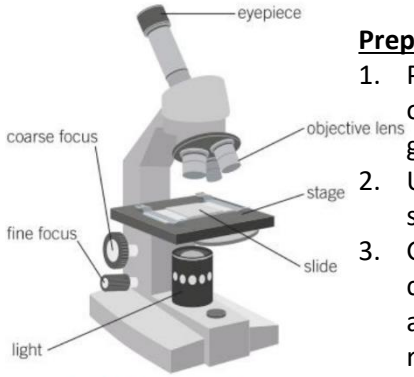
Prokaryotic Cells

They do not have a nucleus, they are usually a lot smaller and may contain plasmids.



Cell		Features
Animal	Sperm	High number of mitochondria Ribosomes that make enzymes in the head
	Nerve	Long Lots of branches (dendrites)
	Muscle	High number of mitochondria High Number of ribosomes Store glycogen
Plant	Xylem	Walls thickened with lignin to strength the cells into a tube
	Phloem	Sections between cells called sieves to help transport substances like dissolved sugars
	Root hair	Large surface area Lack of chloroplasts Large vacuole

RP1 – Microscopy; Observing Plant Cells



Preparing the slide:

1. Place a thin layer of onion membrane on a glass slide with forceps.
2. Use a drop of iodine to stain the cells.
3. Gently place a glass cover slip over the same and tap carefully to remove air bubbles.

Viewing the slide:

1. Place the slide on the stage and turn on the light.
2. Select the lowest magnification objective lens.
3. Look through the eyepiece and turn the coarse focus until the image can be seen.
4. Turn the fine focus until a clear image is formed.
5. Change the objective lens to another with a higher magnification and turn the fine focus re-focus the image.

Microscopes

The development of microscopes of the last 200 years has allowed us to study cells and the structures inside them in more and more detail.

Light Microscope	Electron Microscope
Low resolution Low magnification Cheap	High resolution High magnification Expensive

Calculating Magnification

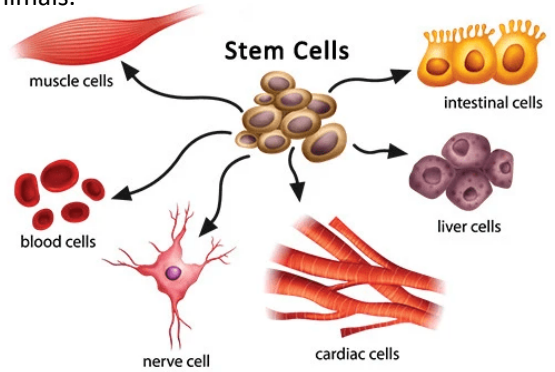
Units for image and actual size may need to be converted before using the equation below.

$$magnification = \frac{image\ size}{actual\ size}$$

mm → µm **x 1000**
µm → mm **÷1000**

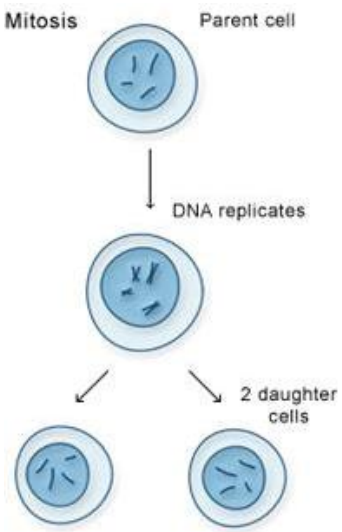
Cell Differentiation

As an organism develops, cells differentiate to form different types of cells. This is an example in animals.



B1 – Cell Biology

Mitosis

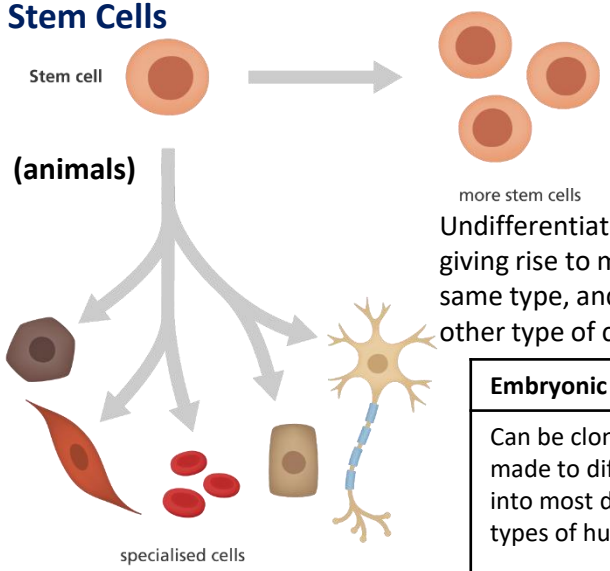


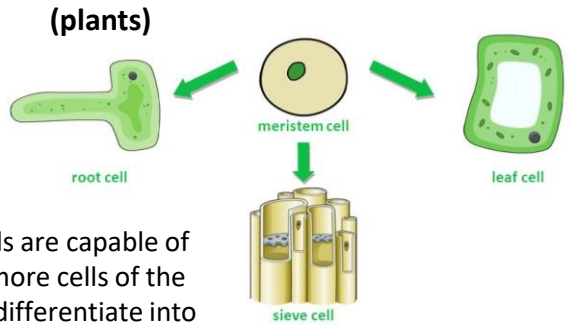
Before a cell can divide it needs to grow and increase the number of sub-cellular structures such as ribosomes and mitochondria. **The DNA replicates** to form two copies of each chromosome.

In mitosis one set of chromosomes is pulled to each end of the cell and the **nucleus divides**.

Finally the **cytoplasm and cell membranes divide** to form <u>two identical cells</u>.

Stem Cells

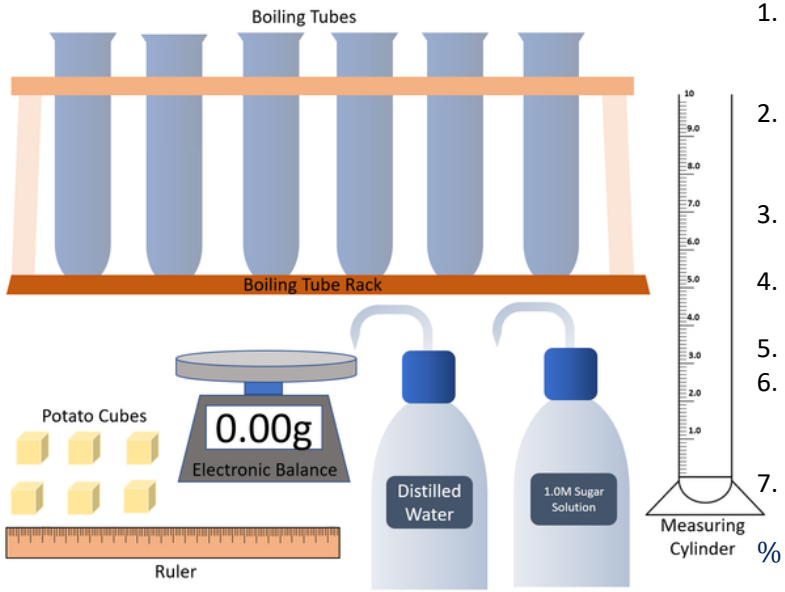




Undifferentiated cells are capable of giving rise to many more cells of the same type, and can differentiate into other type of cells.

Embryonic	Adult	Meristems
Can be cloned and made to differentiate into most different types of human cells	Bone marrow stem cells can form many types of cells including blood cells.	Can differentiate into any type of plant cell, throughout the life of the plant.

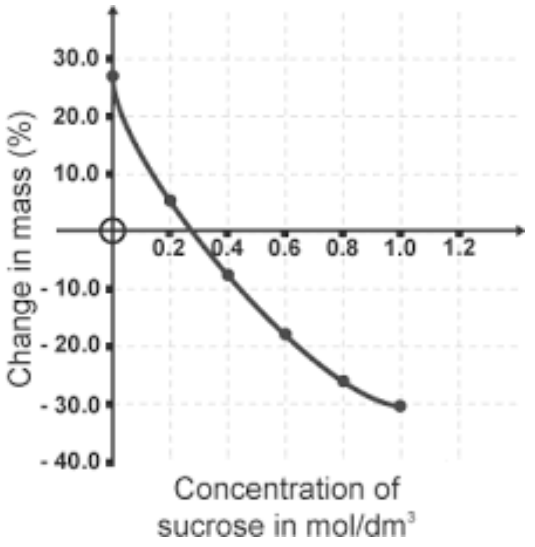
RP2 – Osmosis: The concentration of surrounding solution affects mass of plant tissue



1. Use a cork borer to create 5 cylinders of plant tissue (usually potato) and cut them all to the same length.
2. Measure the mass of each piece using a top pan balance and the length of each piece with a ruler. Record in a table.
3. Measure out 100cm^3 of each concentration of salt/sugar solution into labelled boiling tubes.
4. Place each piece of potato into a boiling tube for 24 hours.
5. Remove the pieces and blot with a paper towel.
6. Measure the mass of each piece using a top pan balance and the length of each piece with a ruler. Record in a table.
7. Calculate the percentage change in mass.

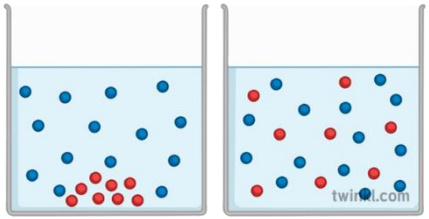
$$\%\ \boldsymbol{change\ in\ mass} = \frac{\boldsymbol{change\ in\ mass\ (g)}}{\boldsymbol{inital\ mass\ of\ potato\ (g)}}$$

<u>Results Graph</u>

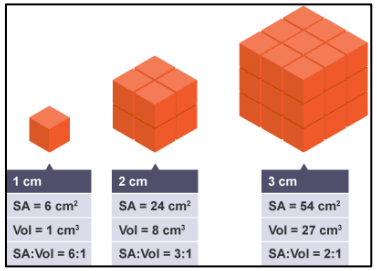


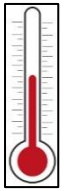
B1 – Cell Biology

Diffusion

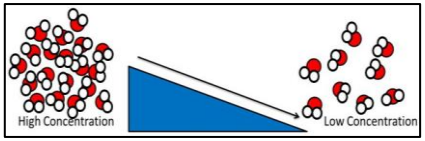


- Substances move a higher concentration of that substance (red particles pictured) to where there is a lower concentration of that substance. (High→ Low)
- This happens because of the random movement of the particles in a fluid (liquid or gas).





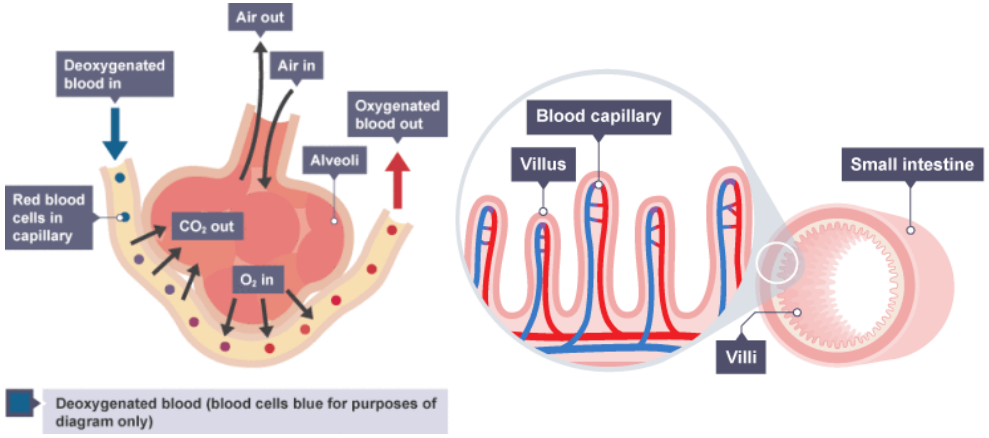
- There are ways the rate of diffusion can be changed:
  - the difference in concentrations (concentration gradient)
  - the temperature
  - the surface area of the membrane



Examples

Alveoli in the lungs and villi in the small intestine are both structured in similar ways so diffusion can happen at a high rate (fast).

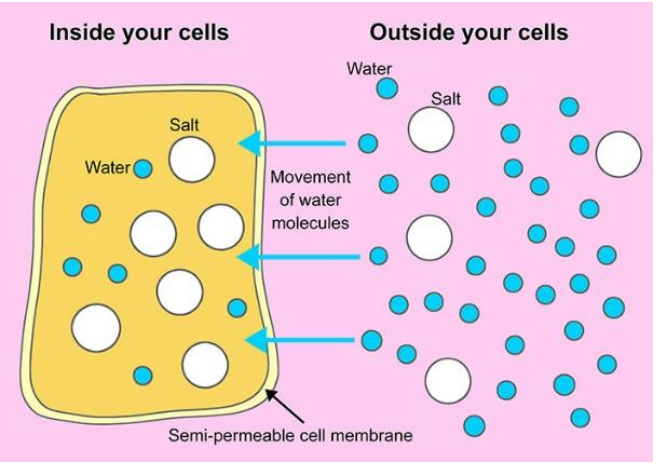
- having a large surface area
- a membrane that is thin, to provide a short diffusion path
- (in animals) having an efficient blood supply



Osmosis

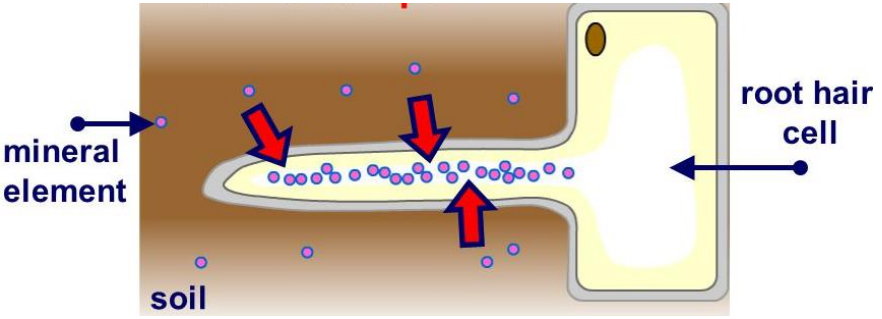
Water may move across cell membranes via osmosis.

Osmosis is the diffusion of water from a dilute solution to a concentrated solution through a partially permeable membrane (H→L).



Partially permeable means small molecules can move through but large molecules cannot.

Active Transport

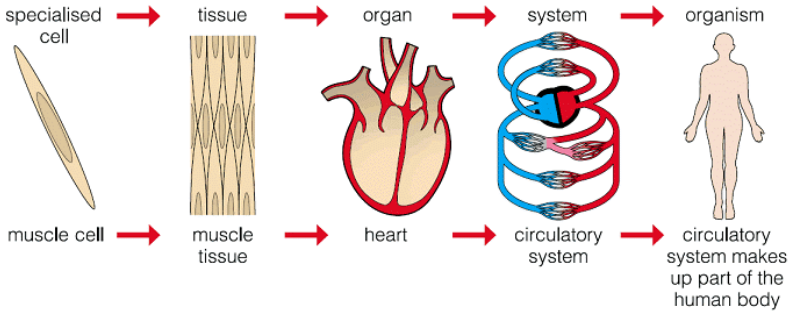


- Active transport is moving substances against the concentration gradient (L→H) so requires energy. This energy comes from respiration.
- This means that cells that carry out a lot of active transport (root hair cells, epithelial cells on villi in the small intestine) contain a lot of mitochondria.

B2 – Organisation

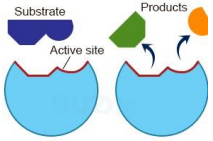
Levels of Organisation

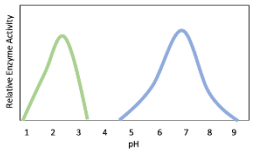
Cells = basic building blocks of all living organisms.
A tissue = group of cells with a similar structure and function.
Organs = aggregations of tissues performing specific functions.
Organs systems = organs organised to form organisms.



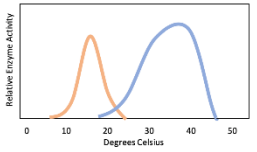
Enzymes

- Biological catalysts
- Digestive enzymes speed up the break down of insoluble food molecules
- Specific shape active site that matches substrate





Enzymes work best at certain temperatures or pH depending on their role.



Bile

The liver makes an **alkaline** solution called bile. Stored by the gall bladder.
Has two jobs:

- Emulsifies fats
- Neutralises stomach acid.

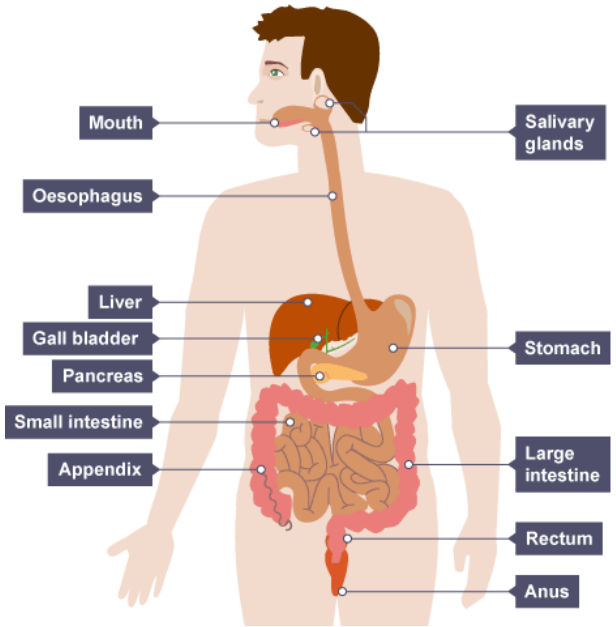
Digestive Enzymes

Starch —(amylase)→ Glucose

Protein —(protease)→ Amino Acids

Fats —(lipase)→ Fatty acids + Glycerol

Digestive System



Organ	Function
Mouth	Teeth and tongue to chew food.
Salivary Glands	Releases saliva containing enzymes.
Oesophagus	Muscle tube to squeeze food along.
Stomach	Contains enzymes and hydrochloric acid. Is made of muscle to churn food. Hydrochloric acid kills bacteria in food
Small Intestine	Where digestion is completed and soluble food particles (glucose, amino acids, fatty acids, glycerol). are absorbed
Large Intestine	Absorbs water.
Liver	Produces bile.
Gall Bladder	Stores bile.
Pancreas	Releases enzymes.

Where are the enzymes?

Enzyme	Salivary glands	Stomach	Pancreas	Small intestine
Amylase	X		X	X
Protease		X	X	X
Lipase			X	X

RP3 – Food Tests

Summaries of the four food tests.

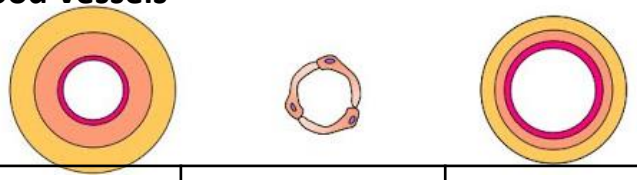
Protein Add Biuret's reagent Positive test; Blue solution turns **Purple**	**Starch** Add Iodine Positive test; solution turns from orange to **Black**
Fats Add Ethanol and water Positive test – solution turns **Cloudy**	**Glucose** Add Benedict's and heat Positive test blue solution turns **Brick red** Water Bath

B2 – Organisation

The effect of pH on the rate of reaction of amylase

1. Add 2cm^2 amylase solution, 2cm^2 of starch solution and 2cm^2 of pH2 buffer to a water bath (37°) in separate test tubes. Wait 10 minutes.
2. While waiting, add 2 drops of iodine solution to each well on the spotting tile.
3. Once the solutions in the water bath have reached 37° pour the amylase and PH2 buffer into the starch solution.
4. Immediately take a sample with a pipette and add to the first well of the spotting tile.
5. Repeat step 4 every 30 seconds until there is no colour change when testing with iodine solution.
6. Repeat steps 1-5 with pH4, pH6, pH8 and pH10 buffers.

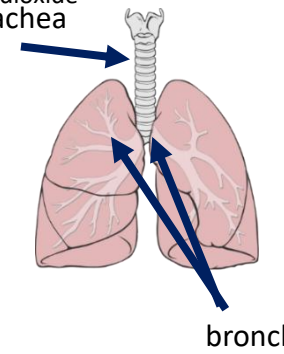
Blood Vessels



Arteries	Capillaries	Veins
• Blood carried away from heart • Thick muscular and elastic walls = withstands high pressure • Small lumen = maintains high pressure	• Walls only one cells thick = shorter diffusion pathway • Lumen just bigger than red blood cell • Blood flows very slowly • Diffusion takes place here	• Blood carried back to heart • Thin walls as blood is low pressure • Large lumen – lower resistance for blood passing through • Valves prevent back flow

Respiratory System

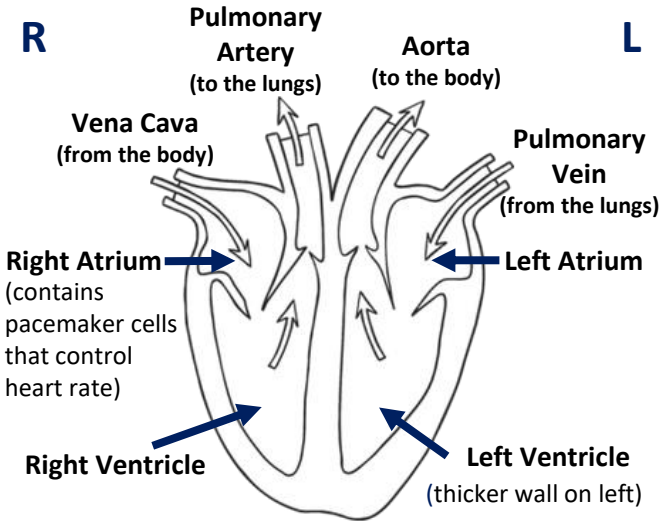
The lungs have two jobs – to get oxygen into the blood and remove carbon dioxide



Structures that cannot been seen on this diagram are the **alveoli and capillary network** – see 'unit 1 - diffusion'.

The Human Heart

Double pump because - left side pumps to whole body, right side pumps to the lungs.



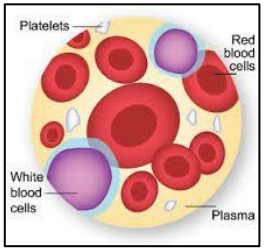
Blood – 4 components

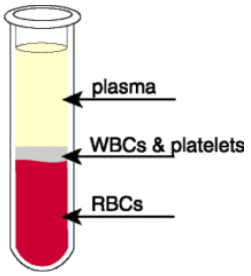
Red blood cells – contain haemoglobin to carry oxygen. More detail…

White blood cells – fight pathogens (see unit 3 – infection and response).

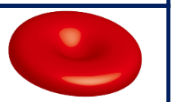
Platelets – cell fragments that clot blood.

Plasma – liquid part that transports cells, cell fragments and dissolved substances (salts, urea, CO_2, hormones…)



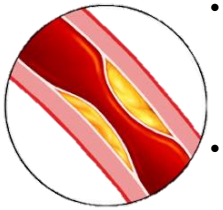


Red Blood Cells (RBCs)



- Contain chemical 'haemoglobin'.
- This reacts/ binds with oxygen to be carried around the body.
- RBCs are ~8µm (relative small animal cell) allows them to fit through capillaries
- Bi-concave disc shape for large SA:V

Coronary Heart Disease (CHD)



- Coronary arteries supply heart muscle with blood (containing glucose and oxygen for respiration)
- Can become narrowed/blocked by fatty deposits if cholesterol high, reducing blood flow.
- Reduced muscle contraction in heart

B2 – Organisation

Heart Disease Treatment – Statins vs Stents

Statins	Stents
• Medication to be taken everyday • Lowers blood cholesterol • Does not work immediately	• Mesh tube to be inserted into artery to hold it open • Surgery required • Works immediately

Faulty Valves

- Valves in veins and the heart prevent backflow of blood
- Faulty valves = don't open or close fully
- Can be replaced with man-made valves or transplants from donors

faulty

healthy

Cancer

Uncontrolled cell growth

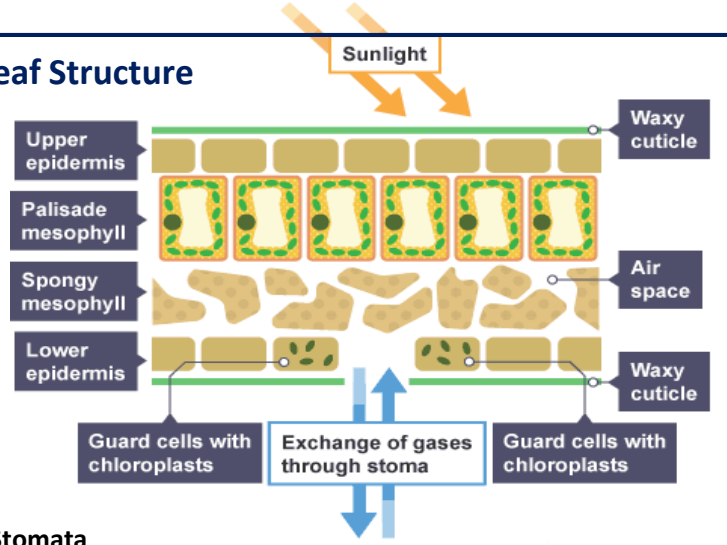
Benign tumours = abnormal cells, contained in one area, in a membrane, do not invade other parts of body.

Malignant tumours = cancer cells, not in a capsule, invade neighbouring tissue, and spread into blood and form secondary tumours.

Risk Factors

Lifestyle factors can have be risk factors for certain diseases. E.g. obesity is a risk factor for type 2 diabetes, or drinking and smoking while pregnant affects the development of the foetus.

Leaf Structure

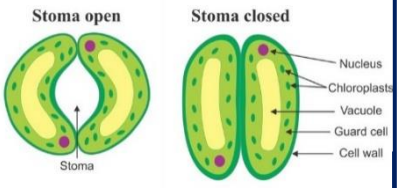


Stomata

Tiny pores on the underside of the leaf.

Allow oxygen and CO_2 to diffuse in and out

Guard cells surround the stomata and can open and close the pore

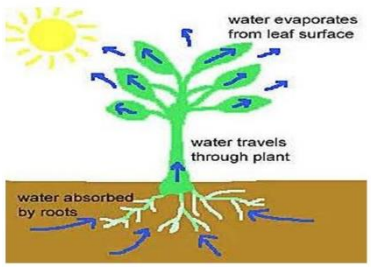


Interaction of Diseases

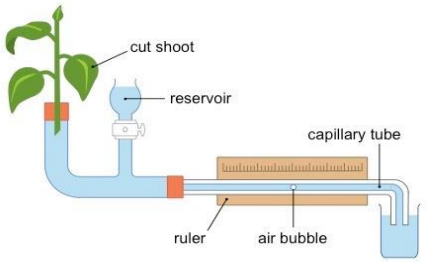
- Defects in the immune system - individual is more likely to suffer from infectious diseases.
- Viruses can trigger cancers, e.g. HPV can trigger cervical cancer.
- Immune reactions caused by pathogens can trigger allergies such as asthma or rashes
- Severe physical ill health can lead to depression and other mental illness.

Transpiration

Movement of water through plant from roots to leaves, driven by evaporation through the stomata



Measuring transpiration



Record the distance the bubble of air moves along the scale during set amount of time to calculate volume of water uptake per minute.

Transpiration	Translocation
Movement of water from roots to leaves	Movement of dissolved sugars from leaves all round the plant
Xylem - hollow tubes strengthened by lignin.	Phloem – tubes of elongated cells.
One way system – roots to leaves.	Two way system – sugars taken to wherever they are needed.

Increasing the rate of transpiration

- Higher temperature
- Lower humidity
- Higher light intensity
- Higher air movement

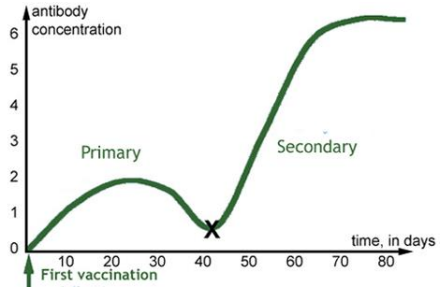
B3 – Infection and Response

Communicable Diseases – diseases caused by a pathogen

Disease	Pathogen	Symptoms	Spread by	Prevent spread	Treatment
Salmonella	Bacteria	Fever, cramps, vomiting, diarrhoea	Contaminated food	Vaccinating poultry, cooking food thoroughly	Antibiotics or management of symptoms
Gonorrhoea	Bacteria	Yellow/green discharge, pain when urinating	Sexual Contact	Using barrier protection, e.g. condoms	Antibiotics
Measles	Virus	Red rash and fever	Breathing in droplets from coughs/sneezes	Vaccination	No cure – only management of symptoms
HIV	Virus	Flu-like symptoms, develops into AIDS	Sexual contact	Using barrier protection, e.g. condoms	Antiretroviral drugs
Tobacco Mosaic Virus (plants)	Virus	'Mosaic' pattern of discolouration on the leaves	Soil	Destroy infected plants	No treatment
Rose Black Spot (plants)	Fungus	Black spots on leaves	Wind or water	Remove and destroy infected leaves	Fungicides
Malaria	Protist	Recurrent episodes of fever	Insect bites (mosquitoes)	Mosquito nets, insect repellent	Antimalarial drugs

Vaccination

- Introducing small quantities of dead or inactive forms of pathogen into the body.
- Stimulates WBCs to produce antibodies.



- If same pathogen returns (X), WBCs remember how to make the right antibodies.
- They make MORE antibodies, MORE QUICKLY, and they stay in body for LONGER.

Antibiotics & Painkillers

Antibiotics = kill bacteria (specific antibiotic for specific bacteria) **THEY DO NOT KILL VIRUSES** e.g. penicillin

Antibiotics cannot kill viruses because viruses live inside cells

Painkillers = stop pain (don't kill microbes, just help with symptoms) e.g. paracetamol

Development of Drugs

Testing for:

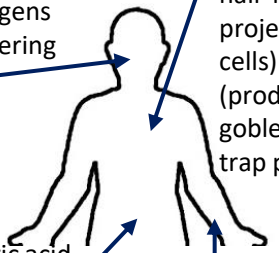
- Safety
- Efficacy (does it work)
- Dosage (how much is needed)

Stage		Description
1	pre-clinical	Tested on cells and tissues. Side effects? Efficacy?
2	pre-clinical	Tested on animals. Side effects?
3	clinical	Clinical trials = tested on humans. 1st health volunteers, 2nd patients with the illness. Dosage gradually increased to optimum.

Non-specific Defence Systems

Nose
Hairs and mucus trap pathogens before entering lungs.

Trachea & Bronchi
Cilia cells (small hair-like projections from cells) and mucus (produced by goblet cells) trap pathogens.

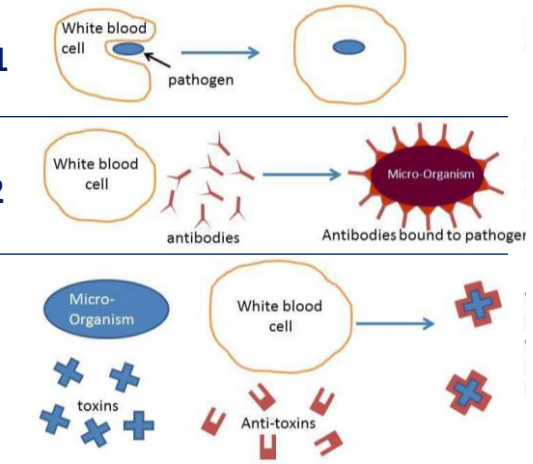


Stomach
Contains hydrochloric acid to kill pathogens that have been eaten.

Skin
If damaged, repairs itself (scabs)

White Blood Cells (WBCs)

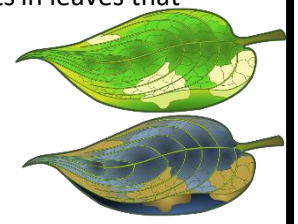
1. Phagocytosis – engulfing the pathogen
2. Producing antibodies – specific to the antigen
3. Producing antitoxins – to neutralise toxins



B4 – Bioenergetics

Photosynthesis

Endothermic chemical reaction that takes place in chloroplasts in leaves that produces glucose and oxygen from carbon dioxide and water



carbon dioxide	+	water	→ (light)	oxygen	+	glucose
$6CO_2$	+	$6H_2O$	→	$6O_2$	+	$C_6H_{12}O_6$

What do plants do with the glucose?

- Stored as starch
- Stored as fats and oils
- For making cellulose (for cell walls)
- For respiration
- For making amino acids (along with nitrates from soil)

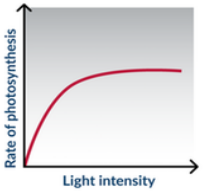
Testing the leaf for starch:

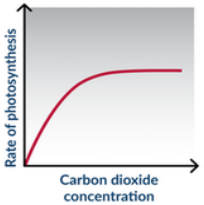
- Boil the leaf for 5 minutes to soften
- Put into heated ethanol to remove chlorophyll (turn off Bunsen burner!)
- Spread leaf on a white tile
- Add iodine
- In the places that contain starch the iodine will turn blue/black
- In a variegated leaf, only the parts containing chlorophyll turn blue black
- This shows chlorophyll is essential for photosynthesis

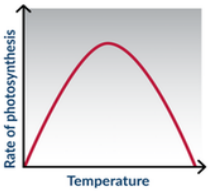
Factors the affect rate of photosynthesis

- Light
- Temperature
- CO_2 concentration

Whichever one is in the shortest supply is called the **limiting factor** – as it is the one limiting the rate of photosynthesis

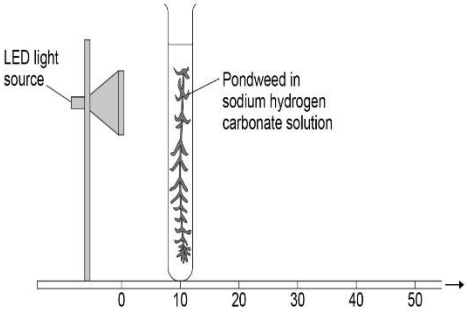






Increased light intensity increases the rate, but only up to a point, when CO_2 or temperature become limiting	Increased CO_2 conc increases the rate, but only up to a point, when light or temperature become limiting	Increased temperature increases the rate, but only up to a point, then the enzymes are denatured & rate drops

RP5 – Effect of light intensity on rate of photosynthesis



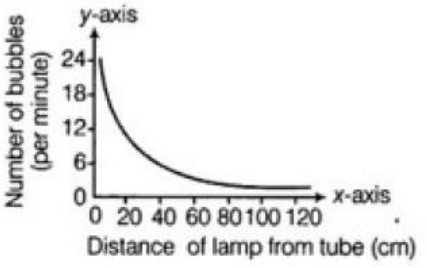
Independent variable: distance between lamp and plant (or light intensity)
Dependent variable – number of bubbles per second / rate of photosynthesis
Controls – temperature of solution, piece of pondweed

1. Measure 10cm length of pondweed and cut with scissors.
2. Place into beaker of 250ml $NaHCO_3$ solution. (this provides CO_2)
3. Place lamp 10cm away from pondweed – turn on lamp and leave for 2 minutes to adjust to light intensity.
4. Count number of bubbles produced in 60 seconds and record in table.
5. Repeat steps 3 and 4 for lamp distances of 20cm – 50cm at 10cm intervals.
6. Keep the temperature of the solution the same (LED light is used to not give off heat)

Inverse Square Law (HT only)

As distance of the lamp doubles the light intensity of the plant quarters $I = \frac{1}{d^2}$

Typical results:



As the **distance** between the lamp and the pondweed **increases**, the **number of bubbles per minute decreases**

B4 – Bioenergetics

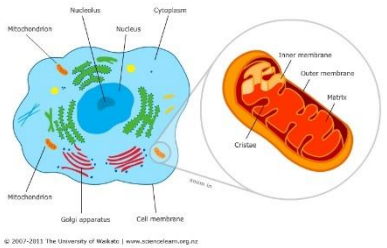
Respiration

Respiration is a chemical reaction that happens in the mitochondria of cells to release energy from glucose.
There are two types – Aerobic and Anaerobic.

Aerobic: - with oxygen

oxygen	+	glucose	→	carbon dioxide	+	water
$6O_2$	+	$C_6H_{12}O_6$	→	$6CO_2$	+	$6H_2O$

Organisms need energy for:
- chemical reactions to build larger molecules
- movement
- keeping warm.



Exercise

During exercise, more energy is needed so that muscles can keep contracting.
This means more respiration is needed.

Increased breath depth -
Get more oxygen into blood per breath and remove CO_2

Increased heart rate -
Get more oxygenated blood to muscles.

Increased breathing rate -
Get oxygen into blood quickly.

Heart beats harder - more blood is pumped with every beat.

During intense exercise, there is just not enough oxygen getting into the body.
The muscles start to respire anaerobically.
The build up of lactic acid can cause cramp/stitch.
(HT ONLY) When exercise is over, the lactic acid has to be oxidised to CO_2 and H_2O. The amount of oxygen needed to do this is called the oxygen debt

Anaerobic respiration

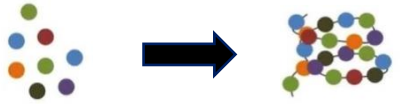
Respiration without oxygen

In animal cells = **glucose → lactic acid**
In plant/yeast cells = **glucose → ethanol + carbon dioxide**
In yeast, this is fermentation and is used in brewing and baking

	Aerobic	**Anaerobic**
Oxygen used?	Yes	No
Waste products	CO_2 and H_2O	Lactic acid (animals) Ethanol + CO_2 (plants/yeast)
Energy released	Lots	Much less

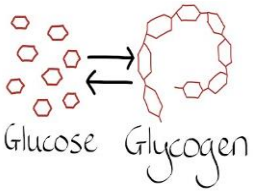
Metabolism

Metabolism is the sum of all the reactions in a cell or the body.
The 'metabolic rate' is the rate at which all of these reactions take place.
An example of a reaction = making proteins using amino acids from digestion.



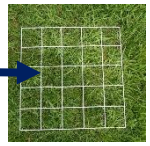
amino acids → **protein**

More examples:
- glucose → glycogen (in muscles/liver)
- respiration
- protein → urea
- glycerol and fatty acids → fats



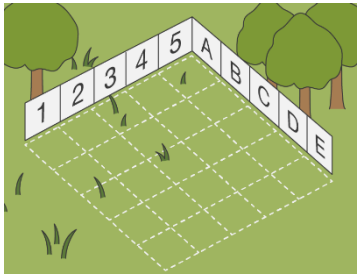
B7 – Ecology

RP7 – Estimating Populations Part 1



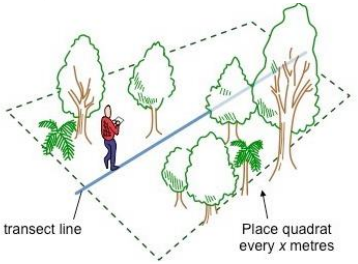
1. Calculate area of site.
2. Divide site up into a numbered grid
3. Use a random number generator to pick coordinates.
4. Randomly throw the 0.25m^2 quadrat at those coordinates.
5. Count the number of particular organism in the quadrat.
6. Repeat steps 3-5 **ten times (minimum).**
7. Calculate mean number of organism.
8. Calculate estimated number organism in site using the following equation

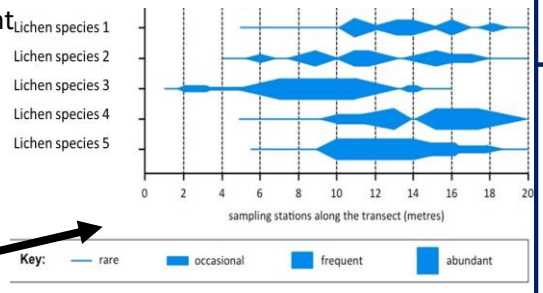
$$\frac{area\ of\ site}{area\ of\ quadrat}\ x\ mean$$



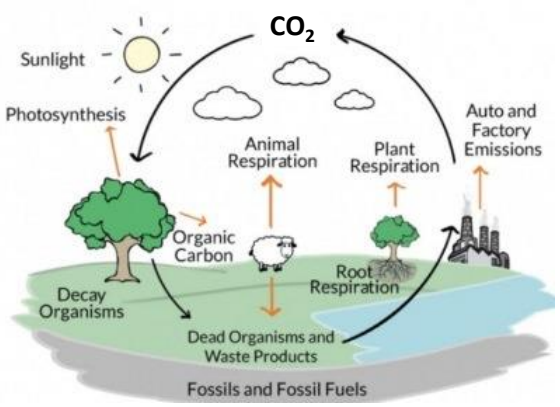
RP7 – how populations may change over a distance

1. Place tape measure (a transect line) through ecosystem being investigated.
2. Place quadrat at regular, random intervals along the transect line and count the number of particular organisms.
3. Draw a distribution graph of your results. (They might look like this.)

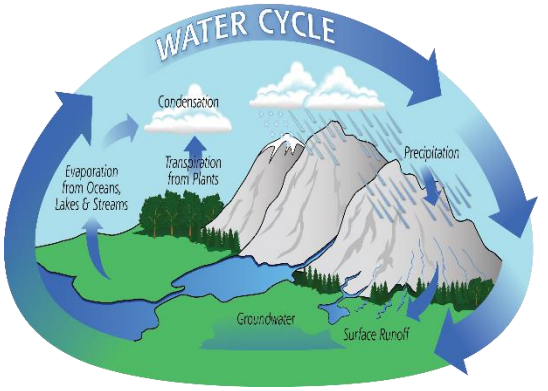




The Carbon Cycle



The Water Cycle



Human Impact on Biodiversity

Waste management	Rapid growth in the human population = more resources are used and more waste is produced – this contributes to pollution. Can occur in water, in air and on land.
Land Use	Humans reduce the amount of land available for other animals and plants by building, quarrying, farming, dumping waste and the destruction of peat bogs.
Deforestation	In tropical areas it has occurred to provide land for cattle and rice fields or grow crops for biofuels.
Global Warming	Levels of carbon dioxide, methane and water vapour in the atmosphere are increasing, and contribute to 'global warming'.

Decay

Microbes such as fungi and bacteria break down dead or dying material. This returns carbon to the atmosphere as carbon dioxide and mineral ions to the soil.

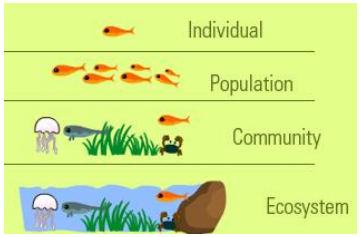
Maintaining Biodiversity

- breeding programmes for endangered species
- protection of rare habitats
- reintroduction of hedgerows
- reduction of deforestation and CO_2 emissions
- increased recycling to avoid landfill

B7 – Ecology

Ecosystems

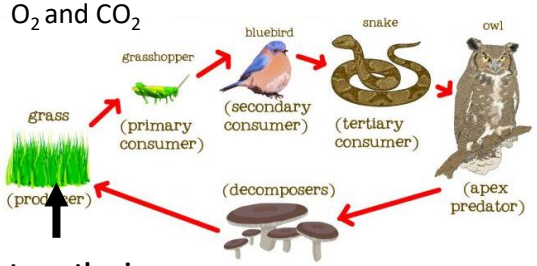
An ecosystem is all the living organisms within an area (community) plus the physical habitat



Interdependence

Organisms rely on each other for…

- Food
- Shelter / nesting sites
- Seed dispersal
- O_2 and CO_2



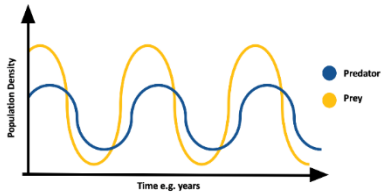
photosynthesises

Biotic and Abiotic Factors

Factors that affect the number of organisms

Biotic – living	Abiotic – non-living
• availability of food • new predators arriving • new pathogens • one species outcompeting another so the numbers are no • longer sufficient to breed.	• light intensity • temperature • moisture levels • soil pH and mineral content • wind intensity and direction • carbon dioxide levels for plants • oxygen levels for aquatic animals.

Predator-Prey Relationships



Population increases and decreases follow similar pattern in a cycle because they affect each other – more prey = more food for predator.

However predator and prey not 'in phase', e.g. predator population changes are delayed as it takes time for the predator population to grow.

Competition

Plants	Animals
Light Space Minerals ions Water	Food Mates Territory

Plant adaptations

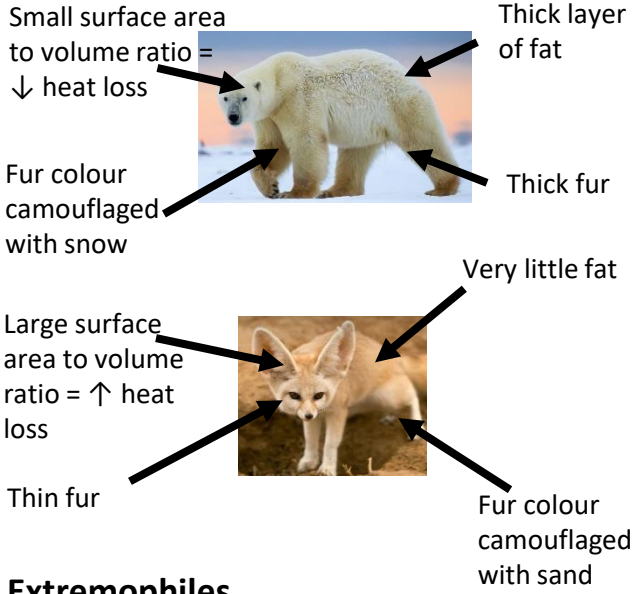
Plants in desert areas have :

- deep roots to maximise water uptake
- thin/no leaves to minimise water loss
- Spines to stop them being eaten

Animal Adaptations

Can be:

- Structural – a feature of the organism's body (e.g. thick fur, bright colours, camouflage)
- Behavioural – responses from the organism (e.g. hibernation, migration, huddling together)
- Functional – a body process (e.g. camel breaking down hump of fat into water, producing little urine



Extremophiles

Extremophiles are organisms that live in extreme environments.
Extreme environments = high temperatures, high pressure or high salt concentration.

E.g. bacteria living in deep sea vents = extremophiles.

B6 – Inheritance, Variation and Evolution

Inherited disorders

Cystic fibrosis
Disorder of cell membranes
Caused by a recessive allele
Causes thick mucus to form in membranes
Main organs affected are lungs, digestive & reproductive organs – pancreas and intestines.

Alveoli get blocked with mucus
Increases diffusion path so less O_2 gets into the blood

♂ Father

♀ Mother	C	c
C	CC	Cc
c	Cc	cc

Polydactyly
Disorder of the hands and feet
Caused by a dominant allele
Causes extra digits, fingers and toes.

Embryo screening
Parents that have inherited disorders may opt for embryo screening

1. Multiple embryos are made in IVF
2. One cell is removed from each embryo
3. The cells are screened for faulty genes
4. Only embryos without the genes for disorders are transferred to the womb of the mother.

\+ Babies born free of that inherited disorder
- no guarantee child will be free of other health issues
- Many embryos are destroyed, which are potential human lives

Variation

May be due to differences in:
- Genes that have been inherited(genetic causes)
- Conditions which they have lived in (environmental causes)

- Combination of genes and the environment.

Mutation = a change in the DNA during copying (randomly). Often has no effect on the gene, but sometimes leads to new proteins being made and a new characteristic being seen

Evolution

Evolution = a change in inherited characteristics of a population over time through natural selection – could lead to a new species.
A **species** is a group of organisms that can successfully breed.
Theory of evolution states that all species have evolved from a simple life forms more than 3 billion years ago.

Natural Selection

Described by Darwin
1. **Variation** within a species – different genes. (due to **mutation**)

2. One gene may give characteristics that are better **adapted** for survival in the environment.

3. Those with **advantageous genes** will survive and reproduce – passing genes to **offspring**.

4. Over long periods of time, all members of that species have the characteristic, may even lead to a new **species**.

Extinction

Extinction = no remaining individuals of a species still alive on Earth.

Factors which could cause extinction:
- New disease
- Rapid change in environment (e.g. meteor/volcano eruption)
- New predators
- New competitors (often man)

Evidence for evolution

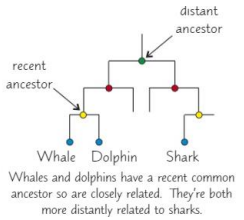
Fossils

Fossils are the **remains of plants or animals** from **millions of years ago:**
They are formed in different ways:
- Remains of an organism that has not fully decayed as one of the decay conditions was absent (e.g. too cold, not enough O_2)
- Mineralised forms of the harder parts of an organisms (such as bones)
- Traces of organisms such as footprints or burrows.

Many early life forms were **soft bodied** so have left few traces behind, as they decayed so we cannot be sure how life started on Earth. Many have been destroyed by Earth's rock cycle. Fossils help us understand how much or little organisms have changed as life developed on Earth.

Evolutionary trees

Show how species have volved from and are related to others



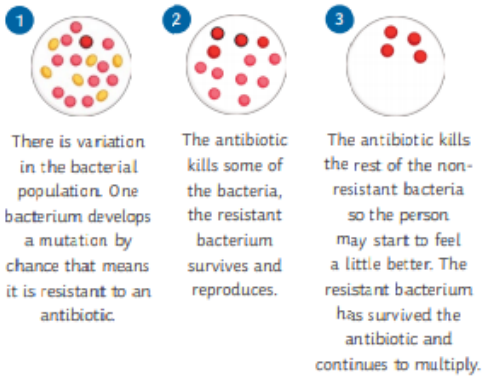
B6 – Inheritance, Variation and Evolution

Resistant Bacteria

- Bacteria **evolve** rapidly as they reproduce at a fast rate. (reproduce approx. every 20 mins)
- Mutations of bacteria can produce new strains.

- Some strains are **resistant** to antibiotics (so are not killed).
- They **survive** and **reproduce** – population of resistant strain rises.
- Resistant strain will spread because people are not **immune** and there is no effective treatment.

- **MRSA** is **resistant** to antibiotics.



How to reduce antibiotic resistant strains:

- Doctors should not prescribe antibiotics for viral infections

- Patients must complete courses of antibiotics

- Agricultural use of antibiotics should be restricted.

Genetic Engineering

- Process which involves modifying the **genome** of an organism by introduction a gene from another organism to give a **desired characteristic**.

Uses of genetic engineering:

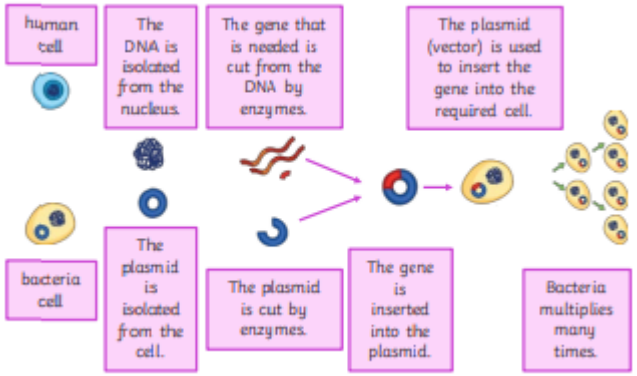
- Plant crops to be **resistant** to diseases or produce bigger, better fruits.

- Bacteria cells to produce useful substances, such as human insulin to treat diabetes.

Genetically modified (GM) crops

Advantages	Disadvantages
Resistant to insect attack	Not sure on long term effects when eating GM crops
Produce increased yields	Could affect populations of wild flowers and insects

Process of Genetic Engineering (HT only)

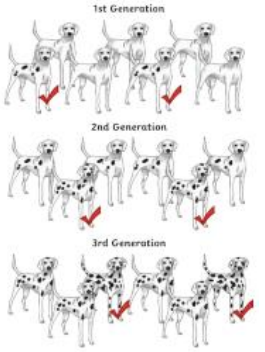


Selective Breeding

- Process which humans breed plants and animals for particular **genetic characteristics**.

Steps of selective breeding:

1. Choose a male and female with **desired characteristics.**



2. Breed together

3. Pick the offspring which have the desired characteristic and breed together.

4. Continue over many generations, selecting the best offspring each time, until all offspring show desired characteristics.

Classification

Linnaeus classified things into: Kingdom, phylum, class, order, family genus and species.

Organisms are named by the **binomial system** of genus and species. (2 names)

Due to evidence from chemical analysis, there is now a 'three-domain system' by Carl Woese:

Domain	bacteria	archaea	eukaryota			
Kingdom	eubacteria	archaebacteria	protista	fungi	plantae	animalia

B5 – Homeostasis and Response

Adrenaline and thyroxine (HT only)

Adrenaline is produced by the **adrenal glands**.
It is produced in times of fear or stress.
It **increases heart rate** to ensure **more oxygen and glucose** to the cells to prepare for the
'fight or flight' response.
Thyroxine is produced by **the thyroid gland.**
It is involved in regulating **metabolic rate** and growth and development.

Puberty

Females – **Oestrogen** is the main female reproductive hormone produced in the ovary. At puberty, eggs begin to mature, and one is released approximately every 28 days. This is called ovulation.

Males – **Testosterone** is the main male reproductive hormone produced by the testes and it stimulates sperm production.

Name of contraception	Description	+	–
Condoms/diaphragm	Barrier	Very effective, condom protects against STIs	Unreliable if not used properly
Oral Contraception (pill)	Hormonal (oestrogen or progesterone, stops FSH so no eggs mature)	Very effective	Must remember to take everyday, can have side effected
Injection/implant/skin patch	Slow-releasing hormone	Long lasting	Side effects such as heavy periods
Intrauterine Device (IUD or Coil)	Barrier method. Can also contain hormones	Long lasting (up to 5 years)	Side effects such as heavy periods
Surgical Sterilisation	Tying or cutting of sperm ducts/ oviducts.	Almost 100% effective	Difficult or impossible to reverse

Menstrual Cycle

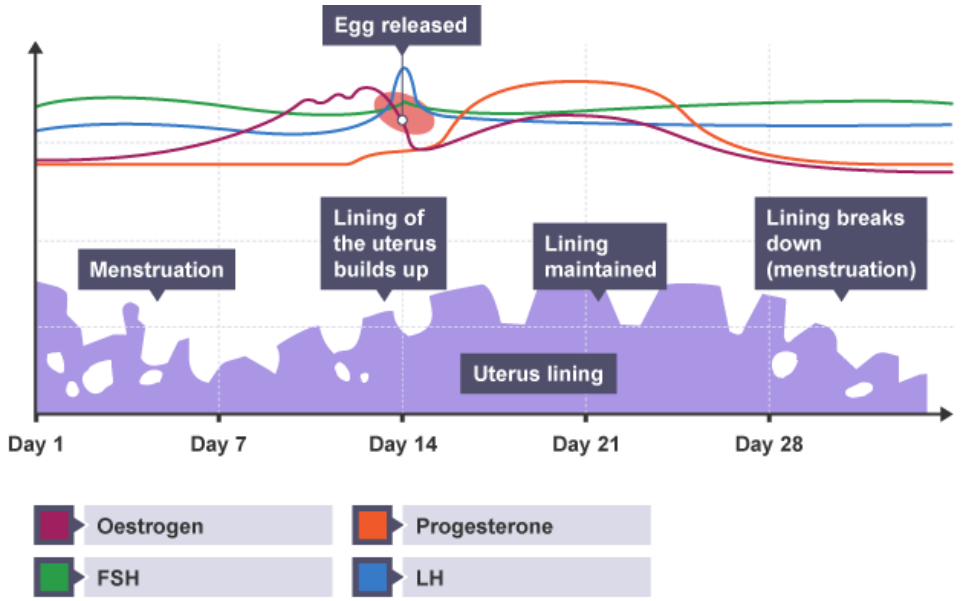
The menstrual cycle is controlled by several hormones:

FSH –from the pituitary. Causes an egg to mature in the ovary

LH – from the pituitary. Causes ovulation

Oestrogen and progesterone are involved in maintaining the lining of the womb.

HT – Oestrogen also feeds back to the pituitary to stop producing FSH.



Infertility (HT only)

Fertility drugs LH and FSH can be given to increase the number of eggs released and increase the change of fertilisation. .

IVF

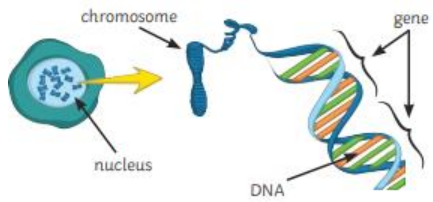
- Woman takes a dose of FSH and LH - stimulates the maturation of several eggs.
- Eggs are collected and fertilised by sperm from the male
- Fertilised eggs develop into embryos.
- One or two embryos inserted into the female's uterus.

Negatives;

- very emotionally/ physically stressful
- success rates are not high
- can lead to multiple births (twins, etc.)
- Many embryos are not used & destroyed

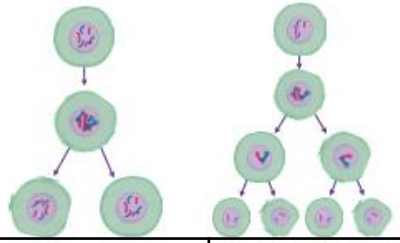
B6 – Inheritance, Variation and Evolution

Cells and cell division



The chromosomes are in the nucleus of cells
Humans have 46 chromosomes.
Chromosomes contain genes, which code for proteins.
In body cells, chromosomes are in pairs – one from each parent.
In sex cells (gametes) they are not in pairs and there is half the number of chromosomes (e.g. 23 in humans)

Cell division – two types:



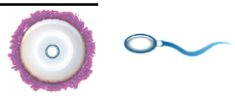
Mitosis (in all body cells)	Meiosis (in testes and ovaries)
2 daughter cells	4 daughter cells
Daughter cells = genetically identical	Daughter cells = not genetically identical
Cell divides once	Two divisions
Daughter cells **have same number** of chromosomes as original cell	Daughter cells **have half** the chromosomes as original cell
Used for growth and repair.	Produces gametes for sexual reproduction

Reproduction

Two types of reproduction – sexual and asexual.

	Sexual	Asexual
Number of parents	2	1
gametes used?	Yes	no
Variation in the offspring	lots	None (unless mutations occur) Offspring are clones

Sexual reproduction



The sperm and egg have half of the genes for the offspring. (in humans 23 chromosomes)
At fertilisation, the sperm and egg nuclei join. (23 + 23 = 46 chromosomes)

There are two genes for any one characteristic – one on the chromosome from mum and one from Dad
Different forms of the same gene are called **alleles**
If the alleles are the same, the person is **homozygous**
If the alleles are different the person is **heterozygous**

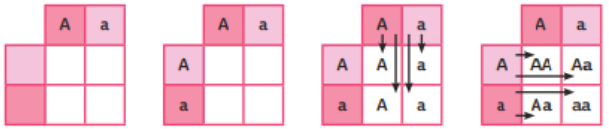
E.g.:
B = brown hair (dominant)
b = red hair

BB = homozygous, brown hair
Bb = heterozygous, brown hair
bb = homozygous, red hair

Gene from each parent

How to complete a punnet square

If A = blue eyes, a = green eyes
Calculate the probability of two heterozygous people having a green eyed child



Step 1
Put one parents alleles into the boxes at the top

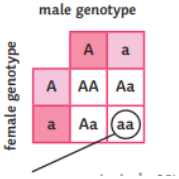
Step 2
Put the other parents alleles into the boxes down the side

Step 3
Write the alleles from parent one in all boxes underneath

Step 4
Put the alleles from the second parent into the boxes to the right

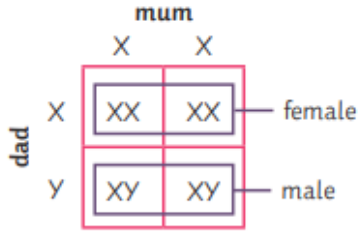
Probability

A green eyed child would have aa genotype.



One of these four has the type aa – that's ¼ , 25% or 0.25.

Sex Determination

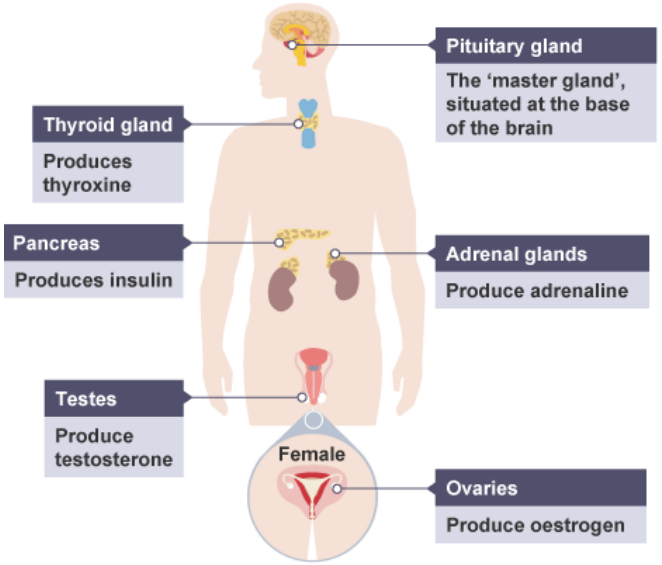


Females carry two X chromosomes (XX)
Males carry one X and one Y chromosome (XY)
50% chance of male and female.

B5 – Homeostasis and Response

Hormonal responses

Hormones are chemicals released by glands
They are carried in the bloodstream.
Hormonal responses are slower than nervous responses but they last longer.



Homeostasis

This means keeping internal conditions (of the body or a cell) constant to ensure optimum functioning.
In humans, this includes regulating:

- temperature
- water levels
- blood glucose concentration

Homeostasis can involve nervous or hormonal responses.
Receptors detect changes in the body
Coordination centres (brain, pancreas, spinal cord etc) receive and process information
Effectors carry out responses to return to normal

Blood glucose concentration

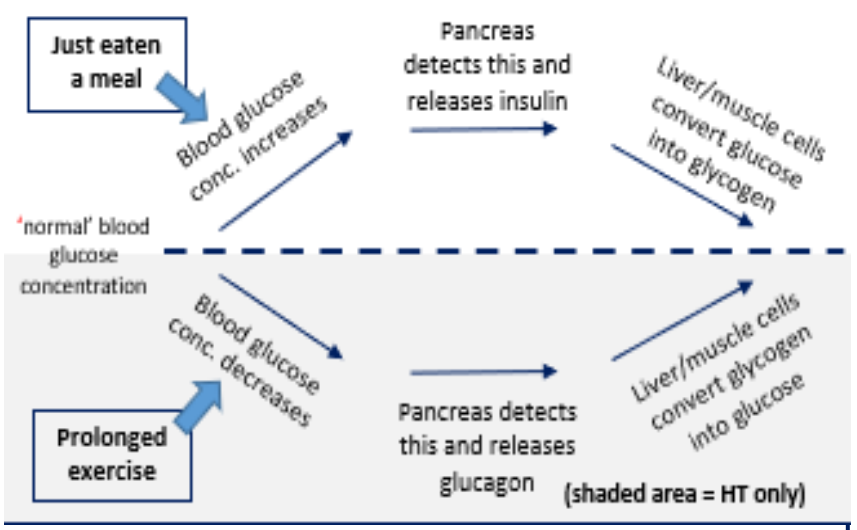
Blood glucose is monitored by the **pancreas.**

If glucose levels rise, the pancreas releases **insulin** into the blood.

This is a message to the liver to remove glucose and store it as **glycogen**.

If blood glucose is too low, **glucagon** is released.

The liver responds by breaking down glycogen into glucose and releasing it into the blood.



Diabetes

There are two types – Type 1 and Type 2
Both result in a lack of control over blood glucose levels

	Type 1	Type 2
Cause	No insulin is made by the pancreas	Insulin is made, but the liver and muscle cells do not respond
Treatment	Injections of insulin Pancreatic transplant	Controlling carbohydrate intake Losing weight

HT only
Negative feedback is when the release of something brings the levels back towards acceptable levels, it maintains a steady state.
E.g. if blood glucose increases, insulin is released to bring blood glucose back towards the normal range.

B5 – Homeostasis and Response

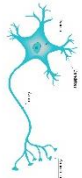
The nervous system

Job is to **detect** stimuli (changes in environment) and **respond** if needed.
Consists of:

Receptors

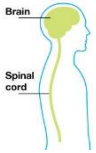
Specialised cells that detect stimuli, found in sense organs and internally

Neurones



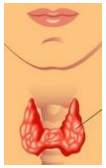
3 types – sensory, relay and motor
Carry **impulses** joining all parts of the nervous system

Co-ordination Centres



Brain, spinal cord, pancreas.
Coordinates the response

Effectors



Organs that bring about a response

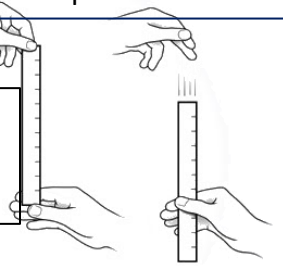
muscle or gland

RP 6 - Investigation into the effect of a factor on human reaction time.

1. Person A holds out hand with a gap between thumb and finger.
2. Person B holds ruler with the zero at the top of person A's thumb.
3. Person B drops ruler without telling Person A and Person A must catch it.
4. The distance on the ruler level with the top of person A's thumb is recorded
5. Repeat this ten times.
6. Repeat steps 1-5 after a factor has been changed
7. Use conversion table to convert ruler measurements into reaction time.

The 'factor' could be…
- Caffeine consumption
- Hours of sleep
- Alcohol consumption
- Amount of practice

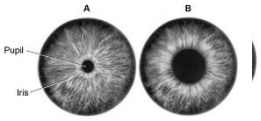
A computer reaction test can also be used.

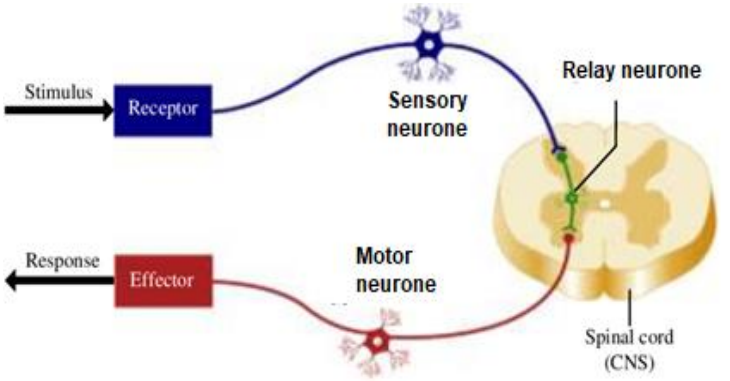


Control variables : distance above the hand, distance between finger and thumb, hand used (dominant or non-dominant, all other factors listed in the box above except the one being changed.

Reflexes

A reflex is an automatic, rapid response
Reflexes do not involve the conscious part of the brain, so cannot be overridden
The response might be brought about by:
- muscle - e.g. pupil being constricted with bright light or knee jerk response
- gland – e.g. mouth watering or tears being released when something gets in your eye





Reflex Arc

stimulus → receptor → **sensory neurone** → **relay neurone** → **motor neurone** → effector → response

Example

Hot pan → pain receptors → **sensory neurone** → **relay neurone** → **motor neurone** → hand muscles → release pan

Biology

Paper 2 Knowledge Organisers

AQA Combined Science (Trilogy)

NAME: _____

CLASS: _____

TEACHER: _____