Biology Knowledge Organisers



Unit 1: Cells

Unit 2: Organisation

Unit 3: Infectious Diseases

Unit 4: Bioenergetics (Photosynthesis and Respiration)

Unit 5: Homeostasis

Unit 6: Genetics, Variation and Inheritance

Unit 7: Ecology

Revision technique: Read, cover, write, check, repeat!

Read your notes.

Cover your notes up and write down as much as you can remember.

Check how you did. Did you miss any information out?

Repeat the whole process.

Biology Exam 1: Units 1-4
Biology Exam 2: Unit 4-7

TIPS: Only try and do a few of the squares at a time.
Don't keep doing the ones you know well. Keep repeating the ones you struggle to remember.

AQA BIOLOGY UNIT 1: CELLS

Cells

Nucleus
Controls cell

Ribosomes
Protein synthesis

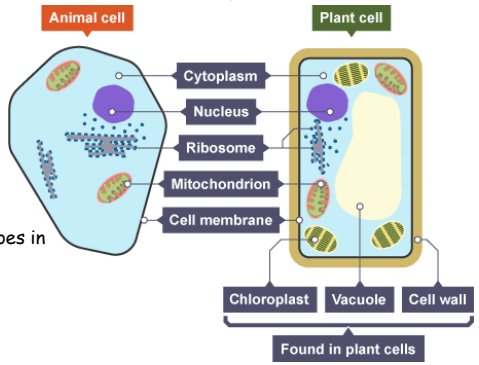
Cell Membrane
Controls what goes in and out the cell

Mitochondria
Respiration

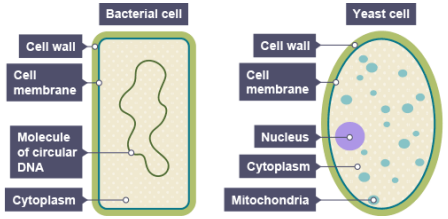
Chloroplast
Photosynthesis

Cytoplasm
Where chemical reactions occur

Eukaryotic cells



Prokaryotic cells – no membrane bound organelles (loose DNA)



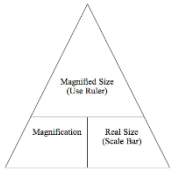
Magnification

Fraction of a metre	Unit	Symbol
One thousandth = 0.001 = 1/1000 = 10^{-3}	millimetre	mm
One millionth = 0.000001 = 1/1000 000 = 10^{-6}	micrometre	µm
One thousand millionth = 0.000 000 001 = 1/1000 000 000 = 10^{-9}	nanometre	nm

To calculate actual size:

1. Measure the organelle with a ruler.
2. Multiply this by 1000 to get a value in micrometres
3. Divide this by the magnification

e.g. The diagram below is a drawing of an organelle from a ciliated cell as seen with an electron microscope.





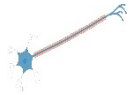
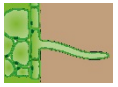
Calculate the actual length of the organelle as shown by the line AB in the diagram. Express your answer to the nearest micrometre (µm).

1. Measure it in mm = 40mm
2. Multiply by 1000 = 40000µm
3. Divide by magnification 40000 / 20000 = 2µm

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.

Specialised Cells – Cells that have differentiated

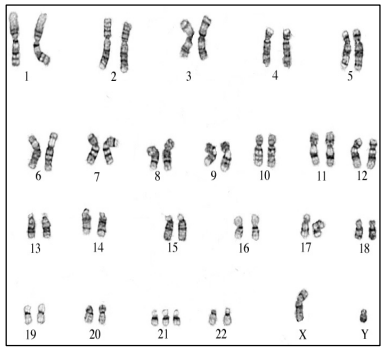
Neurone		• Long and thin. • Have a myelin sheath to prevent loss of impulse. • Form connections with other neurones. • Can carry electrical impulses in one direction.
Sperm		• Contain digestive enzymes for breaking down the outer layer of an egg cell. • Many mitochondria. • Have long tail.
Red Blood		• Large surface area. • Small diameter. • No nucleus. • Contain haemoglobin.
Root Hair		• Found close to xylem • Thin membrane. • Large surface area.
Cone Cells		• Outer segment filled with visual pigment that changes chemically in coloured light. • Lots of mitochondria so that you constantly see in colour. • Specialised synapses connecting to the optic nerve.

Chromosomes

Humans have 23 pairs of chromosomes (46 in total) in all adult cells.

Chromosomes 23 = sex chromosomes (XY = male XX = female)

Karyotype – visual appearance of our chromosomes.



What are the differences?

1. 47 instead of 46
2. Extra chromosome 21 (called Trisomy-21 (Down's Syndrome))
3. Normally 21 should be 2 chromosomes

Bacteria multiply by binary fission.

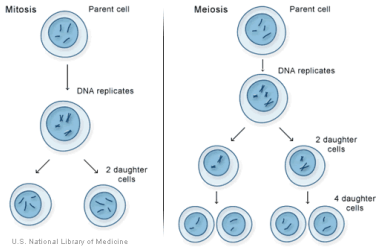
Growth is exponential i.e. 1 → 2 → 4 → 8 → 16 → 32 → 64…

Mitosis and Meiosis – cell division

Mitosis (in humans)

- Occurs all over the body
- Makes new cells with 23 pairs of chromosomes
- Cells divide once
- Makes new body cells.

Interphase: DNA copies



Different stages of mitosis:

Prophase – chromosomes condense

Metaphase – chromosomes line up in the middle

Anaphase – chromosomes pulled apart by spindle fibres

Telophase – 2 new nuclei form

Meiosis (in humans)

- Occurs in testes and ovaries
- Makes cells with 23 chromosomes
- Cells divide twice
- Makes gametes (sperm and egg)

Stem Cells – These are undifferentiated cells

- Embryonic – can make any type of cell
- Tissue-specific – can only make cells from specific parts of the body

Advantages:
- Treat blindness
- Organ transplants
- Treat paralysis

Disadvantages:
- Ethical issues with embryos
- Religious issues

Diffusion

Movement of particles from a high concentration to a low concentration (down a concentration gradient)

To increase rate of diffusion:

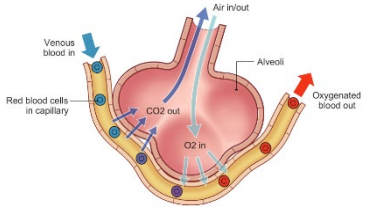
- Increase temperature
- Increase surface area
- Increase concentration gradient
- Shorten distance

Large organisms have a small surface area:volume so require specialised exchange surfaces with large surface area so diffusion is fast enough.

Small Intestine: Villi increase surface area
Blood flow maintains conc. Gradient
Thin wall 1 cell thick

Lungs:
Alveoli increase surface area

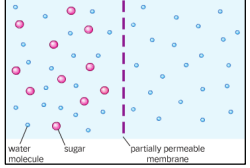
Blood flow and thin walls like the villi



Osmosis

Water travels from a ***dilute solution*** (high water concentration) to a ***more concentrated solution*** (low water concentration).

The water moves across a **partially permeable membrane**.

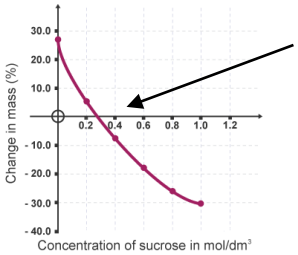


Isotonic means the amount of dissolved solutes is the same on the outside of the cell as the inside, so there is no difference in concentration of water.

Hypotonic means there are more solutes inside the cell than outside, therefore inside the cell has a lower concentration of water.

Hypertonic means there are more solutes on the outside of the cell than on the inside. So there is a lower concentration of water on the outside of the cell.

- **Turgid** – When a cell fills with water (plant cell wall protects cell from bursting)
- **Flaccid** – When a cell loses water



The solution is isotonic where the line crosses the x-axis i.e. 0.3 mol/dm³.

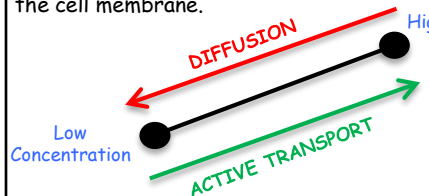
Potato gains mass in a hypotonic solution but loses mass in a hypertonic solution.

Active Transport

This is the opposite of diffusion.

Substances move from an area of low concentration to high concentration, **against the concentration gradient**.

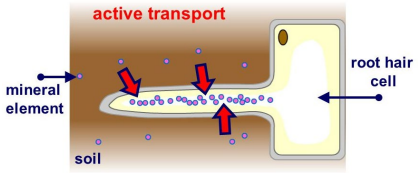
It requires ATP (energy) – this means it need mitochondria. The ATP is used to change the shape of protein channels in the cell membrane.



This happens at the end of small intestine where there are less nutrients than in the blood but we don't want to waste them.

Root hair cells have more minerals than the soil but still needs them. Active transport is used for uptake of these minerals.

Root hair cells therefore have lots of mitochondria.

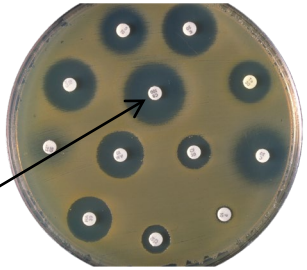


REQUIRED PRACTICAL: Growing Bacteria

- Flame the loop – sterilises it
- Lift lid slightly – prevent airborne bacteria getting into it
- Seal with 2 bits of tape – allows air to get in but keeps lid on for safety
- Incubate at 25°C – prevents pathogens growing

Antibiotics on bacteria on the jelly.

Big space around disk = most bacteria killed



AQA BIOLOGY UNIT 2: ORGANISATION

Tissues and Organs

Tissues: cells working together

Animal	Glandular	• Ribosomes – make enzymes and hormones • Vesicles to store enzymes and hormones
	Muscular	• Long, thin cells contracts • Lots of mitochondria for energy
	Epithelial	• Goblet cells make mucus • Cells have cilia
Plant	Mesophyll	• Lots of chloroplasts • Photosynthesis
	Epidermal	• Thin and translucent to allow light through
	Xylem	• Transports water
	Phloem	• Transports sugars

Organs: tissues working together

Stomach: Glandular: Makes enzymes and acid
Epithelial: mucus protects lining
Muscular: contracts, churns food

Enzymes – biological catalyst made from protein in ribosomes

- Enzymes have an active site (shape)
- Active site fits a substrate and breaks it down



enzyme + reactant ↔ enzyme-reactant complex ↔ enzyme + products

Denature: Active site changes
No longer recognises substrate

- **Temperature** – too cold too slow
  - optimum = 37°C
  - too hot = denatures
- **pH** – enzymes only work at specific pH
  - stomach enzymes need pH 1-2 (acid)
  - intestinal enzymes need pH 7-8 (bile)

Digestive Enzymes

Carbohydrase (e.g. amylase)	Large sugars (starch) → Simple sugars (glucose)	Salivary glands, pancreas, Small intestine	pH7-8 37°C
Protease (e.g. pepsin)	Protein → Amino acids	Stomach Pancreas Small intestine	Stomach = pH1-2 37°C
Lipase (e.g. pancreatic lipase)	Fats → Fatty acids and glycerol	Stomach Pancreas Small intestine	pH 7-8 37°C

Commercial Use – speed up reactions, increase yields but need to monitor temperature and pH.

Industry	Function of Enzymes
Diet foods	change glucose into fructose, which is sweeter so less is needed and is used in 'slimming' foods (isomerase).
Baby food	start off digestion of food (proteases and lipases)
Biological detergent	break down stains (proteases and lipases).

REQUIRED PRACTICAL: Food Tests

Type of Food	Name of Test	Positive Result	Negative Result
Starch	Iodine	Blue/Black	Brown
Glucose	Benedict's (must be heated)	Green → Yellow → Brick red	Blue
Protein	Biuret	Lilac	Blue
Lipids	Emulsion	Cloudy precipitate	Clear

Health and Risk Factors

- **Communicable disease:** Any disease transmitted from one person or animal to another, also called contagious disease.
- **Non Communicable disease:** Medical condition or disease that is non-infectious or non-transmissible.

Risk Factors:

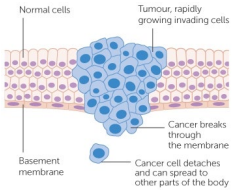
- **Cardiovascular disease:** diet/obesity, age, genetics and exercise.
- **Lung disease:** smoking and cleanliness of the environment.
- **Liver disease:** alcohol, diet/obesity, genetics, drugs and viral infection
- **Type 2 diabetes:** genetics, diet/obesity and exercise

Cancer

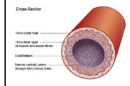
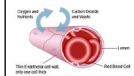
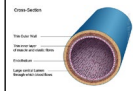
When our cells divide, mutations can occur in the DNA which lead to abnormal cells.

Malignant cancer can spread to other parts of the body. We call this **metastasis**.

A cancer cell can detach from the tumour and be carried by the blood to other parts of the body. The cancer cell can become stuck in a capillary by an organ and then begin growing until it has invaded that organ too.



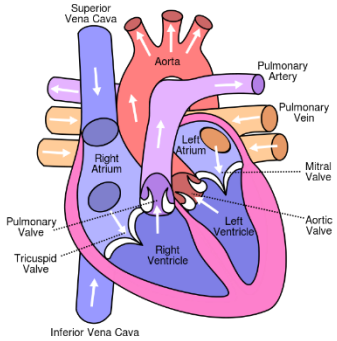
Blood Vessels

Blood Vessel	Diagram	Type of Blood	Pressure	Special Features
Artery		Oxy	High	Thick muscular elastic walls Smaller lumen
Capillary		Both	Med	1 cell thick walls for fast diffusion
Vein		Deoxy	Low	Large lumen Valves to prevent back flow of blood

Blood

- Red Blood Cells – haemoglobin carries oxygen, biconcave disk increases surface area, no nucleus to fit in more haemoglobin.
- White blood cells – fight pathogens
- Plasma – transports dissolved substances
- Platelets – bits of cytoplasm used to form blood clots

The Heart



Double circulation

Right = lungs for gas exchange

Left = Rest of body

Needed because humans are more active and lungs are very delicate so blood can't be at a high pressure but must be to go round the rest of the body.

What could happen if our coronary arteries narrow?

Plaque (fatty deposit) builds on the walls of the blood vessel.

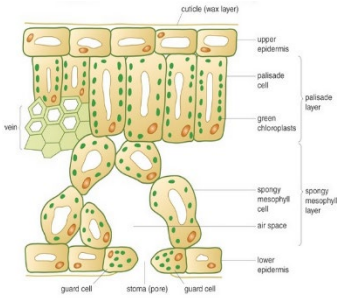
The blood vessel can become blocked or in some cases the blood pressure increases causing some plaque to break away.

The plaque blocks narrower vessels causing blood clots and a lack of oxygen to tissue and organs.

- Lack of oxygen
- Lack of glucose
- For respiration
- No energy for contraction of cardiac muscle
- Heart stops (cardiac arrest)

Plants and Photosynthesis

Roots	• Uptake of water and minerals • Large surface area due to root hair cells • Protein channels for active transport • Meristems – plant stem cells
Stem	• Hold leaves in position • Waxy epidermis to prevent water loss • Xylem – transports water • Phloem – transports sugars
Leaves	• Broad, flat to increase surface area • Contain 4 types of tissue to carry out photosynthesis (see below) • Guard cells close stomata at night to prevent water loss by transpiration • Waxy epidermis to prevent water loss



How is the leaf adapted for efficient photosynthesis?

- Sun hits palisade cells at top
- Palisade – lots of chloroplasts
- Spongy mesophyll allows gas movement
- Xylem brings water
- Phloem maintains concentration gradient by removing glucose
- Guard cells open to allow carbon dioxide to diffuse into the leaf.

CHD and Other Heart Defects

Procedure	How they work	Advantages	Disadvantages
Statins	Drugs that lower blood cholesterol levels preventing plaque forming	Cheap Preventative	Can cause side effects
Stents	Insert a balloon and wire mesh to artery. Inflate balloon and leave wire in place	Invasive Minor surgery	Anticoagulant drugs are needed which prevents blood clotting
Bypass Surgery	Piece of vein is grafted from leg to bypass the blocked coronary artery	Permanent solution	Expensive Scars Major surgery
Mechanical Valve Replacement	Synthetic valve used to replace faulty one.	Last longer	Need anticoagulant drugs
Biological Valve Replacement	Animal valve used to replace faulty one	No drugs needed	Only lasts 15 years
Pacemaker	Device used to trigger the heart to beat in its normal rhythm	Keeps heart beating properly	Surgical procedure Can stop working near machinery and electronic devices
Heart Transplant	Donor heart used to replace patient's heart	Permanent solution	Major surgery Rejection Immunosuppressant drugs needed

Transpiration and Translocation

Phloem



- Phloem vessels are made of long, thin-walled cells that form tubes.
- Sugars and amino acids dissolved in sap are transported in the phloem by a process called **translocation**.
- The ends of the phloem tubes are called **sieve plates** and they have small holes in them to allow transport in both directions.
- Phloem cells have no nuclei. They have **companion cells** next to them to control them which are filled with mitochondria.

Xylem

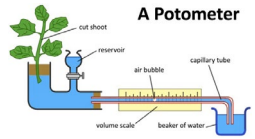


- Xylem tubes are made from long cells with thick, reinforced walls made from **lignin**.
- The vessel has a large hollow lumen for water and minerals to flow through in one direction.
- The cell walls are waterproof which makes the cells die which results in wood in trees!

Transpiration Stream

1. Higher concentration of water in soil than in roots
2. Water moves into roots by osmosis
3. Higher concentration of water in roots than in leaves
4. Water moves up the xylem by osmosis to the leaves
5. Water lost through stomata and used for photosynthesis maintains concentration gradient.
6. This causes more water to be drawn in by the roots. This is called the transpiration stream

A Potometer



AQA BIOLOGY UNIT 3: INFECTIOUS DISEASES

Pathogens – microorganisms that cause disease

	Bacteria	Virus	Fungi
Size	1000nm	20-40nm	2-10μm
Method of reproduction	Grow then divide in two	Invade host cells and tell nucleus to make copies	They release spores which travel through the air
How they make you feel ill	Produce toxins that travel around the body	Make cells burst open	Produce toxic chemicals

Malaria



Caused by a protist called **Plasmodium**. Vector = mosquito

1. Mosquito bite injects sporozoites into blood.
2. Sporozoites invade liver cells.
3. Sporozoites turn into merozoites and burst open liver cells.
4. Merozoites invade red blood cells, digest haemoglobin, replicate and burst open red blood cells.
5. Merozoites taken back up into mosquito.

Prevention:

- Eggs laid in stagnant water – drain pools, spray them with insecticide, spray with oil to prevent oxygen getting to the eggs,
- Mosquito nets and repellant spray.
- Chloroquine

Name of disease	Type of pathogen	Transmission/how to prevent spread	Symptoms	Treatments
Salmonella	Bacteria	Uncooked poultry, dirty work surfaces Cook food thoroughly	Nausea, diarrhoea	Antibiotics
Gonorrhoea	Bacteria	Unprotected sex Wear condoms	Discharge, painful genitals	Antibiotics
Malaria	Protist	Mosquito bites Mosquito nets, drain pools, chloroquine	Tired, headache, vomiting	N/A
HIV	Virus	Blood contact, exchange of bodily sexual fluids, sharing needles Condoms, don't do heroin	Symptoms from various diseases caused by developing AIDs	N/A
Measles	Virus	Droplet infection, sneezes MMR vaccine	Red rash on skin	Painkillers to reduce the symptoms

White Blood Cells

- Phagocytes – Engulf (phagocytosis, non-specific)
- Lymphocytes - Make antibodies (specific proteins that bind to antigens)
- Lymphocytes - Make antitoxins (counteract toxins made by bacteria)

Vaccines

Contain dead or inactive pathogens

1. White blood cells make **antibodies**
2. Antibodies remove dead/inactive pathogen
3. If exposed to real pathogen, antibodies are made **quickly** before they can multiply.

MMR Vaccine = Measles, Mumps and Rubella

Drug Trials

Stage 1: Tested on animals, cells and tissue
Check for toxicity
Stage 2: Tested on human volunteers
Check dosage and side effects
Stage 3: Tested on patients to see if it is effective

Double blind - no one knows who gets the real drug
- no bias
Placebo – fake drug (looks same, taken same way) It is a control.

Thalidomide

- Tested as sleeping pill
- Not tested on pregnant women
- Given to pregnant women for morning sickness
- Babies have limb deformities
- Only given now for leprosy

Medicines – A drug is a chemical that alters how the body works. They alter the normal chemical reactions in the body.

Antibiotics – kill bacteria or prevent them from multiplying.

THEY DON"T KILL VIRUSES because viruses live inside cells.

Painkillers – relieve the symptoms only

Antivirals – target specific viruses and slow down replication.

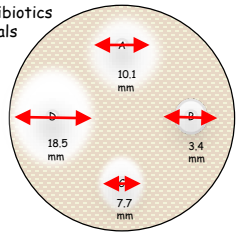
Antibiotic Resistance

1. Mutation occurs when bacteria multiply
2. Mutation makes bacteria resistant to antibiotic
3. Antibiotic kills all the others
4. No competition for food or space
5. New colony of resistant bacteria grows

e.g. MRSA

Causes: Incorrect use of antibiotics
Not completing the full course of antibiotics
Over-sterile environments e.g. hospitals

To calculate clear zone: πr^2



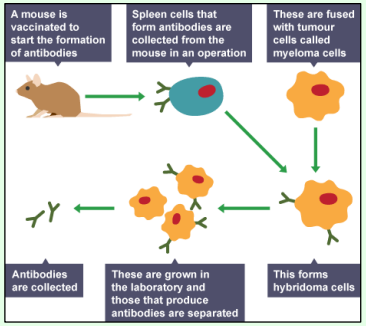
Resistant: 6mm or less
Intermediate: 7-11 mm
Susceptible: 12 mm or more

Monoclonal Antibodies

TRIPLE ONLY

Monoclonal antibodies are identical copies of antibodies that have been made in laboratories.

- **Pregnancy test kits** to identify the small levels of a hormone called hCG, which is present in the urine of pregnant women.
- **Locate blood clots** as they bind to clots.
- **Diagnose and then treat some cancers.** They can bind to the cancerous cells and help the person's immune system attack them.



Advantages: Monoclonal antibodies only bind to the specific cancer cells that need treatment. Healthy cells are not affected at all. In contrast conventional drug treatment is carried all around the body in the blood and can have a devastating effect on healthy cells as well as cancer cells.

Disadvantages: Monoclonal antibodies create more side effects, the most common being an allergic reaction to the drug. An allergic reaction can include these symptoms: chills, fever, an itchy rash, feeling sick, breathlessness, wheezing, headaches, flushes and faintness, changes in blood pressure.

Plant Diseases

TRIPLE ONLY

Some plant diseases are caused by bacteria, fungi and also by vectors e.g. aphids.

Name of disease	Type of pathogen	How it is spread	Symptoms	Prevention/ Treatment
Tobacco Mosaic Virus	Virus	Direct contact with diseased plant material and by insects	Mosaic pattern damaging cells preventing photosynthesis	Field hygiene and pest control
Rose Black Spot	Fungi	Spores carried by wind and spread by rain from leaf to leaf	Purple spots on leaves, dead leaves, poor flowers	Remove and burn affected leaves, fungicides

Aphids – penetrate phloem and take products of photosynthesis. Also act as vectors transferring pathogens to the plants.

Mineral Deficiencies – Soil lacking nitrates = less protein so less growth.
- Soil lacking magnesium = chlorosis = less chlorophyll so less photosynthesis – yellow leaves

Detecting Diseases

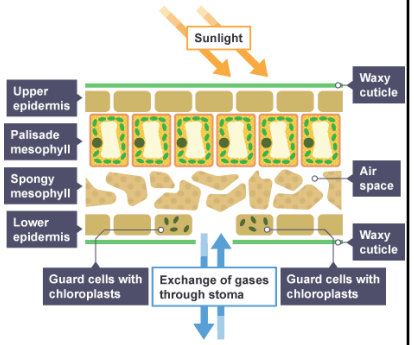
- Fast detection – discoloration, visible pests, stunted growth.
- Compare growth with normal plants or data online
- DNA analysis to identify pathogens (monoclonal antibodies)

Photosynthesis

Carbon Dioxide + Water → Glucose + Oxygen

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

- Gases diffuse through stomata
- Palisade cells have lots of chloroplasts
- Xylem brings water
- Spongy to allow gases to move through leaf.

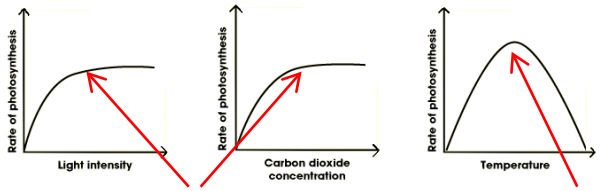


Uses of glucose:

- Respiration – energy – growth
- Starch – storage
- Protein – glucose + nutrients from the soil
- Fats – stored in seeds
- Cellulose – cell walls

Limiting factors

- Light
- Carbon dioxide concentration
- Temperature



Something else limits the rate (temperature, CO_2, amount of chlorophyll)

Controlled by **enzymes** that are too slow when cold and **denature** when too hot

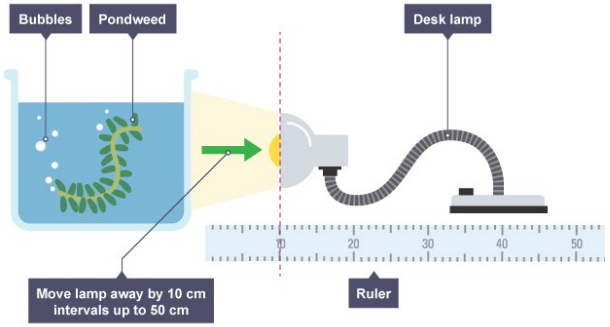
Greenhouses

\+ Control the conditions (heat, CO_2, water, light, pests, weeds)
\+ Grow plants all year round
\+ Grow plants not native to certain countries
\+ Increased crop yields

\- Costs to maintain conditions
\- Conditions need to be monitored

Hydroponics: Plants grown in mineral solution rather than water – control nutrients, no fungal infections from soil.

REQUIRED PRACTICAL: Photosynthesis



In the experiment above:

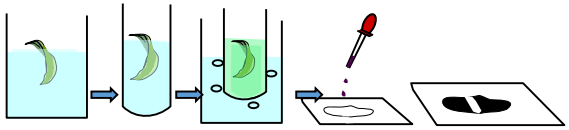
1. Pondweed is in water with sodium carbonate solution (to provide CO_2 for photosynthesis)
2. Move light bulb different distances and count the bubbles of oxygen that are produced per minute.

The closer the light, the more oxygen is made because the rate of photosynthesis increases.

Starch Testing a Variegated Leaf

We test for the presence of **starch** in leaves in order to determine that photosynthesis has occurred. Glucose is rapidly converted into starch for **storage** in the chloroplast and cytoplasm.

De-starching is the process by which the starch reserves in a plant are depleted by depriving the plant of either light or carbon dioxide. We need to **remove all traces of starch** in leaves so that we can provide evidence that photosynthesis takes place during the experiment.

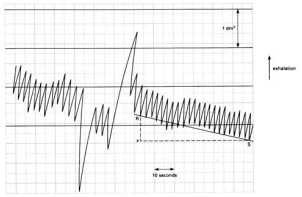


- Boiling ethanol breaks down cellulose and removes chlorophyll.
- Iodine solution turns blue/black where starch is present i.e. where photosynthesis has taken place.

Measuring HR and BR

HR – heart rate monitor
BR – spirometer

Tidal volume – normal volume breathed in and out.



Respiration – energy RELEASE not made (exothermic)

Aerobic: Glucose + Oxygen → Carbon Dioxide + Water

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

- Occurs in mitochondria
- Needs oxygen
- Releases a lot of energy (ATP)

Anaerobic: Glucose → Lactic acid

$C_6H_{12}O_6 \rightarrow 2C_3H_6O_3$

- Occurs in mitochondria
- No oxygen
- Leads to **oxygen debt** (which is why you breathe heavily after sport to pay it back)
- Very little energy is released.

Some microorganisms (e.g. yeast) respire anaerobically producing ethanol and CO_2. This is called **fermentation** and is used to make bread and alcohol.

Exercise effect on HR and BR

Heart Rate increases – more oxygen to muscle
- more glucose to muscle
- more CO_2 and water to lungs

Breathing Rate increases – more oxygen into blood
- more CO_2 and water out of the blood

Stored glycogen in muscle turned into glucose.

Metabolic Rate: The speed of chemical reactions in the body.

- Older = slower
- Female = slower
- High fat to muscle ratio = slower
- Could be inherited

Metabolic reactions:

- Respiration – catabolic (big → smaller molecules)
- Photosynthesis – anabolic (small → bigger molecules)
- Break down of proteins to urea in **liver** – catabolic
- Enzymes breaking down food – catabolic
- Combining glucose with nitrate ions to form amino acids and then protein – anabolic

Anabolic reactions require **energy** from cellular respiration.

Carbohydrates	Energy
Protein	Cell repair, growth and replacement
Fat	Energy and insulation
Fibre	Digestion
Minerals	Calcium – Bones, Iron – Blood
Vitamins	Immune system

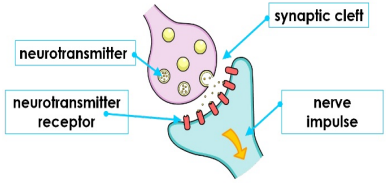
AQA BIOLOGY UNIT 5: HOMEOSTASIS

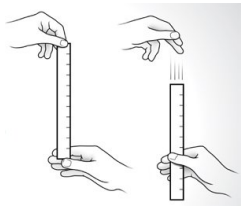
Reflexes – Prevent harm, avoid conscious parts of the brain (faster)

1. Stimulus	e.g.	stand on nail
2. Receptor		pain
3. Sensory neurone		electrical impulse
4. Relay neurone (CNS)		CNS
5. Motor neurone		electrical impulse
6. Effector		muscles

Synapse – Gap between two neurones

1. Electrical impulse arrives at synapse
2. Neurotransmitter diffuses across synapse
3. Bind to receptors on 2nd neurone
4. Electrical impulse passed on





REQUIRED PRACTICAL

Independent Variable:
- Number of practices

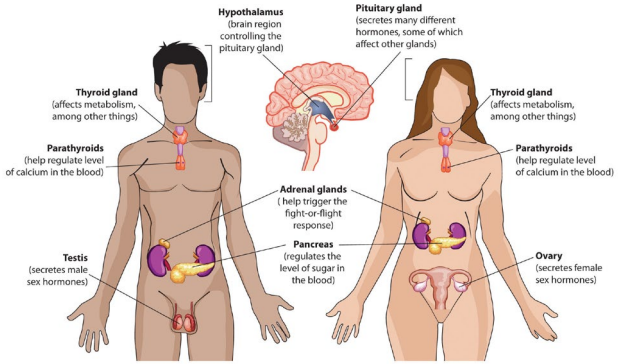
Dependent Variable:
- Reaction time (distance where ruler is caught converted into a time)

Control Variables:
- Ruler dropped from same height
- Use weaker hand each time
- Same mass of ruler
- Same thickness of ruler

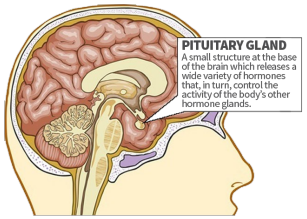
Homeostasis – the maintenance of a constant internal environment.

The main things we need to control in the body are:
- Temperature (thermoregulatory centre in the brain)
- Blood glucose (pancreas)
- Water (kidneys)
- Mineral ions/salts (kidneys)
- Urea (waste) (liver and kidneys)

Endocrine System – the glands of the body – secrete hormones

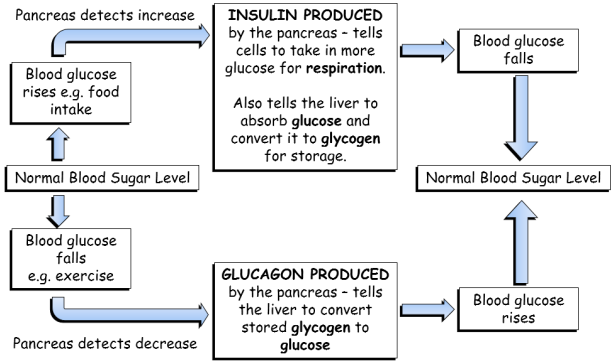


The **pituitary gland** is often referred to as the **master gland** because it stimulates other glands in the body e.g. TSH stimulates the thyroid, FSH and LH stimulate the ovaries.



	NERVOUS SYSTEM	ENDOCRINE SYSTEM
What type of message?	Electrical impulse	Chemical hormone
What do they travel through?	Along neurones	In the blood
Speed?	Faster	Slower
Local or general response?	Local i.e. affects one particular part of the body	General i.e. can affect several organs in the body
How long does the effect last?	Short lasting	Long lasting

Glucose Regulation – Prevent nerve and brain damage



Problem	Hormone	Effect
Too **much** glucose	**insulin**	Stores glucose as glycogen and tells cells to increase respiration
Too **little** glucose	**glucagon**	Converts glycogen to glucose

Type 1 Diabetes
- Born with it
- Don't make insulin

Treatment
- Insulin injected daily
- Pancreas transplant

Type 2 Diabetes
- Brought on by bad diet/obesity
- Body desensitized to insulin

Treatment
- Careful diet
- Exercise

Menstrual Cycle – 28 days (ovulation day 14)

FSH	• From pituitary gland • Egg matures in ovary
Oestrogen	• From ovaries • Stops FSH • Thickens uterus lining • Stimulates LH
LH	• From pituitary gland • Egg released (ovulation day 14)
Progesterone	• Maintains thick uterus lining

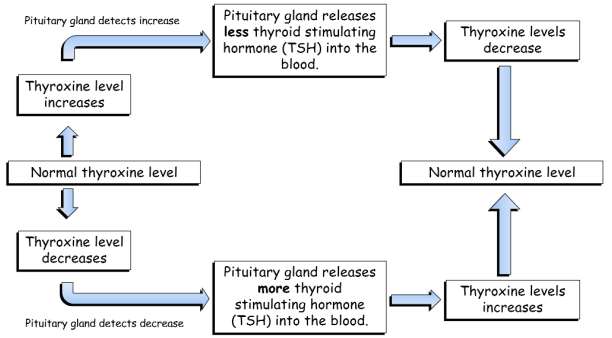
Contraception
- Hormonal methods (pill, patch, implant, injection) contain oestrogen and/or progesterone to prevent FSH release so no egg matures.
- Barrier methods (condoms, diaphragm, cap) can also help prevent spread of STDs.
- Intrauterine devices (coils) prevent implantation of embryo.

IVF (HT ONLY)
1. Give **fertility drugs** (FSH and LH)
2. Remove mature eggs from ovaries
3. Mix with sperm in petri dish
4. Incubate until it is an embryo
5. Insert into woman's uterus

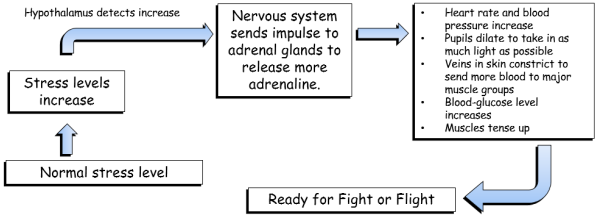
IVF Downsides
Expensive, poor success rate, multiple pregnancies (low birth-weight babies)

Negative Feedback (HT) – Prevent nerve and brain damage

Thyroxine – Metabolism, growth, brain development in children



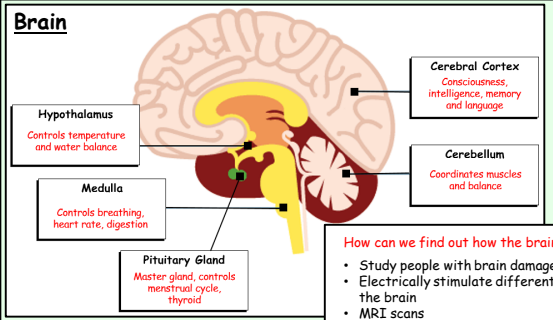
Adrenaline – This is positive feedback.



AQA BIOLOGY UNIT 5: HOMEOSTASIS

TRIPLE ONLY

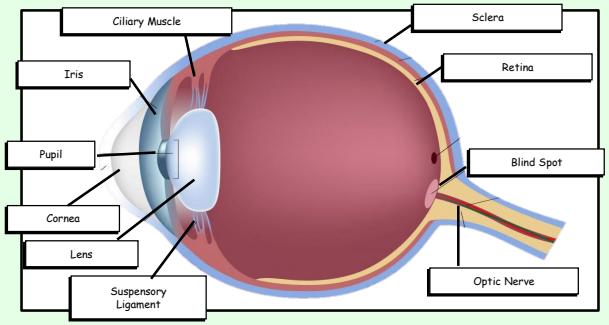
Brain



How can we find out how the brain works?

- Study people with brain damage
- Electrically stimulate different parts of the brain
- MRI scans
- Problems with the brain

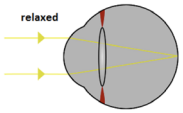
Eyes



The cornea refracts the light but it is the lens that must change shape in order to see the image in focus. The changing of the lens is called **accommodation**.

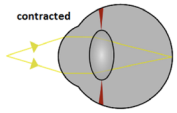
Distant:

- Ciliary muscles relax
- Suspensory ligaments are pulled tight
- Lens pulled thin
- Less refraction



Close up:

- Ciliary muscles contract
- Suspensory ligaments loosen
- Lens gets short and fat
- More refraction

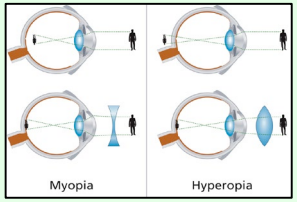


Myopia - you can see close objects clearly but distant objects look blurred.

- short-sighted.
- The light is focussed in front of the retina - lens is too curved or the eyeball is too long.
- Treatment- concave lens in front of the eye to diverge the light rays before they hit the cornea.

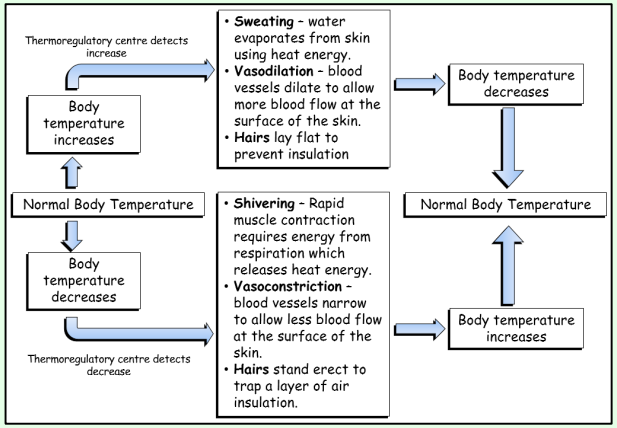
Hyperopia – people can see distant objects but close up objects appear blurry.

- Long sighted.
- The lens is too flat and thin or because the eyeball is too short - light rays are not refracted enough so they focus beyond the retina.
- Treatment - convex lens is used to diverge the light rays before they hit the cornea.



Thermoregulation

Thermoregulation – receptors in thermoregulatory centre in the hypothalamus along with temperature receptors in the skin detect small changes in body temperature.



Waste Products

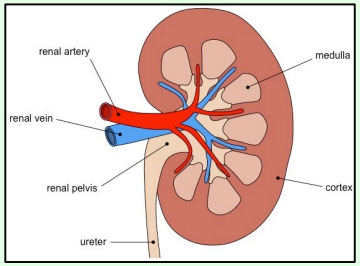
- Carbon Dioxide – produced during respiration, removed along concentration gradient by lungs (causes uncontrollable release of water when we breathe out)
- Urea – deamination in liver

Excess Amino Acids → Ammonia → Urea

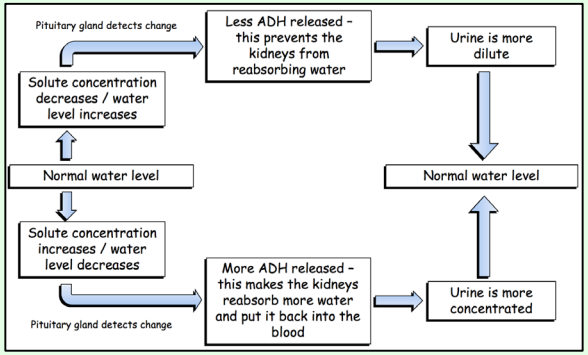
Kidneys

Glucose, mineral ions, urea and water move out of the blood along a concentration gradient. The larger cells and proteins are too big to fit through the cell membranes.

All the glucose is reabsorbed but mineral ions and water are **selectively reabsorbed** depending on the needs of the body.



Water balance is controlled by a negative feedback system monitored closely by the **pituitary gland** in the brain

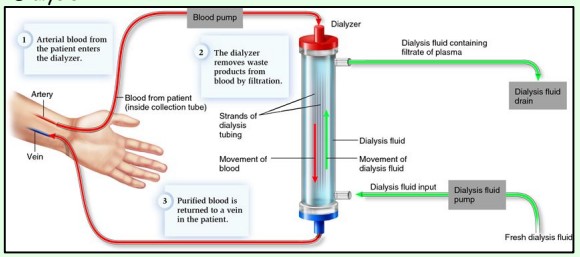


Kidney Failure

Infections, accidents or inheritance can lead to kidney failure. Toxins would build up, pH levels would change, cells would be damaged, enzymes would denature.

Treatment:

- Transplant - Tissue match to ensure antigens are similar
  - Immunosuppressant drugs are given for the rest of your life to decrease the activity of the immune system.
  - Transplanted organs need replacing on average every 9 years.
- Dialysis



The fluid in the dialysis machine on the other side of the partially permeable membrane has **no urea**, a **normal glucose** concentration and a **normal ion** concentration.

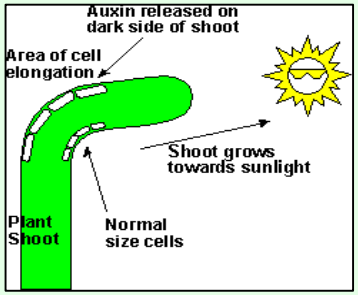
Downsides: 8hrs a few times per week, controlled diet, tired, unwell, expensive, can cause fistulas.

Plant Hormones

Auxin – builds up to cause growth in shoots (opposite effect in roots)

Phototropism – growth to light (shoots)

Geotropism / Geotropism – growth to gravity (roots)



Why do plant shoots grow towards the Sun?

1. Auxin builds up on shaded side.
2. Shaded side grows faster
3. Plant grows in direction of sunlight

Auxin is used as a rooting powder when taking **cuttings** of plants. Also given to **weeds** to disrupt their growth.

Other plant hormones include:

Gibberellins

- Brewing industry to speed up seed germination
- Promote all year round flowering
- Increase fruit size

Ethene

Control fruit ripening for easier transport and longer lasting fruit.

Variation

- **Genetic** – inherited e.g. eye colour, hair colour
- **Environmental** – scars, tattoos, piercings
- **Both** – skin colour (tan), hair style (naturally curly but straightened)

Chromosome – long strands of DNA (23 pairs in normal cells, 23 in sex cells (gametes))
DNA – double helix, all info to make an organism

Sexual Reproduction
- Fertilisation
- Gametes
- Genetic variation in offspring

Asexual Reproduction
- No fertilisation
- No gametes
- Identical clones are made
- E.g. runners in plants

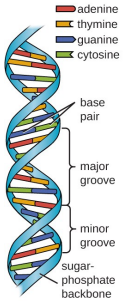
Gender Determination

XX = female
XY = male

During meiosis, 1 sex chromosome goes into one gamete, and the other goes into a second gamete.

The **punnet square** shows there is a **50%** chance of having a boy or a girl every time.

	X	Y
X	XX	XY
X	XX	XY



DNA – Instructions to make an organism.

- Double helix polymer
- Sugar phosphate backbone
- Nucleotides made up of 4 bases that pair up A-T and G-C.
- Every 3 base pairs is the instructions given to a ribosome to make an **amino acid**. These are combined to make **proteins**.

Sections of coding parts of DNA are called **genes**. Non-coding sections of DNA can turn on and off different genes to make different proteins.

Mutation -= change (mistake) in DNA
Mutations in coding = change to characteristic
Mutations in non-coding = bigger changes to the organism



Genome– All genes of an organism

Human Genome Project - map out all 21000 genes

Advantages of HGP	Issues and Concerns with HGP
• Cancer diagnosis • Forensics • Evidence for evolution	• Genetic discrimination • Re-engineer human species • Very expenisive

Genetic Crosses

e.g. A heterozygous brown eyed dog mates with a homozygous blue eyed dog. Brown eyes is dominant.

1. Write genotype of parents

Bb x bb

2. Draw punnet square, write parents on top and side and fill in the boxes

	b	b
B	Bb	Bb
b	bb	bb

3. Write out the possible phenotypes of the offspring

50% chance heterozygous brown eyed
50% chance homozygous blue eyed
or a 1:1 chance of brown : blue

Gene – a section of DNA that codes for 1 characteristic

Allele – different forms of a gene

Genotype – Symbols used to show genes for 1 characteristic e.g. Bb

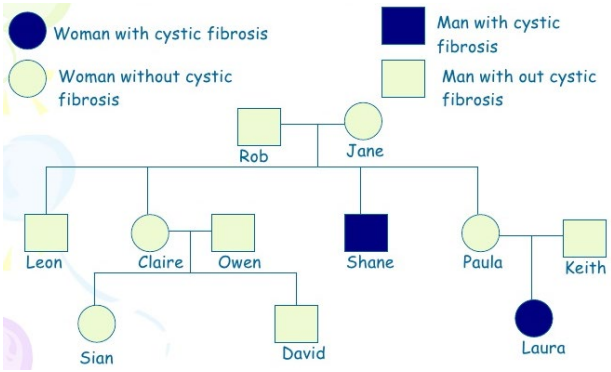
Phenotype – Description of genes e.g. Brown eyes

Homozygous – Both genes are the same i.e. BB or bb

Heterozygous – Both genes are different i.e. Bb

Genetic Diseases

- Polydactyly – **dominant** allele – extra finger or toe
- Cystic Fibrosis – **recessive** allele – excess mucus



Rob and Jane must be Ff (where f means has CF)

Ff x Ff

	F	f
F	FF	Ff
f	Ff	ff

25% chance of CF

Genetic Engineering – adding wanted characteristics to organisms.

e.g. Making Insulin

1. Remove wanted insulin gene using enzymes
2. Take a plasmid from a bacteria (vector)
3. Open plasmid and insert insulin gene with DNA ligase
4. Put plasmid back in bacteria
5. Incubate to allow bacteria to grow and make insulin.

GM Crops

+ Resistant to insects, viruses, fungi
+ Grow bigger, taste better, more nutritious
+ Crops can be grown all over the World
+ Increased crop yield

- Worries over long term effects
- Reduced biodiversity
- Could develop allergies to the food
- Herbicide resistant gene could spread to weeds making superweeds!

Natural Selection

1. Variation occurs naturally within a species due to mutations
2. Some organisms have adaptations increasing their chances of survival
3. These organisms are more likely to reproduce
4. The genes responsible for the adaptation are passed on to their offspring.

Reasons why people didn't believe Darwin at first:
- Against religious beliefs
- They didn't know about genes or mutations at the time so Darwin couldn't explain why some organisms had more useful characteristics
- Not enough evidence

Selective Breeding

Humans breed animals/plants to gain desirable characteristics in offspring (takes many generations).

e.g. disease resistance, increased milk production, behaviour, scented flowers etc.

Downsides – Reduces variation limiting success of survival if conditions change, new diseases might wipe out every member of the same species, inbreeding in animals leads to defects.

AQA BIOLOGY UNIT 6: GENETICS, VARIATION AND INHERITANCE

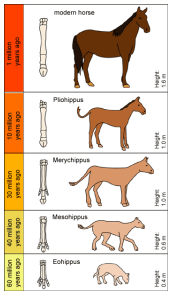
Fossils

These can be made from:

- Bones and teeth
- Minerals that have replaced bone and tissue
- Organisms trapped in amber or ice
- Burrows, tracks, where organisms have laid

Softer body parts such as tissue, muscle etc. **decay** if conditions are suitable.

Fossil record - collection of fossils that show evolution of an organism over many years.



- Usually incomplete as most organisms don't become fossils, softer bodies decay, fossils melt underground due to Earth movement, not been found yet,

- Usually need to comment on changes over time e.g. shape, length or number of bones.

Extinction - Living things become extinct because:

- Habitat changes – not adapted to survive
- New predator – not adapted to get away or hide
- Disease – lack of immunity
- New, more successful competitor – better adapted species will get food, space, water etc.

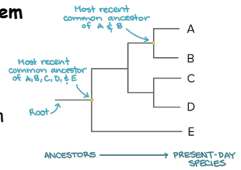
Classification

Carl Linnaeus	Carl Woese

• Grouped according to characteristics and structures that make up organisms.
• Kingdom, Phylum, Class, Order, Family, Genus, Species
	• Three-domain system
	• Based on new chemical analysis techniques that prove some species aren't as closely related as once thought.
	  ◦ Archaea – primitive bacteria
	  ◦ Bacteria – true bacteria
	  ◦ Eukaryota – fungi, animals, plants, protists
	• These are sub-divided into K,P,C,O,F,G and S.

Organisms are named using **binomial system** (genus and species in latin) . It is used worldwide regardless of language.

Evolutionary trees show common ancestors . The more recent the common ancestor, the more closely related they are.

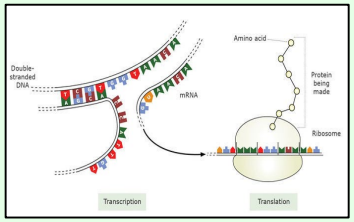


History of Genetics

TRIPLE ONLY

- **Mendel** studied pea plants and discovered that characteristics are controlled by 2 'units' that can be dominant or recessive.
- In the late 19th century behaviour of chromosomes during cell division was observed.
- In the early 20th century it was observed that chromosomes and Mendel's factors behaved in similar ways, leading to the idea that the factors (genes) were located on chromosomes.
- In the mid-20th century the structure of DNA was determined and the mechanism of gene function worked out.

Protein Synthesis



1. DNA strands unwind.
2. A corresponding template of ATGC is made called mRNA.
3. This leaves the nucleus and binds to a ribosome.
4. With the help of tRNA, amino acids are made.
5. The protein is then released from the ribosome.

Animal Cloning

TRIPLE ONLY

Adult Cell Cloning – makes copy of adult

1. Take nucleus from an adult cell
2. Take nucleus out of an egg cell
3. Put adult nucleus into empty egg cell
4. Electric shock
5. When it becomes an embryo, insert into uterus

Embryo Transplant – makes cloned offspring

1. Sperm and egg mixed in petri dish
2. Grow into an embryo
3. Split the embryo into cells
4. Each cell develops into an identical embryo
5. Insert into host uteruses

Plant Cloning

Cuttings – Cut a bit off and plant it.
- Cheap and quick

Tissue Culture – Cells put in growth medium with hormones. Grown all year, can make lots, more expensive.

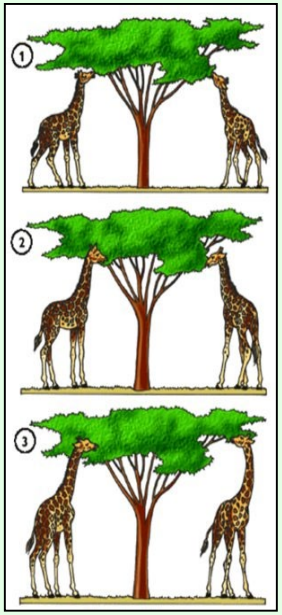
Evolution Theories

TRIPLE ONLY

Lamarck – the more a characteristic is used the more developed it becomes and is then passed on to offspring. *(which is nonsense!)*

E.g. Giraffes stretched their necks to reach higher food and passed on the characteristic to their offspring.

Darwin proposed that a mutation made some giraffes have longer necks so they would be more likely to eat, survive and reproduce.



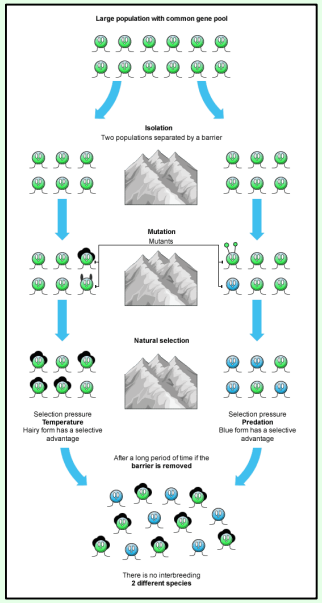
Speciation – making a new species

TRIPLE ONLY

A new species is made by:

Alfred Wallace wanted to publish his findings on natural selection before Darwin which prompted the Origin of the Species.

1. Geographical **isolation** (species split by water or mountains)
2. Genetic variation in both groups means some are more adapted to survive in their own conditions
3. Natural selection – best breed and pass on desirable genes
4. Speciation – new species can't interbreed with the other species



AQA BIOLOGY UNIT 7: ECOLOGY

Biotic and Abiotic Factors

Abiotic Factors
These are **non-living** factors that can affect an ecosystem.
- Light intensity
- Temperature
- Moisture
- Wind intensity/direction
- CO_2 level
- Oxygen level
- Soil pH

Biotic Factors
These are **living** factors that can affect an ecosystem.
- Competition with other species
- Food availability
- New predators
- New diseases

Key Terms

Habitat – where an organism lives
Population – all organisms of a species in a habitat
Community – populations of different species in a habitat
Ecosystem – the interaction of biotic and abiotic factors

The animals and plants are usually **interdependent**:
- Animals eat plants
- Animals pollinate plants
- Animals eat animals
- Animals use plants to build shelters
- Plants use nutrients from animal droppings

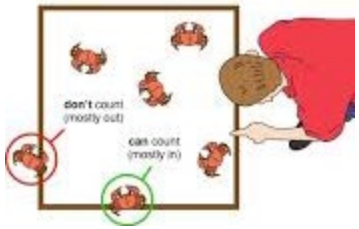
A **stable community** is one where all the species and environmental factors are in balance, so population sizes remain fairly constant e.g. tropical rainforests.

Distribution of Organisms

Where organisms live depends on:
- Temperature
- Amount of light
- Availability of water
- Availability of nutrients
- Availability of oxygen and carbon dioxide

Quadrats – To estimate a population

1. Throw randomly (prevent bias) many times
2. Count number of organisms / % coverage
3. Calculate the mean
4. See how many quadrats fit in whole area
5. Multiply number of quadrats by the mean



Line/Belt Transects – To show distribution

1. Lay tape along the area
2. Place quadrat at regular intervals
3. Count number of organisms / % coverage

Adaptations

Structural: the features of an organism's body structure, e.g. shape, size or colour.

Behavioural: how an organism behaves e.g. some species **migrate** to warmer climates during winter months.

Functional: internal processes of an organism e.g. desert animals produce **little sweat** and small amounts of urine to conserve water.

Arctic
- prevent heat loss
- small SA:Vol = lose less heat
- camouflage from prey

Desert
- large SA:Vol = easily lose and gain heat
- camouflage from prey
- no leaves
- water storage
- deep roots

Predators
- Camouflage
- Mimicry
- Poisons and spikes
- Warning colours

Extremophile – organisms with adaptations to live in harsh habitats to reduce competition.

Competition

Plants – light, space, water, minerals
Animals – space, food, water, mates

Decay

- Detritus feeders = worms, beetles, maggots
- Decomposers = bacteria, fungi
- They respire using waste, dead organisms etc.

Conditions needed = **WARM, MOIST** and **OXYGEN**

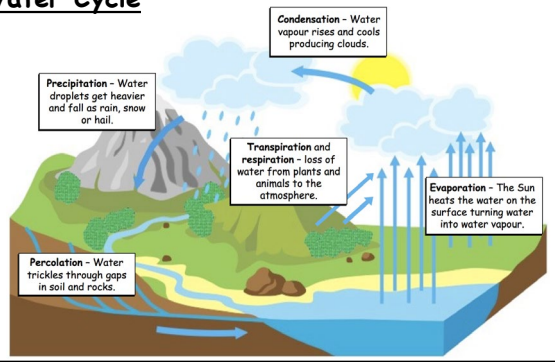
Decay puts nitrates back into the soil and carbon dioxide back into the atmosphere.

Compost Heaps – Decay releases nutrients from dead plants and animals to make fertile soil.

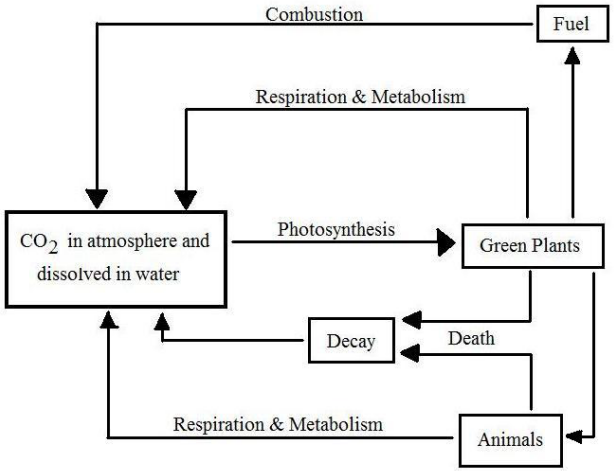


- **Air holes** – let oxygen in, regulate temperature.
- **Warmth** generated by respiring microorganisms.
- Finely shredded waste increases surface area.

Water Cycle



Carbon Cycle



Remember to follow the path of carbon e.g. CO_2 in air taken in by plants (photosynthesis), plants eaten by animals, animals die (decay), microorganisms respire, CO_2 back in the air.

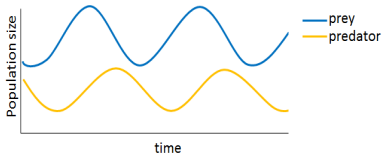
Food Chains

Grass → Rabbit → Fox

(producer → primary consumer → secondary consumer)

Always start with a producer (plant) as they produce their own food – they **photosynthesise** using the Sun's energy to produce **glucose**. Some of this glucose is used to produce new biological molecules in the plant, increasing its **biomass** (an energy store). Some of this biomass is passed on to the animal that eats the plant (secondary consumer). Therefore energy is transferred through organisms in a food chain.

Predator-Prey Relationships



The amount of food limits the population of a species. If the population of prey increases then so will the population of predators. But, as the number of predators increase, the number of prey decrease.

The predator-prey cycles are slightly **out of phase** with each other because it takes a short white for a population to **respond** to changes in the other.

If the number of rabbits increase it will take a while for the foxes to reproduce.

Biodiversity

a measure of the variety of all the different species of organisms on Earth, or within a particular ecosystem. A high diversity ensures the stability of an ecosystem.

A high biodiversity reduces the dependence of one species on another for:

- Food
- Shelter
- Maintenance of the physical environment

Human population has grown due to:

- Growing more food
- Treatment of diseases
- No natural predators

As human population **increases**, biodiversity **decreases** because:

- Land is used for building houses, shops, industry, roads. This destroys habitats.
- Huge areas of land is used for farming so natural animal and plant populations cannot survive.
- Quarrying for metal ores and rocks destroys habitats.
- Waste pollutes the environment and processing it takes up more land.

Restoring biodiversity

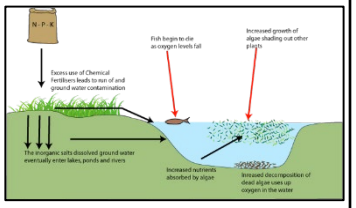
- Breeding programmes for endangered species
- Protection and regeneration of habitats
- Reintroduction of hedgerows and field margins
- Reduce deforestation and carbon dioxide emissions
- Recycling resources – reduces landfill

Pollution

Land
- More people = more sewage which if untreated pollutes soil
- Household waste goes to landfill – toxic chemicals spread into the soil
- Radiation e.g. at Chernobyl
- Herbicides and pesticides can be washed into rivers and streams – become part of food chain (**bioaccumulation**)

Water • Eutrophication

Fertilisers washed into rivers causes increase in algae and plants. These compete for light so die. Decomposers use up all the oxygen in the water when respiring lowering biodiversity.



Bioindicators can be used to identify low oxygen levels e.g. salmon, bloodworms.

Air
- Global dimming – smog and smoke particulates in the air reflect sunlight reducing the amount reaching us lowering ground temperature.
- Acid rain – Fossil fuels contain sulphur and nitrogen. Combustion results in sulphur dioxide and nitrogen dioxide released. These dissolve in rainwater and form sulphuric and nitric acids lowering rain pH.

Effects of Acid Rain
- Kills leaves, flowers etc and destroys roots
- Lowers pH in lakes, rivers etc until they cannot support life
- Acid snow – when it melts it causes major damage as an 'acid flush'
- Other countries are affected due to winds

What is being done about it?!
- Low sulphur petrol
- Clean chimney fumes from power stations
- Catalytic converters on cars
- Rely more on renewable energy sources.

Deforestation & Peat Bogs

Slash and burn
Land cleared for farming, trees burnt releasing CO_2.

There are 3 main reasons for deforestation:
- Grow staple foods e.g. rice
- To rear more cattle
- To grow crops for biofuel

Deforestation increases atmospheric carbon dioxide levels:
- Less trees therefore less photosynthesis removing CO_2 from the air.
- Burning trees releases CO_2.
- Decay of dead plants by microorganisms respiring releases more CO_2.
- Trees take in lots of CO_2 which is then converted into plant tissue. Removal of trees removes CO_2 sinks.

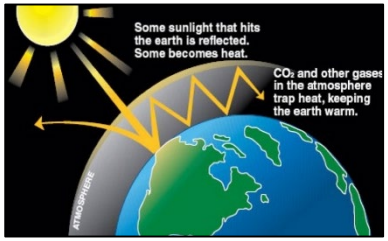
Often large areas are replaced by one single species. This is called a **monoculture**.

Peat bogs – Carbon store formed very slowly. Plant material that hasn't decayed fully due to acidic conditions and a lack of oxygen.
- **Burning** the peat releases its stored carbon back into the atmosphere as carbon dioxide.
- As peat is mixed in with soil it is exposed to *aerobic* conditions and begins to decompose - which releases carbon as carbon dioxide.

Global Warming

More CO_2 being released than taken in e.g. deforestation for rice fields or cattle that both release methane (CH_4)

Greenhouse Effect
1. Sun's energy warms up the surface of the Earth.
2. Most of this energy is radiated back.
3. Layers of CO_2 and CH_4 absorb some of the energy.
4. This warms up the atmosphere and the surface of the Earth.



The greenhouse effect is needed to maintain life but excess gases are causing an increase in temperature.

Global warming could cause:
- **Climate change** – increase severe unpredictable weather, higher temperature sea absorbs less CO_2.
- **Rising sea levels** – ice caps, glaciers
- **Reduced biodiversity** – organisms can't survive as habitats change
- **Changes to migration**
- **Changes to distribution** – some organisms may be able to survive in more places and vice versa.

Decomposition

TRIPLE ONLY

Temperature: Decay is controlled by enzymes so too cold = too slow, too hot = denatured.

Moisture: Makes it easier for microorganisms to digest food and prevents drying out.

Oxygen: For aerobic respiration – grow, reproduce etc. Aerobic respiration results in an increase in temperature in a compost heap.

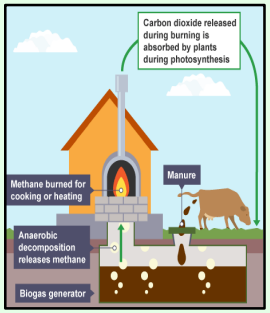
Anaerobic respiration in bacteria can produce methane – flammable gas (fuel)

Biogas can be produced on a small scale in a **biogas generator**.

The carbohydrate-containing materials are fed in, and a range of bacteria anaerobically ferment the carbohydrate into biogas.

The remaining solids settle to the base of the digester and can be run off to be used as **fertiliser** for the land.

The **optimum** temperature for biogas production is between 32°C and 35°C.



Cooler Countries – Slow respiration rate – bury generator with thick walls.
Warmer Countries – Denatures enzymes – bury generator so ground keeps it cool during the day.

Environmental Change

TRIPLE ONLY

Distribution of organisms is caused by:
- Availability of water
- Temperature
- Concentration of dissolved atmospheric gases in water.

Seasonal Changes	Daylight, amount of rainfall, temperature all change with the seasons. Animals migrate.
Geographical Changes	Changes to soil (structure and pH), altitude, saltiness of water. Organisms have adaptations to survive.
Human Interaction	**Negative**: Global warming, acid rain, pollution **Positive**: Maintaining rain forests, reducing pollution, conservation of hedgerows and woodlands
Living Factors	New predator, diseases, new competitors

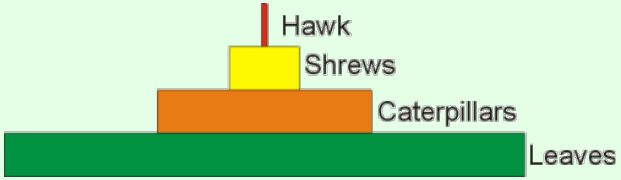
Biomass – mass of organism (no water)

Stages in a food chain are called **Trophic Levels**.

Issues with measuring biomass:

- Kill the organism and dry it out.
- Wet biomass is different depending on conditions, time of day etc.

Pyramid of biomass:



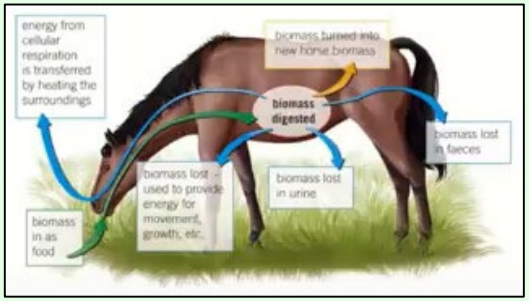
General Biomass Pyramid Rules

- Producer always at the bottom.
- They always look like normal pyramids
- Not all organisms or parts are eaten by the stage above e.g. roots, bones.
- Most biomass taken in is usually used for respiration.
- Food chains are short as so much biomass is lost at each trophic level.

Biomass Transfers

Biomass is lost by organisms because:

- **Faeces** – Herbivores can't digest all the plant material e.g. cellulose, carnivores can't digest bones, hooves, claws. Faeces are broken down by decomposers.
- **Waste** – Excess protein – deamination (urea production)
  - Respiration – glucose used by plants and animals transfers energy to the surroundings e.g. movement.
- **Temperature** – Mammals and birds use respiration for body heat



Food Security & Efficiency

Food Security = Having enough food for the population

Factors threatening food security:

- **Increasing birth rate** – children to work land, large families in some cultures, some religions don't use contraception.
- **Changing Diets** – People look for new interesting food, deprives local people of traditional food, less nutritional foods take less time to cook.
- **New pests and pathogens** – Global travel, animal and plant movement, climate change = wider spread of pathogens which affects farm animals and crops.
- **Environmental Changes** – Global warming = droughts and flooding of farm land.
- **Cost** – Genetic engineered crops cost more money as do irrigation systems, fertilisers and pesticides.
- **Conflicts** – infrastructure damaged, people fear they can't feed their families.

To make food production efficient:

- Shorter food chains so less biomass lost
- Limit movement of farm animals – less respiration more biomass (disease spreads in intensive farms)
- Warmer temperature – less respiration more biomass
- Fish bred in cages on high protein diets

Downsides: Ethical concerns over animal cruelty and welfare
Cost for lighting and heating

Sustainable Food Production

Sustainable = producing foods in ways that supply the whole human population and can continue for years.

Fishing – To prevent overfishing:

- Larger-holed nets to only catch the bigger, older fish
- Ban fishing during breeding season
- Strict fishing quotas to make sure some fishermen only bring in a limited number of specific types of fish.

Mycoprotein (Quorn)

Produced by fungus called ***fusarium*** (grows fast on **glucose** syrup) in a fermenter under **aerobic** conditions.

Fungal biomass is harvested and purified and then dried and processed to make mycoprotein. It can be **shaped** and **flavoured**.

