BIOLOGY

BIOLOGY ULTIMATE GUIDE

HIGHER

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Contents

Respiration:
Respiration is the process by which energy is released from glucose.

Aerobic respiration

glucose + oxygen → carbon dioxide + water (+ energy)

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

Anaerobic respiration

Anaerobic respiration does not need oxygen. It happens when there is not enough oxygen for aerobic respiration. Here is the word equation:

glucose → lactic acid (+ energy)

Much less energy is released by anaerobic respiration than by aerobic respiration.

Muscle fatigue

During hard exercise when anaerobic respiration occurs with aerobic respiration, an **oxygen debt** builds up. This is because glucose is not broken down completely to form carbon dioxide and water. Some of it is broken down to form lactic acid. Panting after exercise provides oxygen to breakdown lactic acid. The increased heart rate also allows lactic acid to be carried away by the blood to the liver, where it is broken down.

Blood pressure

Arteries carry blood away from the heart. The blood in the arteries is under pressure because of the contractions of the heart muscles. This allows the blood to reach all parts of the body.

Blood pressure is measured in millimetres of mercury, **mmHg**. There are two measurements:

systolic pressure - the higher measurement when the heart beats, pushing blood through the arteries, and
diastolic pressure - the lower measurement when the heart rests between beats

A young, fit person may have a blood pressure of about 120 over 70, which means their systolic pressure is 120 mmHg, and their diastolic pressure 70 mmHg.

Blood pressure varies with age. It also varies with lifestyle factors such as:

- diet, stress, exercise, body mass, alcohol consumption

High blood pressure can cause: kidney damage, burst blood vessels, damage to the brain, including strokes

Low blood pressure can cause: fainting, dizziness, poor blood circulation.

Protein: needed for growth and repair (especially in teenagers)

If you eat too much fat and carbohydrates, they are stored in your body. Proteins are different. They cannot be stored. Proteins from meat and fish are called first class proteins. They contain amino acids, which cannot be made by your body. Proteins are made of smaller molecules called amino acids.

Protein deficiency. It can lead to a disease called **kwashiorkor**, which causes a swollen abdomen.

You can calculate the recommended daily average (RDA) intake of protein using this formula:

RDA in g = 0.75 × body mass in kg

The Body Mass Index (BMI) is a guide to whether someone is underweight, normal weight or overweight. You can calculate the BMI using this formula:

BMI = mass in kg ÷ (height in m)^2

Digestion – breaking down of large molecules into smaller molecules so that they can diffuse through the small intestine into the blood stream.
Starts with **physical digestion** – chewing and squeezing in the stomach this increases the surface area for the enzymes to work on.
Chemical digestion – Enzymes break down large insoluble molecules into small soluble molecules so they can diffuse through the small intestine.

Enzyme	Large insoluble molecule	Small soluble molecule
Carbohydrase	Starch	Glucose
Protease	Protein	Amino acids
Lipase (think liposuction)	Fats	Fatty acids and glycerol

Immunity

White blood cells can:

- engulf pathogens and destroy them
- produce *antibodies* to destroy pathogens
- produce antitoxins that neutralise the toxins released by pathogens

Pathogens contain certain chemicals that are foreign to the body, called antigens. White blood cells - lymphocytes - carry antibodies - proteins that have a chemical 'fit' to a certain antigen. When a white blood cell with the appropriate antibody meets the antigen, it reproduces quickly and makes many copies of the antibody that neutralises the pathogen.

Once you have been infected with a particular pathogen and produced antibodies against it, some of the white blood cells remain. If you become infected again with the same pathogen, these white blood cells reproduce very rapidly and the pathogen is destroyed. This is **active immunity**. Sometimes you may be treated for infection by an injection of certain antibodies from someone else. This is **passive immunity**.

Antibiotics (learn this – it does come up)

Antibiotics are drugs that **kill bacteria**, but **not viruses**. Certain antibiotics can be used to treat fungal infections, such as thrush. Over time, bacteria can become resistant to certain antibiotics. To slow down or stop the development of other strains of resistant bacteria, we should:

- avoid the unnecessary use of antibiotics
- always complete the full course

Drug testing

New medical drugs have to be tested to ensure they work and are safe before they can be prescribed. This is done by using computer models and human cells grown in the lab, animal testing and then they are trialled on ill people.

Immunisation

Vaccination – putting a small amount of the inactive or dead pathogen into the body. They stimulate the white blood cells to produce antibodies against the pathogen. The person will not get ill as the pathogen is weakened or harmless.

Malaria (This is the example that they use in the disease section of the exam – learn it)

Some animals such as mosquitoes carry micro-organisms that cause disease. These are called **VECTORS.** Malaria is caused by a **protozoan.** When mosquitoes feed on human blood their sharp mouthparts pierce the skin. Some of the parasites are left in the 'hosts' blood. They feed on red blood cells, causing fever.
To **reduce the cases of malaria – stagnant water is drained, oil is put on the water surface to prevent the larvae breathing and the adults are sprayed with insecticide**. Humans can take simple precautions – mosquito nets.
Antibiotics cannot be used to treat malaria as the disease is caused by a protozoan (simple organism) rather than bacteria.

The main parts of the eye and their function

Part	Function
Cornea	refracts light - bends it as it enters the eye
Iris	controls how much light enters the pupil
Lens	focuses light onto the retina
Retina	contains the light receptors
Optic nerve	carries impulses from the eye to the brain

Accommodation

Light is focused onto the retina by refraction at the cornea, and by the lens. The lens changes shape to make the fine adjustments needed to produce a sharp image. This is called **accommodation**. As we get older, accommodation becomes slower and weaker.

How the shape of the lens is changed (learn this)

object	ciliary muscles	suspensory ligaments	shape of lens
distant	relax	stretch	thin – less convex
near	contract	slacken	fat – more convex

Short-sightedness - Someone with short-sightedness can see near objects clearly, but cannot focus properly on distant objects. This is caused by the eyeball being elongated, so that the distance between the lens and the retina is too great. It can be corrected by placing a concave lens in front of the eye.

Long-sightedness - Someone with long-sightedness can see distant objects clearly, but cannot focus properly on near objects. This is because the lens focuses the sharpest image behind the retina, instead of on it. This defect is often age-related, and due to a loss of elasticity in the lens. It is corrected by putting a convex lens in front of the eye.

Reflexes

Quick, automatic response designed to protect you. Examples include: blinking, pupil changing size, knee jerk response.

Sophie	Stimulus	(change in the environment)
Remembers	Receptor	(gather information from surroundings)
Seeing	Sensory	(carry impulses away from the sense organ)
Craig	Central Nervous System	(brain and spinal cord)

Making	Motor Neurone	(Carry impulses to an effector)
Egg	Effector	(Gland or muscle)
Rolls	Response	(reaction e.g. move)

Synapse

The gap between two neurones is called a **synapse**. The nerve impulse passes across this gap through chemicals that diffuse across the gap. The electrical signal travels along an axon and triggers the release of chemical transmitters from the nerve ending of the first neurone. These diffuse across the gap and make the second neurone re-transmit the electrical signal.

Stimulant drugs increase the amount of the neurotransmitter chemical at some synapses, which increases the frequency of the impulses.

Depressants such as alcohol bind with neurotransmitter receptors, blocking nerve impulses.

Diabetes

Glucose is a sugar needed by cells for respiration. It is important that the concentration of glucose in the blood is maintained at a constant level. **Insulin**, a hormone secreted by the pancreas, controls blood sugar levels in the body. Diabetes is a disorder in which the blood glucose levels remain too high. It can be treated by carefully maintaining a certain diet or injecting insulin. The extra insulin allows the glucose to be taken up by the liver and other tissues, so cells get the glucose they need and blood sugar levels stay normal.

What happens when glucose levels in the blood become too high or too low

glucose level	effect on pancreas	effect on liver	effect on glucose level
too high	insulin secreted into the blood	liver converts glucose into glycogen	goes down
too low	insulin not secreted into the blood	liver does not convert glucose into glycogen	goes up

Menstrual cycle

Several hormones control this cycle (Both hormones are secreted from the ovary):

oestrogen, which causes the repair of the uterus wall

progesterone, which maintains the uterus wall

'The pill' is an oral contraceptive that greatly reduces the chances of mature eggs being produced. The pill contains oestrogen, or oestrogen and progesterone. These hormones prevent eggs from maturing in the ovaries.

Some women have difficulty becoming pregnant because they do not produce enough of a hormone called FSH, which is needed for eggs to mature. Fertility drugs contain FSH, which stimulates eggs to mature in the ovary.

Genetics:

The four bases in DNA are labelled *A*, T, *C* and *G*.

Only some of the genes are used in any individual cell, with the rest being switched off. Genes code for the production for proteins. Some of these are enzymes which control how the cell functions.

Asexual and sexual reproduction

Asexual reproduction

Asexual reproduction only needs one parent. All the offspring are genetically identical to each other, and their parent. They are **clones**.

Sexual reproduction

Sexual reproduction needs two parents. Each parent produces sex cells, called **gametes**:

male gametes are called sperm (23 chromosomes)
female gametes are called eggs (23 chromosomes)

Alleles

Alleles are different versions of the same gene. An allele can be dominant or recessive. Individuals, meanwhile, can be homozygous or heterozygous:

individuals who are **homozygous** for a certain gene carry two copies of the **same allele e.g. BB**
individuals who are **heterozygous** for a certain gene carry two **different alleles e.g. Bb**

A recessive characteristic will only be shown if an individual is homozygous for the recessive allele. A dominant characteristic will be shown even if an individual is heterozygous for the dominant allele.

Genetic diagrams

Genetic diagrams are used to show the possible outcomes of a particular cross. A dominant allele is shown by a capital letter, and a recessive allele by a lower case letter.

Photosynthesis – takes place in the chloroplasts. More photosynthesis in Summer due to more hours of daylight

$$\text{Carbon dioxide + water} \xrightarrow[\text{Chlorophyll}]{\text{Light}} \text{Glucose + Oxygen}$$

- Plants **compete** for light, water and minerals. E.g. small bushes do not grow well under trees due to lack of light and competition for water and minerals. The factors that limit (limiting factors) the rate of photosynthesis are carbon dioxide levels, light intensity and temperature.
- **Glucose** is used for respiration, making cellulose cell walls. It is stored as **STARCH.**
- Plants **respire** to release **energy**

Vertebrates – animals with a backbone (remember MR FAB)

Group	Features	Example
Mammal	Have hair, produce milk and give birth to live young	Whales, bats, humans, dogs
Reptile	Dry scaly skin, lay leather like eggs	Dinosaurs, lizards, snakes
Fish	Slimy scales, gills, fins	Cod, shark
Amphibian	Lay jelly eggs, can live on land and in water, slimy skin	Frogs, toads,
Birds	Feathers, beak	Eagle, Robin

Keeping whales in captivity

Advantage – Research and captive breeding programmes

Disadvantage – People think it is cruel as whales lose their freedom

Some fossil vertebrates and newly discovered species can be difficult to classify. For example, **Archaeopteryx** is an extinct vertebrate known only by its fossil remains. It has characteristics of birds and reptiles. Feathers like a bird and a jaw like a reptile.

Could have evolved feathers from scales:

Variation – there will be variation within the species with the feather/s scales e.g. some may have more feathers.

Survival of the fittest – they would be able to fly away from predators and survive

Natural selection – they would survive to breed and pass on their genes

Species – organisms of the same time
Hybrid – organism made when two different species breed together

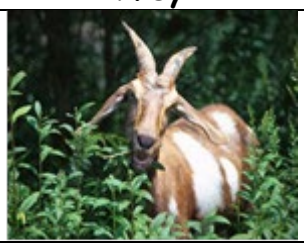
Adaptations

Animal/plant	Adaptations
	Blubber – fat keep them warm Fur on soles of feet for grip Large claws and teeth to kill prey
	Large feet – to spread their weight so they don't sink Bushy eyelashes to keep the sand out of their eyes
	Rounded shape - gives them a small surface area to volume ratio, which reduces water losses. Thick cuticle to reduce water losses green stems which can store water and photosynthesise Widespread root systems, which can le collect water from a large area ong spines instead of leaves, which re reduce water losses and protect agagainst animals that might eat the

	Plant.

Sampling techniques

Quadrats	Pitfall traps

Predator	Prey
	
Animal that hunts and kills other animals for food	the animal that is hunted and killed for food.
- sharp claws and teeth. - Have eyes at the front of their head to help judge distances.	- eyes at the front of their head –all round view - camouflage - live in groups

Natural selection

Animals that are best suited to the changing environment, survive and pass on their genes. Examples include:

- Rats – have become resistant to warfarin.
- Peppered moths – some moths were dark and others pale. In areas of high pollution, lichen on the trees died. Dark moths were camouflaged against the dark bark. The white moths were easily seen by predators and were eaten.

Evolution

Theory that plants and animals 'evolved' (changed) over millions of years. The evidence for this is fossils. Things like teeth, bone and shells don't decay easily. They are eventually replaced by minerals, forming a rock like substance shaped like the original hard part. The fossil record is not complete as fossils could be destroyed and fossilisation is a rare event.

Darwin's theory

The main features in his theory are that:

- individuals compete for limited resources
- individuals in a population show natural variation
- individuals with characteristics best suited to their environment are more likely to survive to reproduce
- 'successful' characteristics are inherited

Species unable to compete successfully eventually become extinct.

Population

The world's population is **increasing**. Problems include:
More resources such as coal oil and gas are burned for energy and heat. This means an increase in pollution e.g. sulphur dioxide and carbon dioxide.
More mineral resources such as limestone, and aluminium are being used.
More sewage can end up in rivers killing fish. Household rubbish is filling up landfill sites.
Recycling is important to conserve resources.

Sustainability

A sustainable resource – a resource that will not run out because it is being produced at the same rate at which it is being used.
Endangered – animals and plants that are in danger of becoming extinct e.g. the tiger, gorilla, red squirrel
Extinct – When all members of the species have died e.g. dodo

Reasons:

Destruction of their habitat, poaching/hunting, pollution

Saving animals from extinction:

- protected areas
- captive breeding
- laws to ban poaching, export of animals or their parts.

Diffusion

Movement of particles from a high concentration (lots) to a low concentration (few).

Diffusion can be **speeded up** when:

- particles move faster, eg when they're **warmer**
- **concentration difference** is greater, eg by replacing air in the lungs with fresh air rich in oxygen
- distance for diffusion is kept to a minimum, eg by having a **thin layer of cells** lining the lungs
- the **surface area** for diffusion is increased eg by folding

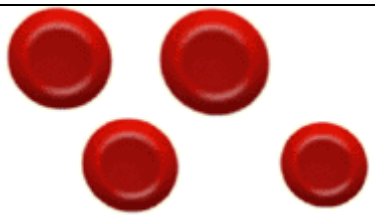
Examples of diffusion in living systems

Location	Substances	From	To	Adaption
lung	oxygen	air space	red blood cells	alveoli (moist lining, good blood supply)
lung	carbon dioxide	blood plasma	air space	alveoli (moist lining, good blood supply)
digestive system	food molecules eg glucose	stomach, intestine	blood	villi, microvilli, good blood supply
uterus	food molecules and oxygen	mother's blood supply	foetus's blood supply	placenta with villi, thin walls and good blood supply
leaf	oxygen	leaf cell	air space	thin leaves, with air spaces and spongy layer

Circulatory system

Blood component	Job
Red blood cell	Carry oxygen
White blood	Defend against disease
Platelets	Help the blood to clot (scabs)
Plasma	Carry hormones, antibodies, carbon dioxide and waste etc.

Red blood cells adaptations

	**Small** – to fit through narrow blood vessels **Bioconcave** – large surface area to gain or lose oxygen more quickly **No nucleus** – more haemoglobin can fit in the cell Contain haemoglobin – absorbs oxygen to form oxyhaemoglobin Haemoglobin + oxygen Oxyhaemoglobin

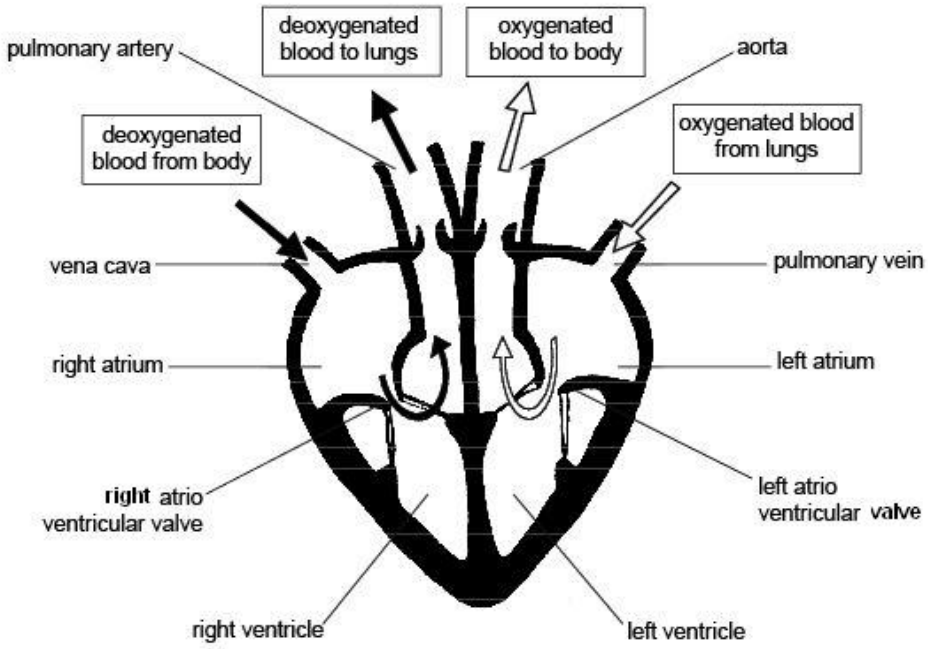
Blood vessel	Job
Artery	Carry blood **a**way from the heart
Veins	Carry blood towards the heart. Have **v**alves.

Capillaries	Thin walls to allow exchange of substances

Valves – prevent the backflow of blood. These are found in veins and the heart. The veins have valves because the blood is at a lower pressure.
NOTE: whether it is a tricuspid valve, bicuspid valve they all do the same job – prevent the backflow of blood!

The heart: (Know that **all valves** prevent the backflow of blood)

The job of the heart is to **pump blood round the body**.



The **left ventricle** exerts more pressure than the right ventricle, and so it has a thicker more muscular wall. This is because it has to pump blood all the way round the body. This is why your heart beat is louder on the left hand side.

Heart problems

Cholesterol – fatty deposits build up causing narrowing of the arteries/blood vessels. This restricts / stops blood flow / oxygen or glucose supply.

Leaking heart valves make blood circulation inefficient. They can be replaced in open heart surgery by transplanted valves from a donor, or mechanical valves. If valves are faulty blood can flow in the wrong direction.

A **faulty pacemaker** causes irregular beating of the heart which in turn causes blood circulation to be inefficient. Artificial pacemakers powered by a battery can be fitted without needing open heart surgery. The problems of fitting mechanical or electrical heart components include:

- rejection by the immune system
- finding a way of reducing the size of the components to fit inside the body
- providing a power supply for pacemakers

In some cases a **heart transplant** may be needed. Problems include:
- difficult to find suitable donors with healthy hearts
- need a correct tissue match

- need to take drugs to stop their immune system from **rejecting** the heart for the rest of their lives. This can lead to greater risk from **infections**.

Growth in humans (learn the order, you will also be required to interpret a graph)

The stages: Infancy, Childhood, adolescence, adulthood, old age

When humans are born, their heads are relatively large, and their legs relatively short. Through childhood their bodies grow faster than their heads until they reach maturity. To check that development is happening at normal rates, infants regularly have their mass and head circumference measured.

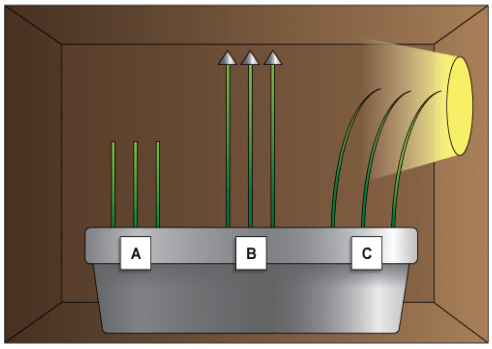
Controlling plant growth

Auxin is a plant hormone produced in the stem tips and roots, which controls the direction of growth.

Plants need light and water for **photosynthesis**. They have developed responses called **tropisms** to help make sure they grow towards sources of light and water.

- **Tropism** – growth in **response** to a stimulus
- **Positive tropism** – **towards** the stimulus
- **Negative tropism** – **away from** the stimulus
- **Phototropism** – growth in response to the direction of **light**
- **Geotropism** – growth in response to the direction of **gravity**

Auxin experiment



3 groups of seeds are grown in a cardboard box.

A - when the tips are removed, no auxin is made so the stems do not grow

B – when the tips are covered, auxin moves to all parts of the stem causing all parts to grow

C - when the tips are lit from one side only auxin accumulates on the shaded side causing it to grow more than the illuminated side

Uses of plant hormones (Make sure you can give an example):

Weedkillers, rooting powder, controlling fruit ripening, dormancy,

Enzymes

Enzymes are soluble protein molecules that can **speed up** chemical reactions in cells. These reactions include *respiration*, *photosynthesis* and making new proteins.

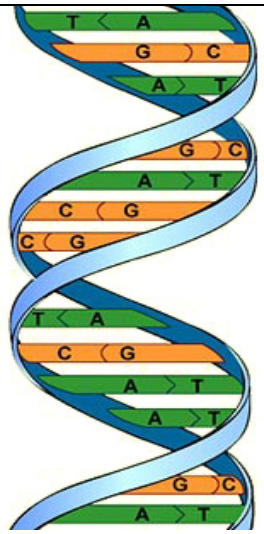
DNA

DNA is a long molecule made up of twisted strands of the bases A, T, C and G.

Genes are sections of the DNA. Each gene has the code for creating a specific protein.

The sequence of bases in the gene controls which amino acids are created and joined to make a specific new protein (or enzyme) molecule. Each amino acid has its own code of **three** bases E.g.

GTACTCTGA - 3 amino acids are coded for.



DNA replication (copying)

When a cell grows and **divides** into two, it first has to make a **duplicate** copy of each DNA molecule

The two strands of the double helix **unzip**, new strands are made by base pairing with complementary bases e.g. base pairing 'A' with 'T'.

The amino acids used to make up new proteins are absorbed from food in the digestive system. It's possible for the **liver** to make more of a particular amino acid if needed in a process called **transamination**.

How to produce a DNA fingerprint - used to solve crimes

1. **Isolation** - separate the DNA from other tissues
2. **Fragmentation** - use an enzyme to break the DNA into short lengths
3. **Separation** - pass an electric current across a layer of gel which has the DNA fragments at one end. The fragments will move different distances across the gel. This is called **gel electrophoresis**
4. **Comparison** - match the pattern of fragments on the gel with other samples of DNA

Cell division

	Mitosis	**Meiosis**
When does it happen?	During growth and repair	During the production of gametes/sex cells (sperm and egg)
Where does it happen?	All cells apart from gametes	Reproductive organs

How many cells are produced?	Two daughter cells	Four daughter cells
How many chromosomes?	Same as the original cell (46 in humans)	Half the number of chromosomes (23 in humans)
Variation?	Identical to the original cell (parent cell)	Daughter cells are genetically different from each other and the parent cell.

Constant cell division ensures that cells never get too large. The larger the cell becomes, the smaller its surface area to volume ratio. Objects with a small surface area to volume ratio find it difficult to maintain exchange of materials with their environment. Large cells could run out of oxygen, and accumulate too much waste, such as carbon dioxide. For this reason it's more efficient for large organisms to be multicellular, rather than single-celled.

These are helpful terms to learn:

- **gamete** – cell with half the normal number of chromosomes, and only used for sexual reproduction
- **zygote** – cell formed when two gametes combine
- **fertilisation** – term to describe the joining of two gametes
- **haploid** – having half the normal number of chromosomes
- **diploid** – having the normal number of chromosomes

Stem cells

During the development of an *embryo*, most of the cells become specialised. They cannot later change to become a different type of cell.

But embryos contain a special type of cell called **stem cells**. These can grow into any type of cell found in the body. They are not specialised. Stem cells can be removed from human embryos that are a few days old, for example, from unused embryos left over from fertility treatment. Some people do not agree with using human embryos for the following reasons:

- Morally wrong/against religious beliefs/ against nature
- May involve the destruction/death of the embryo
- Embryo has the right to live as a potential person
- Unknown risks

Here are some of the things stem cells could be used for:

- making new brain cells to treat people with Parkinson's disease
- rebuilding bones and cartilage
- repairing damaged immune systems
- making replacement heart valves

Gametes – All gametes are Haploid!

Fertilisation – Joining of the nucleus of the sperm and the nucleus of the egg

The egg contains a large **food store** to support the developing zygote until it can get food via the placenta

Sperm

Structure	Job	Adaptation
	Fertilises an egg cell	**Head** - contains genetic information and an enzyme to help penetrate the egg cell membrane. **Acrosome** – contains a type of chemical called an ENZYME to digest the egg membrane. **Middle section** is packed with mitochondria for energy. This energy is released during RESPIRATION **Tail** moves the sperm to the egg.

Selective breeding

Is choosing animals or plants with the desirable features that you want to pass on e.g.

Dairy cattle - Increasing **milk yield** by selecting bulls from high yield herds and breeding them with cows that have the best milk production.

These are the steps in selective breeding:

Decide which **characteristics** are important

1. Choose **parents** that show these characteristics
2. Select the best **offspring** from parents to breed the next generation
3. Repeat the process continuously

Problems with selective breeding

Future generations of selectively bred organisms will all share very **similar genes**. This could make some **diseases** more dangerous as all the organisms would be affected. Also there's increased risk of genetic disease caused by **recessive genes**.

Some genes would be lost, making it more difficult to produce new varieties in the future. In scientific language this would be described as 'inbreeding can lead to a reduction in the size of the gene pool'.

Genetic engineering

A **faster** way of producing new varieties is to transfer the genes for the desired characteristic into an organism **artificially**. This is genetic engineering. The gene may have come from the same species, but genetic engineering also allows the genes from an unrelated organism to be transferred – something that's not possible with selective breeding. Problems, however, include:

- there's a **risk** that there could be unexpected harmful effects, either to the new organism or if the gene 'escapes' into the surrounding populations.

- Some people are concerned about the **health risk** of eating genetically modified food – others think it wrong to create **new life forms**, or move genes between different species, especially if this causes **harm** to the receiver.

Examples of genetic engineering

Example	Gene donor	Gene receiver	Benefit
Golden rice	Carotene gene from carrots	Rice	People lacking vitamin A in their traditional diet can make the vitamin if they eat genetically modified 'golden' rice.
Humalin	Insulin gene from humans	Bacteria	'Human' insulin can be made cheaply and quickly by bacteria to treat diabetics.
Weedkiller resistance	Resistant gene from plant	Soya beans	Genetically modified soya beans can be sprayed with weedkiller and remain unaffected, so only weeds are killed. This increases yields of soya.

Mutation

Mutation means any **change** in the genetic material. They can happen **naturally**. Most mutations are harmful to an individual, but occasionally a mutation can be beneficial. It's possible to speed up mutation rates artificially using radiation or chemicals. **Mutations bring about changes in organisms by changing the sequence of bases in DNA.** This causes a different protein to be made, or blocks the production of the protein completely.

A mutation is likely to change the protein that the DNA codes for because it now codes for a different amino acid / may stop the production or change the shape of the protein.

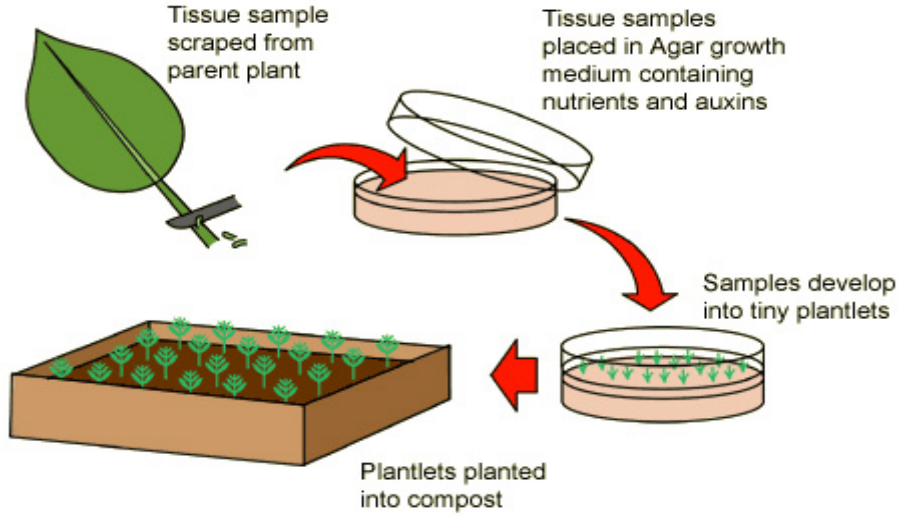
Asexual reproduction – 1 parent

Plants can make identical copies (clones) of themselves. Many plants have ways of increasing their numbers by asexual reproduction – new plants are created by repeated cell division:

- Strawberry plant with runners - stems growing sideways
- A potato plant can produce many **tubers**, each of which can grow into a new plant.

It's fairly easy to artificially produce new plants by taking a cutting, and waiting for the cutting to develop new roots and leaves. An advantage of plants **not being** genetically identical is if one gets disease then not all will.

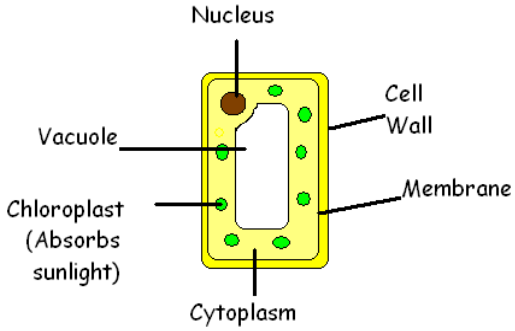
How to clone plants by tissue culture



In summary:

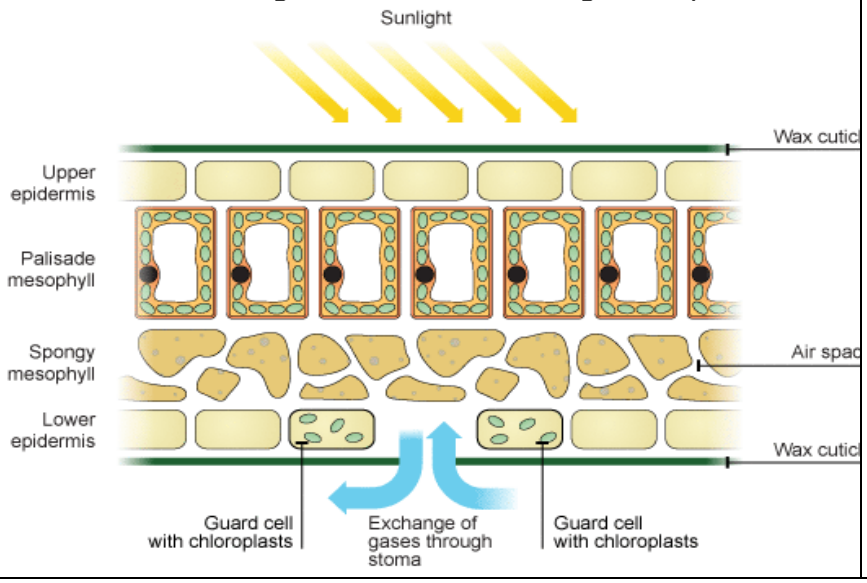
- choose suitable plant
- take small pieces/ use many pieces
- put into aseptic technique/eg of aseptic technique /sterile (to avoid fungus infections)
- Put into suitable growth medium/agar
- leave in suitable conditions/warm and light

Structure of a plant



Leaf structure

- large surface area to absorb more sunlight
- Thin – to allow gases to diffuse through easily

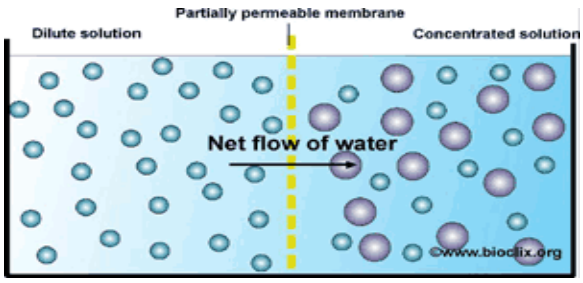


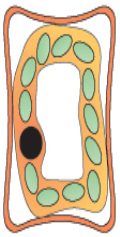
Adaption	Purpose
Large surface area	To absorb more light
Thin	Short distance for carbon dioxide to diffuse into leaf cells
Chlorophyll	Absorbs sunlight to transfer energy into chemicals
Network of veins	To support the leaf and transport water and carbohydrates
Stomata	Allow carbon dioxide to diffuse into the leaf

Adaptations of the Palisade layer –

- chloroplasts can move up or down
- Cells packed close together
- Lots of chloroplasts

Osmosis – water enters the root by osmosis





The movement of water from a dilute solution (lots of water) to a concentrated solution (less water) through a partially permeable membrane (membranes that let small particles pass through but not large particles).
When I do not water my spider plants they **wilt** – this is because the cells become flaccid / not turgid, the cell contents do not push against cell wall, this means that there is less pressure against cell wall (turgor) . The cell membrane also comes away from cell wall .

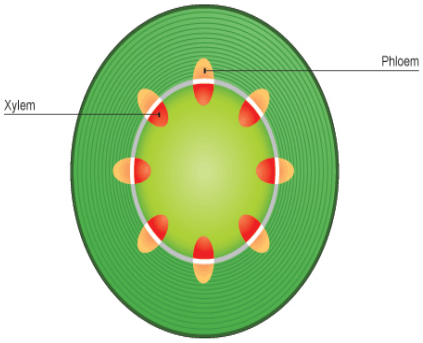
Important vocabulary - higher tier

Lysis – bursting an animal cell by osmosis
Crenation – shrinking an animal cell by osmosis
Turgid – a plant cell fully inflated with water
Plasmolysed – a plant cell that has lost water causing the cell membrane to be pulled away from the inside of the cell wall
Flaccid – a plant cell that is limp through a reduction of pressure inside the cell

Phloem – transports dissolved foods such as sugar from the leaves to the rest of the plant.
Remember: 'Ffff' for food, 'ph' for phloem.

They are living cells

Xylem – transports water from the roots to the leaves. Columns of dead, hollow cells.



Transpiration- evaporation of water from the leaves

Increases: when it is hot
Windy
Less humid
Bright day

Water – has the following uses:

- cool the plant
- Photosynthesis
- Supports the plant and stops it **wilting**
- Transport minerals

Fertilisers- help plants grow (increase crop yield)

Needs to be dissolved in water before it can be absorbed by the roots.

NPK fertilisers contain:
N = Nitrogen
P = Phosphorus
K = potassium
Remember: you can use the periodic table at the back of

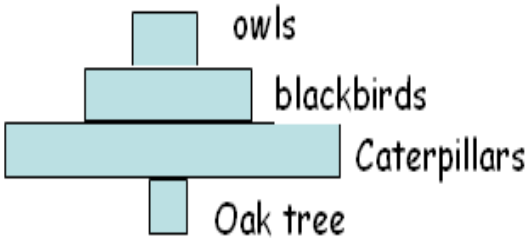
Hydroponics
Growing plants in water that contains minerals and oxygen
Advantage: can be grown in areas where the soil is poor (nutrient deficient) or dry areas.
Disadvantage – expensive.

Note: roots need oxygen for respiration. They also need it for active

your test paper!	transport - dissolved molecules move across a cell **membrane** from a lower to a higher concentration. Energy is needed for this.

Mineral	Leaves	Used for
Nitrates	Poor growth and yellow leaves	**Growth** – All amino acids contain nitrogen. Amino acids are the building blocks of protein.
Phosphates	Poor root growth and discoloured leaves	A component of DNA molecules and cell membranes
Potassium	Poor flower and fruit growth, discoloured leaves	Respiration and photosynthesis - Must be present for photosynthesis and respiration enzymes to work
Magnesium	Yellow leaves	Photosynthesis (chlorophyll contains Mg)

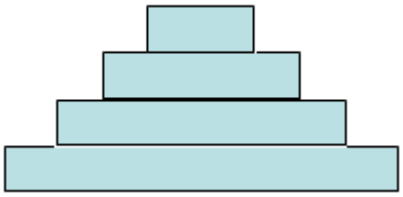
Pyramids of numbers show the number of organisms at each level **not** always a pyramid shape



Remember: all pyramids start off with the plant (producer)

Pyramids of Biomass

Show amount of material at each stage



Always a pyramid shape as…

-some is used for respiration to move/grow

-some is lost as heat

-some material is not digested

-some is lost as faeces

Biomass

Green plants use energy from the sun to make their food. They use this **energy to live and grow**. Some of this energy is passed along food chains to animals.

The **mass of plants and animals** is called **biomass**

Remember – 'Bio' means 'living'.

Biofuels

The energy in biomass can be used in biofuels.

e.g

- wood
- biogas
- alcohol

Decomposers:

Break down plant and animal bodies into simpler chemicals and recycled.

Bacteria and fungi cause decay. They are called **decomposers.**

They need **water, oxygen and a suitable temperature** to survive.

Food preservation

To prevent food going off:

- **Add sugar or salt** – removes water by osmosis
- **Cook the food** (High temp kill microbes)
- **Add vinegar** (too acidic)
- **Drying** – removes the water which

Compost bins often have **holes** at the side to **allow oxygen in**. **Decay** happens **faster in summer** as it is **warmer**. **Detritivores** Larger organisms include **earthworms** that help break down dead leaves, woodlice that break down wood and maggots that feed on animal tissue. These larger organisms are **detritivores**. As they break down leaves etc they increase the surface area for bacteria etc to work on. This speeds up the rate of decomposition.	prevents them growing and digesting food - **Freezing** – can't reproduce at low temperatures - **Canning** - The sealed can is heated to kill bacteria. When it cools, no more bacteria can enter
Intensive farming **Producing as much food from the land you have as quickly as possible.** **Methods include using**: - machinery - hydroponics - fertilisers - fish farms and battery hens - Spray chemicals **Herb**icide – kills unwanted **plants** **Fungi**cide - kills **fungi** **Pest**icides – kill pests **Insect**icides – kill **insects**	**Organic Farming** **Does not use manufactured chemicals.** **Methods include:** - remove weeds by hand to remove competition for light and minerals - Crop rotation - Manure Biological control – a natural predator is released to reduce the number of pests e.g. ladybirds are released to kill and eat aphids. **Advantages** Expensive chemicals don't have to be brought and there is no chemical pollution. **Disadvantages** Less crops

BIOLOGY

BIOLOGY ULTIMATE GUIDE

FOUNDATION

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Contents

Blood pressure

Arteries carry blood away from the heart. The blood in the arteries is under pressure because of the contractions of the heart muscles. This allows the blood to reach all parts of the body.

Blood pressure is measured in millimetres of mercury, **mmHg**. There are two measurements:

systolic pressure - the higher measurement when the heart beats, pushing blood through the arteries, and
diastolic pressure - the lower measurement when the heart rests between beats

A young, fit person may have a blood pressure of about 120 over 70, which means their systolic pressure is 120 mmHg, and their diastolic pressure 70 mmHg.

Blood pressure varies with age. It also varies with lifestyle factors such as:

- diet, stress, exercise, body mass, alcohol consumption, salt

High blood pressure can cause: kidney damage, burst blood vessels, damage to the brain, including strokes

Low blood pressure can cause: fainting, dizziness, poor blood circulation.

Heart disease

- **Increased** by high blood pressure, smoking, salt, eating a lot of saturated fat.
- **Saturated animal fats** such as cholesterol can stick to the walls of the arteries. This build up is called plaque. This slows down or blocks the flow of blood. If this happens in the arteries supplying the heart, it can cause a **heart attack**.
- **Salt** – causes the body to retain more water. This causes a high volume of blood to be pumped by the heart and this increases blood pressure.
- **Smoking** – **carbon monoxide** reduces the amount of oxygen to be carried by the blood. Heart rate increases to make sure oxygen gets to all parts of the body and puts extra stress on the heart. **Nicotine** is a stimulant that causes the heart to beat faster and also make blood vessels narrower.

Fitness – strength, flexibility, stamina, agility, speed	**Health** – free from disease e.g. if David beckham had a cold he would be fit but not healthy.

Protein: needed for growth and repair (especially in teenagers)

Proteins are made of smaller molecules called **amino acids.**

Protein deficiency. It can lead to a disease called **kwashiorkor**, which causes a swollen abdomen.

EAR (estimated average requirement) in g = body mass in kg x 0.6

The multiplication fig of 0.6 in the EAR will vary depending on age, pregnancy and breast-feeding.

The Body Mass Index (BMI) is a guide to whether someone is underweight, normal weight or overweight. You can calculate the BMI using this formula:

BMI = mass in kg ÷ (height in m)^2

Digestion –
Carbohydrates and fats – energy
Protein – growth and repair
Fibre – prevent constipation

Infection and immunity

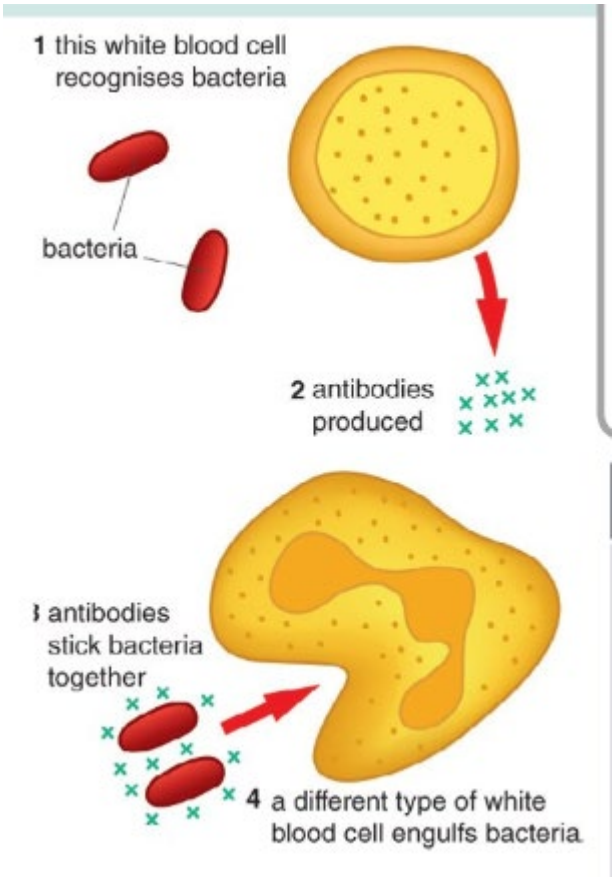
Pathogen	Disease
Fungi	Athletes foot
Bacteria	Cholera
Virus	Flu
Protozoa	Malaria

Not all illnesses are caused by microbes e.g. lack of vitamin C = scurvy.

Defence

Skin, Stomach acid and mucus

White blood cells can:



Pathogens contain certain chemicals that are foreign to the body, called antigens. White blood cells - lymphocytes - carry antibodies - proteins that have a chemical 'fit' to a certain antigen. When a white blood cell with the appropriate antibody meets the antigen, it reproduces quickly and makes many copies of the antibody that neutralises the pathogen.

Once you have been infected with a particular pathogen and produced antibodies against it, some of the white blood cells remain. If you become infected again with the same pathogen, these white blood cells reproduce very rapidly and the pathogen is destroyed. This is **active immunity**. Sometimes you may be treated for infection by an injection of certain antibodies from someone else. This is **passive immunity**.

Antibiotics (learn this – it does come up)

Antibiotics are drugs that **kill bacteria**, but **not viruses**. Certain antibiotics can be used to treat fungal infections, such as thrush. Over time, bacteria can become resistant to certain antibiotics. To slow down or stop the development of other strains of resistant bacteria, we should:

avoid the unnecessary use of antibiotics

always complete the full course

Drug testing

New medical drugs have to be tested to ensure they work and are safe before they can be prescribed. This is done by using computer models and human cells grown in the lab, animal testing and then they are trialled on ill people.

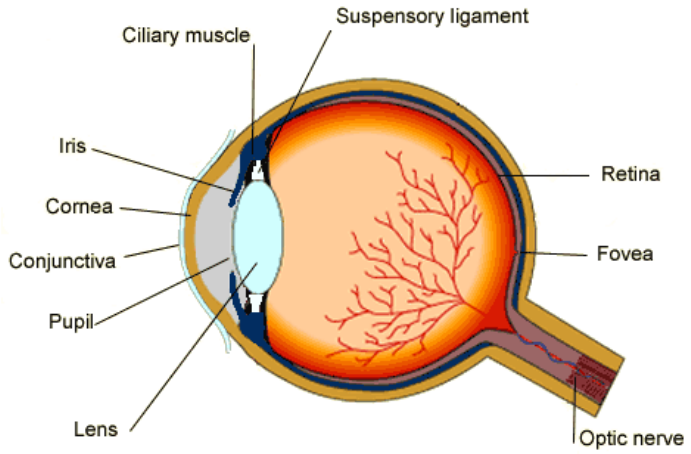
Immunisation

Vaccination – putting a small amount of the inactive or dead pathogen into the body. They stimulate the white blood cells to produce antibodies against the pathogen. The person will not get ill as the pathogen is weakened or harmless.

Malaria (This is the example that they use in the disease section of the exam – learn it)

Some animals such as mosquitoes carry micro-organisms that cause disease. These are called **VECTORS.** Malaria is caused by a **protozoan.** When mosquitoes feed on human blood their sharp mouthparts pierce the skin. Some of the parasites are left in the 'hosts' blood. They feed on red blood cells, causing fever.

To **reduce the cases of malaria – stagnant water is drained, oil is put on the water surface to prevent the larvae breathing and the adults are sprayed with insecticide**. Humans can take simple precautions – mosquito nets.



Part	Function
Cornea	refracts light - bends it as it enters the eye
Iris	controls how much light enters the pupil
Lens	focuses light onto the retina
Retina	contains the light receptors
Optic nerve	carries impulses from the eye to the brain

Reflexes

Quick, automatic response designed to protect you. Examples include: blinking, pupil changing size, knee jerk response. Messages are carried as an electrical impulse along nerves,

Sophie	Stimulus	(change in the environment)
Remembers	Receptor	(gather information from surroundings)
Seeing	Sensory	(carry impulses away from the sense organ)
Rick	Relay neurone	(spinal cord)
Making	Motor Neurone	(Carry impulses to an effector)
Egg	Effector	(Gland or muscle)
Rolls	Response	(reaction e.g. move)

type of drug	effect on the body	example
depressant	slows down brain activity	alcohol, solvents, temazepam
hallucinogen	alters what we see and hear	LSD
painkiller	blocks nerve impulses	aspirin, paracetamol

performance enhancer	improves muscle development	anabolic steroids
stimulant	increases brain activity	nicotine, caffeine, ecstasy

Illegal drugs are classified from Class A to Class C. Class A drugs are the most dangerous, with the most serious penalties for possession or dealing. Class C are the least dangerous, with the lightest penalties, but this does not mean they are safe to use.

Addicted – difficult to give up.

Homeostasis

Maintenance of a constant internal environment. Keep glucose, temperature and water at certain levels in the body e.g. temperature is 37°C.
Too cold – shiver, hair stands up. This will prevent hypothermia.
Too hot – sweat, hair lies flat. This will prevent hyperthermia.

Diabetes

Diabetes is a disorder in which the blood glucose levels remain too high. It can be treated by carefully maintaining a certain diet or injecting insulin. Type 1 diabetes – the body is unable to produce enough insulin. Type 2 diabetes – body either produces too little insulin or the cells don't react to it.

Variation and inheritance

Inherited	Environmental	Both
Eye colour Blood group	Scars Tattoos Piercings	Weight Height

Sex determination

Most body cells contain chromosomes in matched pairs. The number of pairs of chromosomes varies between species. Human body cells have 23 pairs of chromosomes in the nucleus. One of these pairs controls the inheritance of gender - whether offspring are male or female,

in males, the two sex chromosomes are different. They are XY
in females, the two sex chromosomes are the same. They are XX.

Inherited disorders

Some disorders are inherited, such as:

red-green colour blindness
sickle cell anaemia
cystic fibrosis.

Genetic testing

Scientists are now able to test adults and unborn babies for alleles that can cause genetic disorders. However, the

scientific information produced raises many issues that science cannot address. For example, should a couple with a one in four risk of having a child with cystic fibrosis take the gamble, or decide not to have any children at all? If a woman becomes pregnant with a child that is going to have cystic fibrosis, should she have the child, or choose to have an abortion? These are questions about values that science cannot answer. Different people will have different views.

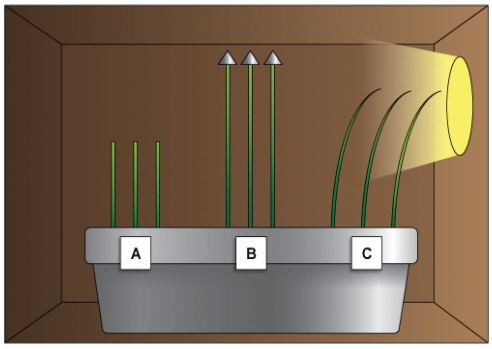
Controlling plant growth

Auxin is a plant hormone produced in the stem tips and roots, which controls the direction of growth.

Plants need light and water for **photosynthesis**. They have developed responses called **tropisms** to help make sure they grow towards sources of light and water.

Tropism – growth in **response** to a stimulus
Positive tropism – **towards** the stimulus
Negative tropism – **away from** the stimulus
Phototropism – growth in response to the direction of **light**
Geotropism – growth in response to the direction of **gravity**

Auxin experiment



3 groups of seeds are grown in a cardboard box.

A - when the tips are removed, no auxin is made so the stems do not grow

B – when the tips are covered, auxin moves to all parts of the stem causing all parts to grow

C - when the tips are lit from one side only auxin accumulates on the shaded side causing it to grow more than the illuminated side

Uses of plant hormones (Make sure you can give an example):

Weedkillers, rooting powder, controlling fruit ripening, dormancy,

Classification

Kingdom	Characteristics	Examples
Plant	Use light energy to produce food by photosynthesis. Cell wall made of cellulose.	Oak tree, rose bush
Animals	Multicellular, no cell wall	Slug, ladybird, lion
Fungi	Make spores instead of seed, cells have a cell wall made from chitin.	Yeast, mushroom
Protoctista	Unicellular	Algae, amoeba
Prokaryotes	No cell wall. Has a cell wall but not made of cellulose.	Bacteria

Arthropods

Class	Feature	Example
Insect	Three body sections, six legs	Beetle
Arachnids	Two body sections, eight legs	Spider, scorpion
Crustaceans	Two body sections and at least ten legs	Crab
Myriapods	Two body sections and many legs	Millipede

Kingdom, **p**hylum, **c**lass, **o**rder, **f**amily, **g**enus, **s**pecies

Kuwait produces crude oil for general sale.

Food chains always start with a plant (producer)

Lettuce → Rabbit → fox

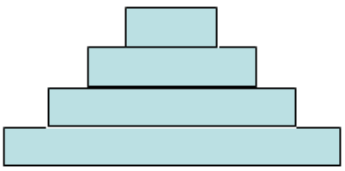
(producer) Primary Consumer, Herbivore Prey — Secondary Consumer Predator

Pyramids of numbers show the number of organisms at each level **not** always a pyramid shape

Remember: all pyramids start off with the plant (producer)

Pyramids of Biomass

Show amount of material at each stage



Always a pyramid shape as…

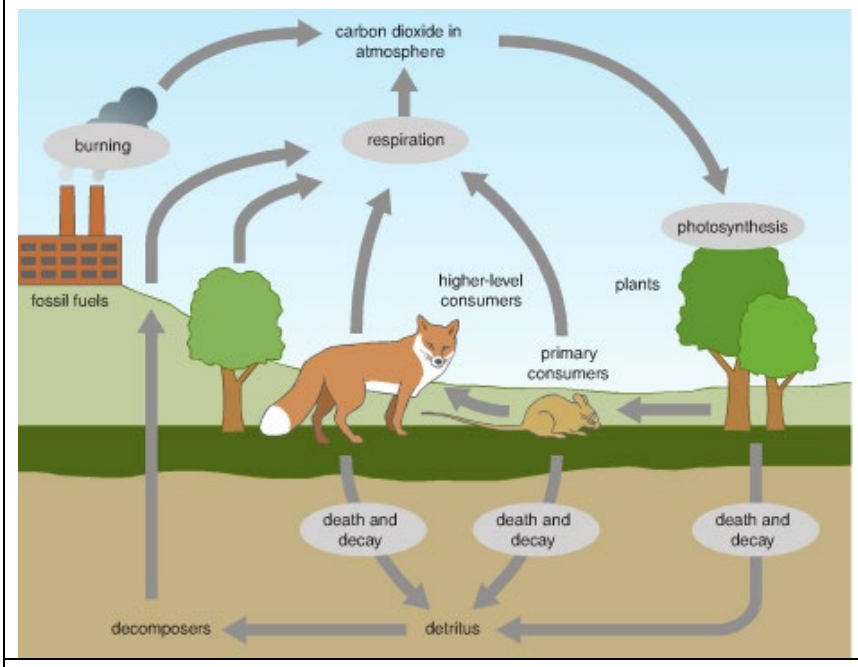
-some is used for respiration to move/grow

-some is lost as heat

-some material is not digested

-some is lost as faeces

Carbon cycle



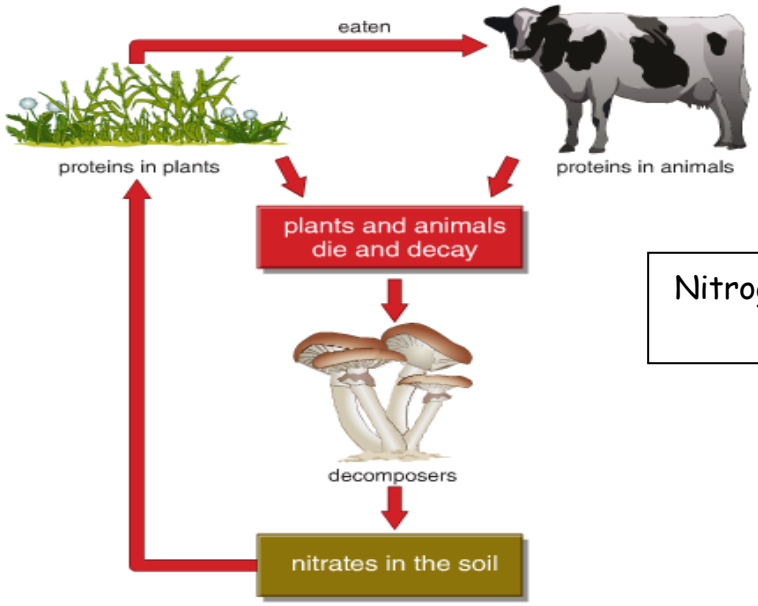
Carbon dioxide is put into the atmosphere by:

- Respiration
- Decomposition
- Combustion (burning) of fossil fuels.

Carbon dioxide is removed by:

- photosynthesis

Nitrogen cycle



Nitrogen is needed for growth and repair.

Competition:

Plants compete for light, water and minerals
Animals compete for food, shelter and a mate.

Mutualism – where two organisms benefit e.g. cleaner species such as a buffalo and an oxpecker. The oxpecker gets food and the buffalo gets cleaned of ticks and fleas.

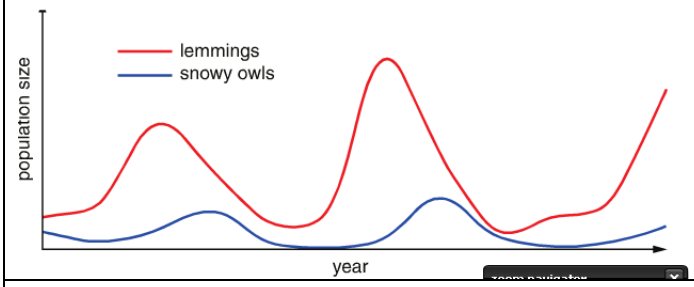
Parasites – only the parasite benefits e.g. fleas, tapeworms.

Predator- prey relationships

Predator	Prey
Animal that hunts and kills other animals for food	the animal that is hunted and killed for food.

In years when there is a lot of food, lemmings reproduce rapidly. If the population grows too large, food becomes scarce and the female lemmings do not reproduce so rapidly.

The snowy owl hunts lemmings. In years when there are more lemming young, there are more prey and the owls successfully raise more young. The owl population increases, so the following year the lemming population decreases as there are more owls to hunt them.



Adaptations

Animal	Adaptations
	Blubber – fat keep them warm Fur on soles of feet for grip Large claws and teeth to kill prey
	Large feet – to spread their weight so they don't sink Bushy eyelashes to keep the sand out of their eyes
	- Widespread root systems, which can collect water from a large area. - Long spines instead of leaves, which reduce water losses and protect against animals that might eat the plant.
Salmon	- Streamlined and have eyes at the side of their heads to give a wider field of view.

Natural selection

Animals that are best suited to the changing environment, survive and pass on their genes. Examples include:

- Rats – have become resistant to warfarin.
- Peppered moths – some moths were dark and others pale. In areas of high pollution, lichen on the trees died. Dark moths were camouflaged against the dark bark. The white moths were easily seen by predators and were eaten.

Evolution

Theory that plants and animals 'evolved' (changed) over millions of years. The evidence for this is fossils. Things like teeth, bone and shells don't decay easily. They are eventually replaced by minerals, forming a rock like substance shaped like the original hard part.

Darwin

When Charles Darwin suggested his theory of natural selection, many people objected for several reasons.

- Some people thought he didn't have enough evidence
- People thought God had created all species
- Some people objected to the idea that humans may have evolved from apes.

Population

The world's population is **increasing**. Problems include:

More resources such as coal oil and gas are burned for energy and heat. This means an increase in pollution e.g. sulphur dioxide and carbon dioxide.

More mineral resources such as limestone, and aluminium are being used.

More sewage can end up in rivers killing fish. Household rubbish is filling up landfill sites.

Recycling is important to conserve resources.

Problem	**Global warming**	**Ozone depletion**	**Acid rain**
Caused by…	Carbon dioxide	CFCs	Sulphur dioxide
Effect	Sea levels rising	Increased skin cancer	Kills trees and fish

Indicator species – is used to estimate levels of pollution e.g. lichen can only live where the air is clear. Stonefly larva can survive in clean water whereas the bloodworm can live in polluted water.

Sustainability

A sustainable resource – a resource that will not run out because it is being produced at the same rate at which it is being used.

Endangered – animals and plants that are in danger of becoming extinct
e.g. the tiger, gorilla, red squirrel

Extinct – When all members of the species have died e.g. dodo

Reasons:

Destruction of their habitat, poaching/hunting, pollution. An increase in population has caused animals to become endangered. Humans have destroyed their habitat by building houses, logging.

Saving animals from extinction:

- protected areas
- captive breeding
- laws to ban poaching, export of animals or their parts.

Whales

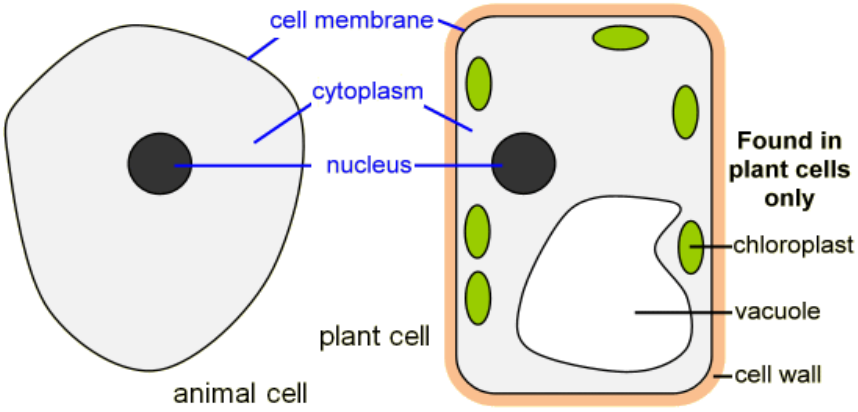
Parts can be used for meat, bones for fertiliser, teeth for buttons.

Keeping whales in captivity

Advantage – Research and captive breeding programmes

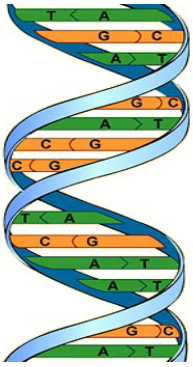
Disadvantage – People think it is cruel as whales lose their freedom

Cells



part	function
nucleus	contains genetic material, which controls the activities of the cell
cytoplasm	most chemical processes take place here, controlled by enzymes
cell membrane	controls the movement of substances into and out of the cell
mitochondria	most energy is released by respiration here

DNA – Discovered by Watson and Crick. They built models based on the work of Rosalind Franklin.



DNA molecules are very long and packed into compact structures called *chromosomes*. Each DNA molecule consists of two twisted strands of **bases** that form a shape called a **double helix**.

The two strands are held together by **bonds** between **pairs** of bases.

Genes – are made of **DNA**. The DNA is a code for making **proteins.** To make a protein a copy of the gene is made as the gene cannot leave the nucleus. The copy leaves the nucleus so that the protein can be made on the ribosomes within the cytoplasm.

Proteins are made of amino acids.

Types of protein

Type of protein	Example	Job
Structural	Collagen	Found in walls of arteries – makes them stronger
Hormone	Insulin	Control blood glucose levels
Carrier molecule	Haemoglobin	Carries oxygen
Enzyme	Amylase	Breaks down starch into glucose

Mutation

- is a change in the genetic material.
- Caused by radiation and chemicals

Enzymes and DNA

Enzymes are large molecules that speed up the chemical reactions inside cells. These reactions include *respiration*, *photosynthesis* and making new proteins. They are affected by temperature and pH. Each type of enzyme does on specific job. Enzymes are a type of protein.

Respiration

Aerobic respiration uses oxygen to release energy.

Glucose + Oxygen ⟶ Carbon dioxide + Water + energy

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

Respiratory Quotients = $\frac{\text{Carbon dioxide produced}}{\text{Oxygen used}}$

For aerobic respiration that uses glucose the RQ is always 1.

Anaerobic respiration – Respiration without oxygen

Glucose ⟶ Lactic acid

Lactic acid builds up in the muscles = **muscle fatigue**. Breathing fast and deep means more oxygen can get into the body to remove the lactic acid. Lactic acid is broken up in the **liver.**

Cell division

Cells **divide** to **grow** and **replace worn out cells**.

Cell differentiation – cells become different shapes or sizes to carry out specialised jobs.

Mitosis

In mammals, body cells are **diploid**. They contain chromosomes in matching pairs. The cells produced are identical and are used to make body cells.

Meiosis

Makes gametes e.g. sperm and egg. Have half the number of chromosomes – haploid.

Sperm

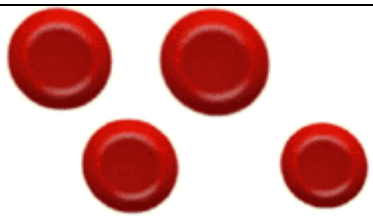
Structure	Job	Adaptation
	Fertilises an egg cell	**Head** - contains genetic information and an enzyme to help penetrate the egg cell membrane. **Middle section** is packed with mitochondria for energy. **Tail** moves the sperm to the egg.

Fertilisation – Joining of the nucleus of the sperm and the nucleus of the egg.

Circulatory system

Blood component	Job
Red blood cell	Carry oxygen
White blood	Defend against disease
Platelets	Help the blood to clot (scabs)
Plasma	Carry hormones, antibodies, carbon dioxide etc.

Red blood cells adaptations

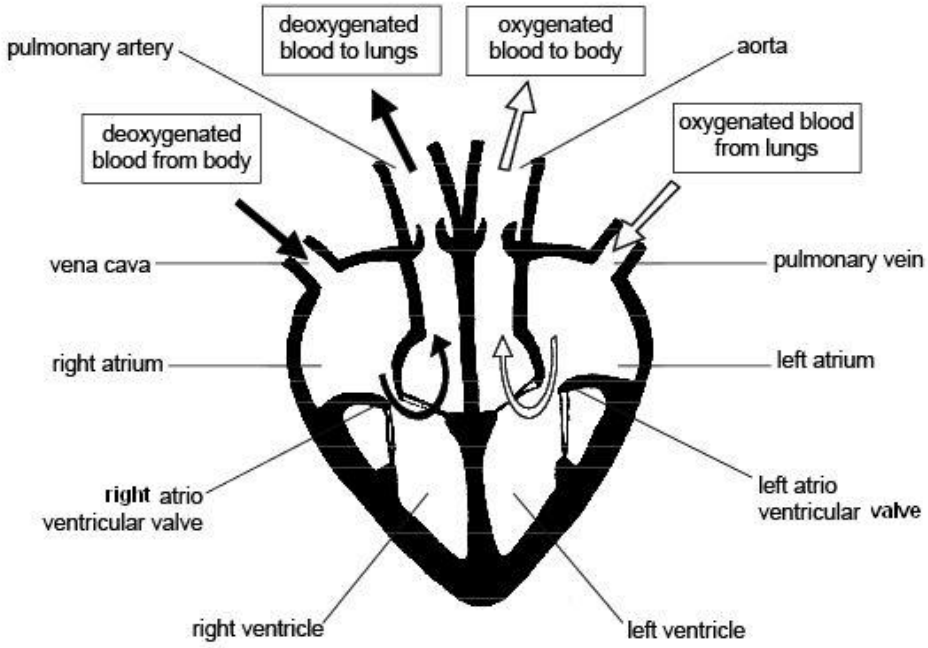
	**Small** – to fit through narrow blood vessels **Bioconcave** – large surface area to gain or lose oxygen more quickly **No nucleus** – more haemoglobin can fit in the cell

Blood vessel	Job
Artery	Carry blood away from the heart
Veins	Carry blood towards the heart
Capillaries	Thin walls to allow exchange of substances

Valves – prevent the backflow of blood. These are found in veins and the heart.

The heart: (Know that **all valves** prevent the backflow of blood)

The job of the heart is to **pump blood round the body**.



Growth in humans (learn the order, you will also be required to interpret a graph)

The stages: Infancy, Childhood, adolescence, adulthood, old age

Stem cells

Can develop into different tissues and organ cells e.g. muscle and blood cells in animals.

Selective breeding

Choosing animals or plants with desirable features that you want to pass on.

1. Select the animal or plant with desirable feature e.g. high milk yield
2. Breed them
3. Select best cross breed.
4. Repeat the selection and breeding process for a number of generations.

Advantage: Animals with desirable features.

Disadvantages: health problems, genes lost

Genetic engineering:

Transferring genes from one organism and putting them into another e.g. insulin produced by bacteria.

Advantages: grow crops quicker, crops resistant to disease, frost etc.

Disadvantages: People are concerned about how our bodies might react in several years.

Cloning

Producing animals or plants that are genetically identical e.g. Dolly the sheep.

Asexual reproduction

Plants can make identical copies of themselves by asexual (one parent) reproduction, for example by tubers and runners.

Plants can make identical copies (clones) of themselves.

	Strawberry plant with runners - stems growing sideways. These **runners** can produce several new plants from one parent.
	Cutting being dipped in hormone rooting powder before planting. This method is quicker than growing plants from seed.

Advantages and disadvantages of cloning

Advantage or disadvantage	Cloning situation
Advantage	All the new plants are genetically identical – they will all have the desired characteristics.
Disadvantage	If a clone is susceptible to disease or changes in environment, then all the clones will be susceptible.
Disadvantage	It will lead to less variation, and less opportunity to create new varieties

Ecosystems

Term	Description
Environment	All the conditions that surround a living organism
Habitat	The place where an organism lives
Population	All the members of a single species that live in a habitat
Community	All the populations of different organisms that live together in a habitat
Ecosystem	A community and the habitat in which it lives

Biodiversity

Biodiversity is the variety of different species living in a habitat. The greater the number of different species in a habitat, the greater its biodiversity.

Natural ecosystem – woodland, lake

Artificial ecosystem – fish farm,

Sampling techniques:

Nets – collect butterflies and moths.

Pooter – suck small insects into a jar

Quadrat – Square frame that is used to sample plants and slow moving animals. Throw frame **randomly**, count animals/plants, **repeat** lots of times.

Calculation

A typical quadrat is 1 m × 1 m, or 1 m^2. Its area might be small compared to the area of a field.

For example, there are 4 dandelion plants inside a 1 m^2 quadrat. The whole field is 50 m^2 in area , the estimated population size of dandelions in the field would be:

4 × 50 = 200

Pitfall trap – small jar is buried, a cover is rested slightly above it to keep out the rain. Small ground organisms – insects, frogs fall in and cannot escape.

Capture-recapture. Some animals are trapped, for example, using pitfall traps. They are **marked** in some harmless way then released. Traps are used a few days later. The numbers of marked and unmarked animals caught in the traps are recorded. The population size is estimated using this formula:

Population size =

$$\frac{\text{number in 1st sample} \times \text{number in 2nd sample}}{\text{number in 2nd sample previously marked}}$$

For example, 10 animals were trapped, marked and released. Two days later, 20 animals were trapped. Of these, 5 were found to be marked.

Population size = $^{10 \times 20}/_{5}$ = $^{200}/_{5}$ = 40

Structure of a plant

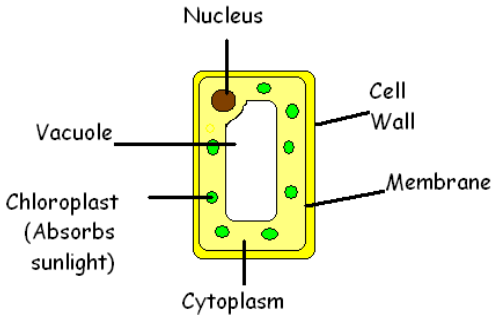
Leaf – absorb sunlight for photosynthesis

Stem – support and transport of substances

Roots – anchorage and to absorb water and minerals

Flower – reproduction

Water enters through the **roots** and **carbon dioxide** through the **leaves.**

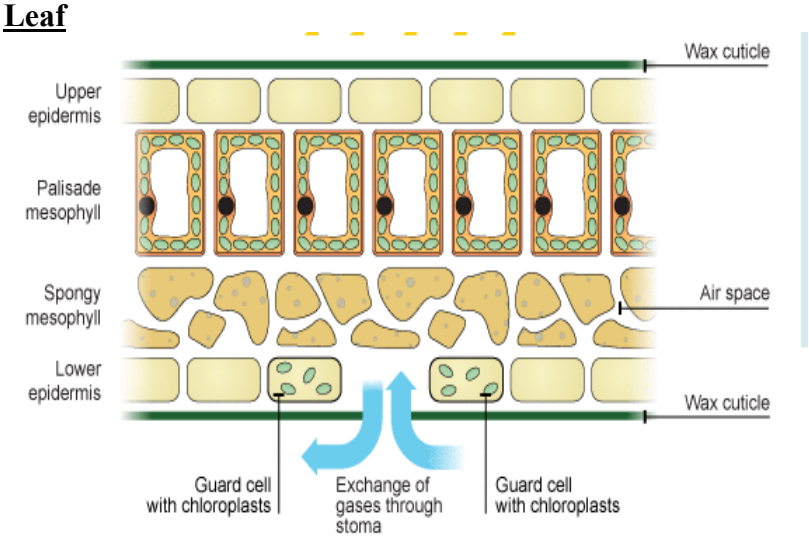


Plants grow better in greenhouses – it's warmer.
Provide extra CO_2 in a greenhouse by burning paraffin.
Photosynthesis happens in the leaves. The energy comes from the sun.
Carbon dioxide + water → oxygen + Glucose

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

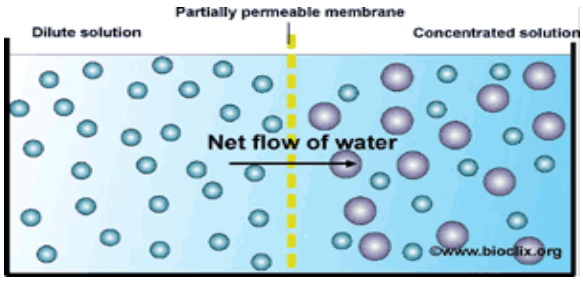
Glucose is needed for respiration, to make proteins for growth and repair, cellulose cell wall.
It is **stored** as **starch**.

Leaf



Adaption of leaf	Purpose
Thin	Short distance for carbon dioxide to diffuse into the leaf
Contains chlorophyll and other pigments	To absorb light from different parts of the Sun's spectrum
Network of vascular bundles (veins)	To support the leaf, and to transport water and carbohydrates
Stomata	Allow carbon dioxide to diffuse into the leaf
Guard cells	To open and close the stomata depending on the conditions

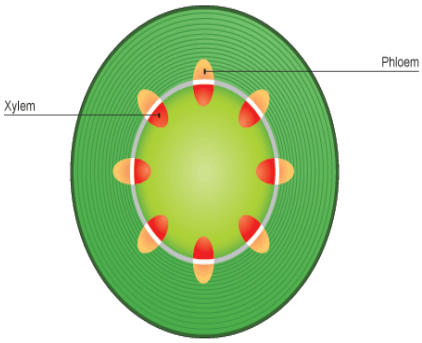
Osmosis – water enters the root by osmosis



The movement of water from a dilute solution (lots of water) to a concentrated solution (less water) through a partially permeable membrane (membranes that let small particles pass through but not large particles).

Phloem – transports dissolved foods such as sugar from the leaves to the rest of the plant.
Remember: 'Ffff' for food, 'ph' for phloem.
When greenfly pierce the stem they are after the sugar solution in the phloem

Xylem – transports water from the roots to the leaves.



Transpiration- evaporation of water from the leaves

Increases: when it is hot
Windy
Less humid
Bright day

Water – has the following uses:

- cool the plant
- Photosynthesis
- Supports the plant and stops it **wilting**
- Transport minerals

When plants are not watered the leaves droop.

Fertilisers- help plants grow (increase crop yield)
Needs to be dissolved in water before it can be absorbed by the roots.
NPK fertilisers contain:
N = Nitrogen
P = Phosphorus
K = potassium
Remember: you can use the periodic table at the back of your test paper!

Fertilisers

Mineral	Used for…
Nitrates	Growth
Phosphates	Respiration and growing roots
Potassium	Respiration and photosynthesis
Magnesium	Photosynthesis

Lack of nitrates = small plants

Hydroponics
Growing plants in water that contains minerals and oxygen

Decomposers:
Break down plant and animal bodies into simpler chemicals and recycled. Objects like tin and glass will not decay.
Bacteria and fungi cause decay. They are called **decomposers.**
They need **water, oxygen and a suitable temperature** to survive.
Compost bins often have **holes** at the side to **allow oxygen in.**
Decay happens **faster in summer** as it is **warmer.**

Food preservation
To prevent food going off:
- **Add sugar or salt**
- **Cook the food** (high temp kills bacteria)
- **Add vinegar** (too acidic)
- **Drying** – without water, bacteria and fungi cannot grow.
- **Cooling** - slows down reproduction
- **Freezing** – kills some bacteria and slows growth and reproduction in others.
- **Canning** (high temp kills bacteria, food is put into cans and sealed while it is still hot. This forms a vacuum and prevents entry of oxygen.

Intensive farming
Producing as much food from the land you have as quickly as possible.

Methods include using:
- machinery
- hydroponics
- fertilisers
- fish farms and battery hens
- Spray chemicals

Herbicide – kills unwanted **plants**
Fungicide - kills **fungi**
Pesticides – kill pests
Insecticides – kill **insects**

Organic Farming
Does not use manufactured chemicals.
Methods include:
- remove weeds by hand to remove competition for light and minerals
- Crop rotation
- Manure

Biological control – a natural predator is released to reduce the number of pests e.g. ladybirds are released to kill and eat aphids.
Advantages
Expensive chemicals don't have to be brought and there is no chemical pollution.
Disadvantages
Less crops