KNOWLEDGE

Physics Topic B10
The human nervous system

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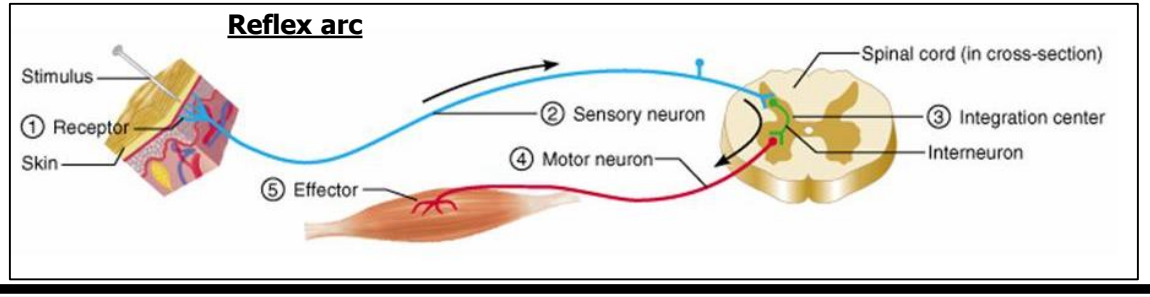
Section 1: Key Terms

Homeostasis	Regulating **internal conditions** to keep them at an **optimum**, **despite** internal and external **changes**. Maintains optimum conditions for **enzymes**.
Negative Feedback (HT)	Negative feedback ensures that **changes are reversed and returned back to the optimum level**.

Section 2a: Nerve Reflexes Key Terms

Central nervous system (CNS)	The **brain** and **spinal cord** together. **Co-ordinates** the **response** of **effectors**.
Reflex action	A **fast, automatic** reaction. Does not involve thinking parts of the brain.
Coordination Centre	**Receives** and **processes information** from receptors e.g. CNS, pancreas.
Synapse	The **gap between two neurons**. Allows many different neurons to connect.
Myelin sheath	Some neurons are surrounded by myelin. **Myelin insulates the neuron** and **speeds up** the transmission of **electrical impulses**.

Reflex arc



Section 2b: The Reflex Arc

Stimulus – a **change** in the **environment**

↓

Receptor – **detects a stimulus**

↓

Sensory neuron – **transmits** electrical impulse travels **to the CNS**

↓

Relay neuron – in the **spinal cord**. Transmits electrical impulses **from the sensory to the motor neuron**

↓

Motor neuron – transmits impulses from **CNS to effector**

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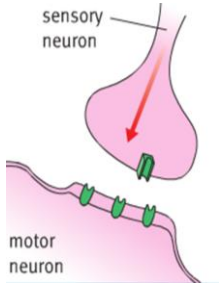
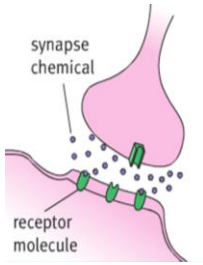
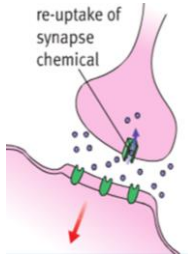
Effector – produces a **response**. Can be a **muscle** or **gland**

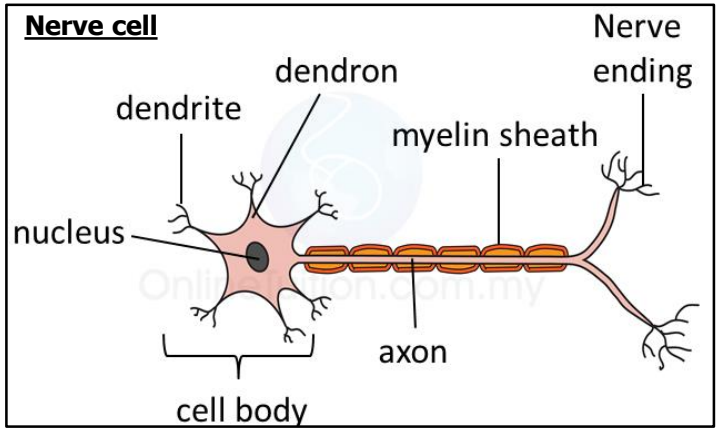
↓

Response – the **change** in response to the stimulus

Section 2c: The Synapse

		
An **electrical impulse arrives** at the synapse.	**Neurotransmitter molecules are released** and **diffuse** across the synapse.	**Neurotransmitter molecules fill receptors** and **cause an electrical impulse in the next neuron**.

Nerve cell



KNOWLEDGE

Physics Topic B10
The human nervous system (separate)

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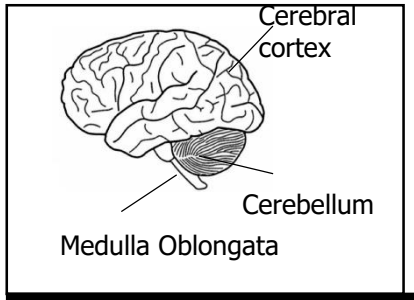
Section 1: The brain

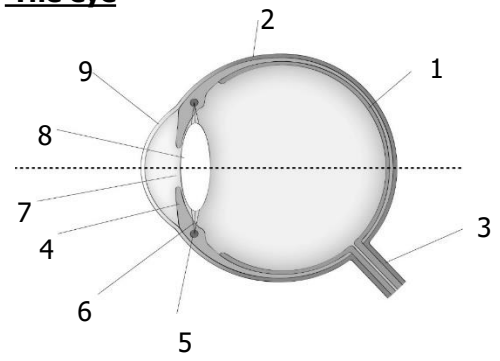
Cerebral cortex	Outer wrinkly part, responsible for consciousness, intelligence, memory and language
Medulla oblongata	Controls unconscious activities e.g. breathing and heartbeat
Cerebellum	Responsible for muscle coordination

Section 2: Studying the brain (HT)

Study people with **brain damage**	If a part of the brain has been damaged the effect on the patient can tell you what this part does
Electrically stimulate the brain	By observing what stimulating different parts of the brain does its possible to get an idea of what those parts do
MRI scans	MRI scans produce detailed pictures of the brain. Scientists can see which parts are active when people are doing things
The brain is **complex** and **delicate** – investigating and treating it is difficult	



The eye



Section 3: The eye key terms and parts

Refraction – the bending of light rays when they pass from one medium to another

Part	Function
1 Retina	Where an image forms at the back of the eye, contains rods and cones
2 Sclera	The white part, protects the eye
3 Optic nerve	Send electrical impulses from the retina to the brain
4 Iris	Coloured muscle controls the size of the pupil
5 Ciliary muscles	Contract and relax to change the shape of the lens
6 Suspensory ligaments	Controls the shape of the lens to focus light rays on the retina
7 Pupil	Hole located in the centre of the iris of the eye that allows light to strike the retina
8 Lens	Refracts light to be focused on the retina
9 Cornea	Refracts light through the pupil
Rods	Light sensitive receptor cells that let you see in low light conditions
Cones	Light sensitive receptor cells that let you see colour

Section 4: Focusing on near and distant objects

To look at **near** objects – ciliary muscles **contract**, suspensory ligaments **slacken**, lens becomes **fat**, **increasing** amount of refraction

To look at **distant** objects – ciliary muscles **relax**, suspensory ligaments **tighten**, lens becomes **thin**, **decreasing** amount of refraction

Section 5: Correcting vision problems

Long sighted (HYPEROPIA)	**Where the image focuses**	**How to correct it**	**Why it occurs**
	Behind the retina	Convex lens	The lens is too weak or the eyeball is too short
Short sighted (MYOPIA)	**Where the image focuses**	**How to correct it**	**Why it occurs**
	In front of the retina	Concave lens	The lens is too strong, or the eyeball is too long
Contact lenses	Good for sports/activities, almost invisible. Could cause infection if not sterilised properly		
Laser eye surgery	Permanent correction of vision problems, however, surgery carries risks		
Lens replacement	Permanent solution, risk of vision loss		

KNOWLEDGE

Biology Topic B11 Hormonal Coordination

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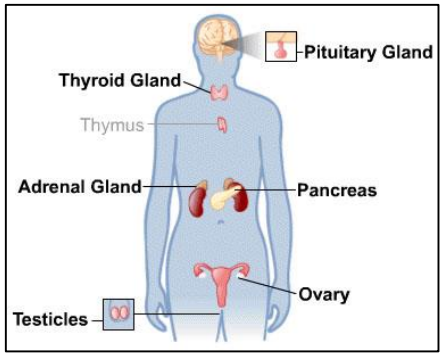
Section 1: Hormonal Control Key Terms

Endocrine System	The system of **glands** that **secrete hormones.**
Hormone	A **chemical secreted by a gland** that **travels in the blood** and has an effect on a **target organ**. The effects are **slower and longer-lasting** than responses from the nervous system.
Pituitary Gland	A gland that **secretes several hormones** into the blood. These hormones in turn act on other glands to stimulate other hormones to be released to bring about effects.
Testosterone	**Male hormone** produced by **testes. Stimulates sperm production.**
Adrenaline (HT)	**Hormone** produced by the **adrenal glands** in times of **fear/ stress.** It **increases the heart rate** and **boosts the delivery of oxygen and glucose to the brain and muscles,** preparing the body for 'flight or fight'.
Thyroxin (HT)	**Hormone** produced by the **thyroid gland.** Thyroxine **stimulates the metabolic rate.** Important in **growth and development.**

Section 4: Location of Endocrine Glands



(HT)

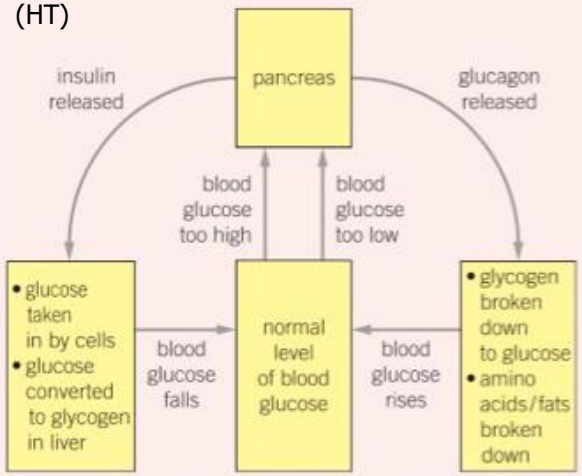


Figure 1 *Negative feedback control of blood glucose levels using insulin and glucagon*

Section 5: Blood Glucose Control Key Terms

Pancreas	The gland that **monitors and controls blood glucose concentration**.
Insulin	A **hormone** produced when **blood glucose concentration is too high**. Causes **glucose to move from the blood into the cells**. In **liver** and **muscle** cells **excess glucose is converted to glycogen**.
Glucagon (HT)	A **hormone** produced when **blood glucose concentration is too low**. Causes **glycogen to be converted into glucose** and **released into the blood**.
Glycogen	A **storage molecule** made from many **glucose molecules bonded together**. Found in **liver** and **muscle** cells.
Type I Diabetes	Disorder in which the **pancreas fails to produce enough insulin**. Causes uncontrolled high blood glucose levels. Treated with **insulin injections**.
Type II Diabetes	Body cells **no longer respond to insulin produced by the pancreas**. A **carbohydrate controlled diet** and **exercise** are common treatments. **Obesity** is a **risk factor**.
Negative Feedback (HT)	Negative feedback ensures that **changes are reversed and returned back to the optimum level**.

KNOWLEDGE

Biology Topic B11 Hormonal Coordination

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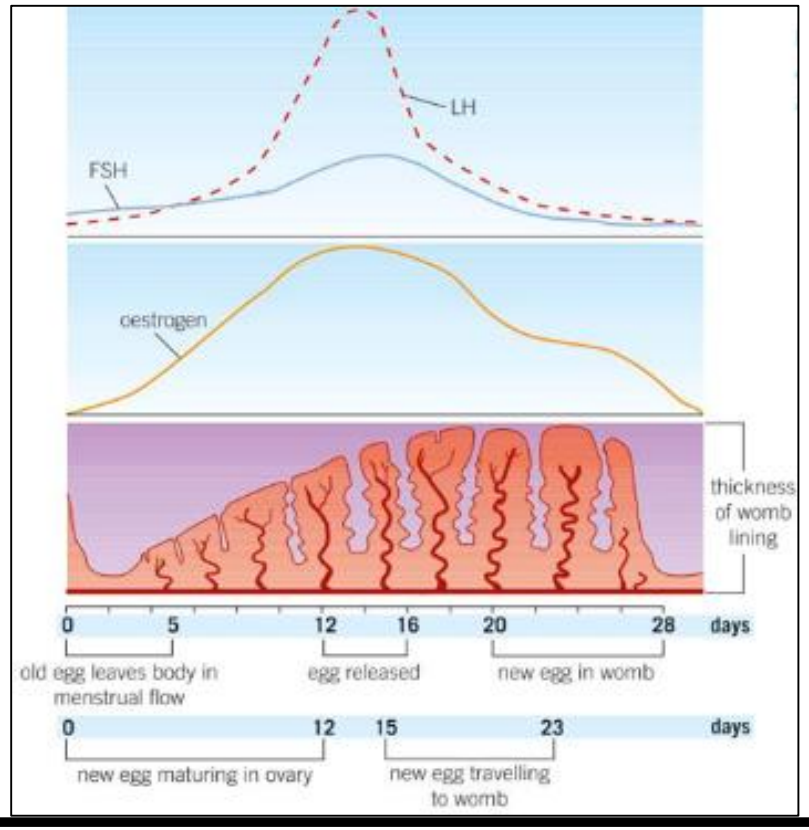
Section 1: Menstrual Cycle (Some HT)	
Ovulation	The **release of an egg cell**. Occurs approximately **every 28 days**.
FSH	Produced by the **pituitary gland**. A hormone that causes an **egg to mature in the ovary**. **Causes oestrogen to be produced.**
Oestrogen	Produced by the **ovaries**. Causes **blood lining of uterus** to **develop**. **Stops FSH being produced. Stimulates release of LH.**
LH	Produced by the **pituitary gland**. A hormone that causes **ovulation**.
Progesterone	Produced by the **ovary**. **Maintains blood lining** in uterus. **Stops production of LH and FSH.**



Section 2: Methods of Contraception		
Method	How it works	Pros (+) and Cons (-)
Oral contraceptives	The contraceptive pill. Contain **hormones to inhibit FSH production** so **eggs do not mature.**	+ 99% effective + Reduces risk of some cancers - Can cause side effects e.g. nausea
Progesterone	Injection, implant or skin patch of slow-release progesterone to stop **eggs maturing and being released**.	+ Fewer side effects than pill. + Doesn't need to be taken daily so less likely to be forgotten - Less effective than pill
Barrier methods	**Condom** or **diaphragm**. **Prevents sperm reaching the egg**.	+ 98% effective (when used correctly) + Prevent STIs - Can break or be used incorrectly
Spermicide	**Kills or disables sperm**. Used with diaphragms to make them more effective.	+ Increases effectiveness of some barriers - Can't be used on its own
Avoiding intercourse	Avoiding intercourse when an egg might be in an oviduct.	- High risk of becoming pregnant
Sterilisation	**Undergoing surgery** to stop sperm or eggs being able to fertilise.	+ Permanently stops pregnancy - Risks from surgery - Expensive to reverse and may not work
Intra-uterine device (IUD)	An **implant into the uterus** that **prevent fertilised eggs implanting into the wall** of the uterus or **release hormones**.	+ Long lasting but can be reversed - Small risk of infection or uterus damage when IUD is implanted

KNOWLEDGE

Biology Topic B11 Hormonal Coordination (HT)

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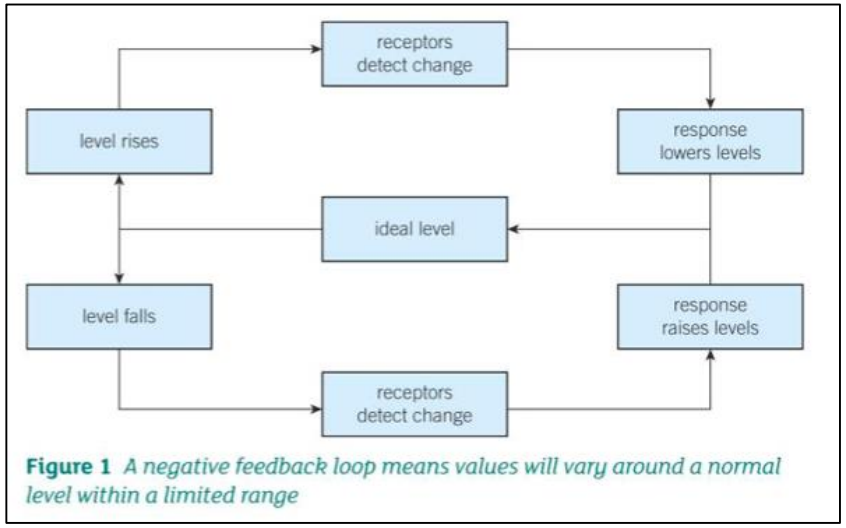


Figure 1 *A negative feedback loop means values will vary around a normal level within a limited range*

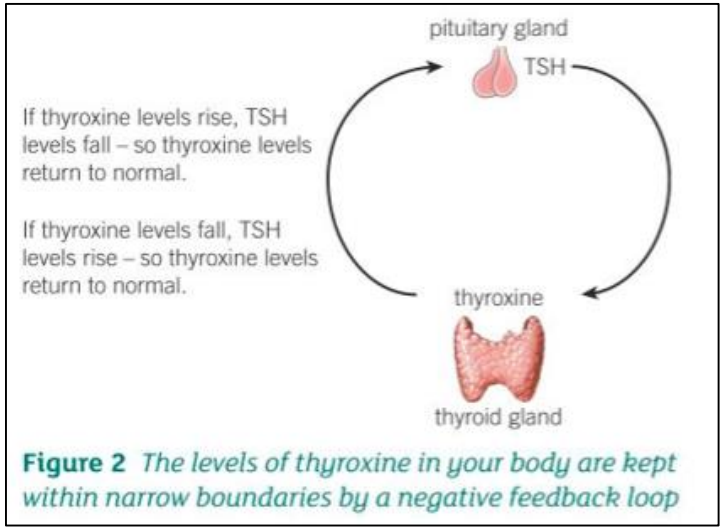


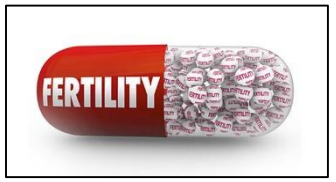
Figure 2 *The levels of thyroxine in your body are kept within narrow boundaries by a negative feedback loop*

Section 1: Thyroxine (HT)	
Thyroxin (HT)	**Hormone** produced by the **thyroid gland.** Thyroxine **stimulates the metabolic rate.** Important in **growth and development.**
Thyroxine is controlled by negative feedback (HT)	If levels of thyroxine in blood fall, sensors in the brain detect this and TSH is released from the pituitary gland. TSH stimulates the production of thyroxine by the thyroid gland. As the level of thyroxine goes up, it is detected by the sensors and the level of TSH released falls.

Section 2: IVF (HT)

Give mother FSH and LH to stimulate production of several eggs → Collect eggs and fertilise with father's sperm in the lab → Fertilised eggs develop into embryos → One or two embryos inserted into mother's uterus

Section 3: IVF Disadvantages (HT)
Emotionally and physically stressful.
Success rates are low.
Can lead to multiple births which are risky for mother and babies



KNOWLEDGE

Biology Topic B11
Hormonal Coordination (Separate)

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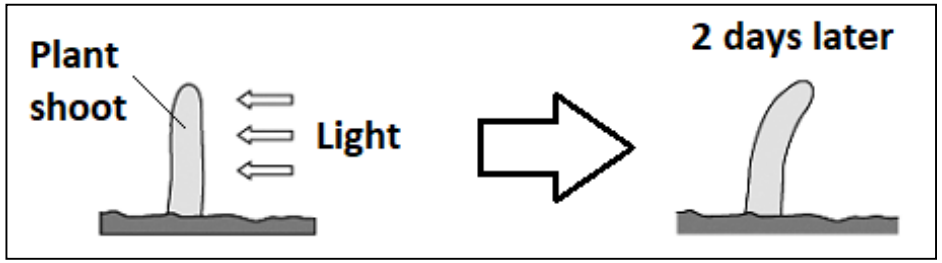
Section 1: Plant hormones		
Auxin	A plant hormone responsible for cell elongation/plant growth	Uses – killing weeds, growing cuttings with rooting powder, growing cells in tissue culture
Ethene	A plant hormone responsible for ripening	Uses – speed up ripening of fruit
Gibberellin	A plant hormone responsible for seed germination	Uses – controlling seed dormancy and germination, inducing flowering, growing larger fruit
Tropism	A plant's response to a stimulus	
Phototropism	A plant's response to light	
Gravitropism	A plant's response to gravity	

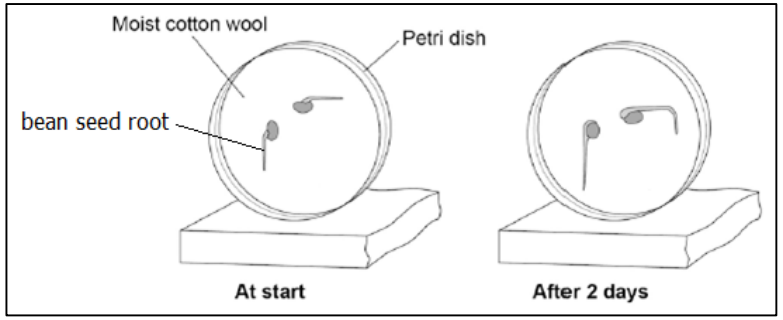
A plant's response to light

- Auxin (a plant hormone) redistributes unequally in the shoot
- More auxin gathers on the dark side of the shoot
- Auxin promotes cell elongation in the shoot
- If the plant cells on the dark side have more auxin they will grow more/faster & longer
- This causes the plant to bend towards the light



A plant's response to gravity

- Gravity produces unequal distribution of auxin
- Auxin is pulled to the lower side of the roots (by gravity)
- In the root auxin inhibits cell growth
- The cells on top elongate faster
- This causes the root to bend downwards

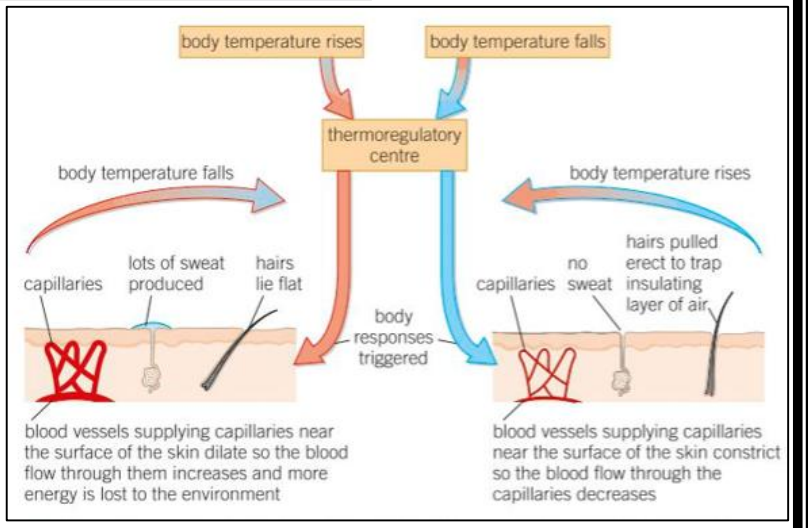


KNOWLEDGE ORGANISER

Biology Topic B12
Homeostasis in action (separate)

Section 1: Temperature control

Vasodilation	Arterioles (blood vessels) supplying skin capillaries dilate so more blood can flow close to the surface of the skin. Helps transfer heat energy from the skin to the environment to cool you down
Vasoconstriction	Arterioles supplying the skin capillaries constrict so less blood flows under the surface of the skin. Reducing heat loss when you are too cold
Sweating	Sweat glands release sweat when you are too hot. When sweat evaporates it transfers energy to the environment
Shivering	Shivering is when muscles contract rapidly, this need respiration which transfers energy to the body to warm you up
Thermoregulatory centre	Found in the hypothalamus in the brain, detects blood temperature changes and receives information about skin temperature too



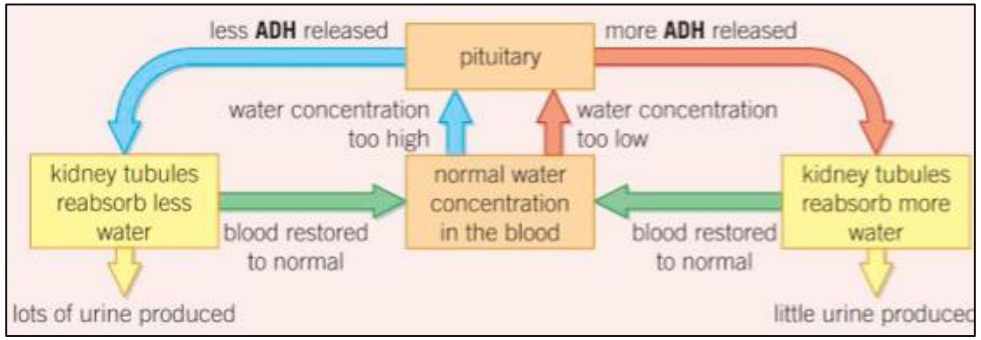
Section 2: Water and nitrogen control

Urine contains…..

Urea	Excess proteins are broken down into amino acids in the liver. These amino acids are turned into ammonia which is toxic so it is quickly turned into urea and excreted from the body in urine
Ions	Excess ions are removed in the urine
Water	Water leaves the body via the lungs during exhalation Water, mineral ions and urea are lost through the skin in sweat Excess water and mineral ions is removed via the kidneys in urine If the body cells lose or gain too much water through osmosis, they do not function efficiently.

Section 3: Water and nitrogen control - ADH

ADH	Anti-diuretic hormone controls the concentration of the urine
Pituitary gland	Releases more or less ADH depending on how much water is in the body
Negative feedback	Controls water levels in the body



KNOWLEDGE

Biology Topic B12
Homeostasis in action (separate)

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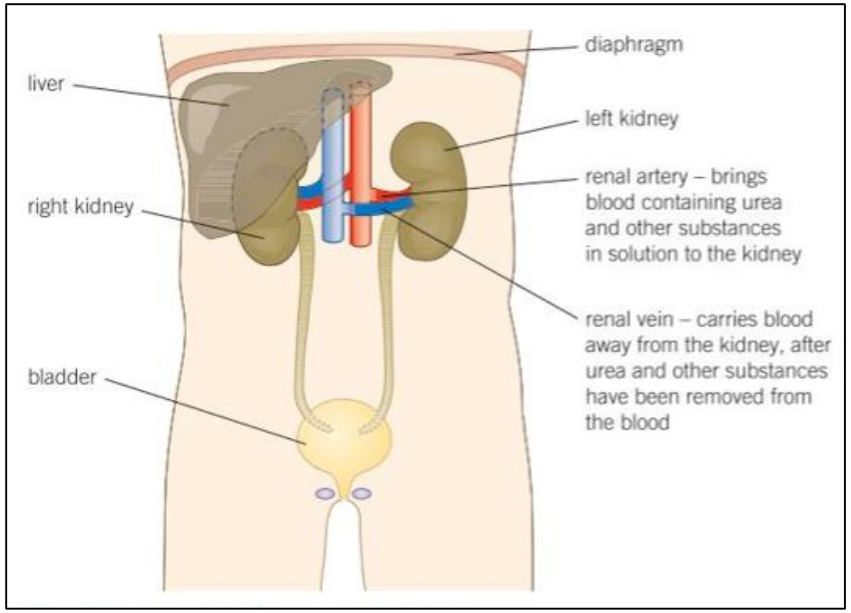
Section 1: The Kidney – removes waste substances

- A kidney produces urine firstly by **filtering** the blood.
- **Selective reabsorption** then occurs. This means that **all** of the **glucose** is reabsorbed back into the blood, along with **some** of the **ions** and **some** of the **water** depending on the concentration of these within the body.
- The kidney **excretes urea** in the urine along with any **excess water and ions**.
- **Protein** molecules are too **large** to pass through the kidney filters so remain in the blood and are not therefore excreted in the urine of a healthy person.



Section 2: Kidney failure Treatments

	Advantages	Disadvantages
Kidney transplants	• Patients can lead a more normal life without having to watch what they eat and drink • Cheaper for the NHS overall	• Organ rejection by the patient's immune system • Must take immune-suppressant drugs which increase the risk of infection • Shortage of organ donors • Kidney only lasts 8-9 years on average • Any operation carries risks
Kidney dialysis	• Available to all kidney patients (no shortage) • Can buy valuable time until a donor is found • No need for immune-suppressant drugs	• Patient must limit their salt and protein intake between dialysis sessions • Expensive for the NHS • Regular dialysis sessions – impacts on the patient's lifestyle • Can cause blood clots or infections

KNOWLEDGE

Biology Topic B13 Reproduction

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Section 1a: Sexual and Asexual Reproduction

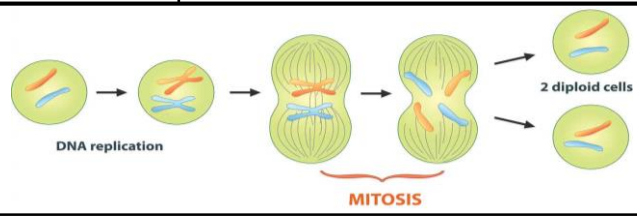
Sexual Reproduction	Reproduction involving the **fusion of gametes**.
Gamete	A **sex cell** that contains **half the genetic information** of a body cell. E.g. **sperm** and **egg** in animals, **pollen** and **ovaries** in plants.
Meiosis	The type of **cell division** that **produces gametes**. Four daughter cells are produced from one original cell. Each cell is genetically different. Each daughter cell has half the genetic information of a body cell.
Fertilisation	**Fusion of gametes**. Restores the full number of chromosomes.
Asexual Reproduction	Reproduction involving **only one parent and no gametes**. No mixing of genetic information so genetically identical **clones** are produced. Only **mitosis** is involved.
Mitosis	**Cell division** that produces two identical daughter cells with the full amount of chromosomes.

Section 1b: Mitosis and Meiosis

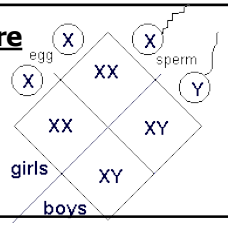
	Mitosis	Meiosis
Number of daughter cells produced	2	4
Variation in cells produced	Genetically identical to each other and parent cell	Different to each other and parent cell
Purpose	Growth, repair, asexual reproduction	Produce gametes for sexual reproduction
Number of chromosomes	Full amount (pairs of chromosomes)	Half (single chromosomes)

Section 1c: Advantages and Disadvantages of Different Types of Reproduction

	Advantages	Disadvantages
Sexual Reproduction	Produces **variation**. Offspring are more likely to **survive changes** to the environment and disease.	**Requires a mate**. **Slower** way of producing offspring.
Asexual Reproduction	Produce **lots of offspring quickly**. **No mate** needed. Time and energy efficient	Offspring are **less likely to survive environmental changes** or diseases.



Punnet square



Section 2: Genetics Key Terms

DNA	**Genetic material**. DNA is a **polymer** made up of **two strands** forming a **double helix**. The DNA makes up chromosomes.
Gene	A gene is a **small section of DNA** on a chromosome. Each gene **codes for a particular sequence of amino acids**, which **make a protein**.
Chromosome	A **long coil of DNA**. Found in the nucleus.
Genome	The **entire genetic material of that organism**.
Allele	**Different versions of the same gene** – dominant and recessive.
Dominant	A dominant allele is **always expressed**. Only **one copy** is needed.
Recessive	Only **expressed if two copies are present**.
Homozygous	**Both alleles** for a gene are the **same** (i.e. both are dominant or both are recessive).
Heterozygous	**Both alleles** for a gene are **different** (i.e. one is dominant, the other is recessive).
Genotype	The **alleles present** for a **particular gene**.
Phenotype	The **physical feature** expressed for a **particular gene**.
Single gene characteristics	Some characteristics are controlled by only one gene e.g. fur colour in mice, colour blindness in humans.
Multiple gene characteristics	Most characteristics are controlled by many genes e.g. height.

Section 3: Gender Inheritance

Human Chromosomes	Human body cells contain **23 pairs of chromosomes.** 22 pairs control characteristics only**, one pair controls sex.**
Males	Males have **two different chromosomes** – **XY**.
Females	Females have **two chromosomes** that are the **same** - **XX**.

Section 4: Genetic Diseases

	Polydactyly	Cystic Fibrosis
Problem	Extra fingers and toes	Disorder of cell membranes. Causes sticky mucus on lungs.
Caused by…	**Dominant** allele	**Recessive** allele
Genotype of people with disease	PP or Pp	cc
Genotype of people without disease	pp	CC or Cc
Does the disease have carriers?	No	Yes – genotype Cc

KNOWLEDGE

Biology Topic B13 Reproduction (Separate)

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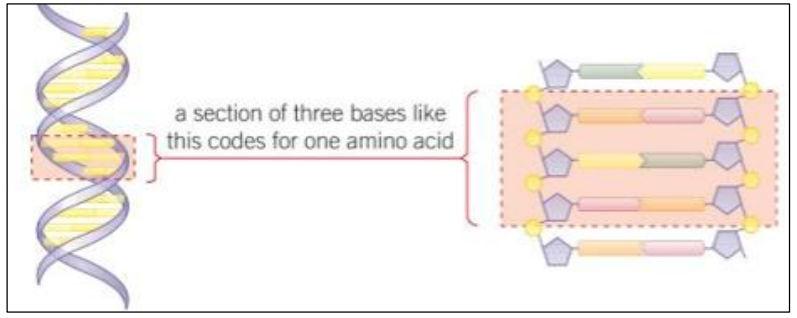
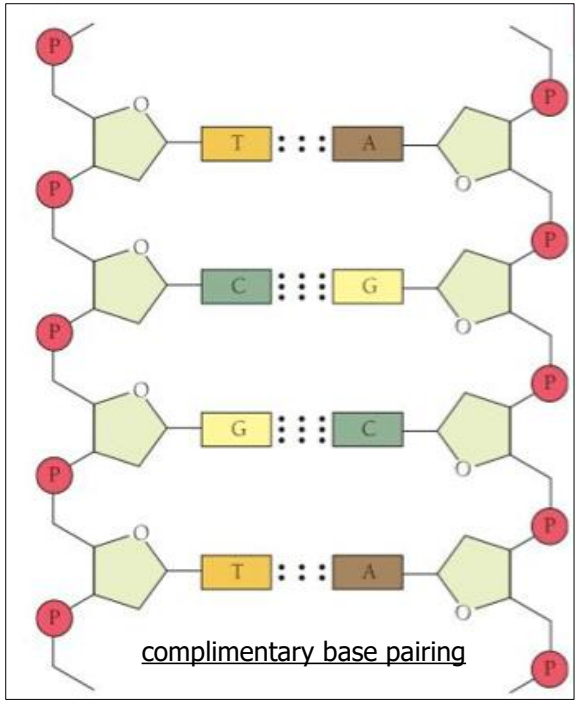
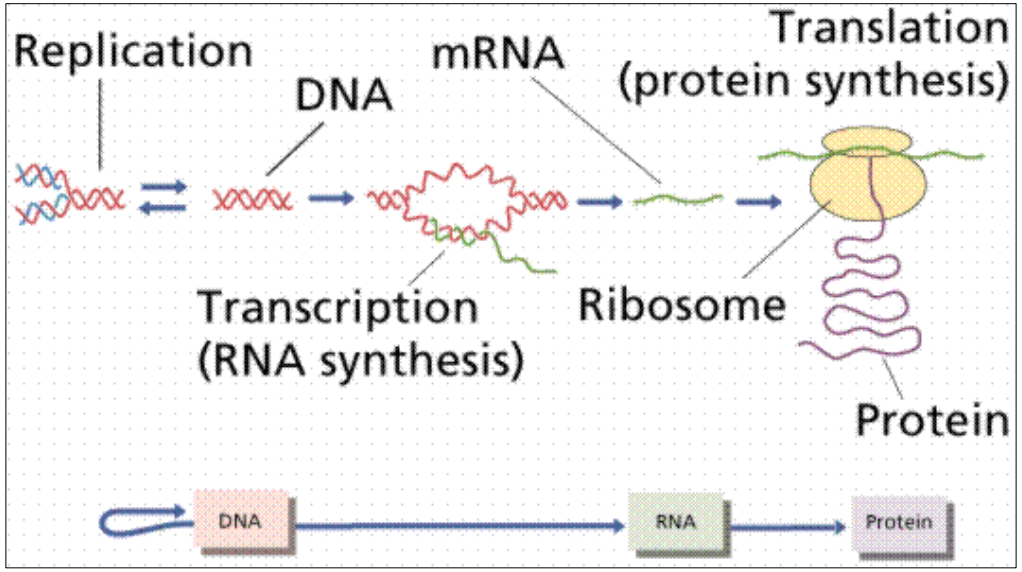
Section 5: Structure of DNA
DNA strands are **polymers** made up of lots of repeating units called **nucleotides**
Each nucleotide consists of one **sugar** molecule, one **phosphate** molecule and one **base**
The sugar and phosphate molecules in the nucleotides form a **backbone** to the DNA strands. The sugar and phosphate molecules alternate. One of four different bases — **A, T, C or G** — joins to each sugar
Each base links to a base on the opposite strand in the helix
A always pairs up with T, and C always pairs up with G. This is called **complimentary base pairing**.
It's the **order of bases** in a gene that decides the order of amino acids in a protein
Each amino acid is **coded for** by a sequence of three bases in the gene
The amino acids are joined together to make various proteins, depending on the order of the gene's bases



Section 6: Protein synthesis	
Proteins	Examples include enzymes, hormones, structural proteins like collagen
Transcription	The first part of the process of making a protein. It takes place inside the cell nucleus. Transcription involves copying the DNA
Translation	Takes place in the ribosomes that are found in the cytoplasm. This is where the messenger RNA is 'interpreted' and the new protein formed
mRNA	Messenger RNA
tRNA	Transfer RNA



complimentary base pairing



Section 7: Mutations	
A mutation	A random change in the DNA
Cause?	Exposure to certain substances/some radiation types
Types?	Insertions, deletions, substitutions

Section 8: Organisms reproducing both sexually and asexually
Malaria parasites reproduce sexually in mosquitoes and asexually in their human hosts
Many fungi reproduce asexually by spores but can also reproduce sexually to give variation
Many plants produce seeds sexually but also reproduce asexually e.g. by runners or bulb division

KNOWLEDGE

Biology Topic B14 Variation and Evolution

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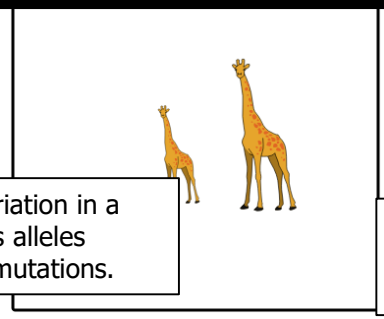
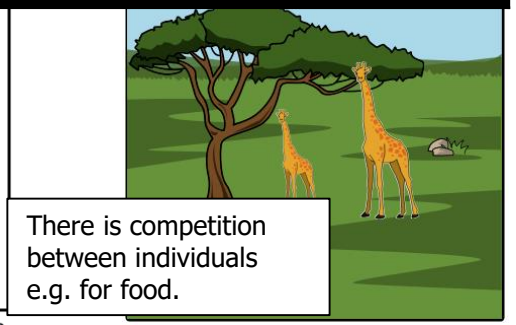
Section 1: Variation and Evolution Key Terms

Variation	The **differences** between organisms. Can be caused by **genes** (e.g. eye colour), the **environment** (e.g. scars) or **both the environment and genes** (e.g. weight). All variation in genes is **caused by mutations**.
Mutation	Mutations are **changes in genes**. **Most have no effect** on the phenotype. Occasionally mutations have a positive effect on phenotype and organisms with these mutations are more likely to survive.
Evolution	The **change in the genes of a population over time**. Occurs through natural selection.
Natural selection	The process by which the **individuals best adapted to the environment survive** and **pass on their genes**.
Speciation	Occurs when **two populations are so different** that they can **no longer breed to produce fertile offspring**. **Two new species** are formed.

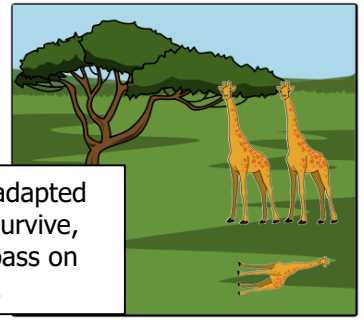
Section 2: Natural Selection



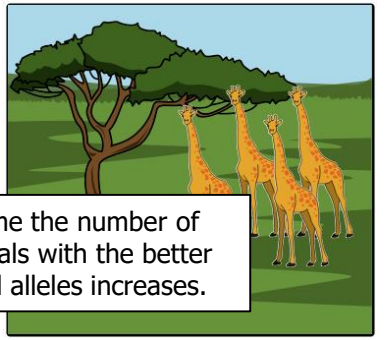
There is variation in a population's alleles caused by mutations.



There is competition between individuals e.g. for food.



The better adapted organisms survive, breed and pass on their alleles.



Over time the number of individuals with the better adapted alleles increases.

Section 3: Selective Breeding

Selective Breeding (Artificial Selection)	The process by which **humans breed plants and animals for particular genetic characteristics.**
Inbreeding	Selective breeding can lead to 'inbreeding' where some breeds are particularly **prone to disease or inherited defects**.

Process of selective breeding:

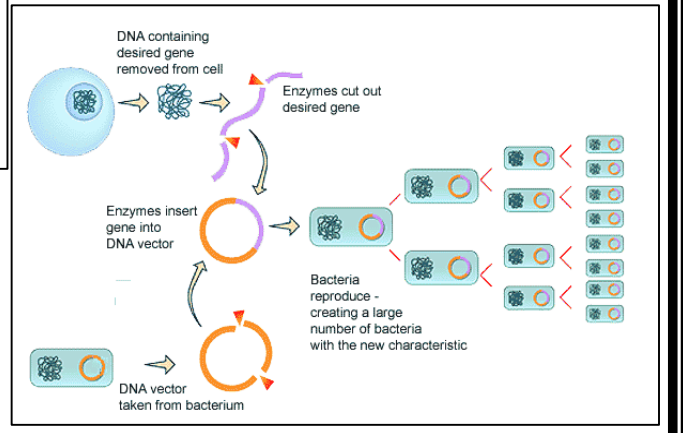
1. Choose parents with correct characteristics from the population.
2. Breed them together.
3. Choose the offspring with the desired characteristics and breed them together.
4. Continue over many generations.

Examples of desired characteristics:

- Disease resistance in food crops.
- Animals which produce more meat or milk.
- Domestic dogs with a gentle nature.
- Large or unusual flowers.

Examples of genetic engineering:

- Bacterial cells have human **insulin gene** inserted into them so that they produce insulin for diabetics.
- Plants that have had genes inserted that make them **resistant to disease, insects** or **herbicides**.



Section 4: Genetic Engineering

Genetic Engineering	A process which involves **modifying the genome** of an organism by **introducing a gene** from another organism to give a desired characteristic.
GM Crop	Crops that have been produced by genetic engineering.
Vector	Something that can **carry a gene into another organism** e.g. **bacterial plasmid** or **virus.**

Process of genetic engineering:

1. Genes are cut out by enzymes.
2. The gene is inserted into a vector (either a bacterial plasmid or virus).
3. The vector is used to insert the gene into the required cells
4. Genes are transferred to the cells of animals, plants or microorganisms at an early stage in their development so that they develop with desired characteristics.

KNOWLEDGE

Biology Topic B14 Variation and Evolution

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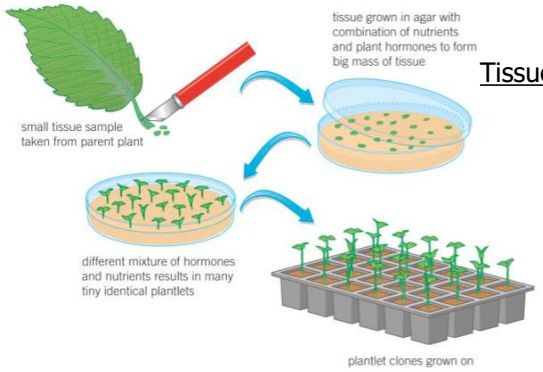
Section 1: Cloning plants and animals

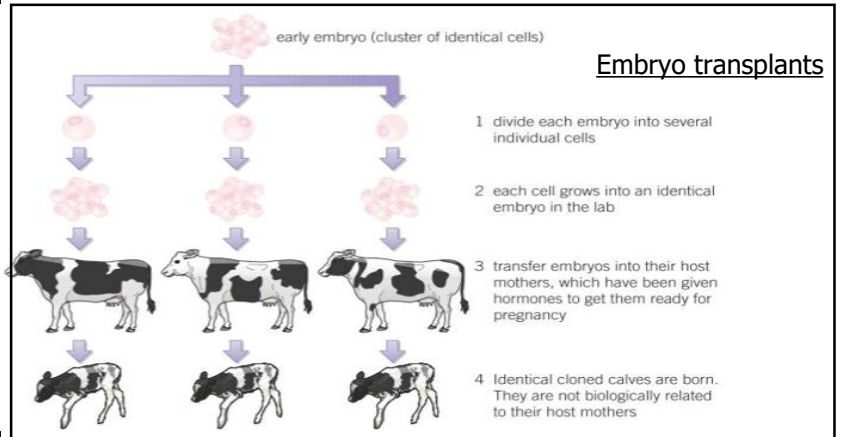
Clone	A genetically identical (to the parent) organism
Cuttings	Gardeners take cuttings to clone plants. **Quick**, **cheap** but **only one** clone at a time
Tissue culture	Scientists clone plants by taking a few plant cells and growing them in a growth medium with hormones. **Mass production** of clones but quite **expensive** compared to cuttings
Embryo transplants	Sperm taken from a 'champion' male animal, used to fertilise a 'champion' egg. An embryo develops and is split many times before any cells become specialised. Cloned embryos are implanted into host mothers resulting in cloned baby animals
Adult cell cloning	Take an unfertilised egg cell and remove its nucleus. A nucleus from an adult body cell is removed and inserted into this empty egg cell. An electric shock fused the two together and stimulates division. An embryo forms and is implanted into he uterus of a female host. A clone of the original adult cell is produced as it has the same genetic information

Issues	**Negatives**	**Positives**
	• Reduces the gene pool • Animal clones might not be as healthy as the normal ones • Worry of human cloning in the future	• Preserve endangered species • Studying animal clones can lead to better understanding of embryo development

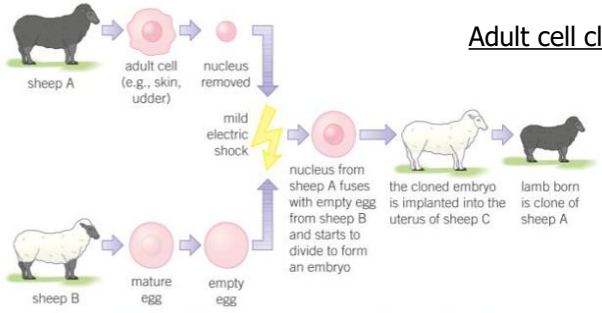
Tissue culture



Embryo transplants



Adult cell cloning



KNOWLEDGE

Biology Topic B15
Genetics and Evolution

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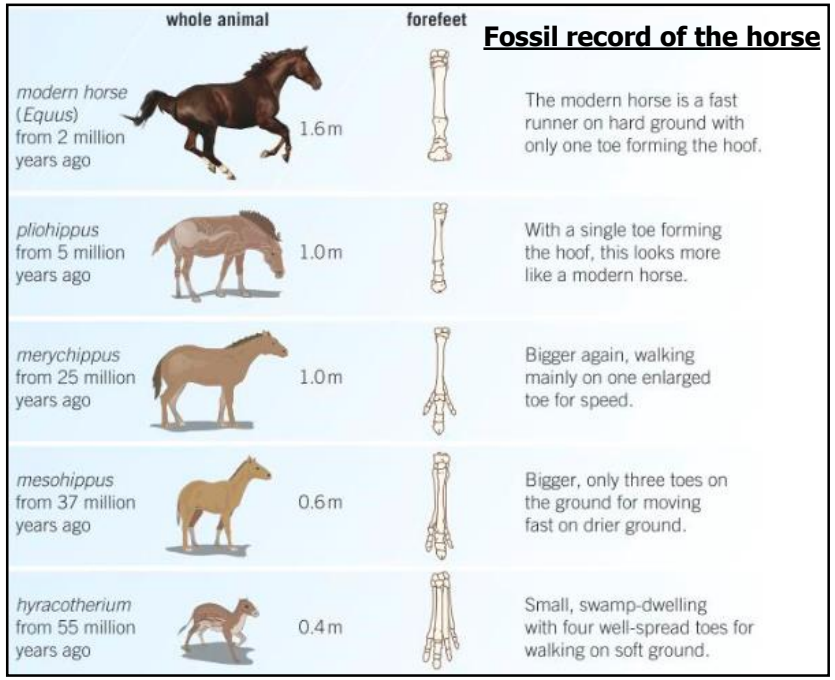
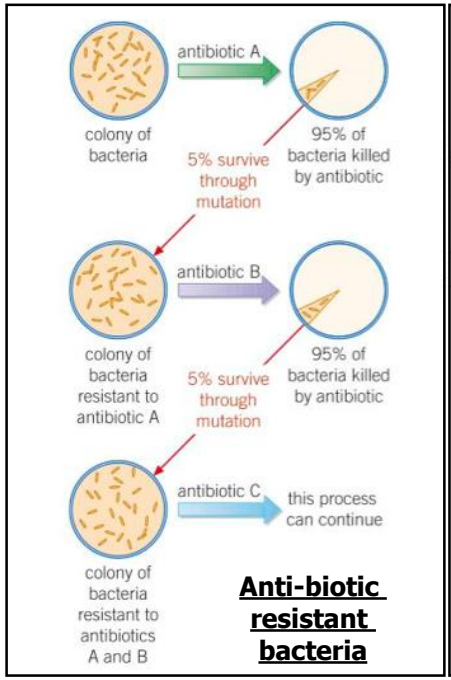
Section 1: Evidence for evolution	
Fossil	The preserved remains of an organism from many thousands of years ago. Formed by either gradual replacement by minerals, casts/impressions or preservation in places where there is no decay like amber
Resistance bacteria	Bacteria can evolve and become antibiotic resistant. Bacteria sometimes develop random mutations, allowing them to survive an antibiotic, they reproduce increasing the population size of antibiotic resistant bacteria

Section 2: Extinction	
Reasons	Rapid environmental changes, new predators, new diseases, better competitor, catastrophic event e.g. volcanic eruption

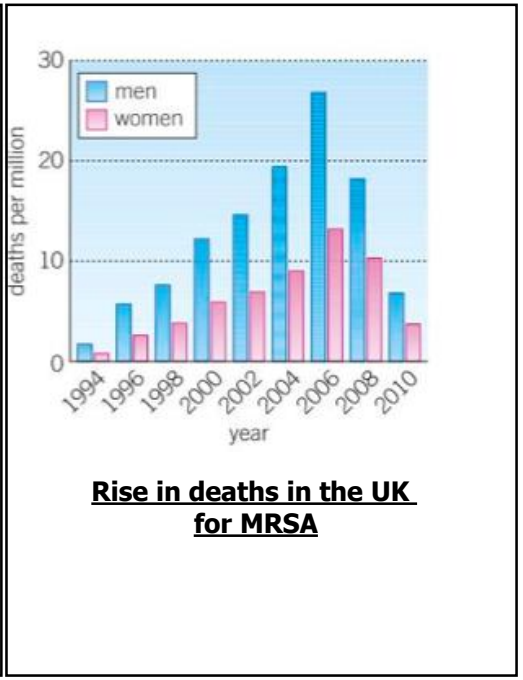
Section 3: Classification and evolutionary trees	
Classification	Organising living organisms into groups
Carl Linnaeus system	Kingdom → Phylum → Class → Order → Family → Genus → Species
Carl Woese 3 domain system	Archaea, Bacteria, Eukartota are the main large groups which are then divided into smaller groups using the keyterms above (kingdom etc…)
Binomial system	Give a 2 part name in Latin to every organism e.g. *Homo sapiens*
Evolutionary trees	Show common ancestors and relationships between species



Fossil record of the horse



Anti-biotic resistant bacteria



Rise in deaths in the UK for MRSA

KNOWLEDGE

Biology Topic B15
Genetics and Evolution (separate)

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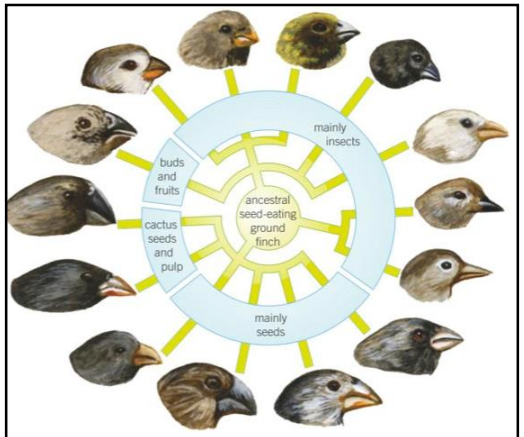
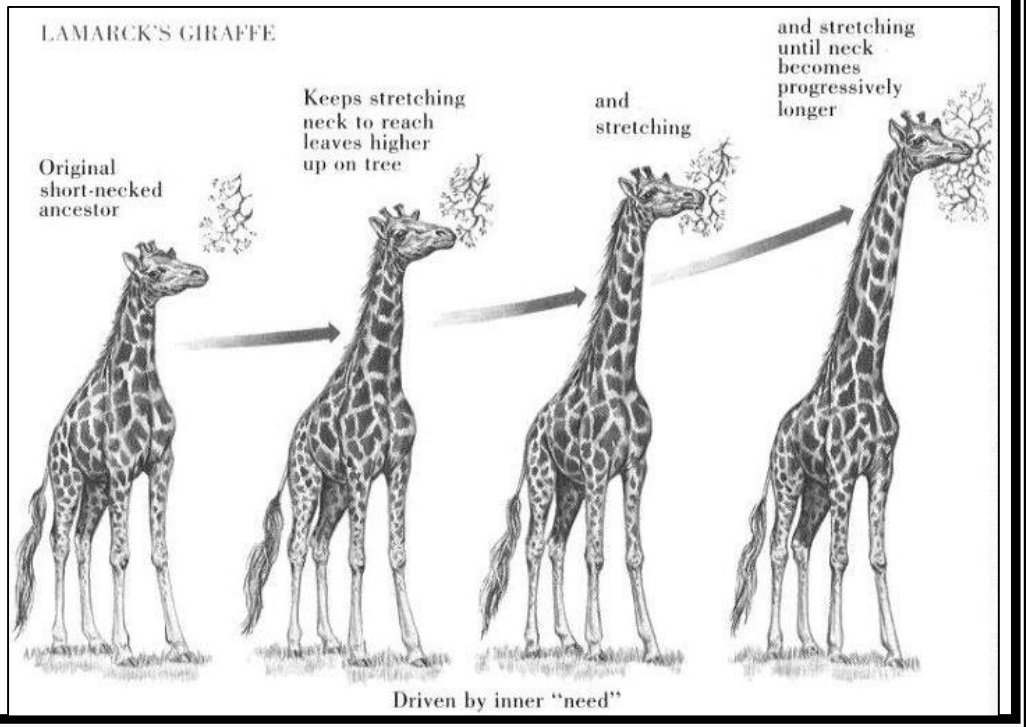
Section 1: Darwin V Lamarck	
Darwin's idea	Evolution by natural selection
Controversy at the time	People **did not believe Darwin** at the time because: - It went against religious beliefs - DNA/genes/the mechanism of inheritance was not understood at the time - There was not enough evidence to convince other scientists
Lamarck's idea	Evolution by acquired characteristics - Organisms that use a characteristic a lot during its lifetime would become more developed e.g. a rabbit using its legs a lot to run would become longer - Then the organisms offspring would inherit this characteristic e.g. the rabbits offspring would also have longer legs
Section 2: Speciation	
Species	A group of similar organisms that can reproduce to give fertile offspring
Speciation	The development of a new species



How the Finch has evolved

Speciation

- two ancestral populations get separated by geographical barrier / by land or sea / were isolated
- genetic variation (in each population) or different / new alleles or mutations occur
- there are different environments / conditions in these two separate areas
- natural selection occurs or some phenotypes survived or some genotypes survived
- (favourable) alleles / genes / mutations passed on (in each population)
- eventually two types cannot interbreed successfully



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Biology Topic B15
Genetics and Evolution (separate)

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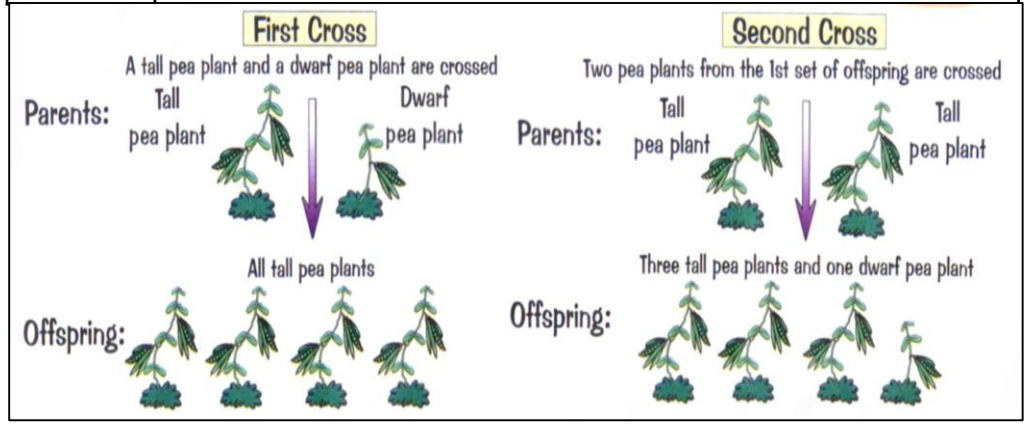
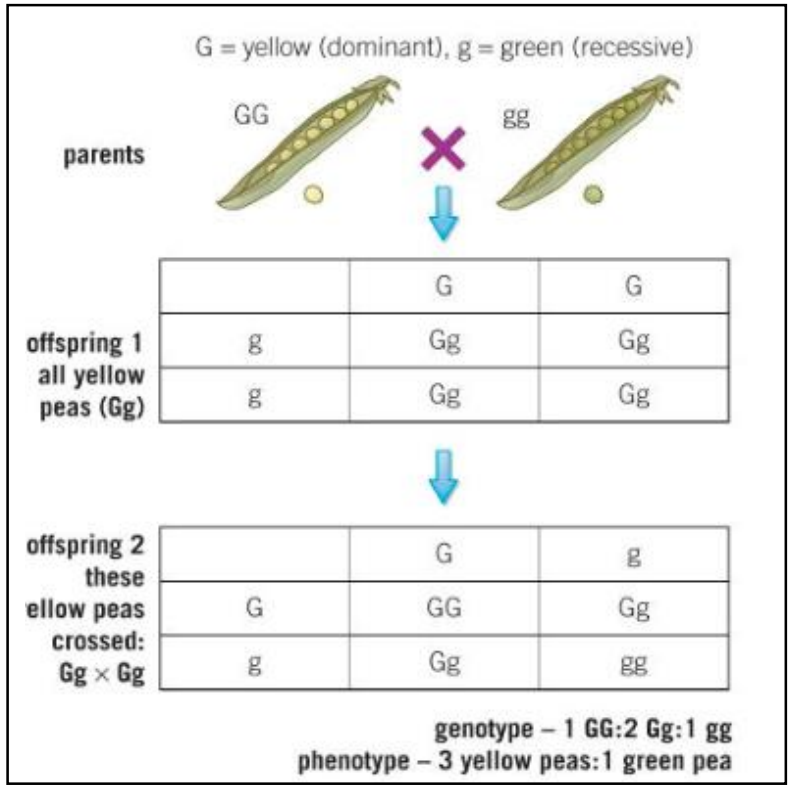
Section 3: Mendel

Mendel	A monk who's research led to the foundation of modern genetics



Experiments	In the mid-19th century Mendel carried out breeding experiments on pea plants. He observed that the inheritance of each characteristic is determined by 'units' that are passed on from parents to offspring
Rejection	Mendel's work was rejected at the time because: - he was just a monk (not a scientist) - chromosomes / DNA / genes not seen / discovered / known at the time - other theories accepted at the time



KNOWLEDGE

Biology Topic B16 Adaptations, Interdependence and competition

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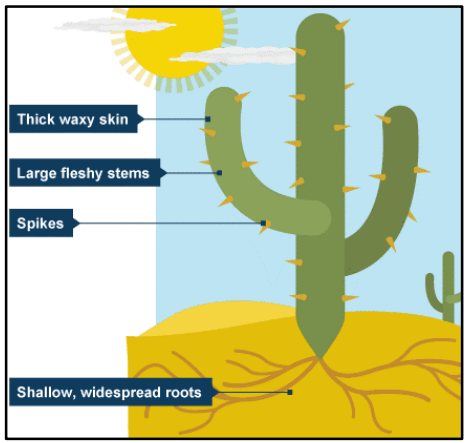
Section 1: Key terms	
Ecosystem	The **interaction** of a **community of living organisms (biotic)** with the **non-living (abiotic)** parts of their environment.
Habitat	The **area** in which an organism **lives**.
Community	**Two or more different species** in an ecosystem**.** A **stable community** is one **where all the species and environmental factors are in balance** so that **population sizes remain fairly constant.**
Population	The **total number of organisms** of **one species** in an ecosystem**.**
Competition	**Plants** often compete for **light, space, water** and **mineral ions.** **Animals** often compete for **food**, **mates** and **territory**
Interdependence	Within a community each **species depends on other species** for **food, shelter, pollination** etc.
Adaptations	A **feature** that an organism has that allows it to **survive** in its ecosystem.
Biodiversity	The **variety** of all the **different species** of organisms **on Earth**, or **within an ecosystem.**

Section 2: Biotic and Abiotic Factors	
Biotic	**Abiotic**
Availability of **food**	**Light intensity**
New **predators** arriving	**Temperature**
New **pathogens**	**Moisture** levels
One species **outcompeting** another	**Oxygen** levels for aquatic animals
	Wind intensity and direction
	Carbon dioxide levels for plants
	Soil pH and **mineral** content

Section 3: Adaptations	
Structural Adaptations	Part of the **body** that helps the organism survive. e.g. polar bears have a thick layer of fat for insulation.
Functional Adaptations	How the **body operates** that helps the organism survive. E.g. camels do not sweat.
Behavioural Adaptations	A **behaviour** that helps the organism survive. e.g. desert rats stay in their burrows during the hottest parts of the day.
Extremophiles	Organisms that have adapted to live in environments with extreme conditions of salt, temperature or pressure.

Section 4: Distribution and Abundance		
	Random Sampling	**Systematic Sampling (transect)**
Purpose	**Estimate the size of a population** in an area.	See how populations and communities **change over a distance**.
Method	• Use approximately 10 or more quadrats • Place quadrats randomly • Count organisms in each quadrat • Use mean number of organisms and multiply by area of field • Repeat in different areas to compare areas	• Place tape measure across area • Place quadrat(s) next to the tape • Count number of organisms in quadrat • Repeat at regular intervals along tape measure



KNOWLEDGE

Biology Topic B17
Organising an Ecosystem

ORGANISER

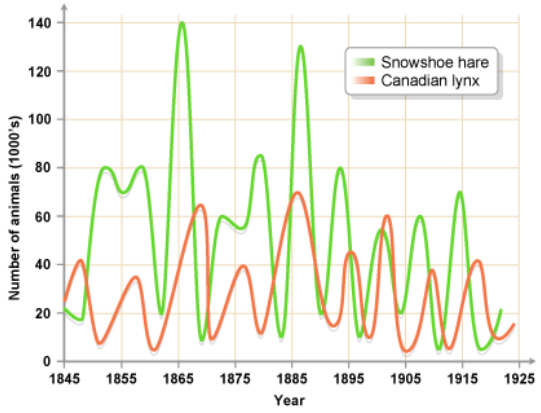
Section 1: Food Chains and Predator-Prey Relationships

Producer – **Start** of a food chain. Produces **glucose** through **photosynthesis.**

Primary Consumer – **Eats** a **producer. Prey** of secondary consumer.

Secondary Consumer – **Eats** a **primary consumer. Predator** of primary consumer.

Tertiary Consumer – **Predates** on **secondary consumer.**



Predator-prey cycles
The population of the **prey increases** **More food** is available for the **predators**, so their population increases. There are **more predators** so the **population of the prey decreases**. There is **less prey to feed on** so the population of **predators decreases.** 19 The **cycle restarts** from the beginning.

Section 2: Rates of Decomposition (Separate)

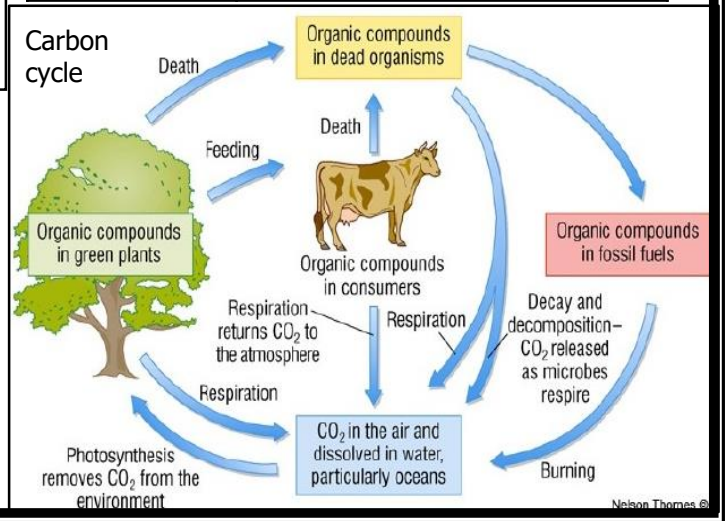
Decomposers	**Microorganisms that break down waste products and dead bodies**
Factors affecting rate of decay	Temperature, oxygen availability and moisture levels
Anaerobic decay	Decay without the presence of oxygen produces methane gas – biogas.

Section 3: Water cycle steps

Evaporation	**Liquid water** is **turned** into **water vapour** in the **atmosphere.**
Condensation	Water vapour **condenses** to **form clouds**.
Precipitation	Water is deposited from clouds as **rain**.

Section 4: Carbon cycle steps

Photosynthesis	**Plants absorb CO_2** from atmosphere.
Respiration	**Animals**, **plants** and **micro-organisms** respire, **releasing CO_2** into the atmosphere.
Decay	The carbon in dead organisms is **released to the atmosphere** by **micro-organisms respiring**.
Combustion	Carbon locked in **fossil fuels** is **released** as CO_2 when fuels are **burned**.



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Physics Topic B18 Biodiversity and Ecosystems

ORGANISER

Section 1: Human effects on biodiversity

Human activity	Why it happens	Effects
Polluting water with fertiliser and sewage	Farmers spread **fertiliser** on fields. **Rain** washes fertiliser into **rivers** and ponds. Sewage is released directly into rivers.	Fertilisers and sewage cause an **increase in growth of algae**. When the algae **die**, they are **decomposed by bacteria** that **use oxygen**. Other animals **die due to a lack of oxygen**.
Using land	Humans **construct buildings**, create **quarries** and **farm**.	**Habitat** for plants and animals is **reduced**.
Destroying peat bogs	Humans **use peat to provide compost** to increase food production.	**Removes habitat, reducing biodiversity. Decay or burning of peat produces CO_2.**
Deforestation	To provide **land for cattle and rice fields**. To **grow crops for biofuels**.	**Burning** or **decomposing trees releases CO_2. Fewer trees to remove CO_2 from the atmosphere. Loss** of **biodiversity.**
Producing acidic gases	**Combustion** of **fossil fuels** releases **carbon dioxide, sulfur dioxide** and **nitrogen oxides.** These gases **dissolve in water** making it **acidic**.	**Acid rain. Damages plants.** Can cause **rivers** and **lakes** to become acidic, killing animals and plants.
Polluting water with toxic chemicals	**Pesticides** and other toxic chemicals (e.g. from **landfill**) are washed into rivers and lakes by **rain**.	**Toxic chemicals accumulate** in animals. The **further up** the **food chain**, the **greater the accumulation**. Top predators die or fail to breed.
Increasing temperature of the planet (global warming)	Humans release extra **greenhouse gases** (**CO_2** and **methane**) into the atmosphere and **less CO_2 is absorbed** by plants through photosynthesis. **Greenhouse gases absorb heat** and stop it escaping to space.	**Loss of habitat** as **sea levels rise**; animals and plants can **no longer survive** in certain areas; **reduced biodiversity**; **change in migration patterns** of animals.
Peat bog destruction	Destruction of peat bogs for land or use as compost	The decay or burning peat releases **CO_2** in the atmosphere

Section 2: Maintaining biodiversity

Breeding programmes for **endangered species.**

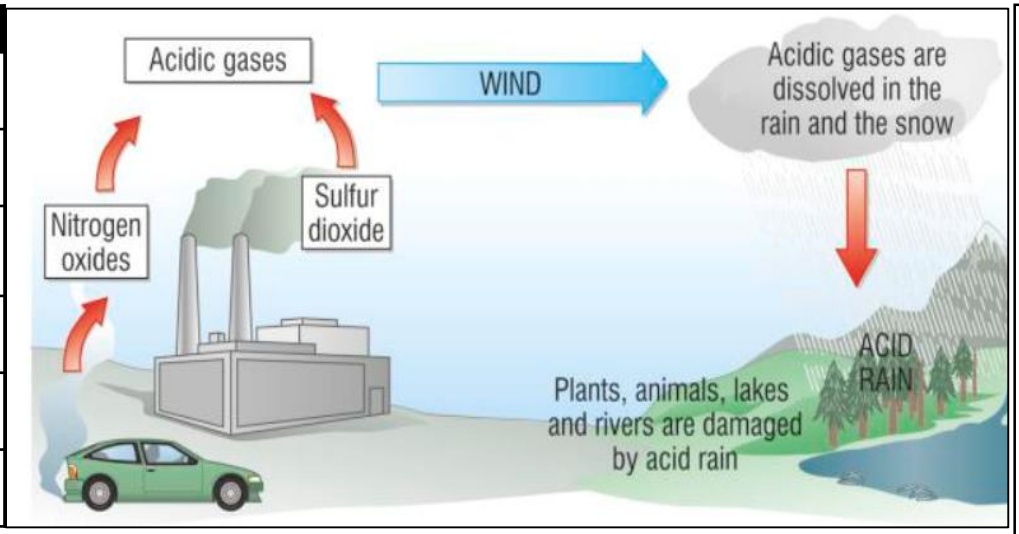
Protection and **regeneration** of **rare habitats.**

Reintroduction of field margins and **hedgerows** in agricultural areas where farmers grow only one type of crop

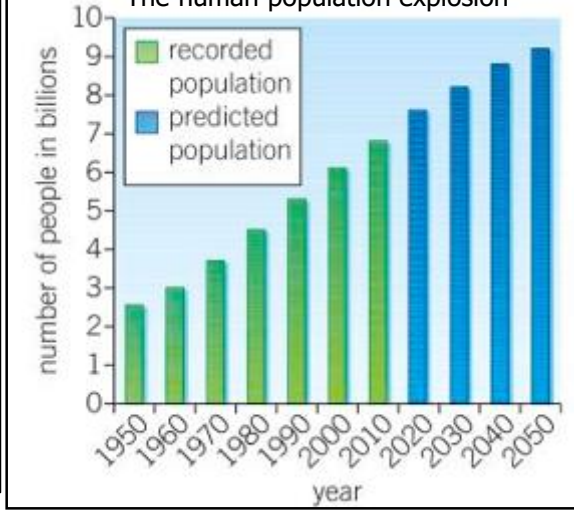
Reduction of deforestation

Reduction of carbon dioxide emissions by some **governments**

Recycling resources rather than dumping waste in landfill.



The human population explosion



KNOWLEDGE

Physics Topic B18
Biodiversity and Ecosystems (Separate)

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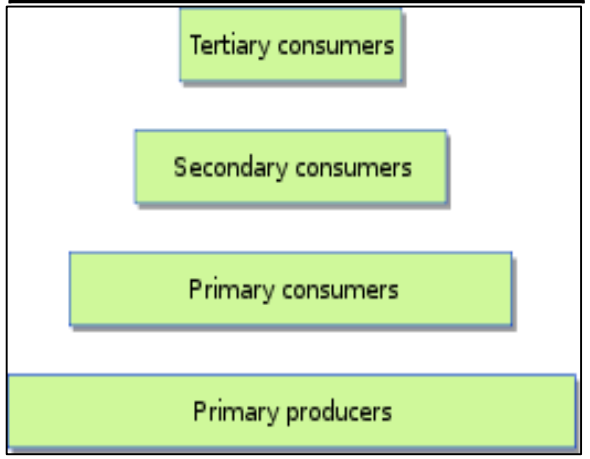
Section 1: Decay

Compost	Decomposed organics matter
Decomposition	The breakdown of organic matter by microbes (bacteria/fungi) or detritus feeders (worms)
Conditions for decay	Warm, plenty of oxygen, moisture, plenty of microbes
Biogas	Methane gas produced by anaerobic decay of waste material, methane is used as a fuel for cooking, heating
Biogas generator	Need constant temperature. 2 types: batch and continuous

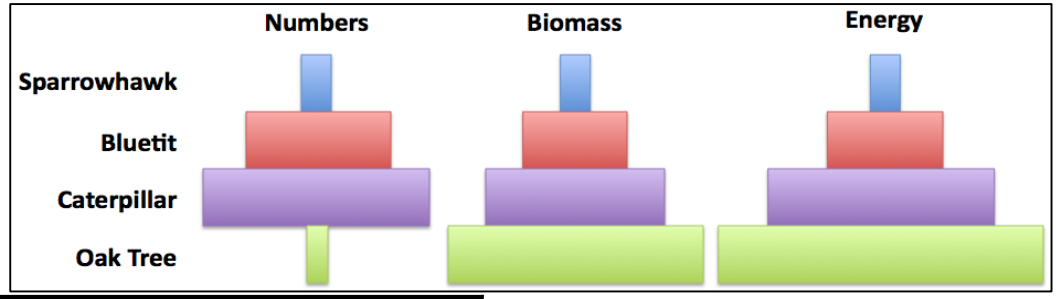
Organism	Biomass, dry mass (g)
Oak tree	100 000
Caterpillar	5000
Blue tit	30
Sparrow hawk	3

Section 2: Tropic levels



Section 3: Pyramids of biomass

Pyramids of biomass	Show the relative mass of each trophic level, must be drawn to scale
Biomass	The total quantity or mass of organisms in a given area or volume



Section 4:Calculating the efficiency of biomass transfer

efficiency = $\frac{\text{biomass transferred to the next level}}{\text{biomass available at the previous level}}$ x100

example from above:
To calculate the % of the energy in the oak tree that is passed to the sparrow hawk here's what to do:
3 ÷ 100 000 = 0.00003
0.0003 x 100 = 0.003%

Section 5: Transfer of biomass

The amount of energy (in the biomass of organisms) is reduced at each successive stage in a food chain
All of prey organism is not consumed e.g. bones, teeth, hair
Energy is 'lost' as the organisms' waste materials (faeces and urine)
Energy is transferred / lost / released during respiration
energy is transferred / lost as movement (kinetic energy)
energy is transferred / lost as heat (thermal energy)
energy is transferred / lost to the surroundings

Section 6: Food security

Food security	Means having enough food to feed the population
Threats to food security	World population rising too quickly, demand for certain types of food leads to scarcity, loss of crops in farming through new pests and disease, war over food
Fish stocks	Are declining due to over fishing. Fishing quotas and net size help to maintain fish stocks
Efficient food production	Intensive farming uses techniques to increase food production e.g. controlled temperature, restricted movement and continual feeding. Although this is controversial
Using biotechnology	Mycoprotein is a food made from fungi