Knowledge organiser title	Specification topic	Page numbers
Homeostasis and the nervous system	B5 Homeostasis and response	**2-5**
2nd Homeostasis and the nervous system	B5 Homeostasis and response	**6-10**
Inheritance, variation and evolution	B6 Inheritance, variation and evolution	**11-15**
Inheritance, variation and evolution	B6 Inheritance, variation and evolution	**16-22**
Ecology	B7 Ecology	**23-27**

Required practical	Page number
Reaction time	
Plant hormones	**10**
Quadrat and transect sampling	**25**
Decomposition	**27**

BIOLOGY B5: Homeostasis & The Nervous System - KO

Nervous system	Reflex arc	Reaction time RP	Homeostasis and the endocrine system	Negative feedback (adrenalin and thyroxin)	Blood glucose control	Diabetes	Hormones in reproduction	Contraception	Artificial control of fertility

Key Words

Key Word	definition
Homeostasis	Maintenance of optimum conditions for function of enzymes and cells in response to internal and external changes
Hormone	Chemical secreted by a gland into the blood stream and carried to target cells,
Effector	Brings about a response. Muscle and/or glands.
Endocrine system	System which releases hormones from glands
Inhibit	Stop or prevent something occurring

Misconceptions

Nerves **DO NOT** carry messages

(nerves carry electrical impulses)

Metabolism is **Not** diges tion

(metabolism are chemical reaction inside cells e.g. respiration)

Type 2 diabetes is **not** controlled by a healthy balanced diet

(low carbohydrate diet)

Key questions

Name the gland and function of the human hormones

Explain how the body controls blood sugar

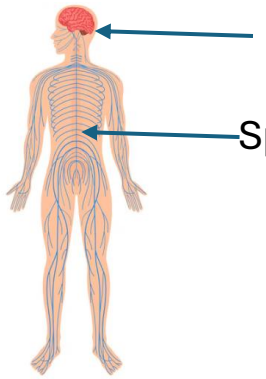
State the roles and interactions of the female sex hormones in the menstrual cycle

Describe the reflex arc

Describe how to carry out IVF

BIOLOGY B5: Homeostasis & The Nervous System - KO Paper 2: KS4

Human nervous system



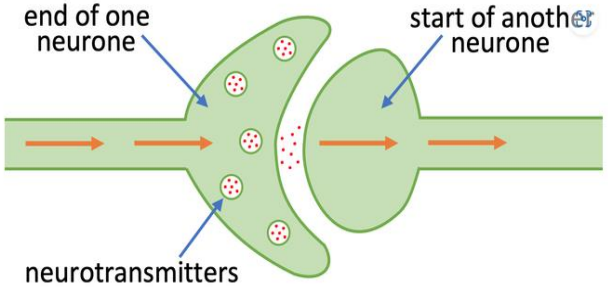
Enables humans to react to their surroundings and to co-ordinate their behaviour

The CNS

The CNS is the brain and the spinal cord.

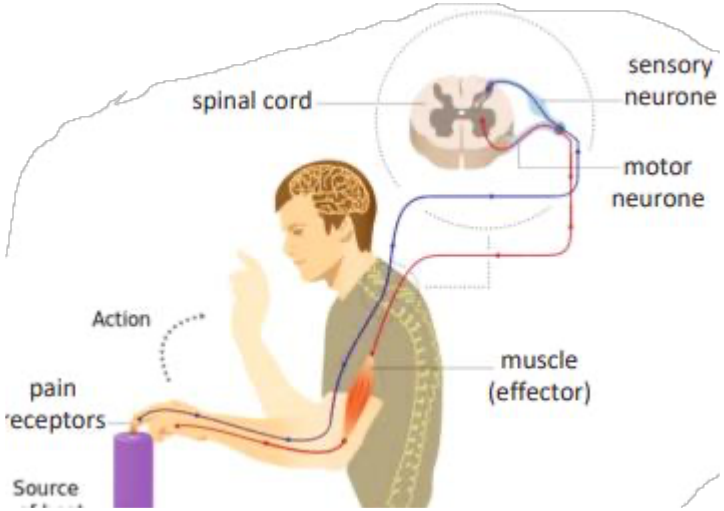
Coordinates the response of effectors; muscles contracting or glands secreting hormones

Synapse



- Impulse arrives
- Chemical released
- Chemical diffuses across gap
- Triggers another impulse

Reflex arc



Stimulus → Receptor → Sensory neurone → Relay neurone → Motor neurone → Effector → Response

Effectors

Effector	Function
Muscle	Contracts to move bones
Gland	Releases hormones

Reflexes

- Fast
- Automatic
- Protective

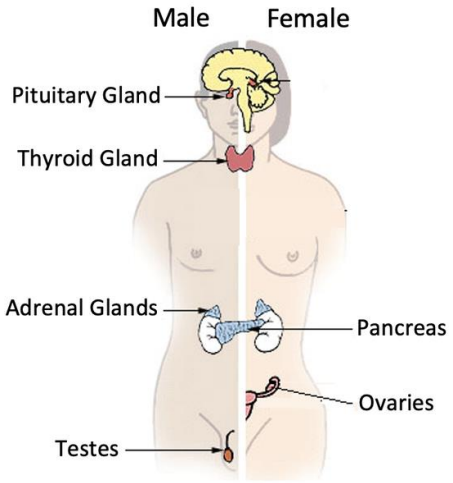
Electrical impulses

Information is passed along the nervous system by a series of electrical impulses

4 BIOLOGY B5: Homeostasis & The Nervous System Paper 2: KS4

Human endocrine system

Composed of glands which secrete chemicals called hormones directly into the bloodstream



Gland	Hormone	Function
Pituitary gland	Growth hormone	Controls growth and other endocrine glands.
Thyroid	Thyroxine	Controls metabolism.
Adrenal gland	Adrenal gland	Prepares the body for rapid activity by increasing heart rate.
Pancreas	Insulin	Controls blood sugar levels (decreases blood sugar levels
Pancreas	Glucagon	Increases blood sugar levels
Ovaries	Oestrogen	Controls the menstrual cycle and changes at puberty.
Testes	Testosterone	Stimulates sperm production and causes the changes at puberty.

hormone

Hormones are chemical messengers which are released into the blood and act on a target organ.

Adrenaline/Thyroxine

Adrenaline	Thyroxine
Produced in adrenal glands, increases breathing/heart rate, blood flow to muscles, conversion glycogen to glucose. Prepares body for 'fight or flight'	Produced in the thyroid gland, increases the basal metabolic rate. Increases respiration

Comparing Endocrine and Nervous system

Endocrine system

- effects are slower
- act for longer.
- travel in blood
- use chemical messengers

Pituitary gland

'Master gland'-secretes hormones into the blood

Stimulates other glands to produce hormones to bring about effects.

Blood glucose concentration

Too high	(HT only) Too low
Pancreas produces the hormone insulin, glucose moves from the blood into the cells. In liver and muscle cells glucose is converted to glycogen for Storage. Decreasing blood sugar levels	Pancreas produces the hormone glucagon that causes glycogen to be converted into glucose and released into the blood. increasing blood sugar levels

Diabetes

Type 1	Type 2
Pancreas fails to produce sufficient insulin leading to uncontrolled blood glucose levels. Normally treated by insulin injection.	Body cells no longer respond to insulin. Common treatments include a low carbohydrate diet and exercise.

Type 2 diabetes is caused by lifestyles high in fat, salt and a lack of exercise

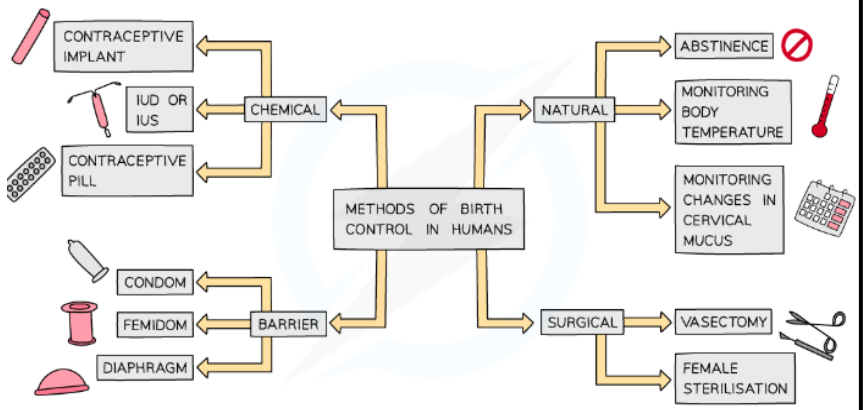
Obesity is a risk factor for Type 2 diabetes

B5: Homeostasis & The Nervous System - KO PAPER 2: KS4

Contraception

Fertility can be controlled by a variety of hormonal and nonhormonal methods of contraception:

- oral contraceptives that contain progesterone / oestrogen to inhibit FSH production so that no eggs mature
- injection, implant or skin patch of slow-release progesterone to inhibit the maturation and release of eggs
- barrier methods such as condoms and diaphragms which prevent the sperm reaching an egg
- IUD which prevent the implantation of an embryo or release a hormone
- spermicidal agents which kill or disable sperm
- abstaining from intercourse when an egg may be in the oviduct
- sterilisation.



Hormones in Reproduction

Oestrogen is the main female reproductive hormone produced in the ovary. -controls menstrual cycle and puberty

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

Hormones in menstrual cycle

Several hormones are involved in the menstrual cycle of a woman.

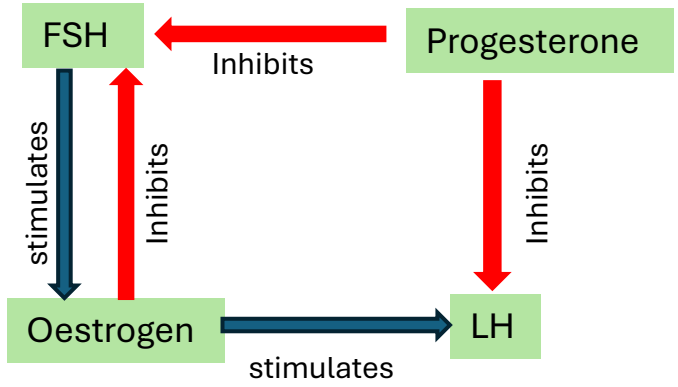
FSH causes maturation of an egg in the ovary.

LH stimulates the release of the egg.

Oestrogen- builds lining of uterus wall

Progesterone are involved in maintaining the uterus lining.

Interactions of hormones



Treating Infertility with Hormones

In Vitro Fertilisation (IVF) treatment:

Fertility treatment gives a woman the chance to have a baby of her own, allows screeing for genetic disease and spare eggs can be donated however

- it is very emotionally and physically stressful
- the success rates are not high
- it can lead to multiple births which are a risk to both the babies and the mother.

Where hormones made

Oestrogen and Progesterone made in the ovary

FSH/LH made in pituitary gland

6 BIOLOGY 2nd B5: Homeostasis & The Nervous System Paper 2: KS4

The eye	Correcting vision	Thermoregulation	Water and nitrogen balance	The kidneys and ADH	Kidney failure	Plant hormones and uses	Plant hormones RP

Key Words

Key Word	definition
Homeostasis	Maintenance of optimum conditions for function of enzymes and cells in response to internal and external changes
Hormone	Chemical messenger secreted by a gland into the blood stream and carried to target cells,
Receptor	Detects a stimulus and triggers an electrical impulse in the sensory neurone
Accommodation	the process of changing the shape of the lens to focus on near or distant objects
Deamination	In the liver amino acids are deaminated to form ammonia. Ammonia is toxic and so it is converted to urea for safe excretion
Excretion	Removing metabolic waste from the body e.g. urea, carbon dioxide

Misconceptions

Blood vessels **do not** move to the surface of the skin when too hot

(blood vessels open)

Key questions

Describe how normal body temperature is maintained

Describe how Auxin deter mines the direction of growth in plants

Describe the roles of hormones in plants

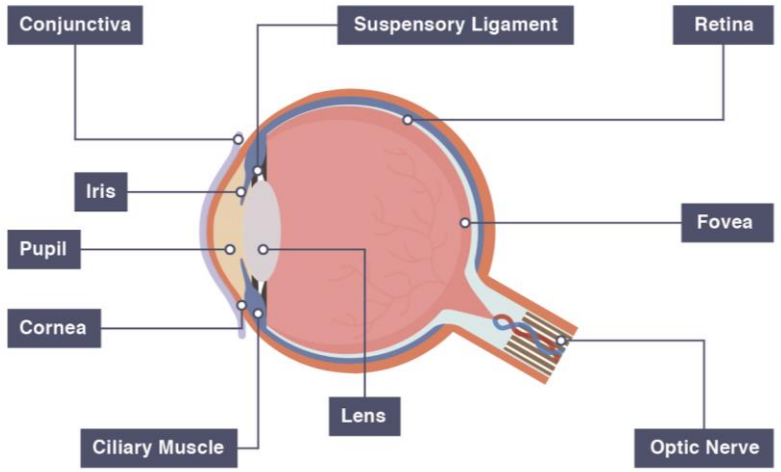
Describe the parts of the eye and how it works

.Describe the role of the kidneys and ADH in maintaining body water levels

7 BIOLOGY 2nd B5: Homeostasis & The Nervous System Paper 2: KS4

The eye

Part	Function
Cornea	Refracts light as it enters the eye
Iris	Controls how much light enters the pupil
Lens	Further refracts light to focus it onto the retina
Retina	Contains the light receptors
Optic nerve	Carries impulses from eye to brain
Sclera	Tough white outer layer of the eye to help protect from injury



Eye Defects

Two common defects of the eyes are myopia (short sightedness) and hyperopia (long sightedness) in which rays of light do not focus on the retina.

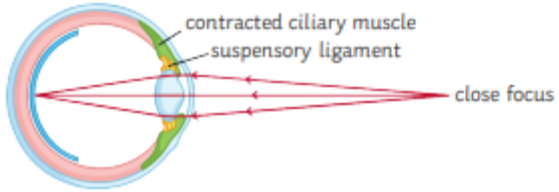
- Generally these defects are treated with spectacle lenses which refract the light rays so that they do focus on the retina.
- New technologies now include hard and soft contact lenses, laser surgery to change the shape of the cornea and a replacement lens in the eye

Adaptation to dim light

Bright light- circular muscles in iris contract, radial muscles relax, pupil contracts letting less light into the eye.
Dim light- circular muscles relax, radial muscles contract, pupil dilates letting more light in

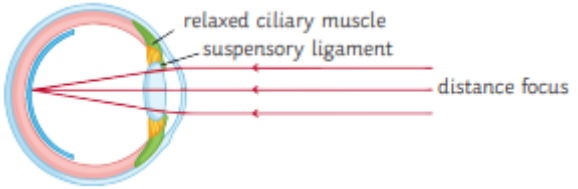
Accommodation

Accommodation- the process of changing the shape of the lens to focus on near or distant objects



To focus on a near object:

- the ciliary muscles contract
- the suspensory ligaments loosen
- the lens is then thicker and refracts light rays strongly.



To focus on a distant object:

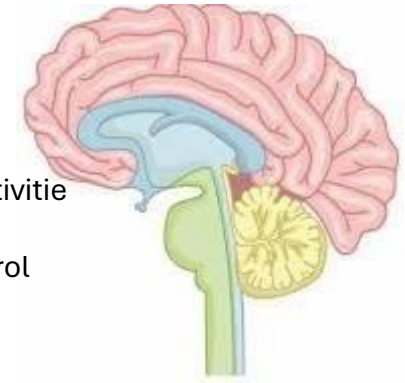
- the ciliary muscles relax
- the suspensory ligaments are pulled tight
- the lens is then pulled thin and only slightly refracts light rays.

BIOLOGY 2nd B5: Homeostasis & The Nervous System Paper 2: KS4

The brain

The brain controls complex behaviour. It is made of billions of interconnected neurones

Cerebral cortex which is concerned with; consciousness, intelligence, memory & language



Medulla controls unconscious activities, e.g. breathing & control of heart rate.

Cerebellum- Coordinates muscular activity & balance

Studying the brain

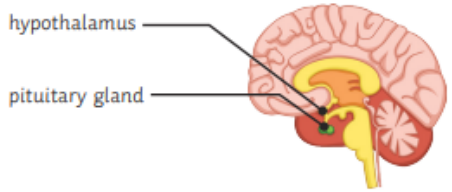
The complexity & delicacy of the brain makes investigating & treating brain disorders very difficult. Neuroscientists have been able to map regions of the brain to particular functions by studying patients with brain damage, electrically stimulating different parts & using MRS scanning.

Body Temperature

Body temperature is constantly maintained around 37˚C.
This is the optimal temperature for enzymes.
If optimum body temperature is not maintained, then cells will not function correctly

Control of body temperature

Body temperature is monitored and controlled by the thermoregulatory centre in the brain.



The thermoregulatory centre contains receptors sensitive to the temperature of the blood.

Too high body temperature

When our body becomes too hot, the following things happen:
- We sweat – water released onto the skin' then is evaporated using heat energy from the body.
- Vasodilation occurs – blood vessels near the skin become wider and blood flow increases meaning more heat is transferred away from the body.

Too low body temperature

When our body becomes too cold, the following things happen:
- We shiver – the skeletal muscles contract rapidly -This generates heat.
- Vasoconstriction occurs – blood vessels near the skin become narrower and blood flow decreases meaning less heat is transferred away from the body.
- Skin hairs stand upright – the hair erector muscles contract and so the hairs stand erect on the skin's surface. This traps an insulating layer of air across the skin's surface and reduces heat loss.

Water control

If body cells lose or gain too much water by osmosis they do not function efficiently

- Water leaves body via lungs during breathing and lost from the skin in sweat.
- Excess water, ions and urea removed via the kidneys in urine

Kidney failure

People who suffer from kidney failure may be treated by organ transplant or by using kidney dialysis.

A dialysis machine acts as an artificial kidney to remove urea and restore the water and ion balance of the blood. Blood is mixed with anti-coagulant and pumped into the dialysis machine. Inside the machine the blood and dialysis fluid are separated by a partially permeable membrane the blood flows in the opposite direction to dialysis fluid, allowing exchange to occur between the two where a concentration gradient exists. Dialysis fluid contains glucose /Ion concentrations similar to a normal level in the blood and no urea

Deamination

The digestion of proteins from the diet results in excess amino acids. In the liver these amino acids are deaminated to form ammonia. Ammonia is toxic and so it is immediately converted to urea for safe excretion

Deamination

Kidneys are important for excretion and homeostasis

Step 1: Small molecules (urea, water, ions, and glucose) are filtered out of the blood in the kidney.

Step 2: Useful substances are selectively reabsorbed back in the blood:

- all of the glucose
- some water – as much as the body needs to maintain a constant water level in the blood
- some ions – as much as the body needs to maintain a constant balance of ions in the blood

Step 3: The substances which are not selectively reabsorbed (the urea, excess water and excess ions) form urine

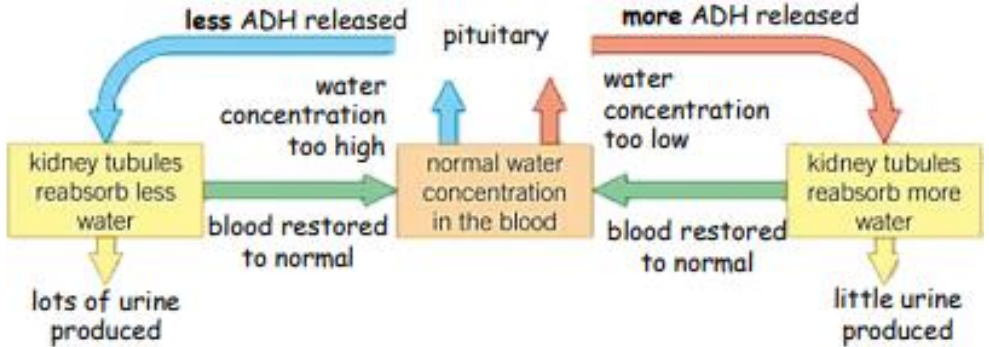
Kidneys and ADH

ADH is released by the pituitary gland.

ADH is important in water control. When we are dehydrated, it makes sure we urinate less and conserve water.

Water content of the blood is controlled via a negative feedback mechanism.

ADH increases the permeability of the kidney tubules-so water reabsorbed into blood



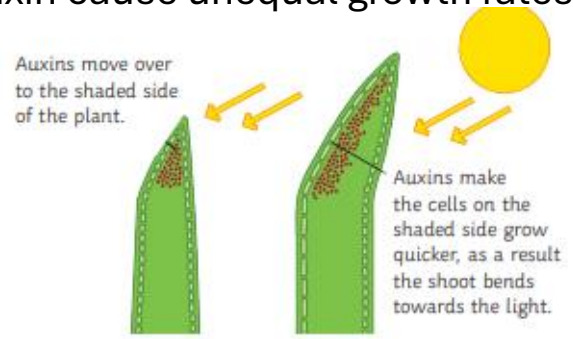
Plant hormones

Plants produce hormones to coordinate and control growth and responses to light (phototropism) and gravity (geotropism).

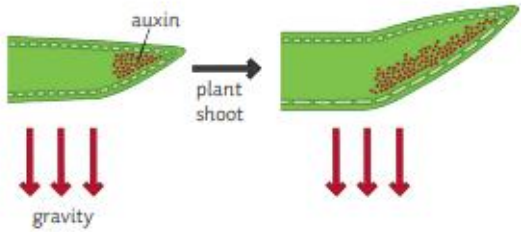
Control of growth

Unequal distributions of auxin cause unequal growth rates in plant roots and shoots.

Responses to light (phototropism)



Responses to gravity (geotropism).



phototropism	Auxin moves to shaded side. The side with the highest concentration of auxins has the highest growth rate and the shoot grows toward the light.
geotropism	Gravity causes an unequal distribution of auxins. lowest concentration has the highest growth rate, and the root grows in the direction of gravity

Use of plant hormones

Auxins are used:
- as weed killers
- as rooting powders
- for promoting growth in tissue culture.

Ethene is used to control
- ripening of fruit during storage and transport.
- cell division

Gibberellins can be used to:
- end seed dormancy
- promote flowering
- increase fruit size.

Required practical activity 8: investigate the effect of light on growth

The independent variables -light and dark conditions.
The dependent variable - the mean height of seedlings.
Control variables -number of seeds ,the volume of water ,the temperature

Method
- Put cotton wool into petri dishes, and add the same volume of water to each dish.
- Add ten seeds to each dish
- One petri dish will sit in full light on a windowsill, the second will be in a dark cupboard, and the final dish will be placed in partial light.
- Every day for one week, measure the height of each seedling .
- Calculate the mean of the seedlings each day, and compare the mean heights in the three different locations.

11 BIOLOGY B6 Triple Inheritance, variation and evolution - KO Paper 2: KS4

Meiosis and fertilisation	Sexual and asexual reproduction	Advantages and disadvantages of sexual and asexual reproduction (Triple Only)	Genetic inheritance intro and key words	Genetic crosses and sex determination	Genetic disorders	Embryo screening and ethics	Mendel (Triple Only)	Genes and the genome, DNA and chromosomes	Protein synthesis, DNA structure and mutations 1 (Triple Only)	Protein synthesis, DNA structure and mutations 2 (Triple Only)

Key Words

Key Word	Definition
Allele	An alternative form of a gene
Dominant	An allele that is always expressed, even if only one copy is present
Fertilisation	The fusion of male and female gametes
Gamete	Sperm cell and egg cell in animals, pollen and egg cell in plants
Genotype	The combination of alleles
Heterozygous	A genotype that has two different alleles.
Homozygous	A genotype that has two of the same alleles.
Mutation	A change in DNA
Phenotype	The characteristic expressed because of the combination of alleles
Recessive	An allele that is only expressed if two copies of it are present

Misconceptions

- Meiosis and Mitosis are the same type of cell division (Meiosis produces gametes, Mitosis produces body cells)
- Asexual reproduction means there is no sexual intercourse (rather than no gametes being involved in asexual reproduction)
- Polydactyly causes extra limbs (rather than extra digits on people's hands and feet)
- Embryos shouldn't be screened as it's 'playing God', or unnatural (rather than every embryo has the right to life)
- Chromosomes, genes and DNA all have the same job (rather than each playing a different role)

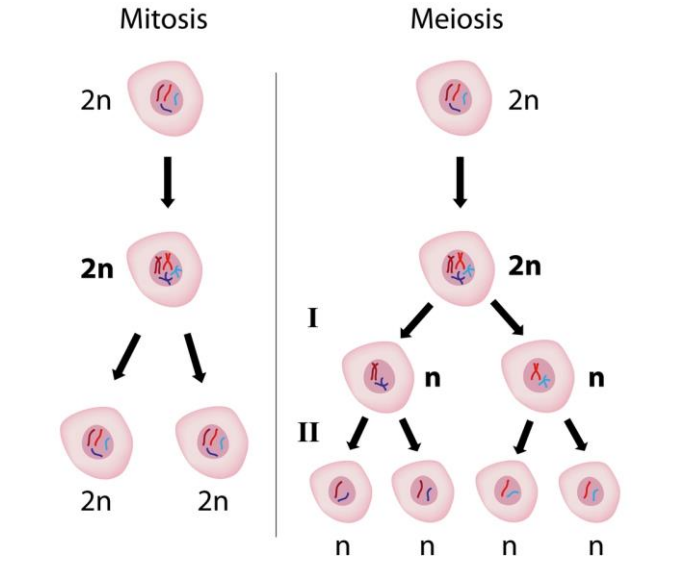
Key questions

- What is the difference between sexual and asexual reproduction?
- How is meiosis cell division different to mitosis cell division?
- How are genetic cross diagrams used to determine the probability of a genetic trait?
- What are the pros and cons of screening embryos for genetic disorders?
- What is the human genome and why has the studying of it been an important scientific development?

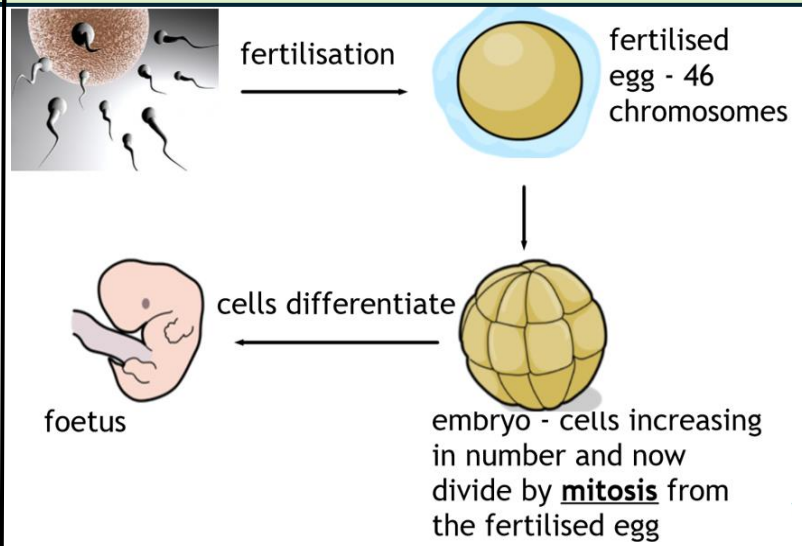
12 BIOLOGY B6 Triple Inheritance, variation and evolution - KO Paper 2: KS4

Meiosis (and mitosis comparison)

Meiosis	Mitosis
Produces two daughter cells	Produces four slaughter cells
Daughter cells are genetically identical	Daughter cells are not genetically identical
The cell divides once	The cell divides twice
The chromosome number is reduced by hall. In humans, this is 23 chromosomes.	The chromosome number of the daughter calls in the same as the parent cells. In humans, this is 46 chromosomes
Produces gametes for sexual reproduction	Used for growth and repair, and asexual reproduction



Fertilisation



Fertilisation is part of sexual reproduction.
Gametes fuse together.
It restores the normal number of chromosomes.
The new cell divides by mitosis.

Sexual and asexual reproduction

Feature	Sexual reproduction	Asexual reproduction
Common in bacteria		X
Plants do it	X	X
Most animals do it	X	
Needs two parents	X	
Needs only one parent		X
Gametes made	X	
Cell fusion involved	X	
No cell fusion involved		X
Variety in offspring	X	
Offspring are clones		X

Advantages of sexual reproduction:

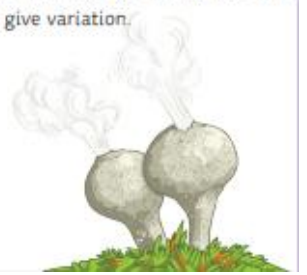
- Produces variation in the offspring;
- If the environment changes, variation gives a survival advantage via natural selection;
- Natural selection can be increased by humans in selective breeding to increase food production.

Advantages of asexual reproduction:

- Only one parent needed;
- More time and energy efficient as they do not need to find a mate;
- Faster than sexual reproduction;
- Many identical offspring can be produced when conditions are favourable.

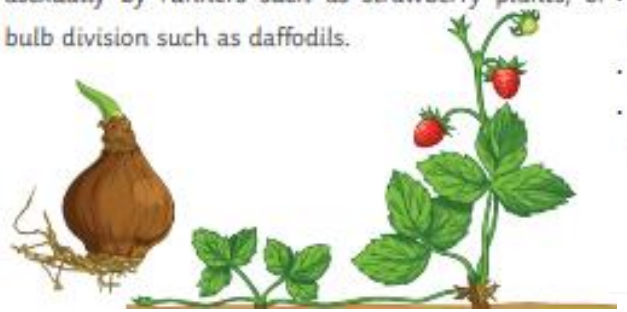
Malarial parasites reproduce asexually in the human host but sexually in the mosquito.

Many fungi reproduce asexually by spores, but also reproduce sexually to give variation.



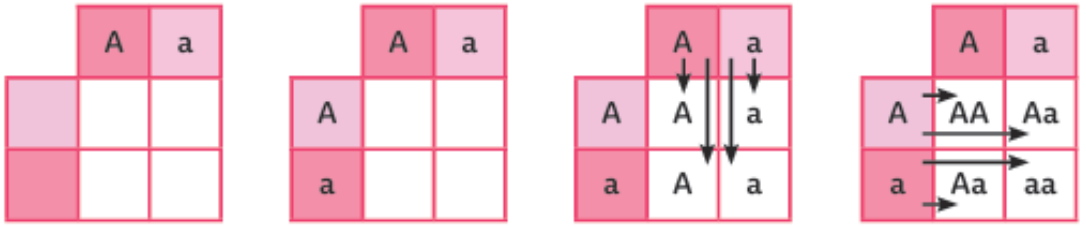
Advantages and disadvantages of sexual and asexual reproduction

Many plants produce seeds sexually, but also reproduce asexually by runners such as strawberry plants, or bulb division such as daffodils.



Genetic crosses using a Punnet Square and working out probability

How to Complete a Punnet Square



Step 1:
Put the two alleles from one parent into the boxes at the top. This parent is a heterozygote. This means they have one dominant and one recessive allele.

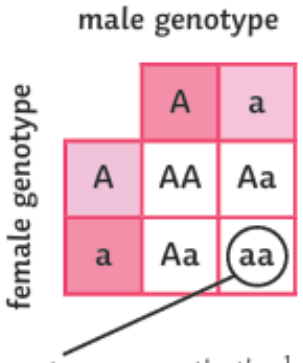
Step 2:
Put the two alleles from the second parent into the boxes on the left. This parent is also a heterozygote.

Step 3:
Put the alleles from the first parent into the two boxes underneath them.

Step 4:
Put the alleles from the second parent into the two boxes to the right of them.

Probability

There are four possible combinations of gametes that offspring can inherit.

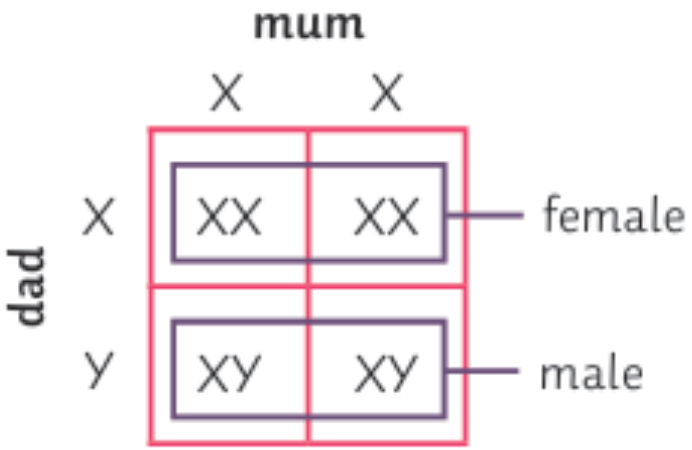


One of these four has the genotype aa – that's $\frac{1}{4}$, 25% or 0.25.

The recessive phenotype has a ratio of 1:3 because only one combination will show the phenotype while the other three will not.

Sex determination

Sex Determination



Females carry two X chromosomes.
Males carry one X and one Y chromosome.

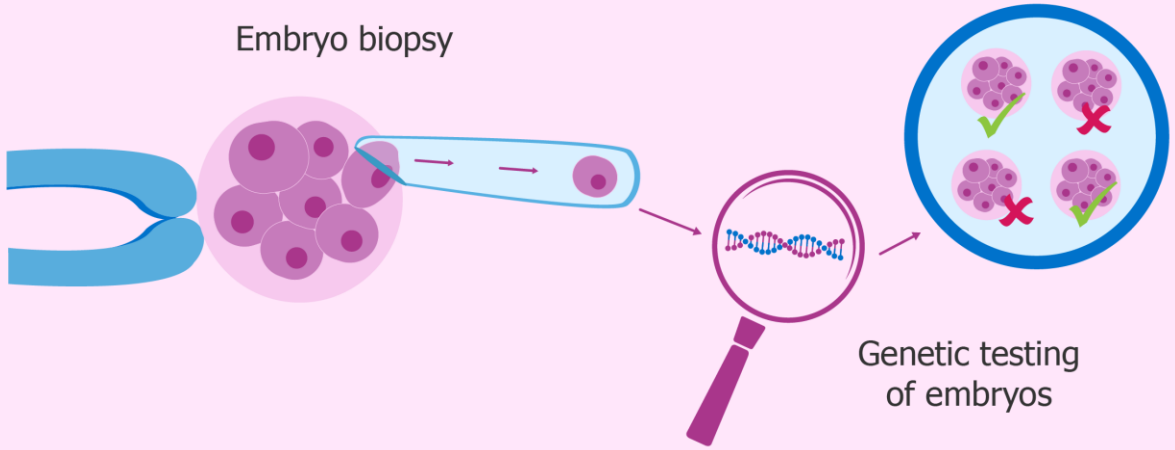
Genetic disorders

Inherited disorder	Dominant or recessive?	Disorder of	Symptoms	Genotype of sufferers
Polydactyly	Dominant	Fingers and toes	Extra fingers or toes	PP or Pp
Cystic fibrosis	Recessive	Cell membranes	Cough, low energy/weight	ff

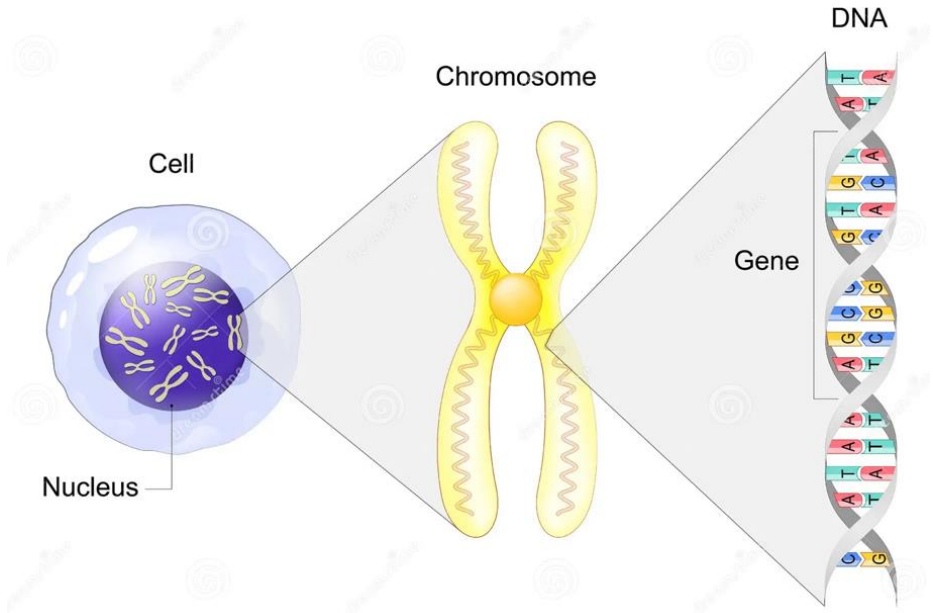
Embryo screening

Embryos can be tested for the presence of a genetic disorder. Screening can be used by people who carry genes linked with inherited disorders.

Advantages	Disadvantages
Reduces number of people in the population with the disorder	Screening is expensive
Reduces healthcare costs	Every embryo has the right to life
Expensive to have a baby with a genetic disorder	Not accepted - playing god, religious reasons, not natural



Chromosomes, genes, DNA and the genome



Key word	Definition
Chromosome	Structures that contain the DNA of an organism
Gene	Small section of DNA that codes for a specific protein
DNA	A polymer that is made up of two strands that form a double helix
Genome	The entire genetic material of an organism.

Mendel

- Austrian monk
- Lived in the mid-19th Century
- Investigated patterns of inheritance in pea plants
- Studied maths and natural history at the University of Vienna.

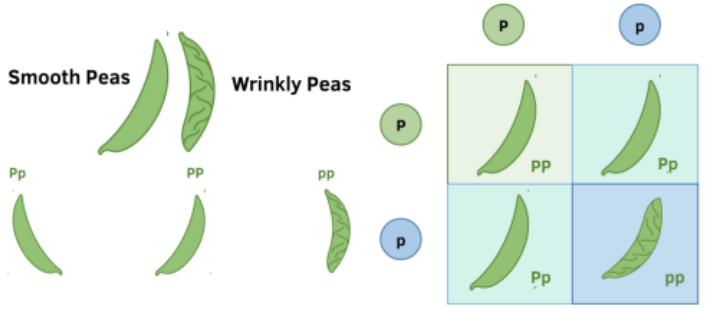


Fig 1. Mendel's experiments lead him to understand that wrinkled peas are a recessive characteristic

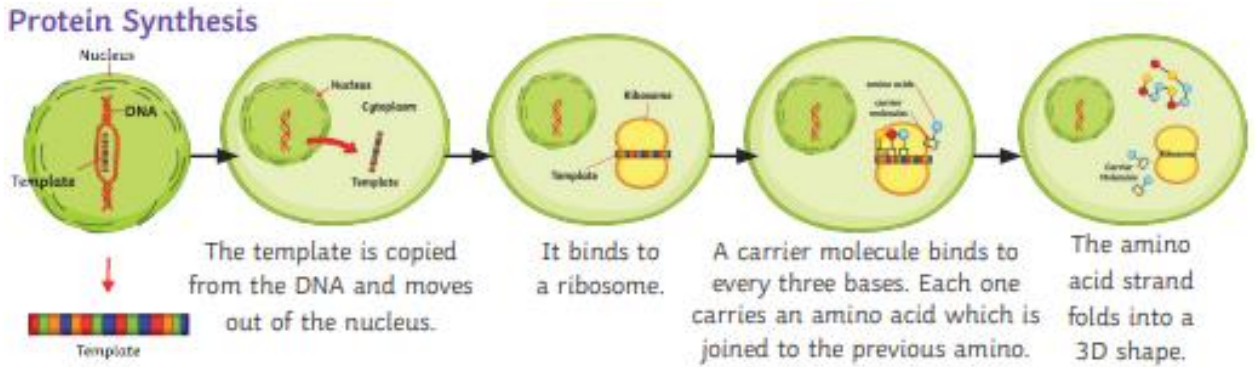
Mendel reached 3 important conclusions:

1. Characteristics in plants are controlled by "hereditary units".
2. Hereditary units are passed on to offspring unchanged from both parents, one from each parent.
3. Hereditary units can be dominant or recessive – if an individual has both the dominant and the recessive unit for a characteristic, the dominant characteristic will be expressed.

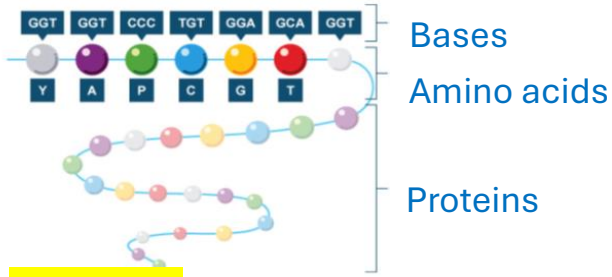
Mendel's discoveries were not appreciated during his lifetime.

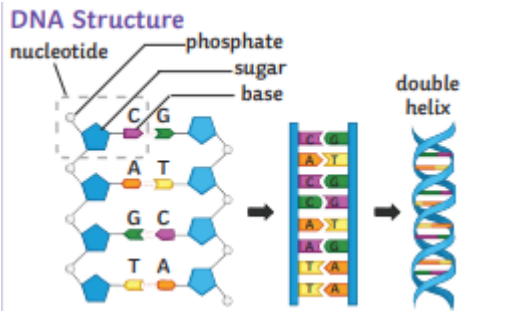
This was mainly because genes, DNA and chromosomes hadn't yet been discovered, so there wasn't any background knowledge to properly understand his findings.

Protein synthesis, DNA structure and mutations



A molecule of mRNA is made by copying the code from the DNA.
The mRNA molecule leaves the nucleus and travels to the cytoplasm.
Carrier molecules bring the correct amino acid to the ribosome in the correct order to form a protein chain.
The protein chain is released into the cytoplasm.





Mutations:

An insertion is where are where a new base is inserted into the DNA base sequence where it shouldn't be.

Deletions happen when a random base is deleted from the DNA base sequence. Like insertions, they change the way the base sequence is "read" and have knock on effects further down the sequence.

Substitutions happen when a random base from the DNA base sequence is changed to a different base.

16 BIOLOGY B6 Triple Inheritance, variation and evolution - KO Paper 2: KS4

Variation and mutations	Natural selection and evolution	Theory of evolution (Triple only)	Speciation (Triple only)	Classification and evolutionary trees 1	Classification and evolutionary trees 2	Fossils and extinction	Antibiotic resistant bacteria	Selective breeding	Genetic engineering	Plant cloning (Triple only)	Animal cloning (Triple only)

Key Words

Key Word	Definition
Evolution	A change in the inherited characteristics of a population over time through a process of natural selection
Evolutionary tree	A method used to show how scientists believe organisms are related
Extinction	The permanent loss of all members of a species
Fossils	The remains of organisms from millions of years ago which are found in rocks
Genetic engineering	The process by which scientists manipulate and change the genotype of an organism.
Natural selection	The process by which organisms that are better suited to an environment are more likely to survive and reproduce
Selective breeding	Humans selecting animals or plants, that have a required characteristic, for breeding.
Variation	Differences in characteristics of individuals in a population.

Misconceptions

- That a mutation is always harmful – most mutations have no effect at all, some are beneficial, and some are harmful
- That humans have evolved from monkeys/apes – we have evolved and branched off from a common ancestor
- That soft tissue can never be fossilised – this isn't true if the fossil is formed in the absence of decay factors
- That antibiotic resistance happens when the body become resistant to antibiotics. It is the bacteria, not humans or animals
- That selective breeding and genetic engineering are the same process – they aren't

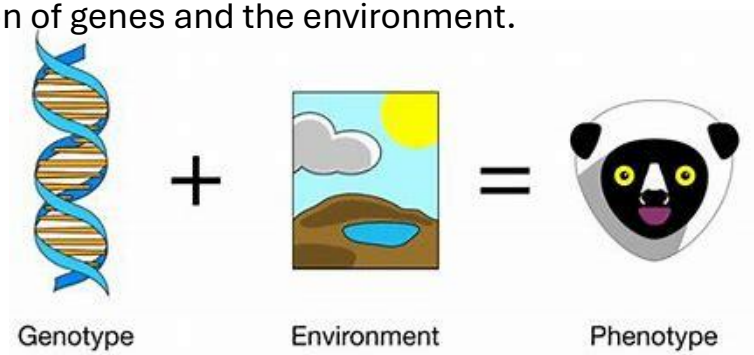
Key questions

- What can cause variation amongst a species and what is a mutation?
- How can evolution be explained by Darwin's theory of natural selection?
- How are living organisms classified and how can evolutionary trees show how organisms are related?
- What is the evidence for evolution and how are fossils formed?
- What are the advantages and disadvantages of selective breeding and genetic engineering?

Variation and Mutations

Differences in the characteristics of individuals in a population is called **variation** and may be due to differences in:

- The genes they have inherited (genetic causes)
- The conditions in which they have developed (environmental causes)
- A combination of genes and the environment.



- There is usually extensive genetic variation within a population of a species
- All variants arise from mutations and that: most have no effect on the phenotype (characteristics) ; some influence phenotype; very few determine phenotype.

Mutations occur continuously. Very rarely a mutation will lead to a new phenotype. If the new phenotype is suited to an environmental change it can lead to a relatively rapid change in the species.

Natural Selection and Evolution

Evolution is change in the inherited characteristics of a population over time through a process of natural selection which may result in the formation of a new species.

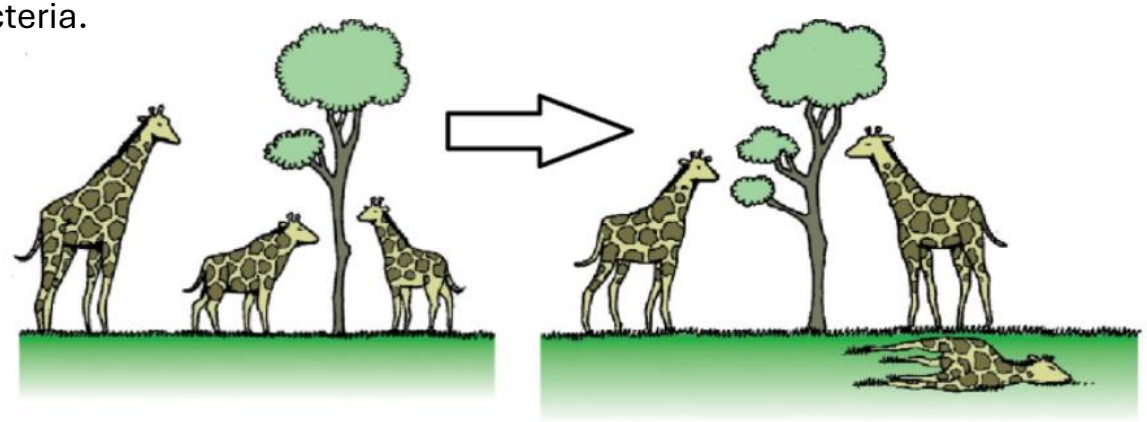
The theory of evolution by natural selection states that all species of living things have evolved from simple life forms that first developed more than three billion years ago.

Evolution occurs through natural selection of variants that give rise to phenotypes (characteristics) best suited to their environment. If two populations of one species become so different in phenotype that they can no longer interbreed to produce fertile offspring they have formed two new species.

The evidence for evolution includes fossils and antibiotic resistance in bacteria.

The theory of evolution by natural selection is now widely accepted.

Evidence for Darwin's theory is now available as it has been shown that characteristics are passed on to offspring in genes. There is further evidence in the fossil record and the knowledge of how resistance to antibiotics evolves in bacteria.



Theory of evolution (Triple only)

Charles Darwin, as a result of observations on a round the world expedition, backed by years of experimentation and discussion and linked to developing knowledge of geology and fossils, proposed the theory of evolution by natural selection.

- **Individual organisms within a particular species show a wide range of variation for a characteristic.**
- **Individuals with characteristics most suited to the environment are more likely to survive to breed successfully.**
- **The characteristics that have enabled these individuals to survive are then passed on to the next generation.**

Darwin published his ideas in On the Origin of Species (1859). There was much controversy surrounding these revolutionary new ideas. The theory of evolution by natural selection was only gradually accepted because:

- **The theory challenged the idea that God made all the animals and plants that live on Earth**
- **There was insufficient evidence at the time the theory was published to convince many scientists**
- **The mechanism of inheritance and variation was not known until 50 years after the theory was published.**

Other theories, including that of Jean-Baptiste Lamarck, are based mainly on the idea that changes that occur in an organism during its lifetime can be inherited. We now know that in the vast majority of cases this type of inheritance cannot occur

Speciation (Triple only)

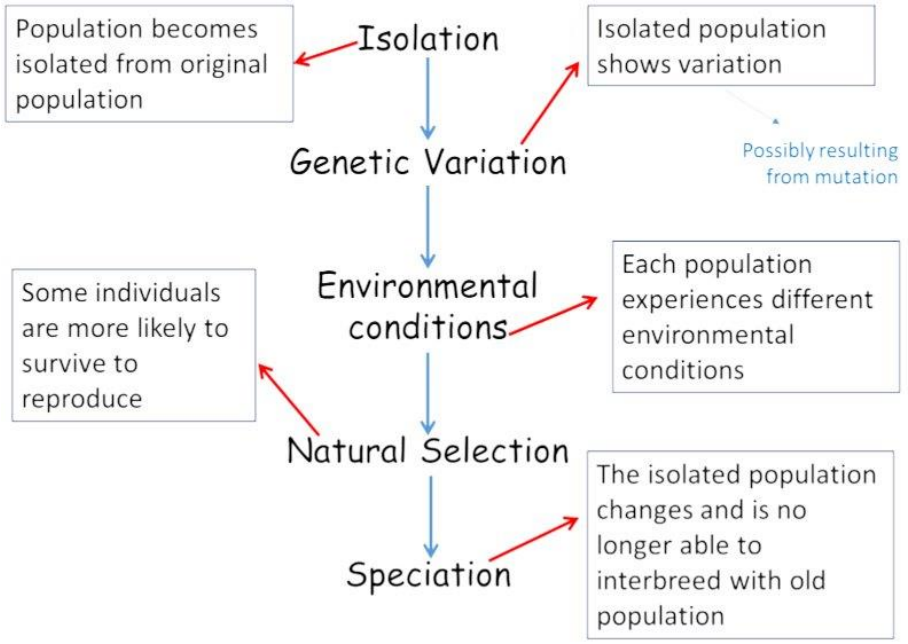
Alfred Russel Wallace independently proposed the theory of evolution by natural selection. He published joint writings with Darwin in 1858 which prompted Darwin to publish On the Origin of Species (1859) the following year.

Wallace worked worldwide gathering evidence for evolutionary theory. He is best known for his work on warning colouration in animals and his theory of speciation.

Alfred Wallace did much pioneering work on speciation but more evidence over time has led to our current understanding of the theory of speciation.

Describe the steps which give rise to new species:

- **Isolation**
- **Genetic variation**
- **Natural selection**
- **Speciation**



Classification

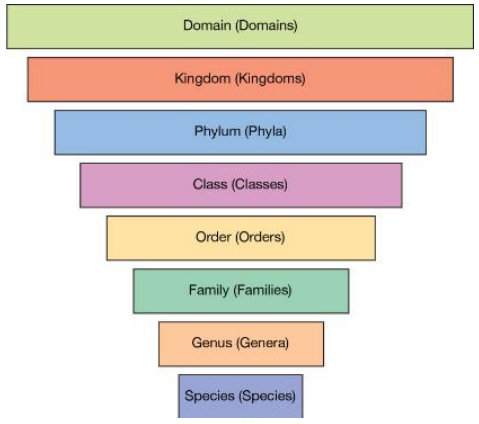
Traditionally living things have been classified into groups depending on their structure and characteristics in a system developed by Carl Linnaeus.

Linnaeus classified living things into kingdom, phylum, class, order, family, genus and species. Organisms are named by the binomial system of genus and species.

As evidence of internal structures became more developed due to improvements in microscopes, and the understanding of biochemical processes progressed, new models of classification were proposed.

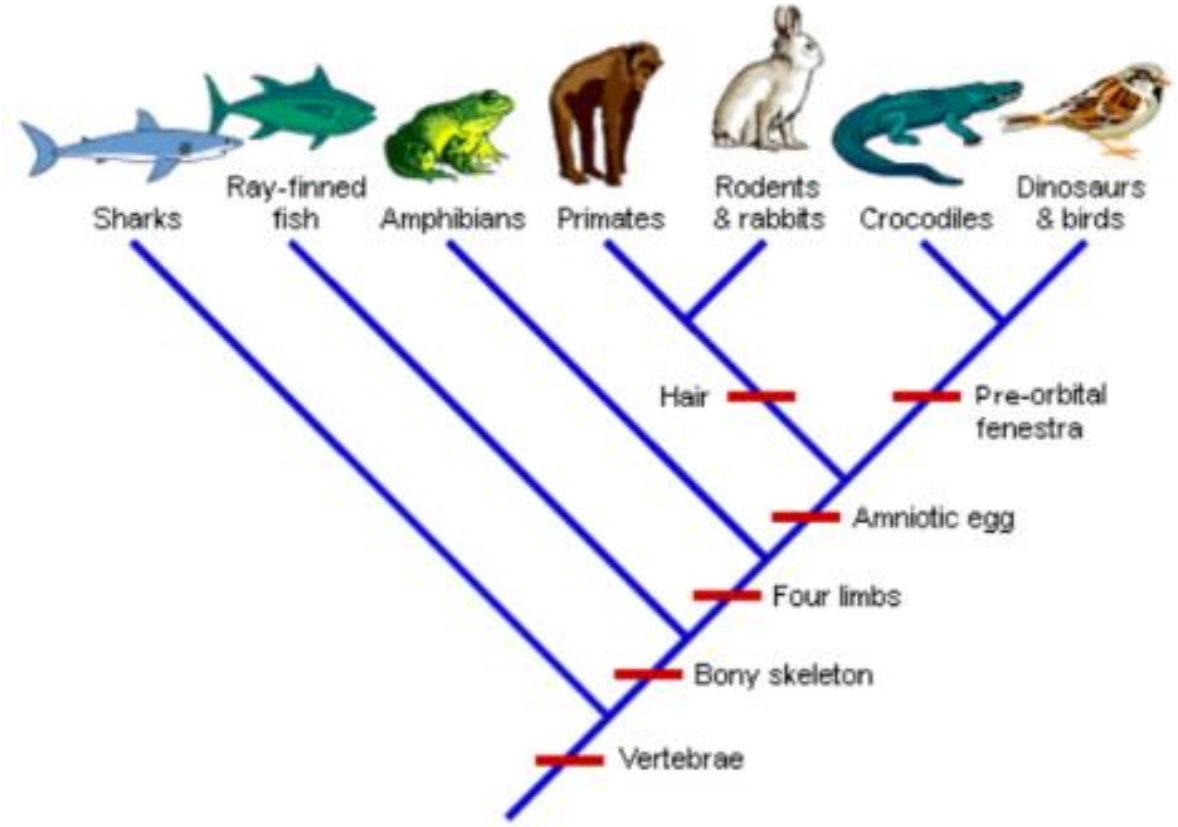
Due to evidence available from chemical analysis there is now a 'three-domain system' developed by Carl Woese.

In this system organisms are divided into:
- Archaea (primitive bacteria usually living in extreme environments)
- Bacteria (true bacteria)
- Eukaryota (which includes protists, fungi, plants and animals).



Evolutionary Trees

Evolutionary trees are a method used by scientists to show how they believe organisms are related. They use current classification data for living organisms and fossil data for extinct organisms.



Extinction

Extinctions occur when there are no remaining individuals of a species still alive.

Factors which may contribute to the extinction of a species are:

- Changes in the environment (e.g. the end of the ice age, global warming)
- New predators
- New diseases
- New competitors
- Natural disasters (e.g. earthquakes, volcanoes, asteroids)

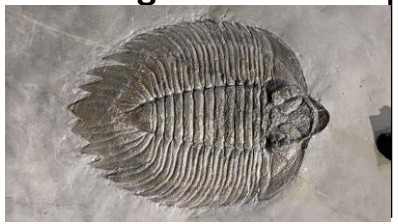
Fossils

Fossils are the 'remains' of organisms from millions of years ago, which are found in rocks. Fossils may be formed:

- From parts of organisms that have not decayed because one or more of the conditions needed for decay are absent
- When parts of the organism are replaced by minerals as they decay
- As preserved traces of organisms, such as footprints, burrows and rootlet traces.

Many early forms of life were soft-bodied, which means that they have left few traces behind. What traces there were have been mainly destroyed by geological activity. This is why scientists cannot be certain about how life began on Earth.

We can learn from fossils how much or how little different organisms have changed as life developed on Earth.



Antibiotic Resistant Bacteria

Bacteria can evolve rapidly because they reproduce at a fast rate.

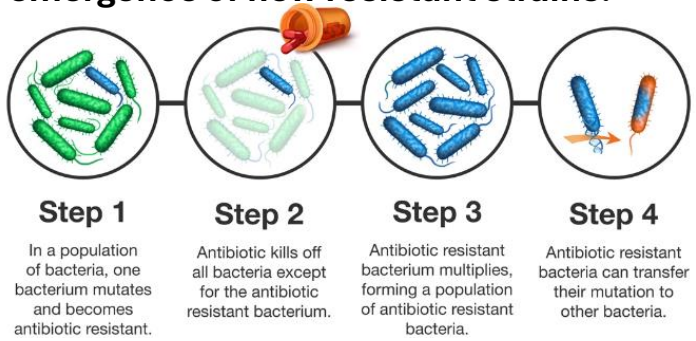
Mutations of bacterial pathogens produce new strains. Some strains might be resistant to antibiotics, and so are not killed. They survive and reproduce, so the population of the resistant strain rises. The resistant strain will then spread because people are not immune to it and there is no effective treatment.

MRSA is resistant to antibiotics.

To reduce the rate of development of antibiotic resistant strains:

- Doctors should not prescribe antibiotics inappropriately, such as treating non-serious or viral infections
- Patients should complete their course of antibiotics so all bacteria are killed and none survive to mutate and form resistant strains
- The agricultural use of antibiotics should be restricted.

The development of new antibiotics is costly and slow. It is unlikely to keep up with the emergence of new resistant strains.



Selective Breeding

Selective breeding (artificial selection) is the process by which humans breed plants and animals for particular genetic characteristics. Humans have been doing this for thousands of years since they first bred food crops from wild plants and domesticated animals.

Selective breeding involves choosing parents with the desired characteristic from a mixed population. They are bred together. From the offspring those with the desired characteristic are bred together. This continues over many generations until all the offspring show the desired characteristic.

The characteristic can be chosen for usefulness or appearance:

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

Selective breeding can lead to 'inbreeding' where some breeds are particularly prone to disease or inherited defects.

Advantages of Selective Breeding	Disadvantages of Selective Breeding
Disease resistance in food crops	Can lead to inbreeding
Animals that produce more meat and milk	Prone to disease
Domestic dogs	Inherited defects (due to reduced gene pool)
Large or unusual flowers	Reduced variation

Genetic Engineering

Genetic engineering as a process which involves modifying the genome of an organism by introducing a gene from another organism to give a desired characteristic.

Plant crops have been genetically engineered to be resistant to diseases or to produce bigger better fruits.

Bacterial cells have been genetically engineered to produce useful substances such as human insulin to treat diabetes.

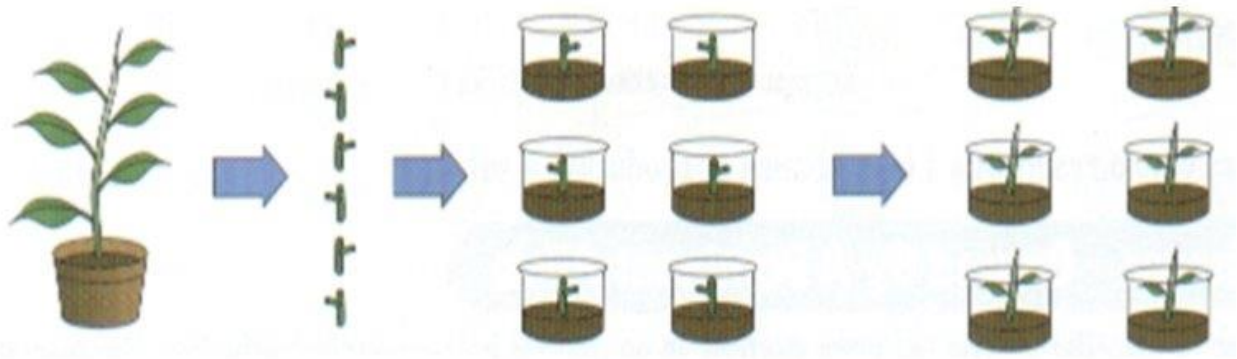
In genetic engineering, genes from the chromosomes of humans and other organisms can be 'cut out' and transferred to cells of other organisms.

Crops that have had their genes modified in this way are called genetically modified (GM) crops. GM crops include ones that are resistant to insect attack or to herbicides. GM crops generally show increased yields. Concerns about GM crops include the effect on populations of wild flowers and insects. Some people feel the effects of eating GM crops on human health have not been fully explored. Modern medical research is exploring the possibility of genetic modification to overcome some inherited disorders.

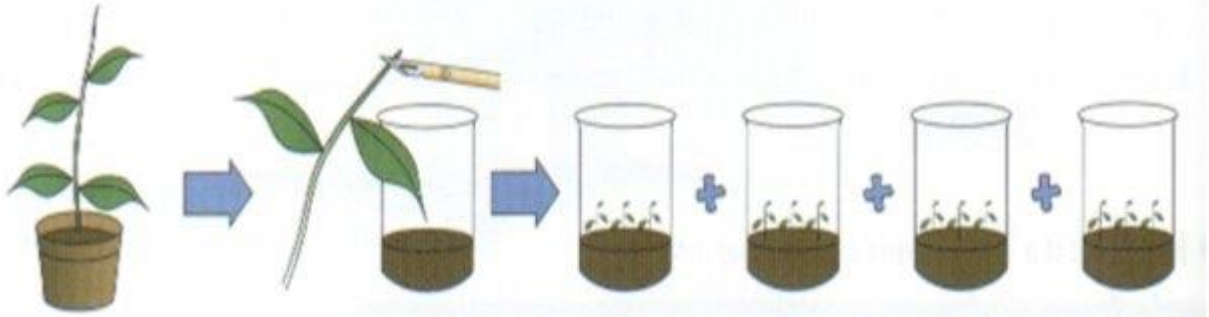
Benefits of Genetic Engineering	Risks of Genetic Engineering
Crops often have a higher yield	Hard to predict how changing an animal's DNA will affect the animal.
Brings more profit for farmers	GM crops might affect the number of wild flowers (and so the population of insects) that live around the crop.
Produce bigger and better fruit and to be disease resistant	Uncertainty about the effects of GM crops on human health.
Could reduce food shortages	Some GM animals may suffer health problems later in life.

Plant Cloning (Triple only)

Cuttings: an older, but simple, method used by gardeners to produce many identical new plants from a parent plant.

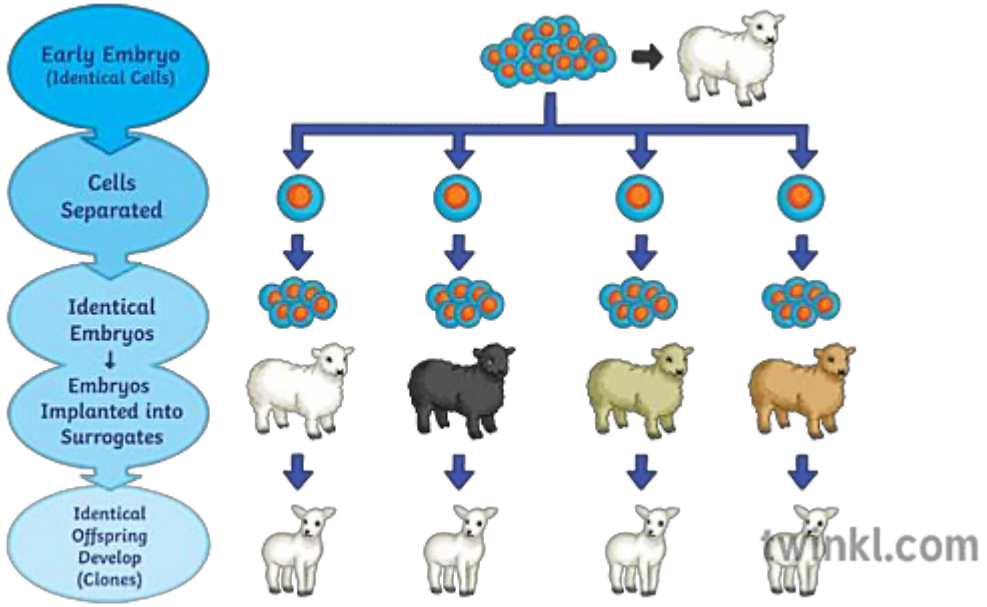


Tissue culture: using small groups of cells from part of a plant to grow identical new plants. This is important for preserving rare plant species or commercially in nurseries.



Animal Cloning (Triple only)

Embryo transplants: splitting apart cells from a developing animal embryo before they become specialised, then transplanting the identical embryos into host mothers.



Adult cell cloning:

- The nucleus is removed from an unfertilised egg cell.
- The nucleus from an adult body cell, such as a skin cell, is inserted into the egg cell.
- An electric shock stimulates the egg cell to divide to form an embryo.
- These embryo cells contain the same genetic information as the adult skin cell.
- When the embryo has developed into a ball of cells, it is inserted into the womb of an adult female to continue its development.

23 BIOLOGY B7 Triple Ecology – Knowledge Organiser Paper 2: KS4

Ecology key words and biotic and abiotic factors	Interdependence, food chains, food webs and predator prey cycles	Adaptations (structural, behavioural, functional and extremophiles	Quadrats, transects and estimating population size intro	Investigate the population size of a common species in a habitat (Quadrat RP)	Decay theory (Triple Only)	Decay Required Practical (Triple Only)	Carbon cycle and water cycle	Global warming	Biodiversity, factors affecting it and maintaining biodiversity	Biomass and efficiency calculations (Triple Only)	Food security, intensive farming and role of biotechnology (Triple Only)

Key Words

Key Word	Definition
Ecosystem	The interaction between the living and non-living parts of an environment
Biotic	Living
Abiotic	Non living
Producer	A plant that carries out photosynthesis – start of a food chain
Interdependence	Where animals/plants depend on each other e.g. for food, shelter,
Stable community	A community where the animal/plant populations don't change
Adaptations	Feature which increases an organism's chance of survival
Extremophiles	Organisms that live in very extreme
Transpiration	Evaporation of water from the leaves
Global warming	Increasing temperature of the earth due to greenhouse gases
Deforestation	Cutting down trees for timber/farmland
Biodiversity	The variety of life

Misconceptions

There is **NOT** a buildup of biomass along a food chain

Predator and prey populations are **NOT** similar in size.

Adaptations do NOT suddenly change in response to the environment

In a food chain the arrows do not show what has been eaten

Key questions

Explain how to sample the number of plants on a school field

Explain the predator – prey relationship

Explain the impact of farming on biodiversity

Describe the methods used to increase biodiversity

24 BIOLOGY B7 Triple Ecology – Knowledge Organiser Paper 2: KS4

Biotic/Abiotic factors

Biotic - Living
Abiotic - Non living

Biotic	Abiotic
Food	Light
Disease	Temperature
Predators	pH of soil
Competition	Availability of minerals

Ecosystems

- Habitat Place where organisms live e.g. woodland, lake.
- Population Individuals of a species living in a habitat.
- Community Populations of different species living in a habitat
- Ecosystem- All the living and non-living parts and their interactions

Competition

Animals compete with each other for food, mates and territory

Plants in a community or habitat compete with each other for light, space, water and mineral ions.

Interdependence

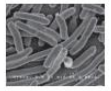
Species depend on each other for food, shelter, pollination, seed dispersal etc.
In a stable community population sizes remain fairly constant

Adaptations

Structural adaptations
- Colours for warning or camouflage
- Feet with a large surface area to stop sinking into the ground.

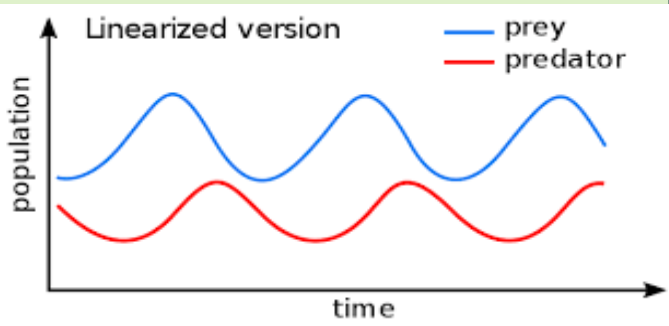
Behavioural adaptations
- Huddling together to stay warm.
- Being active at night

Functional adaptations
- Sweating or not sweating
- Producing toxins

Adaptations		
Plants	*Animals*	*Extremophiles*
Cactus in dry, hot desert	Polar bear in extreme cold artic	Deep sea vent bacteria
		
No leaves to reduce water loss, wide deep roots for absorbing water.	Hollow hairs to trap layer of heat. Thick layer of fat for insulation.	Populations form in thick layers to protect outer layers from extreme heat of vent.

Predator prey relationships

- Prey increase due to less predators.
- Predators increase due to more prey to eat.
- Prey decrease as more eaten.
- Predators decrease as less prey (lag time).

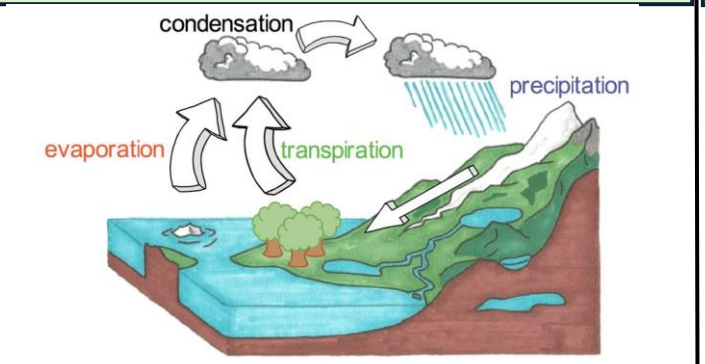


Extremophiles

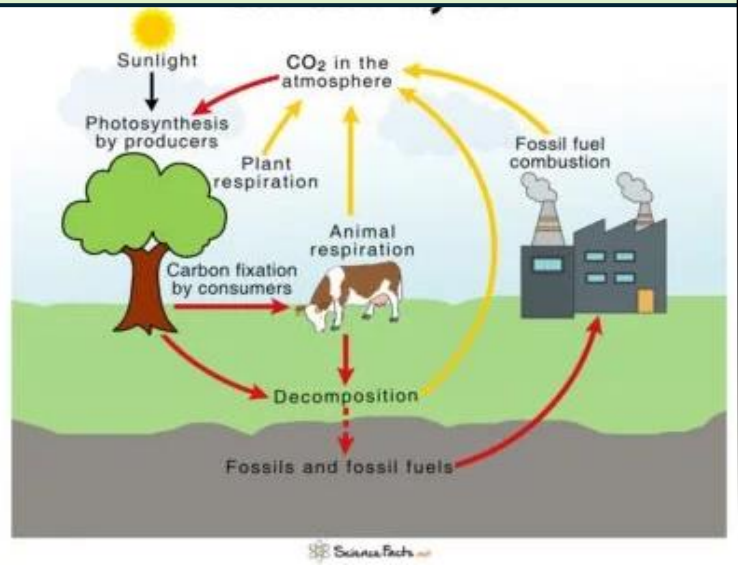
Some organisms live in environments that are very extreme, such as at high temperature, pressure, or salt concentration. These organisms are called extremophiles. Bacteria living in deep sea vents are extremophiles

BIOLOGY B7 Triple Ecology – Knowledge Organiser Paper 2: KS4

Water Cycle

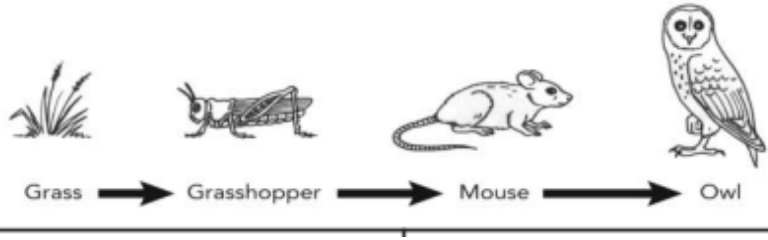


Carbon Cycle

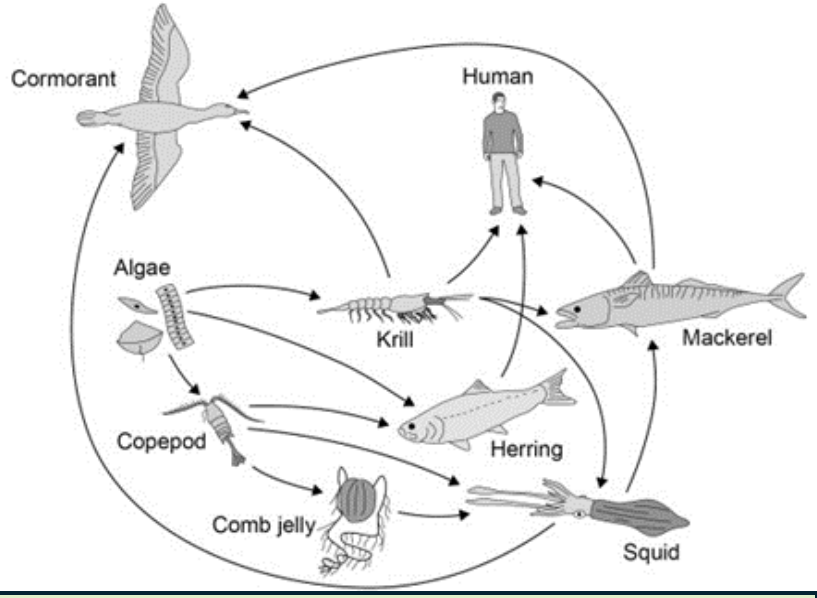


Food chains/webs

Producer	Primary consumer	Secondary consumer	Tertiary consumer



A food chain/wed shows the transfer of energy



Transect sampling

Produce a transect (90 degrees)
Use a Tape measure, Rope
Place a quadrat at regular intervals
Count the number of plants in a quadrat.
Calculate a mean.
Calculate the total area. -mean x area.

Quadrat sampling

- Use a 1m2 quadrat.
- Place Randomly
- Using random coordinates
- Count the number of plants in a quadrat.
- Repeat 10X.
- Calculate a mean.
- Calculate the total area.
- Estimate the population -mean x area.

Peat Bogs

- Peat bogs are dried out and used as a fuel.
- Burning peat releases carbon dioxide into the atmosphere.
- Digging up peat bogs destroys habitats reducing biodiversity.

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Biodiversity

Biodiversity is the variety of all different species of organisms on Earth, or within an ecosystem

Factors reducing biodiversity:

- More waste produced.
- Pollution in water; sewage, fertiliser or toxic chemicals.
- Pollution in air; smoke or acidic gases.
- Pollution on land; landfill and toxic chemicals.
- Cattle Farming
- Deforestation
- Global warming
- Digging peat bogs
- Building

Maintaining biodiversity

- Breeding programs
- Planting hedgerows
- Fishing quotas
- Banning deforestation

Processing data

Median	Middle value in a sample.
Mode	Most occurring value in a sample.
Mean	The sum of all the value in a sample divided by the sample number.

Global warming

Causes

- Cattle Farming
- Deforestation
- Burning fossil fuel
- Burning peat

Effects

- Rising sea levels
- Melting ice caps
- More extreme weather
- Increased ocean and land temperatures
- Reduced biodiversity

Impact of farming

- More grazing cattle- trampling/eating plants.
- Less plants-less photosynthesis.
- More carbon dioxide in atmosphere.
- More methane released (from cows).
- More carbon dioxide from respiration
- More deforestation- to make farmland.
- More sewage in rivers/lakes
- More greenhouse gases (methane/CO2)
- More global warming.
- Ice caps melt, extreme weather.
- Reduced biodiversity

Role of biotechnology

- fungus -mycoprotein, a protein-rich food suitable for vegetarians.
- genetically modified bacterium produces human insulin.
- GM crops provide more food

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Decomposition

Decomposers break down dead plant and animal matter by releasing enzymes into the environment. Small soluble food molecules then diffuse into the microorganism

To investigate the effect of temperature on the rate of decay of fresh milk by measuring pH change.

- Place 20 cm3 of fresh milk into three beakers
- Heat the milk to 5 different temperatures in a water bath
- Use universal indicator paper or solution to determine the pH of the milk
- Cover each beaker in cling film and incubate at the appropriate temperature
- Use universal indicator paper or solution to determine the pH of the milk after 24, 48 and 72 hours

Remember
Protein (pH7) in milk will decay into amino acids (low pH pH1-6).

Transfer of biomass

10% of the biomass from each trophic level is transferred to next trophic level. Losses of biomass are due to:

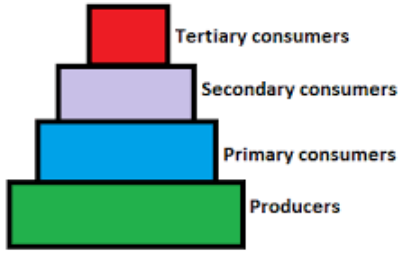
- not all the material eaten is absorbed, some is lost as faeces
- material is lost as waste, such as carbon dioxide and water in respiration and water and urea in urine.
- Large amounts used in respiration.

Factors affecting food security

Food security is having enough food to feed a population.

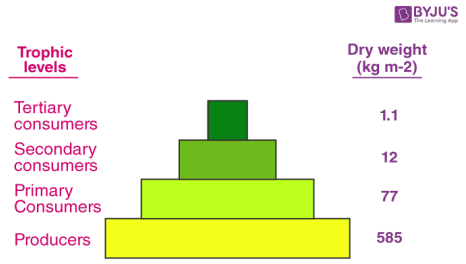
- changing diets in developed countries means scarce food resources are transported around the world
- new pests and pathogens that affect farming
- environmental changes that affect food production, such as widespread famine occurring in some countries if rains fail
- the cost of agricultural inputs
- conflicts that have arisen in some parts of the world which affect the availability of water or food.

Trophic levels



Pyramid of energy

Pyramids of biomass



Pyramid of biomass for grassland ecosystem

Sustainable fisheries

- Control of net size
- fishing quotas

Role of biotechnology

- Fungus -mycoprotein, a protein-rich food suitable for vegetarians.
- Genetically modified bacterium produces human insulin.
- GM crops provide more food

Farming techniques

The efficiency of food production can be improved by

- limiting movement of animals
- by controlling the temperature of their surroundings.
- feed high protein foods to increase growth