Knowledge organiser title	Specification topic	Page numbers
Homeostasis and the nervous system	B5 Homeostasis and response	**2-5**
Inheritance, variation and evolution	B6 Inheritance, variation and evolution	**6-9**
Inheritance, variation and evolution	B6 Inheritance, variation and evolution	**10-14**
Ecology	B7 Ecology	**15-18**

Required practical	Page number
Reaction time	
Quadrat and transect sampling	**17**

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

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

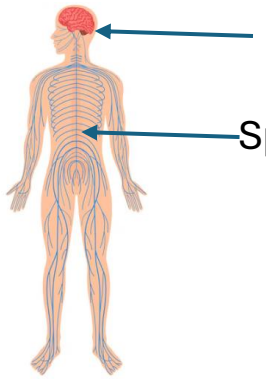
State the roles and interactions of the female sex hormones in the menstrual cycle

Describe the reflex arc

Describe how to carry out IVF

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

Human nervous system



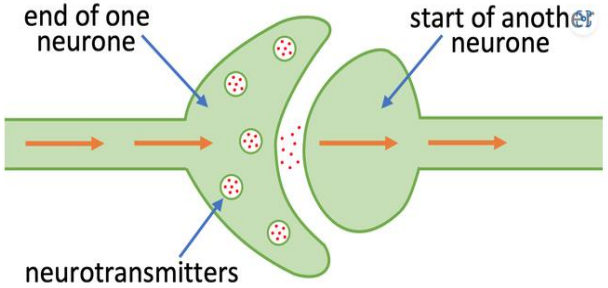
Enables humans to react to their surroundings and to co-ordinate their behaviour

The CNS

The CNS is the brain and the spinal cord.

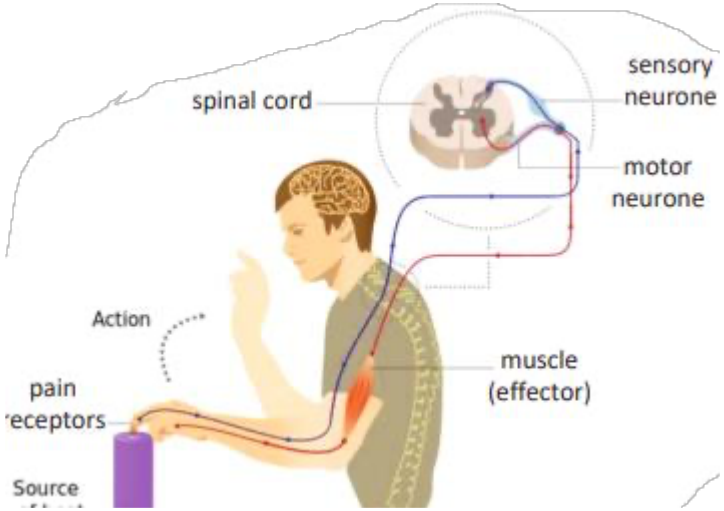
Coordinates the response of effectors; muscles contracting or glands secreting hormones

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

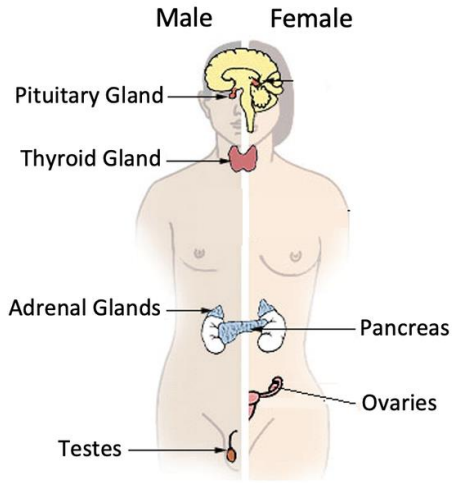
Electrical impulses

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

BIOLOGY B5: Homeostasis & The Nervous System - KO 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

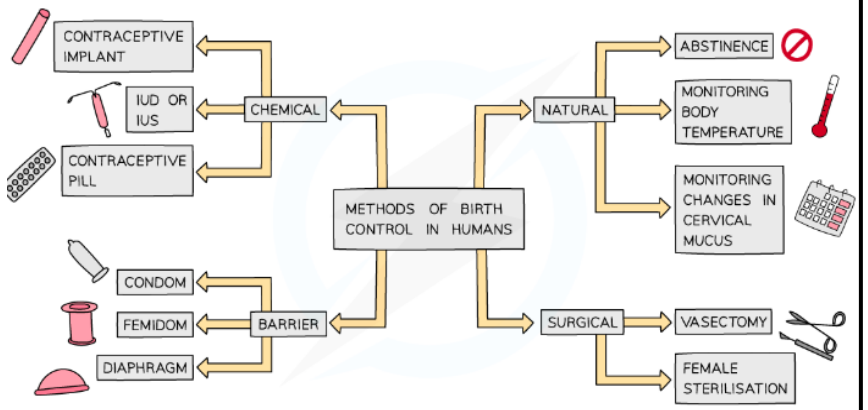
Obesity is a risk factor for Type 2 diabetes

5 BIOLOGY 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.

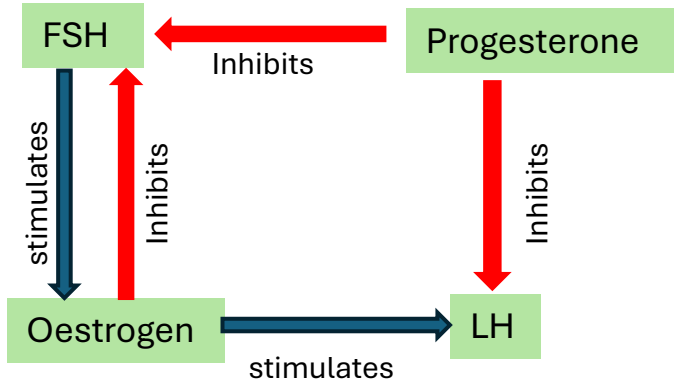
FSH causes maturation of an egg in the ovary.

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 B6 Combined Inheritance, variation and evolution - KO Paper 2: KS4

Meiosis and fertilisation	Sexual and asexual reproduction	Genetic inheritance intro and key words	Genetic crosses and sex determination	Genetic disorders	Embryo screening and ethics	Genes and the genome, DNA and chromosomes

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)

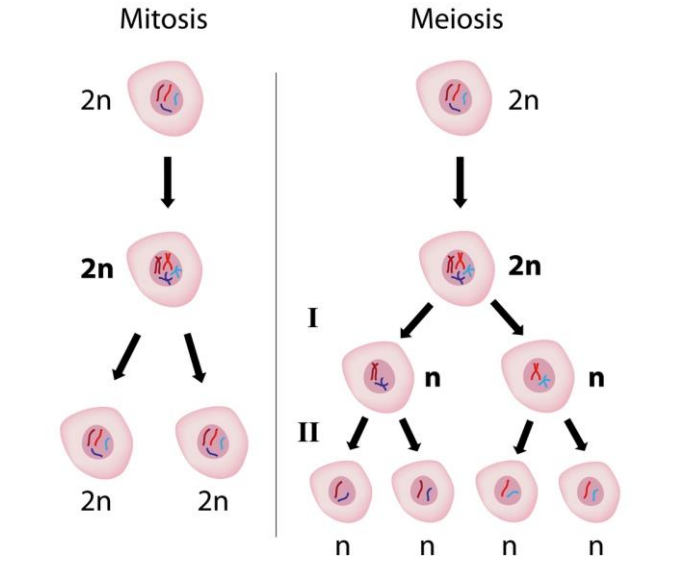
Key questions

- 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?

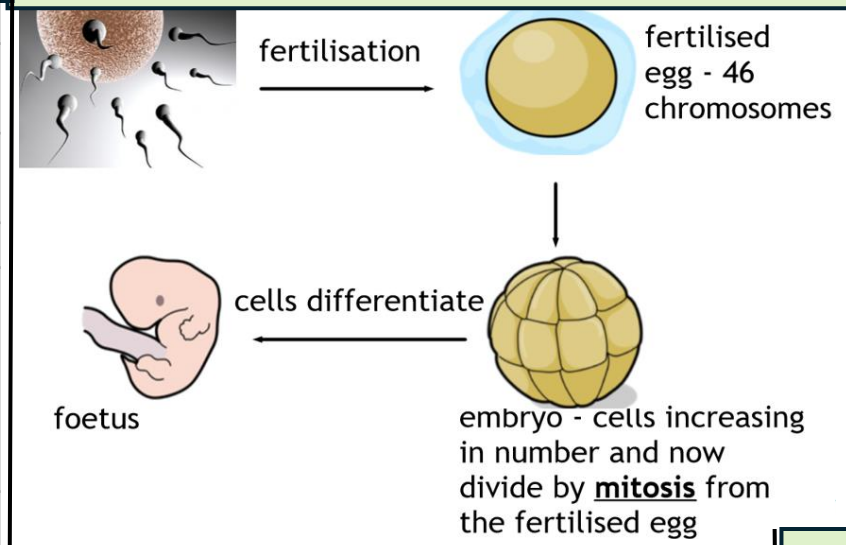
7 BIOLOGY B6 Combined Inheritance, variation and evolution - KO Paper 2: KS4

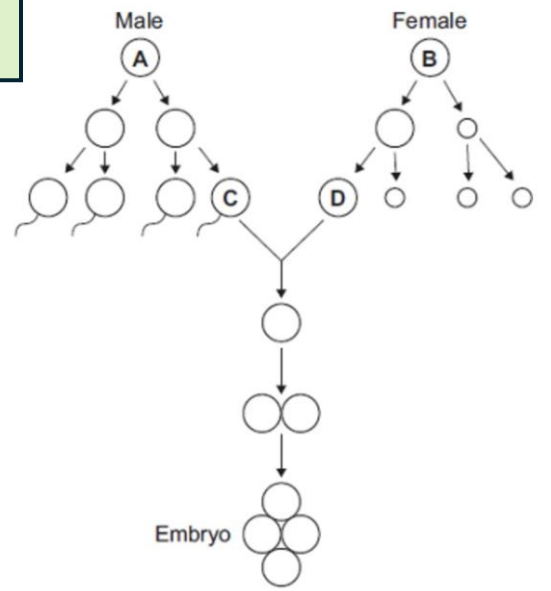
Meiosis (and mitosis comparison)

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

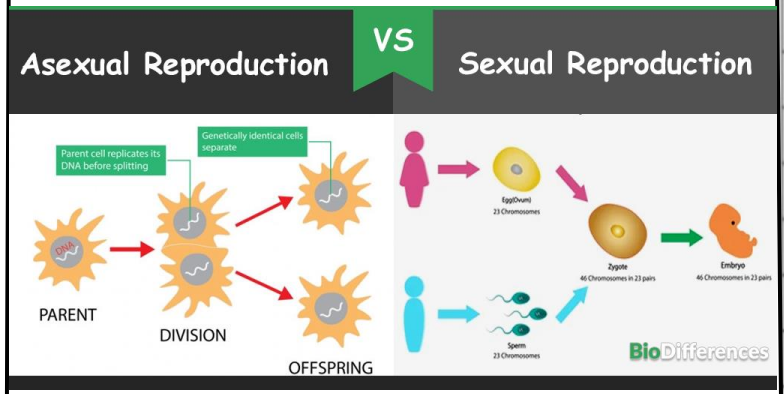


Fertilisation





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

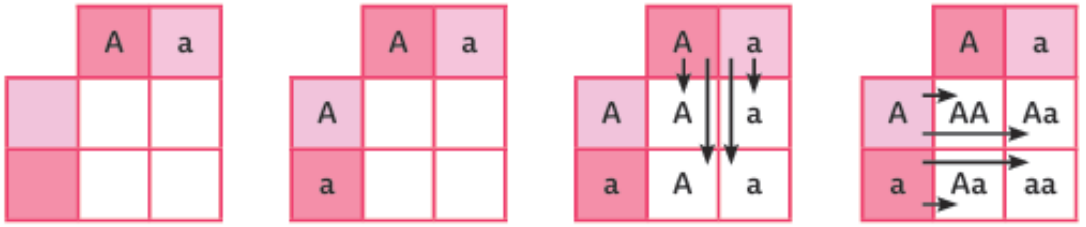


Sexual and asexual reproduction

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

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.

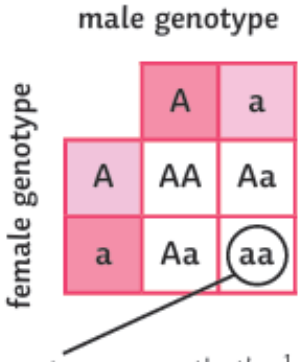
Step 2:
Put the two alleles from the second parent into the boxes on the left. This parent is also a heterozygote.

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.

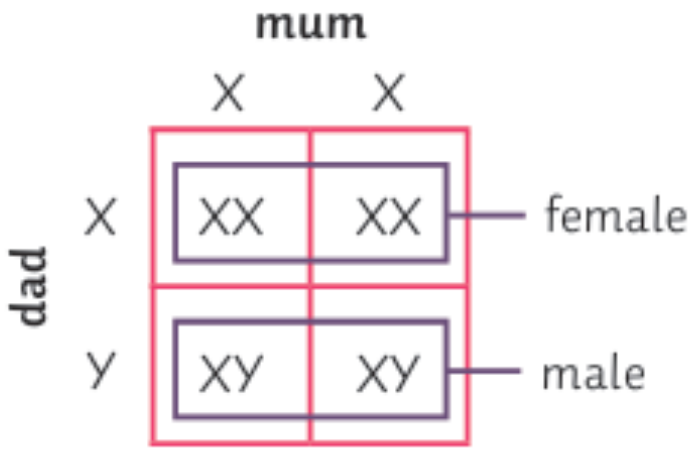


One of these four has the genotype aa – that's $\frac{1}{4}$, 25% or 0.25.

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.

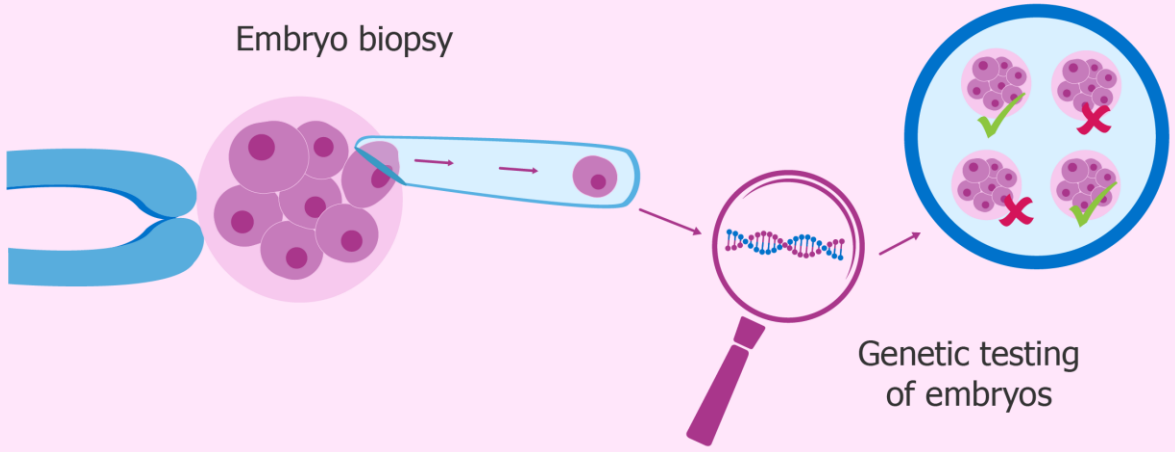
Genetic disorders

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

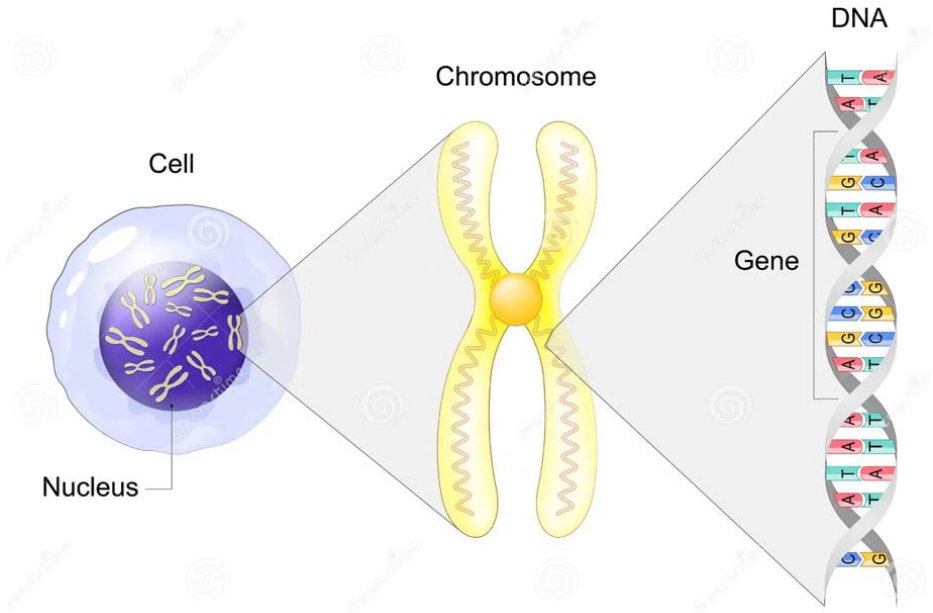
Embryo screening

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.

10 BIOLOGY B6 Combined Inheritance, variation and evolution - KO Paper 2: KS4

Variation and mutations	Natural selection and evolution	Classification and evolutionary trees 1	Classification and evolutionary trees 2	Fossils and extinction	Antibiotic resistant bacteria	Selective breeding	Genetic engineering

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

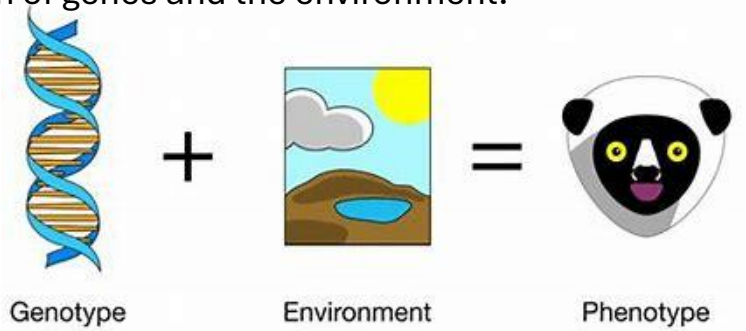
- What can cause variation amongst a species and what is a mutation?
- How can evolution be explained by Darwin's theory of natural selection?
- How are living organisms classified and how can evolutionary trees show how organisms are related?
- What is the evidence for evolution and how are fossils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

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

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.

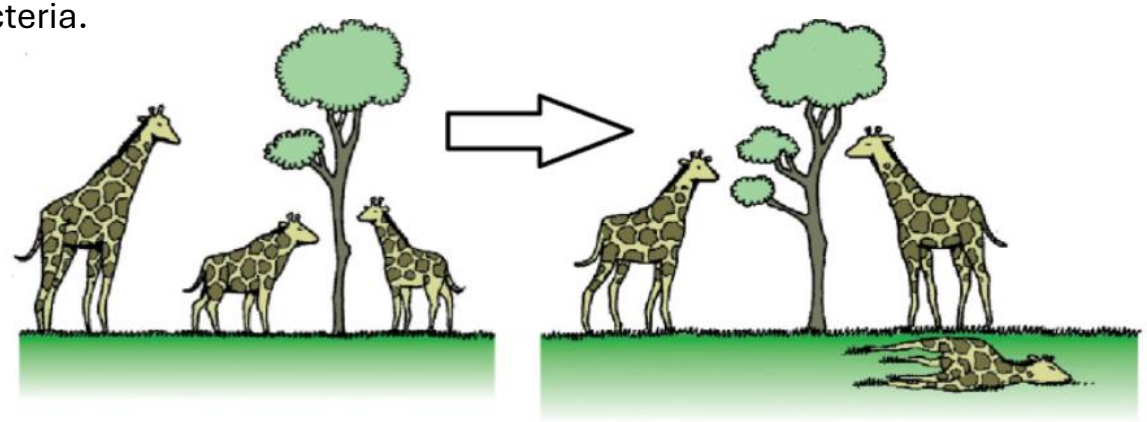
The theory of evolution by natural selection states that all species of living things have evolved from simple life forms that first developed more than three billion years ago.

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.



Classification

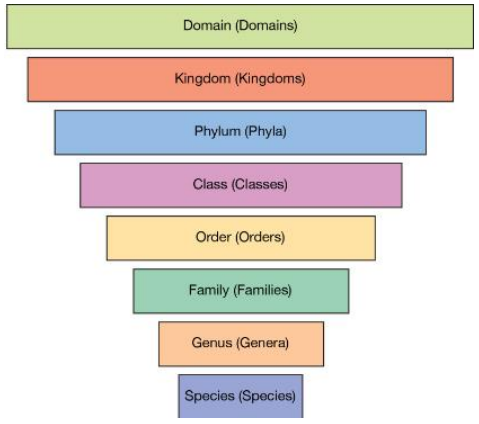
Traditionally living things have been classified into groups depending on their structure and characteristics in a system developed by Carl Linnaeus.

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.

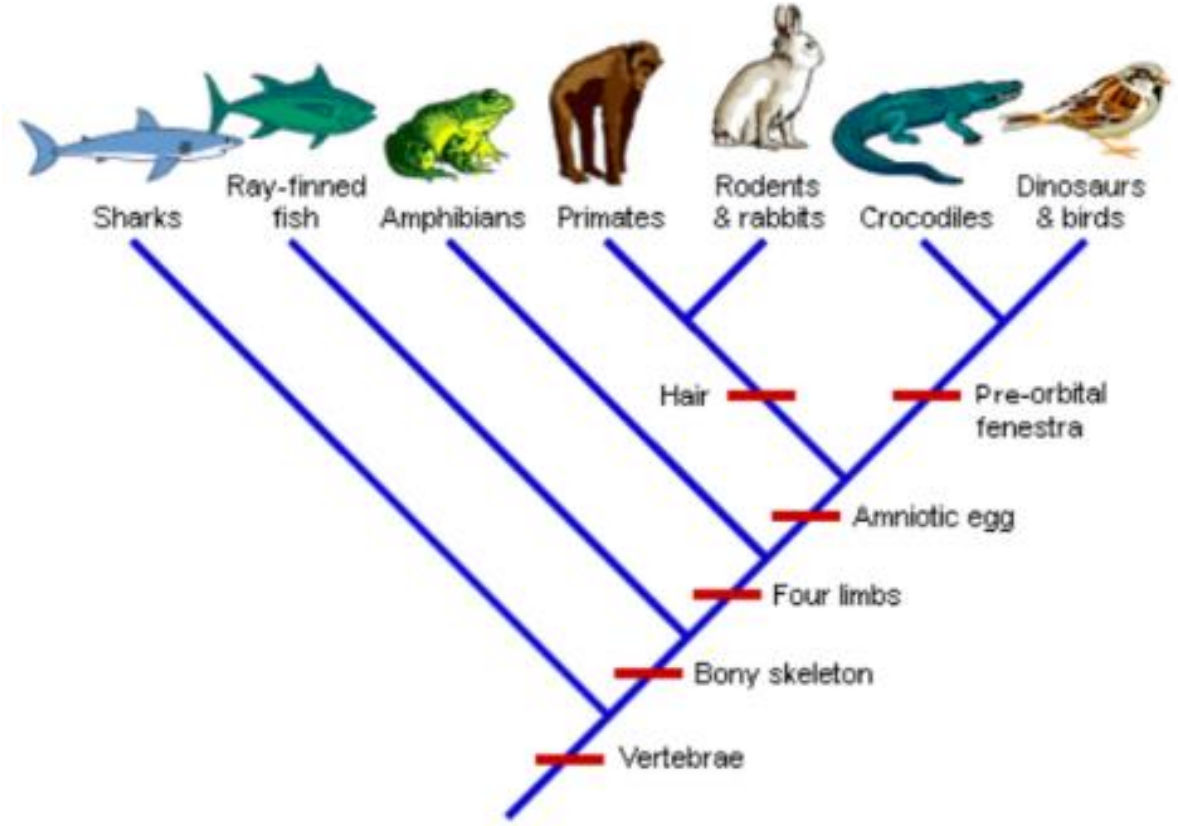
Due to evidence available from chemical analysis there is now a 'three-domain system' developed by Carl Woese.

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.



13 BIOLOGY B6 Combined Inheritance, variation and evolution - KO Paper 2: KS4

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)

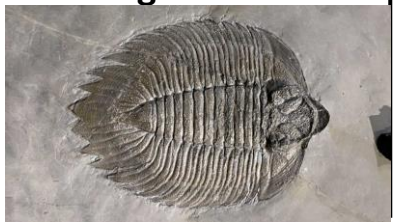
Fossils

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.

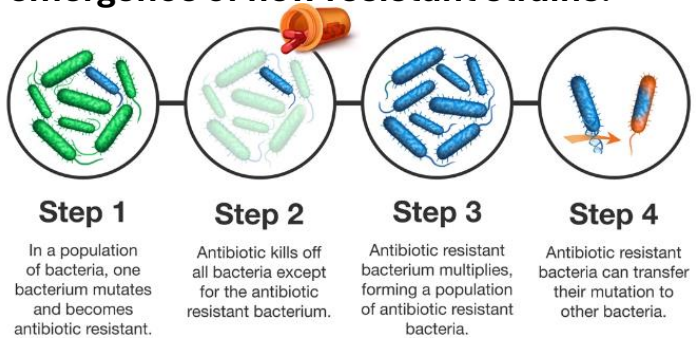
Mutations of bacterial pathogens produce new strains. Some strains might be resistant to antibiotics, and so are not killed. They survive and reproduce, so the population of the resistant strain rises. The resistant strain will then spread because people are not immune to it and there is no effective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



14 BIOLOGY B6 Combined Inheritance, variation and evolution - KO Paper 2: KS4

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.

15 BIOLOGY B7 Combined 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)	Carbon cycle and water cycle 1	Carbon cycle and water cycle 2	Global warming	Biodiversity, factors affecting it and maintaining biodiversity 1	Biodiversity, factors affecting it and maintaining biodiversity 2

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

16 BIOLOGY B7 Combined 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

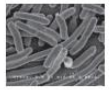
Species depend on each other for food, shelter, pollination, seed dispersal etc.
In a stable community population sizes remain fairly constant

Adaptations

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

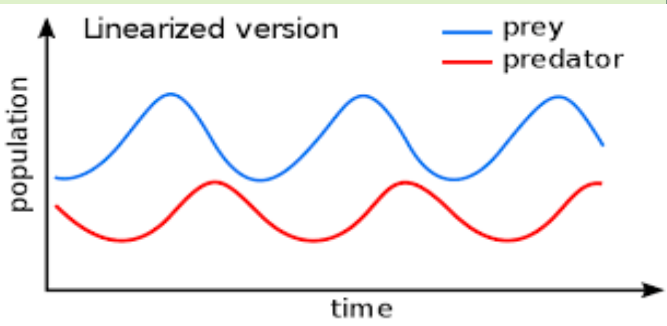
Behavioural adaptations
- Huddling together to stay warm.
- Being active at night

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).

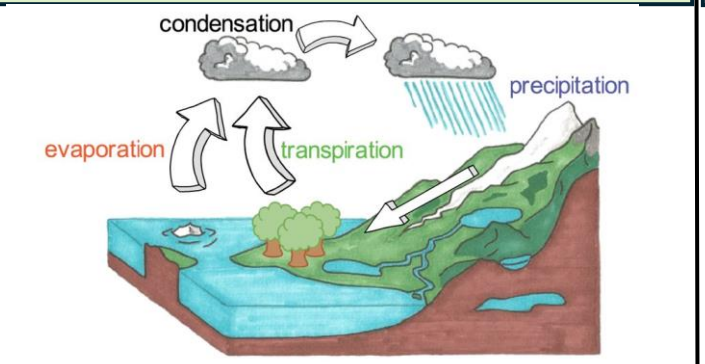


Extremophiles

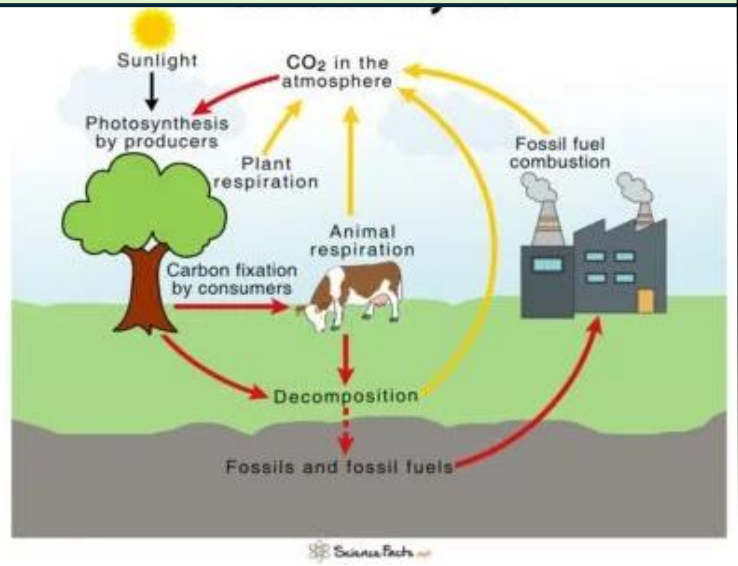
Some organisms live in environments that are very extreme, such as at high temperature, pressure, or salt concentration. These organisms are called extremophiles. Bacteria living in deep sea vents are extremophiles.

17 BIOLOGY B7 Combined Ecology – Knowledge Organiser Paper 2: KS4

Water Cycle

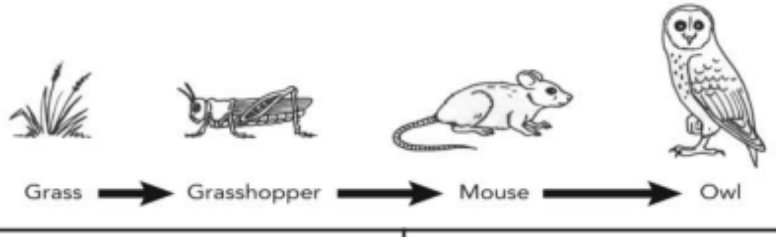


Carbon Cycle

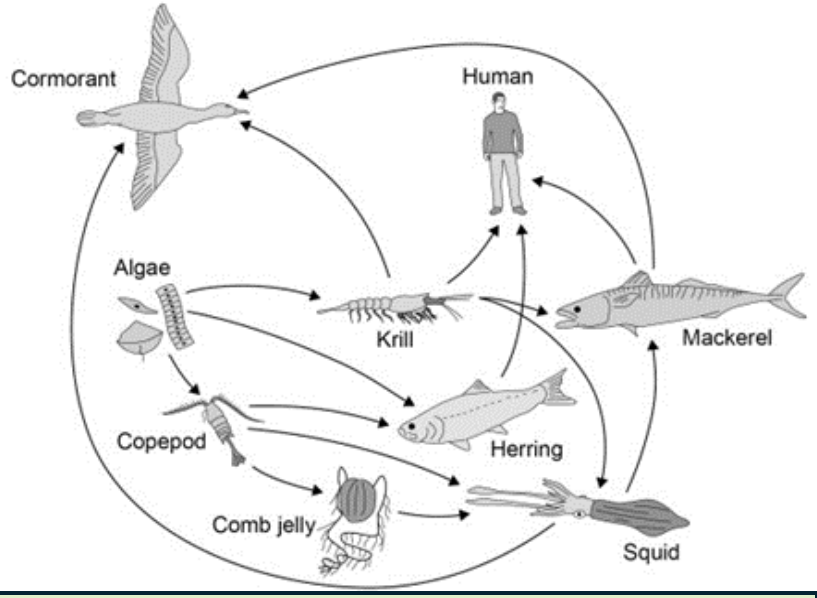


Food chains/webs

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.

18 BIOLOGY B7 Combined Ecology – Knowledge Organiser Paper 2: KS4

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