AQA Biology (Separate Science) Unit 7: Ecology Knowledge Organiser

Keywords

Biodiversity - the variety of living organisms.

Carrion - decaying flesh and tissue of dead animals.

Community - made up of the populations of different species living in a habitat.

Competition - the negative interaction between two or more organisms which require the same limited resource.

Consumers - feed on other organisms for their energy. Can be primary, secondary or tertiary.

Decomposers - organisms which feed on dead and decaying organisms. They break down the biomass and release nutrients into the soil.

Deforestation - the removal and destruction of trees in forest and woodland.

Ecosystem - the interaction between the living organisms and the different factors of the environment.

Global warming - the increase of the average global temperature.

Habitat - where a living organism lives.

Interdependence - the interaction between two or more organisms, where it is mutually beneficial.

Population - the number of individual organisms of a single species living in a habitat.

Predators - organisms which kill for food.

Prey - the animals which are eaten by the predators.

Producers - convert the sun's energy into useful compounds through photosynthesis. They are green plants or algae.

Scavengers - organisms which feed on dead animals (carrion).

Species - organisms of similar morphology which can interbreed to produce fertile offspring.

Abiotic and Biotic Factors

Abiotic factors are the non-living factors of an environment. E.g. moisture, light, temperature, CO_2, wind, O_2 or pH.

Biotic factors are the living factors of an environment. E.g. predators, competition, pathogens, availability of food.

Adaptations

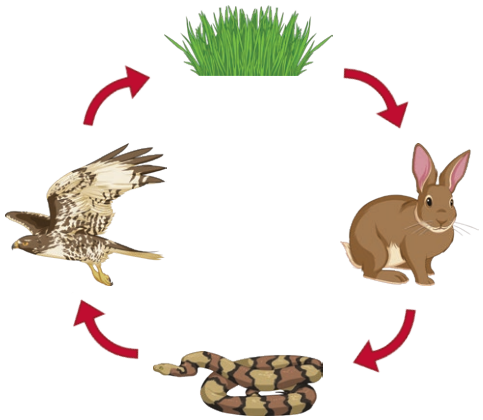
Adaptations are specific features of an organism which enable them to survive in the conditions of their habitat.
Adaptations can be structural, behavioural or functional:

- **Structural adaptations** are features of the organism's body e.g. colour for camouflage.
- **Behavioural adaptations** are how the organism behaves e.g. migration to a warmer climate during colder seasons.
- **Functional adaptations** are the ways the physiological processes work in the organism e.g. lower metabolism during hibernation to preserve energy.

A plant or animal will not physically change to adapt to its environment in its lifetime. Instead, there is natural variation within the species and only organisms whose features are more advantageous in the environment survive. The survivors then go on to reproduce and pass on their features to some of their offspring. The offspring who inherit these advantageous features are better equipped to survive.
Charles Darwin described this process as 'survival of the fittest'.

Food Chains

The source of all energy in a food chain is the sun's radiation. It is made useful by plants and algae which produce organic compounds through photosynthesis.

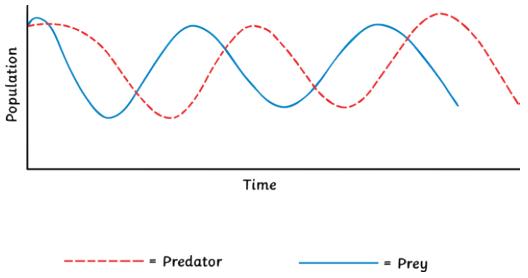


The living organisms use the energy to produce biomass and grow.

When a living organism is consumed, some of the biomass and energy is transferred. Some of the energy is lost.

Remember: the arrow in a food chain indicates the direction of the flow of energy.

Populations of predators and prey increase and decrease in cycles. The size of the predator population depends on the size of the prey population and vice versa. Overall, there is a stable community.



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Competition

Species will compete with one another and also within their own species to survive and to reproduce.

Mutualism occurs when both species benefit from a relationship. **Parasitism** occurs when a parasite only benefits from living on the host.

Animals compete for resources such as food, water and space/ shelter. They may also compete within their own species for mates.
Plants compete for resources including light, water, space and minerals. All these resources are needed for photosynthesis so the plant can make its own food. Plants do not need to compete for food.

Deforestation and Land Use

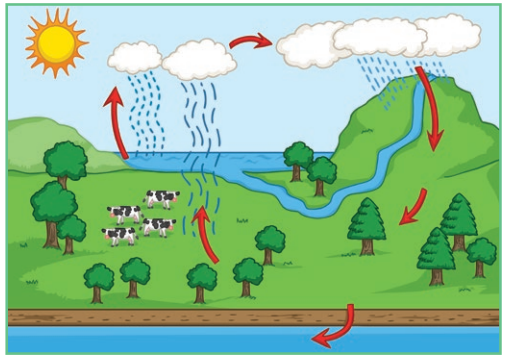
Humans use land for buildings, quarrying, mining, agriculture and landfill. As the human population increases and we take more land, there is less space for other organisms to live.
Deforestation (to use wood as a fuel/material or to clear space for other uses) destroys habitats where other organisms live.

Peat bogs are produced when decomposition occurs over a very long time. Peat stores a lot of carbon and can be extracted for use by gardeners or as an energy source. Burning peat releases a lot of carbon dioxide into the atmosphere which contributes to the greenhouse effect.

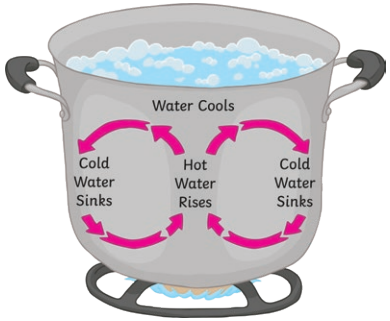
Trees absorb carbon dioxide for photosynthesis, so as they are

cut down and removed, less carbon dioxide is taken from the atmosphere. Furthermore, when the trees are burned, they release carbon dioxide back into the atmosphere. The excess carbon dioxide can lead to global warming and the changes to the ecosystem cause reduced biodiversity.

Water Cycle



Convection is the movement caused within a fluid as the hotter, less dense material rises and colder, denser material sinks under the influence of gravity. This results in the transfer of heat.



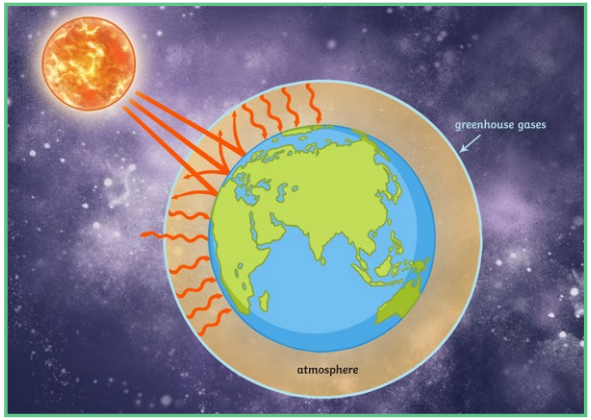
Evaporation occurs when heat energy from the surroundings (or a heat source) is transferred to water particles as kinetic energy. The particles begin to move more rapidly and can turn from a liquid into a gas.

When moving particles transfer kinetic energy to the surroundings, the particles begin to move more slowly and can turn from a gas into a liquid. This is **condensation**.

Precipitation occurs when rain, snow, sleet, or hail falls to (or **condenses** on) the ground.

Transpiration is the process by which water is carried through plants from roots to the stomata on the underside of leaves and it evaporates into the surroundings.

Global Warming



The greenhouse effect is the natural process where some of the Sun's radiation is trapped within the insulating layer of the atmosphere. This maintains a temperature suitable to support life on Earth.

Most of the radiation from the Sun is absorbed by the Earth when it reaches the surface. The rest of the infrared radiation is reflected from the surface and absorbed by the greenhouse gases and clouds in the atmosphere. This is then re-emitted in all directions.

However, due to many contributing factors, the global temperature is gradually increasing. Several gases, called greenhouse gases, trap the heat around the Earth; the most concerning is carbon dioxide. Human activities contribute to the excess amount of carbon dioxide in the atmosphere and so are a cause of global warming.

Global warming leads to the melting of ice caps, rising sea levels, flooding, changes to climate, changes in migration patterns, changes in species distribution and reduction in biodiversity.

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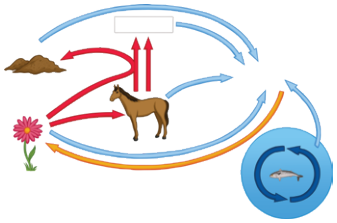
RPI: Field Techniques Quadrats and Transects

The distribution of an organism is affected by the environment and abiotic factors.
Quadrats can be used to measure the frequency of an organism in a given area e.g. the school field. You could count the individual organism or estimate the percentage cover. You must collect data from at least two areas to make a comparison. Quadrats should always be placed randomly.

Transects are used to measure the change of distribution across an area e.g. from the edge of a river and moving further from the water's edge. You could either count the number of organisms touching the transect at regular intervals or use a quadrat placed at regular intervals along the transect.

$$\text{mean} = \frac{\text{total number of organisms}}{\text{number of quadrats}}$$

Carbon Cycle



The main focus on the carbon cycle is its transfer to and from the atmosphere. When carbon is in the atmosphere, it combines with oxygen to form carbon dioxide, a greenhouse gas.

Carbon is transferred from the atmosphere when plants absorb carbon dioxide for photosynthesis and when the gas is dissolved into oceans.

Carbon is transferred to the atmosphere through respiration by animals, plants and bacteria and by combustion of fossil fuels (coal, oil and natural gas).

Dead animals and plants are decomposed and their matter is broken down by microbes and fungi. These organisms are collectively called decomposers. When the organisms are broken down, the microbes and fungi release carbon dioxide into the atmosphere through respiration.

Biodiversity and Waste Management

Biodiversity is the variety of living organisms on the earth or in an ecosystem. It is important in helping to maintain stable ecosystems. Organisms are often interdependent, relying on others as food sources, or to create suitable environmental conditions to survive. Human survival is also dependent on this biodiversity.

The global human population has exceeded 7 billion.
Human population has increased due to modern medicine and farming methods, reducing famine and death from disease.
This means a greater demand for food, resources and water.
It also means more waste and emissions are created.

Sewage, toxic chemicals, household waste and gas emissions pollute the water, land and air, killing plants and animals and reducing biodiversity.

Maintaining Ecosystems and Biodiversity

There are many ways that biodiversity and ecosystems are maintained:

- Breeding programmes can help to protect endangered species from extinction.
- Conservation programmes can help to protect and preserve specialised ecosystems and habitats such as peat bogs and coral reefs.
- Reintroduction of hedgerows and field margins on agricultural land can help improve biodiversity by breaking up the monoculture crops.
- Sustainable forestry programmes help to manage the woodlands and reduce the deforestation to a sustainable rate.
- Societies actively encourage recycling and reusing of products and packaging to reduce the household waste going to landfill sites.

Unfortunately these programmes can be difficult to manage. They are often expensive and are difficult to regulate. People who are employed in certain areas, e.g. tree felling, cannot always transfer their skills to an environmentally friendly role and so become unemployed. It is difficult to maintain biodiversity whilst preventing crops being overrun with pests and weeds, which would affect food security for the human population.

Decomposition and Decay

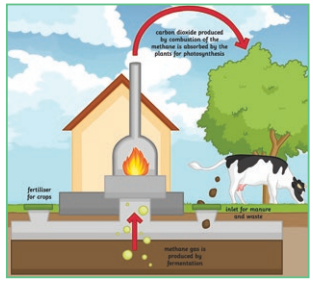
Decomposition is the process of rotting (decay) of a material. The optimum conditions for decay to occur are warm, moist conditions with a plentiful supply of oxygen available. This is because it is microorganisms which are breaking down the larger material into smaller pieces. The microorganisms can digest the material more efficiently and quickly when the conditions are warm, moist and there is a high level of oxygen.

Food can be preserved by many methods to prevent or reduce the rate of decay. These include cooling, canning, freezing, drying, pickling (adding vinegar) or adding salt or sugar.

Some microorganisms ferment waste materials, producing biogas, which can be used as a fuel source. Biogas is produced in a generator (or a digester) using many different microorganisms to ferment the carbohydrates in plant and animal waste. Waste from factories or sewage treatment plants can also be used in a biogas generator. By-products of the fermentation process can be used to fertilise crops and gardens.

There are two main types of generators: batch and continuous.

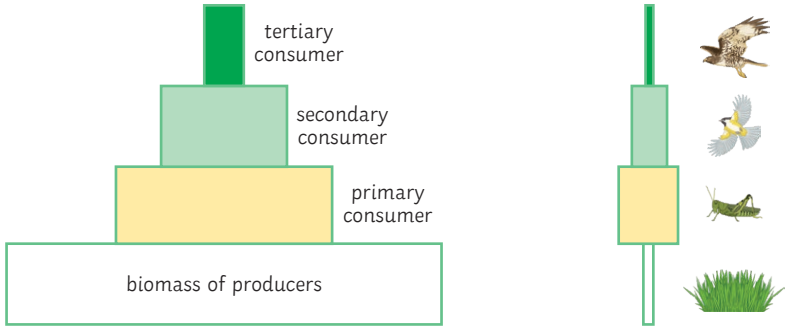
- A batch generator is manually loaded with the waste and emptied by hand afterwards. It only runs for a short while each time.
- A continuous generator is more automated and the waste is continually fed in. The products made are removed at a steady, continuous rate. It is used for more large-scale projects.



Pyramids of Biomass and Biomass Transfer

Biomass is the amount of living matter in a given area.

To find the biomass, we simply multiply the mass of an individual organism by the number of organisms.



A **pyramid of biomass** shows you how much biomass there is in each trophic level. They should be drawn to scale so each bar accurately represents the amount of biomass in that trophic level.

A **pyramid of number** shows you how many of each organism there is in each trophic level.

On average, only 10% of the biomass is transferred to the next trophic level each time.

Energy is lost from trophic levels as heat energy when the organism respires or moves.

Energy is used by the organism for life processes such as homeostasis and growth.

Some of the biomass cannot be eaten e.g. snail shell.

Not all of the organism is eaten by a consumer e.g. stalks and roots.

Biomass and energy are lost in excretions (like poo).

$$\text{Efficiency} = \frac{\text{energy available to the next trophic level}}{\text{energy that was available to the previous trophic level}} \times 100$$

Impact of Environmental Change (HT only)

Changes in the environment can affect the abundance and distribution of the organisms living there.

Abundance means a very large number of organisms.

Distribution means the way in which the organisms are spread over an area.

The changes can be **seasonal**, **geographical** or caused by **human interaction** with the environment. The changing seasons mean that factors including temperature and availability of water can change. These factors impact the organisms living in the ecosystem.

- Birds such as geese migrate south from Europe during the winter months when the temperatures are colder.
- Whales migrate south through the oceans to breed in warmer waters near the equator.
- Worms bury themselves deeper into the earth during the winter to avoid the effects of frost and cold temperatures.
- Land animals such as caribou migrate to find warmer temperatures and food during the colder months.

Some species depend on certain conditions to thrive and give us an indication of factors, such as oxygen availability or pollution. For example, lichens: there are three types of lichens. A lichen is a plant species which grows in exposed areas such as rock surfaces or tree bark. They are adapted to absorbed nutrients from sparse sources, such as rain water. Depending on the level of pollution, different types of lichen are more abundant. We call these types of organisms **bioindicators** and they can help us to monitor the level of pollution or the different factors affecting an ecosystem.

Intensive Farming and Sustainable Fishing

To increase the efficiency of the energy transfer, farmers employ techniques to reduce the amount of energy lost between the trophic levels. These techniques are collectively known as **intensive farming**.

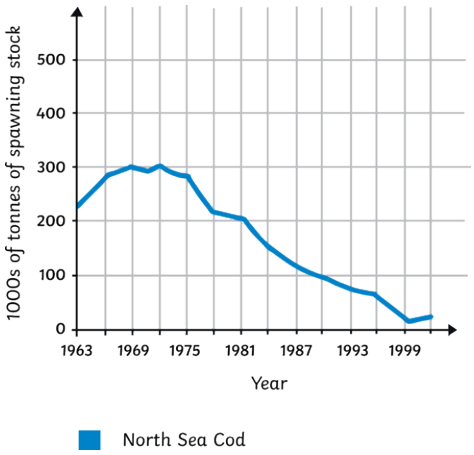
- Animal enclosures are covered and heated to regulate the temperature of the surroundings. This reduces heat loss and energy use for homeostasis and growth.
- Plant-growing spaces are covered and heated to regulate the temperature. This improves the growth and enables the environmental conditions to be controlled more closely.
- Some animals are fed high-protein foods and supplements to their usual diet to increase their growth and produce higher yields of meat, milk or eggs.

Although these methods increase the output, many people believe it is unnecessarily cruel to the animals. Due to the crowded nature of the enclosures, animals are given antibiotics to prevent disease. These antibiotics can be transferred to humans through our food, and scientists claim this is a possible cause of increasing bacterial resistance to antibiotics.

Ocean fish stocks are declining across the world. If the population size is depleted too much, then the breeding rate will no longer sustain a stable population and the species may become extinct.

Fishing regulations are enforced by many countries to help promote the recovery of natural fish stocks in the oceans and to help maintain populations at sustainable levels.

Regulations control the size of the nets allowed to be used and the introduction of fishing quotas helps to limit overfishing in some areas.



RPI: Decay - Investigating the Effect of Temperature on the Rate of Decay of Milk by Measuring pH Change

Milk is an alkaline solution.

- Phenolphthalein (an indicator) is pink in solutions with a pH of 10 or above.
- If the pH drops to about 8, the solution will become colourless.
- Lipase is an enzyme that will break down the fat in milk.
- As lipase breaks down fat to fatty acids, the pH of the solution lowers.

Independent variable – temperature (controlled by water baths and measured using a thermometer).
Dependent variable – time taken for indicator to change colour (measured using a timer).

To calculate the mean:

$$\frac{\text{total time taken for pink colour to disappear (s)}}{\text{number of trials}}$$

Remember to check for any anomalies. If there is an anomaly, discard it and do not add it to your total. Collecting repeated results and calculating an average allows you to identify any anomalous results and improves the reliability of your data.

1. The investigation is carried out at five different temperatures: 0, 20, 40, 60 and 80°C.
2. Label five test tubes as 'lipase' and add 1cm^3 of lipase to each one.
3. Take another five test tubes and add five drops of phenolphthalein to each one.
4. Add 5cm^3 of full fat milk to the test tubes containing phenolphthalein solution and label them 'milk'.
5. Using a clean pipette, add 7cm^3 of sodium carbonate solution to the milk (the solution should turn pink).
6. Place a test tube of lipase and a milk test tube into the water baths until they are both of the desired temperature.
7. To achieve 0°C, place the test tubes in a beaker of ice.

Biotechnology

Biotechnology and agriculture can be combined to provide some possible solutions. These include the following:

- Mass production of mycoprotein which is a protein-rich food suitable for vegetarians.
- Genetically modified bacterium which produce human insulin which is a chemical used in the treatment of diabetes.
- Genetically modified crops, such as golden rice, which provide higher yields or greater nutritional values per unit.

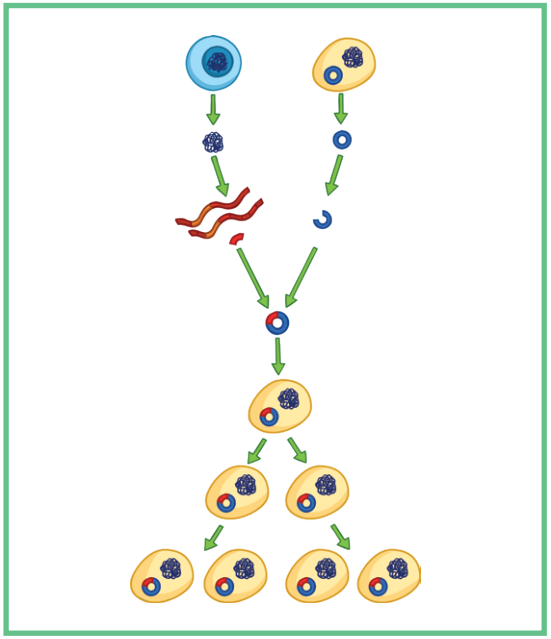
Mycoprotein Fermenters

- Mycoprotein is a protein product.
- It is made by the fungus *Fusarium*.
- The fungus is grown in 40m-high fermenters which run continuously in 5-week cycles.
- After the growth cycle, the fungus is harvested, purified, dried and prepared for food products.
- The fermenter is sterilised and ready to repeat the process with a new batch of fungi.

- Genetic modification uses technology to transfer genes from one species to another.
- It can be used to improve food production.
- Genes can be transferred to give plants increased resistance to herbicides, for example.

Genetically modified organisms may present a hazard to human health. They could lead to allergic reactions or have higher than natural levels of toxins.

Recombinant DNA technology involves the transfer of genes from one species to another. It can be used to make another organism, usually bacteria, produce a protein. The bacteria are grown in fermenters and can produce huge amounts of the protein. Human insulin is now produced using recombinant DNA technology, as described below.



Food Security

Food security means a whole population have access to enough nutritious food to sustain a healthy lifestyle. This is achieved using methods which the planet can continue to sustain for further generations of the population.
However, there are several biological factors which can threaten food security.

These factors include:

- increasing birth rate
- changing diets
- new pests and pathogens
- widespread famine
- drought
- increasing costs
- war and conflicts

Trophic Levels

Trophic levels describe the position of an organism within the food chain.

They can be represented by numbers.

The higher the number, the further along the food chain.

Trophic levels only represent the living organisms (so the sun isn't included).

Scavengers and decomposers are not represented in the trophic levels either.

Level 1: Producers

Level 2: Primary Consumers

Level 3: Secondary Consumers

Level 4: Tertiary Consumers