AQA BIOLOGY UNIT 7: ECOLOGY

Biotic and Abiotic Factors

Abiotic Factors
These are **non-living** factors that can affect an ecosystem.
- Light intensity
- Temperature
- Moisture
- Wind intensity/direction
- CO_2 level
- Oxygen level
- Soil pH

Biotic Factors
These are **living** factors that can affect an ecosystem.
- Competition with other species
- Food availability
- New predators
- New diseases

Key Terms

Habitat – where an organism lives
Population – all organisms of a species in a habitat
Community – populations of different species in a habitat
Ecosystem – the interaction of biotic and abiotic factors

The animals and plants are usually **interdependent**:
- Animals eat plants
- Animals pollinate plants
- Animals eat animals
- Animals use plants to build shelters
- Plants use nutrients from animal droppings

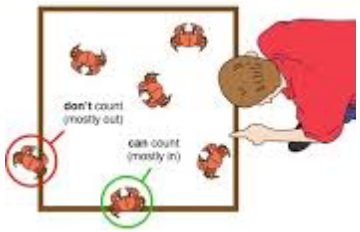
A **stable community** is one where all the species and environmental factors are in balance, so population sizes remain fairly constant e.g. tropical rainforests.

Distribution of Organisms

Where organisms live depends on:
- Temperature
- Amount of light
- Availability of water
- Availability of nutrients
- Availability of oxygen and carbon dioxide

Quadrats – To estimate a population

1. Throw randomly (prevent bias) many times
2. Count number of organisms / % coverage
3. Calculate the mean
4. See how many quadrats fit in whole area
5. Multiply number of quadrats by the mean



Line/Belt Transects – To show distribution

1. Lay tape along the area
2. Place quadrat at regular intervals
3. Count number of organisms / % coverage

Adaptations

Structural: the features of an organism's body structure, e.g. shape, size or colour.

Behavioural: how an organism behaves e.g. some species **migrate** to warmer climates during winter months.

Functional: internal processes of an organism e.g. desert animals produce **little sweat** and small amounts of urine to conserve water.

Arctic
- prevent heat loss
- small SA:Vol = lose less heat
- camouflage from prey

Desert
- large SA:Vol = easily lose and gain heat
- camouflage from prey
- no leaves
- water storage
- deep roots

Predators
- Camouflage
- Mimicry
- Poisons and spikes
- Warning colours

Extremophile – organisms with adaptations to live in harsh habitats to reduce competition.

Competition

Plants – light, space, water, minerals
Animals – space, food, water, mates

Decay

- Detritus feeders = worms, beetles, maggots
- Decomposers = bacteria, fungi
- They respire using waste, dead organisms etc.

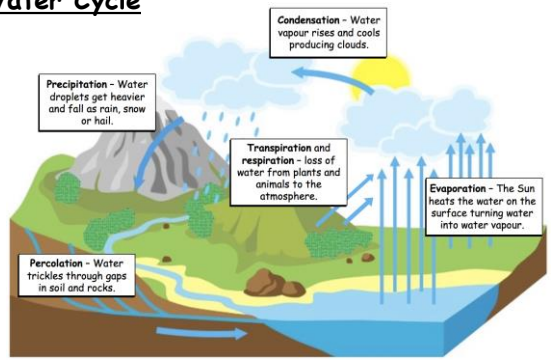
Conditions needed = **WARM, MOIST** and **OXYGEN**

Decay puts nitrates back into the soil and carbon dioxide back into the atmosphere.

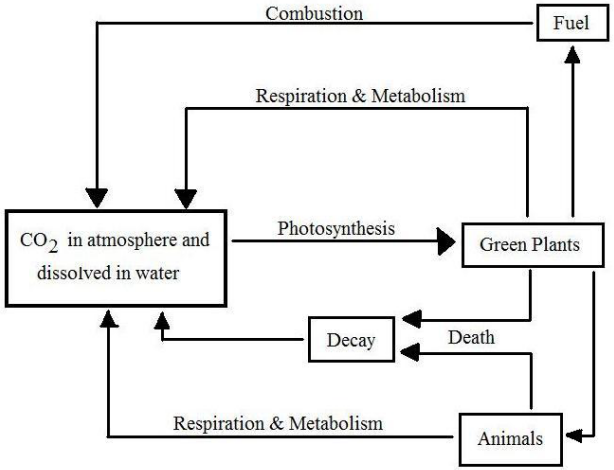
Compost Heaps – Decay releases nutrients from dead plants and animals to make fertile soil.

- **Air holes** – let oxygen in, regulate temperature.
- **Warmth** generated by respiring microorganisms.
- Finely shredded waste increases surface area.

Water Cycle



Carbon Cycle



Remember to follow the path of carbon e.g. CO_2 in air taken in by plants (photosynthesis), plants eaten by animals, animals die (decay), microorganisms respire, CO_2 back in the air.

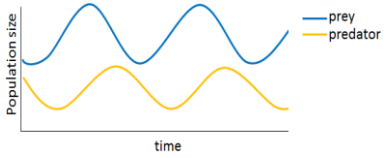
Food Chains

Grass → Rabbit → Fox

(producer → primary consumer → secondary consumer)

Always start with a producer (plant) as they produce their own food – they **photosynthesise** using the Sun's energy to produce **glucose**. Some of this glucose is used to produce new biological molecules in the plant, increasing its **biomass** (an energy store). Some of this biomass is passed on to the animal that eats the plant (secondary consumer). Therefore energy is transferred through organisms in a food chain.

Predator-Prey Relationships



The amount of food limits the population of a species. If the population of prey increases then so will the population of predators. But, as the number of predators increase, the number of prey decrease.

The predator-prey cycles are slightly **out of phase** with each other because it takes a short white for a population to **respond** to changes in the other.

If the number of rabbits increase it will take a while for the foxes to reproduce.

Biodiversity

a measure of the variety of all the different species of organisms on Earth, or within a particular ecosystem. A high diversity ensures the stability of an ecosystem.

A high biodiversity reduces the dependence of one species on another for:

- Food
- Shelter
- Maintenance of the physical environment

Human population has grown due to:

- Growing more food
- Treatment of diseases
- No natural predators

As human population **increases**, biodiversity **decreases** because:

- Land is used for building houses, shops, industry, roads. This destroys habitats.
- Huge areas of land is used for farming so natural animal and plant populations cannot survive.
- Quarrying for metal ores and rocks destroys habitats.
- Waste pollutes the environment and processing it takes up more land.

Restoring biodiversity

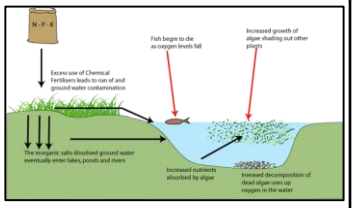
- Breeding programmes for endangered species
- Protection and regeneration of habitats
- Reintroduction of hedgerows and field margins
- Reduce deforestation and carbon dioxide emissions
- Recycling resources – reduces landfill

Pollution

Land
- More people = more sewage which if untreated pollutes soil
- Household waste goes to landfill – toxic chemicals spread into the soil
- Radiation e.g. at Chernobyl
- Herbicides and pesticides can be washed into rivers and streams – become part of food chain (**bioaccumulation**)

Water • Eutrophication

Fertilisers washed into rivers causes increase in algae and plants. These compete for light so die. Decomposers use up all the oxygen in the water when respiring lowering biodiversity.



Bioindicators can be used to identify low oxygen levels e.g. salmon, bloodworms.

Air
- Global dimming – smog and smoke particulates in the air reflect sunlight reducing the amount reaching us lowering ground temperature.
- Acid rain – Fossil fuels contain sulphur and nitrogen. Combustion results in sulphur dioxide and nitrogen dioxide released. These dissolve in rainwater and form sulphuric and nitric acids lowering rain pH.

Effects of Acid Rain
- Kills leaves, flowers etc and destroys roots
- Lowers pH in lakes, rivers etc until they cannot support life
- Acid snow – when it melts it causes major damage as an 'acid flush'
- Other countries are affected due to winds

What is being done about it?!
- Low sulphur petrol
- Clean chimney fumes from power stations
- Catalytic converters on cars
- Rely more on renewable energy sources.

Deforestation & Peat Bogs

Slash and burn
Land cleared for farming, trees burnt releasing CO_2.

There are 3 main reasons for deforestation:
- Grow staple foods e.g. rice
- To rear more cattle
- To grow crops for biofuel

Deforestation increases atmospheric carbon dioxide levels:
- Less trees therefore less photosynthesis removing CO_2 from the air.
- Burning trees releases CO_2.
- Decay of dead plants by microorganisms respiring releases more CO_2.
- Trees take in lots of CO_2 which is then converted into plant tissue. Removal of trees removes CO_2 sinks.

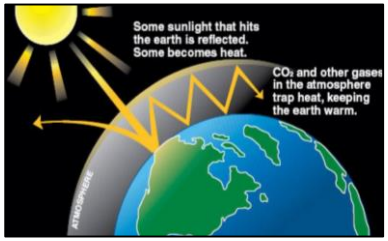
Often large areas are replaced by one single species. This is called a **monoculture**.

Peat bogs – Carbon store formed very slowly. Plant material that hasn't decayed fully due to acidic conditions and a lack of oxygen.
- **Burning** the peat releases its stored carbon back into the atmosphere as carbon dioxide.
- As peat is mixed in with soil it is exposed to *aerobic* conditions and begins to decompose - which releases carbon as carbon dioxide.

Global Warming

More CO_2 being released than taken in e.g. deforestation for rice fields or cattle that both release methane (CH_4)

Greenhouse Effect
1. Sun's energy warms up the surface of the Earth.
2. Most of this energy is radiated back.
3. Layers of CO_2 and CH_4 absorb some of the energy.
4. This warms up the atmosphere and the surface of the Earth.



The greenhouse effect is needed to maintain life but excess gases are causing an increase in temperature.

Global warming could cause:
- **Climate change** – increase severe unpredictable weather, higher temperature sea absorbs less CO_2.
- **Rising sea levels** – ice caps, glaciers
- **Reduced biodiversity** – organisms can't survive as habitats change
- **Changes to migration**
- **Changes to distribution** – some organisms may be able to survive in more places and vice versa.

Decomposition

TRIPLE ONLY

Temperature: Decay is controlled by enzymes so too cold = too slow, too hot = denatured.

Moisture: Makes it easier for microorganisms to digest food and prevents drying out.

Oxygen: For aerobic respiration – grow, reproduce etc. Aerobic respiration results in an increase in temperature in a compost heap.

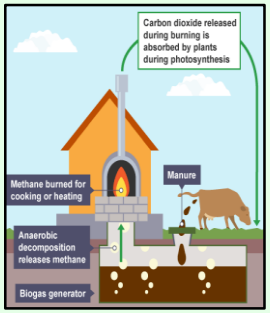
Anaerobic respiration in bacteria can produce methane – flammable gas (fuel)

Biogas can be produced on a small scale in a **biogas generator**.

The carbohydrate-containing materials are fed in, and a range of bacteria anaerobically ferment the carbohydrate into biogas.

The remaining solids settle to the base of the digester and can be run off to be used as **fertiliser** for the land.

The **optimum** temperature for biogas production is between 32°C and 35°C.



Cooler Countries – Slow respiration rate – bury generator with thick walls.
Warmer Countries – Denatures enzymes – bury generator so ground keeps it cool during the day.

Environmental Change

TRIPLE ONLY

Distribution of organisms is caused by:
- Availability of water
- Temperature
- Concentration of dissolved atmospheric gases in water.

Seasonal Changes	Daylight, amount of rainfall, temperature all change with the seasons. Animals migrate.
Geographical Changes	Changes to soil (structure and pH), altitude, saltiness of water. Organisms have adaptations to survive.
Human Interaction	**Negative**: Global warming, acid rain, pollution **Positive**: Maintaining rain forests, reducing pollution, conservation of hedgerows and woodlands
Living Factors	New predator, diseases, new competitors

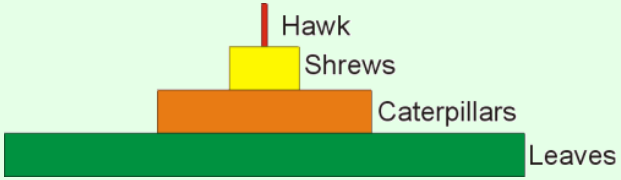
Biomass – mass of organism (no water)

Stages in a food chain are called **Trophic Levels**.

Issues with measuring biomass:

- Kill the organism and dry it out.
- Wet biomass is different depending on conditions, time of day etc.

Pyramid of biomass:



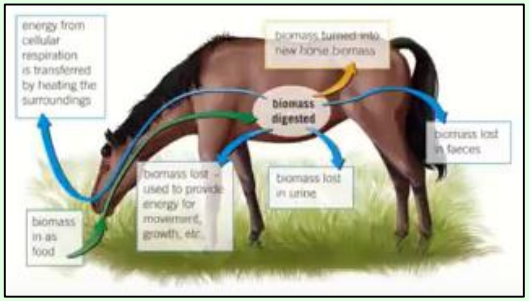
General Biomass Pyramid Rules

- Producer always at the bottom.
- They always look like normal pyramids
- Not all organisms or parts are eaten by the stage above e.g. roots, bones.
- Most biomass taken in is usually used for respiration.
- Food chains are short as so much biomass is lost at each trophic level.

Biomass Transfers

Biomass is lost by organisms because:

- **Faeces** – Herbivores can't digest all the plant material e.g. cellulose, carnivores can't digest bones, hooves, claws. Faeces are broken down by decomposers.
- **Waste** – Excess protein – deamination (urea production)
  - Respiration – glucose used by plants and animals transfers energy to the surroundings e.g. movement.
- **Temperature** – Mammals and birds use respiration for body heat



Food Security & Efficiency

Food Security = Having enough food for the population

Factors threatening food security:

- **Increasing birth rate** – children to work land, large families in some cultures, some religions don't use contraception.
- **Changing Diets** – People look for new interesting food, deprives local people of traditional food, less nutritional foods take less time to cook.
- **New pests and pathogens** – Global travel, animal and plant movement, climate change = wider spread of pathogens which affects farm animals and crops.
- **Environmental Changes** – Global warming = droughts and flooding of farm land.
- **Cost** – Genetic engineered crops cost more money as do irrigation systems, fertilisers and pesticides.
- **Conflicts** – infrastructure damaged, people fear they can't feed their families.

To make food production efficient:

- Shorter food chains so less biomass lost
- Limit movement of farm animals – less respiration more biomass (disease spreads in intensive farms)
- Warmer temperature – less respiration more biomass
- Fish bred in cages on high protein diets

Downsides: Ethical concerns over animal cruelty and welfare
Cost for lighting and heating

Sustainable Food Production

Sustainable = producing foods in ways that supply the whole human population and can continue for years.

Fishing – To prevent overfishing:

- Larger-holed nets to only catch the bigger, older fish
- Ban fishing during breeding season
- Strict fishing quotas to make sure some fishermen only bring in a limited number of specific types of fish.

Mycoprotein (Quorn)

Produced by fungus called ***fusarium*** (grows fast on **glucose** syrup) in a fermenter under **aerobic** conditions.

Fungal biomass is harvested and purified and then dried and processed to make mycoprotein. It can be **shaped** and **flavoured**.