BioMedical Admissions Test (BMAT)

Section 2: Biology

Topic B10 - Ecosystems

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Organisation Levels In Ecosystems

- ➔ An **individual** is a single organism.
- ➔ A **population** is a group of organisms of the same species that live within the same area.
- ➔ A **community** is a collection of all the different populations that live together in the same ecosystem.
- ➔ A **habitat** is the area where organisms live.
- ➔ An **ecosystem** describes the way that the living (i.e. the community of organisms) and non-living components of the environment interact.

Environmental Change

The environment in which organisms live and compete is **constantly changing**. Communities are affected by both:

Biotic (living) factors:

- Competition for resources
- Infectious disease
- Predation
- Food supply

Abiotic (non-living) factors:

- Light intensity
- pH of water/soil
- Temperature
- Availability of water
- Availability of oxygen
- Pollution of air/water

Changes to any of these factors can lead to changes in population:

- Population size can **increase** e.g. if more food is available or there is less predation
- Population size can **decrease** e.g. if less food is available or there is more predation
- Population **distribution** can change e.g. if there is a rise in average temperature

Competition Between Organisms

In order for organisms to survive and reproduce, they must retrieve resources from their environment. Animals and plants require slightly different things to survive:

- Plants:
  - Light
  - Space (for example, for roots to spread)

    - Water
    - Mineral ions from the soil
- Animals:
    - Territory
    - Food
    - Water
    - Mates

Environmentally, there are **limited amounts** of these resources, and therefore organisms will have to **compete** with each other.

There are two types of competition, depending on who is competing:

- **Interspecific** - individuals compete with those of **another species**
- **Intraspecific** - individuals compete with those of the **same species**: 'survival of the fittest'

> ***Exam Tip*** - Intraspecific competition tends to be more important than interspecific as the organisms have the same needs. Therefore, they'll be competing for exactly the same resources, rather than just similar ones.

Relationships Between Organisms

Predator-Prey Cycles:

- In a typical predator-prey cycle, the peaks and troughs of each population numbers generally follow each other - prey numbers are higher than predator numbers!
- More prey, means more predators are able to feed, survive and reproduce - this leads to an increase in predator numbers.
- These cycles take a while to sync up because it takes time for the populations to respond to changes.

Parasitic Relationships:

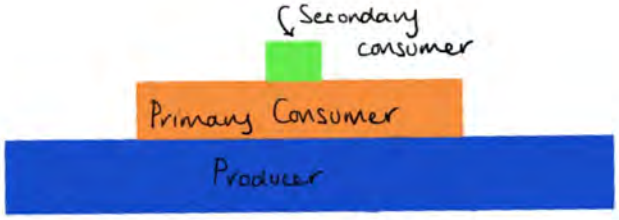
- Parasites are organisms that 'feed' off a host, **without giving anything back** to the host.
- This means that only the parasite benefits, whereas the **host is harmed**
- An example of this is animal fleas

Mutualistic Relationships:

- Here, an organism lives on a host organism, but in return there is an **exchange of resources.**
- **Both organisms benefit** from this relationship.

- An example of this is with hermit crabs who place sea anemones on their shells for protection, whilst the anemone can eat scraps of food left from the crab and can be transported to areas with fresh food sources.

Trophic Levels and Biomass



Biomass is the **mass** of a living organism - we can represent the biomass of a food chain as a **biomass pyramid.**
Trophic levels are the levels within the food chain

- **Producers** are usually **photosynthetic plants**
  - These plants absorb light energy from the Sun using chlorophyll
  - These are then stored in carbohydrates, fats and proteins - creating the plant's biomass
- **Primary consumers** are **herbivores** which eat the plants, e.g. caterpillar
- **Secondary consumers** are **carnivores** which eat the primary consumers, e.g. birds
- **Tertiary consumers** are often not present due to the loss of biomass through each stage of the food chain

As you move up the trophic levels, the **biomass decreases.** Often, but not always, the numbers of organisms as you move up each level decreases too.

Energy Transfer

There is also a loss of energy as you move up trophic levels. Energy is lost at different stages:

- **Energy lost during photosynthesis** - photosynthetic plants use only about 1% of the Sun's light energy during photosynthesis, with the remainder lost by reflection or used for transpiration.
- **Energy lost through respiration** from conserving heat and movement.
- **Energy lost through waste** - some of the biomass is inedible (e.g. bone) or indigestible (e.g. cellulose in cell wall).

> ***Exam Tip*** - Biomass pyramids don't tend to exceed 4 or 5 trophic levels as so much energy is lost at each stage. There is not enough energy available after 4 or 5 trophic levels to sufficiently support organisms.

We can use food chains and **food webs** (multiple interlinking food chains) to show the energy transfer between trophic levels. From this we can calculate the efficiency of the energy transfer.

Exam Tip - We can calculate the efficiency of the transfer of energy between trophic levels using the following equation:

Efficiency = (energy available to next level)/(energy from previous level) x100

The Carbon Cycle

There are **4** main processes involved in the carbon cycle:

Photosynthesis

- As we know, photosynthesis is carried out by green plants (and some bacteria)
- Sugars are formed from the process, which are then converted to starch or cellulose, or used to make fats and proteins.
- This is the only process which removes carbon dioxide from the environment

Respiration

- Animals and plants respire in order to release energy for metabolic processes
- This process releases carbon dioxide as a waste product into the environment
- Remember that the equations for respiration and photosynthesis are opposite, meaning that theoretically they should balance but combustion of fossil fuels and deforestation has created an imbalance

Decomposition

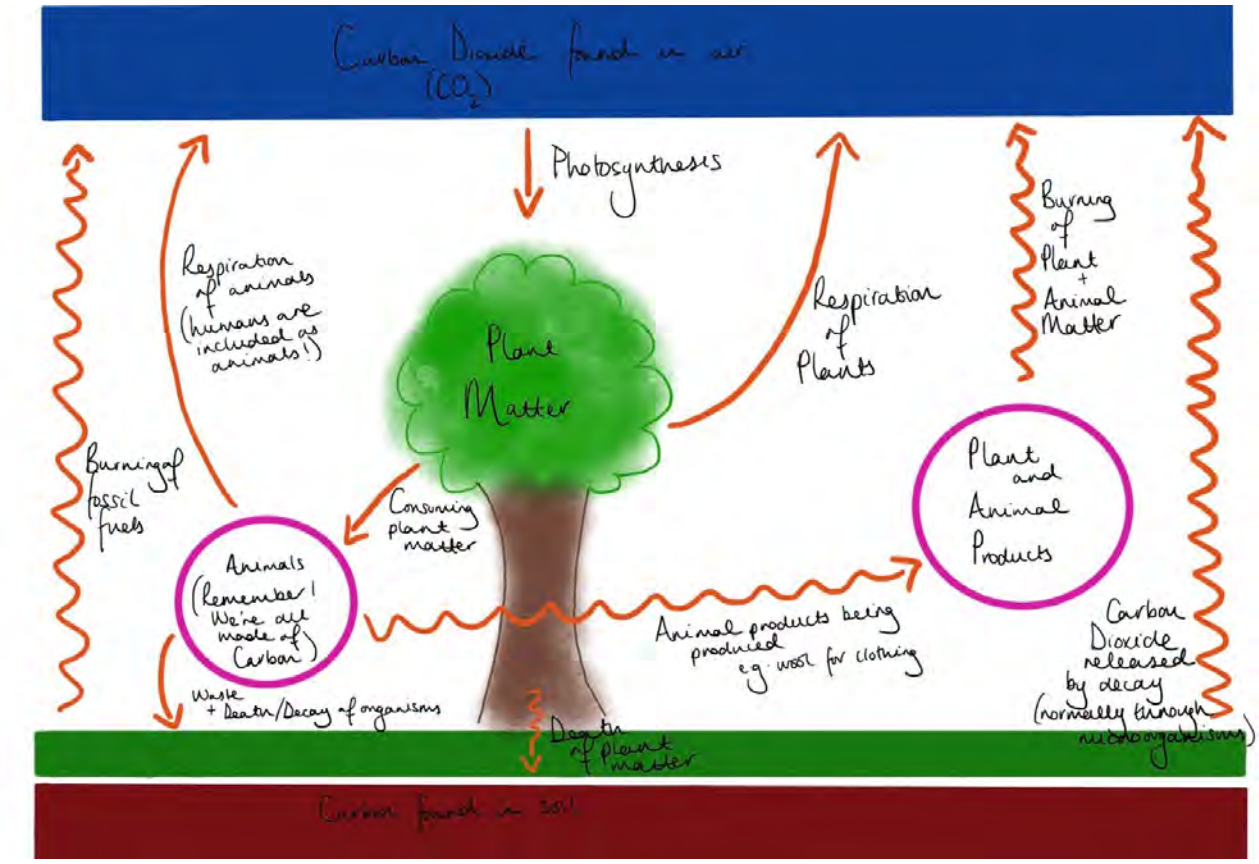
- When organisms die or produce waste, decomposers (such as fungi and bacteria) break down the complex organic molecules and return the elements to the soil.
- These decomposers are also known as detritus feeders

Combustion

- When plant or animal matter (fossil fuels) are burnt this releases carbon dioxide into the environment
- The equation for the complete combustion of carbon is $C + O_2 \rightarrow CO_2$
- Mass deforestation and burning increases the amount of carbon dioxide returned to the atmosphere, whilst reducing the amount removed through photosynthesis.

Exam Tip - Although the carbon cycle seems very complicated - it's actually really simple! Think about the life processes of both plants and animals (respiration, photosynthesis and death/waste) and think about the transfer of carbon. The main thing to remember is that carbon

is always recycled back into the environment!



The Water Cycle

Water is lost to the environment through:

- **Transpiration** - the loss of water vapour from plants through the stomata to the atmosphere
- **Evaporation** - from the surface of the sea, rivers and other bodies of water creating water vapour in the atmosphere
- **Condensation** - the water vapour from evaporation condenses to form clouds

Water returns to the land through:

- **Precipitation** - water in the clouds falls to the land in the form of rain or snow
- **Osmosis** - plant roots absorb water