

Biology Knowledge Organiser

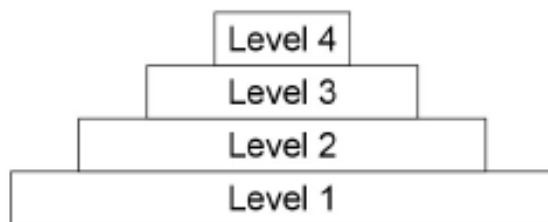
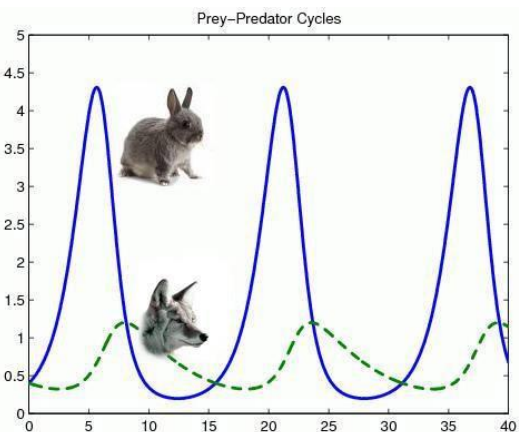
B17 - Organising an ecosystem - Triple science only

Organisation of ecosystems and trophic levels

Apart from some ecosystems in deep sea vents, ALL biomass on Earth is produced by **photosynthetic** organisms. So, these organisms are called **producers (trophic level 1)**. This is vital for other organisms, since these producers start off food chains. **Food chains** represent the feeding relationships in a community. The producer is usually a green plant or algae, and they make **glucose** by photosynthesis.

The producers are eaten by **primary consumers (trophic level 2)**, which might be eaten by the next trophic level – **secondary consumers (trophic level 3)**. The secondary consumers may be eaten by **tertiary consumers (trophic level 4)**. Of the consumers, if they kill and eat other animals, they are called **predators**. The animals eaten by predators are their **prey**. Carnivores that don't get eaten by anything else are called **apex predators**.

In a *stable* community (one that stays pretty steady in terms of population sizes), the population size of predators and their prey rise and fall in cycles, as the graph shows. When there aren't many predators, the prey population grows rapidly. When it rises, there is more food for predators so their population increases. This puts pressure on the prey so their population drops – cycles, see graph.



Key Terms	Definitions
Photosynthetic	Describes any organism that can carry out photosynthesis, producing biomass from simple chemicals (CO ₂ and H ₂ O)
Biomass	The materials that living things are made from: proteins, carbohydrates and lipids.
Food chain	Used to represent the feeding relationships in a community. Starts with a producer and shows what organism eats what, as well as how energy and biomass are transferred in the community.
Trophic level	Position in a food chain. Producers = level 1.
Ingest	Eat/consume
Egest	Excrete as faeces

Pyramids of biomass

Biomass is simply living mass/material. Biomass is made by producers, but bear in mind they only transfer about 1% of the energy from light that hits them. A pyramid of biomass has trophic level 1 at its base, and each block of the pyramid has a width to represent the amount of mass at each trophic level. See diagram.

The blocks **HAVE TO** get smaller, because not all biomass is transferred from one trophic level to the next (only about 10% in fact). This is because:

- Not all of the organisms in each trophic level actually get eaten by the trophic level above
- Not all the material that is eaten (**ingested**) is actually absorbed into the body – some is **egested** as faeces
- Large amounts of the biomass absorbed at each trophic level is used in **respiration** (especially glucose, of course) – meaning that the biomass is converted to carbon dioxide and water. These products are released in urine and breathing out. (furthermore, urea is lost in urine, so it isn't available for the next trophic level).

As a result of all this, usually the number of organisms decreases as you go up the trophic levels (although it also depends on the size of the organisms!).

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Decomposition - Triple science only

Decomposition is the breaking down, or decay, of biological material. Microorganisms digest dead organic material to simpler molecules, so the complex molecules bodies are made from (like proteins, lipids and carbohydrates) are recycled in the environment. They do this by secreting enzymes into their immediate environment and absorbing the soluble products of digestion by diffusion.

The **rate** of decay is affected by:

- **Temperature** – the activity of decomposers increases as it gets warmer (although decomposers are killed by very high temperatures)
- **Water** – moist conditions speed up decay because molecules to be digested may be dissolved
- Availability of **oxygen** – decay is fastest if there is a good supply of oxygen, simply because the decomposers can then respire more efficiently. This is why compost bins should have holes in the side!

Compost is just the material left after decay of waste organic material has happened. Compost is very useful to farmers and gardeners as a natural fertiliser for crops.

Where decay happens without oxygen, **anaerobic** decay takes place. This produces **methane** gas. This can be very helpful – methane is a good fuel, so it is deliberately produced like this in many places, especially warm countries. The decay happens in a **biogas generator** – biogas just refers to the methane.

The water cycle and the carbon cycle

Like carbon, water is constantly cycled in ecosystems between abiotic and biotic components of the ecosystem. Water is released in aerobic respiration by all organisms. In terms of the abiotic components, water is constantly evaporated and precipitated (so, goes from land/waterways to the atmosphere and back again). The water precipitated provides fresh water for organisms on land before draining into the sea.

In all ecosystems, many materials have to be cycled through the biotic and abiotic components of the ecosystem – e.g. water, carbon, minerals, nitrogen. Microorganisms play a key role in cycling such materials. Carbon can appear in abiotic locations (the air as CO₂, in soil minerals) and biotic locations (in the carbohydrates, lipids and proteins that living organisms are built from). When we say it is cycled through these components, we mean that carbon atoms don't stay in any material for ever. They are cycled by various processes:

- **Photosynthesis** – takes carbon from the atmosphere (in the form of CO₂) and converts it to biomass
- **Respiration** – all living organisms, including plants and microorganisms, respire, which converts biomass into CO₂, which enters the atmosphere. While decay is taking place, carried out by microorganisms, they respire, which releases CO₂.
- **Feeding** – when consumers eat other organisms, the carbon in the other organism's biomass is transferred to the consumer.

Key Terms	Definitions
Decomposer	An organism that digests dead organic material.
Distribution	Describes how organisms are spread in an ecosystem.
Abundance	How many individuals of a particular species there are.
Quadrat	A square frame used for sampling plants in an ecosystem. Can be used for counting plants for measuring the coverage of the ground by a particular species.
Transect	Sampling method where a quadrat is laid down at regular intervals along a line. This is used to measure the change in distribution of organisms when a particular factor changes, such as light intensity.
Interval	The spaces between measurements – e.g. on a transect, the interval might be 1 m.

Measurements of ecosystems

Biologists measure both the **distribution** and **abundance** of organisms in ecosystems to help us understand them (see definitions). It would be impractical to attempt to count e.g. all the seaweed on a beach, so biologists use **sampling** techniques. If you just want to measure the abundance in an area, or to compare two locations for abundance of e.g. seaweed, **random sampling** would probably be used of the area. To count plants, quadrats are used. If, however, you are interested in how the distribution (spread) of organisms changes as a factor changes, you measure along a **transect**. For instance, with the seaweed example, you could set up your transect line down the beach towards the water (just using a long tape measure) and measure the coverage by seaweed at 2 metre **intervals**, or some other suitable interval. Data may be summarised using means, modes or medians, and graphs can be produced to represent differences between locations, or the change in distribution along a transect.

