Background information

Year 9, unit 1: Ecosystems

Definitions

Ecosystem: a system formed by the interactions between a community of living organisms in a particular area and their physical environment.

Community: all the living organisms in a geographical area at that time.

Abiotic: factors in the physical environment that affect the survival of an organism (ie the amount of light, air temperature, availability of water).

Biotic: other living organisms that may affect a plant or animal's survival (ie predators, competitors or food sources).

Food chain: a series of links between different organisms based on feeding relationships.

- All food chains must start with a **producer**.
- **Autotrophs** are organisms that use inorganic matter (**chemotrophs**) or sunlight (through photosynthesis) to produce chemical energy.
- **Heterotrophs** are organisms that obtain their energy through the eating of other living organisms (consumer) or their products (detrivore or decomposer).
  - **Consumers** can include herbivores (eats plants), carnivores or predators (eats live prey) and scavengers (eats dead animals/carrion).
  - **Detrivores** eat dead organic matter (leaves and droppings) to produce organic faeces.
  - **Decomposers** eat dead organic matter to produce soluble organic and inorganic matter.

Food webs: a series of interlinking food chains.

Not all organisms want to kill each other.

Symbiosis: two organisms living together in close relationship.

Mutualism: a relationship where both organisms benefit (insects get nectar and flowers become pollinated).

Commensalism: a relationship where one organism gains a benefit while the other organisms neither benefits nor is harmed (barnacles on a whale get protection and nutrient filled water flowing past, while the whale neither benefits or is disadvantaged).

Parasites: organisms that need to feed on another organism, in the process causing harm to their host. It is important to note that it is often a disadvantage for the parasite to kill their host. Mistletoe lives off the nutrients gathered by their host tree. The tree often has its growth restricted by the loss of nutrients.

Population of a species: the number of that species in the same geographic area at the same time. A population can decrease due to emigration and deaths, and increase due to births and immigration. This can be affected by biotic and abiotic factors. A decrease in habitat can cause a decrease in food and water supplies, and protection from shelter. This can decrease a population. Other factors, such as an increase in competition or the population of a predator, can also decrease a population. Alternatively, an increase in food supply, a decrease in predator numbers, with little competition for shelter or mates can increase the numbers of a population. This can be a result of seasonal changes. An example of this is the increase in general populations during spring and a decrease in winter.

Energy

It is important to remember and include the basic doctrine of physics, that energy (that which can change the motion, physical composition or the temperature of an object) cannot be created or destroyed. Therefore, we cannot say 'energy is lost' as it would be incorrect. Instead, energy is transformed into a form that is difficult to reuse. Therefore, the Sun is constantly putting energy into an ecosystem. Light energy from the sun is used by chlorophyll in plants to split water molecules so that they can react, with carbon dioxide, to form glucose and oxygen. This process is called **photosynthesis** and can be represented by the chemical equation:

$6CO2 + 6H2O \rightarrow C6H12O6 + 6O2$

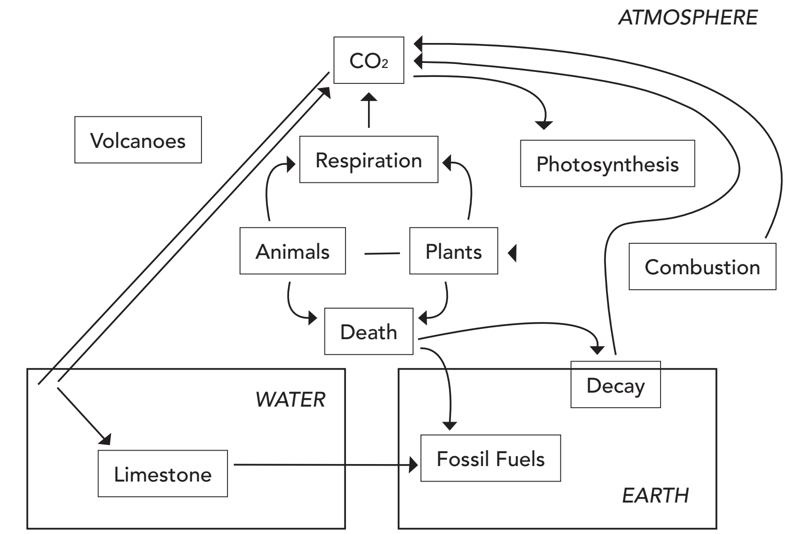
The plants use 90% of the chemical energy (glucose) for everyday living and it is ultimately converted to heat. This is called **respiration** and is the reverse of the photosynthesis equation (this means plants also need oxygen). The remaining 10% of chemical energy is converted to proteins and other molecules for growth.

Therefore, a herbivore that eats the plant only gets the 10% of chemical energy that was originally converted from sunlight. The herbivore, in turn, uses 90% of the plant's chemical energy for everyday movement, and maintenance converting it to heat. The remaining 10% is used for body growth and development. This means 10% of the10% from the plant's chemical energy ie only 1% of the Sun's energy, makes its way into the muscle and other tissues of the herbivore.

This is decreased even further as we move up the food chain. A carnivore eats the herbivore. Ninety per cent of the chemical energy eaten by the carnivore is converted to heat and movement by the animal, leaving just 10% for growth (0.1% of the original energy absorbed from the Sun by the plant). This is known as the **10% rule.**

This can be represented diagrammatically in an energy pyramid where producers are the base or first trophic level of the pyramid. The second trophic level is the herbivore and is one-tenth the length of the first trophic level. The third trophic level is the first order carnivore and is one-tenth the size of the second trophic level. There is a limit of 4-5 trophic levels in each energy pyramid as there is not enough energy to be passed on. This is the reason why food webs usually only contain 4-5 organisms. **Matter** is anything that occupies space and has mass. It is constantly recycled in an ecosystem. There are several cycles of matter that are tracked by scientists. The most common of these is the **carbon cycle** (see image on next page).

Carbon Cycle



Lesson 2: instructions for playing rabbit and fox chasey

Background information

The predator-prey relationship is complicated and is often affected by the physical conditions in the ecosystem. When there is a lot of prey, predators will breed, often producing large litters where most survive. This increases the pressure on the prey and the population decreases. This decreases the food supply of the predator, resulting in starvation and a correlating decrease in population. This produces a cyclic pattern of an increase in population, followed by a decrease. This simulation will illustrate the cyclical pattern of a population.

Equipment

- 4 witches' hats
- popcorn
- cloth 'tails' for rabbits

Procedure

Stage 1:

Measure and mark with witches' hats, a 30 m x 30 m square in the school ground. Randomly throw three handfuls of the popcorn across the area.

Choose five students to be the initial population of rabbits. To stay alive the rabbits must collect five pieces of popcorn in a limited amount of time (thirty seconds). The popcorn collected should be removed from the ecosystem by placing in a bag. (Ensure students do not eat the popcorn collected.)

Any rabbit that survives is then able to reproduce by selecting another student to become their 'baby'. Record the total number of the rabbit population at the end of the season (ie when the popcorn on the ground has been 'consumed'.)

Repeat the simulation. Record rabbit population numbers in a table (Table 1) at the end of each season.

Note: Extra popcorn can be added occasionally to represent a good season with plenty of food.

Table 1: Populations of rabbits over many seasons

	Season1	**Season 2**	**Season 3**	**Season 4**	**Season 5**	**Season 6**
Number of rabbits						

Highlight the seasons that are droughts (poor food supplies) and bumper years (good food supplies).

Stage 2:

Foxes move into the rabbits' community. A fox must catch a rabbit in order to survive. Rabbits should hang a cloth tail from their belts. A fox can 'eat' the rabbit by removing the cloth from the belt. Foxes can reproduce by catching two rabbits in a season.

In a table (Table 2) record the number of rabbits and foxes at the end of each season.

Table 2: Populations of rabbits and foxes over many seasons

	Season 1	**Season 2**	**Season 3**	**Season 4**	**Season 5**	**Season 6**
Number of rabbits						
Number of foxes						

Conclusion

Graph the results of the simulation with a bar graph showing the number of each animal at the end of a time period. Ask the students to write a description of the simulation explaining the effect of increased food supplies, decreased food supplies and competition on predator populations. Ask students to explain what characteristics in populations help some animals survive. Can the students predict the results for the next two seasons?