



Food Chains

BIOLOGY • ECOSYSTEMS • FOOD CHAINS

Section 1: Food Chains and Webs

• What Is a Food Chain?

A food chain simply describes the feeding relationships in an ecosystem. For example, in a woodland ecosystem the leaves on the tree are eaten by caterpillars, which in turn are eaten by sparrows, which in turn are eaten by hawks. In this food chain the trees are acting as producers, as they use the energy from sunlight to manufacture food through a process called photosynthesis. All other organisms higher up the food chain rely upon this food that the trees have made. Those organisms that feed on the trees, such as the caterpillars, are called primary consumers or herbivores. Those that feed on the herbivores, such as the sparrows, are known as secondary consumers or carnivores, while the hawks in this example are called tertiary consumers or top carnivores.

• Suggested Films

- Oceanic Food Chain
- What Is a Food Chain?



Peregrine falcons are predators which feed on a diet of smaller birds

Extension Question

Q1. What is a trophic level?

A trophic level is a feeding level. Producers occupy the first trophic level, followed by the herbivores in the second trophic level, the carnivores in the third and so on.

• What is a food web?

DIAGRAM 01:



In real ecosystems, food chains do not operate in isolation from one another, but instead overlap and connect with each other. These are called food webs and they show the interconnectedness of organisms in an ecosystem. Hawks may eat more than just sparrows, including other small birds and mammals, which in turn eat a number of different food sources, some of which they compete for. Furthermore, some organisms operate at more than one trophic level and so are called omnivores.

Extension Question

Q2. Why is it important to know about food chains in an ecosystem?

Because species are so interconnected within an ecosystem, a small change in one population can sometimes have dramatic and unexpected effects on others. It is important, therefore, to know how human activities might affect the functioning of an ecosystem.

• How does energy pass through a food chain?

The Sun is the ultimate source of energy for all food chains and therefore all ecosystems. Plants are able to use solar energy to make food through the process of photosynthesis. The food that they make is then eaten by different organisms and the energy is therefore passed up the food chain from one trophic level to the next. This process is very inefficient, however, as energy is lost when animals move, excrete and respire. As a result, less and less energy is available to the next trophic level and so less life is supported at higher trophic levels. Pyramids of biomass can be constructed to demonstrate this.

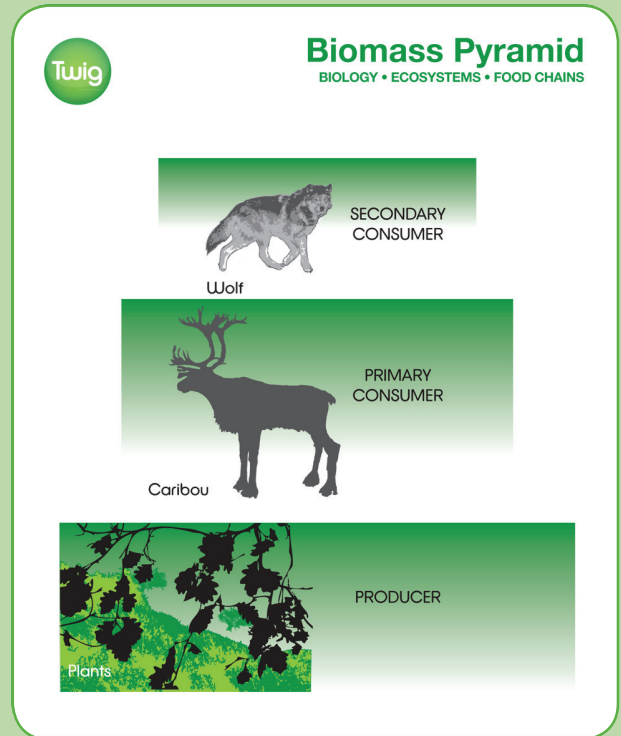
• Suggested Film

- What is a Food Chain?



Energy from plants is passed up the food chain when eaten by animals

DIAGRAM 02:



Extension Question

Q3. How many trophic levels are there in a food chain?

Typical food chains have between three and five trophic levels. It is very rare to find a food chain with more than five trophic levels, as there is so little energy left available to support a population of organisms at an additional trophic level.

Section 2: Human Effects on Ecosystems

• How can humans affect food chains?

Human activity can sometimes have dramatic effects on food chains and therefore ecosystems. For example, the removal of a top predator by hunting can cause dramatic, and sometimes unexpected, effects on the species lower down in the food chain. Similarly, overfishing of certain species has caused significant shifts in the populations of other organisms in marine ecosystems, some of which have proved disastrous for the fishing industry.

• Suggested Film

- Invading Animal Species: The Cane Toad



Overfishing can have dramatic effects on marine ecosystems

Extension Question

Q4. What happens when new species are introduced into an ecosystem?

There are several examples of man introducing species to ecosystems with disastrous results. The introduction of a new species which did not evolve in that ecosystem, can sometimes have a devastating effect as the new organism is able to occupy a new niche and thereby interact in entirely new ways with other organisms, often outcompeting them and potentially driving them to extinction.

• **How does pollution affect food chains?**

Pollution can affect food chains in a number of ways. Pollution can have long-term effects on the atmosphere, which cause changes to abiotic factors, such as temperature and rainfall, which in turn can have significant impacts on living organisms in food chains. Some pollutants, such as pesticides and industrial wastes like mercury, can affect organisms directly by reducing population numbers. Others can accumulate in a food chain, often causing the most damage to animals at the top of the food chain. This is known as bioaccumulation.

• **Suggested Films**

- **Bioaccumulation in Food Chains**
- **FactPack: Mercury in Food Chains**

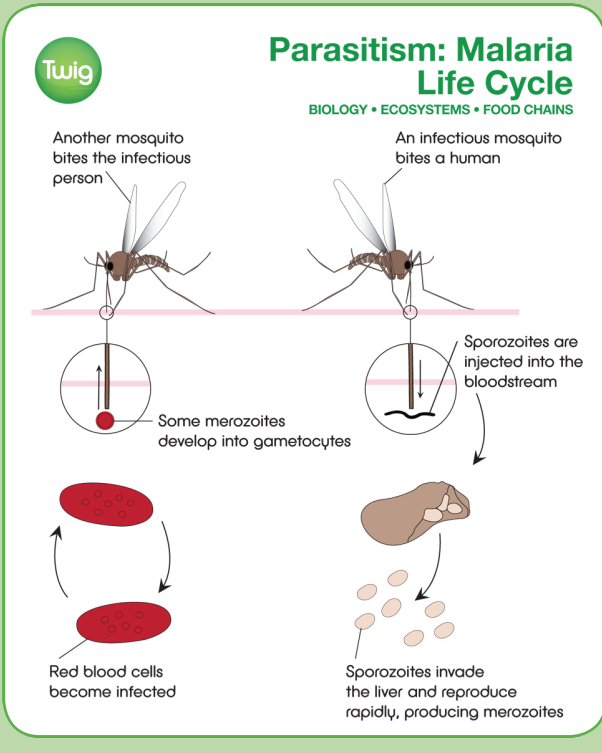
Extension Question

Q5. What does bioaccumulation mean?

If animals eat compounds which they cannot break down and excrete, these compounds are stored in their bodies. The more they eat, the more the concentration of the compound increases until it becomes toxic. Of course, animals higher up the food chain are eating lots of animals which already have high levels of the toxin, so they bio-accumulate it in their bodies to the greatest extent and are most likely to suffer the consequences!

• **What other feeding relationships are present in ecosystems?**

DIAGRAM 03:



As well as classic predator–prey relationships, many organisms derive the energy they need through different means. Parasites, for example, live on, or in, their host and derive food from the host and cause harm to it as a result. Examples include blood-sucking insects and worms inside an animal’s gut. Parasites can play an important part in the make-up of a food chain and therefore in the way an ecosystem operates. Similarly, decomposers are very important in the functioning of ecosystems. Decomposers, which include many bacteria and fungi, feed by secreting enzymes on to dead organic matter, digesting it and absorbing it. In the process, decomposers play an important role in the recycling of nutrients, such as carbon and nitrogen.



Extension Question

Q6. What is mutualism?

Unlike parasitism, mutualism is a relationship between two species in which both benefit. Mutualism is often based on a feeding relationship, where one or both species derive food. For example, lichens consist of a fungus and an alga, both providing each other with essential nutrients. Similarly, many mutualistic bacteria live in the guts of mammals, deriving food from their host but helping with the digestion of food in return.

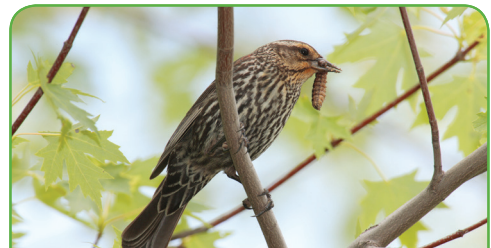
• Suggested Films

- Symbiosis: Parasitism
- Fungi
- Symbiosis: Mutualism

Section 3: Nitrogen Cycle

• How do nutrients cycle in an ecosystem?

While energy is supplied to an ecosystem from the Sun and is ultimately lost, nutrients such as carbon and nitrogen are continually recycled and reused over and over. For example, the carbon in carbon dioxide is used by plants in photosynthesis to manufacture organic compounds, such as sugar, starch and fat. Some of the carbon in these compounds is returned to the air when the plant respire, but some is passed up the food chain to herbivores and on to carnivores, which also return carbon back to the atmosphere when they respire. When living organisms die their bodies can be decomposed by fungi and bacteria, which again respire and return the carbon back to the atmosphere to complete the cycle.



A red-winged blackbird (secondary consumer) eats a caterpillar (primary consumer)

Extension Question

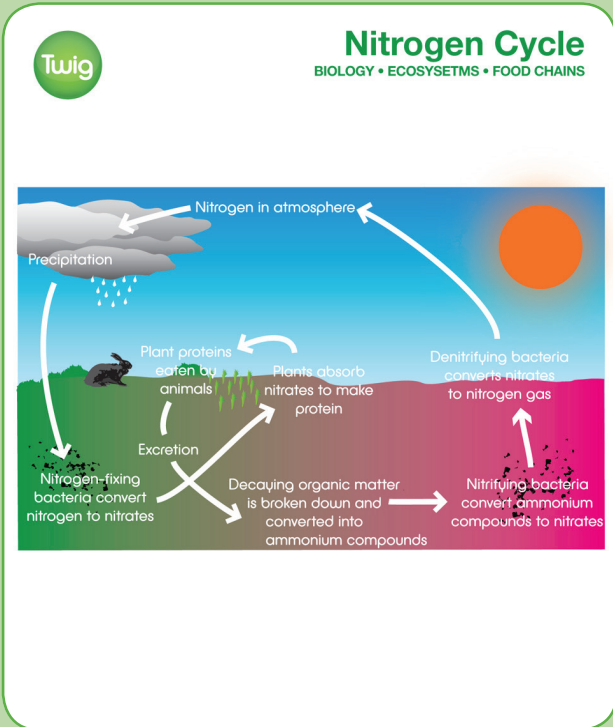
Q7. How are fossil fuels formed?

Fossil fuels are formed when dead animals and plants are not completely decomposed and instead become buried and compressed over many millions of years. Fossil fuels, such as coal and oil, can eventually be retrieved from the earth and burnt to release energy. The carbon in them is released back into the atmosphere as carbon dioxide, which plants can once again use to photosynthesise.

• How does nitrogen cycle in an ecosystem?

Nitrogen is an important element in biological systems, as it is needed to construct proteins and DNA. As producers, plants acquire it from the soil in the form of nitrates and use it to manufacture proteins and DNA. These nitrogen-containing compounds are then passed along food chains and return to the soil when organisms either excrete wastes or die. Decomposers decay this waste matter, and soil bacteria regenerate nitrates from it, thereby replenishing the soil. In addition, some bacteria in the soil are able to fix nitrogen gas directly from the atmosphere into the soil. These are called nitrogen-fixing bacteria and they live either free in the soil or in mutualistic relationships with plants called legumes.

DIAGRAM 04:



• **Suggested Film**
– The Nitrogen Cycle

Extension Question

Q8. How do farmers keep their fields rich in nitrates?

Because crops are removed from fields, soil can become infertile unless nutrients are replenished. Farmers usually apply artificial fertilisers rich in nitrates, but it is also possible to add natural organic fertilisers to the soil, such as manures and composts. Crop rotation can also help, as can the growing of clover whose roots contain mutualistic nitrogen-fixing bacteria!