SNC1D
BIOLOGY

SUSTAINABLE ECOSYSTEMS

- Interactions in Ecosystems (P.30-32)

Ecological Niches

Why are there so many large trees and other plants in the forest but so few large animals? Why do you see hundreds of mosquitoes but not as many frogs to eat them? Each species is limited by the resources it needs.

Ecological Niches

*Every species interacts with its environment and other species. These interactions are referred to as the species' **ecological niche**. The ecological niche of a species includes what it eats, what eats it, where it lives, and how it behaves.*

ECOLOGICAL NICHE

- an organism's job
- includes where it lives, what it eats, what eats it, and how it behaves

Ecological Niches

Think about the niche of a black bear. Black bears eat plant parts such as nuts and berries. They also eat insects and, occasionally, other small animals. They have few predators other than human hunters, but other organisms such as biting insects and parasites feed on them.

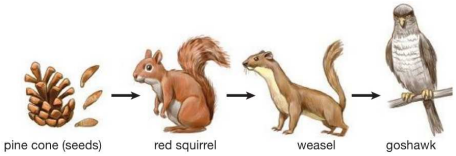
PRACTICE

1. Consumers can be further classified as to what they eat. List these classifications.

Types of Consumers

TYPES OF CONSUMERS

- herbivore ☞ only eats plants or other producers
- carnivore ☞ only eats other consumers
- omnivore ☞ eats both producers and consumers
- scavenger ☞ feeds on dead organisms
- decomposer ☞ feeds on decaying organisms



Decomposers – A Special Group of Consumers

PRACTICE

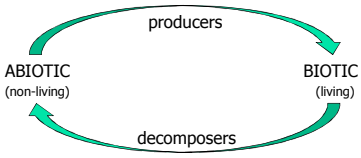
2. Decomposers are considered a special group of consumers. Why?

*They are the only consumers that can break organic matter down and release the nutrients back into the ecosystem. The major decomposers are fungi and bacteria. They do not consume the organic matter directly. Instead, they release special chemicals, called **enzymes**, into the organic matter to break it down. They then absorb the nutrients that are released.*

Decomposers – A Special Group of Consumers

DECOMPOSERS

- fungi and bacteria
- use enzymes to break organic matter down and release the nutrients back into the ecosystem
- link the biotic and abiotic world



Decomposers – A Special Group of Consumers

PRACTICE

3. All decomposers are consumers, but not all consumers are decomposers. Explain.

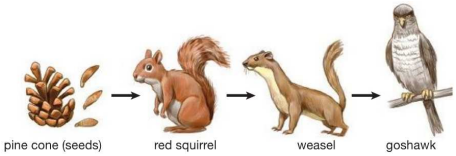
Decomposers are considered a consumer but only decomposers can break organic matter down and release the nutrients back into the ecosystem.

Food Chains

*The most common interactions between species are through feeding relationships. The easiest way to display these relationships is with **food chains**. Food chains illustrate who eats whom in an ecosystem.*

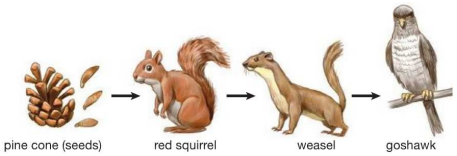
FOOD CHAIN

- illustrates who eats whom in an ecosystem



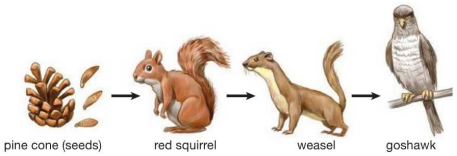
Food Chains

*Consider the food chain illustrated below. The seeds of a producer (the pine tree) are eaten by a herbivore (the red squirrel), which is in turn eaten by a carnivore (the weasel). The weasel then falls prey to a top carnivore (the goshawk). Each of these relationships is a link in the food chain. Carnivores linked in a food chain have a predator-prey relationship with the animals they eat – the hawk is the **predator** and the weasel is the **prey**.*



Energy in Food Chains

In this food chain, some of the chemical energy stored in the pine seeds is passed through the red squirrel to the weasel and ends up in the goshawk. In this way, food chains show how energy passes through an ecosystem. Remember that all organisms continually use and release energy to their environment. This means that energy is continuously lost from all levels of the food chain.



Trophic Levels

*Ecologists refer to the **trophic level**, or feeding level, to describe the position of an organism along a food chain. Producers occupy the lowest, or first, trophic level. Herbivores occupy the second trophic level, and carnivores occupy the third and fourth trophic levels.*

Trophic Levels

TROPHIC LEVEL

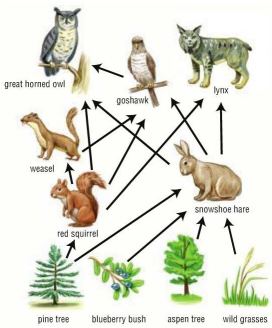
- indicates the position of an organism in a food chain
  - 1st – producer
  - 2nd – primary consumer
  - 3rd – secondary consumer
  - 4th – tertiary consumer

Food Webs

Food chains do not exist in nature – they are used to show simple feeding relationships. Food chains are part of a larger, more complex system of relationships that exist among species. A more accurate, but still incomplete, way to illustrate interactions is with a ***food web****. This shows a series of interconnecting food chains.*

FOOD WEB

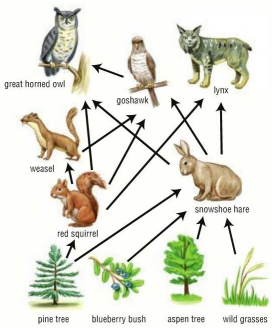
- shows how different food chains interconnect



Food Webs

NOTE!

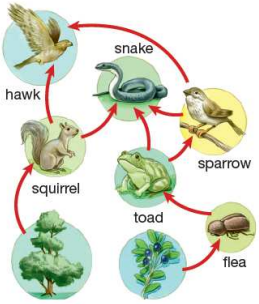
Food webs are highly complex, with consumers feeding on many species. The large number of interactions tends to reduce the vulnerability of any one species to the loss or decline of another species. For this reason complex food webs are thought to be more stable than simple food webs.



Food Webs

PRACTICE

4. Examine the food web given to the right. How many of the following are there?
   - (a) food chains 5
   - (b) producers 2
   - (c) consumers 6
   - (d) herbivores 2
   - (e) carnivores 4
   - (f) omnivores 0
   - (g) top carnivores 2
   - (h) highest trophic level 5
   - (i) primary consumers 2
   - (j) secondary consumers 3



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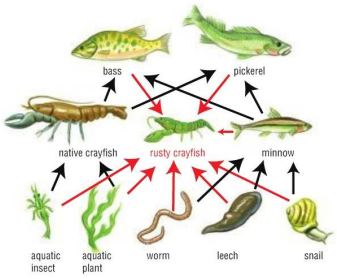
Effects of Changes to a Food Web

Food webs are useful tools to figure out what may happen when a species is removed from or added to an ecosystem. For example, if a species is removed from a food web, the species it feeds on may increase dramatically in numbers. Conversely, the population of a newly introduced species may disrupt the entire food chain.



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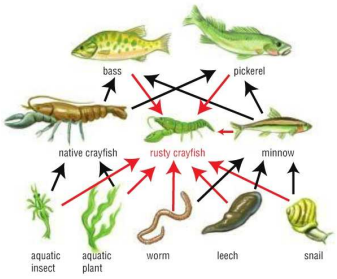
Effects of Changes to a Food Web

For example, the invasive rusty crayfish (labelled in red) competes with native crayfish for many of the same foods. It also feeds on the eggs of bass and pickerel. Large fish feed on native crayfish but usually avoid eating the rusty crayfish.



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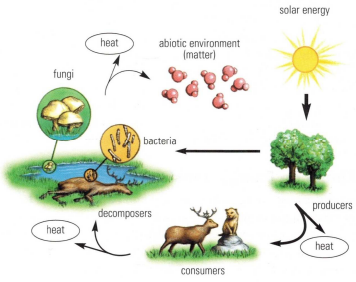
Effects of Changes to a Food Web

Human actions can also disrupt a food web. For example, toxic substances we use may enter an aquatic ecosystem and disrupt or stop the growth of a plant species. Consumers of that species will also suffer because their food source will be reduced or removed.

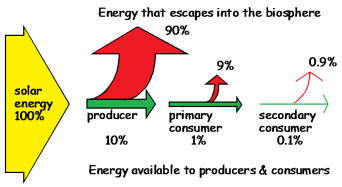
Energy Pathways

All organisms carry out cellular respiration and release energy. When one organism consumes another, it takes the energy it needs to live and releases thermal energy (i.e. heat). And when this organism is eaten by another organism, the chemical energy stored in its body is passed on to the other organism.



Energy Pathways

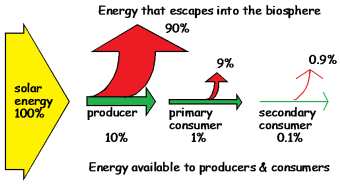
Typically, though, only about 10% of the energy taken in by organisms at one trophic level is passed on to organisms at the next trophic level. At each next higher level, the amount of available energy decreases. As a result, the number of organisms at each trophic level is also significantly reduced.



Energy Pathways

ENERGY PATHWAYS

- ~ 10% of the energy at one trophic level is passed on to organisms at the next trophic level (90% is used for life or lost as thermal energy)
- at each next higher level, the amount of available energy decreases (as do the number of organisms)



Energy Pathways

PRACTICE

5. Discuss the energy efficiency of a food chain with four trophic levels. Where does the energy go?

100% → 10% → 1% → 0.1% → 0.01%
(sun) (#1) (#2) (#3) (#4)

the energy is:

- used for life processes (reproducing, surviving, ...)
- lost as thermal energy

Energy Pathways

PRACTICE

6. Usually, more organisms are found at lower trophic levels than at higher trophic levels. From an energy flow point of view, explain why.

at each higher level there is less energy available so there are fewer consumers

The Interaction of Living Things – DYK?

On September 26, 1991, four men and four women entered a gigantic dome near Tucson, Arizona, that contained 3800 species of plants and animals. Named Biosphere 2, the dome was the largest, and most expensive, artificial ecosystem ever created. The dome was sealed after they entered. They were to live there for a year. Nothing was to be brought in; nothing, and no one, would be allowed out. All raw materials and waste products were to be recycled by humans, animals, and plants living together. It was hoped that, if it worked, a similar artificial ecosystem could be used in space exploration.

The Interaction of Living Things – DYK?

However, the experiment demonstrated in a fairly short time that we do not know everything we need to know about ecosystems. Despite careful advanced planning to ensure the right numbers of plants and animals, and the use of computer simulations and electronic monitoring devices, the amount of carbon dioxide in the air inside the dome kept increasing. Scientists were not able to establish a workable balance between the number of plants and animals. Only 47 days later, on November 12, the team running the experiment gave up and pumped purified air in from the outside.

✔ Check Your Learning

1. Food chains and food webs always start with a producer. Explain why this is necessary.

   producers (plants) are the only organism that is able to capture light energy (abiotic world) and make it available to the rest of the food web (biotic world)

✔ Check Your Learning

2. Consider a food chain consisting of grass, rabbits, and foxes. How would a decrease in the number of rabbits (perhaps caused by human hunting) affect the foxes? the grass?

   foxes – population will decline (less food)
   grass – population will increase (fewer consumers)

✔ Check Your Learning

3. Suppose that an unknown disease were to kill all the bacteria and fungi in an ecosystem. What would happen to nutrient cycling in the ecosystem?

   nutrients would not be returned to the soil for plants to use – plants would die, and then ...

✔ Check Your Learning

4. A food web contains green plants, grasshoppers, frogs, snakes, insect-eating birds, and falcons. Which group would contain the most energy? the least energy?

   most – the green plants (producers)
   least – the falcons (top carnivore)

✔ Check Your Learning

TEXTBOOK

P.35 Q.9,10,13,15

WIKI (BIOLOGY)

- 1DBIOL - QUIZ1 (Diversity in Ecosystems)
- 1DBIOL - ASG2 (Predator-Prey Relationships)

1DBIOL – ASG2 (Predator-Prey Relationships)

NOTE!

When you are finished, it should look something like this.