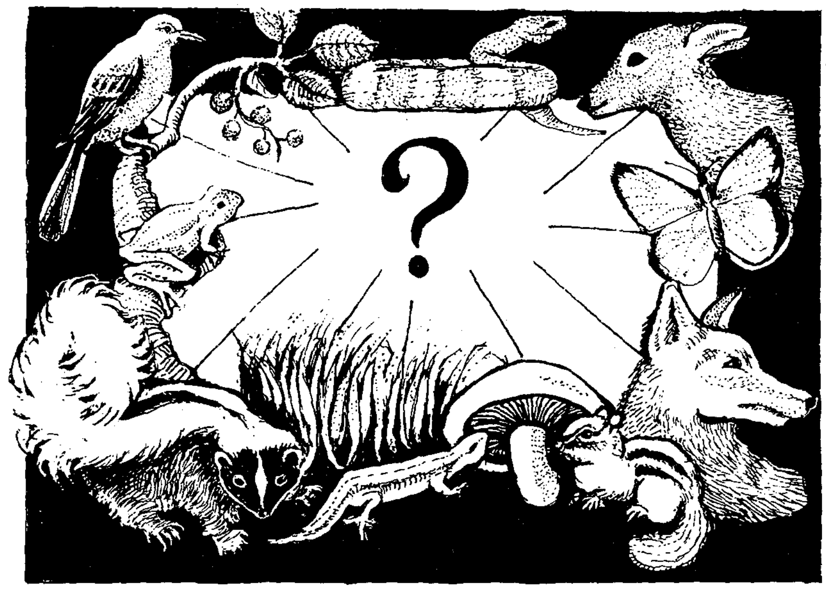
1.8 Making Food Webs



Action Synopsis

Students make food webs of their study site, then trace how a change in one population could affect other populations within the web.

Session 1	**40 minutes**
1. Show a food web made by a team of ecologists.	*linking to real world*
2. Discuss populations and food webs.	*introducing new information*
3. Work in groups to make food webs using study site organisms.	*processing findings*

Session 2	**40 minutes**
1. Talk about how changes in one part of a food web can cause changes in other parts of the web.	*introducing new information*
2. Prepare and exchange "What if ... " food web scenarios.	*applying knowledge*
3. Summarize and discuss how people's actions can affect food webs.	*reflecting*

Desired Outcomes

Throughout the lesson, check that students:

✓ Know that most animals eat and are eaten by more than one thing.

✓ Understand that a food web shows all the likely feeding relationships at a location.

✓ Are able to explain the different ways a change in one population can ripple through a food web.

What You'll Need

Sessions 1 & 2

For the class:

- ❑ overhead transparency of "Food Web" (page 155)
- ❑ overhead marker
- ❑ 20–30 buttons or beans, two colors (optional)
- ❑ food chains from Lesson 1.6
- ❑ master list of study site organisms from Lesson 1.3
- ❑ several copies of the *Who Eats What* guide (pages 355–382)
- ❑ other resource books (see "Resource List," pages 51–55)

For each group of 3–4 students:

- ❑ materials for making food webs (see "Getting Ready")

Vocabulary

FOOD WEB - The connections among everything organisms in a location eat and are eaten by.

POPULATION - A group of the same kind of organism living in the same place.

Getting Ready

Session 1

♦ Gather materials for groups to use to make food webs, such as large sheets of butcher paper, slips of paper or self-stick removable notes in two colors, and markers

♦ Plan to use the same student groups as for Lesson 1.3 and Lesson 1.6.

Session 2

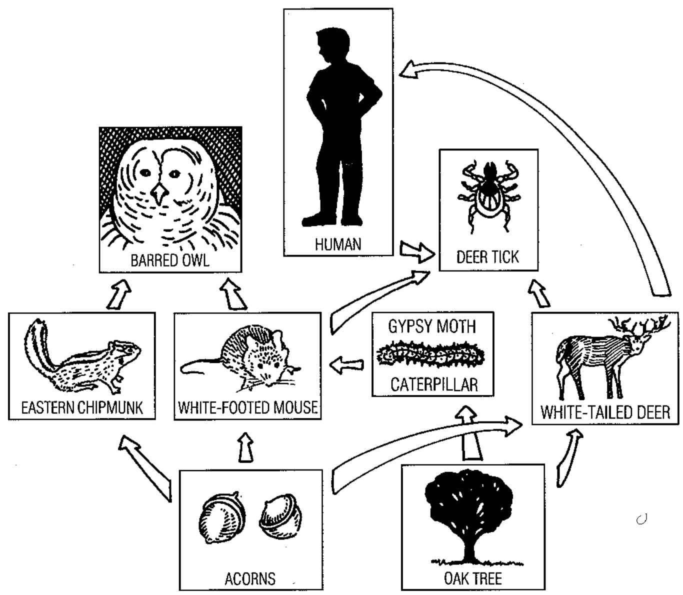
♦ Consider reading a food web story to your students to provide additional examples of how a change in one population can affect an entire food web. See *Wolf Island* and *The Day They Parachuted Cats on Borneo* in the "Resource List" (pages 54–55).

Action Narrative

Session 1

Today we're going to make FOOD WEBS. Here is a picture of one.

Show the "Food Web" overhead.



What do you notice about the difference between a food chain and a food web?

A food chain shows just one thing that each animal eats and is eaten by; a food web shows all the things an animal eats and is eaten by.

This food web was made by a group of scientists who work at the Institute of Ecosystem Studies, an ecology research center in New York state. They figured out this food web by studying plants and animals that live in oak forests. Some of the things living in the forest are: oak trees, white-footed mice, chipmunks, white-tailed deer, barred owls, Lyme ticks, and gypsy moths. Each scientist has a different specialty — plants, mammals, and insects. They work together to try to figure out how changes in one population of plants or animals affects the other populations in the food web. Do you know what I mean by a POPULATION?

A population is a group of the same kind of organism living in an area. You can illustrate this by spreading two colors of buttons on a table. All of the (red) buttons represent one population, such as deer mice, and all of the (blue) buttons represent another population, such as Lyme ticks. Have students count how many organisms there are in each population. Students might be familiar with the Federal Census Bureau which counts the population of people living in the United States.

A lot of people are interested in the size of the populations of the organisms in this food web. Can you think why?

Students might suggest some of the following reasons: 1) Lyme ticks carry Lyme disease which makes people very ill; 2) gypsy moths can destroy whole forests by eating all the leaves off of trees; 3) when there are a lot of deer they eat people's shrubs, gardens and crops, and cause accidents when they run in front of cars, but some people like having a lot of deer to watch or hunt for meat; and 4) oak trees make valuable lumber.

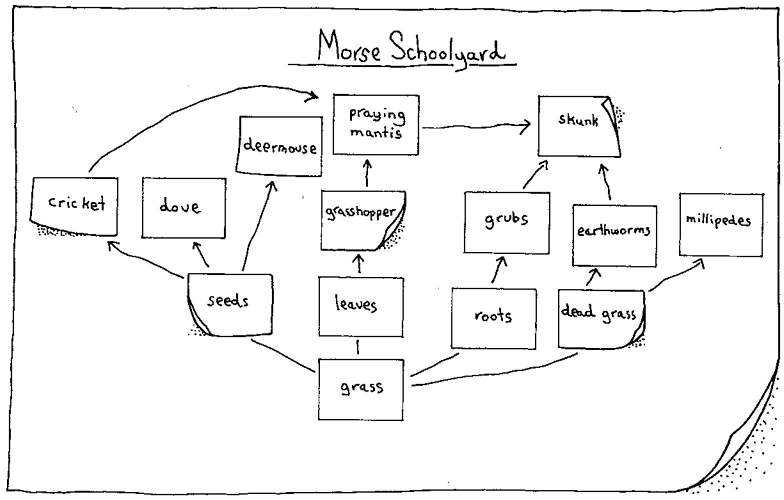
If ecologists can figure out what makes the populations of these organisms grow or shrink, they can help people manage forest resources. Let's see what the food web tells us about what each animal eats.

Go over the food web, asking students to interpret what each organism eats and is eaten by. The arrows in a food web point away from the thing being eaten, towards ("into the mouth of") the organism that is eating it. Food webs are often organized like food chains, with producers on the bottom, herbivores in the middle, and carnivores on the top.

Now you'll work in groups to make food webs using your research findings, just like the scientists who made this web. Start your webs with an organism you saw in your study plot. Work in your groups to decide what to include in your food web, and how to organize it. You can use the *Who Eats What* guide, resource books, and everyone's food chains for information about who eats what.

Show students the materials they can use to make their food webs. It will take them a while to decide how to organize their webs. It is usually easiest for them to choose one organism, then work outward to form a web above, below, and around it. After they have a core web, you can suggest that they look at their list of study plot organisms, and at the master list of study site organisms, to see if they can make any other connections to their web. They don't have to make a web of the entire study site.

You might suggest that groups figure out some way (e.g., two different color removable notes or paper slips) to indicate which plants and animals they know are on the site, and which they just assume are there because of evidence they saw. Students can also indicate how sure they are of each food link by using a dotted line to show connections of which they aren't sure, and a solid line for those of which they are sure. It's best if students use a pencil to draw connections initially, then use a pen or marker to darken the lines once they are satisfied that everything is correct.



NOTE: Since different parts of a plant are food resources for different animals, students should specify the plant parts that each animal consumes.

Session 2

The next step in understanding food webs is to think of a "What if . . . " sequence of events.

Show the food web overhead transparency.

For example, what would happen if one year all the oak trees in the forest produced a huge crop of acorns?

Work through the food web putting a plus or a minus sign on the overhead next to organisms that students predict will increase or decrease in the first year after acorn production increases.

Next talk about what would happen the following year. If herbivores (e.g., mice, chipmunks) increase the first year because they have more acorns to eat, then their predators (e.g., owls) will gradually increase because they will also have more food. Once predators increase, the populations of the herbivores they eat will decline.

Encourage students to think about how a change could affect organisms on both ends of the arrows, to emphasize that effects ripple through a food web in all directions. For instance, an increase in mice might lead to a decrease in gypsy moth caterpillars, since mice eat them. But it might also lead to an increase in owls, since there are more mice for them to eat.

What would happen if a lot of mice died over a very hard winter?

Put a big X through the mouse picture and discuss the effects on the food web.

Thinking Like Food Web Scientists

A lot of questions and complications will arise in discussing how a change in one population could affect an entire food web, which are exactly the kinds of issues that make food web scientists' work challenging! For instance, if mice decrease, will there be more acorns for deer to eat so that they are able to have more offspring? And if deer increase as mice decline, will tick populations change? Will some of these population shifts "even out" so that top level predators are not affected?

Through raising questions and making predictions, students will realize that they need to know how much each organism depends on another one for food. For instance, do enough people depend on deer for food to really make a difference in the human population size if deer increase? Students also might begin to think about how the forest itself could change if herbivores eat all the acorns and oak saplings. If gypsy moths eat oak leaves, letting light onto the forest floor that used to be shady, will new types of plants grow where oak saplings once did? Help students to realize that scientists begin their research by making predictions, just as they are doing, but they can't be sure what really happens in nature until they actually study these communities in the forest.

The scientists doing the food web study in New York predict that in years when oak trees produce a lot of acorns, mice populations will increase. Then their populations will crash the next year when the oak trees have fewer acorns. When this happens, there will be fewer animals to eat gypsy moth larvae, so the gypsy moths will hatch and eat the leaves off of the oak trees. This means that the oak trees won't have enough energy to produce acorns. Also, with no leaves on the oak trees a lot more sunlight will hit the forest floor, making it possible for new kinds of plants to grow there. Since the oak trees aren't producing many seeds, and new kinds of trees are starting to grow, the whole forest could change. All this because of food web links among acorns, mice, and gypsy moths!

Read students a food web story to provide other examples of ripple effects in food webs. (See "Getting Ready," page 149.)

Now work with your group to write a "What If . . . " question about your food web. On a separate piece of paper, record what you think would happen to every organism on your food web. Then exchange your web and question, but not your answers, with another group. When both groups have written predictions about each other's food webs, get together to compare your answers.

Encourage students to express and justify the reasoning behind their predictions of how a change will ripple through their food web. After they exchange answers with another group, don't let them just "correct" and hand back one another's papers. Ask them to talk through differences of opinion by presenting the reasoning behind their predictions. Encourage them to achieve consensus by deciding which arguments make the most sense, or which have the most evidence to back them up. In some cases, two predictions may be equally valid, which is acceptable so long as students see that they are both based on sound reasoning.

Conclude the activity with questions such as:

What are the different ways a change in one population can ripple through a food web?

1) If a predator increases, its prey decreases; 2) If a predator decreases, its prey increases; 3) If prey increases, its predators increase; 4) If prey decreases, its predators decrease; 5) Predators can indirectly benefit their prey's food (e.g., an owl eating mice helps gypsy moths) or their prey's competitors (e.g., an owl eating a chipmunk helps mice).

What would be the advantages and disadvantages of eating one or many things?

Animals that have adaptations for using one particular food source often can out compete animals that are less well equipped to use that food. However, relying on one food source makes an animal vulnerable when the food becomes scarce.

What investigations could you do to figure out if your predictions are correct?

Students might feed or remove organisms, then watch what happens to the size of populations of other organisms. Encourage them to think about how they could count organisms. Scientists usually do this by sampling a population rather than counting every individual. This is the difference between a U.S. population census that counts every head, and an opinion poll that takes a sample that represents the whole population.

In what different ways could people's actions affect your food webs?

People often cause wildlife populations to increase or decrease. For instance, when human populations increase, raccoon populations often increase because people's garbage is a food resource for raccoons. Deer populations increase where people change the landscape in ways that make more deer browse available. The population of timber wolves has been greatly decreased because of hunting pressure, and loss of habitat when people built towns and cities.

Are there any organisms on your webs that people might want to control?

People like to control plants and animals that they consider pests, as well as those that they can use to make their own lives better or more enjoyable.

Should people try to manage and control nature?

Some might argue that since people already have a large impact on plants and wildlife, we should try to balance protection and use of natural resources. One example of using knowledge of who eats what in nature is biological control, in which farmers and gardeners introduce insects or bacteria to eat or infect pests that eat their crops, instead of using pesticides.

Ongoing Assessment

Student Reflections

Have students send a C-Mail message or record thoughts in their journals. Optional writing prompts include:

What kind of changes to the outdoors have I seen that could have affected the food web in that place?

What does the food web that I am part of look like?

Teacher Reflections

❑ Do students understand the difference between a food chain and a food web?

❑ Did they make correct linkages in their food webs?

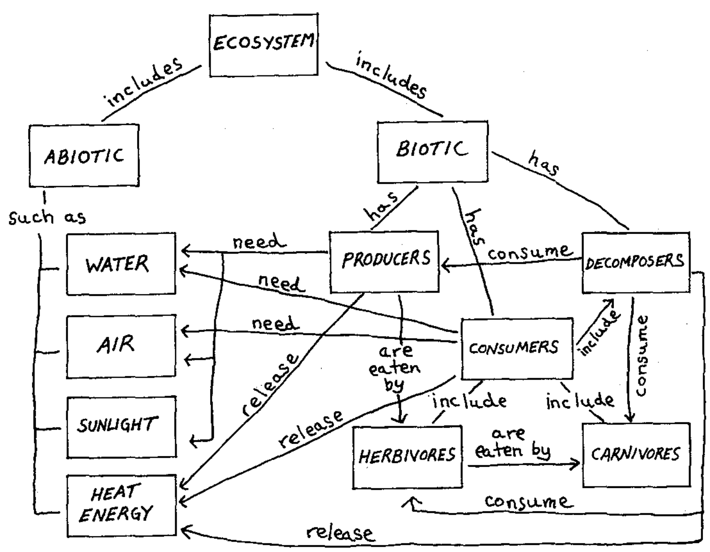
❑ Were they able to predict how organisms directly linked to a changed population could be affected, as well as how those several steps removed might change?

❑ Could they express their reasoning for the changes they predicted in their webs, and were they able to change their minds when someone else presented a stronger argument?

❑ Can they make general statements about the different ways changes can ripple through a food web?

Extensions

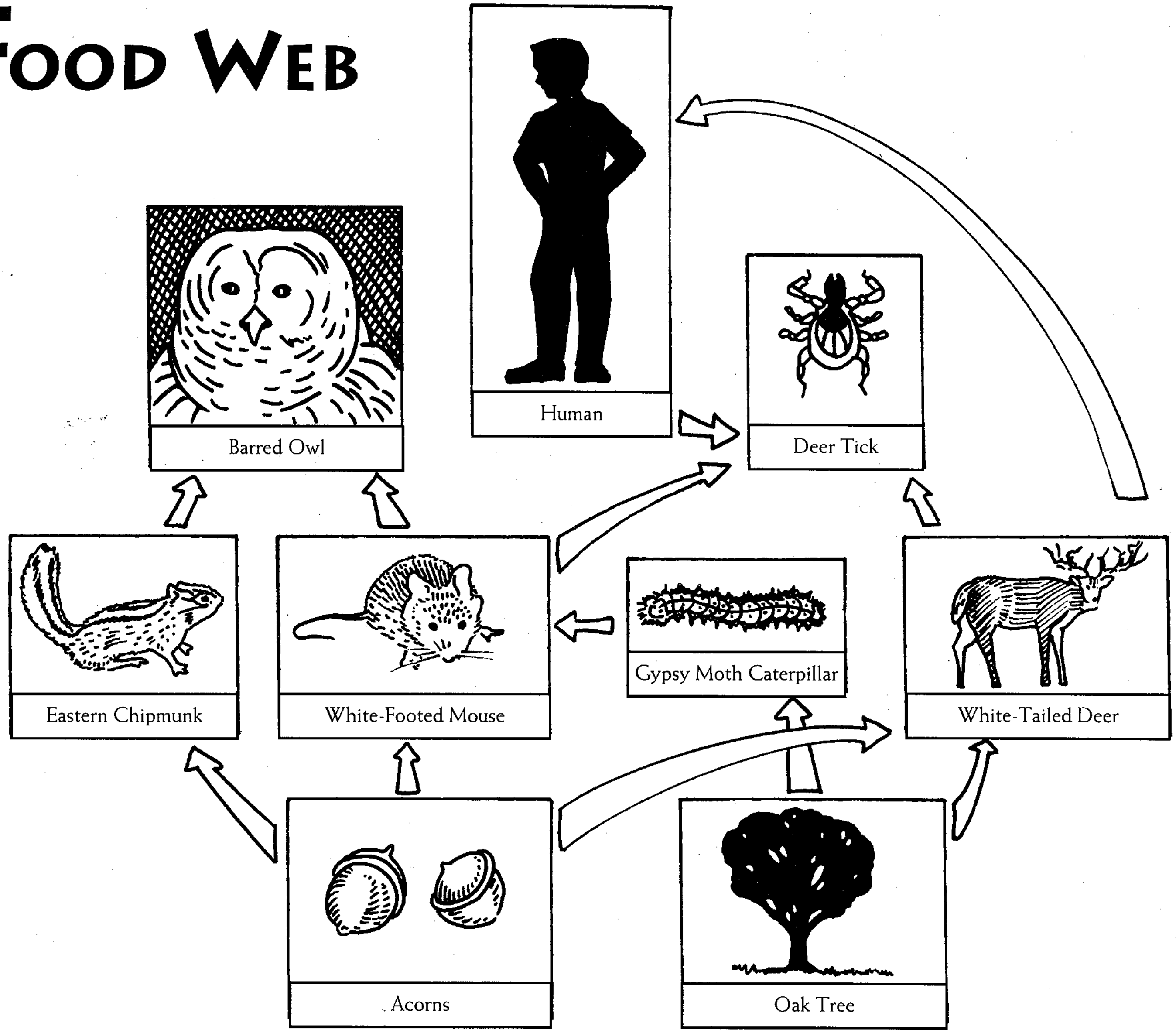
Concept Maps. Introduce concept mapping to students (see pages 25–27) if they are not already familiar with the process. Select all or some of the concept map cards on pages 43–44, then copy one set of cards for each group of 3–4 students. Have them construct concept maps that display their understanding of interrelationships within an ecosystem. Help students compare their new concept maps with those they made after Lesson 1.3 to see how their ideas have changed.



Pollutant Pathways. Have students pick a pollutant, such as lead or PCBs, and find out how it gets into food chains. Trace it through an entire food web.

Food Web Drama. Challenge students to write and perform a play that shows food web interactions before and after a disturbance to the web.

Food Web


Human
Barred Owl
Deer Tick
Eastern Chipmunk
White-Footed Mouse
Gypsy Moth Caterpillar
White-Tailed Deer
Acorns
Oak Tree