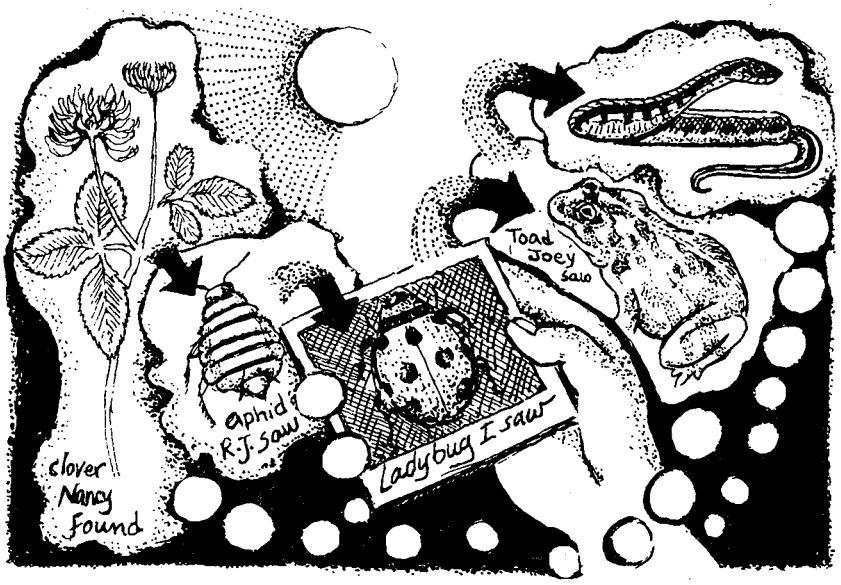
1.6 Making Food Chains



Action Synopsis

Students make food chains for their study site organisms, and learn food chain terminology.

Session 1		**40–60 minutes**
1. Share thoughts about food chains.		*examining prior ideas*
2. Make a food chain as a class, using an example from the school lunch menu.		*introducing new information*
3. Work in groups to organize and make food chains for study site organisms.		*processing findings*
4. Present and discuss food chains.		*communicating*

Session 2		**40 minutes**
1. Review the process of photosynthesis.		*examining prior ideas*
2. Introduce food chain terminology.		*introducing new information*
3. Work in groups to label food chains.		*applying knowledge*
4. Analyze food chains to see that all parts can be traced back to plants and sunlight.		*reflecting*

Desired Outcomes

Throughout the lesson, check that students:

✓ Have a clear picture of the feeding relationships of animals on their study site.

✓ Recognize the strengths and weaknesses of different sources of information.

✓ Understand that plants make their own food.

✓ Are able to define food chain terms and give examples of organisms that fit in each category.

✓ Realize that plants are the ultimate source of food energy for all organisms in a food chain.

What You'll Need

Sessions 1 & 2

For the class:

- ❑ several copies of the *Who Eats What* guide (pages 355–382)
- ❑ other resource books (see "Resource List," pages 51–55)

Vocabulary

CARNIVORE - An animal that eats meat.

CONSUMER - An animal or microbe that gets food by eating things.

DECOMPOSER - An animal or microbe that uses dead plants and animals as food.

FOOD CHAIN - A diagram that shows the flow of food from producers to all types of consumers. The original food source for all organisms in a food chain can be traced to plants.

HERBIVORE - An animal that eats plants.

OMNIVORE - An animal that eats both plants and animals.

PHOTOSYNTHESIS - The process by which plants make sugars in their leaves.

PREDATOR - An animal that kills and eats other animals.

PREY - An animal that is eaten by other animals.

PRODUCER - A green plant that makes sugar for food using the process of photosynthesis.

Getting Ready

Session 1

- Plan to use the same student groups as for Lesson 1.3.

Action Narrative

Session 1

Today we're going to make FOOD CHAINS using our study site organisms. Who can tell me what a food chain is?

Students sometimes confuse food chains with nutrition and the four food groups, explaining food chains as *Like what's written on the label — sodium, nutrition, fat, cholesterol, all that stuff.* Or, *It's like placing the foods in sections, like the steaks and pork chops are in the meat family.* Children who have a more accurate idea about food chains typically say something like, *A big thing eats a smaller thing, and that thing eats something smaller, and it keeps on going like that.* Notice where your students' ideas about food chains fall on the continuum from purely intuitive notions, to a vague understanding of the structure of food chains, to a thorough understanding of how sun's energy is turned into food energy by plants, then passed along the food chain.

A food chain is a way to describe how matter and energy in food get passed along from plants to animals when one thing eats another thing. Why is it important to understand food chains?

Spend a few minutes helping students think about the larger significance of food chains. Some of the reasons they might mention are: for human health protection — understanding how chemicals like pesticides get into our food and then into us helps save lives; to prevent extinctions — knowing about ecological linkages helps people evaluate the consequences of their actions and modify them to prevent the extinction of plants and animals; to preserve biodiversity — understanding how plants and animals are linked in food chains helps people make sure that organisms in an area have what they need to stay alive.

Let's make a food chain together. What is on the lunch menu today?

Write a menu item (e.g., *FISH*) on the board, leaving space to construct a chain up and/or down depending on whether the item is a plant or animal.

If it is an animal, start the food chain by working downward, listing what organism students suggest it might have eaten, then what that organism could have eaten, and so on until you have a plant at the base of the list.

Fish (Haddock)
↑
Insects, Minnows
↑
Algae

You can record just one item at each level of the food chain or several possibilities.

What do you notice about the direction I've drawn the arrows?

Help students see that the arrows point from the item being eaten into the "mouth" of the animal that eats it.

To continue a food chain for an animal, or to begin a food chain for a plant, work upwards, listing what organism eats the item, what eats the organism that eats it, and so on until the students get to an organism that they say nothing eats. Stretch their thinking toward decomposers by asking what might eat the top level organism after it dies.

Bacteria, Worms, Bugs
↑
People, Bears, Sharks, Bigger fish, Kingfishers, Hawks, Osprey, Raccoons
↑
Fish (Haddock)
↑
Insects, Minnows
↑
Algae

There could be disagreement and uncertainty about what eats what. This creates a great opportunity for students to practice scientific thinking. Even though the point of this activity is to show the structure of a food chain rather than to teach the specific diets of certain animals, it's good to get students in the habit of supporting their claims with evidence or a knowledge source. Model the process by asking a few students where they got their information about what something eats. Then encourage students to ask one another to share how they know something, before you add new suggestions to the board. This will help them internalize the habit of looking for evidence behind claims, rather than seeing this as something only the teacher does. It's important that this be done in the spirit of intellectual curiosity, so students don't feel put on the spot and turn defensive when asked to elaborate on their ideas. List whatever ideas the class finds plausible, and tell them that it's okay to go with hunches so long as they acknowledge that the idea is uncertain and needs further research.

Work in groups to make food chains using the organisms you found on our study site. Start each food chain with an animal someone in your group saw (or saw evidence of) in your study plot. You can use the *Who Eats What* guide and other references to find out what each animal eats.

If you find out that an animal eats or is eaten by something nobody found in your plot, put a star by it when you include it in your food chain. That way we'll know which things we don't know for sure are on the site.

It will take students a while to decide how to organize their food chains: horizontally or vertically; in boxes or on lined paper; with a predetermined number of steps or going as far as they can. Groups will also need to determine how many food chains to make, and whether to work on each one together or have each person make one. If after an initial

planning period some groups are frustrated or overwhelmed, suggest that they begin with three steps:

Step 2:		Step 1:		Step 3:
What it eats	→	**An animal you saw or saw signs of**	→	**What eats it**

Encourage students to use specific names of organisms in their chains if they can: "robin" rather than "bird;" "ant lion" rather than "bug;" "palmetto leaves" rather than "leaves." For plants, be sure to have them name the plant part (e.g., leaves, stems, seeds, roots) that an animal eats — this is more important than including the species name of the plant.

Students will need to use a lot of organisms they didn't find to make complete food chains for those they did find. Before they include something they didn't see on the study site in a food chain, ask them to think through how possible it is that the organism lives there. (Have them use a list of common organisms in your region if you have one.) If it does not seem likely that it would live on the site, encourage students to find out if there is another kind of food that their organism eats. The goal is to make plausible food chains.

This activity could extend into two periods, especially if students take seriously the need to research information so that their food chains are accurate. When they complete their work, have pairs of groups show each other the food chains they made.

Afterwards, engage the whole class in a discussion of questions such as the following:

How did you know what an animal eats?

Help students become aware of the variety of sources of information they used. They probably made many of the food chains based on some general knowledge they already had. This knowledge might be grounded in experience (a direct observation), or vague. Students might have used books, but what did they do if a book said something they didn't believe, or if it left out something they know is true? Perhaps they relied on an "expert," either someone they know or someone on television. Discuss which sources students consider to be the most reliable and why.

How did you resolve any differences of opinion within your group about what something eats?

Scientists always have to provide evidence for claims they make. Have students think about what made some people's claims more convincing than others. Making clear how one has come to know something, and stating how strong the evidence is for a conclusion, are two of the most central practices of science.

Did any two groups have a different food chain for the same animal?

Most animals eat and are eaten by more than one thing, so it is possible that several different food chains for one animal could be correct.

Were you surprised by anything you found out?

Students may read things that surprise them. For example, large carnivores such as foxes eat a lot of berries and insects, and daddy-longlegs are insects with six legs, not spiders — in fact they eat spiders.

Session 2

Let's look again at the example of a food chain we made from the lunch menu. (Draw it on the board if it has been erased). **Does anyone know what ecologists call plants like the one that is at the base of our food chain?**

Students are probably familiar with the word PRODUCER. Write it next to the plant at the base of the food chain.

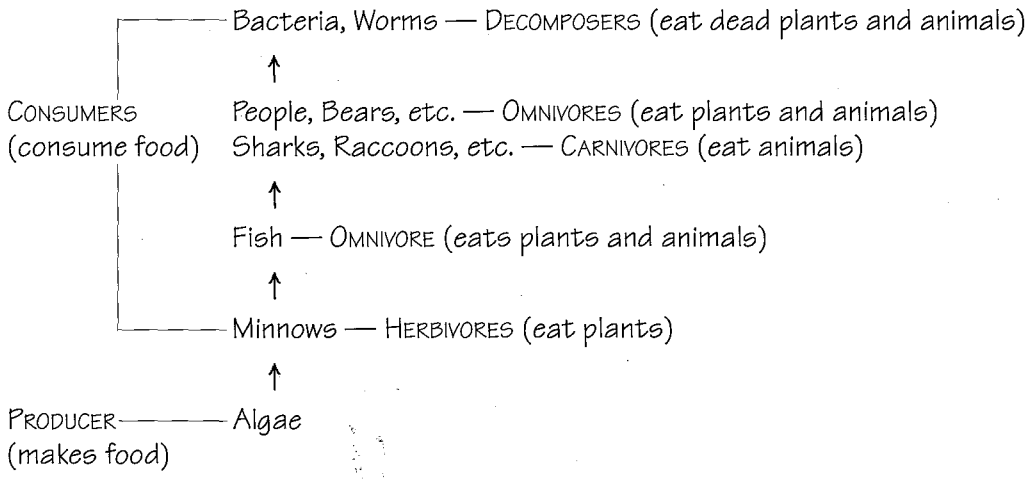
Why do you think scientists call plants producers?

Plants use the process of PHOTOSYNTHESIS to produce sugars that they and animals use as food.

If your students have not yet developed a basic understanding of photosynthesis, you might want to take a few periods to focus on photosynthesis now or at the end of the module. One technique to help students examine their ideas is to ask them to jot down a response to a question such as: "How do plants meet their food needs?" Then have each student talk over their response with a partner, and together write a revised statement. Then have each pair get together with another pair, and repeat the process as a group of four. Finally have two groups of four share their statements and write a new version. Debrief as a class, targeting unresolved issues and differences of opinion that need to be addressed. (See "Children's Ideas about Food for Plants," page 119, and "Sugar Factory Skit," page 121.)

What are other terms ecologists use for organisms at each level in a food chain?

Move up the food chain written on the board, seeing if students can identify the ecological term to describe each category.



Also introduce the term Predator (an animal that eats another animal — a carnivore or an omnivore) and Prey (an animal that is eaten by another animal).

Now label each organism on your food chains using these new words: producer, herbivore, carnivore, omnivore, decomposer.

Sometimes students get stuck on what to call dead plants and plant parts such as berries, bark, or roots. These can be labeled producers.

Who can find something in your food chains that is not connected to sunlight?

Some students might suggest things that aren't linked to living plants, such as an earthworm that eats dead leaves, a beetle or fly that lives on animal droppings, or a carnivore such as a spider. In each case, ask them what the organism they mentioned eats, what that organism eats, and so on until they realize that food for all organisms starts with the sun's energy that plants use to make food.

No matter where an organism is on a food chain, you can always trace its food back to plants and sunlight. Could we survive in a world without plants?

Hopefully students' answer will be a resounding *No!* Expect however, that some students will not be fully convinced that all life depends on plants for food, although they might agree that we couldn't survive without plants because we need the oxygen that they release. Watch in future discussions to make sure they develop the understanding that even animals that don't eat plants depend on them for food.

Children's Ideas about Food for Plants

Plants' ability to make food from raw ingredients in nature is one of the most essential biochemical processes on earth. Photosynthesis provides all of the energy that makes food chains possible.

Children draw a natural and sensible parallel between food that people and other animals ingest, and the things plants take in from the environment. They wonder why adults say that plants make their own food, yet also admit that plants take in sunlight, air, water, soil nutrients, and "plant food." From a child's point of view, there is not a clear difference between the materials plants take in and the hot dogs and cookies they eat. Scientists, on the other hand, accept that soil nutrients, water, and air are not food because they do not contain food energy that can be measured in calories.

It is not unusual to hear students — from primary grades up through high school and even into college — state that plants use soil and water as food, yet in the next breath dutifully recite that *plants make their own food*. The following interchange between two sixth graders highlights how two incompatible sets of beliefs — their own and a scientific one — can coexist in children's minds.

Dominick: *Maybe the soil is its food. Maybe. It doesn't have a mouth, but maybe it goes inside of it.*

James: *It does!*

Dominick: *You're right. But the green plants don't really eat.*

James: *They do, they do. They drink, they eat. Like they get the food through the roots. Roots suck up water, it goes to the stem, the sun gives off light into the leaf which sends it in together and it makes food for the plant.*

Although James has some understanding of photosynthesis, he calls it eating, and indicates that both what the plant takes in through its roots and what it makes in its leaves are its food. Dominick on the other hand is reluctant to call soil food, but since it goes inside of the plant, he decides that food might be the best thing to call it. He also hesitates to call a plant's process of taking in soil and water eating. Both of these boys are struggling to reconcile their everyday understanding of "food," "eating,"and "drinking" with a scientific explanation of photosynthesis.

Thinking and talking about their beliefs are exactly what students need to do in order to revise their naive notions into scientifically accurate conceptions. As students express their ideas about photosynthesis, tell them that scientists often use terms differently than we do in everyday conversation. This will help them begin to bridge the two worlds of understanding.

For more background on children's ideas about photosynthesis and suggestions for teaching the concept, see page 51 for information on *The Power Plant* by K. Roth and C. Anderson.

Ongoing Assessment

Student Reflections

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

What would I have to do to be positive about what an animal eats?

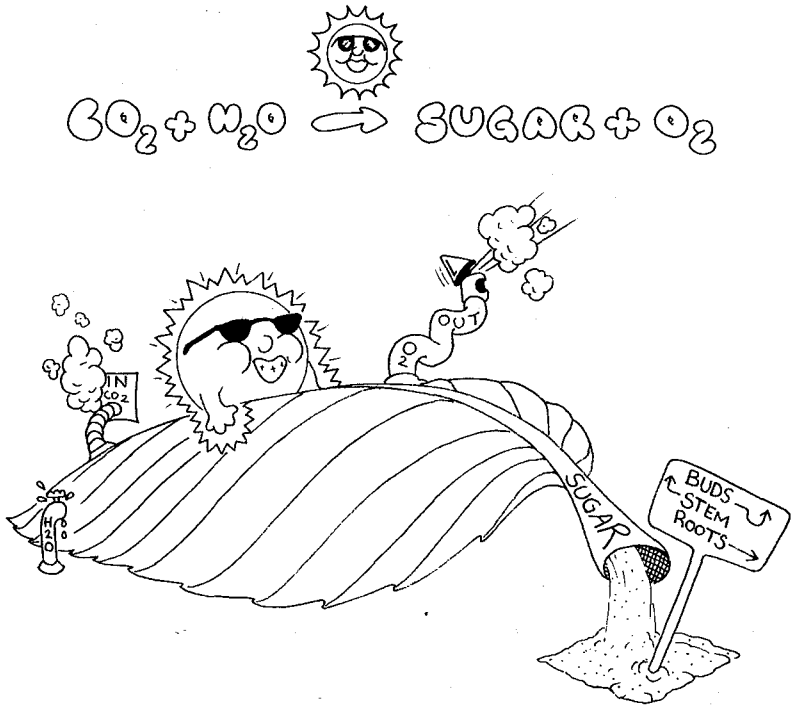
I was surprised to learn...

Teacher Reflections

- ❑ How much effort did students put into making their food chains accurate?
- ❑ Were they able to articulate what sources of information they find most reliable?
- ❑ Do they understand that plants make their own food?
- ❑ Did students label their food chains correctly? Which items did they find difficult to categorize?
- ❑ Do they understand that the ultimate source of energy for every living thing on a food chain is sunlight?

Extensions

Sugar Factory Skit. Challenge students to develop and perform skits demonstrating the process of photosynthesis. They can portray leaves as "sugar factories" that have: 1) raw materials (carbon dioxide and water); 2) energy to make the factory run (sunlight); 3) a manufacturing process (combining carbon dioxide and water with the aid of chlorophyll in leaves); 4) a product (sugar); and 5) a byproduct (oxygen).



Sunlight for Supper? For a homework assignment, ask students to trace everything they eat for supper back to sunlight.

Ode to Plants. Have students write a song, poem, or rap thanking plants for providing all living things with the food energy they need to survive.

Personal Food Connections. Help the class draw a map of food relationships. Encourage students to make a list of what they eat during one day, then look in encyclopedias or go to the grocery store to find out where these foods are grown, or in the case of animals, what they eat. On a map of the world mark the locations of these food sources with pictures, then draw lines connecting them to your location. Have students measure the distances across which humans are able to obtain food and compare these to the food-getting habits of the organisms on their study site.

Food Chains Everywhere. Categorize everything encountered in stories, in lunch boxes, in magazine ads, etc. as a product of a producer, consumer, decomposer, or the non-living environment.

DDT Danger. Have students look up Rachel Carson in the library to learn how she made the public aware of the dangers of the pesticide DDT. Make food chains that show how DDT got into predators such as eagles, falcons, and hawks.