Chapter 1 · Lesson 2

Food Chain Tag

Who's bungry? Let's become bacteria, minnows, perch, northern pike, and anglers and join a food chain in action!

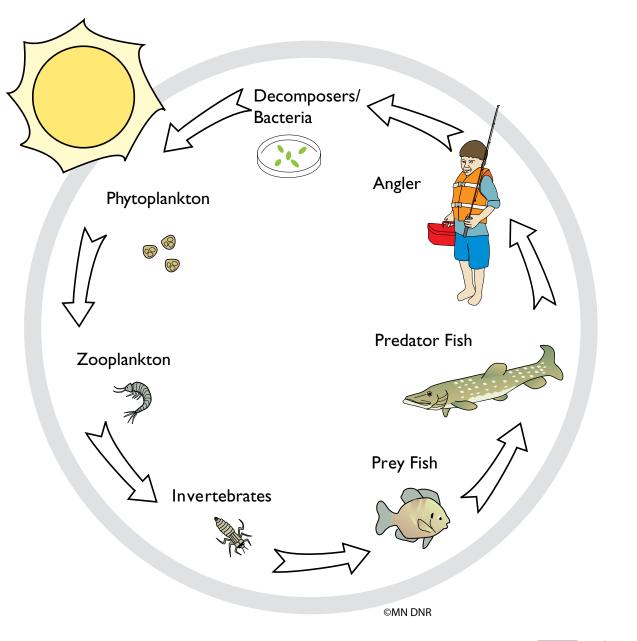




Table of Contents

1:2-A
1:2-C
l:2-D
2-1-8
1:2-1
1:2-1
1:2-2
1:2-8
1:2-8
:2-13
:2-14
:2-15
:2-16
:2-18
:2-19
:2-20
:2-24

Chapter 1 • Lesson 2

Please note: Academic Standards are updated regularly and our alignments will be updated on the DNR Academic Standards Website at: www.mndnr.gov/education/teachers/edstandards_intro.html

Food Chain Tag

Minnesota Academic Standards

Lesson *introduces* this Benchmark.
 Lesson *partially* addresses this Benchmark.
 Lesson *fully* addresses this Benchmark.

Language Arts

Grade 3

I. Reading and Literature

B. Vocabulary Expansion:

Benchmark 1—The student will acquire, understand and use new vocabulary through explicit instruction and independent reading.

Benchmark 3—The student will use context and word structure to determine the meaning of unfamiliar words.

III. Speaking, Listening, and Viewing A. Speaking and Listening:

Benchmark 1—The student will participate in and follow agreed-upon rules for conversation and formal discussions in large and small groups.
Benchmark 2—The student will demonstrate active listening and comprehension.
Benchmark 3—The student will follow multi-step oral directions.

Grades 4 and 5

- I. Reading and Literature
- B. Vocabulary Expansion:

Benchmark 1—The student will acquire, understand and use new vocabulary through explicit instruction and independent reading.

III. Speaking, Listening, and Viewing A. Speaking and Listening:

Benchmark 1—The student will participate and follow agreed—upon rules for conversation and formal discussions in large and small groups. Benchmark 2—The student will demonstrate active listening and comprehension.

Science

Grade 3 III. Earth and Space Science C. The Universe:

Benchmark 3—The student will observe that the sun supplies heat and light to the Earth.

IV. Life Science

C. Interdependence of Life:

Benchmark 2—The student will know that changes in a habitat can be beneficial or harmful to an organism.

Grade 5

IV. Life Science F. Flow of Matter and Energy

Benchmark 1—The student will recognize that organisms need energy to stay alive and grow, and that this energy originates from the sun. **S Benchmark 2**—The student will use food webs to describe the relationships among producers,

consumers, and decomposers in an ecosystem in Minnesota. $\textcircled{\sc opt}$

Benchmark 3—The student will recognize that organisms are growing, dying and decaying, and that their matter is recycled.

Environmental Literacy Scope and Sequence

Benchmarks

- Social and natural systems are made of parts. (PreK-2)
- Social and natural systems may not continue to function if some of their parts are missing. (PreK-2)
- When the parts of social and natural systems are put together, they can do things they couldn't do by themselves. (PreK-2)
- In social and natural systems that consist of many parts, the parts usually influence one another. (3-5)
- Social and natural systems may not function as well if parts are missing, damaged, mismatched or misconnected. (3-5)

For the full Environmental Literacy Scope and Sequence, see:

www.seek.state.mn.us/eemn_c.cfm

Chapter 1 • Lesson 2

Food Chain Tag

Grade Level: 3-5 Activity Duration: 30 minutes Group Size: 15-40 Subject Areas: Language Arts, Physical Education, Science Academic Skills: analysis, application, gathering, interpretation, kinesthetic concept development, large group skills Setting: large indoor or outdoor open area Vocabulary: angler, balance, biomass, carrying capacity, consumer, decomposer, ecosystem, emigrate, food chain, food web, nutrient cycle, phytoplankton, plankton, predator, prey, primary consumer, producer, secondary consumer, zooplankton Internet Search Words: decomposition, food chain, food web,

Internet Search Words: decomposition, food chain, food web plankton, predator-prey relationship

Instructor's Background Information

All things on the planet—both living and nonliving—interact. An **ecosystem** is defined as the set of elements, living and nonliving, that interact, over time, within a defined locale. A food chain demonstrates one way in which ecosystem elements interact in a systematic manner.

Food Chains

In an ecosystem, numerous interactions between organisms result in a flow of energy and cycling of matter. Food chains, the nitrogen cycle, and the carbon cycle are examples of these interactions. A **food chain** is the sequence of steps through which the process of energy transfer occurs in an ecosystem. All organisms need a continuous supply of energy. Energy flows through an ecosystem in one direction—through food chains.

Food chains illustrate how energy flows through a sequence of organisms, and how nutrients are transferred from one organism to another. Food chains usually consist of producers, consumers, and decomposers. If a food chain has more than one consumer level, its consumers are defined as primary, secondary, or tertiary consumers. Primary consumers eat plants, secondary consumers eat primary consumers, and tertiary consumers eat secondary and primary consumers.

Summary

In this active role-playing lesson, students discover how energy flows and is transferred between the interdependent organisms of an ecosystem by assuming various roles (minnows, perch, northern pike, bacteria, and anglers) in an aquatic food chain. Each species feeds on plankton or on one another—to obtain the food that provides the needed energy for survival in the lake. Decomposers break down dead plants and animals, recycling nutrients. In successive rounds of Food Chain Tag, new species are introduced and population ratios altered in an effort to balance the simulated ecosystem.

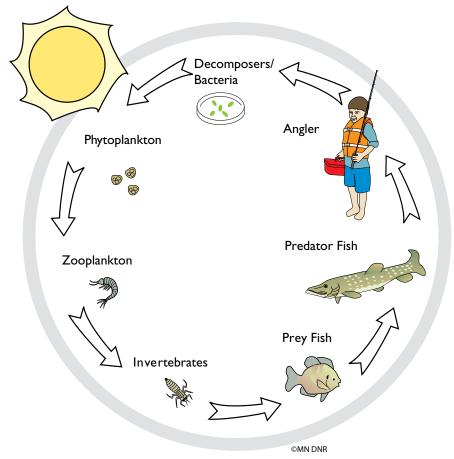
Student Objectives

The students will:

- 1 Illustrate that energy is transferred through an aquatic food chain by producers, consumers, and decomposers.
- 2 Illustrate how decomposers recycle nutrients from dead plants and animals.
- Examine predator-prey relationships by assuming the roles of predators and prey in a lake ecosystem.
- 4 Define carrying capacity.
- 5 Determine the necessary number of predators and prey to achieve balance in a simulated lake ecosystem.
- 6 Explain how organisms in a food chain depend on one another for survival.

Materials

- Aquatic Food Chain Sheet
- Aquatic Food Chain Cards
- Scissors
- Glue
- Construction paper or card stock
- Clear contact paper or laminating material
- Food Chain Identification Tags
- Clothespins or other clips, string, or yarn to thread through identification tags so they can be worn necklacestyle
- Paper plates, one per student (optional)
- Markers (optional)
- 500 poker chips (or other tokens) to simulate plankton
- Plastic cups or plastic sandwich bags, one per student, to simulate stomachs
- Hula-hoops, two or more, to simulate cover
- Several laminated illustrations of lily pads
- Masking tape, for creating boundaries that simulate cover
- Rope, 50-100 feet long, or several field cones, to define lake boundary
- Whistle or other noisemaker

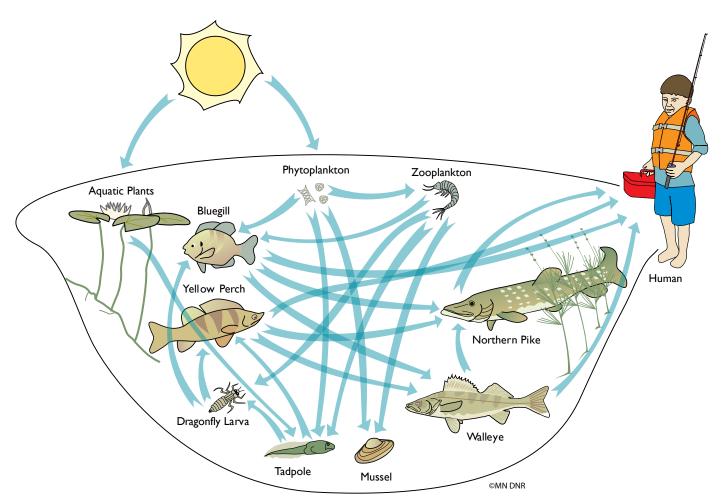


A food chain illustrates the movement of energy in an ecosystem.

The sun is the ultimate source of energy for all food chains. Through the process of photosynthesis, plants use light energy from the sun to make food energy. Energy flows, or is transferred through the system as one organism consumes another.

Food Webs

The concept of a food chain is an abstraction or generalization. Ecosystems are more complicated than a single food chain would indicate. Most aquatic ecosystems contain many more species than those in a single food chain, and all of these species interact and are interdependent. Like people, most aquatic organisms consume more than one type of food. A **food web** is a diagram of a complex, interacting set of food chains within an ecosystem.



Parts of a Food Chain

A food chain includes the sun, plants, primary consumers, secondary consumers, and decomposers.

The sun provides light energy (radiation), the ultimate energy source for all freshwater aquatic food chains.

Plants are the next link in a food chain. **Plankton** are among the smallest living organisms in ponds, lakes, rivers, and streams. This group includes tiny free-floating plants, animals, and some forms of bacteria. They range in size from microscopic bacteria and single-celled organisms to larvae and invertebrates large enough to be visible to the unaided eye. With little or no swimming ability, most plankton floats freely with the currents in open water.

Phytoplankton are free-floating microscopic plants and bacteria suspended in the water that, like other plants, produce food energy directly from the sun's light energy. Plants (including phytoplankton) are called **producers** because they can produce simple nutrients and sugars (food energy) directly from the sun's light energy through the process of photosynthesis. As the base of food chains, phytoplankton populations are indicators of aquatic health. The food energy produced by phytoplankton supports much of the other life in the water. A food web illustrates complex feeding relationships within an ecosystem. All organisms in a food web are interdependent. A food chain is just one strand of a food web.



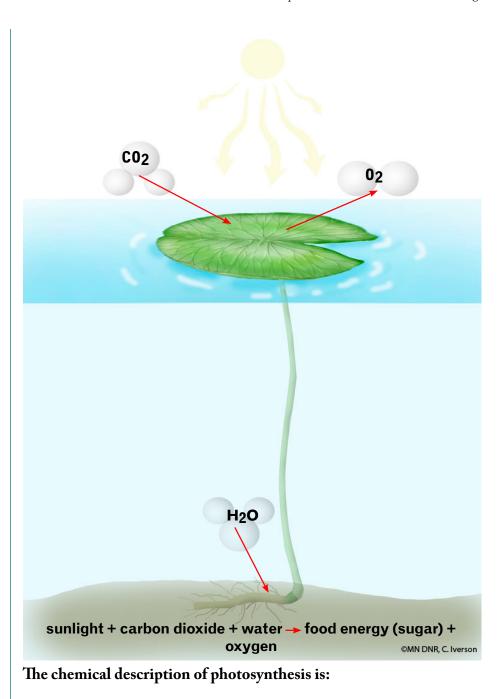
By their shear numbers, phytoplankton are the main producers in the lake. If you could weigh all of these microscopic plants, they would weigh more than macroscopic plants.

Chapter 1 • Lesson 2 • Food Chain Tag

Plants contain the green pigment chlorophyll and other pigments known as carotenoids. These pigments capture the sun's light energy, which plants convert to chemical energy (carbohydrates or sugar) through the process of photosynthesis. Other organisms consume plants to obtain the chemical energy that fuels life processes, including respiration, movement, growth, and reproduction. Plants obtain additional substances necessary for photosynthesis (carbon dioxide and hydrogen) from the air, water, and soil. Oxygen is a by-product of photosynthesis. Producers are the first link in every food chain, and they support all forms of animal life, including people.



Why do most plants look green to us? Plant pigments don't effectively absorb green and yellow light, so this light passes through the leaves, or is reflected from the surface of the leaves. This reflected light is the green color that we perceive.

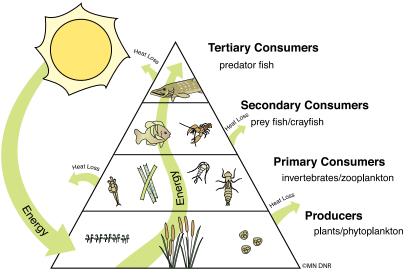


LIGHT ENERGY + $6C0_2$ + $6H_20$ = $C_6H_{12}0_6$ + 60_2 carbon water simple sugars oxygen dioxide or food energy

Food energy transfers to microscopic aquatic animals, or **zooplankton**, as they consume phytoplankton. The zooplankton population in a lake or river can be a useful indicator of future fishery health because zooplankton are an important food for small fish (such as minnows) that are next in line in the food chain. Many larger fish, such as yellow perch, depend on a diet of smaller fish.

A **consumer** is an organism that obtains energy from eating other plants or animals. A relatively large quantity of plant material is

required to support primary consumers. Animals that eat only plants (or phytoplankton) are primary consumers, or herbivores. Primary consumers, in turn, support a relatively smaller number of secondary consumers, or carnivores—animals that eat other animals. In food chains, most of the food energy consumed by organisms fuels growth and other functions. As an organism uses energy, food energy is converted to heat energy, which is lost from the system. Some food energy is stored in the tissues of organisms, and is, in turn, consumed and used by other organisms in the food chain.



This aquatic food pyramid illustrates energy transfer and relative biomass (defined below) in an aquatic ecosystem. Producers make up the greatest biomass in the system, and support all other life forms. Producers convert light energy from the sun into food energy. This food energy is transferred through the levels of the food pyramid, or trophic levels, as one organism consumes another. At each level in the food pyramid, energy is lost to the surrounding environment as heat as the organisms use food energy to feed, respire, grow, and reproduce. For this reason, each trophic level can only support or provide energy for a smaller biomass of organisms. Energy is also lost as heat on each level as organisms eat, move, grow, and reproduce. The sun continually replaces the energy in the system. Because energy is lost at each level, most food pyramids contain, at most, four trophic levels.

Biomass describes any organic plant or animal material available in an ecosystem on a renewable basis. A large biomass of producers at the bottom of the food pyramid supports a relatively smaller biomass of consumers, which support an even smaller biomass of secondary consumers. Energy flows from one level to the next as the organisms use it.

An animal that hunts, captures, and consumes other animals is a **predator**. Northern pike and eagles are predators, for example. An animal consumed by a predator is described as **prey**.



Some carnivores can also be called **piscivores**, which are animals that eat fish.

From bacteria to northern pike to people, all living things are composed of these elements:

- carbon
- hydrogen
- nitrogen
- oxygen
- phosphorus
- sulfur

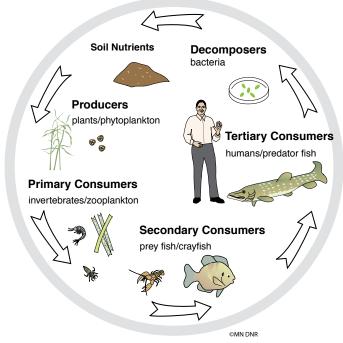


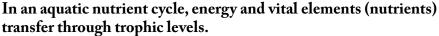
All plants require sixteen elements or basic nutrients. Most plants take in at least 23 different elements. Some nutrients aren't required by plants, but they're beneficial or needed by other organisms that consume plants. **Decomposers**, such as bacteria and fungi, complete the food chain by consuming dead plants and animals and breaking them into nutrients. One nutrient by-product of decomposition is carbon dioxide, a simple substance that producers need to create food energy. Decomposers are the crucial last link in a food chain—they put nutrients back into the ecosystem. They also keep the landscape tidy—imagine what it would be like if decomposers didn't break down dead plants and animals!

Food Energy and the Nutrient Cycle

Nutrients are continually recycled in all ecosystems, but energy flows one way.

Nutrients are the materials required for life, and they build and renew organisms as they cycle through food chains. For example, carbon dioxide and water (which contains carbon, hydrogen, and oxygen), which plants use to convert the sun's energy into carbohydrates, also cycle through consumers as the consumers eat plants. (They also cycle through other consumers.) When consumers die, bacteria and fungi decompose them, releasing these and other nutrients (phosphorous, nitrogen, and sulfur) into the soil, water, and air. These nutrients are available to plants again, which use them to convert the sun's energy into carbohydrates. Decomposers are often referred to as **nutrient recyclers** because they break down dead material to provide the nutrients producers need to continue the cycle. Each plant, animal, and person is composed of nutrients that have been—and will be—used by other organisms in a continuous cycle. This sharing and recycling of nutrients is known as the **nutrient cycle**.





A Food Chain Is a System

Producers, primary consumers, secondary consumers, and decomposers are connected and interdependent by means of habitat needs and simple food chains. Loss or damage to just one link in a food chain eventually affects all organisms in the food chain system.

A food web is a larger, more complex system. But, as in food chains, loss or damage to a single strand in the food web impacts the entire system.

The food chain system is composed of parts, including the sun, plants, herbivores (plant-eaters or primary consumers), carnivores (animaleaters or secondary consumers) and decomposers. A food chain illustrates how the various parts of a natural system have *functional* as well as *structural relationships*. Two main processes occur in this energy transfer system. One involves the movement of energy—in the form of light energy or radiation from the sun—to plants through photosynthesis. The second involves the movement of energy, in the form of organic molecules or food energy, from plants to herbivores to carnivores through consumption of biomass, as illustrated in the food pyramid model.

The parts of a food chain work together efficiently and demonstrate integration. Through the process of evolving together over time, present-day species of plants, herbivores, carnivores, and decomposers have developed ecological relationships. These relationships—of one species to another and between each species and its environment maintain population levels and balance within ecosystems.

Carrying Capacity

The maximum number of individuals or inhabitants that an environment can support without detrimental effects on the habitat or to the organisms over time is referred to as **carrying capacity**. Aquatic habitats contain limited amounts of necessary food, water, cover, space, and other resources. The quantity and quality of these resources influence the carrying capacity of a habitat. Because resources are limited, the population growth of a given species slows as its population approaches the habitat's carrying capacity. At times, a population may exceed carrying capacity but it will decrease eventually. Population numbers tend to fluctuate over time, depending on seasons and changes in weather, climate, and other environmental shifts. Other influences include excessive predation, the introduction of exotic species, disease, pollution, over-harvesting, poaching, development, agriculture, and recreation.

If a fish population grows dramatically, becoming larger than the carrying capacity of the lake ecosystem, the fish consume resources much faster than they can be naturally replenished. Eventually, this can result in serious habitat degradation and a reduced carrying capacity.



Because all organisms are interconnected and depend on one other for survival, other populations of organisms are impacted, too. Excessive numbers of one type of fish competing for food and other resources will eventually lead to the death of many individuals if balance isn't restored. Fish sometimes **emigrate** (leave an area) and the size of the population in the habitat decreases. This, in turn, affects the predators that normally depend on that type of fish for food. This eventually impacts the entire food chain.

Balance

An ecosystem that can sustain itself over time through the interrelationships of its living and nonliving components is said to be in **balance.** Food chains are one type of interaction among organisms, and are part of a larger system of cycles, checks, and balances that maintain stable ecosystems—those that function continuously and remain viable over time. An ecosystem in balance is sustainable.

S Procedure

Preparation

- 1 To make the Aquatic Food Chain Cards, copy and cut them from the sheet.
- 2 Glue each picture to a sheet of construction paper or card stock. Laminate them or cover them with contact paper.
- 3 To make Food Chain Identification Tags, copy and cut them from the sheets. To make a set for each game, you'll need
 - 36 minnow cards
 - twelve yellow perch cards
 - three northern pike cards
 - two angler cards
 - two bacteria cards
- 4 Attach each card to a sheet of construction paper or card stock—use a different color of construction paper or card stock for each species..
- 5 Laminate the cards, or cover them with contact paper.
- 6 Attach clothespins or other clips, string, or yarn so the tags can be worn necklace-style.

Activity

Warm-up

- 1 When the students settle down and you have their attention, ask them where they get all that energy! (We get our energy from the food we eat. All food energy can be traced back to the sun.) Ask the students what they ate for dinner last night. You may wish to have them draw pictures of the foods on a paper plate. Ask them to diagram the flow of food energy from their dinner back to the sun. Did anyone have fish for dinner?
- 2 Ask students to think about how fish get the energy they need to swim around, and to grow. What do fish eat?





- 3 Choose six volunteers to come to the front of the class.
- 4 Give each volunteer one Aquatic Food Chain Card.
- 5 Ask the volunteers to try to line up in the order of a food chain (without talking). How did they do? Explain food chains, food webs, and predator-prey relationships. Explain that light energy from the sun helps tiny green plants called phytoplankton (producers) grow and produce food energy in a lake. Zooplankton and aquatic invertebrates (water insects, bugs and crustaceans) and small fish, like minnows (primary consumers), eat the phytoplankton. Larger fish, like perch (secondary consumers), eat the smaller fish. Then, an even larger fish, such as a northern pike, eats the perch. Finally, an eagle or an angler might catch a perch or northern and eat if for dinner. The steps through which food energy flows and is transferred is called a food chain.
- 6 Ask the students the following questions. Which organisms in our food chain are predators? Which animals are prey species? Can an animal be both predator and prey? (The perch is one example of a species that is both predator and prey. Perch eat minnows, and are also eaten by larger fish such as northern pike.)

Lesson

- 1 To begin the game, identify the boundaries of your lake ecosystem (an area approximately half the size of a basketball court) and conduct the activity within this space. Use a rope or field cones to mark the boundary. Define ecosystem for the students.
- 2 Scatter plankton (poker chips) randomly around the lake, reserving approximately 100 poker chips for use in Round Three.

Round One: Primary consumers—15-36 minnows

- 1 Distribute a minnow identification tag to each student.
- 2 Hand students a "stomach" (plastic cup or sandwich bag) in which to put their "food" (poker chips). Put all the "minnows" (students) in the lake. When the activity starts, the minnows will try to fill their stomachs, one poker chip at a time, with as much "plankton" as they can.
- 3 Tell the students the rules of the lake:



- To avoid collisions, tell the students that they may not run! Repeat this, if necessary, throughout the activity. The instructor may wish to assume the role of an eagle—whose eagle eyes see every fish in the lake. The eagle is a predator and will make a quick lunch of any fish that runs!
- Everyone must stop "feeding" (putting poker chips in their plastic cup or bag) promptly at the sound of the signal. Demonstrate the signal on the whistle or other noisemaker.
- Everyone must remain within the lake boundary.



This activity is a simulation, so some of the species' roles are simplified. In actual aquatic habitats, many species eat more than one type of food. In this activity, one food chain is identified. It can be a strand in a more complex aquatic food web.

- 4 Let the feeding continue until the minnows have eaten all the plankton.
- When the plankton are gone, give the signal to stop feeding. Ask 5 the students how many minnows filled their stomachs with fifteen or more poker chips (plankton)? Those minnows survived! What happened to all the food in the lake?
- Introduce the term carrying capacity. What will happen in our lake 6 now that all the food is gone?
- Thinking about the food chain, how could we balance the lake? 7
- Have students return plankton to the lake. 8

Round Two: Secondary consumers—four to twelve perch (depending on class size)

- Put two hula-hoops into the lake. Tell the students the hula-hoops 1 represent cover and are safe places for prey. Only one student at a time may hide in a hula-hoop, and only for five seconds at a time. Tell students that they can't stand next to the cover and go in and out. They must move to other areas of the lake before they can return to cover.
- 2 Add another layer of consumers to the lake. Exchange several students' minnow identification tags for perch identification tags. The number of perch will depend on the size of your class. If your group size is about fifteen, you may wish to start with four perch. If your group size is closer to 35, try starting with eight or nine perch.
- Tell students the perch can eat plankton in the lake, just as the 3 minnows do. But, perch are predators and can also eat minnows. Predators catch their prey by tagging them. When tagged, the minnow, or prey, must empty the contents of its stomach into the stomach of the predator, which is the perch. The tagged fish is now "dead" and must sit down at the edge of the lake.
- Begin the feeding and continue until most of the plankton has been 4 eaten before giving the signal to stop feeding.
- How many minnows have plankton in their stomachs? Those 5 minnows survived! How many minnows survived? How many perch survived? A perch has survived if it has food in its stomach.
- What would happen to the food if we kept playing? Is anything 6 missing from our lake?
- Have students return plankton back to the lake. 7

Round Three: Decomposers—one to four bacteria

- Select one or two of the minnows to portray bacteria. 1
- 2 Tell students the bacteria break down the dead plants and animals into nutrients and they're called decomposers. In this round, when the minnows are tagged, they must sit down and wait to be decomposed by the bacteria. The bacteria will take them to the edge of the lake. To prevent students from feeling frustrated at having been tagged and sitting out the rest of the round, demonstrate that it can be fun to "decompose" on the edge of the lake! (Be dramatic.) Give the 100 reserved poker chips to the bacteria. The bacteria



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toss a few poker chips back into the lake when they take a tagged minnow to the edge of the lake. This represents the nutrients the bacteria release, which provide new phytoplankton growth in the lake. The phytoplankton, in turn, provides food for zooplankton and other consumers.

- 3 Start the game again. You may wish to periodically add a few minnows (the ones that get tagged) back into the game as this round progresses, to show reproduction of minnows.
- 4 Let the feeding occur until most of the plankton are consumed, or after several minutes of your aquatic ecosystem functioning in balance.
- 5 How many minnows survived? How did the bacteria affect the lake ecosystem? Is our ecosystem balanced? What does our ecosystem need? (You may need to adjust the ratio of minnows, perch, and bacteria to better balance the system).
- 6 Ask students if anything else could be missing from the lake. Can they think of another predator to add to the lake?
- 7 Have students return the plankton to the lake.

Round Four: Predators—one to four northern pike, depending on class size

- 1 Add northern pike to the lake. Exchange up to three minnow identification tags from the remaining minnows for northern pike identification tags, depending on the size of your class. You may also wish to have some minnows and perch trade roles, giving more students opportunities to be predators. The northern pike are predators that feed on the perch. When a perch gets tagged, the student must empty half the contents of its stomach into the stomach of the northern pike and sit down to wait for the bacteria to take them to the edge of the lake. Then they give their remaining poker chips (food energy) to the bacteria to scatter back into the lake as phytoplankton. (The northern pike can eat perch or minnows. But remind the students that northern pike usually go after the perch because they're larger and give them more food energy for less work. Perch still eat both minnows and plankton. Minnows eat only plankton.)
- 2 Both minnows and perch may hide in the cover (hula-hoops), but the same rules apply: only one fish in a hula-hoop at a time, and for only five seconds. They must then move around the lake.
- 3 Restart the game. When much of the plankton is gone, or when the system has been operating in balance for several minutes, stop the game. Determine how many survivors remain in the lake. Are there minnows left? How many perch are left? Did the northern pike survive? A northern pike has survived if it has food (poker chips) in its stomach. A healthy, balanced lake will have more prey individuals than predators. How could you adjust the numbers so this occurs? (An approximate ratio of 6 (minnows): 3 (perch): 1(northern pike) balances this simulated lake.
- 4 Students should begin to understand that energy flows through



ecosystems and is constantly being replenished by the sun as nutrients cycle or circulate through the ecosystem. Tell students that an ecosystem is defined as all living and nonliving things interacting within a defined place. One way that living and nonliving things interact is by means of a food chain.

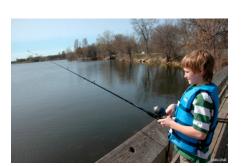
5 Have students return the plankton to the lake.

Round Five: Top predators—one or two anglers

- 1 Discuss with students how people are part of the ecosystem, and how they might impact it.
- 2 Select one or two of the minnows to be anglers. Give each an angler identification tag to wear. Explain that anglers must first find bait— by tagging one minnow—before they can fish. While linking arms, the minnow and angler must then try to catch a perch or northern pike by having the minnow ("bait") tag that fish. (Only one fish can be caught at a time.) The angler will then take the fish's food energy and escort this "caught" fish to the edge of the lake. Ask students what happens to the food energy (poker chips) from the fish the angler catches. Remind students that the fish can still use the cover to hide from predators and anglers.
- 3 When most of the plankton is gone, stop the game. Determine which species survived. If the lake ecosystem is in balance, there should be more minnows than perch, and more perch than northern pike.
- 4 Have students discuss the results of this round. Is the lake balanced or is it headed for trouble? How did anglers affect the lake ecosystem? If the impact was dramatic, what could be done to limit the anglers' impact on the lake? (Examples include creating regulations such as designating fishing seasons for certain species or establishing catch limits.) What would happen if the number of northern pike exceeded the carrying capacity? (Eventually, they could be the sole remaining fish and have no more food to eat.) Could the northern pike survive this situation?
- 5 If time permits, try to balance the lake by varying the ratios of different fish species in the lake, then play more rounds and discuss what happens. Have the students determine what adjustments after each round to balance the ecosystem. Try adding more anglers and introduce fishing regulations to maintain a balanced ecosystem.

Wrap-up

- 1 Hand out copies of the Aquatic Food Chain Sheet and review definitions of food chain, ecosystem, and carrying capacity.
- 2 What was it like to be a prey species? A predator? Why?
- 3 What would happen if anglers caught too many predators? Would the ecosystem be balanced? (If the northern pike were overfished, there would be few predators left to eat the perch. The perch population would increase until they ate most of the minnows. If the perch were overfished, the northern pike would be affected because their food source would be diminished. The northern pike



population in this case might start to decline. They may have to find their way to another lake through an outlet or stream flowing into the lake—or succumb to starvation.)

- 4 What was the role of the bacteria? (They are decomposers and return nutrients to the food chain.) What is the role of the plankton? (Phytoplankton, a producer, makes food energy from the sun's energy through the process of photosynthesis. Zooplankton are primary consumers that eat phytoplankton, and provide food for larger organisms in the lake.)
- 5 Why can't all lakes be brimming with large or "trophy" fish? (Too many large predators deplete the numbers of available prey. Carrying capacity limits the population size of each species in the lake ecosystem.)

Assessment Options

- Have students demonstrate their understanding of food chains by drawing a food chain poster. The poster should illustrate energy transfer starting with light energy from the sun through a producer, primary consumer, secondary consumer, and decomposer. Encourage students to do some research and include local aquatic organisms other than the ones used in Food Chain Tag.
- 2 Have students write a story or poem about what it was like to be a minnow, perch, northern pike, or angler in the game. They should include how their organism fits into the food chain in relation to the other organisms in the lake. They should also consider how they're affected by changes in the ecosystem, or if an ecosystem becomes unbalanced.
- 3 Divide the class into groups of five or six have the groups research an aquatic food chain containing organisms different from those in the game. They should determine what each organism eats, and which are producers and consumers. (These food chains could include muskrats, eagles, herons, other types of fish, and so forth.) Have the students play an additional round of Food Chain Tag as a narrated skit, acting the different predator-prey-producer roles to show different ways of balancing the system. (For example, if we have too many predators, we must increase the amount of prey or decrease the number of predators to balance the system.) Ask the students to include an explanation of what happens when the system becomes unbalanced with more members of a species than the system can support. Ask them to explain carrying capacity.
- 4 Assessment options include the Checklist and Rubric on the following pages.

Checklists are tools for students and instructors. Checklists involve students in managing their own learning. They help students understand and set learning goals before the lesson begins, and help them monitor their progress during the lesson, ensuring that they meet learning goals and objectives by the end of the lesson. Students can also use checklists to discover areas that may need improvement. Checklists help instructors monitor each student's progress throughout the lesson, facilitating appropriate adjustment of instruction to ensure learning by the end of the lesson. The instructor may wish to have students add several of their own learning goals to the checklist to personalize it, and to accommodate varied learning needs and styles.

Grade

26-28 points = A Excellent. Work is above expectations.

22-25 points = B Good. Work meets expectations.

17-21 points = C

Work is generally good. Some areas are better developed than others.

13-16 points = D

Work does not meet expectations; it's not clear that student understands objectives.

0-12 points = F Work is unacceptable.

Food Chain Tag Checklist

Possible Points	Points Earned	Points Earned
	Student	Instructor
6		Student understands roles of <i>producers</i> , <i>consumers</i> and <i>decomposers</i> in Food
4		Chain Tag. Student understands the importance of <i>predators</i> in balancing the lake ecosystem and limiting the size of prey
3		populations. Student understands that a larger number of <i>prey</i> are necessary to
2 2 3		support a smaller number of predators. Student defines carrying capacity. Student defines plankton. Student draws a link from the sun to a specific family or species of aquatic
3		producers in the poster. Student draws a specific primary and secondary consumer. The link is accurate for the food chain.
2		Student draws a decomposer and links
3		it to the food chain. Student's poster is attractive, legible, and easily seen from a distance.
Total Poi	ints	,

Total Points

28

____ Score _____

Food Chain Poster Criteria	4 Excellent	3 Good	2 Fair	1 Poor	0 Unacceptable
Food chain tag role- playing	Understands the roles of producers, consumers, and decomposers. Suggests addition of predators to balance lake ecosystem and limit size of prey populations. Understands ratio of predators to prey (larger number of prey necessary to support a smaller number of larger predators). Defines carrying capacity and plankton.	Understands role of producers and consumers and decomposers. Understands that predators limit size of prey populations. Understands that plankton are tiny plants and animals that live in water, and that phytoplankton are producers.	Understands predator- prey relationships (predators hunt, capture, and eat prey species). Understands that bacteria consume and break down dead plants and animals, releasing nutrients back into the lake, where phytoplankton use them to produce food energy.	Remembers that minnows eat plankton, yellow perch eat minnows, northern pike eat yellow perch, anglers catch fish, and that bacteria put nutrients back into the lake.	Doesn't understand the food chain concept or predator- prey relationships.
Source of energy and producers	Poster links the sun to a specific family or species of aquatic producers.	Poster shows accurate producers that are examples of various aquatic plants.	Poster links the sun to a producer and shows examples of terrestrial and aquatic plants.	Poster shows no direct link between the sun and the producers. Only aquatic or only terrestrial plants shown in poster.	No producers indicated or identified on the poster.
Consumers and decomposers	A specific primary and secondary consumer are drawn. The link is accurate for food chain. A decomposer is drawn in the food chain.	A specific primary consumer is linked to the producer. A decomposer is drawn in the food chain.	A variety of consumers are drawn, but none consume the producers drawn in the food chain. Decomposer drawn in the food chain.	A secondary consumer is linked to a producer. No decomposers present in the food chain.	No producers indicated or identified on the poster.
Design and materials	Poster is attractive, legible, and easily viewed from a distance.	Poster is attractive and easily viewed.	Poster is not easily viewed from a distance.	Poster is messy, illegible, and not easily viewed from a distance.	No producers indicated or identified on the poster.

(Calculate score by dividing total points by number of criteria.)

Score_

Diving Deeper

S Extensions

- Select a poker chip color to represent pollution in the lake—but don't tell the students that this color has significance until later in the game. This color can signify a contaminant such as mercury or PCBs. Let the fish feed on all colors of chips. At some point during the game, stop the action and tell the students that one chip color represents contaminants, such as mercury or PCBs, in the lake. Assess the levels of contamination in each type of fish. Which type of fish has eaten the largest amount of the polluted poker chips, and why? (There should be larger concentrations of the pollution-colored poker chips in the stomachs of the secondary and tertiary consumers that are higher in the food chain.)
 - Define and discuss the concepts of **bioaccumulation** and **biomagnification**. Demonstrate how levels of contaminants accumulate in higher concentrations in the upper portions of the food chain. How could this affect people?
 - Tell students that the fish in the game whose stomachs contain a concentration of more than 75 percent of the pollution colored chips are unhealthy, and that they demonstrate unusual behaviors. Assign these students a movement other than walking (such skipping, crawling, or walking backward) and resume the game. What impact does this have on the balance of the lake?
 - Define mercury and PCBs (polychlorinated biphenyls). Discuss what happens when mercury and PCBs enter the environment in terms of lakes and streams and people. Point out that some fish in lakes and streams may have unhealthy levels of mercury, PCBs, and other contaminants in their bodies. These fish can be harmful to people that eat them, particularly if they're eaten regularly. People can reduce their risk of consuming harmful contaminants by following guidelines found in the Minnesota Department of Health Fish Consumption Advisory that can be viewed online at www.health.state.mn.us. (For more information on mercury, PCBs, and other contaminants, see Lesson 6:5—Eating Fish.)
- 2 Form a food web with the students. Paste or draw pictures of the sun, plants, and animals on cards. Form a circle and give one card to each student sitting in the circle. Start with the student holding the sun card, and give them a ball of yarn. Have that student say, "I am the sun, and I give my energy to the phytoplankton." The sun should holds one end of the yarn and pass the ball to the student holding the phytoplankton card. The phytoplankton then holds part of the yarn and continues the process. At the end, each student will hold part of the yarn, making it evident that these items are

connected in the multiple food chains that form a food web. Make cards to illustrate and include multiple food chains, such as:

 $sun \rightarrow phytoplankton \rightarrow zooplankton \rightarrow sunfish \rightarrow decomposer \rightarrow cattail \rightarrow muskrat \rightarrow fox \rightarrow hawk \rightarrow decomposer \rightarrow algae \rightarrow water penny \rightarrow minnow \rightarrow largemouth bass \rightarrow human$

Pull or tug at one of the strands of the web to indicate a disruption in the system. For example, silt from a development project covers all the sunfish eggs, decreasing the population of sunfish in the lake. As members of the food web feel a tug, have that student explain how they were impacted by the disruption in the food chain. That student must then tug on the yarn. How far through the web is the impact of the original disruption felt?

- For the final round of the game, ask students what they think a Minnesota DNR Fisheries Manager might do to manage a lake to provide good fishing year after year. You may want to institute a fishing license when the anglers are added by writing the word "license" on the angler identification tags. Suggestions might include stricter regulations, habitat improvement projects, and stocking plans. Impose restrictions on anglers by having them hop on one foot or walk backwards. Play out the final round to demonstrate the students' various management suggestions. Discuss Minnesota fishing regulations, and special regulations on certain lakes. (See the current Minnesota fishing regulations booklet and Lesson 4:1—Fishing Regulations and Sportsmanship for more information.)
- 4 To further explore aquatic habitats and food webs with an investigative, hands-on "desktop ponds" activity, obtain the Great Explorations in Math and Science (GEMS) instructor's guide, *Aquatic Habitats: Exploring Desktop Ponds*, by Katherine Barrett and Carolyn Willard (This guide is available through the Lawrence Hall of Science, University of California at Berkeley, Berkeley, CA 94720-5200, 800-727-4368.)

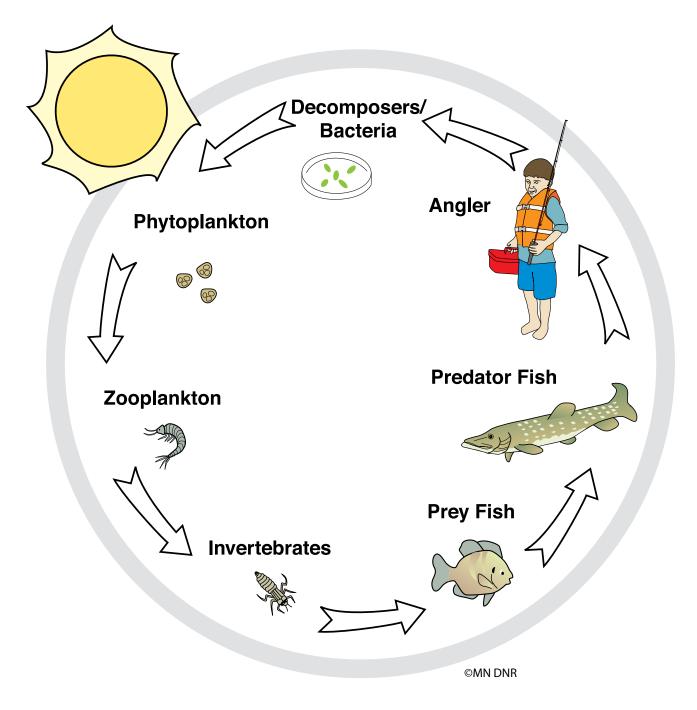
For the Small Fry

SK-2 Option

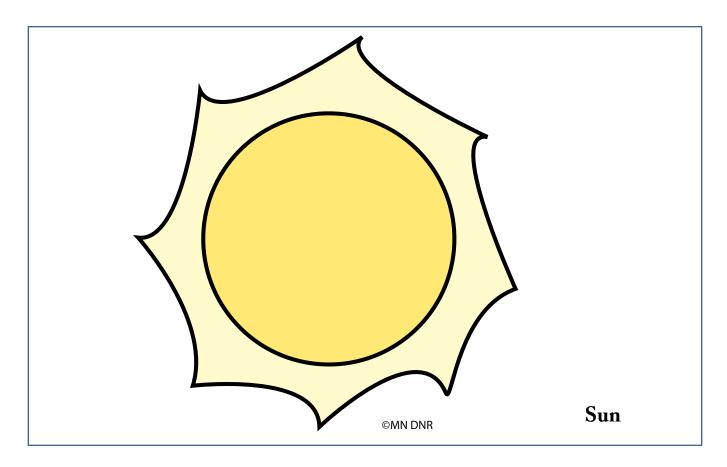
- 1 Ask the fish to count the number of chips in their stomachs after each round. For example, minnows may need five chips to survive, perch may need ten chips, and northern pike may need 20 chips.
- 2 In Round Two, have the captured minnows empty their stomachs into the stomachs of the perch, but then allow them to continue feeding (collecting chips) instead of sitting out.
- 3 Do only Rounds One, Two, and Four, skipping Round Three.
- 4 Reinforce that light energy from the sun makes plants (including phytoplankton) grow. Describe a food chain for the students. (Small animals, insects, and small fish eat plants. Big fish eat the small fish. People can eat the big fish.) Introduce the terms food chain, predator, and prey. Disregard the terms producer, consumer, decomposer, and carrying capacity.

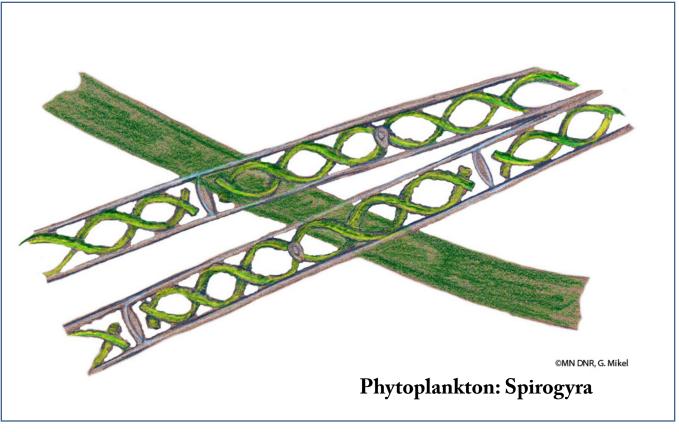
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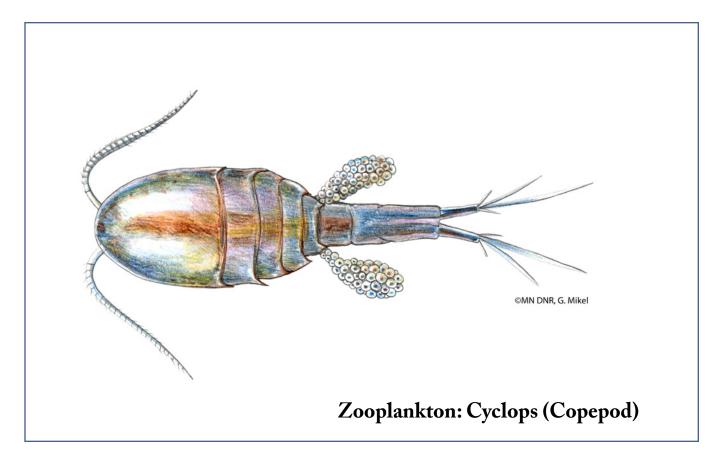
Aquatic Food Chain Sheet

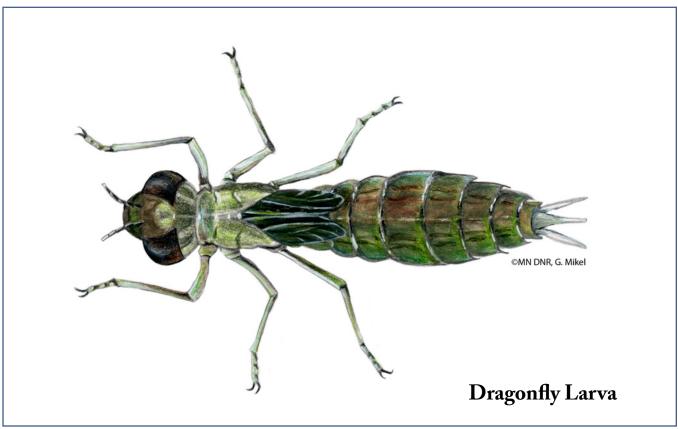


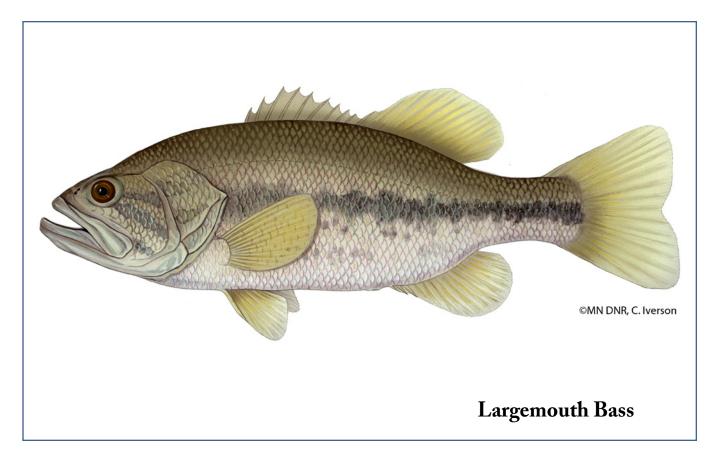
A food chain models the flow of energy through an ecosystem and the transfer of food energy from one organism to another. The sun is the source of energy in food chains. In a food chain all organisms are connected to one other and interdependent. If one link in a food chain is damaged or destroyed, all parts of the food chain are affected and the functioning of the system will be impaired.

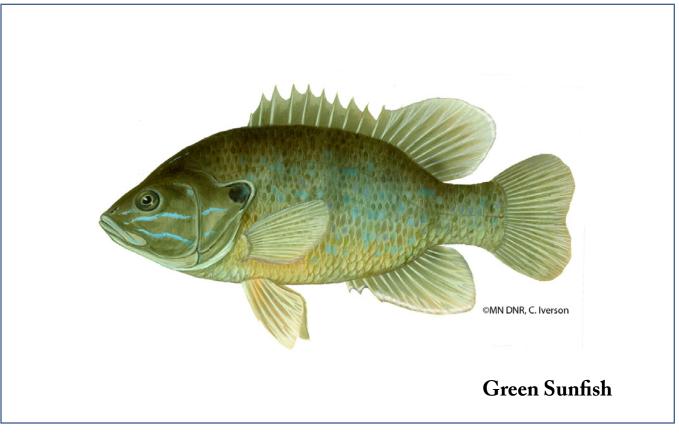


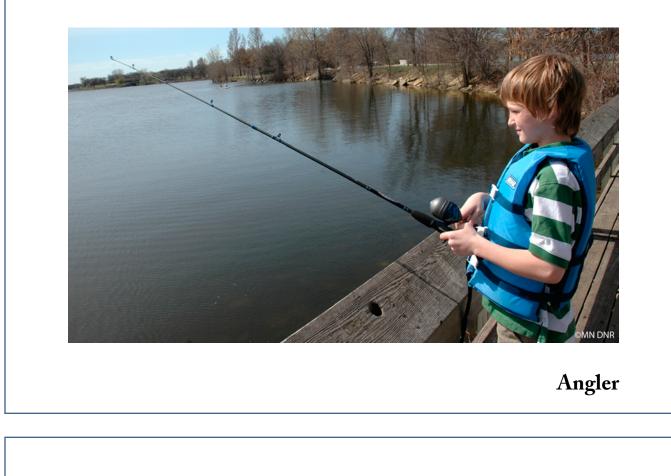


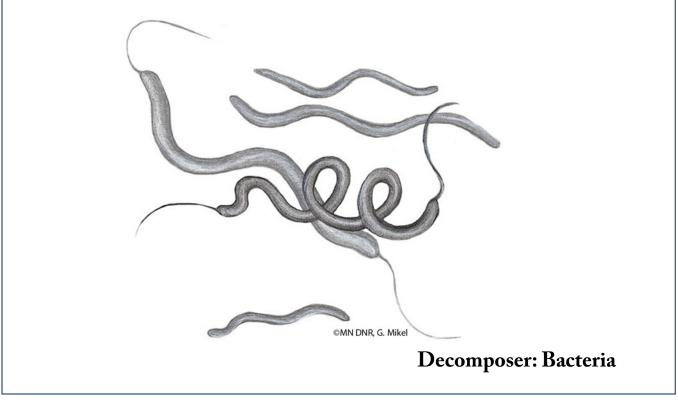












Food Chain Identification Tags

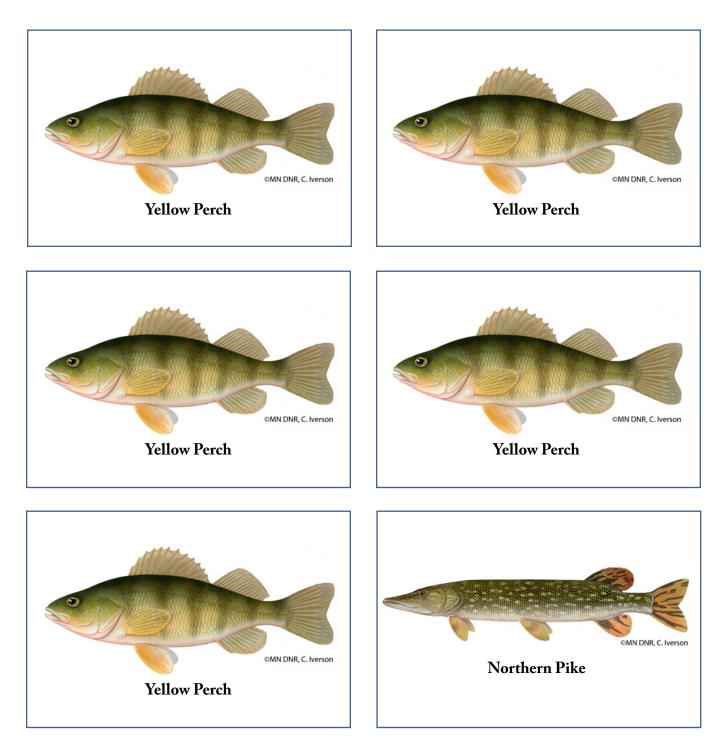
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Chapter 1 • Lesson 2 • Food Chain Tag

Food Chain Identification Tags

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Food Chain Identification Tags

Make one copy of this page.

