Unit 2

Upper Mississippi River Ecosystems

Unit 2: Upper Mississippi River Ecosystems **builds on the broad overview provided in** ***Unit 1: Upper Mississippi River Watershed.*** **Students build on the knowledge and skills gained about the geography, history, earth science, and physical science of the entire watershed to focus on the river itself in Unit 2. The wall map introduced in Unit 1 is used again in Unit 2 as the main conceptual thread running throughout the guide.**

Unit 2 emphasizes life science and geography. In this unit, students explore what ecosystems are and how they are made up of living and non-living things. They investigate what a healthy river system is, how the river's health is measured and monitored, and what happens to the river—as well as people, plants, and animals—if the river is not healthy. This unit also includes an in-depth exploration of bird migration, which helps prepare students for lessons and activities on human history and migration in ***Unit 3: Mississippi River History and Culture.***

2.0 Introduction to Upper Mississippi River Ecosystems: Pre- and Post-Assessments

Prepare students for learning about the Upper Mississippi River Ecosystems through pre-post assessments, key vocabulary, and outdoor exploration of their local ecosystems.

2.1 At Home in the River: Plants, Animals, and Habitats of the Upper Mississippi River

Learn how living things are connected to their environment by creating a food chain checkers game and raising tadpoles.

2.2 Just Passing Through: Bird Migration and the Mississippi River Flyway

Take a birdwatching field trip and recreate the Mississippi Flyway in the classroom or schoolyard.

2.3 Well River Checkup: Assessing the Health of the River

Investigate what happens to the river when you wash a car and test the effects of phosphates on pond water.

2.4 Life on the Brink: Endangered Species of the Upper Mississippi River

Research endangered species in your state and create a wildlife garden in the schoolyard.

2.5 Mississippi River Sustainability: How to Make a Positive Impact on Your Environment

Calculate your eco-footprint and read and learn the inspiring story of how one young person made a difference.

Introduction to Upper Mississippi River Ecosystems

UNIT 2

Unit 2 goal

Explore the ecosystems of the Mississippi River and how humans affect them

Lesson goal

Introduce students to the ecosystems of the Mississippi River

Lesson objectives

- Define terms related to ecosystems of the Mississippi River
- Study the ecosystems of Upper Mississippi River floodplain
- Investigate biotic and abiotic components outdoors

Educational standards

- Life Science
- Science as Inquiry
- Science in Personal and Social Perspectives
- History and Nature of Science

What you'll need

- Binoculars
- Magnifying glass
- Pencil
- Field guide
- Journal

How long it will take

- *Activity 1:* 15 min.
- *Discussion:* 60-90 min.
- *Activity 2:* 30-45 min.

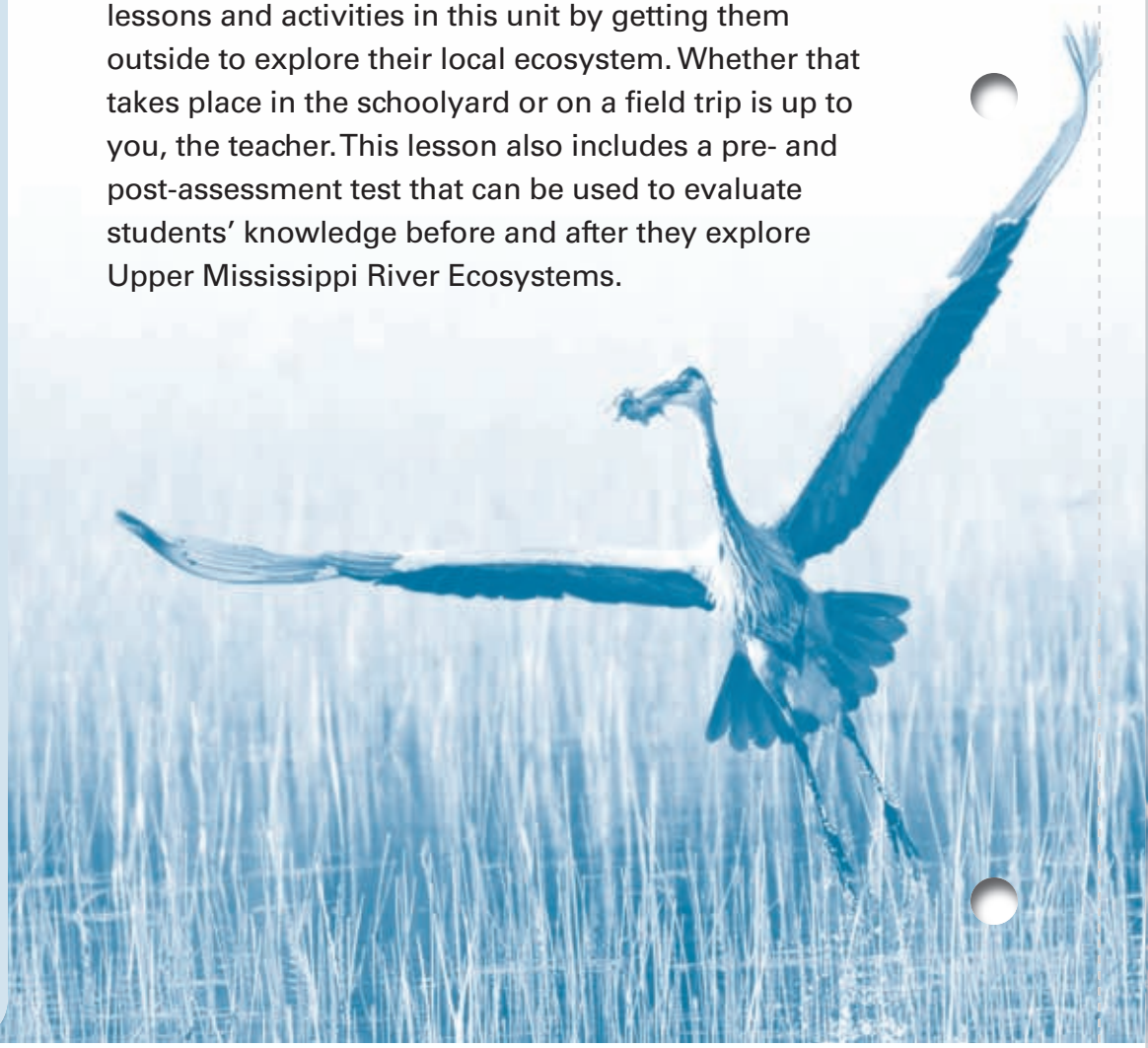
What's next!

Understanding how living things interact in an ecosystem

Introduction

In Unit 1 we examined how the Mississippi River made its mark on the country's ecosystems and commerce. In Unit 2 we will explore the ecosystems of the Mississippi River in more depth and learn how human activity has affected them. Students learn about the health of Upper Mississippi River ecosystems, habitats, and species through a variety of hands-on and outdoor activities that focus on life science and geography.

This introductory lesson prepares students for the lessons and activities in this unit by getting them outside to explore their local ecosystem. Whether that takes place in the schoolyard or on a field trip is up to you, the teacher. This lesson also includes a pre- and post-assessment test that can be used to evaluate students' knowledge before and after they explore Upper Mississippi River Ecosystems.



Pre- and Post-Assessment

15 MINUTES

What you'll need

- Activity worksheet (pages 66–67)

Do This

1. Copy and distribute the Pre- and Post- Assessment activity worksheet on the following page.
2. Allow 15 minutes for students to complete the assessment.
3. Save the pre-assessments to compare with a post-assessment given after students complete all the lessons in this unit using this same activity worksheet.
4. Calculate each student's percent increase in knowledge.

Answer Key

1. Producer ---------- Makes its own food
2. Prey ---------- Hunted by another animal for food
3. Scavenger ---------- Eats dead things
4. Carnivore ---------- Eats only other animals
5. Herbivore ---------- Eats plants
6. Omnivore ---------- Eats plants and animals
7. Biotic ---------- Organisms, living or dead, or any part of them
8. Abiotic ---------- Non-living components in the environment
9. Predator ---------- Hunts other animals for food
10. Ecosystem ---------- Living and non-living things interacting in a system
11. Species ---------- Single kind of living thing
12. Habitat ---------- Place where all survival needs are met

Multiple Choice

1. D
2. B
3. C
4. B
5. D
6. C
7. A
8. C
9. C
10. A

"We consider species to be like a brick in the foundation of a building. You can probably lose one or two or a dozen bricks and still have a standing house. But by the time you've lost 20 percent of species, you're going to destabilize the entire structure. That's how ecosystems work."

– Donald Falk, *Christian Science Monitor*, May 26, 1989

Unit 2 Assessment

Name _____ Date _____

Matching

Draw a line from the word on the left to the correct definition on the right.

1.	Producer	Organisms, living or dead, or any part of them
2.	Prey	Eats plants and animals
3.	Scavenger	Hunts other animals for food
4.	Carnivore	Non-living components in the environment
5.	Herbivore	Hunted by another animal for food
6.	Omnivore	Single kind of living thing
7.	Biotic	Living and non-living things interacting in a system
8.	Abiotic	Place where all survival needs are met
9.	Predator	Eats plants
10.	Ecosystem	Eats dead things
11.	Species	Eats only other animals
12.	Habitat	Makes its own food

Multiple choice

Circle the correct answer. There may be more than one correct answer.

1. Living things are connected to their environment because they:

   a. Live in the same ecosystem
   b. Interact with each other
   c. Are part of the habitat food web
   d. All of the above

2. Why is the Mississippi River called a flyway?

   a. Airplanes fly up and down the river
   b. Birds follow the river when migrating
   c. Golfers play on the river
   d. All of the above

3. Water that goes down the storm drain ends up:
   a. Back in the faucet
   b. In the backyard
   c. In the river
   d. At my neighbor's house

4. Which are ways we can help our local endangered species?
   a. Remove native plants
   b. Plant a garden to attract wildlife
   c. Use plastic instead of paper
   d. All of the above

5. How can you make a positive impact on your environment?
   a. Recycle instead of throwing things away
   b. Clean up after your dog
   c. Collect rainwater to reuse
   d. All of the above

Choose the BEST definition for the word.

6. Endangered
   a. Non-living thing
   b. Part of the food chain
   c. In danger of no longer existing

7. Photosynthesis
   a. Plants making food
   b. Camera taking photos
   c. Plants making oxygen

8. Species
   a. Abiotic factors
   b. Non-living thing
   c. Single kind of living thing

9. Riparian habitat
   a. City neighborhood
   b. Amusement park
   c. River bank

10. Conservation
    a. Preserving natural resources
    b. Renewing water
    c. Discovering fossil fuels

Introduction 2.0

UNIT 2

Background

We are all dependent on the life-support services that healthy ecosystems perform. Ecosystems provide food and habitat for diverse communities of people, plants, and animals. They also purify our air and water, recycle our waste, regulate climate, and moderate floods and drought.

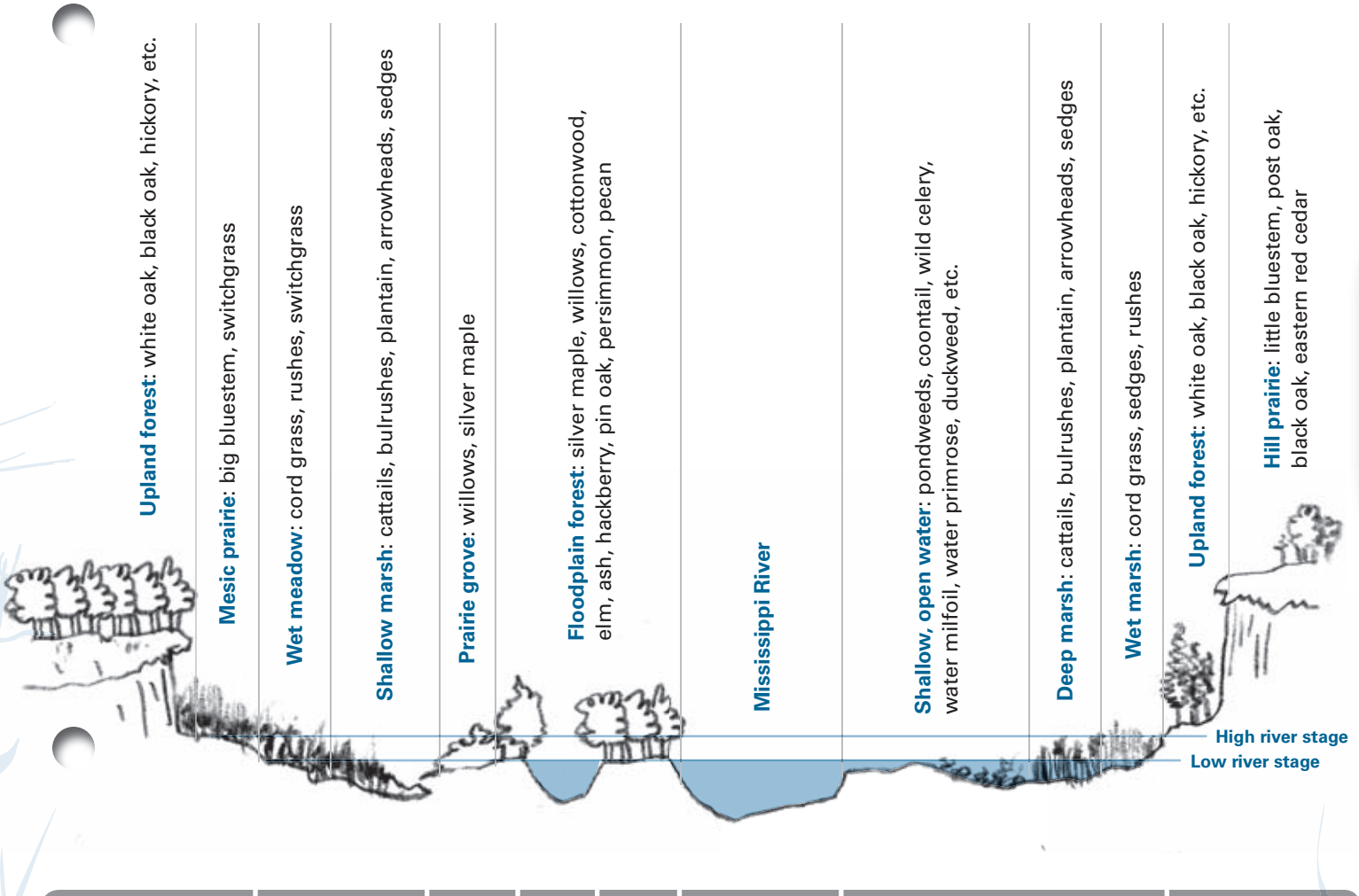
What is an ecosystem?
Many different definitions of ecosystem exist, from the very simple to the extremely complex. These definitions are open to debate because they have legal and political ramifications for international agreements protecting biodiversity.

Simply put, any group of living and non-living things interacting with each other can be considered an ecosystem. The abiotic, or non-living, components of an ecosystem are the physical factors of the environment, such as rocks, soil, sunlight, water, and air. The living, or biotic, components of an ecosystem include the organisms, both living and dead, such as plants and animals, that interact with and are dependent on abiotic factors. Together these components interact to create a stable, self-sustaining system.

An ecosystem can be as small as a puddle or as large as the Earth itself and can be temporary or permanent. The larger and more diverse in biotic and abiotic components, the more productive the ecosystem. Biodiversity is used as a measurement of ecosystem health.

The Convention on Biological Diversity defines an ecosystem as a "dynamic complex of plant, animal, and micro-organism communities and their non-living environment interacting as a functional unit. " The Convention on Biological Diversity is an international, legally binding treaty adopted in Rio de Janeiro in June 1992 and ratified by 192 countries. The United States was not one of them.

Different types of ecosystems are usually identified based on the types of native plant communities that occur in an area. Different ecosystems are found together in a geographical area called a biome that shares the same climatic conditions.



Ecosystems of the Upper Mississippi River Floodplain

Look at the cross-section of the Upper Mississippi River Floodplain. Low-elevation floodplain areas, which are usually inundated, support aquatic and wetland plants. Areas subject to frequent flooding support flood tolerant species. The least flood-tolerant plant species occur on well-drained, high elevation areas. Flooding is the major disturbance on low-elevation floodplains. Fire was once an influence on high-elevation floodplains, but fires have been suppressed and agriculture is currently the major influence.

Introduction 2.0

UNIT 2

This is a Landsat map of the Upper Mississippi River between Lock and Dam 8, near Genoa, Wisconsin, and Lock and Dam 7, near Dresbach, Minnesota. It was created using data collected by a Landsat satellite to map land cover and land use areas.

River floodplains create a dynamic mosaic of riverine, wetland, and grassland habitats that support a diverse variety of plant and wildlife species.

- **River channels**
- **Wetlands**
- **Grasslands**

Need to Know

- **Organism**: An individual living thing, such as a plant, animal, fungus, or bacteria.
- **Species**: A single kind of organism. All people are one species.
- **Population**: A group of the same species living in the same place at the same time.
- **Abiotic factors**: Non-living chemical and physical components in the environment, such as temperature, light, moisture, or air currents. Examples: rocks, soil, sunlight, water, air, and any items made by humans from non-living components, such as brick and cement.
- **Biotic factors**: The organic components in an environment that affect organisms. They consist of plant and animal organisms, both living and dead, as well as the results of their activities, including what they eat and defecate.
- **Biome**: A geographical area that shares the same climatic conditions.
- **Community**: Different populations of species that live and interact together. Several communities live together in an ecosystem.
- **Ecosystem**: Any group of living and nonliving things interacting with and dependent on each other to create a stable, self-sustaining system.
- **Biodiversity**: The number and variety of organisms in a given locality, community, or ecosystem.

Minnesota Dwarf Trout Lily *(Erythronium propullans)*

STANDARDS CORRELATION

Taken as a whole, this introductory lesson addresses several key science objectives. In addition to learning about populations and ecosystems (life science), students engage in hands-on scientific exploration, which helps them understand science as a human endeavor and gives them the foundation necessary to do scientific inquiry. They also begin to understand science from a personal and social perspective.

Incorporating the extension suggestions adds a new dimension to this lesson by including activities that feature fine arts and language arts standards.

Discussion (60 - 90 minutes)

Once students have completed the pre-assessment, begin the discussion by asking them to visualize their schoolyard or backyard. Prompt them by asking specific questions about key features, such as grassy and paved areas, paths, playground equipment, other children, flowers, and insects. Make a list of their answers.

Then ask students to think about their community, starting with their families and moving up to their street, neighborhood, town or city, and state.

Use these personal references as the context to define and discuss the key terms and concepts for this lesson to prepare students for the Explore Your Ecosystem activity. Emphasize biodiversity and discuss why it is important.

> *"The links between ecosystem and human health are many and obvious: the value in wetlands of filtering pollutants out of ground-water aquifers; the potential future medical use of different plants' genetic material; the human health effects of heavy metal accumulation in fish and shellfish. It is clear that healthy ecosystems provide the underpinnings for the long-term health of economies and societies."* – F. Henry Habicht, *EPA Journal*, September–October 1990

UNIT 2

Explore Your Ecosystem

Grades
5–6

Class or small group activity

30–45 MIN.

Depending on size of exploration area and distance from school

What you'll need

- Observation activity worksheet (page 73)
- Binoculars
- Magnifying glass
- Pencil
- Field guide
- Journal

Do Ahead

Explore the schoolyard and/or park before conducting this activity so you will have some ideas for where to have the students start exploring.

Do This

1. Open the door and step into your ecosystem! Go outside and investigate your schoolyard or a nearby park. Better yet, take a field trip to a National Wildlife Refuge near your school.
2. Investigate the surroundings and note the biotic and abiotic factors there – what living and non-living components can you find? Use the magnifying glass to view small items up close. Use the binoculars to view things far away.
3. Log your findings in your observation activity worksheet on the following page.
4. Start a journal. Check the same area weekly and update your journal.

Safety Tip

Be sure to review your safety rules before the trip.

Explore Your Ecosystem

Name _____ Date _____

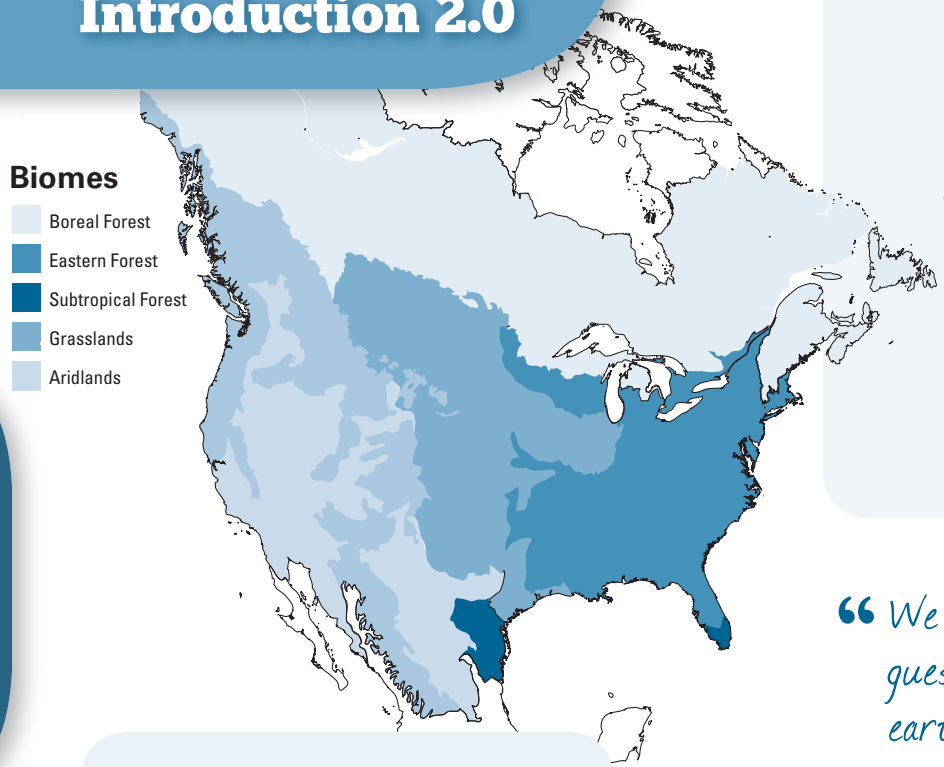
Biotic (birds, worms, plants)	**Abiotic** (rocks, bicycle, fence)	**Where you found it** (near the school entrance or by the swings)

Notes for your journal _____

_____

_____

_____



Fast Facts

- The U.S. Fish & Wildlife Service has identified and defined boundaries for 53 ecosystem units by grouping watersheds. To learn more, go to the U.S. Fish & Wildlife Service website (www.fws.gov) and search *Ecosystem Units*.

> "We have forgotten how to be good guests, how to walk lightly on the earth as its other creatures do."
>
> – Barbara Ward, *Only One Earth*, 1972

Extension Suggestions

~ Career launch

Invite a local **biologist**, **conservationist**, or **ecologist** to speak to the class. Ask students to research the field and prepare questions in advance. See *A1: Career Launch* on page 312 for career information and professional associations.

~ Get out!

- Take a field trip to a nature center or wildlife refuge and ask students to identify biotic and abiotic components or write in a journal. Call ahead for pre-visit materials for tips and ideas of other activities.
- Encourage students to ask their families to spend a day together at a nature center or wildlife refuge and present a report about what they learned to the class.

~ Express yourself!

Ask students to write a poem or paint a picture of their favorite spot outdoors that includes biotic and abiotic factors.

Consider doing a class photo journal on an aspect of water. Visit a park or a nature center to take photos and keep a diary of what you saw, heard, and felt. Write captions for your photos.

Welcome to Our Mississippi

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http://www.OurMississippi.org

~ Learn more online

Learn about ecosystems and biomes from the Franklin Institute website (www2.fi.edu)
Search keywords: **Living things, habitats and ecosystems**

Learn about abiotic and biotic factors from the Utah Education Network website (www.uen.org)
Search keywords: **Abiotic and biotic factors**

Go exploring on the U.S. Fish & Wildlife Service website (www.fws.gov)
Search keywords: **Neighborhood explorers**

At Home in the River:

Plants, Animals, and Habitats of the Upper Mississippi River

Introduction

Lesson 2.1 At Home in the River: Plants, Animals, and Habitats of the Upper Mississippi River builds on the knowledge and skills learned in the last lesson about Upper Mississippi ecosystems to look at plant and animal communities at the habitat level. Students explore how living things are connected to their environment by creating a food chain checkers game and raising tadpoles.

Background

Home sweet home

A habitat is an organism's "home." It is the place where a population of plant or animal species naturally lives and grows. Habitats supply the basic needs for survival, such as food, water, shelter, and space, and vary in size depending on the species and the resources available. Many species may also have different habitat needs at different life stages and times of year.

All living things need energy to live, and they depend on each other for food. Food chains are more than just a collection of organisms that eat each other. They are also a conduit for the accumulation and transfer of energy. There are many habitats and food webs within an ecosystem.

Unit 2 goal reminder

Explore the ecosystems of the Mississippi River and how humans affect them

Lesson goal

Understand how living things are connected to their environment

Lesson objectives

- Define terms related to ecosystems of the Mississippi River
- Research species connections in a food web
- Understand the importance of indicator species
- Care for tadpoles in an aquarium and record their development

Educational standards

- Life Science
- Science in Personal and Social Perspectives
- Fine Arts
- Language Arts

What you'll need

- 3 pieces of 20" x 20" poster board in 3 different light colors
- Pen or pencil
- Scissors
- Glue
- Checkerboard
- Frog eggs or tadpoles
- Aquarium or fish bowl with a screen top
- Pond, rain or conditioned water
- Fish food
- Sponge

How long it will take

- *Discussion/prep time:* 1 hr.
- *Activity 1 and 2:* 1 hr. each

What's next!

Exploring why and how birds migrate

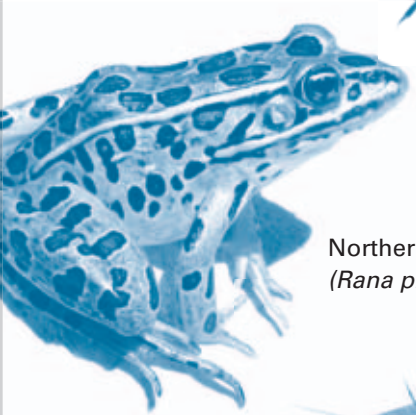
Indicator species

Some plant and animal species are especially sensitive to habitat changes, and are the first to show signs of stress when a habitat is unhealthy. Frog populations have been declining all over the world for years. Loss of habitat, water pollution, fungal disease, and predation by non-native species are a few of the causes.

Sources: Environmental Protection Agency (EPA); Mississippi National River and Recreation Area; Upper Mississippi River Conservation Committee; U.S. Fish & Wildlife Service, Midwest Region; U.S. Geological Survey (USGS) Upper Midwest Environmental Sciences Center; USGS Biological Resources Discipline; *The Facts on File Dictionary of Biology*, 3rd ed., by Robert Hine.

Mayfly
(Ephemeroptera)

Caddisfly Larvae
(Trichoptera)



Northern Leopard Frog
(Rana pipiens)

Flathead Catfish
(Pylodictis olivaris)

Need to Know

- **Predators**: Animals that kill and eat other animals.
- **Prey**: Animals that are killed and eaten by other animals.
- **Herbivores**: Animals that eat only plants.
- **Omnivores**: Animals that eat both plants and other animals.
- **Carnivores**: Animals that eat only other animals.
- **Invertebrates**: Animals without backbones, which includes about 95 percent of all animal species, such as insects, worms, spiders, crustaceans, and mollusks.
- **Crustaceans**: Large group of invertebrates that includes shrimp, crabs, and barnacles.
- **Mollusks**: Large group of invertebrates that includes snails, slugs, clams, and mussels.
- **Plankton**: Microscopic organisms that live in both salt and fresh water.
- **Phytoplankton**: Microscopic plants that live in or near the surface of the water.
- **Zooplankton**: Microscopic animals that eat other plankton, such as phytoplankton.
- **Habitat**: The place where a population of species makes its home and meets all of its needs for survival, including food, water, shelter, and space. Within each ecosystem, there are many different habitats that vary in size.
- **Riparian habitat**: The habitat along the bank of a river.
- **Food chain**: The relationships between organisms in a habitat arranged in order of predation (interactions between predators and prey).
- **Food web**: All the food chains in a particular habitat.
- **Photosynthesis**: The process though which plants make their own food from sunlight, water, and a gas called carbon dioxide.
- **Producers**: Organisms, such as plants and algae, that make their own food through photosynthesis.
- **Consumers**: Members of the food chain that eat other living things. There are four types, or trophic levels, of consumers:
  1. Primary consumers: Animals that only eat plants (herbivores), such as rabbits, deer, and elk. Many primary consumers are prey for consumers at higher trophic levels.

2. Secondary consumers: Animals that eat other animals, including both omnivores and carnivores.
3. Tertiary consumers: Carnivores that eat other carnivores.
4. Quaternary consumers (also called apex predators): Animals that are at the top of the food chain and have no predators within their ecosystem, such as the gray wolf, grizzly bear, bald eagle, osprey, great horned owl, coyote, lynx, and wolverines. Humans are also apex predators.

- **Scavengers:** Animals that eat dead things.
- **Detritus**: Small pieces of organic material from dead and decaying plants and animals.
- **Decomposers**: Living things that break down the cells of dead plants and animals into simpler parts, helping to return nutrients to the soil to be used by primary producers. Decomposers include fungi (mold), bacteria, and worms.
- **Bacteria**: Large group of single-celled organisms that live in soil, water, organic material, and the bodies of living plants and animals.
- **Recycling**: The act of using things again. When organisms die or produce waste, they become food for decomposers, which break down the organic matter into nutrients that can be used again by producers.
- **Indicator species:** A species whose presence, absence, or health tells us about the health of its habitat or ecosystem. Also called bioindicators. Fish, aquatic plants, and aquatic invertebrates are excellent indicator species because they:
  - live in the water for some or all of their life
  - differ in their tolerance to amount and types of pollution
  - live for several years

Sources: U.S. Fish & Wildlife Service, Midwest Region; U.S. Geological Survey (USGS) USGS Biological Resources Discipline; The Facts on File Dictionary of Biology, 3rd ed., by Robert Hine.

Discussion (about one hour)

Begin the **discussion about habitats** by asking students how their homes and communities provide them with the food and shelter they need to be healthy and safe. Use the context of their homes to introduce and discuss the key terms and concepts relating to species and habitats. Explain the difference between habitats and ecosystems. Once students understand the concept, move on to food chains.

Begin the **discussion about food chains** by asking students to log what they ate the day before and look up its nutritional information to determine where on the food chain their meals came from. Compare several different types of meals, from highly processed meals to whole foods, to get a wide range of foods from almost every trophic level. Use these personal references as the context to define and discuss the key terms and concepts.

STANDARDS CORRELATION

Used in its entirety, this lesson explores life science by examining populations and ecosystems in more detail. Students learn about the complex relationships between producers and the different levels of consumers. They see how energy is transferred through food chains and understand how organisms are categorized by their function in the ecosystem.

Students again engage in hands-on scientific exploration, which furthers their understanding of science as inquiry and as a human endeavor. Language arts and games are incorporated into this lesson to make the activities more engaging to a wide variety of learning styles. Extension suggestions offer ideas for deepening activities and incorporating personal and social perspectives.

Once students understand the complex relationships among species in a food chain, use another visual to show how many food chains create an ecosystem's food web.

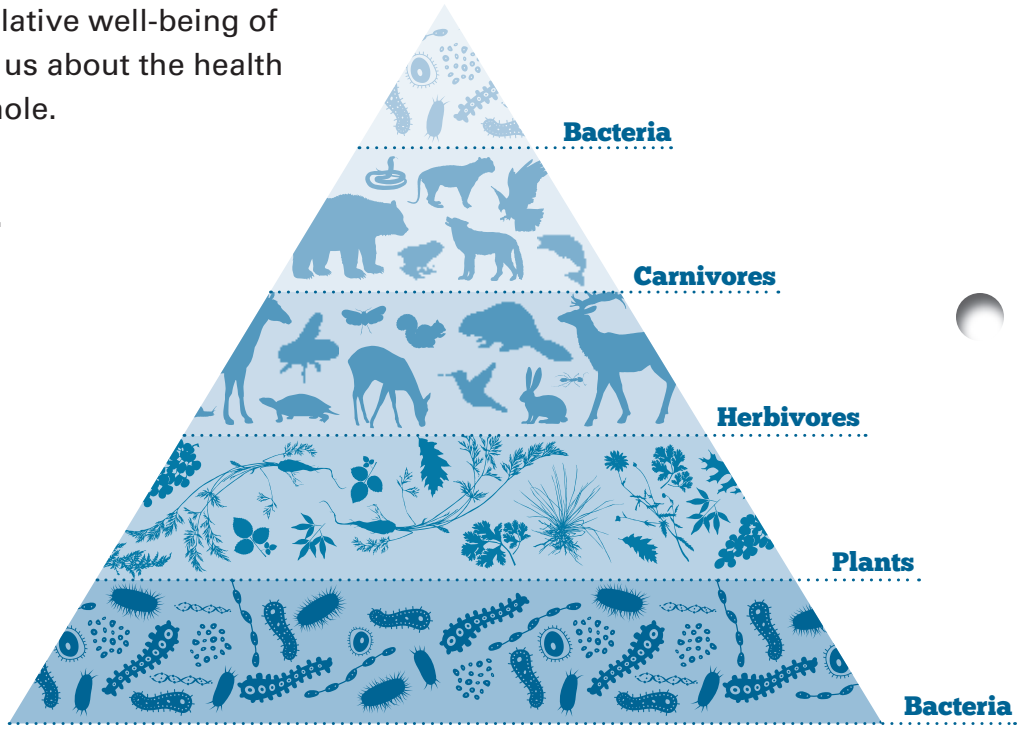
Finish the discussion by defining and discussing indicator species using the mayfly as an example. Mayflies are an excellent example of an invertebrate indicator species because of their varied tolerance for pollution and their role in the food chain as a major food source for fish. Discuss what the presence, absence, or relative well-being of mayfly populations tells us about the health of an ecosystem as a whole.

Teacher Tip

Use visuals to help students understand the complex interactions in food chains and food webs. The food chain table and the ecological pyramid will help students understand the relationships.

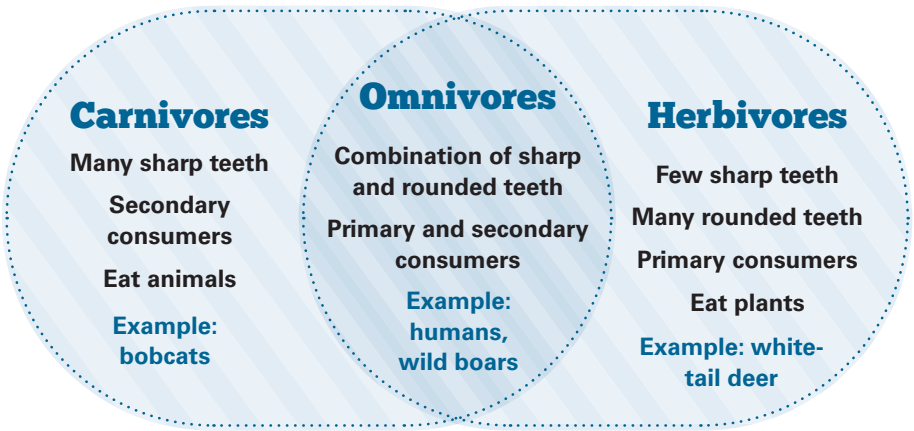
Ecological Pyramid

An ecological pyramid makes clear two important facts about food webs. It shows how the total number of organisms found in any one level decreases as you go up the pyramid, which means the amount of available energy decreases as well. For example, let's say an ecosystem that contains 10,000 lettuce plants can support 100 rabbits, but only 10 owls, and just 1 hawk.



Venn Diagram

Use a Venn Diagram to help students understand how the terms producers and consumers relate to herbivore, carnivore, and omnivore as well as the terms predator and prey. Describe and discuss their different roles.

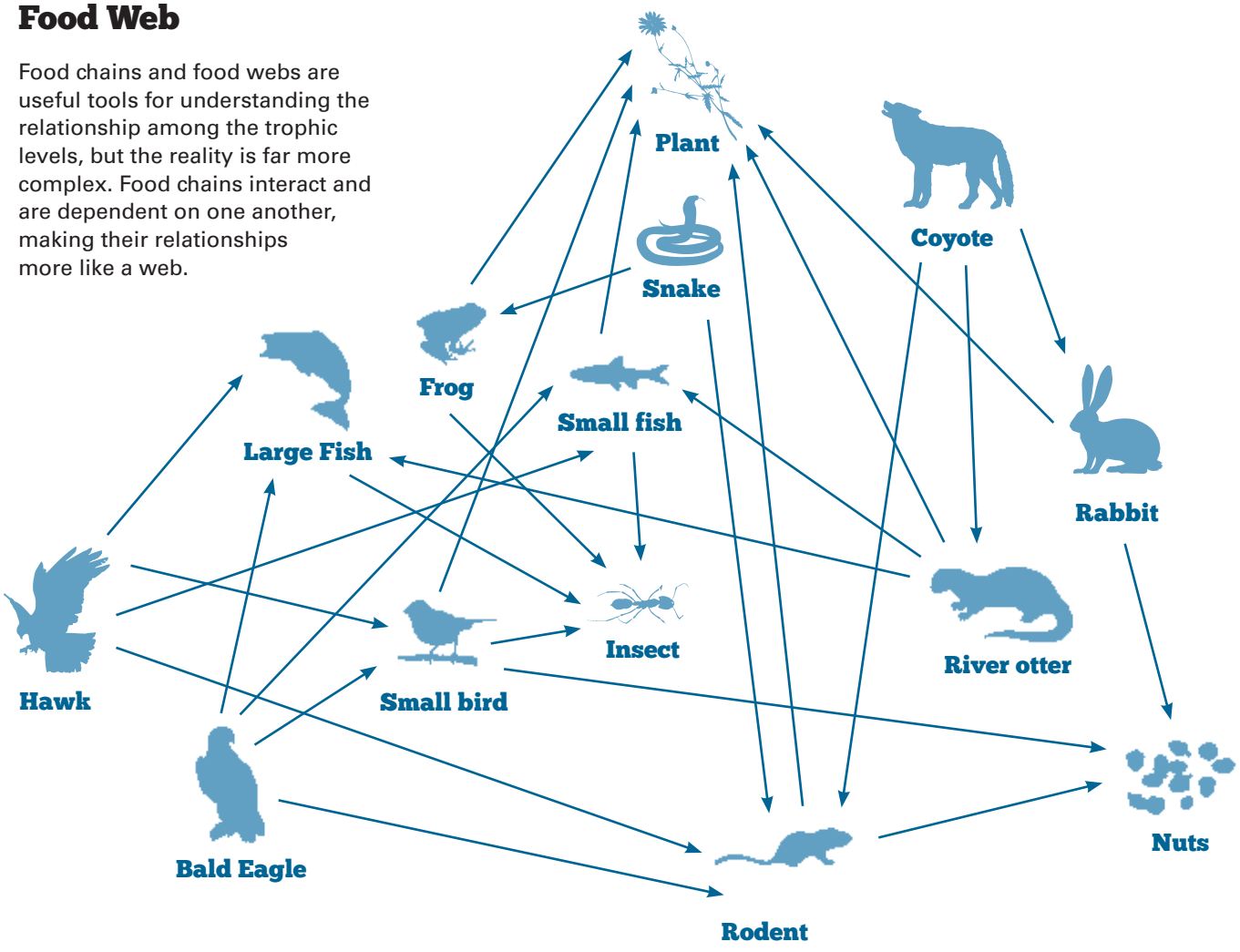


Trophic Level: The position of an organism in a food chain

Trophic Level	Grassland Ecosystem	Wetland Ecosystem	River Ecosystem
Decomposers	Worms	Fungi (mold)	Bacteria
Primary Producers	Grass	Algae and Aquatic Plants	Phytoplankton
Primary Consumers	Grasshopper	Mosquito Larva	Minnow
Secondary Consumers	Rat	Dragonfly Larva	Crayfish
Tertiary Consumers	Snake	Fish	Fish
Quaternary Consumers	Hawk	Raccoon	River Otter

Food Web

Food chains and food webs are useful tools for understanding the relationship among the trophic levels, but the reality is far more complex. Food chains interact and are dependent on one another, making their relationships more like a web.



Fast Facts

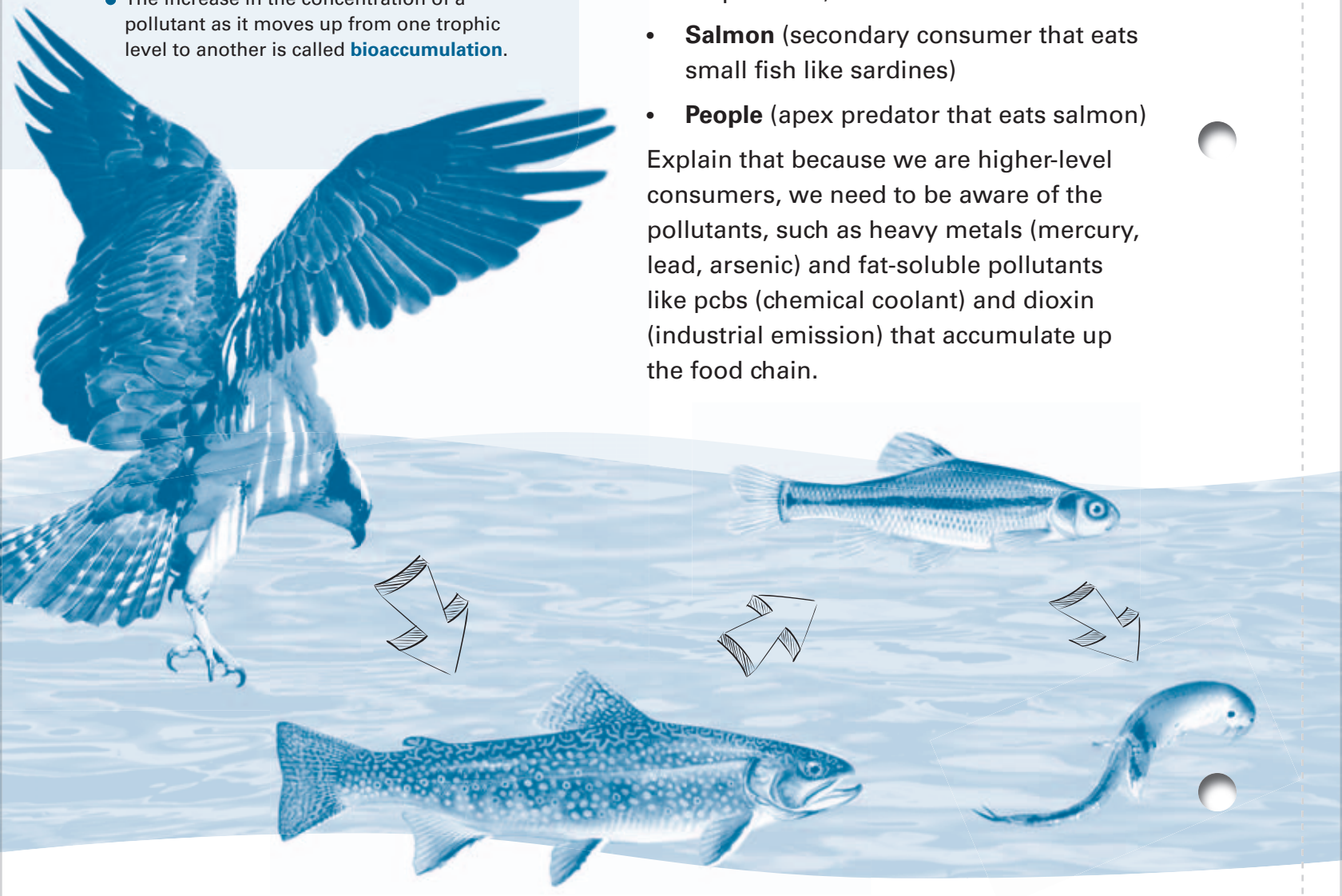
- Only 6% of the native habitats of the Upper Mississippi River floodplain remain today.
- The Upper Mississippi River floodplain is home to more than 50 species of mammals.
- At least 163 species of fish live in the Mississippi River.
- At least 45 species of amphibians and reptiles inhabit the Upper Mississippi River area.
- There are more than 50 documented species of mussels in the Upper Mississippi River.
- The increase in the concentration of a pollutant as it moves up from one trophic level to another is called **bioaccumulation**.

Bonus Round Discussion

If you have the time, build on the meal analysis discussion to explore the implications of eating higher or lower on the food chain. For example, describe the health benefits of omega 3 fatty acids, such as preventing disease (cancer and cardiovascular disease) and improving brain and immune system functioning. Then identify the different food sources of omega 3 and their place in the food chain:

- **Flaxseed oil** (primary producer)
- **Sardines** (primary consumer that feeds on plankton)
- **Salmon** (secondary consumer that eats small fish like sardines)
- **People** (apex predator that eats salmon)

Explain that because we are higher-level consumers, we need to be aware of the pollutants, such as heavy metals (mercury, lead, arsenic) and fat-soluble pollutants like pcbs (chemical coolant) and dioxin (industrial emission) that accumulate up the food chain.



Food Chain Checkers

Grades

5–6

Class or small group activity

1–3 CLASSES

depending on student research time

What you'll need

- 3 pieces of 20" x 20" poster board in 3 different colors, each light enough to write on
- Pen or pencil
- Scissors
- Glue
- Checkerboard
- Activity worksheets (page 83)

What's for Dinner?

Students learn about the connections among species in a food web by researching what local animals eat and creating a Food Chain Checkers game based on the trophic levels of the animals they choose.

Do This

Step A: Warm-up

1. Have each student research at least two local species to discover what they eat.
2. Discuss their findings and record them on the board.
   - You will need a minimum of 12 species for each student to make enough checkers to play a game.
   - Be sure to include humans.
   - Consider including pelican, sandpiper, least tern, sanderling, plover, bald eagle, and osprey in preparation for Lesson 2.2 on bird migration.

Step B: Complete the Food Chain Chart

1. Ask students to complete a food chain for each ecosystem in the *Who Eats Whom?* activity worksheet on page 83. Use the chart below to help students who have difficulty assigning species to the trophic levels for each ecosystem.
2. Ask students to pick 12 species from their Food Chain Chart to play checkers.

LEVEL	Grassland ecosystem	Wetland ecosystem	River ecosystem
Producers	1. Grass	1. Algae & aquatic plants	1. Phytoplankton
Primary consumers	2. Grasshopper	2. Mosquito larva	2. Minnow
Secondary consumers	3. Rat	3. Dragonfly larva	3. Crayfish
Tertiary consumers	4. Snake	4. Fish	4. Fish
Quaternary consumers	5. Hawk	5. Raccoon	5. River otter

Step C: Make the checkers

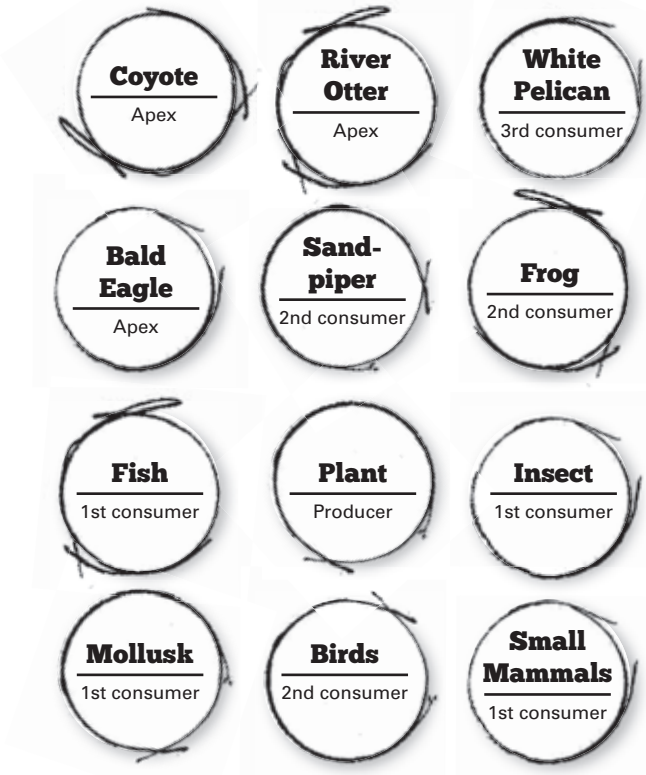
1. Have students work in teams of two to make and play one game of checkers.
2. Choose two colors to use to make the checkers.
   - Cut out 12 circles sized to fit in the size of the squares.
   - On one side write the name of each species and its trophic level (decomposer, primary producer, primary consumer, secondary consumer, tertiary consumer, or apex consumer).
   - The other side is left blank unless the checker reaches the opposite side of the board. If that happens, have students turn the checker over and write apex on the blank side.

Step D: Rules of the game

1. Place the highest-level consumers at the back of the board and the lowest level in front.
2. To play, move diagonally like checkers. Capture checkers by "eating" (i.e., diagonally jumping over) any species that are on a lower trophic level, which represents a legal move. Remove the jumped checker.
3. Checkers that reach the last row of the opposite side of the board become apex predators. Have students turn over that checker and write "apex" on the blank side. It can now legally jump any piece.
4. Game ends by capturing all of the opposing player's pieces, by leaving the opposing player with no legal moves, or with a draw.

Teacher Tip

If pressed for time, use the sample checkers below instead of asking students to make their own.



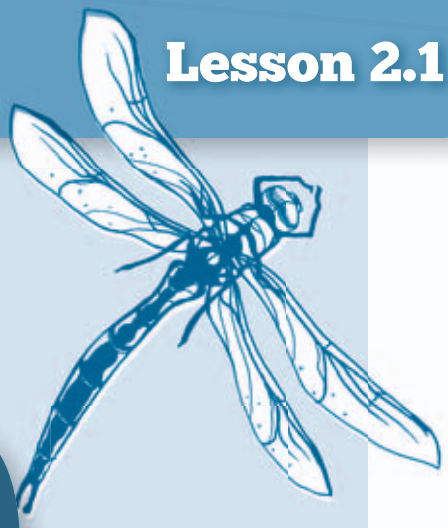
Who Eats Whom?

Name _____ Date _____

LEVEL	Grassland ecosystem	Wetland ecosystem	River ecosystem
Primary producers	1. Grass	1. Wetland plants	1. Phytoplankton
Primary consumers	2.	2.	2.
Secondary consumers	3.	3.	3.
Tertiary consumers	4.	4.	4.
Quaternary consumers	5.	5.	5.

Make food chains for three types of ecosystems (grassland, wetland, and river) by filling in the chart above with the appropriate species for each trophic level. Use species from the list below or research your own examples.

1. **Turtles** eat: snails, crayfish, insects, small fish, aquatic plants
2. **Muskrats** eat: a variety of plants
3. **Great blue herons** eat: fish, invertebrates, small mammals, reptiles, amphibians
4. **Crayfish** eat: detritus, small fish, plants, snails, plankton
5. **Frogs** eat: insects, invertebrates, plants
6. **Tadpoles** eat: phytoplankton
7. **Mosquitos** eat: plant nectar and blood
8. **Dragonflies** (adults) eat: mosquitoes, flies, bees, ants
9. **Zooplankton** eat: phytoplankton
10. **Largemouth bass** eat: zooplankton, crayfish, small fish, frogs
11. **Pond snails** eat: detritus and plants
12. **Bluegills** eat: insects, larvae, crustaceans, plants
13. **Raccoons** eat: plants, crayfish, frogs, fish
14. **Minnows** eat: small snails, zooplankton, insect larvae
15. **River otters** eat: crayfish, freshwater mussels, fish, frogs
16. **Bacteria** eat: detritus (dead or decaying organic matter)
17. **Bobcats** eat: rabbits, rodents, squirrels, birds, fish, insects
18. **Spiders** eat: flies, insects, other spiders
19. **Humans** eat: plants, mammals, birds, fish, crayfish
20. **Coyotes** eat: rabbits, rodents, squirrels, birds, fish, insects, snakes
21. **Owls** eat: small mammals, rodents, small occasional bird
22. **Horses** eat: grass, hay, grain
23. **White pelicans** eat: small fish, salamanders, crayfish
24. **Sandpipers** eat: insects, small crustaceans, mollusks
25. **Least terns** eat: small fishes, shrimp, invertebrates
27. **Plovers** eat: insects, larvae, marine worms
28. **Bald eagles** eat: fish, waterfowl, shorebirds, small mammals, turtles, carrion
29. **Ospreys** eat: fish, snakes, voles, squirrels, muskrats



Raising Tadpoles

UNIT 2

Grades
5–6

Class or small group activity

12 WEEKS

1 hour to start. Half day if combined with a field trip. Ongoing project lasting up to 12 weeks.

By caring for tadpoles and witnessing their metamorphosis into frogs or toads, students understand that some species may also have different habitat needs at different life stages and times of year. They also learn about the importance of clean water.

Teacher Tip

It usually takes between 6 and 12 weeks for some species to grow from egg to tadpole to frog.

What you'll need

- Frog eggs or tadpoles (about 2 or 3 tadpoles per quart of water)
- Aquarium or fish bowl (about 10 gallons) with a screen top
- Pond, rain, or conditioned water
- Fish food
- Sponge
- Gravel and aquatic plants (if desired, but not necessary)
- Activity worksheet (page 87)
- Be sure to get permission from property owner before collecting pond water or other items, and do not release non-native species into the environment

Do This

1. Set up tadpole aquarium. Depending on where you get the tadpoles and what kind of water you use, this may take several days.
   - Clean, chlorine-free water is essential for tadpoles. Rain or pond water is best.
   - If using tap water, condition it with chlorine removers from a pet store or leave it in the sunlight for two days to break down the chlorine.
2. Get frog eggs or tadpoles.
   - Buy frog eggs or tadpoles online or from a pet or a pond supply store. Ask for the scientific name and find out the specific habitat and food requirements for that species.

- If you are doing this lesson in early spring, consider taking the class on a field trip to gather frog eggs or tadpoles. Be sure to get permission from property owners before collecting pond water or other items.
  - Timing. It's best to gather eggs in early spring so they turn into frogs before school ends.
  - Get ready. Wear the right clothes for the weather and the place.
  - Know when and where to go. Listen for frog calls. That lets you know the time is right. Look in still ponds, puddles, and ditches near the water's edge. Frogs usually lay their eggs around tall grasses or submerged sticks or logs.
  - Know what to look for. The eggs are together in a large clump of jelly. Each egg has a dark center (the tadpole) and a jelly "egg" around it.
  - Scoop up a clump of eggs along with some pond water, mud, and plants.

3. Care and feeding.
   - The pond plants you collect provide plenty of food during the first days of hatching. After that, feed the tadpoles about twice per week. They will eat finely ground fish food or spinach and lettuce leaves that have been briefly boiled.
   - If the tank gets too dirty, replace with fresh pond or rainwater. If you have to use tap water, remember to condition it first.

There Was an Old Lady Who Swallowed a Fly

There was an old lady who swallowed a fly.
I don't know why she swallowed the fly,
I guess she'll die.

There was an old lady who swallowed a spider,
that wiggled and wiggled and tickled inside her.
She swallowed the spider to catch the fly.
I don't know why she swallowed the fly.
I guess she'll die.

There was an old lady who swallowed a bird.
How absurd to swallow a bird.
She swallowed the bird to catch the spider,
that wiggled and wiggled and tickled inside her.
She swallowed the spider to catch the fly.
I don't know why she swallowed the fly.
I guess she'll die.

There was an old lady who swallowed a cat.
Imagine that, she swallowed a cat.
She swallowed the cat to catch the bird.
She swallowed the bird to catch the spider,
that wiggled and wiggled and tickled inside her.
She swallowed the spider to catch the fly.
I don't know why she swallowed the fly.
I guess she'll die.

There was an old lady who swallowed a dog.
My what a hog, to swallow a dog.
She swallowed the dog to catch the cat.
She swallowed the cat, to catch the bird,
She swallowed the bird to catch the spider,
that wiggled and wiggled and tickled inside her.
She swallowed the spider to catch the fly.
I don't know why she swallowed the fly.
I guess she'll die.

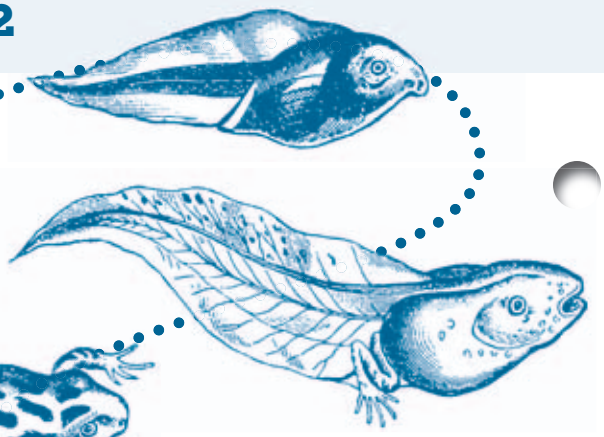
There was an old lady who swallowed a cow.
I don't know how she swallowed a cow.
She swallowed the cow to catch the dog.
She swallowed the dog, to catch the cat.
She swallowed the cat to catch the bird.
She swallowed the bird to catch the spider,
that wiggled and wiggled and tickled inside her.
She swallowed the spider to catch the fly.
I don't know why she swallowed the fly
I guess she'll die.

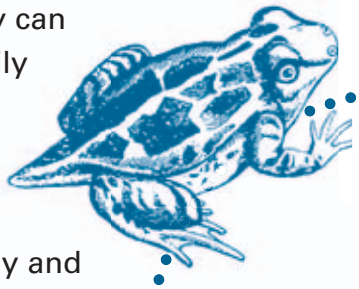
I know an old lady who swallowed a horse...
She's dead of course!

—Rose Bonne

Teacher Tip

Ask students to find the flaw in this nursery rhyme's food chain.





- When the tadpoles start developing legs, they need some sort of perch so they can get out of the water. Floating water lily leaves and branches are ideal, but a sponge will work. Make sure to keep a screen across the top.

4. Have students observe the tadpoles daily and record their development in a journal, lab report, or online.

5. What to expect:
   - Back legs will develop first, then front legs.
   - Tails are resorbed after front legs emerge.
   - Once the tadpole's tail is gone, it is considered a frog.

6. If you gathered eggs or tadpoles from a local pond or stream, release your frogs back to where you found them. Be sure to get appropriate permissions before releasing the frogs. If you choose to keep the frogs, you need to begin to feed them insects and give them firm ground as well as lots of water. **However, if you purchased your eggs or tadpoles from a store, do not release them into the environment.** They may not be a native species, and many states have laws prohibiting the release of aquarium fish and amphibians for fear of introducing diseases or invasive species.

Raising Tadpoles

Journal Page

Name _____ Date _____

Lesson 2.1

> "Our challenge for the future is that we realize we are very much a part of the earth's ecosystem, and we must learn to respect and live according to the basic biological laws of nature."
>
> – Jim Fowler

Extension Suggestions

~ Career launch

Invite a local ecologist, biologist or conservationist to speak to the class. Ask students to research the field and prepare questions in advance. See *A1: Career Launch* on page 312 for career information and professional associations.

~ You are what you eat

Ask students to talk to their parents about where in the food chain their meals come from and think about the health and environmental implications for the way they eat.

~ Get out!

Go on a tour of a local food processing plant.

~ Express yourself!

As a class activity, ask students to write a poem about food webs using cumulative verses similar to "There Was An Old Lady Who Swallowed A Fly." Each student adds a verse and then repeats the entire poem.

Welcome to Our Mississippi

File Edit View Favorites Tools Help

http://www.OurMississippi.org

~ Learn more online

Contribute to the food web by helping decomposers do their thing both at home and at school. Learn about composting from the Environmental Protection Agency website (www.epa.gov) and search keywords: ***Backyard composting***

Learn more about the indicator species from the Environmental Protection Agency website (www.epa.gov) and search keywords: **Indicator Species**

~ Grades K–4 Extension

Recycle, reuse, reduce: what on earth can you do with an old jelly jar? Go to Environmental Protection Agency website (www.epa.gov) and search keywords: **EPA waste kids education**

~ Volunteer!

- Visit the Living Lands & Waters website (www.livinglandsandwaters.org) Click on **Get Involved.**

~ Get involved

- There are many opportunities to help protect and restore habitat along the Upper Mississippi River. Find out how at the Mississippi River Wild website (www.mississippiriverwild.com) Click on **volunteer.**
- Contact local, state, or federal agencies for volunteer opportunities.

Just Passing Through:

Bird Migration and the Mississippi River Flyway

Introduction

Lesson 2.2 Just Passing Through: Bird Migration and the Mississippi River Flyway uses the knowledge and skills learned in the last lesson about habitats and food chains to understand the habitat needs of migratory birds. In this lesson, students recreate the Mississippi Flyway in the classroom or schoolyard and take a birdwatching field trip.

Background

Bird migrations are among nature's most dramatic events. Birdwatching is the fastest growing outdoor activity in America. It is one of the best ways to connect students with nature and science.

Need To Know

- **Migration**: Migration is the movement of a species from one place to another, often following a change of season.
- **Migration route**: The paths taken during the course of migration by a single bird species.
- **Stopovers**: Places where birds stay for a brief time during their migration.
- **Breeding grounds**: The area where an animal mates and produces offspring.
- **Flyway**: General flight routes used by many migrating bird species between their wintering grounds and their breeding grounds. There are four major migratory flyways in North America: Atlantic, Mississippi, Central, and Pacific Flyways.
- **Wetlands**: An area of land where the soil is saturated with moisture some (seasonally) or all of the time.
- **Riparian habitat**: Riparian is the habitat along the bank of a river.

Unit 2 goal reminder

Explore the ecosystems of the Mississippi River and how humans affect them

Lesson goal

Understand why the Mississippi Flyway is a major migration route for birds

Lesson objectives

- Define terms related to ecosystems of the Mississippi River
- Research migration routes and identify stopovers
- Create a flyway in your classroom
- Prepare for a birdwatching field trip
- Go birdwatching

Educational standards

- Life Science
- Science in Personal and Social Perspectives
- Geography
- Fine Arts
- Language Arts

What you'll need

- Chairs, desk, or safety cones
- Paper and clipboard
- Tape
- Student journals
- Pencils and crayons
- Binoculars
- Hat
- Waterproof boots or shoes
- Field guide

How long it will take

- *Discussion:* 20 min.
- *Activity 1:* 60 min.
- *Activity 2:* Half-day field trip

What's next?

Assessing the health of the Mississippi River

Why do birds migrate?
The reasons are complex and not fully understood, but the simple answer is because they can. The ability to fly allows birds to seek out the best places to find food and safe places to breed and to escape harsh winter weather.

Migration is no easy feat, however. Migrating birds must endure storms, bad weather, exhaustion, and natural obstacles such as mountain ranges. They also encounter many human-made challenges and obstacles as well, including habitat destruction, pollution, and structures that disorient them, such as skyscrapers and lighthouses.

All kinds of birds migrate, from large cranes and geese to small songbirds and tiny hummingbirds. A few species fly non-stop, some for several days, covering great distances. But most birds stop along the way to rest and refuel. Finding habitat that will provide them with the food and shelter they need during their journey is vital to their survival.

Fast Facts

- 65% of all bird species migrate.
- About 326 bird species—60% of all North American birds—use the Mississippi River Basin as their migratory flyway.
- 40% of all North American migratory waterfowl use the Mississippi River corridor during their spring and fall migration.
- The Riverlands Migratory Bird Sanctuary (RMBS) is designated an Important Bird Area by the National Audubon Society.
- The Upper Mississippi River National Wildlife and Fish Refuge is designated a Globally Important Bird Area. Many species of birds stopover or nest along its 261 miles of Mississippi River floodplain from Wabasha, MN, to Rock Island, IL:
  - 50% of canvasback ducks
  - 20% of the eastern U.S. population of tundra swans
  - 167 active bald eagle nests in recent years
  - 2,700 bald eagles stop during spring migration
  - 5,000 herons and egrets nest in up to 15 colonies

STANDARDS CORRELATION

In this lesson, we continue to explore life sciences while developing research skills. Students use traditional library research methods as well as Internet technology to discover information about bird migrations and the Mississippi Flyway. They then apply life science and geographic knowledge and use their creativity in the Classroom Migration activity, which incorporates visual arts standards by asking students to draw, paint, or build dioramas of migration stopovers. By exploring the habitat requirements of migratory birds, students also gain insight into the balance needed between wetland protection and economic development, which aligns with science in personal and social perspectives standards.

How do they know when it's time to go?
The change in the length of daylight, which causes hormonal changes in birds, is the main cue that lets birds know it's time to migrate. As the time to migrate approaches, birds eat as much as they can to store energy for the trip.

How do birds find their way?
Scientists are still investigating all the possible ways birds navigate during long migrations, but many believe birds orientate themselves using the position of the sun during the day and the stars at night, just as humans have done for millennia. Studies also suggest birds use a combination of other abilities, including sensing the earth's magnetic fields and using visual landmarks such as coastlines, rivers, and mountains.

Mississippi Flyway
Birds follow the Mississippi Flyway to fly from central Canada to the Gulf of Mexico. Some use it to migrate from the Arctic Ocean to Patagonia in South America. They choose this route because of its north-south orientation, lack of large obstacles such as mountain ranges, and its abundance of habitat, including channels, backwaters, sloughs, wetlands, and adjacent uplands.

Going the distance
Several species make incredibly long migrations each year traveling from summer breeding grounds to winter feeding areas.

- **American avocets** prefer open water and marshy habitats as they migrate between southern wintering and northern breeding grounds.
- **American white pelicans** travel along the Mississippi River Flyway between their summer breeding grounds in central Canada and their wintering grounds in the southern United States and Central America.
- **Barn swallows** migrate more than 6,000 miles each year from the arctic to South America.
- **Sandhill cranes** depend on wetlands as places to rest and refuel on their spring and fall migrations from southern United States and Mexico to Canada.
- **Tundra swans** can fly as fast as 80 miles per hour and as high as 4,000 feet.

American avocets

American white pelican

Barn swallow

Sandhill crane

Tundra swan

Monarch butterfly

Fun Fact!

The **monarch** is the only butterfly that migrates north and south. No one individual can make the entire trip. It takes three or four generations to complete the migration from Mexico to Canada and back again. During the migration female monarchs lay their eggs along the way and their offspring finish the trip.

Something Told the Wild Geese

Something told the wild geese
It was time to go.
Though the fields lay golden
Something whispered, "Snow."
Leaves were green and stirring,
Berries, luster-glossed,
But beneath warm feathers
Something cautioned, "Frost."
All the sagging orchards
Steamed with amber spice,
But each wild breast stiffened
At remembered ice.
Something told the wild geese
It was time to fly—
Summer sun was on their wings,
Winter in their cry.

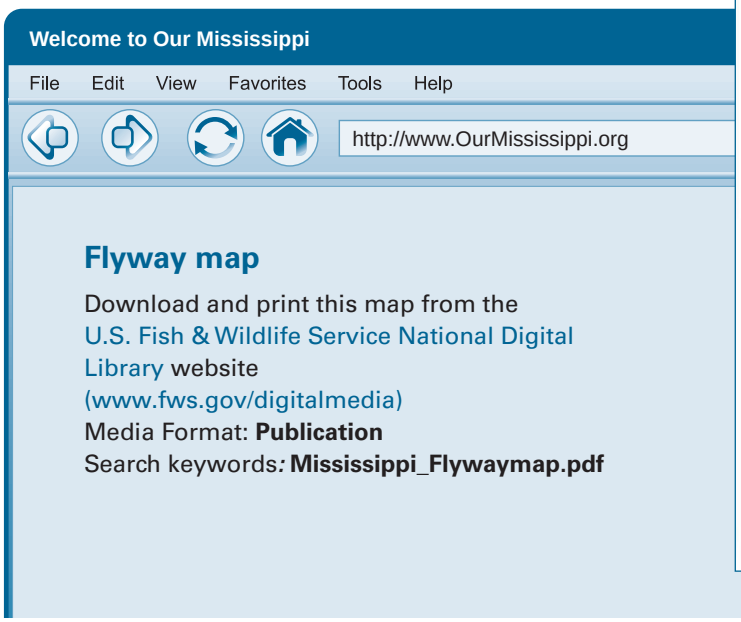
– Rachel Field

Discussion (about 20 minutes)

Begin the discussion about bird migration by asking students questions about how their families prepare for a long trip. Do they plan trips based on the seasons? How do they find their way? What do they eat? Where and how often do they stop to rest or sleep? Use this personal context to introduce students to vocabulary and key concepts about bird migration and center the discussion on the three main questions:

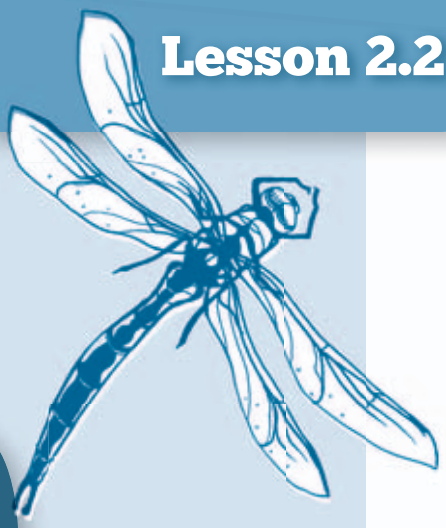
Why do birds migrate?
How do they know when it's time to go?
How do birds find their way?

Introduce the Mississippi Flyway as one of four important migratory flyways in North America using the flyway map and discuss the importance of wetlands to migrating birds.



Flyway map

Download and print this map from the U.S. Fish & Wildlife Service National Digital Library website (www.fws.gov/digitalmedia)
Media Format: **Publication**
Search keywords: **Mississippi_Flywaymap.pdf**



UNIT 2

Mississippi Flyway

Classroom Style

Grades

5–6

Class or small group activity

1 HOUR

Plus student research time

What you'll need

- Chairs, desks, or safety cones (if outside)
- Paper for drawing stopovers
- Paper for labeling stopovers and birds
- Student journals
- Tape
- Pencils
- Crayons
- Field guide
- Clipboard or other hard surface to write on
- Game cards (pages 96-97)

Create a classroom "Mississippi Flyway" and have the students migrate around the room as birds.

Do This

Step A: Warm-up

1. Identify a cast of migratory birds for students to choose from and write them on the board. The Mississippi Flyway is used by large numbers of ducks, geese, shorebirds, blackbirds, sparrows, warblers, and thrushes. Suggestions for species: lesser scaup (duck), ring-neck duck, wood duck, hummingbird, northern shoveler (duck), American golden plover (shorebird), sanderling (shorebird), killdeer (shorebird), lesser yellowlegs (shorebird), Lincoln's sparrow, Tennessee warbler, Swainson's thrush, peregrine falcon (raptor), osprey (raptor), great egret, Caspian tern, and American white pelican.
2. Ask individual students or small groups to select one or more species to research. They will become that species (as an individual or a flock) for the classroom flyway activity. They should find out:
   - What their species eats
   - Where their species rests
   - What are hazards their species may encounter

Teacher Tip

If possible, include more if you have the time and space. Adding local stopovers, such as community parks or farmers' fields, will add interest and relevance.

3. At a minimum, ask students to research the following Mississippi Flyway stopovers, noting the mix of ecosystems each contains (grassland, wetland, and riparian habitats).
   - Mississippi National River and Recreation Area
     - **www.nps.gov**, search keywords "Mississippi River facts"
   - Upper Mississippi River National Wildlife and Fish Refuge (along the river in four states)
     - **www.fws.gov**, search keywords "Upper Mississippi refuge"
   - Great River National Wildlife Refuge
     - **www.fws.gov**, search keywords "Great River refuge"
   - Delta National Wildlife Refuge
     - **www.fws.gov**, search keywords "Delta refuge profile"
   - Riverlands Migratory Bird Sanctuary
     - **www.mvs.usace.army.mil/rivers/RMBS.html**
4. Ask students to draw pictures of the ecosystems at each stopover.
5. Locate and label the flyway stopovers and the wall map.

Step B: Get ready

1. Rearrange the classroom to create at least five stopovers using chairs, desks, or safety cones (if outside or in the gym).
2. Designate each area as one of the flyway stopovers researched in class and mark with student drawings.
3. Print and cut out five sets of game cards. Each set includes Go, Stop, and Yield cards.
   - **GO** cards send students forward.
   - **YIELD** cards make students pause, perform a task, and continue their journey.
   - **STOP** cards mean that particular bird dies on the journey.
   - **GO BACK** cards make students encounter a hazard and go back to a previous rest stop.
4. Put a set of cards at each stopover.

Step C: Migrate!

1. Have students use the game cards included in the lesson to migrate their bird around the classroom "flyway," first north and then south with stops at the appropriate stopovers.
2. At each stopover station, students read the card aloud and move accordingly. If students pull a STOP card, they should die a dramatic death and return to their seats OR they may join another student as part of their flock. The joining student follows the main student and does whatever his/her card says, as in "follow the leader."
3. Ask students to log their journeys in a logbook or journal.

Game Cards

Copy this page 1-sided and cut each card out. *Students take a card and read it aloud, place that card on the bottom of the deck and follow the directions. Students who "die a dramatic death" may join another student as part of his/her flock, following the first student's lead.*

GO Sunny day. Perfect day for flying. **Fly on to the next stopover.**	**GO BACK** Wetland is GONE! Someone built an apartment building. **Go back 1 stopover to rest and eat.**	**YIELD** POURING! Heavy rain. **Stay here until you count to 100. Then fly on to the next stopover.**	**STOP** OH NO! Eaten by a predator. **Die a dramatic death. Log your death.**
GO Catch a breeze! **Fly on to the next stopover.**	**YIELD** OUCH! Diving for a fish, you get a hook in your wing. **Stay at this stopover until an Audubon volunteer removes it. Stretch your wings 5 times. Then fly on to the next stopover.**	**YIELD** Caught! A scientist is banding your legs so your flight can be tracked. **Kick and flap your wings 10 times. Then fly on to the next stopover.**	**STOP** Bright lights ahead! Whoa, the lighthouse beam confused you. You crashed into it. **Die a dramatic death. Log your death.**
GO Ride'em…barge? Caught a ride on a barge. **Go to the next stopover.**	**YIELD** Smell that! It's your favorite food. You stay to eat your fill. **Sing a happy song. Then fly on to the next stopover.**	**GO BACK** Holy frozen fish! Pond stopover is still frozen. **Go back 1 stopover.**	**STOP** Watch OUT. Airplane ahead. Oh No! You flew into it. **Die a dramatic death. Log your death.**
GO Mmmm good! A farmer has planted your favorite berries. **Fly on to the next stopover.**	**YIELD** BRRRRR Frost last night. **Flap your wings 10 times to warm yourself. Then fly on to the next stopover.**	**YIELD** Whew! You have been flying all night and are very tired. **Count to 100 while you rest some more. Then fly on to the next stopover.**	**STOP** OH NO! You flew into the side of a glass building. **Die a dramatic death. Log your death.**

Game Cards

Copy this page 1-sided and cut each card out. *Students take a card and read it aloud, place that card on the bottom of the deck and follow the directions. Students who "die a dramatic death" may join another student as part of his/her flock, following the first student's lead.*

GO

Flying high! You flew high enough to catch a fast tailwind. **Fly on to the next stopover.**

YIELD

Yuck! Someone sprayed the field with pesticide. **Roll on the floor and moan 6 times. Then fly on to the next stopover.**

YIELD

Tornado blew you off course. **Spell "migration" aloud 5 times. Then fly on to the next stopover.**

GO

Hooray! You made it to a National Wildlife Refuge! Your're protected here. **Fly on to the next stopover.**

GO

Do you hear birds singing! **Sing your favorite song. Then fly on to the next stopover.**

YIELD

You spotted a potential mate. Do a courtship dance! **Flap your arms and run in circles while you count to 50. Then fly on to the next stopover.**

GO

Yum. School kids planted some of your favorite food. Now you're all fueled up. **Fly on to the next stopover.**

STOP

OH NO! You got caught by someone's cat. **Die a dramatic death. Log your death.**

GO

Mayflies are hatching! Mayflies are hatching! **Eat up and fly on to the next stopover.**

YIELD

Holy Hurricane, Batman! Blown off course. **Circle the stopover 10 times. Then fly on to the next stopover.**

YIELD

Watch Out! Almost hit by a jet ski. **Lie down and count to 10. Then fly on to the next stopover.**

YIELD

Pea Soup? Fog? **Draw a picture of yourself as a bird as you wait for the fog to clear. Then fly on to the next stopover.**

STOP

OH NO! You perched on a faulty power line. **Die a dramatic death. Log your death.**

YIELD

Hold up! The youngsters need to rest. **Hop on 1 foot and recite the 4 times table. Then fly on to the next stopover.**

STOP

OH NO! You cannot find a safe place to stop! You become too tired to go on. **Die a dramatic death. Log your death.**

GO

Students created bird habitat in their schoolyard! It's the perfect place to eat and rest. **Fly on to the next stopover.**

Stopover Labels

Copy this page 1-sided and cut each label out. *To add your city park or another regional stopover, adjust your copier so that the light gray box description does not copy. Enlarge these labels on the copier as necessary. Then fill in your regional stopover. Suggestion: Have students draw, paint or build dioramas for each stopover.*

Canada

Upper Mississippi River NWFR, MN

Upper Mississippi River NWFR, WI

Upper Mississippi River NWFR, IL

Upper Mississippi River NWFR, IA

Two Rivers National Wildlife Refuge, IL

Riverlands Migratory Bird Sanctuary, MO

Great River National Wildlife Refuge, MO

Delta National Wildlife Refuge, LA

Central America

(Your City Park)

NWFR = National Wildlife and Fish Refuge

Bird Watching Field Trip

Grades

5–6

Class or small group activity

4 HOURS

1 half day field trip

What you'll need

- Observation sheet (pages 100-101) or a notebook journal
- Paper
- Pencil
- Clipboard
- Binoculars
- Hat
- Waterproof boots or shoes
- Field guide

During spring or fall, take students on a half-day field trip to a local birding hotspot or National Wildlife Refuge to watch birds. You can find a map of refuges on the U.S. Fish & Wildlife Service website: www.fws.gov/refuges.

Do This

1. Prior to the field trip, have each student research four common migratory bird species in your area, focusing on identifying features, habitat, food sources, and migration destination. See the list of birds in Activity 1 on page 94 for suggestions.
2. At the site, remind students they are guests in the birds' home. They should talk softly, walk slowly, and observe birds from a distance using binoculars so as not to disturb them, especially birds on nests.
3. Have students complete their observation sheets in the field and draw a picture of each bird.

Teacher Tip

*The American Museum of Natural History's book, **Birds of North America**, is an excellent reference about birds.*

Once threatened with extinction, the eastern bluebird has made a strong comeback, thanks to backyard birders who put up and monitored nesting boxes.

Activity Extension

~ Become a citizen scientist

Students can become citizen scientists by recording their sightings online at Cornell Lab of Ornithology's eBird website ***www.ebird.org***. Click **Submit Observations**.

Bird Watching

Observation Chart

Name _____ Date _____

EXAMPLE

Species: GREAT EGRET **Time of day:** 11:25 AM

Habitat: Wooded swamps and ponds

Food source: Fish, snakes, frogs and other birds

Migration: From U.S. to Mexico, Latin and South America

Size: 38" length and 51" wingspan

Identifying features:
- all white
- yellow beak
- dark legs and feet

Where was the bird? Standing on a rock

What was the bird doing? Watching the water

Drawing of the bird:

EXAMPLE

Species: KILLDEER **Time of day:** 1:25 PM

Habitat: Prefers open areas, especially around water

Food source: insects, earthworms, snails

Migration: From Canada and Northern U.S. to Mexico

Size: 10" length and 24" wingspan

Identifying features:
- small bird with long slender legs
- brown back and white breast
- black collar and black band across breast

Where was the bird? On a sandbar

What was the bird doing? Resting

Drawing of the bird:

Species: **Time of day:**

Habitat:

Food source:

Migration:

Size:

Identifying features:

Where was the bird?

What was the bird doing?

Drawing of the bird:

Species:	**Time of day:**	
Habitat:	Where was the bird?	What was the bird doing?
Food source:		
Migration:	Drawing of the bird:	
Size:		
Identifying features:		

Species:	**Time of day:**	
Habitat:	Where was the bird?	What was the bird doing?
Food source:		
Migration:	Drawing of the bird:	
Size:		
Identifying features:		

Species:	**Time of day:**	
Habitat:	Where was the bird?	What was the bird doing?
Food source:		
Migration:	Drawing of the bird:	
Size:		
Identifying features:		

Lesson 2.2

Extension Suggestions

UNIT 2

Career launch

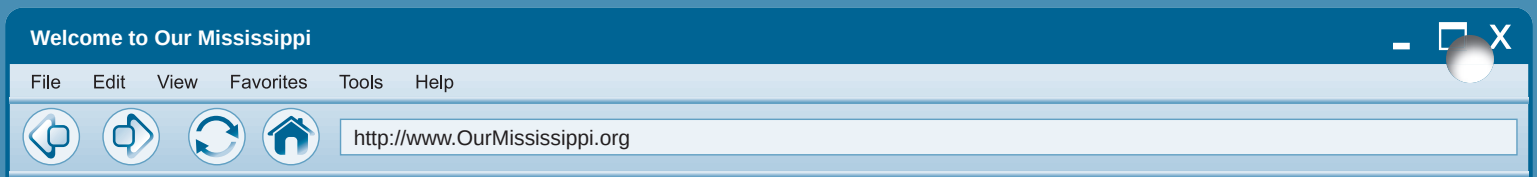
Invite a **birdwatcher**, **ornithologist** or **wildlife biologist** to speak to the class. Ask students to research the field and prepare questions in advance. See *A1: Career Launch* on page 312 for career information and professional associations.

Explore

- Celebrate **International Migratory Bird Day**. Learn more at **www.birdday.org**.
- **Build a bird feeder**. Visit the Audubon Society's web site for instructions on building birdfeeders from a variety of materials, including recycled milk cartons (**www.audubon.org**) Click on: **Education > Educators' lounge > Nature activities**

Get out!

Visit a **National Recreation Trail** operated by the U.S. Army Corps of Engineers along the Mississippi River. Go to **www.usace.army.mil** Keyword search: **National Recreation Trails**



Learn more online

Play an **online bird migration game** on the Smithsonian Migratory Bird Center website (nationalzoo.si.edu)
Keyword search: **Bird game**

Learn about **flyways** from the U.S. Fish & Wildlife Service website (www.flyways.us) or download the PDF at www.iptv.org/mississippi/lessonplans/ActivityPDFs/Science/Flyaways.pdf

Learn about **birds and other wildlife** and when and where to see them from the Upper Mississippi River National Wildlife Refuge website (www.fws.gov)
Keyword search: **Midwest Upper Mississippi River**
Click on: **Wildlife observation**

Visit the Mississippi National River and Recreation Area website (www.nps.gov/miss)
Keyword: **Animals**

Kids and Nature… a Match Made in the Outdoors. Go to www.usace.army.mil
Keyword search: **Kids and nature**

Learn about **birdwatching and bird migration** and see a **directory of bird watching clubs** by state at the U.S. Geological Society website (www.birdingguide.com)

Explore **bird migration** at the U.S. Geological Survey website (www.npwrc.usgs.gov/resource/birds/migratio/index.htm)

Find additional educational resources online on the Council for Environmental Education's Flying Wild website (www.flyingwild.org), the Cornell Lab of Ornithology's Education Program website (www.birds.cornell.edu/education), or the Smithsonian Migratory Bird Center website (www.nationalzoo.si.edu)
Keyword: **Migratory birds**

Additional places to learn about birds:

- Riverlands Migratory Bird Sanctuary (www.mvs.usace.army.mil/rivers)
- Audubon Society (www.audubon.org)
- Cornell Lab of Ornithology (www.birds.cornell.edu)

Well River Checkup:

Assessing the Health of the River

Introduction

In *Lesson 2.3 Well River Checkup: Assessing the Health of the River,* students learn how their actions become part of the water cycle and impact the health of the water supply. They trace how the everyday action of washing a car can impact the environment, and they test pond water for its phosphate content.

Background

A safe supply of water is the most important element of a healthy society, yet about 1/3 of the world's population doesn't have access to clean, safe drinking water. Drinking contaminated water is a major cause of disease and illness around the world.

Many people don't think about where their water comes from or where it goes. We trust the water that comes out of our pipes is safe and clean, and we don't think much about it after it goes down the drain.

In most homes, the water that goes down the sinks, showers, and toilets flows to the wastewater treatment plant, where it is treated before it is discharged into the Mississippi River. However, pollutants from yards and streets that flow into storm drains are not treated. They travel directly into our creeks, wetlands, lakes, and the Mississippi River and harm or even kill the plants and animals that live there.

Sources: Environmental Protection Agency (EPA); Stormwater SMART, Piedmont Triad Council of Governments; University of Minnesota, Department of Chemistry; Upper Mississippi River Basin Association; U.S. Geological Survey (USGS) Water Resources of the United States; Wilkes University Center for Environmental Quality, Environmental Engineering and Earth Sciences; Wisconsin Department of Natural Resources.

Unit 2 goal reminder

Explore the ecosystems of the Mississippi River and how humans affect them

Lesson goal

Understand we all use and reuse the same water

Lesson objectives

- Understand point and non-point pollution
- Examine the effects of detergents and fertilizers on aquatic life
- Test for dissolved oxygen in water samples
- Determine the relationship between pollutants and dissolved oxygen in water
- Collect and interpret data

Educational standards

- Physical Science
- Life Science
- Science in Personal and Social Perspectives

What you'll need

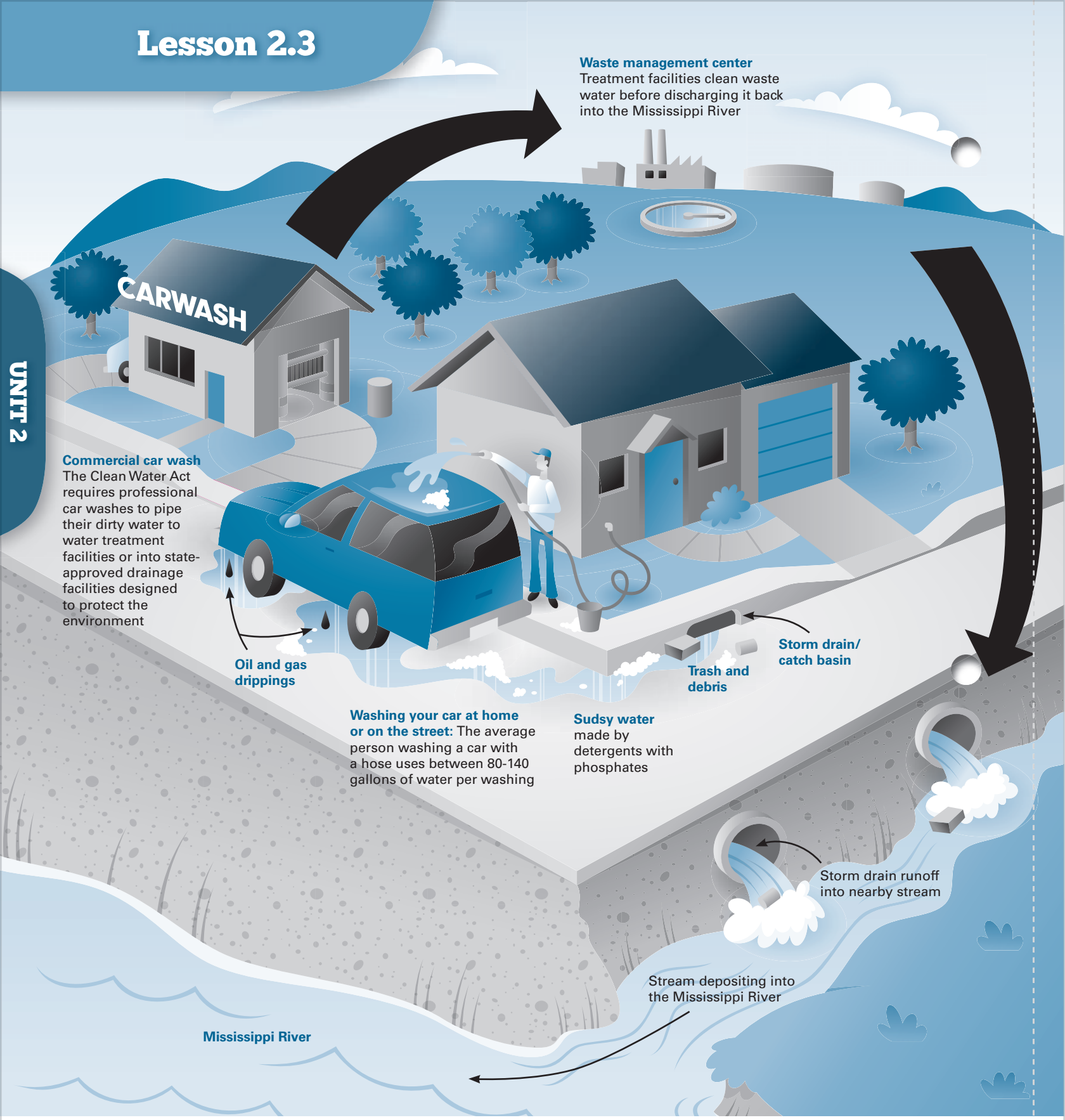
- Distilled water
- Mud or dirt
- Water plants and gravel
- Long-handled spoon or thin gardening trowel
- 3 half-gallon glass jars
- Masking tape/pens for labels
- Measuring spoons
- Fertilizer containing phosphates
- Dissolved oxygen test kit

How long it will take

- *Discussion:* 30 min.
- *Activity 1:* 15 min.
- *Activity 2:* 2 weeks

What's next?

Learn about the endangered species in your state and how you can help



Go Commercial

When it comes to washing your car, there's no home advantage. Taking it to a commercial car wash is an eco-friendly alternative. Washing your car at home wastes water and washes pollutants—including oil, gas, and phosphates from fertilizers and detergents—down the storm drain and directly into rivers and streams untreated.

Need to Know

- **Pollution**: The contamination of air, water, or soil by substances that are harmful to living organisms, usually caused by human activities. Pollution is divided into two main categories:
  - *Point source*: Pollution that can be traced back to a single origin or source, such as a sewage treatment plant discharge.
  - *Non-point source*: Pollution that cannot be traced back to a single origin or source, such as stormwater runoff, water runoff from urban areas, and failed septic systems.
- **Contaminants** enter the Mississippi River untreated from runoff and stormwater drains. Treated wastewater enters the river directly through discharge pipes from industry and wastewater treatment plants. Contaminants include:
  - *Pesticides and herbicides*: Substances, chemical or biological, used to prevent or destroy pests, such as unwanted rodents, insects, plants, and fungi.
  - *Petroleum*: A naturally occurring, flammable liquid consisting of a complex mixture of hydrocarbons and other organic compounds. Includes fuels (gasoline, diesel fuel, jet fuel) and lubricants (motor oil).
  - *Toxic metals*, such as mercury, lead, and arsenic.
  - *Nitrate*: A form of nitrogen, a plant nutrient used in fertilizer. Excess amounts can cause an overgrowth of bacteria and algae, which can deplete oxygen and kill fish.
  - *Phosphate*: A form of phosphorus, a plant nutrient used in fertilizers, detergents, matches, explosives, and pesticides. Like nitrogen, it can lead to an overgrowth of bacteria and algae, which can deplete oxygen and kill fish.
- The two most-common contaminants in the Mississippi River are **PCBs** and **mercury**. These chemicals often bioaccumulate in species as you move up the food chain from one trophic level to the next. See the definitions on page 80.
  - *PCBs* are human-made organic chemicals known as chlorinated hydrocarbons, used as a cooling agent for transformers, carbonless papers, cutting oils and hydraulic fluids. They were banned because of their toxicity in 1979. Very stable compounds, PCBs do not break down quickly or easily, which is why they are still a problem today.
  - *Mercury* is a naturally occurring element that is toxic at certain levels. Mercury was used in the making of paints, agricultural chemicals, and in mining and smelting. Today, mercury mainly enters the environment as air pollution from the burning of coal and falls from the air to accumulate in streams and oceans.

What can I do to SAVE water?

- Check faucets for leaks. Even a slow drip can waste 15 to 20 gallons every day.
- Take shorter showers and install a water-saving showerhead.
- Turn off the water while brushing your teeth.
- Use a shut-off nozzle to water your plants.
- Let the rain water your lawn
- Replace your old toilet to a low-flow model and save about 2 gallons per flush.

STANDARDS CORRELATION

The activities and discussions in this lesson focus on the content standards for life science (populations and ecosystems; diversity and adaptations of organisms) and physical science (properties) with an emphasis on inquiry and active learning. To make these activities and discussions relevant and personal, they are placed in the context of science in personal and social perspectives wherever possible.

Discussion (about 30 minutes)

In Unit 1 we learned about the water cycle, so we know that the amount of water on earth has always been the same. What does that tell us about the water we drink?

Fast Facts

- The Upper Mississippi River provides water to approximately 2.8 million people.
- More than 7 billion gallons of water are withdrawn from surface water sources each day.
- Approximately 278 facilities discharge wastewater into the Upper Mississippi River, including industrial facilities and municipal sewage treatment plants.
- Dumping 1 quart of motor oil down the storm drain can pollute 250,000 gallons of water.
- Water consumed washing cars:
  - At home: 80-140 gallons
  - At a professional car wash: 30-45 gallons

As water travels over or through the ground, it dissolves minerals and picks up substances left by people, pets, or wildlife. Untreated water can contain a variety of contaminants, including:

- Microscopic organisms from sewage or animals, such as bacteria
- Fuels (gasoline, diesel fuel, jet fuel) and lubricants (motor oil)
- Heavy metals, such as mercury and arsenic
- Industrial chemicals and detergents
- Fertilizers
- Pesticides

Where does water go after we use it? Usually one of two places: **storm drains** and **sewage systems**.

Storm drains collect water from outside our homes and businesses and carry it, untreated, directly to streams and rivers. Only rain should go into storm drains, not trash, oil, or other pollutants.

Sewers collect water from inside homes and businesses and carry it to treatment plants, where it is cleaned before it reaches streams and rivers.

Some communities have combined systems that collect wastewater and storm runoff together in one pipe. During heavy rainfall, this system can overflow, discharging untreated wastewater directly into streams and rivers.

> *"In every glass of water we drink, some of the water has already passed through fishes, trees, bacteria, worms in the soil, and many other organisms, including people... Living systems cleanse water and make it fit."*
>
> – Elliot A. Norse, Conservation Biologist, 1985

Virtual Car Wash

Grades

5–6

Class or small group activity

15 MINUTES

What you'll need

- Activity worksheet (pages 108–109)

Washing your car at home wastes water and washes pollutants in rivers and streams untreated. Most people keep their hoses running while they wash their cars. By the time they are through they can see the water draining down the driveway and into the street. The average person washing a car uses between 80-140 gallons of water per washing.

Do This

1. Ask students, where does used water go when you wash a car in your driveway? Have students use the graphic to trace its path on the activity worksheet.
2. What does it carry with it? Think about what may be on the car, on the driveway, in the street.
3. Instead of letting the water run, use a bucket and a hose with a shut-off nozzle and wash your car on the grass so the soapy water soaks into the ground. Better yet, take the car to the local car wash. At all car washes, the water will be treated before it is returned to the river.

Check out your local car wash!

- Ask them how they dispose of their used water. Does it go to a treatment facility? Do they treat it on site and reuse it?
- How many cars do they wash in one week? How much water do they use per car? Figure out the total gallons of water they use in one week.

Answer Key

1. The water goes down into the driveway into the storm drain, which empties into the Mississippi River untreated directly or through a tributary.
2. Soapy water plus grease and grime on a car contains asphalt from the roads, asbestos from the brakes, oil and gasoline that has dripped from the car, rubber particles from the tires, toxic metals, and rust.
3. Instead of letting the water run, use a bucket and a hose with a shut-off nozzle and wash your car on the grass so the soapy water soaks into the ground. Better yet, take the car to the local car wash. At all car washes, the water will be treated before it is returned to the river.

Virtual Car Wash

Name _____ Date _____

Do This

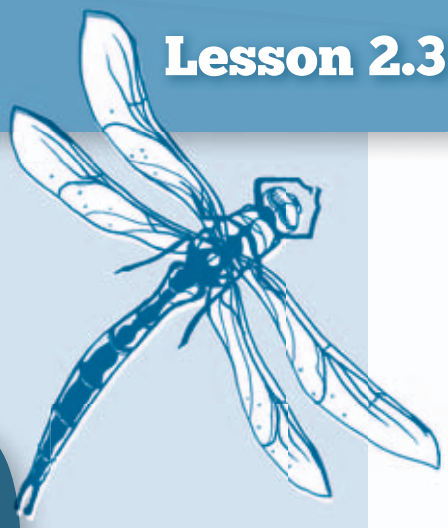
- Plan a virtual car wash. Write down what you need.
- Follow the water. Mark the path of the water used to wash your car on the drawing.

Answer the following questions

1. Where does used water go when you wash a car in your driveway?

2. What does it carry with it? Think about what may be on the car, on the driveway, in the street.

3. What can you do to protect the environment AND have a clean car?



UNIT 2

Phosphates in Your Water

Grades
5–6

Class or small group activity

2 WEEKS

What you'll need

- Water, plants (including roots), and mud from a pond
- Long-handled spoon or thin gardening trowel
- 3 half-gallon, glass canning jars
- Masking tape/pens for labels
- Measuring spoons
- Fertilizer containing phosphates
- Dissolved oxygen test kit (available at aquarium supply stores)
- Activity worksheet (pages 112-113)

Runoff from fertilizers and detergents containing phosphates can have adverse effects on waterways and aquatic life. They cause excess nutrient levels that can lead to an overgrowth of bacteria and algae, which can deplete oxygen and kill fish.

Do this

1. Collect water, plants (including roots), and mud from a pond. Be sure to get permission from property owner before collecting pond water or other items.
2. Plant equal amounts of water plants in three half-gallon, wide-mouth canning jars. Use a long-handled spoon to make sure the roots of the plants are securely in the mud mixture.
3. Slowly pour pond water into the jar. Try not to stir up the mud too much.
4. Label jars 1 through 3.
5. Place the appropriate amount of fertilizer in each jar using the amounts listed in the chart.
6. Measure the amount of dissolved oxygen in each jar according to the kit directions and record it on the activity sheet.
7. Put all the jars in a sunny location.
8. Observe daily for 2 weeks and record your observations.
9. On day 7 and day 14, measure the amount of dissolved oxygen in each jar again and record it on the activity sheet.
10. Record, analyze, and discuss your observations.

Analysis

At the end of the experiment, which jar had the most vigorously growing plants? Answer is Jar 3: 1 tsp fertilizer
Which one had the least dissolved oxygen? Answer should be Jar 3: 1 tsp fertilizer

Conclusions

What would happen in a stream that has an excess of phosphates, warm temperatures, and good sunlight? Answer: Phosphates stimulate the overgrowth of plants. As the plants die, decomposers grow rapidly and consume oxygen. This lowers the oxygen level, suffocating fish and other organisms that require oxygen.

Progress Samples

	Jar 1: Control (no fertilizer)	Jar 2: 1/2 tsp fertilizer	Jar 3: 1 tsp fertilizer
Day 1			
Dissolved oxygen	Varies	Varies	Varies
Day 7			
Dissolved oxygen	Varies	Varies	Varies
Day 14			
Dissolved oxygen	Varies	Varies	Varies

Teacher Tip

Dissolved oxygen (DO) levels vary with water temperature and altitude. Cold water holds more oxygen than warm water, and water holds less oxygen at higher altitudes. DO levels also fluctuate seasonally and over a 24-hour period. DO should average between 5.0 and 7.0 ppm. PPM (parts per million) is equal to milligrams of DO per liter of water.

Phosphates in Your Water

Name _____ Date _____

During the next two weeks, you will observe and record what happens to 3 jars of pond water when you add different amounts of detergent containing phosphates.

Materials

- Water, plants (including roots), and mud from a pond
- Long-handled spoon or thin gardening trowel
- 3 half-gallon, glass canning jars
- Masking tape/pens for labels
- Measuring spoons
- Fertilizer containing phosphates
- Dissolved oxygen test kit (available at aquarium supply stores)

Do This

1. Collect water, plants (including roots), and mud from a pond. Be sure to get permission from the property owner before collecting pond water or other items.
2. Plant equal amounts of water plants in three half-gallon, wide-mouth canning jars. Use a long-handled spoon to make sure the roots of the plants are securely in the mud mixture.
3. Slowly pour pond water into the jar. Try not to stir up the mud too much.
4. Label jars 1 through 3.
5. Place the appropriate amount of fertilizer in each jar using the amounts listed in the chart.
6. Measure the amount of dissolved oxygen in each jar according to the kit directions and record it on the activity sheet.
7. Put all the jars in a sunny location.
8. Observe daily for 2 weeks and record your observations.
9. On day 7 and day 14, measure the amount of dissolved oxygen in each jar again and record it on the activity sheet.
10. Record, analyze, and discuss your observations.

	Jar 1: Control (no fertilizer)	Jar 2: 1/2 tsp fertilizer	Jar 3: 1 tsp fertilizer
Day 1			
Dissolved oxygen	_____	_____	_____
Day 7			
Dissolved oxygen	_____	_____	_____
Day 14			
Dissolved oxygen	_____	_____	_____

Analysis

At the end of the experiment, which jar had the most vigorously growing plants?

_____

Which one had the least dissolved oxygen?

_____

Conclusion

What would happen in a stream that has an excess of phosphates, warm temperatures, and good sunlight? _____

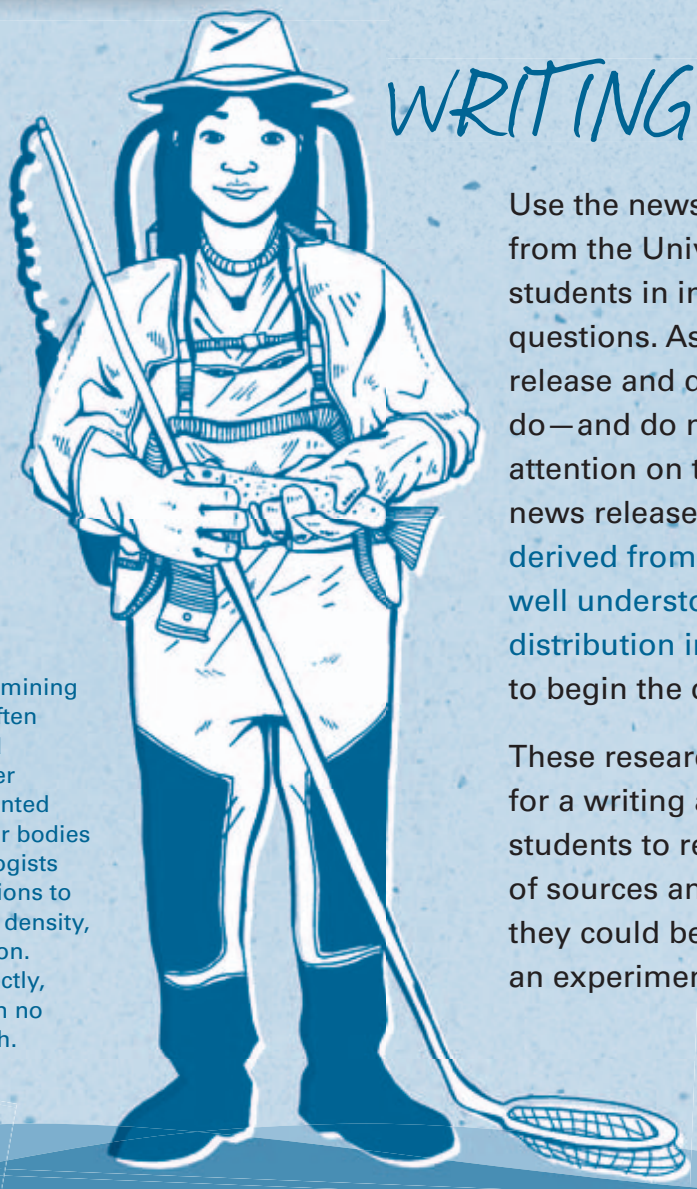
_____

_____

WRITING EXTENSION

Grades 9–12

Individual activity

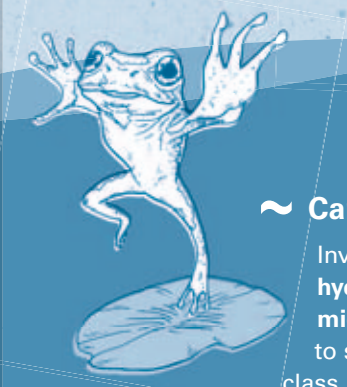


To stun fish before examining them, fish biologists often use backpack-mounted electrofishers in smaller streams and boat-mounted electrofishers in deeper bodies of water. It allows biologists to sample fish populations to determine abundance, density, and species composition. When performed correctly, electrofishing results in no permanent harm to fish.

Use the news release (on the next page) from the University of Minnesota to engage students in inquiry by developing research questions. Ask students to read the news release and discuss what the findings do—and do not—tell us. Focus students' attention on the final paragraph in the news release, "The toxicity of the dioxins derived from triclosan currently is not well understood, nor is the extent of their distribution in the environment at large," to begin the discussions.

These research questions can then be used for a writing assignment that requires students to research and access a variety of sources and communicate findings, or they could be used to design and conduct an experiment.

Extension Suggestions



~ Career launch

Invite a local **hydrologist** or **microbiologist** to speak to the class. Ask students to research the field and prepare questions in advance. See *A1: Career Launch* on page 312 for career information and professional associations.

~ Get out!

- Volunteer to monitor water quality in your state's lakes and rivers. Contact your state Department of Natural Resources for information.
- Visit the National Great Rivers Research and Education Center in Alton, Illinois, to learn more about the health of the Mississippi River. The Center's scholars and scientists study the ecology of the river and its tributaries, the watersheds that feed them, and the river communities that use them. Visit online at **www.ngrrec.org**

~ Stencil stormdrains

Stencil stormdrains to remind people not to pollute our watershed. Go to the Friends of the Mississippi River website, **www.fmr.org**, and search keyword: **stenciling**.

~ World Water Monitoring Day

Celebrate World Water Monitoring Day on September 18. Join in the effort to monitor water quality between March and December each year. Learn more at **www.worldwatermonitoringday.org.**

Well River Checkup

Assessing the Health of the River

Name _____ Date_____

Read, analyze, and hypothesize

1. Read the news release below from the University of Minnesota.
2. Think about what else you would want to know about the issue.
3. Develop three research questions that you could use to write a research paper or design an experiment.

Read Below

University of Minnesota News Release

University of Minnesota study finds rising levels of dioxins from common soap ingredient in Mississippi River sediments

Dioxins in general decreasing, but those derived from triclosan increasing

MINNEAPOLIS / ST. PAUL (05/18/2010) Specific dioxins derived from the antibacterial agent triclosan, used in many hand soaps, deodorants, dishwashing liquids, and other consumer products, account for an increasing proportion of total dioxins in Mississippi River sediments, according to University of Minnesota research. The study appears online in the May 18 issue of the journal *Environmental Science and Technology*.

The researchers, from the university's Institute of Technology (soon to be College of Science and Engineering), found that over the last 30 years, the levels of the four dioxins derived from triclosan have risen by 200 to 300 percent, while levels of all the other dioxins have dropped by 73 to 90 percent.

In April, the Food and Drug Administration announced it would study the safety of triclosan, which has been linked to disruptions of hormonal function and may also play a role in the evolution of bacterial resistance to antibiotics. In papers published in 2003 and 2009, university civil engineering professor William Arnold and his colleague Kristopher McNeill, a former professor in the university's Department of Chemistry, discovered that triclosan, when exposed to sunlight, generated a specific suite of four dioxins.

In the current study spearheaded by Jeff Buth, a recent Ph.D. graduate in chemistry (supervised by Arnold and McNeill), the researchers examined sediment core samples from Lake Pepin, an enlargement of the Mississippi River 120 miles downstream from the Minneapolis-St. Paul metro area. The sediment cores, containing a record of pollutant accumulation in the lake for the past 50 years, were analyzed for triclosan, the four dioxins derived from triclosan, and the entire family of dioxin chemicals. The study was a collaborative effort between researchers at the University of Minnesota, Pace Analytical (Minneapolis), the Science Museum of Minnesota, and Virginia Tech.

"These four dioxins only come from triclosan. They didn't exist in Lake Pepin before triclosan was introduced," Arnold said. "In the most current sediments, these triclosan-derived dioxins account for about 30 percent of the total dioxin mass."

Triclosan was first added to commercial liquid hand soap in 1987, and by 2001 about 76 percent of commercial liquid hand soaps contained it, researchers say. About 96 percent of triclosan from consumer products is disposed of in residential drains, leading to large loads of the chemical in water entering wastewater treatment plants.

Triclosan is incompletely removed during the wastewater treatment process, and when treated wastewater is released to the environment, sunlight converts some of the triclosan (and related compounds) into dioxins. Triclosan and the dioxins ended up in Lake Pepin sediments by sticking to organic particles in the river, which then sank when they reached the calmer waters of the lake.

The toxicity of the dioxins derived from triclosan currently is not well understood, nor is the extent of their distribution in the environment at large, Arnold says.

End of article

Research Questions

1. _____

2. _____

3. _____

Life on the Brink:

Endangered Species of the Upper Mississippi River

Karner Blue Butterfly
(Lycaeides melissa samuelis)

Introduction

Lesson 2.4 Life on the Brink: Endangered Species of the Upper Mississippi River builds on the knowledge and skills learned in lessons 2.1 and 2.2 to learn and share about local endangered species and create habitat for wildlife in the schoolyard.

Background

In the history of life on earth there have been at least five mass extinctions, each caused by natural disasters and processes. Using mathematical modeling, scientists estimate that of all the species that have lived on the Earth since life first appeared here three billion years ago, only about one in a thousand species is still living today. That means 99.9% of all species that have ever lived are now extinct.

Extinction is a natural process. It is a normal part of evolution. But the current extinction rate is anything but natural. We are now at the beginning of a new sixth extinction. It is unlike anything since the end of the dinosaurs. But this time the cause is different. It is the result of the spread of just one species—us.

Gray Wolf
(Canis lupus)

UNIT 2

Unit 2 goal reminder

Explore the ecosystems of the Mississippi River and how humans affect them

Lesson goal

Learn how we can help endangered species that depend on the Upper Mississippi River

Lesson objectives

- Define terms related to ecosystems of the Mississippi River
- Identify endangered species in your local area
- Design and plant a school wildlife garden

Educational standards

- Physical Science
- Life Science
- Geography
- Science in Personal and Social Perspectives

What you'll need

- Nature magazines
- Access to the Internet
- Shovels
- Hoes
- Rakes
- Plants
- Plant seeds
- Water containers or hose

How long it will take

- *Discussion:* 30 min.
- *Activity 1:* 15 min.
- *Activity 2:* 3-4 days

What's next?

Learn how we can make a difference in our environment

Fast Facts

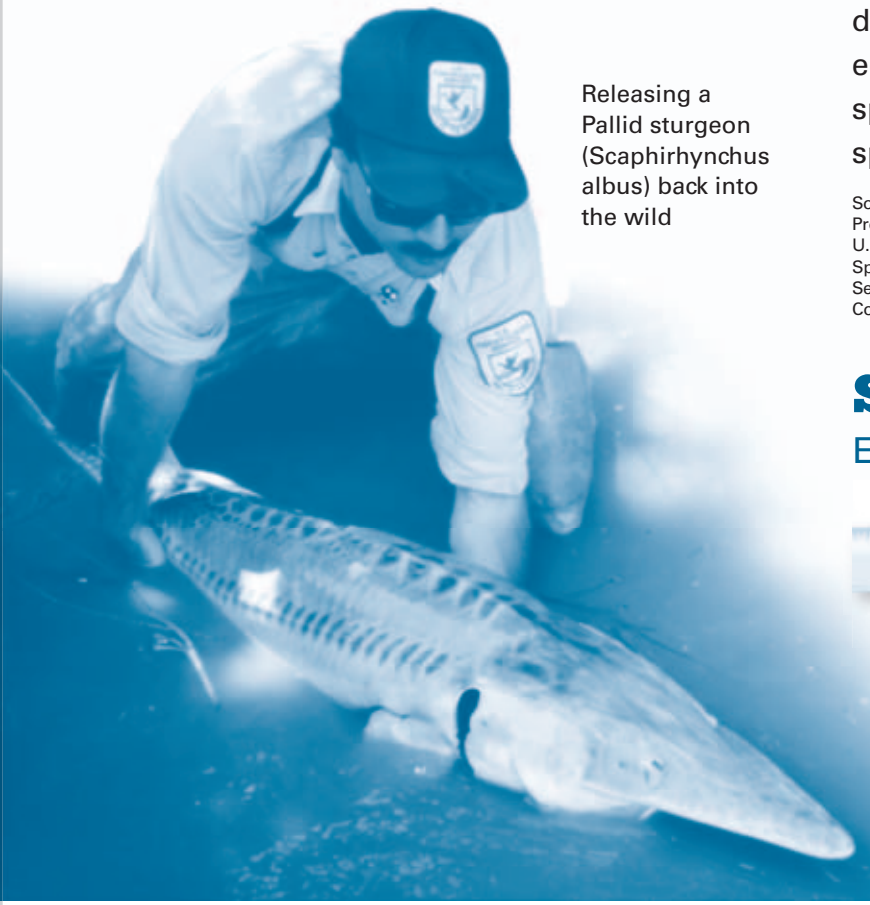
The United States has more ecosystems and habitat types than any other nation. They support species of plants and animals found nowhere else on earth.

The Upper Mississippi River Basin provides critically important habitat for 286 state-listed, 36 federal-listed, or candidate species of rare, threatened, or endangered plants and animals.

Number of endangered species that depend on the Upper Mississippi River by state:

- Illinois: 24 listings
- Iowa: 12 listings
- Minnesota: 12 listings
- Missouri: 27 listings
- Wisconsin: 15 listings

More than 500 species in North America have disappeared in less than 400 years. Scientists estimate that the natural extinction rate is approximately one species lost in every 100 years. As much as 20 percent of all living populations could become extinct by 2028.



Releasing a Pallid sturgeon (Scaphirhynchus albus) back into the wild

Why are more species going extinct today?

More species are going extinct today because we are altering the air, water, and land faster than species can adapt. Most species have the ability to adapt to a changing environment. But if the changes become too severe in their ecosystem, they cannot survive.

Endangered Species Act

In 1973, the U.S. Congress passed the Endangered Species Act. Its purpose is to conserve and protect threatened and endangered species and the ecosystems they depend on to survive. Because species are linked and dependent upon each other within their ecosystems, the loss of just one plant species can cause up to 30 other species to disappear with it.

Sources: Environmental Protection Agency (EPA) Endangered Species Protection Program; National Wildlife Federation; National Park Service; U.S. Army Corps of Engineers' Threatened, Endangered, and Sensitive Species Protection and Management System; U.S. Fish & Wildlife Service Endangered Species Program; U.S. Geological Survey; Wildlife Conservation Society; World Wildlife Fund.

So what's the good news?

Endangered means there is still time.

STANDARDS CORRELATION

The activities and discussions in this lesson focus on the content standards for life science (populations and ecosystems; diversity and adaptations of organisms). To make these activities and discussions relevant and personal, they are placed in the context of science in personal and social perspectives wherever possible.

Discussion (about 30 minutes)

Review the vocabulary from the previous lessons in this unit and introduce the words endangered and extinct. Ask students about animals that have become extinct (passenger pigeon) or nearly became extinct (bald eagle, peregrine falcon, bison, wolf, grizzly bear) in North America. Explain that biologists estimate that more than 500 species, subspecies, and varieties of North American plants and animals have become extinct since the Pilgrims landed at Plymouth Rock in 1620.

Review terms and concepts about ecosystems and habitats and ask students to think about what might cause extinction. Discuss why species become endangered and the impact of human behavior. Introduce the major threats to species using this acronym **HIPPO** as a memory aid:

- **H**abitat loss
- **I**ntroduced species
- **P**ollution
- **P**opulation growth (of humans)
- **O**ver-consumption

Habitat loss

The most common reason for extinction is habitat loss. An animal's habitat features all the necessities of life including access to food, water, shelter, and space. When people cut down forests, dig mines, build cities, or make roads, they destroy habitats. There is no place left for plants, fish, and wildlife.

Invasive species

Invasive species are the second-biggest threat to endangered species. An animal introduced to a new area competes with native species for resources. In some cases, an introduced species is more successful, and they outcompete or displace native species. Introduced species prey on them, eat their food, infect them, or otherwise disrupt them.

Pollution

Pollution affects animals both directly and indirectly. For example, acid rain destroys forests, oil spills kill coastal plants and animals, poisons wash into waterways, and plastic trash entangles wildlife. Oil spills kill seabirds, marine, and coastal life. Between 1993 and 2002, nearly 650,000 tons of oil spilled into the sea in 470 separate accidents. In 2010, one of the largest oil spills occurred in the Gulf of Mexico.

Human population

The second "P" represents the number of people on our planet. Currently, our planet houses over six billion people who compete for resources such as food, water, medicine, clothes, shelter, and fuel, which affects how much the animals have. With more than six billion people on the planet, we are crowding the earth and driving other species out.

Over-consumption

"O" stands for over-consumption. Many industrialized nations consume resources at a rate faster than the resources can be reproduced.

Brainstorm ways students can help prevent plants and animals from going extinct. The best thing that anyone can do to combat these threats is to educate themselves. Learn about the issues and decide how you can make a difference.

Lesson 2.4

"The most effective way to SAVE endangered species is to protect the places they need to live." – Lois Capps

Asian Carp

Several species of Asian carp were introduced to U.S. fish farms in the 1970s to help control algae. Some escaped into the Mississippi River in the 1970s and soon began displacing native fish. Efforts are underway to prevent the Asian carp from entering the Great Lakes, which are connected to the Mississippi River through the Illinois Waterway. These efforts include electric barriers and netting.

Faced with dwindling supplies of more popular fish, some fishermen are starting to sell Asian carp to fish markets. Popular in Asian American communities, many expect demand for this fish to grow, especially if its name is changed to something that sounds tastier, such as Rock Island sole.

Need to Know

- **Conservation**: The wise use of natural resources in order to ensure continued availability to future generations.
- **Non-renewable resources**: Non-living resources that do not regenerate themselves.
- **Niche**: The role played by an organism in a biological community.
- **Adaptation**: Biological characteristic that improves the chance of survival of an animal and its descendants.
- **Carrying capacity**: The maximum number of healthy individuals within a species that a habitat can sustain.
- **Extinct**: A plant or animal species that is no longer living on earth. Although extinction is a natural part of evolution, the rate at which species are becoming extinct is estimated at 1,000 times the average extinction rates in the evolutionary time scale.
- **Endangered**: A plant or animal species that is in immediate danger of becoming extinct and needs protection to survive.
- **Threatened**: An organism whose population is declining in numbers, but has not yet become endangered. A plant or animal species that is likely to become endangered if it is not protected.
- Most of the environmental changes that threaten endangered species are caused by human actions. Some scientists believe that if these changes continue at current rates, one-half of all species of life on earth will be extinct in 100 years. Threats to endangered species include:
  - *Habitat loss*: The depletion of natural environments due to human activity or natural disasters.
  - *Introduced or exotic species*: An organism that is not native to that area.
  - *Pollution*: Any substance that destroys the purity of land, air, or water.
  - *Human population*: As of May 2010, the population of humans was about 6.8 billion. The last 100 years have seen a rapid increase in human population due to medical advances and increases in agricultural productivity due to technological advances.
  - *Over-consumption*: The excessive use of an animal by humans that results in a decline in the wild population of that species.

Who is Endangered?

Grades

5–6

Class or small group activity

15 MINUTES

This activity asks students to select an endangered animal, identify its physical and behavioral characteristics, research major threats facing it, and discuss ways of improving its chances for survival.

Do This

1. Introduce the lesson by selecting an endangered animal to discuss as a class.
   - Identify its physical and behavioral characteristics.
   - Describe its role or purpose and its adaptations.
   - Discuss the factors that may have contributed to causing this animal to be designated as "endangered."

2. Allow the students to work individually or in groups to:
   - Research endangered species in your region and select an animal to teach the class about.
   - Identify its habitat and characteristics.
   - Discuss what factors have caused it to become endangered.

3. Ask students to focus on the following questions during their research:
   - A general description of your animal.
   - Is your animal extinct, highly endangered, endangered, or threatened? If so, why?
   - What type of environment does your animal need to survive?
   - What impact have humans had on your animal?
   - What measures are being taken to help the survival of your animal?
   - Find pictures of local endangered species.

4. Present findings to the class.
   - Put a picture of the species in an appropriate location on the laminated wall map (there may be several).
   - Explain why these species are endangered and what students might do to help.

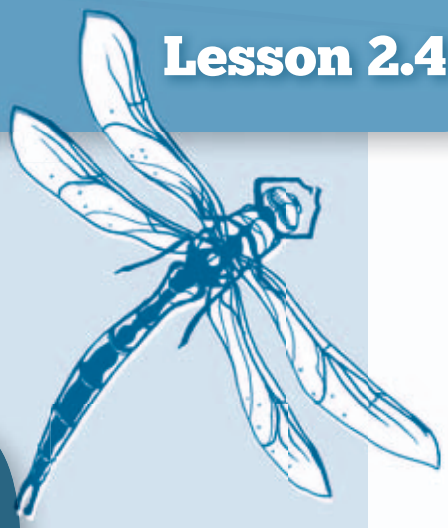
What you'll need

- Nature magazine for pictures
- Access to the Internet for pictures

Teacher Tip

See A5: Endangered Species by State on page 320. If students have not come up with these species on their own, assign species to individual students or groups.

- *Copperbelly water snake*
- *Interior least tern*
- *Map turtle*
- *Pallid sturgeon*
- *Peregrine falcon*
- *Piping plover*
- *Red-cockaded woodpeckers*
- *Whooping crane*



UNIT 2

Create a Wildlife Garden

Grades
5–6

Class or small group activity

3–4 DAYS

Total to plan and plant the garden. *30 minutes to prep students prior to visitor arrival. 1 day teacher pre-reading. 1-2 days for students to research how and what to plant in the garden.*

What you'll need

- Shovels
- Hoes
- Rakes
- Plants
- Plant seeds
- Water containers or hose

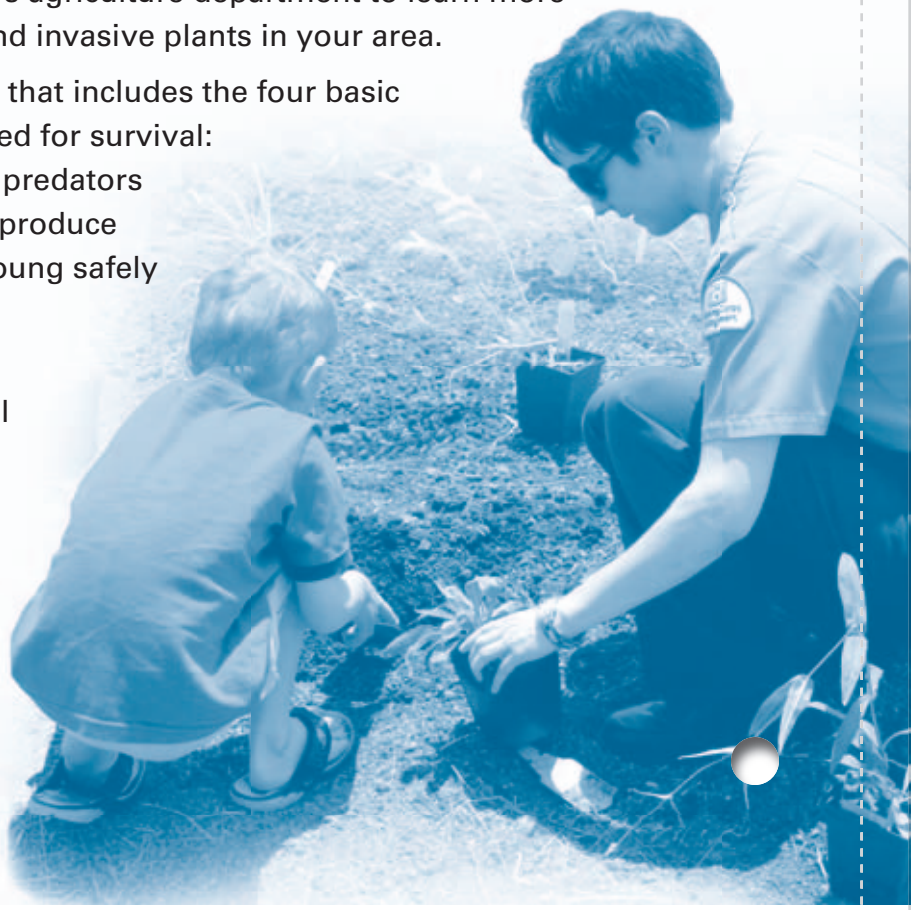
Teacher Tip

Research and develop habitat for a specific species in your area.

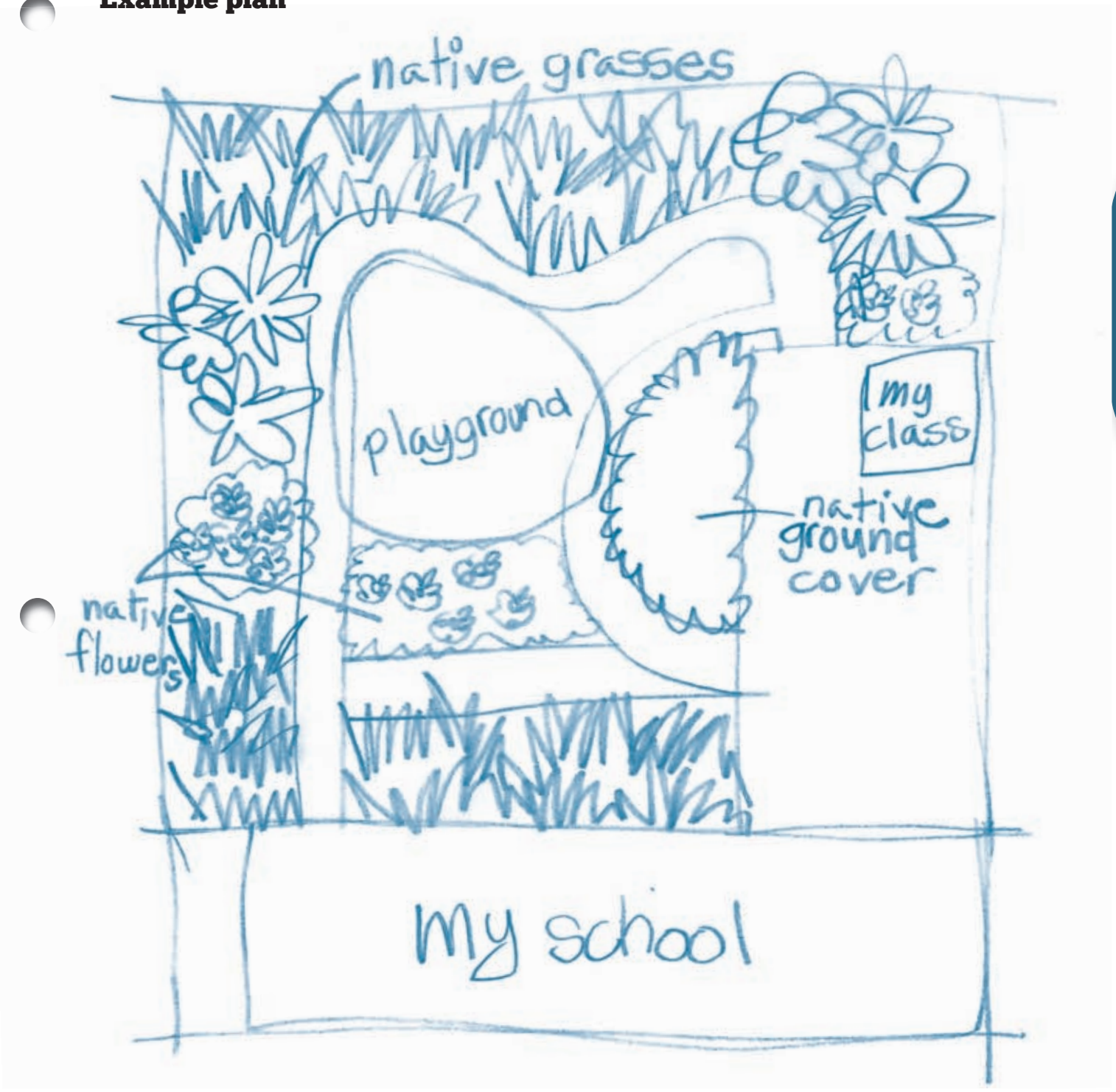
According to the National Wildlife Federation, setting aside just one tenth of an acre to create a schoolyard or backyard wildlife habitat would make a measurable impact on America's and the world's ecology. It could provide habitat for migratory birds, native plant species, butterflies, reptiles, amphibians, and beneficial insects.

Do This

1. Research the habitat needs of resident and migratory species in your area.
2. Identify habitat elements that already exist.
3. Identify native plants. You do not want to introduce invasive non-native plants into our schoolyard ecosystem. Check with your state's agriculture department to learn more about native and invasive plants in your area.
4. Develop a plan that includes the four basic elements needed for survival:
   - Cover from predators
   - Places to reproduce and raise young safely
   - Water
   - Food
5. Create the ideal wildlife habitat for your area!



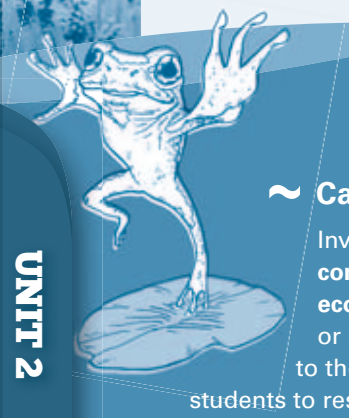
Example plan



"It's the little things that make the big things possible. Only close attention to the fine details of any operation makes the operation first class."

– J. Willard Marriott, founder of the Marriott Corporation

Extension Suggestions



Career launch

Invite a local **conservationist**, **ecologist, biologist,** or **botanist** to speak to the class. Ask students to research the field and prepare questions in advance. See *A1: Career Launch* on page 312 for career information and professional associations.

Express yourself!

Next time you are outside, take a journal with you. Write down what you see, hear, smell, and touch. Illustrate your journal with drawings of what you observe.

Volunteer

Help with a conservation project at a local nature center, park, or wildlife refuge.

Get out!

Help restore and protect habitat in your own backyard and in your community:

- Build homes for birds.
- Plant native trees, shrubs, and flowers to attract wildlife, birds, and butterflies.
- Join a local clean-up effort to make these areas better places to live.
- Participate in community projects to plant riverbanks with native plants to protect soil and provide habitat.

Investigate

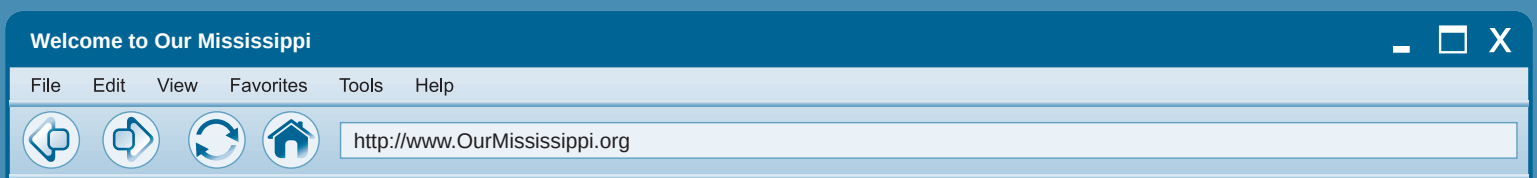
Research some of the invasive species threatening the Mississippi River, such as the Asian carp and zebra mussels, and teach others what they can do to help prevent their spread.

Adopt an endangered species

Adopt an endangered species native to your area by learning all you can about it and sharing that information with your family, friends, and classmates.

Create habitat for wildlife

Create habitat for wildlife in your schoolyard through the U.S. Fish & Wildlife Service's *Schoolyard Habitat Program*. Go to **www.fws.gov** and search keywords **schoolyard habitat**. You can also have your schoolyard habitat certified by the National Wildlife Federation. Learn more at **www.nwf.org.** Search keywords: **schoolyard habitat**



Learn more online

Join the National Wildlife Federation's Schoolyard Habitat program on the National Wildlife Federation website (www.nwf.org) and have your school's wildlife garden certified.

Play an online game. Build a wild version of yourself on the Wildlife Conservation Society website (www.buildyourwildself.com)

Learn about endangered and threatened species from the U.S. Fish & Wildlife Service website's Endangered Species Program (www.fws.gov) Search keywords: **Endangered Species Program**

Learn about wildlife from the Wildlife Conservation Society website (www.wcs.org), and the World Wildlife Fund website (www.worldwildlife.org)

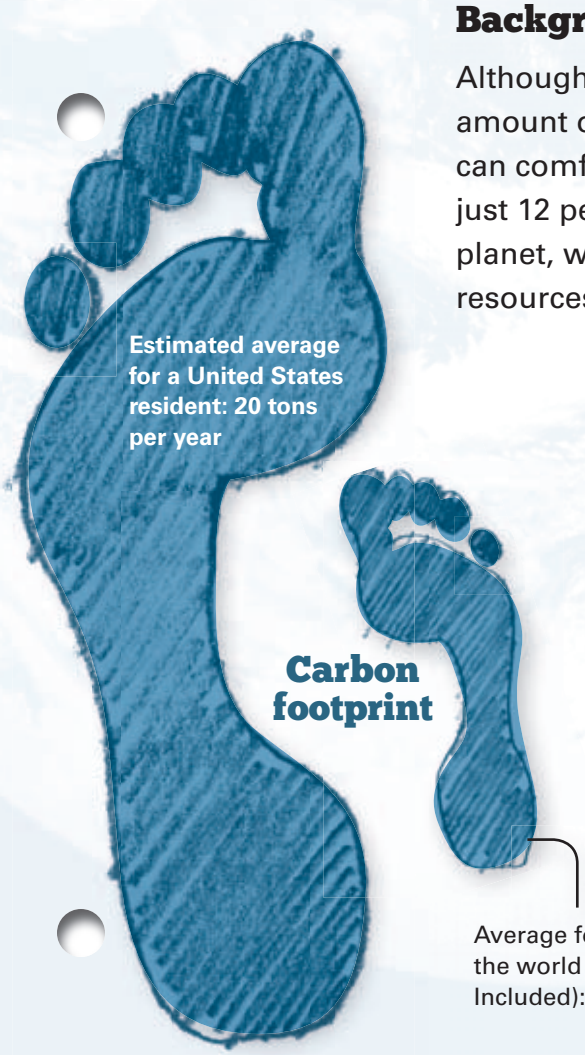
Identify invasive and non-native plants with the help of the U.S. Fish & Wildlife Service and help remove them from your area. Go to www.fws.gov/midwest Search keyword: **invasive plants**

Mississippi River Sustainability

How to Make a Positive Impact on Your Environment

Introduction

Lesson 2.5 Mississippi River Sustainability: How to Make a Positive Impact on Your Environment focuses on actions students can take to conserve resources and live sustainably. They calculate their eco-footprint and read and discuss the inspiring story of how one person made a difference.



Background

Although the earth seems large, the amount of land surface where humans can comfortably live is relatively small—just 12 percent. To protect our home planet, we must learn how to conserve resources and live sustainable lifestyles.

The term "carbon footprint" has become a buzzword, but it is a complex and inexact measurement. Yet it is an apt metaphor for our impact on the planet. By exploring the concept of a carbon or eco-footprint, students learn that simple lifestyle choices have a meaningful impact on the planet.

Unit 2 goal reminder

Explore the ecosystems of the Mississippi River and how humans affect them

Lesson goal

Learn how we can make a positive impact on our environment

Lesson objectives

- Define terms related to ecosystems of the Mississippi River
- Discuss the effect humans have on the environment
- Identify conservation ideas for school and home

Educational standards

- Physical Science
- Life Science
- Science in Personal and Social Perspectives

What you'll need

- Chad Pregracke activity worksheet
- Videotape of the Discovery Channel's *River Warriors*
- Television with a VCR or video player
- Access to the Internet

How long it will take

- *Discussion:* 1 hr.
- *Activity 1:* 1 hr.
- *Activity 2:* 1 class period

What's next?

Learn about history and culture along the Mississippi River

UNIT 2

In essence, an eco-footprint is the negative impact that something has on the environment. Carbon footprint usually refers specifically to the amount of carbon emitted by something during a given period. It relates to the amount of greenhouse gases produced in our day-to-day lives through burning fossil fuels for electricity, heating, and transportation.

Our eco-footprint refers not only to our energy consumption, but to all the lifestyle choices we make that impact the earth, including what we buy, how we live, and what we throw away.

Discussion (about 1 hour)

Energy consumption

Introduce key terms and concepts by asking students if they engage in the following activities:

- Ride in a car
- Turn on a light
- Watch television
- Play a video game
- Microwave a meal
- Listen to a stereo
- Use the air conditioner
- Use a hair dryer
- Wash or dry clothes
- Use a dishwasher

Explain to students that many of our other daily habits and behaviors depend on energy, most of which cause pollution.

Need to Know

- **Eco-footprint**: The negative ecological impact that something has on the environment. Also called ecological footprint.
- **Carbon footprint**: The amount of carbon emitted by something during a given period. It relates to the amount of greenhouse gases produced when fossil fuels are burned.
- **Greenhouse gases**: Gases that trap heat in the atmosphere, much like a greenhouse. Greenhouse gases include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), halogenated fluorocarbons (HCFCs), ozone (O_3), and hydrofluorocarbons (HFCs).
- **Global warming**: An average increase in the Earth's temperature, which causes changes in climate.
- **Climate change**: Often used synonymously with the term global warming, it refers to the long-term changes in the climate of a region. A warmer earth may lead to changes in rainfall patterns, a rise in sea level, and a wide range of impacts on plants, wildlife, and humans.
- **Sustainable**: If something is sustainable it can be kept going. Sustainable fishing means fishing in a way that does not reduce the number of fish and endanger them.
- **Biodegradable**: Something that can be broken down naturally and then becomes part of the soil, water, or air.

Because the use of energy is a part of our everyday lives, nearly every daily habit has a carbon cost. Discuss how these activities use sources of energy that is created by burning carbon-based fossil fuels, which release large amounts of greenhouse gases such as carbon dioxide.

The good news is there are many ways that students can reduce their eco-footprint. Ask students to brainstorm ways they can conserve energy at school and at home. Possible answers might include:

- Turn off lights when you leave a room
- Walk or bike instead of riding in a car
- Use less heating or air conditioning
- Buy locally grown food
- Buy products with less packaging

Explain to students that many of their answers are examples of conservation. Conservation is the quickest, most immediate way to save energy or other resources.

Conserving resources

Discuss the three R's of recycling: reduce, reuse, and recycle. Explain that recycling is not a new idea. In the 18th century, people called "rag-pickers" scavenged for bits of cloth to sell for use in paper production. They received money for their bundles of recycled cloth much like we do for recycling cans and bottles today. During the 1940s, recycling scrap metal and paper were part of the war effort.

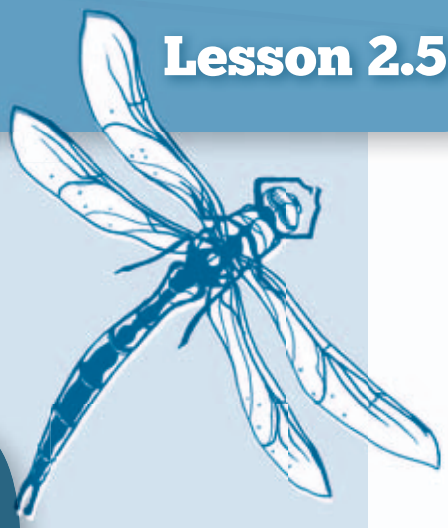
At the end of the discussion on recycling, add a 4th R—rethink. Challenge students to reconsider some of their energy consumption and buying habits.

Reducing waste

Ask students what happens when something can no longer be reused or recycled. What happens to all that garbage? It becomes part of the waste stream.

STANDARDS CORRELATION

The activities and discussions in this lesson apply the life science and physical science knowledge learned in the other lessons in this unit to explore ecosystem sustainability from personal and social perspectives.



Read and Comprehend

UNIT 2

Grades

5–6

Class or small group activity

1 HOUR

Plus essay homework

What you'll need

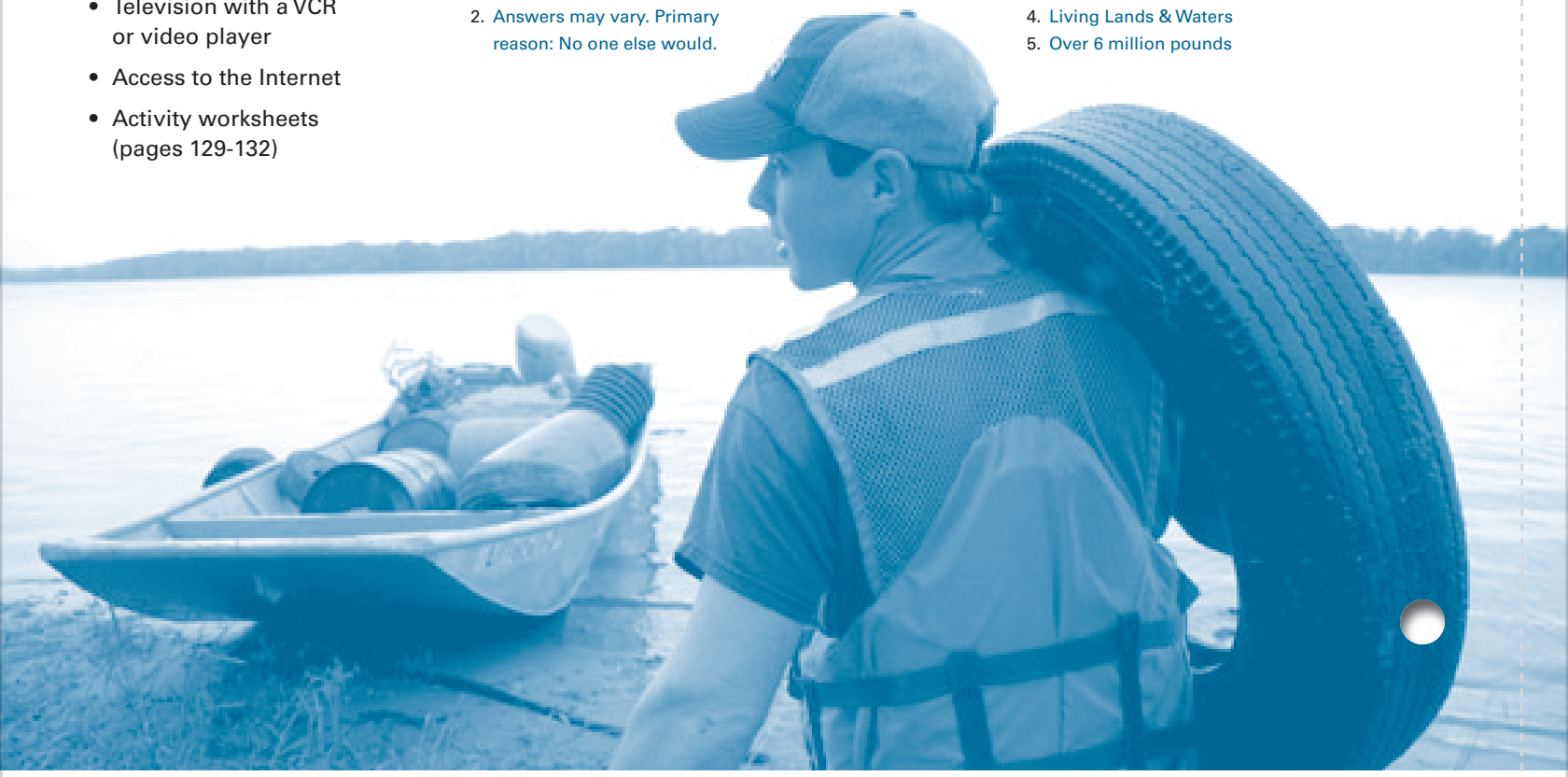
- Videotape of the Discovery Channel's *River Warriors*
- Television with a VCR or video player
- Access to the Internet
- Activity worksheets (pages 129-132)

Do This

1. Ask students to read Chad Pregracke's biography and write the answers to the questions on the student activity worksheet to test their reading comprehension.
2. Show the class the Discovery Channel Documentary, *River Warriors*, about Chad and his non-profit organization Living Lands and Waters.
3. Ask students to research Chad online and write an essay about his vision and accomplishments.

Answer Key

1. 15 miles from the Mississippi River outside of Hampton, Illinois.
2. Answers may vary. Primary reason: No one else would.
3. Commercial fisherman, shell diver, and barge hand
4. Living Lands & Waters
5. Over 6 million pounds



Read and Comprehend

Chad Pregracke: Mississippi River Hero

Name _____ Date _____

Today Chad Pregracke is a River Warrior. He is known all around the country for organizing massive river cleanups, filling large barges with garbage pulled from the Mississippi River. His hard work, charismatic leadership, and vision of a clean river have earned him many awards and honors over the years, including the prestigious National Jefferson Award for Public Service. His efforts have been written about in *Time*, *People*, and *National Geographic* magazines and shown on television on *CNN* and the *Discovery Channel*.

However, not that long ago he was a student just like you. Chad grew up just 15 miles from the Mississippi River outside of Hampton, Illinois. He and his older brother spent much of their time on, in, and around the Mississippi and Illinois Rivers. During summer breaks from high school and college, Chad worked on the river as a commercial fisherman, shell diver, and barge hand.

While working and playing on the river, Chad couldn't help but notice all the trash along the river. Believing someone in charge should take care of it, he started calling government agencies to notify them of the problem. He even sent photos of the large piles of garbage as proof. No one responded. Year after year passed by and the problem only worsened.

In 1997 Chad decided that, if no one else was going to clean up the river, then he would, one piece of garbage at a time. Working alone, Chad began pulling trash from the Mississippi River. That first year, he removed 45,000 pounds of garbage by himself. People began taking notice.

In 1998 at the age of 23, Chad founded *Living Lands & Waters*, a nonprofit organization based in East Moline, Illinois, dedicated to cleaning up and preserving our nation's rivers. With support from individuals and corporations, Chad raised enough money to hire a small cleanup crew and fleet of boats.

Today, the organization has grown to include 10 full-time employees and a fleet of 4 barges, a towboat, 6 workboats, 2 skid steers, 5 work trucks, and a large box truck. With this equipment, the crew is able to travel and work in an average of 9 states a year along the Mississippi, Illinois, Ohio, Missouri, and Potomac Rivers, as well as many of their tributaries.

Since the project's inception, Chad, his crew, and over 60,000 volunteers have collected over 6 million pounds of debris from our nation's greatest rivers. Most recently, Chad expanded the mission of the organization to include *Big River Educational Outreach*, *The MillionTrees Project*, and the *Adopt-a-River Mile* programs.

Answer the following questions about Chad Pregracke.

1. Where did Chad grow up? _____

2. Why did Chad decide to clean up the Mississippi River? _____

3. What jobs did Chad do on the river during summer breaks? _____

4. What is the name of the non-profit organization Chad started? _____

5. How many pounds of garbage have Chad and his organization pulled from U.S. rivers?

Your Eco-Footprint

Grades

5–6

Class or small group activity

1 CLASS PERIOD

What you'll need

- Activity worksheet (page 132)

In this lesson, students learn what their eco-footprint is over the course of a normal day.

Do This

1. Distribute the **Eco-Footprint Pledge** activity worksheet and guide students in completing the activity.
2. After students have completed their list of daily habits, divide them into small groups.
3. Working in groups, have students identify similarities in their habits and behaviors and then work together to come up with options for reducing their eco-footprints.
4. Ask students to reflect on some of the ways they can reduce their eco-footprint and choose three to commit to in everyday life. Have them write it as a pledge using "I" statements.

Possible answers:

Daily habits: Ride in a car, turn on a light, microwave a meal, watch television, play a video game, listen to music, use the heat or air conditioner, use a hair dryer, wash or dry clothes, or use a dishwasher

Reducing our eco-footprint:

- Turn off lights when you leave a room
- Walk or bike instead of riding in a car
- Use less heating or air conditioning
- Buy locally grown food
- Buy products with less packaging

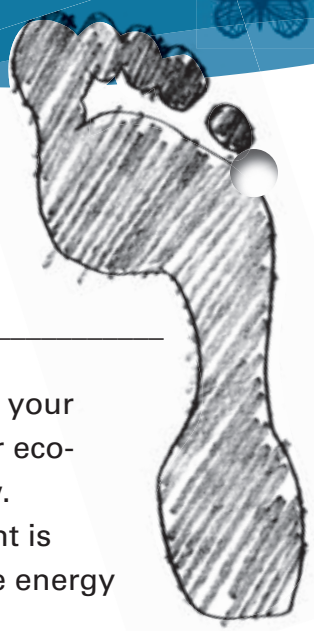
leave no trace
CENTER FOR OUTDOOR ETHICS

Outdoor Ethics

- Plan ahead and prepare
- Dispose of waste properly
- Leave what you find
- Respect wildlife
- Be considerate of other visitors

These excerpts from the *Leave No Trace Seven Principles* have been reprinted with permission from the Leave No Trace Center for Outdoor Ethics. For more information, visit www.LNT.org.

Eco-Footprint Pledge



Name _____ Date _____

Almost every daily habit or behavior contributes in some way to your eco-footprint. The good news is that there are lots of things we can do to reduce our impact on the planet.

First, think about the parts of your daily routine that add to your eco-footprint and list them below. Remember, your eco-footprint is increased every time you use energy that comes from fossil fuels.

_____

_____

_____

_____

_____

_____

Next, compare your lists and discuss which daily habits or behaviors are most common among your classmates. Once you've identified these, list the "**Top 5 things we can do to reduce our Eco-Footprint**."

1. _____

2. _____

3. _____

4. _____

5. _____

Finally, take a pledge to help the earth. Choose three items from the list and make it part of your everyday life. Write these down using "I statements." For example: I can _____less/more.

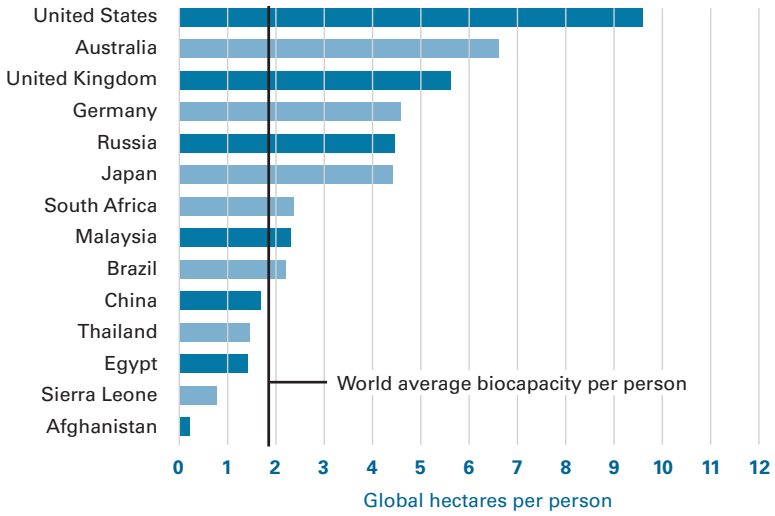
1. _____

2. _____

3. _____

On average, each person needs 2.2 global hectares, which is a measurement used to describe the biocapacity (amount of life) an area can support. The actual area of land a global hectare covers varies depending on the land type. For example, one global hectare of cropland takes less room than one global hectare of pastureland because more pasture is needed to provide the same biocapacity. In other words, pastureland is much less biologically productive than cropland.

Ecological Footprint per person by country (2003)



Extension Suggestions

~ Career launch

Invite a local **climatologist** or **ecologist** to speak to the class. Ask students to research the field and prepare questions in advance. See *A1: Career Launch* on page 312 for career information and professional associations.

~ Get out!

Volunteer for a river or park cleanup with a local conservation group or start your own.

Leave it cleaner than you found it! Go for a hike, a bike ride, or paddle around your local lake. Take a small trash bag and pick up litter along your route.

~ Express yourself!

Keep an eco-footprint journal. Use it to track how different actions and choices can help you change your footprint.

Trace the lifecycle of a piece of trash! Select a piece of trash and find out about its life: where and how did it start? What raw materials were used to create it? Where has it been? How it was used? Where it will end up?

Welcome to Our Mississippi

File Edit View Favorites Tools Help

http://www.OurMississippi.org

~ Learn more online

Calculate your family's carbon footprint online at the Nature Conservancy website (www.nature.org)
Search keywords: **carbon footprint calculator**

Or use the EPA website (www.epa.gov)
Search keywords: **household emissions calculator**

Explore climate change on the EPA website (www.epa.gov)
Search keywords: **kids page climate change**

Examine trash and climate change on the EPA website (www.epa.gov)
Search keywords: **trash and climate change**

Learn about Community River Cleanups, Big River Educational Workshops, Million Trees Project, Riverbottom Forest Restoration, and Adopt-a-River Mile programs at Living Lands and Waters at www.livinglandsandwaters.org

Learn more about the Center for Outdoor Ethics: Leave No Trace at www.lnt.org