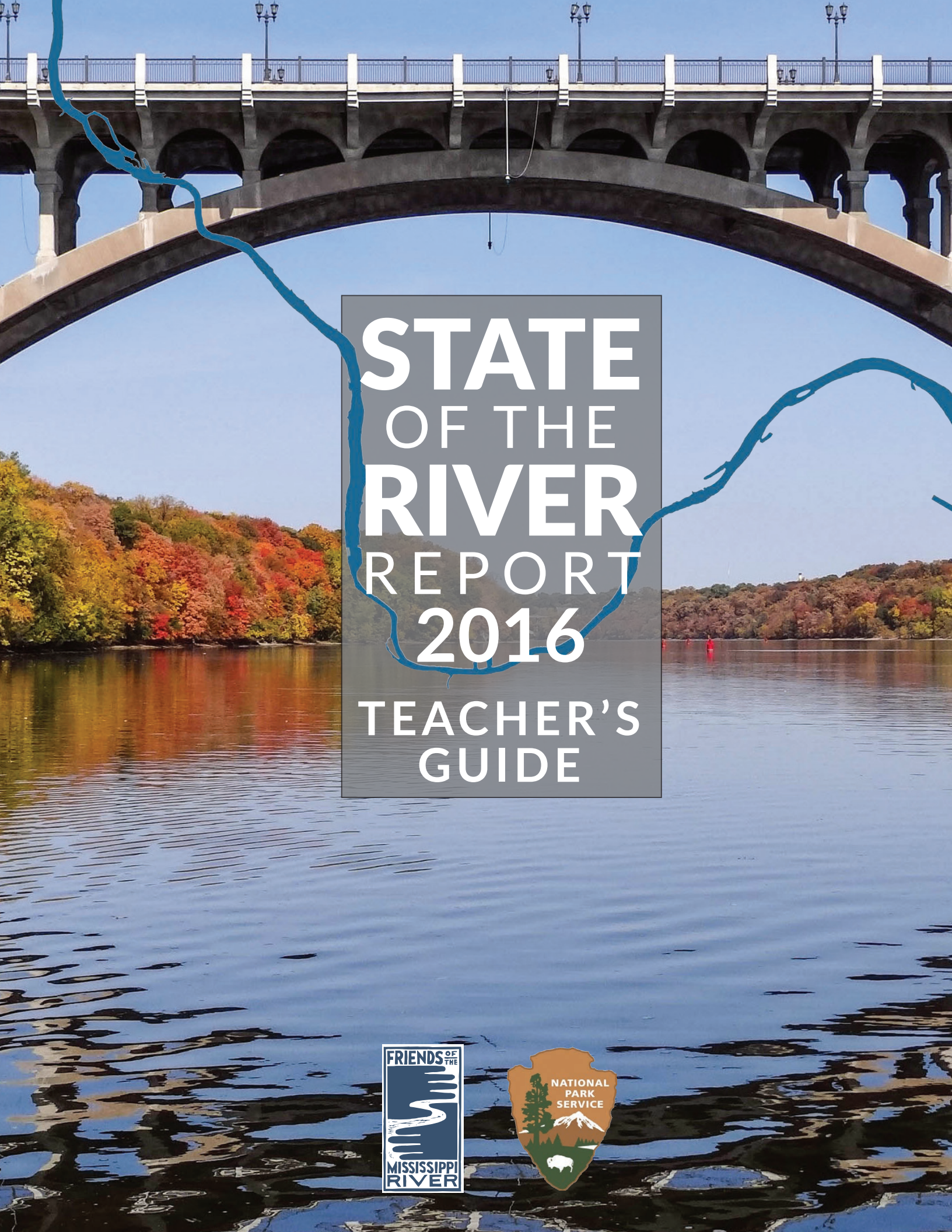
STATE
OF THE
RIVER
REPORT
2016
TEACHER'S
GUIDE
FRIENDS OF THE
MISSISSIPPI
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NATIONAL
PARK
SERVICE

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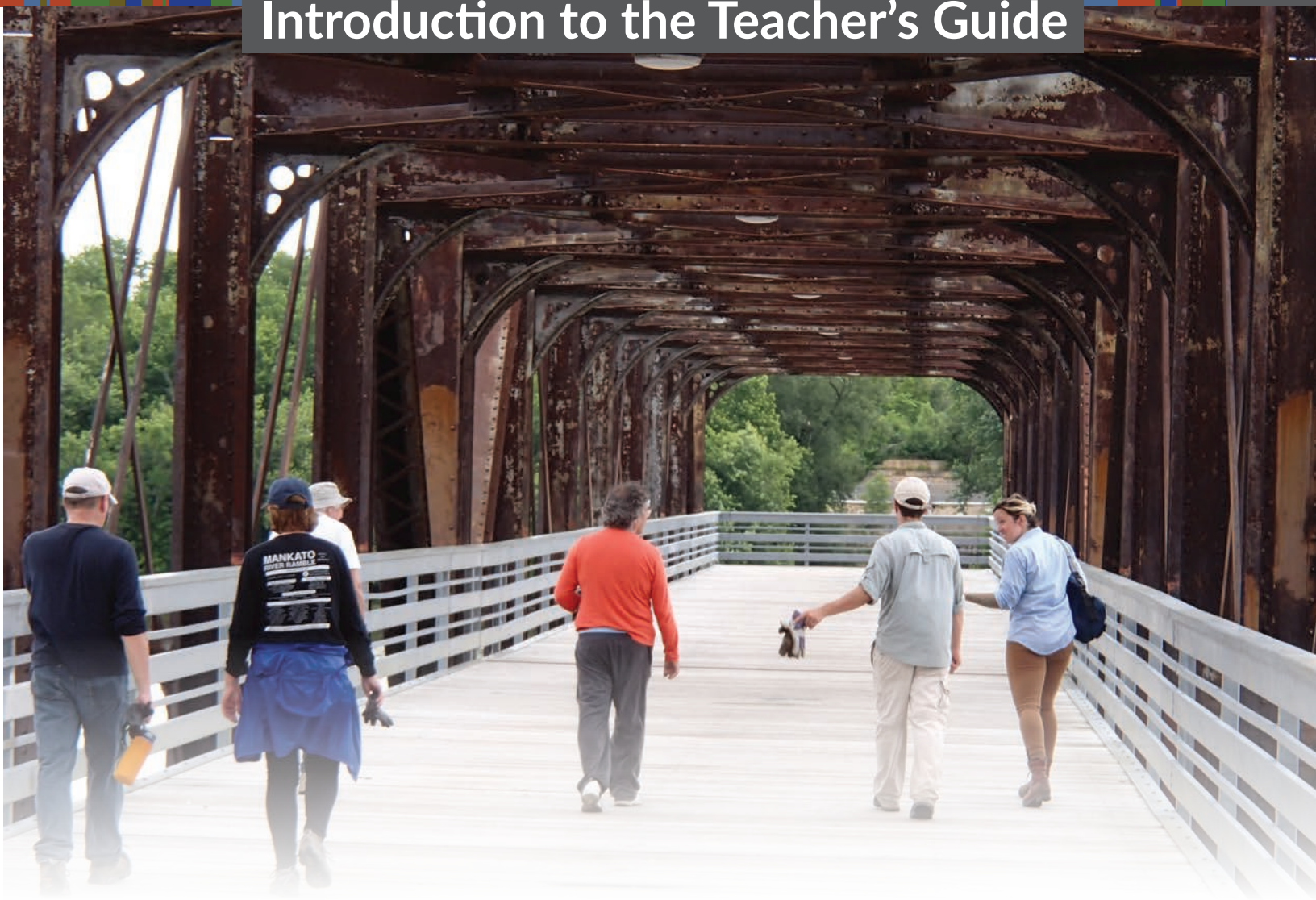
STATE OF THE RIVER

TEACHER'S GUIDE

www.stateoftheriver.com

Introduction to the Teacher's Guide



The process of developing the Teacher's Guide to the *State of the River Report* began by surveying almost one hundred educators.

The Teacher's Guide aims to apply the content of the *State of the River Report* to K-12 classrooms. Lessons are anchored in Minnesota state standards providing information, resources and activities that fulfill a benchmark.

By design, lessons may stand alone or be embedded in a unit of study. Field trips are not necessary to provide students with engaging, interactive, place-based experiences! The Teacher's Guide provides lessons that educators can easily implement in their schools and classrooms.

Teachers are encouraged to apply the lesson presented here to a service project found at the end of the guide. These opportunities will help students transfer what they have learned into action!

Please email products, pictures of student engaged in learning or the Student Stewardship Guide (page 30) to teachersguide@stateoftheriver.com. Your questions and feedback are also welcome!

Thank you for supporting the development of river stewards!

Author
Dr. Meg Cavalier

Design & Layout
Bob Spaulding

The mighty Mississippi River

Photo credit: Gordon Dietzman, MNRRA

The Mississippi River flows approximately 2,350 miles from Lake Itasca to the Gulf of Mexico.

It has long been one of the defining natural features of the United States.

This great river drains all or part of 31 states and two Canadian provinces, or about 40% of the area of the lower 48 states.

The Ojibwe Indians of northern Minnesota called it “Messipi” or “Big River,” and it was also known as the “Mee-zee-see-bee” or the “Father of Waters.”

Today, the river serves as an important environmental, cultural and recreational resource, as well as an artery of commerce and industry.

The river serves as a migratory flyway for more than 40% of all North American waterfowl and shorebirds. It is home to at least 260 species of fish, 50 mammal species, 145 species of amphibians and reptiles, and 38 species of mussels.

The Mississippi River system is also the primary source of drinking water for about 18 million Americans in 50 U.S. cities, including roughly one million Minnesotans.

The 29 locks and dams on the Mississippi River allow for navigation from St. Louis to Minneapolis. To move goods up and down the Mississippi, the U.S. Army Corps of Engineers maintains a 9-foot shipping (or navigation) channel from Baton Rouge, La., to Minneapolis.

Roughly 60% of grain exported from the U.S. is transported and shipped on the Mississippi River, along with billions of dollars’ worth of freight each year.

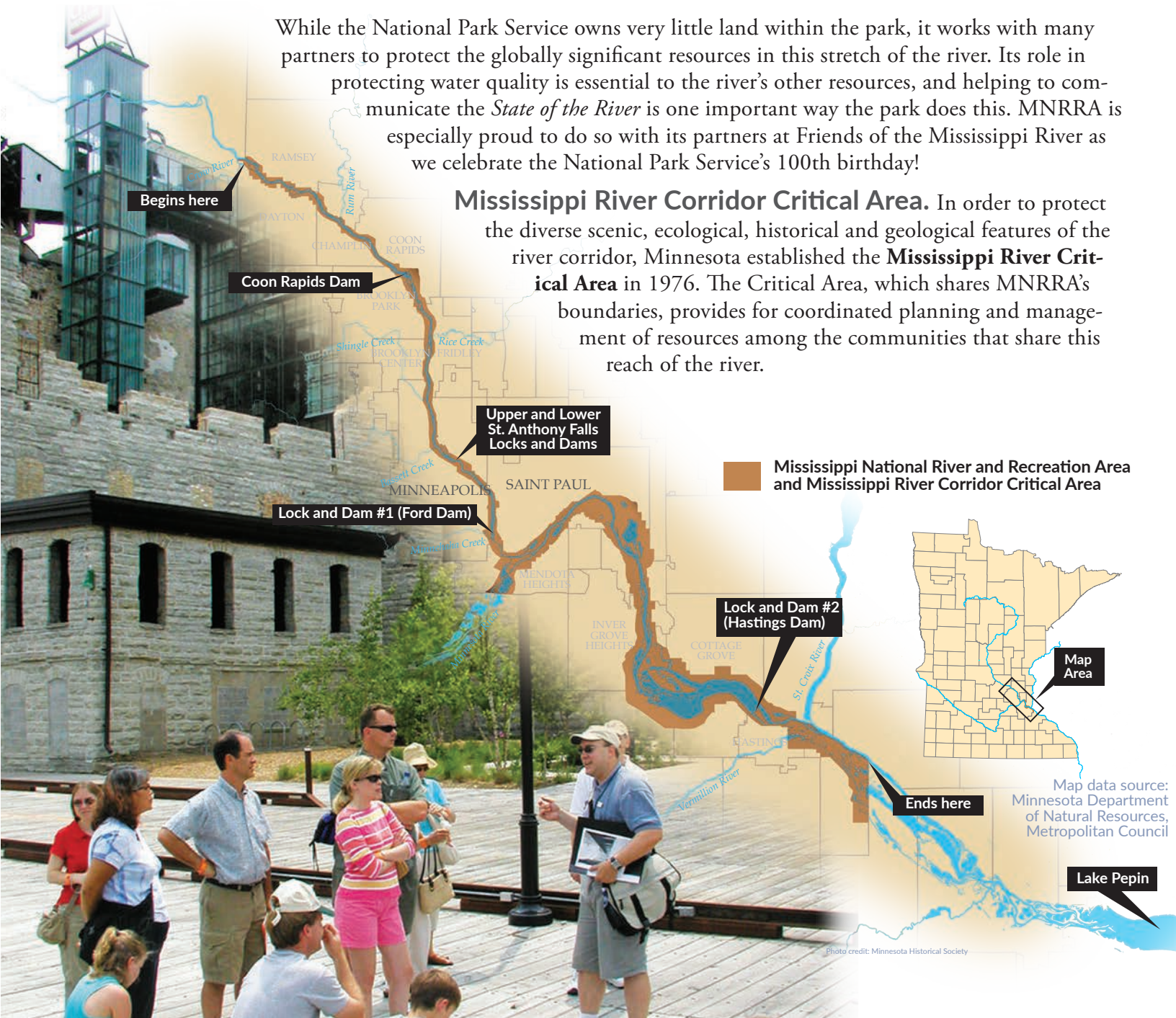
Did you know that the Mississippi River in the Twin Cities is a national park?

For 72 miles (from the Crow River confluence in Dayton and Ramsey, to just past the St. Croix River confluence near Hastings and Prescott) the Mississippi is so unique that Congress designated it a national park in 1988: the Mississippi National River and Recreation Area (MNRRA). How many times have you visited this national park, maybe without even realizing it?

The river changes character more within this park than anywhere else along its entire length. Entering the park as a modest-sized prairie river, it plunges over St. Anthony Falls (its only true waterfall) and through a deep, wooded gorge (its only true gorge), and then emerges in St. Paul as a large floodplain river before flowing 800 miles downstream to St. Louis and beyond.

While the National Park Service owns very little land within the park, it works with many partners to protect the globally significant resources in this stretch of the river. Its role in protecting water quality is essential to the river's other resources, and helping to communicate the *State of the River* is one important way the park does this. MNRRA is especially proud to do so with its partners at Friends of the Mississippi River as we celebrate the National Park Service's 100th birthday!

Mississippi River Corridor Critical Area. In order to protect the diverse scenic, ecological, historical and geological features of the river corridor, Minnesota established the **Mississippi River Critical Area** in 1976. The Critical Area, which shares MNRRA's boundaries, provides for coordinated planning and management of resources among the communities that share this reach of the river.



Mussels in the Mississippi River

Life Science
Grade 3

Benchmark 3.4.1.1.1
Compare how the different structures of plants and animals serve various functions of growth, survival and reproduction.

Guiding Question
How do a mussel's body parts help the mussel grow, survive and reproduce?

Learning Target
I can compare how a mussel's body parts help the mussel grow, eat and reproduce.

Lesson Length: Two, 50 minute class periods

Vocabulary
- **Mussel:** mollusk that lives underwater and has two shells
- **Glochidia (glo·chid·i·a):** mussel larvae (newly hatched)
- **Host Fish:** specific fish that helps mussels grow
- **Siphon:** a tube used to move liquid

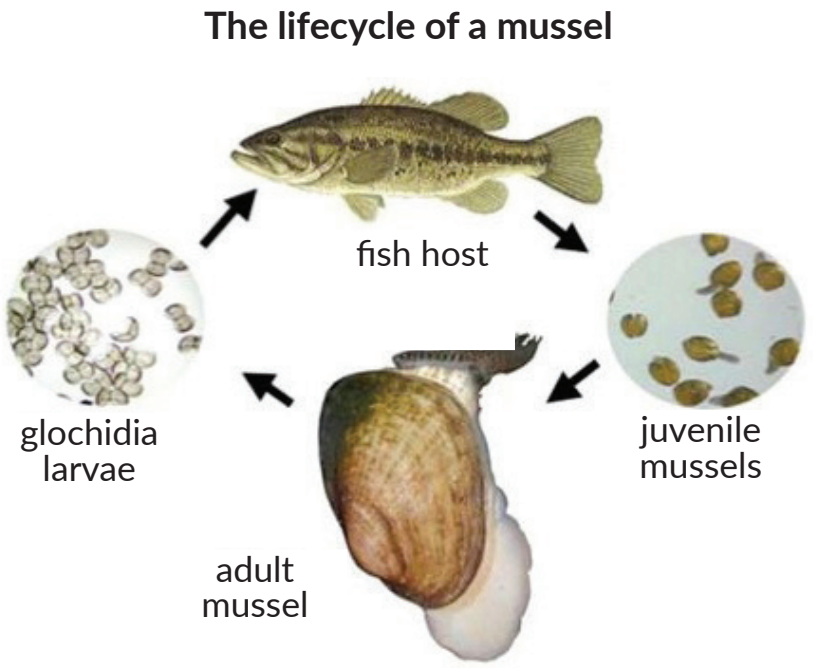
Connection to State of the River Report
Mussels (page 31)

Mussels are mollusks or bivalves which means that they have two shells. They have a foot that moves the mussel slowly. They live underwater partially buried in sand or mud and filter water to get oxygen and food (small pieces of plants and soil). Mussels can't swim and are directly impacted by the water around them. Fish are an important part of the lifecycle. We know that a river is healthy when there are lots of native mussels! There are about 50 species In Minnesota, but 25 are listed as endangered.

Materials
- Note cards or paper
- Computer and projector
- Painters' tape or magnets

With Students

Introduce the lesson by asking students the guided question and sharing the learning target. Begin by describing the lifecycle of a mussel, highlighting the body parts used in the process.



Source: Water Resources Center at Minnesota State University, Mankato

Adult Mussel: The male releases sperm into the water and the current carries them downstream toward a female. The female siphons in sperm to fertilize her eggs. The chance of fertilization is low, unless males and females are near one another.

Glochidia: The larvae develop inside the female. She then releases thousands of tiny larvae called glochidia.

Host Fish: The glochidia must attach to the gills or fins of a host fish to continue growing. Female mussels have different adaptations to attract the right type of fish. Some release glochidia in shapes such as worms and some display a lure that is a part of their body!

Juvenile Mussels: Young mussels stay attached to the fish for several days up to a few months while they grow into juveniles. This doesn't hurt the fish. The juvenile mussel detaches from the host fish and burrow in the sand on the river bed. There they will grow quickly for a few years and become an adult mussel.

Watch the following video of the mussel's life cycle: https://www.youtube.com/watch?v=I0YTBj0WHkU

Watch the following video of a mussel moving: http://www.dnr.state.mn.us/mussels/howlive.html

Ask students how the mussel's body help the mussel move. What parts of the body does the mussel use in reproduction? Highlight how structure determines function in the videos.

- Foot to move
- Siphon to bring in sperm and release fertilized eggs
- Siphon to eat
- Mantle to attract host fish

Activity: Interactive Word Wall

Print or write the following words on a notecard or paper. Create enough so that each student has one or assign pairs of students to a word. (There may be two or three students with the same word.) Hand out the note cards and ask each student to draw a picture that represents the word or phase related to the life cycle of a mussel.

- Glochidia
- Host Fish
- Juvenile Mussel
- Adult Mussel
- Release into the water (with an arrow)
- Attach to fins or gills (with an arrow)
- Float down to the riverbed (with an arrow)
- Grow, grow, grow! (with an arrow)

Ask the students to share their picture and talk about how the card relates to the lifecycle of a mussel. As the student shares, have them place the note card on the floor or white board (with magnets or painter's tape). Students should not place cards randomly, but rather make connections between the words and talk about the relationships.

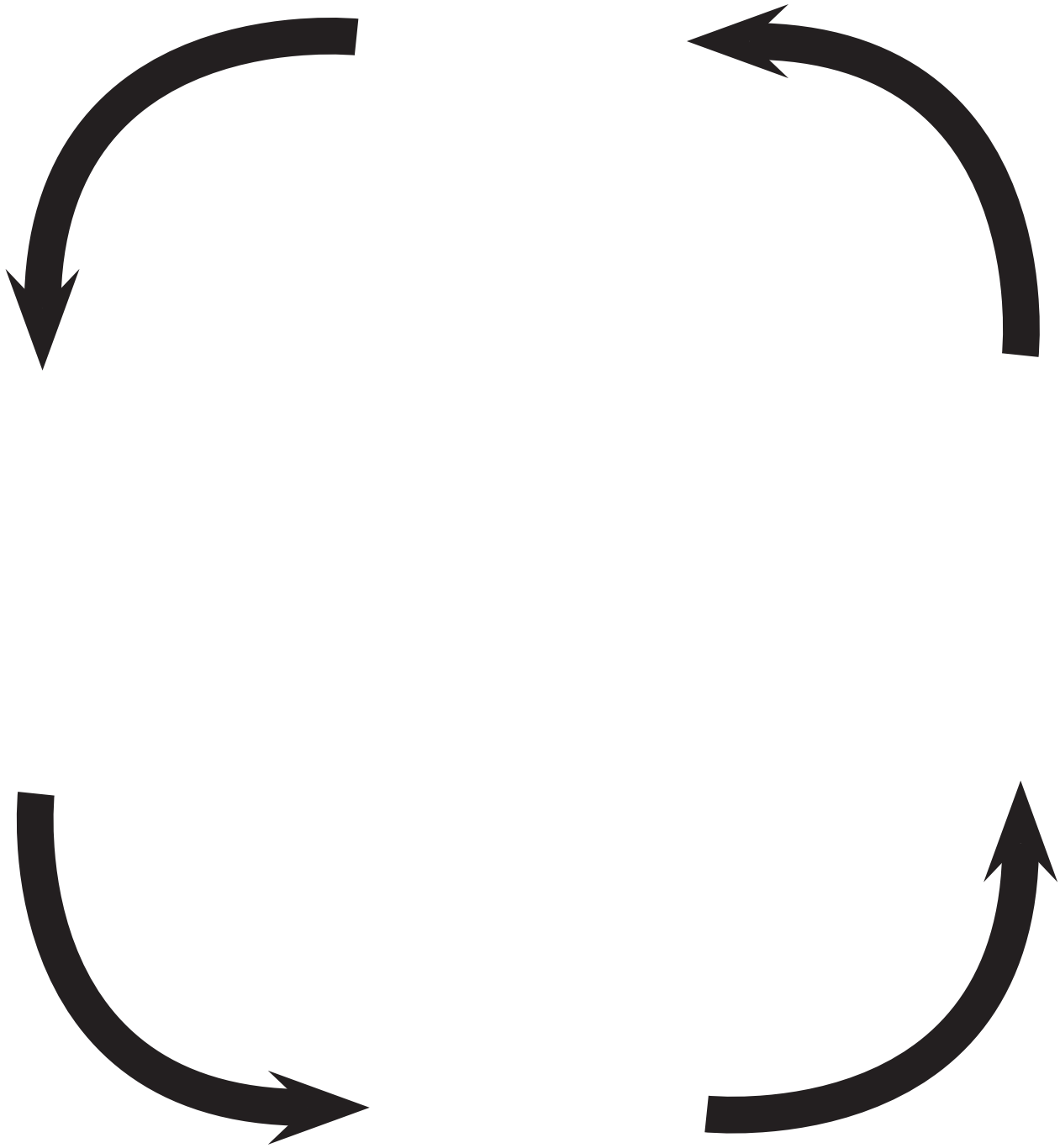
Additional Resource

Field guide to Mussels in Minnesota includes anatomy image:
http://mrbdc.mnsu.edu/sites/mrbdc.mnsu.edu/files/public/pdf/askexpert/mussel_fieldguide.pdF

Mussel Lifecycle

Name: _____

Draw and label a picture of each stage of a mussel's lifecycle.



Where does your water come from?

Earth Science
Grade 4

Benchmark 4.3.4.1.1
Describe how the methods people obtain and use water in their homes and communities can affect water supply and quality.

Guiding Questions
How do you use water at home, school and in your community?
Where does water come from when we turn on the sink at home or school?
How do people change the water supply and quality of water?

Learning Target
I can describe how water gets to my house.
I can explain how water quality and supply is affected by people.

Lesson Length: Two, 50 minute class periods

Vocabulary
- **Filter:** a device that removes something unwanted from a liquid
- **Drinking water treatment facility:** the place where river water is cleaned before going to homes and schools
- *E. Coli:* a bacteria from human and animal waste
- **Nitrate (NO3):** a compound that comes from decomposing organic materials like plants, farm fertilizers, manure and human waste.

Connection to State of the River Report

Bacteria (pages 16-17) and Nitrate (pages 36-37)

Fifty cities in the United States get their water from the Mississippi River. This includes about 1,000,000 people in Minnesota. Water for homes, schools, and businesses in Minneapolis, St. Paul and St. Cloud comes from the Mississippi. Most people use water from the Mississippi River everyday!

Parts of the Mississippi River have too much bacteria. *E. Coli* is a bacteria that comes from animal and human waste. This pollutant can make people sick. Drinking water plants remove bacteria before water gets to homes and schools.

Nitrate helps plants grow, but too much in water is harmful to fish and other aquatic life. Human activities can greatly increase nitrate concentrations. Water in the Mississippi River meets drinking water standards for nitrate, and the treated drinking water from the river is safe to drink. Minnesota does not have nitrate standards to protect aquatic life in the river.

Cropland is the main source of nitrate in Minnesota. Too much nitrate contributes to the "dead zone" in the Gulf of Mexico. Nitrogen travels downstream and feeds massive algae blooms each year. Decomposition of the algae removes oxygen from the water, suffocating marine life that is unable to escape.

Materials

- Two liter bottle with the bottom four inches cut off by an adult
- Paper towels
- Materials for filter: gravel, sand, coffee filters, nylons, rubber band and cotton balls for your filter
- Water with cooking oil, food coloring, pieces of paper, and tiny pieces of plastic
- nylons

With Students

Introduce the lesson by asking students the guided question and sharing the learning target. Watch 'How It's Made: Drinking Water' to find out how water gets from the river to the drinking fountain at school.
https://www.youtube.com/watch?v=eIoSt0-K7wI

Introduction: Think, Pair, Share

Ask students to write down their response to the following questions. Then have students share with a partner. Lastly, have pairs of students share their answers with the whole class.

- How do you use water at home, school and in the community?
  - Recreation, drinking, hygiene, etc.
- Where does water come from when we turn on the sink at home or school?
  - Encourage students to think locally and more broadly
  - Infrastructure
  - River, lakes, aquifers, ocean
- How do people change the water supply and quality of water?
  - Positive: saving water, planting rain gardens, keeping storm drains clear, picking up pet waste
  - Negative: runoff pollution, chemicals, increased flow of river that can cause increased erosion, harm habitat, and carry more pollutants into the river system

Activity: Building a water filter

Explain that students will be building their own water filters. The goal is to get the dirty water as clean as they can.

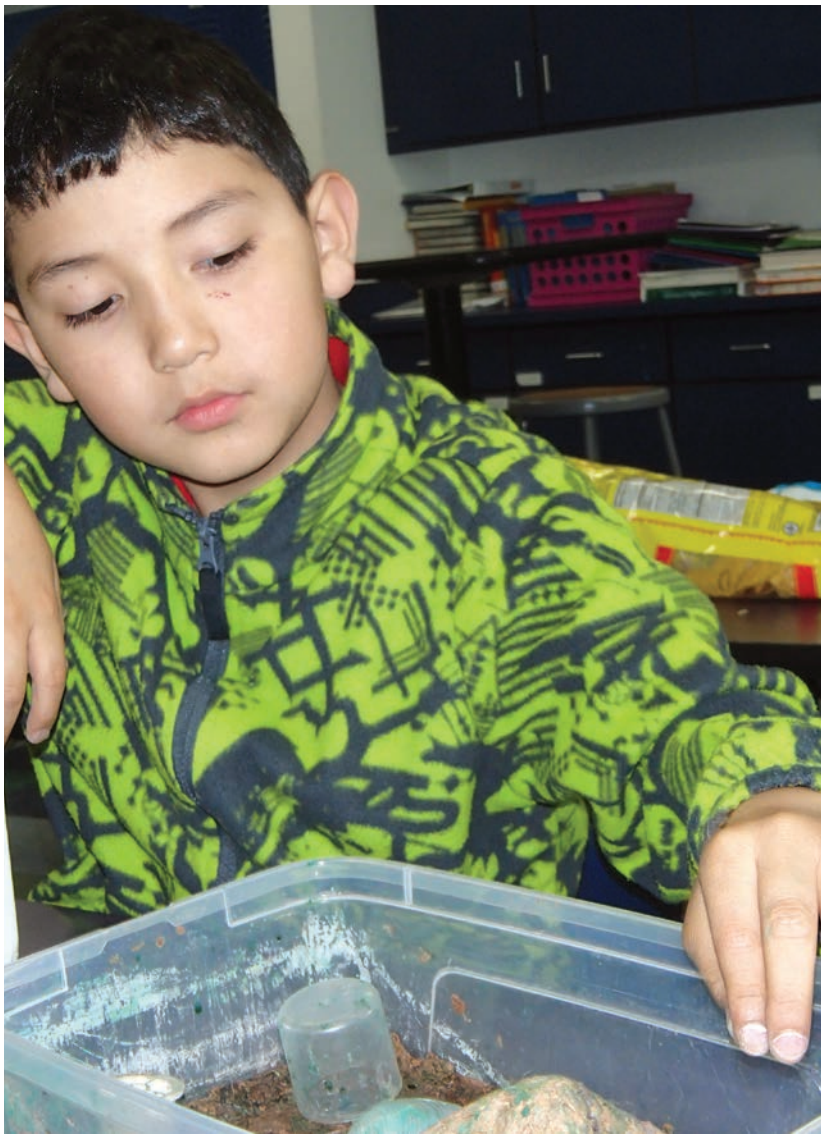
1. Have the class help make a large batch of "dirty" water for everyone to use.
2. Put the top of the bottle upside-down (like a funnel) inside the bottom half. Students will build the filter in the top half. The bottom half will hold the filtered water.
3. Place the nylon over the spout of the bottle and secure with a rubber band. This will ensure that the gravel, sand and other items do not pour out.
4. Layer the filter materials inside the top half of the bottle. Encourage students to think about what the material might

remove from the dirty water.
5. Pour the dirty water through the filter.
6. What does the filtered water look like? Ask students to record their observations.
7. Take the filter apart and look at the different layers. Can you tell what each material removed from the water?
8. Wipe the bottle clean and try again. Try putting materials in different layers or using different amounts of materials.

Reflection: Think, Pair, Share
Ask students to write down their response to the following questions. Then have students share with a partner. Lastly, have pairs of students share their answers with the whole class.

Which filter worked the best and why?
How is water filtered before coming into our homes or school?

Additional Resource
Image of water treatment process: http://www.thameswater.co.uk/cycles/accessible/water_treatment.html



Humans and the Mississippi River

Life Science
Grade 5

Benchmark 5.4.4.1
Give examples of beneficial and harmful human interactions with natural systems. For example: Recreation, pollution, wildlife management.

Guiding Questions
How do you interact with water?
How do people interact with water in our community?

Learning Target
I can describe examples of how people interact with water in positive and negative ways.

Lesson Length: Three, 50 minute class periods

Vocabulary
- **Runoff:** water moving over the land into a body of water
- **Pollution:** substances that make the land, water, or air dirty and not safe to use
- **Impervious surface:** covered by hard materials (such as asphalt, concrete, brick) that water cannot go through
- **Pervious surface:** allows water to go through, usually a natural material
- **Chloride:** a salt that naturally occurs at low levels in lakes and streams, also comes from road salt
- **Pesticides:** chemicals used to control weeds, insects and other pests
- **Mircoplastics:** small pieces of plastic from litter, tires, clothes, and other products

Connection to State of the River Report

Chloride (pages 38-39), Pesticides (pages 40-41) and Microplastics (pages 42-43)

People impact water in the Mississippi River everyday even if they don't know it! Chloride, pesticides and microplastics are three pollutants that have a negative impact on the river. These chemicals enter the river in several ways. When it rains water travels quickly over impervious surfaces, through storm drains and into the river.

Chloride is a salt that naturally occurs at low levels in lakes and streams. It also comes from road salt and some other human sources. Once chloride is in the water, there is no feasible way of getting it out. There is not too much chloride in the Mississippi River, but levels in the river are increasing and many streams, wetlands and lakes in Minnesota have chloride levels that exceed standards.

Pesticides are used to control unwanted insects, plants, rodents, fungi, mold or bacteria. Pesticides are used on farms and in urban areas. Chemicals move into water when it rains or as snow melts.

Microplastics are small pieces of plastic from litter, tires, and other products such as make up and some types of fabric. These pollutants are washed down the drain in homes or with storm water runoff, enter the river, build up in plants and animals and then move up the food chain.

Materials

- Two large clear containers
- Two flat surfaces (cooking sheet or plastic tray)
- Towel or felt to cover one of the flat surfaces
- Spray bottle
- Sand or small pieces of leaves (chloride pollutant)
- Small pieces of plastic (microplastic pollutant)
- Food coloring (pesticide pollutant)
- Cooking oil (motor oil pollutant)
- Sprinkles (fertilizer pollutant)

Source: NOAA Marine Debris Program

With Students

Introduce the lesson by asking students the guided question and sharing the learning target. Bring students to an outdoor area. This can be on school grounds, at a nearby park, intersection, or commercial area. Ask students to write down their observations of people interacting with water and the environment in positive and negative ways. Encourage students to utilize multiple senses. Ask students what they see, hear, and smell. Point out pervious and impervious surfaces. Help students make the connection between how people interact with the environment as it relates to water. The following are examples of such. Gardens are pervious surfaces and help filter water. The car someone is driving to work may be polluting water with oil or plastic from the tires. Yard waste or trash near a storm drain will enter the river. Water will travel quickly over all of the impervious surfaces (roof, parking lot, street, sidewalk) and carry pollutants to the river.

Back in the classroom, ask students to gather in groups of two or three and classify the human interactions as beneficial or harmful to water. Have students share out and capture ideas on the whiteboard. Introduce the three pollutants described in this section.

Activity: Runoff demonstration

Introduce the demonstration below by explaining that rain and snow carries pollutants to the river in runoff water. Three pollutants that reach the Mississippi River in runoff water are chloride, pesticides, and microplastics. Relate the student's observations to runoff pollution. Explain that the following demonstration shows how water brings pollutants into the river and how we can 'slow down' runoff, which can help in removing some pollutants.

1. Fill the large clear containers with water to represent the Mississippi River. Place the flat surfaces so that it slopes down into the water. This represents the ground. Lay the towel or felt on one of the flat surfaces. This represents a pervious surface.
2. Ask students to pour a 'pollutant' onto both flat surfaces.
3. Spray the 'pollutants' with water for 30 seconds to represent a rainstorm. Observe what happens to the 'pollutants' and the river.
4. Repeat with each 'pollutant'.

Ask students to talk in pairs about the following questions. Record students' answers as they share with the class.

- How does pollution on the ground travel to our water supply, the Mississippi River?
- Why is water cleaner in one of the containers?
- How does this relate to how people use land?
- How can we make a positive impact on the quality of the water in the Mississippi River?

Build your own river system!

Science, Technology, Engineering, Math & Society
Grade 6

Benchmark 6.1.3.1.1
Describe a system in terms of its subsystems and parts, as well as its inputs, processes and outputs.

Guiding Questions
What is a river system?
What are the subsystems, parts, input, outputs and processes of a river system?

Learning Target
I can create a model of a river system and describe the parts of the system.

Lesson Length
Two, 50 minute class periods

Vocabulary
- **River system:** a large network of land, streams, lakes and rivers that are interconnected
- **Parts of a river system:** streams, land (flood plains, wetlands), source, delta, upstream, downstream
- **Subsystems of a river system:**
  - **collecting system:** network of tributaries in the headwater region, collects and funnels water and sediment to the main stream
  - **transporting system:** the main stream, a channel through which water and sediment move from the collecting area toward the ocean
  - **dispersing system:** network of distributaries at the mouth of a river (delta), where sediment and water are dispersed into an ocean, a lake, or a dry basin
- **Inputs:** how water enters the river (rain, storm water runoff, treatment center, tributaries, or source)
- **Outputs:** how water leaves the river (evaporation, delta to ocean)
- **River source:** the beginning of a river, also called the headwaters.
- **River mouth:** the place where a river flows into a larger body of water, such as a lake, or an ocean
- **Upstream:** toward the source of a river
- **Downstream:** toward the mouth of a river
- **Tributary:** a smaller stream or river that joins a larger stream or main river
- **Meander:** a loop or bend in a river
- **Erosion:** the gradual wearing away of land surface materials, such as rocks, sediments, and soils, by the action of water, wind, or a glacier
- **Sediment:** Pollutant of tiny particles of soil and organic matter that are suspended in the river's water
- **Envirotranspiration:** The process by which water is transferred from the land to the atmosphere by evaporation from the soil and other surfaces and by transpiration from plants.

Connection to State of the River Report

Flow and hydrology (pages 12-14) and Sediment (pages 34-35)

Rivers systems are complex and include a large network of land, streams, lakes and rivers that are interconnected. There are many different parts of a river system including: streams, different landforms (flood plains/wetlands), the source, and delta.

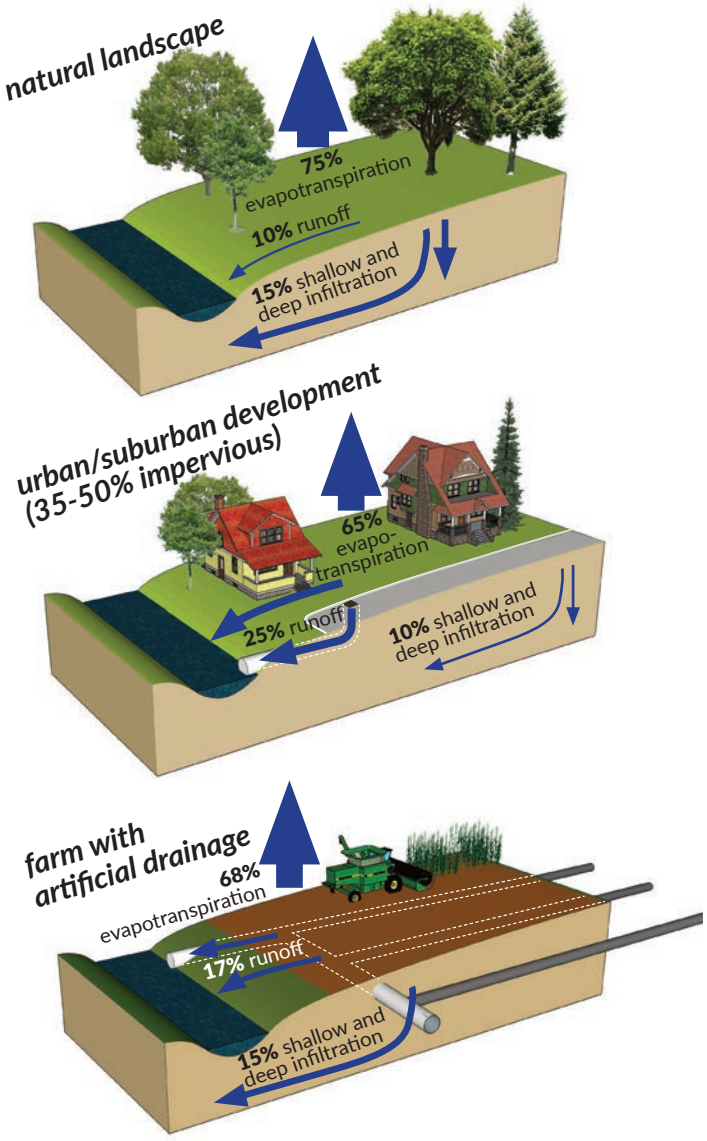
There are several different subsystems including the collecting system (network of tributaries), transporting system (main stream), and dispersing system (network of distributaries at the mouth of a river where sediment and water are dispersed into a lake or ocean). Water enters into the system through rain, stormwater runoff, wastewater treatment plants, tributaries or the source, and leaves the system at outputs (evaporation or delta).

The amount of rain and snow impacts river flow. High and low flows can have both positive and negative effects on river health. Low flows tend to deliver less pollution to the river and can help the growth of water plants. However, low flow can increase concentrations of some pollutants. High flows can cause increased erosion, harm habitat, and carry more pollutants into the river system. However, high flows can also restore natural floodplains and dilute pollutants.

People have changed land in ways that increase water flow to nearby water. Examples of this are roads, rooftops and drained farm fields.

Erosion is a process of a river system and is the gradual wearing away of land surface materials, such as rocks, sediments, and soils. Sediment is tiny particles of soil and organic matter that are suspended in the river's water. Erosion is increased when the river flows quickly. Too much sediment can harm wildlife in the Mississippi River. This can cause harm to habitats as well as carry other pollutants and sediment into the river system.

Water and the landscape



Materials

- Rectangular aluminum pan (turkey roasting pan), one for each group of students
- 32-quart rectangular plastic storage bins, one for each group of students
- Bag of sand, enough to fill each pan halfway
- Spray bottle, one for each group of students
- Watering can and water, one for each group of students
- Blocks, 4 – 6 for each group of students
- Scissors, one for each group of students
- Paper and pencil, one per student

Activity: Build a river system

Introduce the lesson by asking students the guided question and sharing the learning target. Tell students that they will create their own small-scale rivers using a stream table.

1. Use scissors to cut a hole close to the rim on the short side of each rectangular aluminum tray.
2. Distribute the aluminum trays, plastic bins and blocks. Explain that each aluminum tray will be a stream table. The blocks will be used to prop the stream table up to form an incline, and the plastic storage bin will be placed under the hole in the aluminum tray to catch the extra water.

3. Have students pour sand evenly into the tray until it is filled halfway. Spray the sand with water and stir the sand around until it is all wet.
4. Distribute watering cans and tell students that they will perform an experiment to model and compare differences between river formations on a flat but inclined terrain, and river formation on a landscape with hills and valleys. During each activity, have students record their observations and create a final sketch of the resulting river.

Flat and Inclined Model

1. Have students smooth and flatten the surface of the sand and then place one or two blocks under one side of the tray to create an inclined plane.
2. Ask students to record their predictions about what will happen when the water is poured from the higher end slowly and then quickly.
3. Have students pour the water in a steady, moderate stream and record their observations.
4. Next, have student pour the water quickly in a larger stream and record their observations.
5. Have students discuss the similarities or differences between each of their models. What were their observations? Did each model have the same result? How did the landscape influence the course of the river? Record their answers.
6. Have students empty the water from the plastic bin and refill the watering can to prepare for the next experiment.

Hills and Valleys Model

1. Have students build hills and valleys in the sand.
2. Ask students to record their predictions about what will happen when the water is poured from the higher end slowly and then quickly.
3. Have students pour the water in a steady, moderate stream and record their observations.
4. Next, have student pour the water quickly in a larger stream and record their observations.
5. Have students discuss the similarities or differences between each of their models. What were their observations? Did each model have the same result? How did the landscape influence the course of the river? Record their answers.

Think, Pair, Share

Ask students to write down their responses to the following questions. Then have students share with a partner. Lastly, have pairs of students share their answers with the whole class.

- How would the river formation be affected if the water continued to flow in your model?
- How would the river formation be affected if the sand were replaced with soil?
- What human activities can affect a river system?

Bald eagles and the metro Mississippi River

Life Science
Grade 7

Benchmark 7.4.4.1
Describe ways that human activities can change the populations and communities in an ecosystem.

Guiding Questions
Why did bald eagles almost go extinct?
Why are bald eagles now flourishing in the Mississippi River Corridor?

Learning Target
I can describe how human activities had positive and negative effects on eagle populations and communities in an ecosystem.

Lesson Length: Two, 50 minute class periods

Vocabulary
- **Population:** group of the same type of organisms living together in the same area
- **Communities:** groups of populations living together in a habitat
- **Ecosystem:** a system of organisms and nonliving features (landforms, buildings, etc.)
- **Atmospheric deposition:** The pollution of water caused by air pollution.

Connection to the State of the River Report
Bald eagles (pages 28-30)

In 1963, only 417 bald eagle pairs nested in the lower 48 states. Today, nearly 10,000 pairs live in the lower 48 states, including over 1,300 in Minnesota. This improvement is linked to protections from the Bald Eagle Protection Act (1940), the Clean Water Act (1972), a national ban on the pesticide DDT (1972) and the Endangered Species Act (1973).

Eagles feed primarily on aquatic prey and are susceptible to contaminants present in fish and other wildlife. Young bald eagles, or nestlings, are particularly vulnerable to these contaminants and can help us understand overall ecosystem health.

Materials

- Eggs (one per group)
- Vinegar
- Bowl
- Plastic wrap
- Six pieces of evidence (found on pages 21 to 23 of the Teacher's Guide)

With Students

Introduce the lesson by asking students the guided question and sharing the learning target. This inquiry based lesson will provide an opportunity for students to explore why bald eagles almost became extinct. Students will answer questions using cooperative learning and scientific data. After analyzing information, students will understand how ecosystems and the food pyramid affects the bald eagle population. Students should be familiar with food pyramids prior to the lesson.

Note: One piece of evidence requires advanced preparation. To make a model of a bald eagle egg, place one egg for each group (plus extra) in a bowl with vinegar for three days prior to the class. Store the eggs in a refrigerator covered in plastic wrap. On the day of the activity, rinse the eggs and double bag them individually. The shells should be very fragile.

Activity: State of the Eagle Report

Create groups of three or four students. Show students one piece of evidence every five minutes using a projector or print outs. Explain that each piece of evidence will be analyzed to help answer the guiding question: 'Why did the bald eagle almost become extinct?'. After reviewing the piece of evidence students write one 'yes or no' question based on the evidence that they would like answered to help determine why the bald eagle almost became extinct. After each of the five minute periods each group will ask their question for the teacher to answer. This process continues for all six pieces of evidence.

The answer to why the bald eagle almost became extinct is complicated. The teacher should explain that the simple 'yes or no' questions they create will not provide all the answers.

After presenting the six pieces of evidence, most students will have an understanding of why the bald eagle almost became extinct. Either in class or for homework, students should write a summary paragraph describing why the bald eagle almost became extinct citing at least three pieces of evidence including the energy pyramid. Drawing a food web for the eagle population could be an extension to the lesson.

Additional Resource

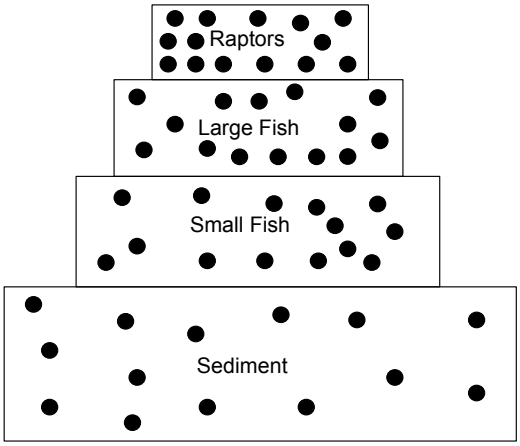
The DNR maintains a live webcam of an eagles' nest in the Twin Cities http://www.webcams.dnr.state.mn.us/eagle/

Evidence of Bald eagles and the metro Mississippi River

Evidence One: Image of bald eagle

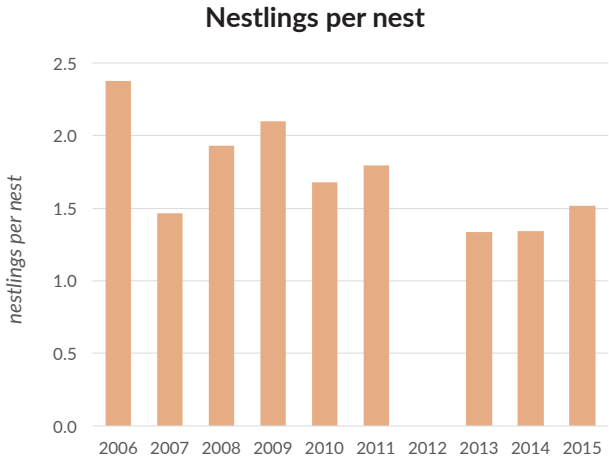
This picture shows a bald eagle in flight. Notice what the eagle is carrying.

Evidence Two: Concentration of Perfluorinated chemicals (PFCs) in food pyramid



The black dots represent the pollutant PFC. Notice that there are 14 block dots in each box.

Evidence Three: Population



Currently, the metro river is home to approximately 55 active nesting sites, indicating a strong and stable bald eagle population. Research is tracking this productive eagle population, which averages about one and a half nestlings per nest per year. This is well over the threshold for a healthy population.

Evidence Four: PFCs and Lead

Perfluorinated chemicals (PFCs) are a family of manufactured compounds widely used in stain-, grease- and water-resistant products. High levels of PFCs in humans are associated with obesity and diabetes. PFCs also contribute to fish consumption advisories in the metro river. Overall concentrations of PFCs declined in nestlings between 2006 and 2014. However, compared to upriver nestlings, PFC levels were nearly twice as high in the lower portion of the river, including record levels in a nestling near Hastings.

Lead is a neurotoxin with potentially harmful impacts to eagle nestlings and other wildlife. It is introduced into the environment by fishing tackle, ammunition, and atmospheric deposition. Research has documented the presence of lead in eagles throughout the river corridor. These concentrations are higher than the levels found in other national parks sampled in the region. Two nestlings monitored in 2015 had some of the highest levels yet recorded: more than 160 parts per billion at Flint Hills and more than 260 parts per billion at Lake Rebecca. The Raptor Center has established a threshold of 200 parts per billion for an adult bald eagle to need treatment for lead poisoning.

Evidence Five: PBDEs

Polybrominated diphenyl ethers (PBDEs) are a common flame retardant used in plastics, electronics, fabrics and other commercial products. There is concern over their environmental toxicity and persistence in the food chain. Studies on humans and laboratory animals show PBDE exposure can interfere with immune and thyroid function, and alter human infant behavior.

Between 2006 and 2011, levels of PBDEs in the metro portion of the river declined by 10% overall. However, compared to upstream nestlings, concentrations were twice as high in nestlings downstream of the Metro Wastewater Treatment Plant with further increases downstream.

Evidence Six: Bald eagle egg model

The model of a bald eagle egg is the final piece of evidence and demonstrates the fragility of the eagle eggs before the national ban on the pesticide DDT (1972). As the students examine the eggs share with students that DDT thinned eagle's egg shells.

Land and Water Use

Earth Science
Grade 8

Benchmark 8.3.4.1.2
Recognize that land and water use practices can affect natural processes and that natural processes interfere and interact with human systems.

Guiding Questions
How does our use of the land affect the Mississippi River?
How does the Mississippi River impact humans?

Learning Target
I can explain how land and water use affect natural systems.
I can explain how erosion and sediment affect water quality.

Lesson Length: Three, 50 minute class periods

Vocabulary
- **Erosion:** to wear away, or remove, rock or soil particles by water, ice, and/or wind
- **Sediment:** any particle of soil or rock that has been deposited by water, wind, or glaciers
- **Sedimentation:** tendency for particles in suspension to settle out of fluid
- **Turbidity:** the cloudiness of a liquid caused by individual particles floating in the liquid
- **Impervious surface:** covered by hard materials (such as driveways, parking lots and rooftops) that water cannot go through
- **Pervious surface:** allows water to go through, usually a natural material

Connect to State of the River Report: Flow and hydrology (pages 12-14) and Sediment (pages 34-35)

Sediment is washed into the Mississippi River every time it rains. The amount of rain impacts river flow. High and low flows can have both positive and negative effects on river health.
- High flows can cause increased erosion, harm habitat, and carry more pollutants into the river system. However, higher flows can also restore natural floodplains and dilute pollutants.
- Low flows tend to deliver less pollution to the river and can help the growth of water plants. However, low flow can increase concentrations of some pollutants.

The sediment is composed of both living (leaves, grass, roots) and non-living material (soil, sand, gravel, dirt and other particles). As the speed of the water decreases the heaviest sediments drop out first. This process causes erosion of riverbanks and creates deposits of sediment such as sand bars and deltas. Sediments are particles suspended in water. As water slows down, the sediments are deposited, forming layers.

With Students:
Introduce the lesson by asking students the guided question and sharing the learning target. Begin by asking students what they know about how land use in their community might affect the Mississippi River. Students should identify the different ways water gets to the river including impervious surfaces.

Photo: National Agriculture Imagery Program, Minnesota, 2010.

The amount of rain and snow impacts river flow. High and low flows can have both positive and negative effects on river health. High flows can cause increased erosion, harm habitat, and carry more pollutants into the river system. However, higher flows can also restore natural floodplains and dilute pollutants.

Note: Teachers may also choose to modify the fifth grade 'Build your own river system' activity as it is relevant to the benchmark.

Activity: Build an Erosion Model

Students will build an erosion model and identify how the river impacts human systems such as water quality, flow and flooding. Explain that students will be working in small groups to build three different models that show how water interacts with pervious and impervious surfaces. Ask students to predict what the water will look like in the glass after it has gone through each of the three bottles and record their answers. It may be beneficial to assign roles to group members such as recorder, time keeper, material master and someone to encourage equal voices.

Materials:

- Three, two liters bottles
- Soil
- Mulch or dead leaves
- Sod or establish plant
- Watering can and water

Directions:

1. Cut off one side (lengthwise) of the bottles
2. Fill all three with soil
3. Add mulch or dead leaf cover to the dirt in one of the bottles
4. Add sod or plant with established roots to one of the bottles.
5. Leave the soil bare in one of the bottles.
6. Suspend or hang the bottles over the 3 cups at a 45 degree angle with the spouts facing downward.
7. Use the watering can to apply equal amounts of water to each bottle, until water runs through the bottle.

Ask students to record their observations answering the following two prompts:

- Compare the turbidity in each of the cups of water.
- How did the soil change in each of the bottles? Describe how each of the bottles looked before, during and after the 'rain'.

Photo: Asian Carp Regional Coordinating Committee under CC BY 2.0 license via http://tinyurl.com/z5f4yse

Activity: Sediment Jars

Explain to students that they will be building sediment jars as a model of the process of sedimentation.

Materials:

- Plastic bottles or mason jars
- Water
- Gravel
- Sand
- Dirt
- Organic Material (leaves, sticks, stems, flowers)

Directions:

1. Add gravel to the bottle (two inches)
2. Add sand to the bottle (two or three inches)
3. Add dirt to the bottle (half an inch)
4. Add a few pieces of organic material to the bottle
5. Fill the bottle almost full with water
6. Put the cap on the bottle
7. Shake the bottle to simulate a rainstorm
8. Record observations
9. Observe the bottle for at least ten minutes and record again
10. Place the sediment jar in a location where it will not be disturbed. Observe how the layers define overnight and record again

Ask students to record their observations answering the following two questions:

- How does this relate to sediment in the river?
- What happens when the flow increases?

Invasion of flying fish

Life Science
Grades 9-12

Benchmark 9.4.4.1.2
Describe the social, economic and ecological risks and benefits of changing a natural ecosystem as a result of human activity.

Guiding Question
How did invasive Asian carp get to the Mississippi River?
How do invasive Asian carp impact the Mississippi River socially, economically and ecologically?

Learning Target
I can describe how humans influence the invasive Asian carp population in the Mississippi River.
I can describe how invasive Asian carp impact the Mississippi River socially, economically and ecologically.

Lesson Length: Three, 50 minute lessons

Vocabulary
- **Invasive species:** organism that is not native to a specific location and causes damage to the environment, economy or human health
- **Native species:** organisms that occur naturally in a given location within an ecosystem
- **Invasive Asian carp:** a family of fish native to Asia, invasive species in the Mississippi River
- **Ecosystem:** a system of organisms and nonliving features (landforms, buildings, etc.)

Connect to State of the River Report
Invasive Asian carp (pages 26-27)

Asian carp were originally imported to the southern U.S. from China to control aquatic vegetation and parasites in fish farms. The carp escaped to the Mississippi River and its tributaries in the 1970s, and populations were well established in southern river states by the 1980s. Their population and range have increased dramatically in recent years, and the fish have reached states throughout the upper Mississippi River, including Minnesota.

Asian carp are a group of invasive fish consisting of four species: bighead, black, grass and silver carp. These fish can severely disrupt aquatic ecosystems as they out-compete native fish species and outgrow natural predators. Three of the species (bighead, black and grass carp) can grow to over 100 pounds. Silver carp commonly grow to 20-40 pounds and leap as high as 10 feet from the water when disturbed.

In Minnesota, at least 76 bighead, silver and grass carp have been caught from the Mississippi and St. Croix Rivers since 1996. While no reproducing populations of Asian carp are known to exist in Minnesota, these data suggest the fish are present in the metro area rivers.

Materials
- Computers, one for each group
- Projector

With Students
Introduce the lesson by asking students the guided question and sharing the learning target. Engage students in a brief discussion about native and invasive species and the reasons why invasive species may be harmful to an ecosystem. Explain to students that they will be watching a series of videos and reading articles related to Asian carp and the Mississippi River. They will be expected to capture details using the note catcher provided on page 29.

- Read about Asian carp on pages 26 and 27 in the State of the River Report
- Read an Overview of Asian carp Overview published by the National Park Service: https://www.nps.gov/miss/learn/nature/ascarpover.htm
- Watch the video Jumping Asian carp: https://www.youtube.com/watch?v=sxSvhtPoKU4
- Watch the video Tracking Asian carp: https://www.youtube.com/watch?v=h_UjXsf3EDs
- Watch the video Asian carp Invasion: http://www.youtube.com/watch?v=yS7zkTnQVaM

Facilitate a discussion regarding how Asian Carp have impacted the Mississippi River socially, economically and ecologically. Capture students notes on the whiteboard using the same categories on the note catcher.

Activity: Create a public service announcement (PSA)

Describe that PSAs aim to educate viewers to adopt a favorable view toward an issue or take action. They use concise language and get to the point quickly. The average PSA is only 30-60 seconds long. PSAs are based on facts, cite data and use an engaging format of mixed media to hold the viewer's interest.

Show students a variety of PSAs.
Student created PSA: http://studentpsa.com/psa/
Water Conservation: https://www.youtube.com/watch?v=94Ve2vctL9c
Ad Council: http://www.adcouncil.org/Our-Campaigns

Engage the class in a discussion of what makes an effective narration for a PSA. Create a list on the board with characteristics such as factual data, persuasive content, concise language, details to support ideas, etc.

Using notes from the lesson, students should make a PSA answering the question 'How do Asian Carp impact the Mississippi River socially, economically and ecologically?'. Explain to students that they will choose the format for their PSA. Examples of such are:
- Audio (this can be done using cell phones)
- Podcast
- Video
- Brochure
- Newsletter
- Letter to the editor

Students may present the PSA to the class, include on the class or school website, submit to local newspapers or radio stations. Students may also submit their PSA to teachersguide@stateoftheriver.com. Entries will be posted on the www.stateoftheriver.com website.

Invasion of Flying Fish Note Catcher

Name: _____

How have Asian Carp impacted the Mississippi River in the following categories:

Socially	Economically	Ecologically

Service Projects

Create and Adopt a 'Student Stewardship Guide'

Encourage students to apply lessons in the Teacher's Guide to positive actions steps that they and their families can make to improve water quality in the Mississippi River. Brainstorm ideas to include in the Student Stewardship Guide. Then create a visual representation and ask students to sign in support. This could be on cardstock, poster or banner. Share the Student Stewardship Guide with families and the community!

- Write a paragraph for a school newsletter
- Present at a school event or in the community
- Hang in the classroom, hallway or front office

The *State of the River Report* is accompanied by a Stewardship Guide that can be found at www.stateoftheriver.com. Please reference this as a resource in developing a Student Stewardship Guide. You are encouraged to share your Student Stewardship Guide with Friends of the Mississippi River at teachersguide@stateoftheriver.com.

FRIENDS OF THE MISSISSIPPI RIVER

Service projects supported by Friends of the Mississippi River

Storm Drain Stenciling

In cities through Minnesota and the country storm water pours down drains at the edge of streets and parking lots headed directly for rivers, lakes, oceans and bays. That water carries more than expected as all of the pollutants on our yards and sidewalks that can fit down the drain also end up in those water bodies. Many cities including St. Paul choose to spread the word by asking volunteer groups to stencil a message next to the drain and pass out educational flyers. Friends of the Mississippi River can help your students stencil in St. Paul. http://fmr.org/stencil-storm-drains-fmr

Friends of the Mississippi River: Trash Cleanups and Youth programs

Cleaning up around your school and neighborhood is a fantastic way to help water quality as it prevents trash from reaching our waterways. If your group is interested in working next to the river or lake in your area or participating in a program about water quality there are plenty of organizations, including Friends of the Mississippi River and the National Park Service, ready to help. http://fmr.org/youth-participation

Please contact Kate Clayton, Youth Coordinator for more information.
kclayton@fmr.org
(651)222-2193 x23

Service projects supported by National Park Service

Seed Bombs

Seed Bombs are small balls of soil, compost, and seeds that can be thrown or placed as part of the restoration of a site. A park service ranger will visit your classroom and lead a 90 minute lesson on prairies and their benefit to the Mississippi River. As part of the lesson, students will make seed bombs which they can later distribute at the school or along the river if the school chooses to do a habitat restoration event. All materials are provided. There is a $60 fee per classroom for materials. Scholarships are available.

Plant Nursery

Host a Plant Nursery at your school! Partner with the National Park Service to grow native plants from seed for the park's habitat restoration events, a perfect hands-on learning opportunity in your school. You must have space to hold 3-10 flats for plants indoors or in a greenhouse. The National Park Service provides soil and native seeds and can provide a limited number of lights and stands. Students will learn about native plants, stewardship, and be able to exercise their green thumb. You'll watch your seeds grow into young plants, and then join a ranger on a late May or early June restoration planting field trip in a park along the Mississippi River.

Habitat Restoration

At Habitat Restoration Events, students work with National Park Service Rangers to remove an invasive plant species, plant a native species or collect seeds at various locations along the Mississippi River. A typical two to three hour period includes students rotating between a habitat restoration activity and a hike or lesson related to the site's history or natural resources. Sites are available throughout the metro area. These service projects are available April through mid November. Availability is very limited in May and September.

Please contact Kathy Swenson, Volunteer Manager for more information.
miss_volunteer@nps.gov
(651) 293-8424

Photo credit: Irene Jones/FMR

Friends of the Mississippi River
101 East Fifth Street, Suite 2000
Saint Paul, MN 55101

(651) 222-2193

www.fmr.org

Mississippi National River and Recreation Area
111 Kellogg Boulevard East, Suite 105
Saint Paul, MN 55101

(651) 290-4160

www.nps.gov/miss

www.stateoftheriver.com