The Scene

Something is wrong with the Sparkling River. What was once a clear, clean, diverse body of water has become a sluggish, murky eyesore. The residents who moved into the new development along the river are angry that their beautiful riverfront homes are now worth less than when they bought them. Anglers are upset with declining water quality in what used to be an excellent trout stream.

The city has asked you, a fish biologist and expert on **degraded** ecosystems, to come and speak to the angry residents and anglers about what has gone wrong with the river and offer suggestions on how to fix the problems. What do you think could be wrong? What types of surveys would you need to conduct in order to find the culprits? How could the local residents solve the problems you discover?

INSTRUCTORS: Answers found in Section Assessment on page 81.

SECTION B

People Knowledge

Ecosystems are not perfectly stable machines. Trophic pyramids can crash, dissolved oxygen levels can plummet, temperatures can swing, and shelter can disappear. Sometimes the changing dynamics of an ecosystem are natural fluctuations or disruptions: A volcanic eruption that clouds the sky around the globe can slow photosynthesis and disrupt the trophic pyramid. A long winter that keeps ice on for an extra month can deplete oxygen in a frozen lake. A flood can wash out gravel on the bottom of a stream.

At other times, disruptions to an ecosystem result from human decisions and actions. To be an educated angler, you should be able to recognize some of the actions humans take that can affect fish populations and some steps you can take to improve fishing conditions. In this section, we will discuss some human choices that are changing the environment and several management efforts beneficial to both people and fish.

Head To Head

In this chapter, three lesson plans outline some common threats that compromise the health of a fishery.

To The Point

OBJECTIVES: Students will be able to:

- describe at least five sources of contaminated runoff
- detail at least five impacts that contaminated runoff has on aquatic ecosystems
- discuss at least five actions that can be taken to reduce or eliminate contaminated runoff

METHOD: Students will plan an information program to alert the public to specific nonpoint source pollution problems and solutions for their watershed.

MATERIALS:

1) Overheads or PowerPoint slides made from a topographic map and/or watershed map of your area

2) Information about your local watershed

3) internet and computer access or copies of Main Activity handouts listed below

You can find topographic maps through the Wisconsin Geological and Natural History Survey: **uwex.edu/wgnhs.htm**
Find your watershed through the Environmental Protection Agency's watershed website: **cfpub.epa.gov/surf/locate/index.cfm**
Locate information on Wisconsin watersheds and river basins through the DNR's website at: **dnr.wi.gov/org/gmu**

SETTING: Indoors or outdoors

DURATION: Three to four 45-minute sessions, plus time for research

VOCABULARY: Stressors, watershed, point source pollution, nonpoint source pollution, effluent, runoff, atmospheric deposition, neurotoxin, persistent organic pollutants, bioaccumulation.

STANDARDS:
Science: A 8.8, 12.1, 12.5; F 8.9, 8.10, 12.8.
Environmental Education: A 8.3, 8.4, 8.5, 8.6, 12.5; B 8.5, 8.8, 8.10, 8.15, 8.17, 8.18, 8.19, 8.21, 12.5, 12.17, 12.18; D 8.1, 8.5, 8.6, 12.1, 12.5.
Language Arts: C 8.1, 12.1; F 8.1, 12.1.
Social Studies: A 8.1, 8.11, 12.4, 12.11, 12.12.

BACKGROUND: In 1972, Congress passed the Clean Water Act to help protect and restore U.S. lakes, streams, and rivers so they would be clean enough for fishing, swimming, and other recreational uses. Point sources (factories and wastewater treatment plants) were required to obtain permits limiting the amount of pollution they could release, track their waste discharges, and report on their efforts to reduce pollution.

The Act had widesweeping results. For example, fish began to live in parts of the Wisconsin River again, and citizens began to notice improved water quality in other rivers flowing through their communities. But the law did not address nonpoint source pollution, which occurs when rain and melting snow wash contaminants off urban and rural land. Nonpoint source pollutants include fertilizers and pest control chemicals; oil, grease, and toxic fluids from roads, driveways, and parking lots; sediments from poorly-managed construction sites; and bacteria and nutrients from livestock, pet wastes, and faulty septic tanks, to name a few.

This type of water pollution continues to pose a major threat to aquatic ecosystems around the world, including Wisconsin. Cleaning it up requires a high degree of cooperation among federal, state, and local governments and citizens. Fortunately, many effective projects are under way —look for some in your community!

OPENING: Have students read **To the Point** in their booklets. Ask if anyone knows the name of your local watershed. Show a map of your local watershed, perhaps combined with a topographic map, to show the boundaries of the watershed and the path that water follows from students' lawns to the nearest waterbody and where it travels from that point on. Emphasize that any substance that falls on the ground in the watershed will enter local waterbodies. Many seemingly small things, like pet waste, combine to create large pollution problems, like eutrophication. Anything that is "in the wrong place at the wrong time in the wrong quantity" becomes a pollutant. Ask students to think about pollutants that might come from their own daily activities or pollution-creating activities that they see happening in their watershed.

MAIN ACTIVITY: Tell students that their assignment is to develop a plan to provide information about the causes, results, and prevention of nonpoint source pollution for various public audiences. Discuss the idea of

"target audiences" and who they might be in your local area. Students should realize that because there are so many potential sources of contaminated runoff, there are also many different groups of people who could use specific information about their contributions to nonpoint source pollution. Brainstorm different groups of people that might benefit from nonpoint source pollution education and where students might access these groups. Possibilities include local crop farmers, dairy farmers, homeowners, urban residents, or construction workers.

Assign one target audience to each group of three to four students. Students will research nonpoint source pollutants that could originate with their audience, how those pollutants affect aquatic ecosystems, and potential ways to reduce these pollutants. Students will develop a plan to communicate this information. The plan will include a poster or brochure and an event where this information could be presented. Students should also consider props or tools that could help them present the information to their audiences, like watershed models or maps.

The following websites have helpful information for understanding nonpoint source pollution problems and solutions. If students have access to the internet, you can point them in the direction of these websites. If students do not have access to the internet, you may want to make copies from these websites to help students conduct research.

Planning With Power: A land use planning website with many informational handouts about the sources and effects of nonpoint source pollution (managed by Purdue University). **planningwithpower.org/pubs.htm**

Environmental Protection Agency: Information about sources of contaminated runoff can be found at **epa.gov/owow/nps/categories.html** and Success Stories about nonpoint source pollution restoration projects can be found at **epa.gov/owow/nps/Success319/**

National Oceanic and Atmospheric Administration: NOAA's Ocean Science Education pages have a helpful kit of educational materials about nonpoint source pollution: **oceanservice.noaa.gov/education/kits/pollution/welcome.html**

CLOSING: Have students present their planned information program to the class. Allow each group to add to a list of problems various contaminants cause in aquatic environments. Have a parallel list with suggestions for preventing contaminated runoff.

ASSESSMENT QUESTION: What is the difference between point and nonpoint source pollution? Name five nonpoint source pollutants and five ways of addressing these sources.

ANSWERS: *Point source pollution: an identifiable source that dumps directly into a waterbody. Nonpoint source pollution: pollution that comes from many places across a landscape.*

Possible pollutants: soil, oil, fertilizer, manure, dog waste. Possible ways to address them: control erosion with native plants, keep your car in good condition and dispose of used oil properly, apply fertilizer only in the places and amounts needed, capture manure, collect dog waste and throw it in the trash.

EXTENSIONS:

Service Learning: Have students present their posters at an actual public meeting or to another classroom.

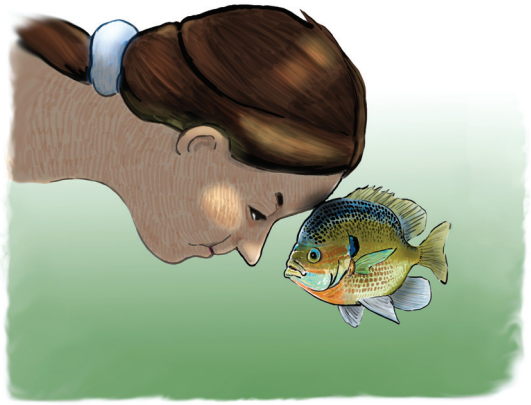
In Depth: Invite guest speakers to describe local environmental issues and encourage students to attend public hearings

If you have downloaded this booklet, please see the appendix that follows for additional materials.

3

Head to Head

What sorts of decisions do humans make that can affect fish? Sometimes actions that humans take create obvious problems for fish. When a wetland is filled in or a septic tank overflows into a river, the effects on fish populations are immediate and visible. Often, however, we are unaware of the impacts our choices have on aquatic environments. In this section, we'll discuss some environmental **stressors** that affect fish.



In this section, we'll discuss some environmental stressors that affect fish.

To the Point

Water that comes out of our taps at home—the water that we drink and shower in—has been filtered and cleaned. That's not the case for fish. Fish have to swim in whatever water comes their way, even if it is polluted. Water pollution can come from two types of sources: **point** and **nonpoint**. A point source of pollution is a particular, identifiable source of pollution that dumps pollutants directly into a water source. A pulp and paper mill, for example, that discharges **effluent** (waste material) into a nearby stream is a point source and is, therefore, regulated by the Clean Water Act. Many of these sources have been cleaned up over the years. Nonpoint source pollution is much harder to regulate, because it comes from many places across a landscape.

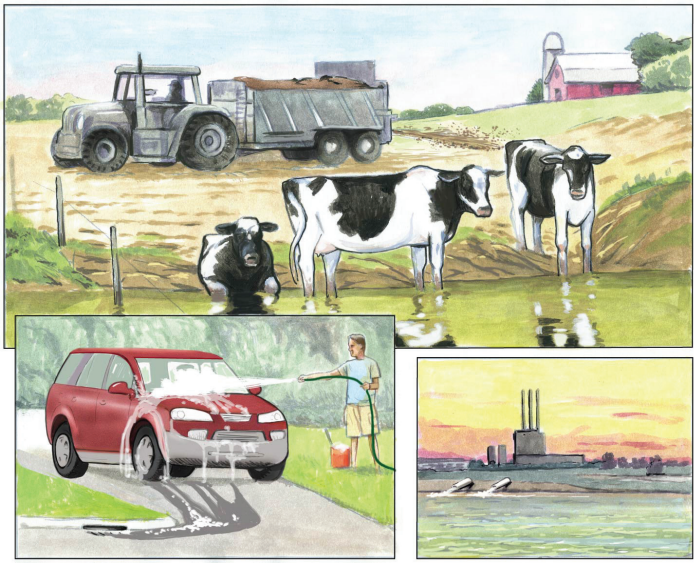
Point source
a particular, identifiable source of pollution that dumps pollutants directly into a water source

Nonpoint source
pollution that comes from many places across a landscape

Effluent
waste material

Runoff

Nonpoint source pollution can come from many places. The oil that drips out from under a car, the salt used to make roads safe in winter, and the dog deposit Spot left on your lawn can all become aquatic pollutants. Rain and snowmelt will carry these items into your local stream or down into the groundwater where they contaminate the water. This polluted **runoff** is the leading cause of water quality problems in Wisconsin and in the United States.



Runoff, atmospheric depostition and erosion can all affect water quality.

Watershed Moment

When rain falls on your roof, where does it go? Down the gutters, off the pavement, into the ground…and then where? The rain that falls on your house will eventually make its way into a large waterbody, like Lake Michigan, the Mississippi, or Lake Superior. On its way, it will travel through a network of streams, rivers and, perhaps, some wetlands and lakes. Each waterbody your water passes through is affected by the decisions you, and those who share your watershed, make. What's your watershed, and who shares it with you?

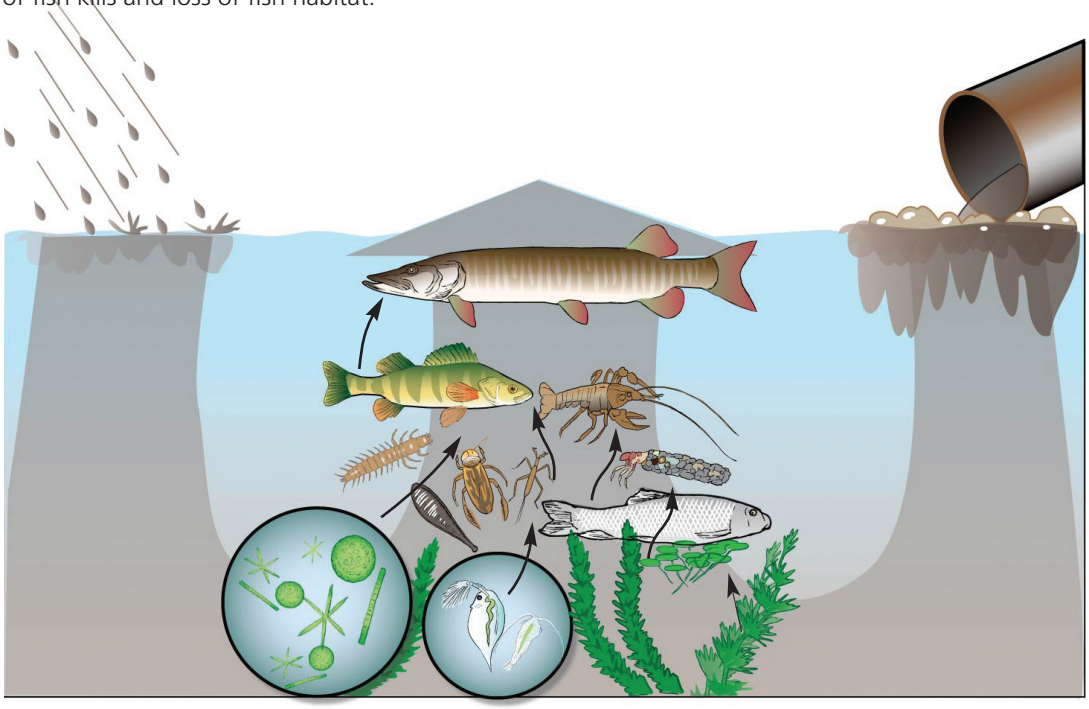
Erosion

Wind, water, and ice movement are natural processes that cause soil erosion, but certain activities can accelerate it. A cow walking into a stream will kick up soil along the bank. A construction worker digging a hole for a new foundation breaks up soil and piles it up. Both actions allow loose soil to more easily wash away in a rainstorm or with melting snow.

Eroded soil that enters the water can bury fish habitat and smother fish eggs. Eroded soil as a nonpoint source pollutant can be a major cause of fish kills and loss of fish habitat.

Atmospheric Deposition

When we burn coal for electricity, when a volcano explodes, and when a waste incinerator operates, the smoke and steam that are emitted carry chemicals with them up into the atmosphere. These chemicals can travel long distances in air currents—crossing city, state, and national borders—and will eventually fall to the ground with rain droplets or snow in a process called **atmospheric deposition**. Atmospheric deposition is another form of nonpoint source pollution that affects the fish in Wisconsin.



Contaminants move up the food chain.

Neurotoxin
A poison that affects the brain and nervous system

Persistent organic pollutants
Contaminants which do not break down in the environment

Bioaccumulation
The build-up of substances such as pesticides or other toxins in an organism

What's in Your Water… Ends Up in Your Fish

Atmospheric deposition and runoff are responsible for two contaminants of particular concern for anglers in Wisconsin: mercury and PCBs, respectively. Both are highly toxic and have properties that allow them to remain in our environment for long periods of time.

Once mercury is in the water, bacteria convert it into methylmercury, which is a powerful **neurotoxin** (a poison that affects the brain and nervous system).

Polychlorinated biphenyls (PCBs) were used in industrial applications like paint and hydraulic equipment until they were banned in 1976 because of their toxicity. They are **persistent organic pollutants** (contaminants which do not break down in the environment) and continue to leak out of contaminated sediments, hazardous waste sites, and old products.

When small fish eat bacteria or plankton that have been exposed to methylmercury, for example, that mercury begins to accumulate in the fish's body. **Bioaccumulation** (the build-up of substances such as pesticides or other toxins

in an organism) can have serious implications for fish and angler health.

Toxins aren't the only way that runoff and atmospheric deposition affect fish. When chemical fertilizers and manure, both of which contain phosphorus, are applied to lawns and fields at rates the land cannot absorb, excess phosphorus runs off into waterbodies. Too much phosphorus in the water causes algal blooms that can make water look like pea soup. Not only does a pea soup lake look and smell bad, it can also kill fish and wildlife. When a mat of algae covers the water, it blocks sunlight needed by other aquatic plants and as it decays uses oxygen needed by fish. Massive algal blooms can also produce toxins that sicken wildlife and, occasionally, pets and humans.

Perhaps the most prevalent runoff contaminant is sediment. The sand, dirt, and gravel from construction sites, roadways, backyard gardens, or farm fields become contaminants when they enter the wrong places in the wrong quantities. Sediment in water can alter stream flow, cover important spawning habitat, or make the water murky. Murky water has lower levels of dissolved oxygen and increased water temperatures which both affect fish populations. Murky water also prevents sunlight from reaching submerged plants which stunts their growth.

Fish Consumption Advisory

Certain lakes and rivers have special mercury or PCB advisories. Go to the DNR website at **dnr.wi.gov/fish/consumption** to investigate which ones. By observing the recommendations in the DNR's "Choose Wisely" fish consumption guide you can enjoy fish as a regular part of your healthy diet.

Making a Difference

Here are a few steps that you can take to reduce your own contribution to nonpoint source pollution:

- Take unwanted household chemicals and medications to hazardous waste collection centers. Do not pour them down the drain or onto the ground.
- Use low-phosphate or phosphate-free soaps and detergents, non-toxic cleaning supplies, and water-based products.
- Clean up after your pets.
- Reduce the amount of chemicals your car releases into the air by driving only when necessary and keeping your car tuned up. Clean up spilled auto fluids and never dump oil or antifreeze into your household trash.
- Support farm practices such as rotational grazing or fencing off streams. These actions will reduce the amount of streambank erosion caused by cattle and the amount of manure that runs off directly into the water.

Prescription for Trouble

Leftover medicine can present problems for aquatic wildlife when it is flushed down the toilet. Sewage treatment plants do not have the ability to remove drugs from the water, so fish end up "taking" leftover prescriptions. To solve this problem, some communities schedule special collection days for citizens to do a "clean sweep" of their medicine chests. This helps to reduce the amount of medication entering the food chain.