

## SECTION 1.8 INTRODUCTION

**1.8 Read****What are Some Sources of Pollution in a River?**

† 1 class period\*

**Overview**

Students have learned that various land uses can change the water that is part of their watershed. They have learned that runoff from residential, commercial, agricultural, and industrial land use can carry different substances into water that eventually winds up in river water. This runoff can erode soil, which is carried to rivers. Deposition is the dropping of soil from the river once it slows down. Depending on the size of the soil particles and how swiftly the river water is flowing, eroded soil is deposited at various places. Groundwater forms when water is able to seep into soil. It is especially important for agricultural areas. Groundwater too, eventually reaches a river. Both runoff and groundwater can be contaminated by substances or pollutants as they move over and through the ground.

In *Section 1.8*, students will read about point-source and non-point sources of pollution. Point-source pollution occurs when pollutants are put directly into bodies of water. These can be easily identified. Examples of point-source pollution are untreated sewage, chemicals that leak from barrels into groundwater and then into rivers, chemicals from industrial smokestacks that are washed by rainfall into water supplies. Non-point sources of pollution are not so easily identified. They might be oil in runoff from cars and trucks on city streets, excess fertilizer from lawns and farms, salt and sand used by cities to treat icy roads, and trash that has been dumped by the side of the road.

\*A class period is considered to be one 40 to 50 minute class.

Targeted Concepts, Skills, and Nature of Science	Performance Expectations
Humans use rivers for residential, commercial, industrial, and agricultural purposes. Their activities affect water quality along a river.	Students should be able to provide examples of how land used by humans along a river can have an impact on the quality of water in a watershed.
Flowing water transports materials.	Students should be able to say that when water moves materials from one place to another, it redistributes these materials. In doing so, sometimes harmful or excess materials enter a watershed and cause changes there.

Targeted Concepts, Skills, and Nature of Science	Performance Expectations
Pollutant to a watershed may occur from point source or non-point sources of human activities.	Students should be able to distinguish between point-source pollutants and non-point source pollutants and identify examples of each.

### Materials

1 per classroom	Optional: projection images from students' text
1 per class	class <i>Project Board</i>
1 per group	set of images of various land uses along the Rouge River

## Activity Setup and Preparation

There is no investigation for this section, but equipped with new information about point and non-point sources of pollution, students can study the illustrations of common settings on pages 46 and 47 and restudy photographs of activities along the Rouge River and add to their ability to observe about how pollutants enter a watershed and what effects they can bring about.

With expanded information derived from observation and investigations in previous sections, students can add evidence to the Project Board.

## Homework Options

### Reflection

- Science Content:** Describe two non-point sources of pollution that you might see in your neighborhood or on your way to school. *(Answers will vary but may include: car exhaust, a car dripping oil or gasoline, a truck spreading salt on an icy street, someone spreading fertilizer on a lawn.)*
- Nature of Science and Science Process:** On the way to school one day, you see a tanker truck pulled up by a small stream. The tanker is unloading a liquid into the stream. What might you do? *(Answers will vary but there are laws against this activity. Suggestions may include making a note of any name on the truck of its license plate, calling local law enforcement, or calling the local environmental protection agency. Even if the truck is gone when law enforcement arrives, scientists can test the water to find out what was poured into the stream and if the dumping company is known, they can be fined.)*



1 class period\* u

## 1.8 Read

### What are Some Sources of Pollution in a River?

5 min.

Students are introduced to the term pollution to describe substances that change the quality of water in a watershed.

#### META NOTES

The *What's the Point* text on page 50 of the student book identifies the big ideas in this section. This text may help you to focus your students' learning through class discussions. Visit *What's the Point* on page 50 before any class discussions.

\*A class period is considered to be one 40 to 50 minute class.

## SECTION 1.8 IMPLEMENTATION

### 1.8 Read

#### What are Some Sources of Pollution in a River?

**pollution:** substances added to air, water, or soil that cause harm to the environment.

You built and ran models of land use using a stream table. You observed the effects of the different kinds of land use on erosion, deposition, and runoff in a watershed. During the classroom discussion, you might have discovered something more. Human activities also change the quality of the water. As the water flows through the watershed, it carries with it stuff it picks up along the way. This could be dirt and soil eroded from land. Runoff and groundwater can also pick up substances like chemicals, small particles, and pieces of trash that can affect the quality of the water. Scientists call these substances that end up in the river **pollution**. Pollution can cause harm to human health or the environment. Most of the time, these substances result from human activities. Normally, they are not found in natural environments. They can be very dangerous because living organisms may not be able to handle them.



#### Stop and Think

Look at the pictures below and on the next page. You might have seen scenes like these in your neighborhood, or town. People are walking down the street. People are washing their cars. Some are taking care of their lawns. Someone is pouring something down a sewer drain. Workers are fixing something under the street.



Project-Based Inquiry Science

46

### Engage


Divide the opening paragraph into three sections to give students a chance to focus on various aspects of changed water quality.

- Have a student volunteer read the first section (ending with “Human activities...”) for the purpose of reviewing what students have done and bringing students’ attention to the human influence on water quality.
- Have a second student read through the bold term, pollution to develop an idea of how water moving through a watershed picks up materials that can affect water quality.

- Have the third student read through to the end of the paragraph, which emphasizes the potential harm that can come from polluted water.


### ◆ Evaluate

Evaluate students' understanding of pollution as presented in this paragraph by asking questions such as "What causes pollution?" "What things are found in polluted groundwater?", "How do you know if water is polluted?" and "How might changes in water quality affect the quality of your life?"



### Stop and Think

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46

Project-Based Inquiry Science

### TEACHER TALK

“Think about what you’ve learned about materials and water moving through watersheds as you look at the two illustrations on pages 46 and 47. Study the two pictures. Think about where you live. Different people may see different activities going on. First, answer the questions individually. Then we will talk about them as a class.”

Possible Answers:

1. The images represent residential and commercial land use.
2. Residential:
  - a. Man dumping oil down a drain—the drain may lead directly to a river. This is illegal in most states.
  - b. Car leaking oil into gutter—the oil eventually will be washed into the drain and go to the river

### META NOTES

Middle school students may think that pollutants can only be substances that do not occur in nature. They may use the word *chemicals* to describe pollutants. In fact, everything is made of chemical elements. Pollutants are substances that harm the environment. For example, manure is a “natural” substance. In small quantities, manure can be helpful if it is used as a fertilizer. However manure can be a pollutant in surface runoff and groundwater supplies. Extensive university research focuses on how to manage manure disposal for large dairy and cattle farms.

### Stop and Think

15 min.

*Students analyze common human activities that result in changes to water quality. This prepares them for learning the differences between point and non-point sources of pollution in rivers.*

### META NOTES

Anticipate that students may interpret the illustrations differently from what you predict or plan.

- c. Person washing car — the soapy water will enter groundwater and some may flow down to the drain.
- d. Woman littering— the litter may be washed into the drain and move to the river
- e. Watering the lawn and sidewalk— some of the water will enter the groundwater; water landing on the sidewalk will be runoff.
- f. Woman raking and bagging leaves— removing litter from lawn although when leaves break down and enter their materials enter groundwater, they act as a natural fertilizer.

Commercial:

- a. Store owner pouring dirty water into drain— probably goes directly into the river.
  - b. Car leaking oil onto street— the oil eventually will be washed into the drain and go to the river
  - c. Woman littering— the litter may be washed into the drain and move to the river
  - d. Hole in street to possibly repair a broken sewer line—
3. Both areas will have runoff because of paved areas; grassy areas will absorb water. The commercial area has no grassy area for groundwater to form.
4. In grassy areas, water may pick up chemicals (fertilizers) from gardening. In both, runoff carrying discarded oil and contaminated wastes and litter cause pollution in rivers.

### **Guide**

Consider projecting an image of each illustration. To facilitate class discussion, begin by asking students to identify the pollution they see going on in each image and list these.

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1.8 Read



Answer the following questions as you look at the pictures.

1. What kind of land use does each picture represent?
2. Identify all of the examples of human activities shown in each picture. Describe how each activity might cause pollution.
3. How does this land use affect the water that flows through it?
4. Think about what might happen in each place when it rains. Describe what could be on the ground that might cause pollution in a river.

### Sources of Pollution in Rivers

Once pollutants get into soil or water, they are carried by surface and groundwater to rivers. This way they are distributed over large areas, sometimes miles away from their source.

Depending on how the pollution enters a body of water, pollution sources are divided into two groups, **point-source pollution** and **non-point-source pollution**.

**point-source pollution:** pollution that originates from a single point or location.

**non-point-source pollution:** pollution that comes from many sources over a large area.

## Engage

Prepare students for learning about the current classifications of pollution—point and non-point sources but initially, do not use the terms. Ask, “What are some sources of pollution in a river?” List their ideas in two columns (point and non-point) without telling them what the columns mean.





Then have students read Sources of Pollution in Rivers on pages 47-49. After students have read the terms and their descriptions, go back to the initial two lists you recorded and have students identify what class of pollution their ideas fall in to (point or non-point).

# Point Sources of Pollution and Non-Point Sources of Pollution

10 min.

### Point Sources of Pollution

Point-source pollution comes from a specific point or location. From this location, the pollution is discharged directly into rivers, lakes, or oceans. Scientists can easily identify the source of this type of pollution. They analyze the water at different points in the river or lake. The closer to the point source they measure, the higher the amount of pollutant they find.

Examples of Point Sources of Pollution	
Sources	How the Pollution Enters the River
 <p>leaking pipes</p>	Pipes that transport oil or chemicals can release these substances through cracks. These substances are carried to rivers by water.
 <p>barrels leaking chemicals</p>	Old barrels containing chemicals are sometimes dumped or buried in the ground. Over time, the chemicals leak out of the barrels and are carried to the river by water.
 <p>smokestacks</p>	Smokestacks from factories can release dangerous chemicals into the air. When these chemicals fall to the ground as small particles, or mix with rain, they are carried to rivers by water.
 <p>sewage discharge</p>	Raw sewage, or sewage that is treated only partially, sometimes is discharged directly into rivers. This sewage can contain harmful chemicals and bacteria.

### Non-Point Sources of Pollution

Non-point-source pollution comes from many sources and locations. Scientists cannot easily identify all the sources of this pollution. For example, one non-point source of pollution is runoff containing fertilizer used on lawns or farmland. Because the runoff has material from so many different farms or lawns, it would be difficult to pinpoint the source of the fertilizer. Another non-point source of pollution is urban runoff from roads and parking lots. Water running off these surfaces can carry oil leaked from cars or salt used to melt ice to a river. This type of pollution is often carried to the river by runoff over large areas. Non-point sources of pollution are

## Engage

Have half of the class look at the illustrations in the Point Sources chart and half study the illustrations in the Non-point Sources chart. Then have the class discuss share reasons why the examples have been classified as they are. They might also want to go back and reclassify the two lists on the board or add to them.

## Guide and Assess

To confirm that students understand the difference between the two categories of pollution, facilitate a class discussion by having them consider the following: (Scenario 1) Some people live in cities on rivers, so it probably doesn't take long for a pollutant in some runoff to reach the river.







## Reflect

10 min.

Students apply what they have just read to situations they have already looked at by revisiting the photographs of the Rouge River watershed in the Unit introduction and in Section 1.6.

1.S Read

much more difficult to control. It is hard to determine who or what is responsible for this pollution. Non-point sources of pollution can originate from a very large land area such as an entire watershed.

Examples of Non-Point Sources of Pollution	
Sources	How the Pollution Enters the River
<b>fertilizer</b> 	Many people fertilize crops, lawns, and other plantings. Eventually, the fertilizer can be carried to rivers in runoff.
<b>urban runoff</b> 	Vehicles and other equipment can leak lubricants and fuel that eventually wash into rivers.
<b>litter</b> 	People drop or dump trash and litter in public spaces. This litter is eventually carried to waters by wind and runoff.
<b>salt and sand</b> 	Communities spread salt and sand to prevent roads from icing over. This eventually is carried to rivers by runoff.

## Reflect

Look back at the photographs you reviewed early in the Unit. The photographs show scenes of the land use you were assigned and that you modeled with your stream table. Discuss with your group the types of pollution that may result from your land use.

- Record all of the pollution sources your group identifies in the photos, including both point sources and non-point sources.
- Record any pollution sources you think might be there because of certain activities or events shown in the photos.
- For each pollution example you record, determine if it is a point source or non-point source of pollution. Make sure you write the reason why you think so.



LT 49

LIVING TOGETHER

## △ Guide

Ahead of time, review the photographs from pages 6 and 7, and 36 through 38. Select photos that will enable students to demonstrate their understanding of point vs. non-point source pollution sources.

Divide the class into their teams or groups. Assign each group one or more photographs that you have selected from earlier in the text. Ask groups to prepare a presentation that lists what they think are sources of pollution in the photograph, what they think is the reason for the pollution, and whether it is a point-source or non-point-source pollution. Students are also to give reasons (evidence) for their choice.

Have each group present their photo and conclusions. Encourage the rest of the class to communicate their ideas and ask questions of the presenters.

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Learning Set 1 • How Do Flowing Water and Land Interact in a Community?

Your teacher will lead a class discussion where each group shares their photos and their work. Listen carefully as other members of your group discuss their observations and conclusions. With your class, review and discuss the observations and conclusions drawn by other groups investigating a different land use. How are the pollution sources similar or different for each land use? Come up with a list of types of pollution you agree upon. List the types of pollution you found for each of the land uses your class has investigated.

### Update the Project Board

The questions you focused on in this Learning Set were *How does water affect the land as it moves through the community?* and *How does land use affect water as it moves through a community?* Return to your Project Board to update any questions or ideas you have posted. You now have many items to post in the *What are we learning?* column. Be sure to cite (in the *What is our evidence?* column) the evidence you collected to support what you say you have learned about pollution and land use. Discuss with your class what you learned and recorded on your Project Board that can help you answer the two questions. You might make up and discuss several new ideas or understandings that should be recorded on the Project Board.



### What's the Point?

There are many different ways that land use can add pollutants to a watershed. All of the different ways of polluting are grouped into two different types: point sources and non-point sources of pollution. Point sources of pollution, the kind that happen in many industrial areas, are very harmful. However, they are a lot easier to stop than non-point sources of pollution. Non-point sources of pollution can be more difficult to find. They do not come from a specific place. Agricultural areas, like farms, and residential areas create a lot of non-point sources of pollution through fertilizers.

Project-Based Inquiry Science

58

## Update the Project Board

10 min.

*Students revisit the class Project Board to add information that shows the evolution of their ideas as they have learned new information about water in watersheds.*

Inform the class to be polite during presentations. Tell them that they might not always agree with the presenters' conclusions. If they disagree with the presenters' conclusions, they should voice their differences politely, but be prepared to give reasons for their viewpoint.

### △ Guide

Remind students that in column 3 of the *Project Board*, they are to answer the question "*What are we learning?*" In column 4, they are to provide evidence that supports what they say they have learned.

We have learned a lot about point and non-point source pollutants. We will need this information as we move ahead through the unit. Scientists keep track of everything they read, think about, and do in an experiment to answer their questions. The Project Board gives us a place to keep track

of what we are learning. What you have learned in this *Learning Set* needs to be added to the *Project Board*. In addition, let's recall the *Big Question* *How does water quality affect the ecology of a community?* How does what you are learning relate to this *Big Question*?

Ask students to state claims for column 3 and evidence supporting the claims for column 4. You might have to help them get started by writing the first Claim statement. Remind students that they can have more than one claim. Examples of four possible claims and their evidence might include:

**Claim 1:** Human activities on land can affect the water quality of a river. If land is changed and roads and large areas are paved, water quality can be affected.

**Evidence for Claim 1:** Changing the form of land affects erosion and deposition of rivers. Our stream table model showed that for paved areas, erosion increased due to faster runoff.

**Claim 2:** Deposition of materials occurs when water movement slows down.

**Evidence for Claim 2:** In our stream table model, we observed that as water flowed faster, it carried more soil. Then, as it slowed down, it released the soil. This happens on curvy rivers too where fast moving water eroded the outside curves and then dropped soil on the inside curves where water slowed down. This was hard to see on our model, but we also read about this.

**Claim 3:** How land is used affects how water flows over or through land to a river.

**Evidence for Claim 3:** From our stream table model, we observed that when there is a lot pavement, there is more runoff and it can move faster. We decided that this causes more erosion and carries more water to a river. Fast moving water can stir up soil in the river and erode soil there. In places where there is grassy and trees (vegetation), water is absorbed into the ground. It becomes part of groundwater and moves more slowly into a river. Land without vegetation or pavement is bare soil. It can be eroded easily by fast-moving water and is moved to rivers.

**Claim 4:** Human activities can cause changes in water that result in pollution.

**Evidence for Claim 4:** In the reading, we learned how human activities such as careless dumping of materials; accidental spills, manufacturing, farming, and dumping trash can cause pollution in a watershed. Some of these substances go directly to a river and some of them move through groundwater over a long time.

## Assessment Options

Targeted Concepts, Skills, and Nature of Science	How do I know if students got it?
Humans use rivers for residential, commercial, industrial, and agricultural purposes. Their activities affect water quality along a river.	<p><b>ASK:</b> What is one way that humans have affected the movement of water in a watershed.</p> <p><b>LISTEN:</b> Students have many choices here. Listen for such human activities as pavement, and any of the four types of land use that students experimented with.</p>
Water and land interact.	<p><b>ASK:</b> How does pollution in a river near a factory or farm tell you that land and water interact.</p> <p><b>LISTEN:</b> Answers will vary but students might say that pollutants found in a river or stream got there way by groundwater or runoff from pavement. Those substances are not naturally part of a river.</p>
Water flow transports and redistributes materials in a stream.	<p><b>ASK:</b> How can runoff redistribute soil or sediment in a river?</p> <p><b>LISTEN:</b> Students should be able to say that water in the form of runoff from pavement; moves fast and can stir up and lift soil or sediment in a river, causing erosion. Later, as the water slows down, the sediment drops out or is deposited to the bottom of the river at another place along the river.</p>

## Teacher Reflection Questions

- What difficulties did students have in distinguishing point and non-point sources of pollution in the illustrations? Were they able to make connections between water flow in a watershed and the spread of pollution? What changes should be made to the lesson to help students find examples of point source and non-point source pollutants?
- How did the *Project Board* assist students in making connections between concepts they have learned so far. IN what ways if the Project Board valuable for recording information students need to answer the Big Question and address the Big Challenge?
- How has students' conceptualization of a watershed changed since the beginning of this *Learning Set*?