

Pollution



Delta Science Readers are nonfiction student books that provide science background and support the experiences of hands-on activities. Every **Delta Science Reader** has three main sections: *Think About . . .*, *People in Science*, and *Did You Know?*

Be sure to preview the reader Overview Chart on page 4, the reader itself, and the teaching suggestions on the following pages. This information will help you determine how to plan your schedule for reader selections and activity sessions.

Reading for information is a key literacy skill. Use the following ideas as appropriate for your teaching style and the needs of your students. The After Reading section includes an assessment and writing links.

OVERVIEW

In the Delta Science Reader *Pollution*, students read about how human and natural activities can cause land, air, and water pollution. They learn what can be done to reduce pollution and conserve natural resources. They read about the difference between renewable and nonrenewable resources. Noise and light pollution are also introduced. In a biographical sketch, students meet a famous scientist—Rachel Carson—whose warnings about the dangers of pesticides led to the banning of DDT. Finally, students learn about alternative energy sources and why it is important to develop them.

Students will

- ▶ discover facts about land, air, water, noise, and light pollution
- ▶ learn how pollution affects various ecosystems
- ▶ explore ways to prevent and reduce different types of pollution
- ▶ find out about renewable and nonrenewable resources and alternative energy sources
- ▶ examine nonfiction text elements such as table of contents, headings, and glossary
- ▶ interpret photographs and graphics to answer questions
- ▶ complete a KWL chart

READING IN THE CONTENT AREA SKILLS

- Set a purpose for reading
- Recognize the causes and effects of different types of pollution
- Identify problems caused by pollution and solutions to those problems
- Draw conclusions and make inferences from text information
- Identify main ideas and supporting details in text passages
- Demonstrate critical thinking
- Interpret graphic devices
- Summarize and paraphrase text passages

NONFICTION TEXT ELEMENTS

Pollution includes a table of contents, headings, photographs, captions, boldfaced terms, a circle graph, and a glossary.

CONTENT VOCABULARY

The following terms are introduced in context and defined in the glossary: *acid, acid rain, air pollution, biodegradable, chemical, conservation, ecosystem, filter, food chain, fossil fuels, global warming, greenhouse effect, groundwater, groundwater quality, incinerator, land pollution, light pollution, natural resource, noise pollution, nonrenewable resource, ozone, pollutant, pollution, reclamation, recycle, renewable resource, sanitary landfill, smog, thermal pollution, water pollution, wetland*

BEFORE READING

Build Background

Access students' prior knowledge of pollution by displaying and discussing the cover. Ask, *What do you see?* (smoke coming out of smokestacks) *What will happen to the smoke?* (It will go into the air.) *What effect*

will the smoke have on the air? (It will make it dirty/pollute it.)

Read the title aloud, and invite students to share what they know about the topic from their personal experiences and hands-on explorations in science. To stimulate discussion, ask questions such as these: *What are some things that pollute our land, air, and water? How does pollution affect our everyday lives? What can be done to prevent pollution?*

Begin a group KWL chart by recording facts students know about pollution in the K column and things they would like to learn in the W column. You may want students to copy the KWL chart so they can maintain their own charts as they read.

K What I Know	W What I Want to Know	L What I Learned	+ What I Want to Explore Further

Preview the Book

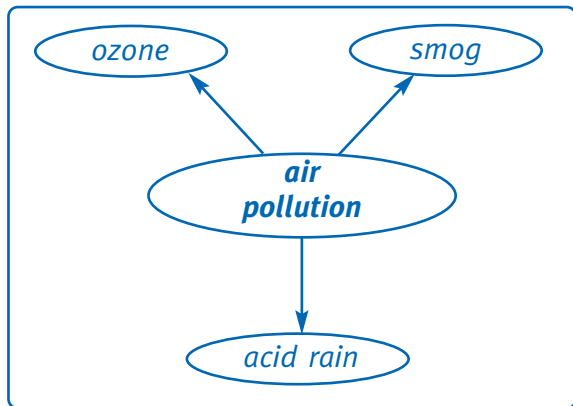
Explain that when students preview nonfiction, they should look at the title, the table of contents, headings, boldfaced words, photographs, illustrations, charts, graphics, and captions.

Then preview the book with students. Call attention to the various nonfiction text elements and explain how they can help students understand and organize what they read. Ask questions such as these: *How do the headings help you predict what you will read about? What do you see in this picture? How do you think it will help you understand the text?* Explain that the words in boldface type are important words related to pollution. Point out that these words are defined in the glossary. Choose one word and have students find its definition in the glossary.

Preview the Vocabulary

You may wish to preview some of the vocabulary words before reading, rather than waiting to introduce them in the context of the book. Possibilities include creating a word wall, vocabulary cards, sentence strips, or a concept web.

For example, some vocabulary words relate to air pollution. Work with students to develop a web like the one below.



▲ A concept web for **air pollution**.

Set a Purpose

Discuss with students what they might expect to find out from the book, based on their preview. Encourage them to use the questions on the KWL chart to set an overall purpose for reading.

GUIDE THE READING

Preview the book yourself to determine the amount of guidance you will need to give for each section. Depending on your schedule and the needs of your class, you may wish to consider the following options:

- **Whole Group Reading** Read the book aloud with a group or the whole class. Encourage students to ask questions and make comments. Pause as necessary to clarify and assess understanding.
- **Shared Reading** Have students work in pairs or small groups to read the book

together. Ask students to pause after each text section. Clarify as needed and discuss any questions that arise or have been answered.

- **Independent Reading** Some students may be ready to read independently. Have them rejoin the class for discussion of the book. Check understanding by asking students to explain in their own words what they have read.

Tips for Reading

- If you spread out the reading over several days, begin each session by reviewing the previous day's reading and previewing what will be read in the upcoming session.
- Begin each text section by reading or having a volunteer read aloud the heading. Have students examine any illustrations or graphics and read accompanying captions and labels. Discuss what students expect to learn, based on the heading, illustrations, and captions.
- Help students locate context clues to the meanings of words in boldface type. Remind them that these words are defined in the glossary. Provide help with words that may be difficult to pronounce.
- As appropriate, model reading strategies students may find helpful for nonfiction: adjust reading rate, ask questions, paraphrase, reread, visualize.

Think About . . . (pages 2–13)

Page 2 **What Is Pollution?**

- Have students read the text on page 2. Assess understanding by asking, *What do all living things need?* (clean land, air, and water) *What do we call these things?* (natural resources) *What is pollution?* (damage done to land, air, or water) *How do people damage these natural resources?* (by adding harmful things called pollutants)

- If necessary, provide help with the pronunciation of *ecosystem* (E-ko-sis-tuhm).

Pages 3, 4, 5 *Land Pollution*

Page 3 *The Problem of Waste*

- Have students read the introduction to page 3. Before having them continue reading, ask, *What kinds of things might people add to land that cause land pollution?* (Accept reasonable responses.)
- Then have students read the first paragraph and study the graph. If necessary, explain that a circle graph shows what percentage each part is of the whole. Explain: *The whole circle represents the total amount of trash produced. Each section of the circle shows the amount of that type of trash related to the total.* Ask questions such as these to guide students in analyzing the graph: *What type of trash represents the greatest part of the total?* (paper) *Which is the next largest?* (yard trimmings) *Which types of trash are equal in amount?* (wood and glass) *Which way of presenting this information would be easier to read, a list of types of trash with their percentages or a circle graph? Why?* (circle graph, because you can easily compare the amounts of different kinds of trash and see how much each kind contributes to the whole) Ask, *What was the most surprising thing you learned about the problem of waste?* (Responses will vary.)
- Have students finish reading page 3 to learn how waste is handled. Assess understanding by having students describe in their own words the three ways of dealing with waste that are presented. (burying food and other materials that will break down in sanitary landfills, burning waste in incinerators, recycling materials that can be used again) Invite students to share what they know about the ways waste is handled in your community.

- You may wish to use the information about waste to begin a problem-solution chart for types of pollution and ways of preventing or reducing damage to the environment. Explain: *A chart is a good way to organize information.* It makes the information easy to read. Continue adding to the chart as problems and solutions are discussed.
- If necessary, provide help with the pronunciation of *biodegradable* (bi-o-dih-GRADE-uh-buhl).

Further Facts

- Recycling 1 ton of paper saves 17 trees; almost 26,500 L (7,000 gal) water; 1,750 L (463 gal) oil; 266 kg (587 lb) air pollution; 2.34 m³ (3.06 yd³) landfill space; and 4,077 kilowatt-hours of energy.
- Every day, 62 million newspapers are printed in the United States, and 44 million of them are thrown away. This means that the equivalent of about 70,000 trees will be dumped into landfills every day.
- The steel industry recycles about 19 billion cans into new products every year. That's about 600 cans a second!
- Recycling one glass bottle saves enough electricity to light a 100-watt bulb for 4 hours.

Page 4 *Chemical Pollution*

- Have students read page 4 to learn about another type of land pollution. Ask, *What is the main idea—the most important point the text makes—about chemical pollution?* (Chemicals can seep into the groundwater and pollute it.) *What other harm can be caused by chemicals used on fields and lawns?* (They can kill helpful animals and birds.) *Why was storing harmful chemicals in metal drums at dumps and landfills a poor solution?* (The drums leaked.) *How are scientists trying*

to solve the problem of chemical pollution? (by finding ways to recycle chemicals or make them less harmful)
What is another way to prevent chemical pollution? (use fewer harmful chemicals)

- You may wish to tell students that some farmers practice what is called *organic farming* to solve the problem of chemical pollution. These farmers do not use chemicals on their crops at all. They use organic fertilizers, such as cow and horse manure, and deal with pest control in natural ways, such as using pests' natural enemies.

Page 5 *Changing the Land*

- Have students read page 5, look at the photograph, and read the caption. Explain, if necessary, that strip mining involves removing the layers of soil over the coal or other mineral to be mined, then digging out the mineral. This leaves the land raw and damaged.
- Discuss the effects of changing the land by the activities mentioned in the text. Ask, *What are some of the ways people change the land?* (by building houses, businesses, and other structures; by mining and lumbering; by growing crops and grazing animals; by using land that was once forests, prairies, or deserts) For each kind of human activity, invite students to speculate about the impact on the living and nonliving things in the affected ecosystem. (Changes in an environment may cause some organisms to move out, some to move in, some to survive and reproduce, and some to die.)
- Assess understanding by having students explain the difference between renewable resources and nonrenewable resources. (Renewable resources can be replaced; nonrenewable resources cannot be replaced.) Point out that some renewable resources, such as wind and sunshine, are available in limitless supply. Other renewable resources, such as fresh water and forests, can be replaced in a fairly

short length of time. Challenge students to name as many renewable resources as they can think of. (Answers may include trees, farm crops, fish and other animals, wool from sheep, cotton, water, sun, wind.) Point out that anything that can be grown or that reproduces is a renewable resource. Ask students to name nonrenewable resources in addition to oil, coal, and minerals. (natural gas, soil)

- If necessary, provide help with the pronunciation of *nonrenewable* (non-re-NOO-uh-buhl) and *reclamation* (rek-luh-MAY-shun).

Pages 6, 7, 8 *Air Pollution*

Page 6 *Natural Air Pollution*

- Have students read the introduction to the section on air pollution, look at the photograph, and read the caption. Before students read the page, challenge them to think of other possible causes of natural air pollution. (Accept reasonable responses.) Then have them read page 6.
- After students read, have them name three sources of natural air pollution. (windstorms, volcanoes, fires caused by lightning) Ask, *How do windstorms cause air pollution?* (They blow dust into the air.) *How do volcanoes cause air pollution?* (They send dust, ash, and gases into the air.) *How do fires caused by lightning cause air pollution?* (They send smoke, ash, and gases into the air.) *Is there any way to prevent these natural causes of air pollution?* (no)

Page 7 *Burning Fuels*

- Have students read page 7. After students finish, ask, *How does the burning of fuels cause air pollution?* (It produces waste gases.) Then have students explain the greenhouse effect. (Some gases in the air trap heat. This warms Earth's climate.) Ask, *In what way is the greenhouse effect good for Earth?* (Most living things need a warm climate for survival.) Help students

understand that some greenhouse gases occur naturally in the atmosphere, while others result from human activities. Naturally occurring greenhouse gases include water vapor and carbon dioxide. Certain human activities create waste gases that add to the levels of some of these naturally occurring gases. Ask, *How can waste gases cause problems related to the greenhouse effect?* (Waste gases can trap more heat and make the climate too warm.)

- If students question how raising livestock can create waste gases, explain that decomposing livestock wastes release gases such as ammonia, methane, nitrous oxide, carbon dioxide, and hydrogen sulfide into the air. Some of these form greenhouse gases and affect the atmosphere. Some animals, including cows, emit methane during digestion. Animal wastes also pollute the groundwater.
- Ask, *What is smog?* (a kind of air pollution) *What causes smog?* (sunlight reacting with pollutants caused by burning fuels) *What harmful effects can smog have on people?* (It irritates eyes and makes it hard to breathe.) Point out that the word *smog* was first used in 1905 in a newspaper report describing a new kind of air-quality problem becoming common in large cities: “smoky fog,” or smog.
- Ask, *What causes acid rain?* (Chemicals from burning coal combine with moisture in the air and form acids.) *What harmful effects does acid rain have?* (It can hurt plants and animals and damage buildings and statues.) *After learning about the greenhouse effect, smog, and acid rain, what conclusion can you draw about burning fossil fuels?* (It is bad for the environment.)

Further Facts

- Acid rain does not usually kill trees and other plants directly. Instead, it damages their leaves so that they cannot make food. In addition, acid rain

dissolves nutrients and helpful minerals in the soil and washes them away before plants can use them to grow.

- Lakes and streams are normally slightly acidic. Acid rain can make them very acidic, and very acidic conditions can harm or destroy plant and animal life.
- Much of the acid rain in the eastern United States is the result of pollutants from coal-burning power plants in the Midwest. The acid gases released into the air are carried eastward by prevailing winds. In areas where the weather is wet, the acids become part of the rain, snow, and fog.

Page 8 *Cleaning the Air*

- Have students read page 8 to learn about ways to keep our air clean. Then ask, *What is the simplest way to keep our air clean?* (Use less fossil fuel.) Have students summarize some changes that have been made by power plants, factories, and automobile manufacturers to reduce air pollution. (use of wind power to produce electricity, treatment of coal to make it less polluting, adding scrubbers to smokestacks, catalytic converters on cars)
- Ask, *How can ordinary people help reduce air pollution?* (We can use less fuel and electricity.) *How can we use less fuel?* (carpooling, using buses, walking, and bicycling; keeping the heat low; using less hot water) *How can we use less electricity?* (Turn off lights and other things we aren’t using; use bulbs that need less electricity.)
- If necessary, provide help with the pronunciation of *catalytic* (kat-uh-LIT-ik).

Pages 9, 10, 11, 12 *Water Pollution*

Page 9 *Waste Water and Thermal Pollution*

- Read the introduction on page 9 with students. Then have them read the section on waste water. Ask, *What makes waste*

water from homes and other buildings harmful? (Germs that carry disease can grow in it.) *What harmful effects can this have?* (People can get sick; it can kill water plants and animals.)

- Before students read the section on thermal pollution, ask whether they know what *thermal* means. If necessary, explain that *thermal* means “relating to heat.” After reading, assess comprehension by having students summarize the effects of thermal pollution. (Heated water holds less oxygen, so some fish and plants may die. Warm water may keep the eggs of some fish from hatching.)

Page 10 *Oil Pollution*

- Before students read the caption on page 10, invite them to speculate about what the people in the photograph are doing. Then have them read to learn about the problem of oil pollution.
- Elicit the causes and effects of oil pollution. Ask, *What is one major cause of oil pollution?* (oil spills) *What effects does oil pollution have?* (It can kill plants and animals and pollute beaches.) *What do people do to try to clean up the effects of oil pollution?* (clean oil-covered birds, bulldoze and carry away polluted sand on beaches, burn floating oil or pump it from the water’s surface) *What is the best solution to oil pollution?* (prevention)
- You may wish to tell students that the problem of oil spills increased with the use of supertankers that can carry more than 4 million barrels (170 million gallons) of oil. Each year thousands of oil spills—large and small—are reported; the total amount of oil spilled into the ocean annually is greater than 9 million barrels (378 million gallons)!

Further Facts

- The largest oil spill in the United States occurred when the tanker *Exxon Valdez* ran aground and spilled almost

11 million gallons of crude oil into Prince William Sound, Alaska, in March 1989.

- The *Exxon Valdez* oil slick eventually coated more than 2,000 km (1,300 mi) of the Alaskan coastline, including many islands. The pollution killed 250,000 sea birds and more than 3,000 sea mammals and required a massive, expensive, long-term cleanup effort.
- How much oil is 11 million gallons? That amount would totally fill 9 school gymnasiums or 430 classrooms.

Page 11 *Chemicals in the Water*

- Before students read page 11, review what they learned about chemical pollution on page 4. Then have them read to discover more about this problem.
- After students read, assess understanding by having them describe what happens in a food chain when water is polluted by mercury. (Tiny living things take in mercury when they eat. Small fish eat these tiny things, and they get mercury in their bodies. The same thing happens to bigger fish that eat small fish. Animals that eat fish get mercury in their bodies.) Encourage students to make an inference about what can happen to people who eat fish contaminated with mercury. (Their bodies will be contaminated by the mercury.)
- Have students look at the photograph and read the caption to learn about another way chemicals in water can affect an ecosystem. Point out that although this type of pollution benefits the algae, it is harmful to fish.
- Explain that *bacteria* is the plural of *bacterium*, and *algae* is the plural of *alga*. Write all four words. Tell students that many science words come from ancient Latin and Greek, and their plural forms are different from the plurals of English words. *Bacterium* comes from a Greek word that means “staff” (some bacteria are rod-

shaped), and *alga* comes from the Latin word for “seaweed.”

Page 12 *Preventing Water Pollution*

- Have students read page 12 to discover ways of preventing water pollution. Ask, *How are bodies of water cleaned naturally?* (Oxygen given off by plants helps break down wastes.) *Why is this not the solution to water pollution?* (People pollute water faster than plants can clean it, and some chemicals can’t be broken down.)
- Help students understand that the amount of fresh water in lakes and rivers (and stored as groundwater or in glaciers) is limited. Its availability for use can be extended by recycling and conserving water and by reducing water pollution.
- Check comprehension by having students summarize ways in which people are trying to prevent or lessen water pollution. (water treatment plants, artificial wetlands, double hulls on oil tankers, laws about chemical disposal, lowered use of chemicals by farmers, cooling ponds at power plants)

Page 13 *Noise and Light Pollution*

- Before students read page 13, ask, *What do you think noise pollution is?* (too much loud noise) *What might cause it?* (Answers may include radios and other audio equipment, city traffic, factory machines, and so on.) *Why might too much noise be considered a type of pollution?* (Accept reasonable responses.) Have students speculate what light pollution is. Then have them read to confirm their ideas.
- Ask, *What is noise pollution?* (too much loud noise; any kind of noise that bothers people) *How can noise pollution harm people?* (Loud noise can damage hearing, disturb sleep, and cause headaches.) *How can noise pollution in oceans harm whales?* (Whales use sound to

communicate; loud noises can cause a problem with their communication.)

- Ask, *What is light pollution?* (when artificial light enters the night sky or affects people and animals) *What harmful effects can light pollution have?* (make it hard to see objects in space, disturb sleep, confuse young sea turtles) You may wish to tell students that astronomical observatories in some parts of the world have had to close because of poor visibility caused by light pollution.
- In 1988 the International Dark-Sky Association was founded to build awareness of the problem of light pollution and to propose solutions. Encourage students to offer suggestions about how to reduce light pollution. Tell them that one major problem is outdoor lights in parking lots that send light into the sky. This also wastes energy. Some communities have passed laws to require shielded outdoor lighting that directs light only onto the ground where it is needed.

People in Science (page 14)

Rachel Carson

- Before students read, ask whether they have ever heard of Rachel Carson. Encourage volunteers to share what they know about her and her work. You may wish to tell students that Rachel Carson has been called the “mother of modern ecology” for her efforts to make people aware of the environment and our effect on it.
- After reading, bring out the main ideas about Rachel Carson’s accomplishments. Ask, *What did Rachel Carson warn people about in her book Silent Spring?* (the dangers of using pesticides) *What is the purpose of pesticides?* (to kill unwanted bugs) *What harmful effects do pesticides have?* (They threaten birds and other animals.) *What results did Carson’s book have?* (People began to think about the environment in new ways; DDT was banned.)

- You may wish to tell students that when DDT builds up in a bird’s body, it makes the bird’s eggs thin, weak, and easily broken, which prevents the birth of baby birds. Among other species, bald eagles almost became extinct. Since DDT was banned in the United States in 1972, some bird species—including the bald eagle—have recovered.

Further Facts

- Rachel Carson was born on a farm in Pennsylvania. She credited her mother with introducing her to the world of nature.
- After teaching zoology at the University of Maryland, Carson was hired as a biologist by the U.S. Bureau of Fisheries (now the Fish and Wildlife Service). One of her jobs was to write a radio show titled “Romance Under the Waters.” She used the show to share with listeners the undersea world that she loved.
- Her first published book was *Under the Sea Wind* in 1941. Next came *The Sea Around Us* in 1951, *The Edge of the Sea* in 1956, and *Silent Spring* in 1962. Each of her four books became best-sellers.
- After reading *Silent Spring*, President John F. Kennedy called for testing of the chemicals Carson mentioned in the book. This eventually led to the banning of DDT.

Did You Know? (page 15)

About Alternative Energy Sources

- Before students read, ask them to suggest other sources of energy that could replace the burning of fossil fuels. (Students may be aware of solar and hydroelectric energy.) If students mention nuclear energy, point out the problem of nuclear waste disposal.
- After students read about solar energy, have them explain the steps in the process

of using sunlight to heat water and homes. (Sunlight heats metal plates. In turn, the metal plates heat a liquid that flows through pipes in a water tank. This heats the water in the tank.)

- Have students summarize the alternative energy sources mentioned. (solar energy, wind energy, hydroelectric energy, biomass energy, hydrogen fuel cells, geothermal energy) If necessary, explain that hydroelectric dams use the energy of falling water to turn turbines that convert the mechanical energy of the falling water into electrical energy.
- If necessary, provide help with the pronunciation of *hydroelectric* (hi-dro-ih-LEK-trik), *biomass* (BI-o-mass), and *geothermal* (jee-o-THUR-muhl).

Further Facts

- The ancient Romans used hot springs to heat their homes and baths. Geothermal energy is used today to heat homes in Iceland, Turkey, and Japan.
- Wind farms are built in areas where the wind is steady, often near mountain passes. The top three wind-energy-generating states in the United States are California, Minnesota, and Texas.

AFTER READING

Summarize

Complete the KWL chart you began with students before reading by asking them to share the answers to their questions. Call on volunteers to retell each text section. Then have students use the information in the KWL chart to write brief summary statements.

Discuss with students how using the KWL strategy helped them understand and appreciate the book. Encourage them to share any other reading strategies that helped them understand what they read.

Direct attention to the fourth column in the chart and ask: *What questions do you still have about pollution? What would you like to explore further?* Record students' responses. Then ask, *Where do you think you might be able to find this information?* (Students might mention an encyclopedia, science books, and the Internet.) Encourage students to conduct further research.

Review/Assess

Use the questions that follow as the basis for a discussion of the book or for a written or oral assessment.

1. What is pollution, and what is its major cause? (Pollution is damage done to land, air, and water. Its major cause is human activity.)
2. What are some causes of land pollution, and how can they be reduced or prevented? (Improper disposal of trash creates land pollution. Sanitary landfills and burning can get rid of waste, and recycling can reduce the amount of waste. Chemicals used by farmers and on lawns seep into and pollute the ground. People can stop using harmful chemicals or use less of them.)
3. What human activities cause air pollution? (manufacturing, burning fossil fuels in homes, factories, and vehicles, and raising livestock)
4. Describe ways in which humans cause water pollution. (dumping wastes and waste water into rivers and lakes, heat from factories and power plants, oil spills, chemicals in waste water, chemicals used by farmers)

Writing Links/Critical Thinking

Present the following as writing assignments.

1. Explain how the causes of land pollution also cause water pollution. (Waste and chemicals pollute the land. These pollutants seep into the groundwater and pollute it.)

2. Choose one type of pollution. Tell what you and our family or you and your classmates can do to prevent or reduce it. (Responses will vary.)

Science Journals: You may wish to have students keep the writing activities related to the Delta Science Reader in their science journals.

References and Resources

For trade book suggestions and Internet sites, see the References and Resources section of this teacher's guide.