



We All Live Downstream

NAAEE Guidelines for Learning:

4th Grade

Strands I C, E, G; Strand 2.2 C

5th - 8th Grade

Strands I C, E, Strand 2.4 A

Lesson Outcomes:

Students will understand...

- the difference between the two primary categories of pollution sources: point and non-point
- that pollution sources exist in their own neighborhoods
- how pollutants impact the health of waterways, ecosystems, animals, and humans
- that humans can take actions to reduce pollution

Students will be able to...

- define and understand water quality terms, including **pollution**, point source pollutant, and non-point source pollutant
- create a map of a pollution study site on their school grounds or in their community
- identify and document both point and non-point source pollutants in a defined study area, and map where they travel within a watershed
- lead their class in a group discussion
- develop a graphic organizer to illustrate pollutant types

Duration of Activity:

Two hours

Vocabulary:

Acid rain, agriculture, erosion, impervious, leached fields, non-point source pollution, point source pollution, stormwater, watershed

Setting:

Indoors and outdoors

Materials:

Student Pages:

1. "Picture Water Pollution:" One printed copy, plus one copy printed on a transparency
2. "Pollution Source Survey:" One printed copy per group of three to four students
3. "Graphic Organizer Examples:" One copy printed on a transparency
4. "Discussion Tips & Questions" (optional): One printed copy per student

Teacher Page:

1. "Picture Water Pollution Reference:" One printed copy with the "N" and "NP" cards cut out
- Computers and access to the Internet and a GIS program
 - Sheet of butcher paper and markers/crayons
 - Blackboard/whiteboard and chalk/dry erase markers, or sheet of butcher paper and markers/crayons
 - Cameras (one per each group of three to four students, if possible)
 - Clipboards and writing utensils

Summary

Students will investigate and distinguish between **point source** and **non-point source** pollutants. They will survey where there are evidences of such **pollutants** in their community.

Background Information

Pollution is a watershed-wide problem. Given the flow of water from points of higher elevation to those of lower elevation, and the flow of water downstream from the Potomac's highlands to the Chesapeake Bay, every instance of pollution can affect water quality at all points further downstream.

Scientists divide water pollution into two categories: point source and non-point source. Point source pollution originates from a single source, such as a sewage treatment plant, power plant, or large animal feedlot.

In contrast, non-point source pollution comes from a variety of sources. This form of pollution results every time rainwater or snowmelt washes over the land, carrying with it any pollutants—including chemicals and manure used in agriculture; oils and fertilizers from roads and lawns; **sediment** from construction sites; and garbage. Rain can also mix with chemicals in the air to create non-point source pollution in the form of **acid rain**. Non-point source pollution contributes most of the nitrogen, phosphorous, and sediment polluting our waterways.

Point source pollution is regulated by the federal government. In 1977, in response to public outcry about water quality across the country, the U.S. Environmental Protection Agency (EPA) enacted the Clean Water Act, still effective today. Through the Act, it is unlawful for any person or business to discharge a pollutant from a point



source into navigable waters, unless the EPA grants them written permission to do so. The EPA determines what substances, and in what quantity, can be put into rivers and streams based on safety to humans and animals.

In comparison to regulated point source pollution, given its extensive and **amorphous** nature, non-point source pollution is much more difficult to control. Unfortunately, non-point source pollution is also the greatest threat to the quality of the Potomac River and its tributaries.

Non-point source pollution is particularly harmful in the absence of **riparian forest buffers**, without which rivers and streams have no defense against stormwater runoff. Every day, development results in the loss of up to 32 acres of forest within the Potomac River watershed¹.

Further exacerbating the impact of non-point source pollution are extensive networks of **impervious** surfaces—roads, parking lots, driveways, and other paved surfaces—which prevent water from soaking into the ground. In doing so, these surfaces elevate the **velocity** of runoff, and increase **erosion** and **sedimentation**. When the percentage of impervious surfaces in a watershed is greater than 20 percent, water quality declines so much so that only hardy, pollution-tolerant insects, fish, **reptiles**, and **amphibians** can survive.²

To help identify water pollution sources and effects, government agencies and nonprofit organizations monitor water quality, conducting both chemical and biological assessments. Biological tests involve using the numbers and kinds of **aquatic** animals present in a waterway to determine types or levels of water pollutants. In addition to testing rivers and streams, agencies also analyze stormwater runoff.

Government and nonprofit organizations work with neighborhood groups, farmers, industry leaders, and others throughout the watershed to educate them about the impacts of their actions on water quality. Many programs—including **storm drain stenciling** in urban neighborhoods and riparian forest buffer incentives in agricultural areas—have also been developed to reduce our impact on the health of the Potomac River and its **tributaries**. We can take a variety of simple actions in our own homes and yards, including not using fertilizers and reducing paved surfaces, to play our part in keeping waterways clean.

Essential Questions

- What is pollution?
- What is the difference between a point source and non-point source pollutant?
- How do pollutants affect water quality?

Pre-assessment

Present the Essential Questions to the class, asking the students to define the following terms: pollution, non-point source pollutant, and point source pollutant. After they share their thoughts, provide the students with the following definitions: *Point source pollution originates from a single source. In contrast, non-point source pollution comes from a variety of sources.* Break the students into pairs to brainstorm examples of point and non-point source pollutants. After approximately five minutes of brainstorming, ask teams to share their ideas with the class. Clarify any misunderstandings.

Lesson Procedures

1 Using an overhead projector, project “Picture Water Pollution” on a blank wall. Ask students to discuss the various pollution sources depicted in the illustration, and to distinguish between those that are point source versus non-point source. Provide them with definitions that they may not know.

2 Divide the class into two teams. Distribute the tags you cut out from the “Picture Water Pollution Reference” Teacher Page to each team, as outlined in the document (the “P” tags represent point source pollutants; the “NP” tags represent non-point source pollutants). Ask the teams to take turns deciding if a particular pollution activity depicted in the “Picture Water Pollution” illustration is an example of a point or non-point source pollutant. When a team answers correctly, ask them to tape up an appropriate tag (“P” or “NP”) beside the pollution source on the “Picture Water Pollution” projection, and award that team one point. Once the class considers each pollution activity illustrated, the team that has earned the most points wins. Challenge the students to discuss whether there was more point or non-point source pollutants and why. For guidance throughout this exercise, refer to the “Picture Water Pollution Reference” Teacher Page.

3 Explain to the students that they will investigate evidence of point and non-point source pollutants originating from their school grounds or elsewhere in their community. Start by showing them a map of the area they will investigate. Display a city map or an online map generated by a Geographic Information System, such as Google Earth (<http://earth.google.com/>). Lead the class in a group activity of drawing a large map of the study area on a piece of butcher paper. Divide the students into groups of three or four and assign each group a designated area on the

¹Todd, Albert. H. and Eric Sprague. “Interstate Commission on the Potomac River Basin Symposium” PowerPoint presentation. USDA Forest Service and The Conservation Fund, October 29, 2005.

²Barnes, Kent B., John M. Morgan III, and Martin C. Roberge. *Impervious Surfaces and the Quality of Natural and Built Environments*. Baltimore, Maryland: Department of Geography and Environmental Planning, Towson University, 2000.



map to study. Ensure that the group assignments cover the entire study area.

4 Distribute to each group a copy of the “Pollution Source Survey,” a clipboard, and (if possible) a camera. Take the students outside to the study site and give them 15 to 20 minutes to search for evidence of pollutants. Assign them to complete the first page of the survey and to take photographs of any pollution sources they identify. If there are a limited number of cameras, have the entire class take turns photographing their pollution sources.

5 Remaining outside, gather the class together. Ask pairs of students from each group to share their findings—including where they found each pollutant and whether it is point or non-point source—with the entire class until they have discussed all types of pollutants they located. Clarify any misunderstandings.

6 Return to the classroom. Ask the groups to refer to the first page of their “Pollution Source Survey” and to use the information shared outside by their classmates to answer the questions on the second page of the survey worksheet.

7 On a blackboard, whiteboard, or piece of butcher paper, make two columns labeled, “point source” and “non-point source.” Ask each group to report to the class how many pollution sources they identified in each category, and record these numbers on the board or paper. Tally the total number of pollutants identified by the entire class in each category, and calculate the percentage of point source versus non-point source pollutants by dividing each category total by the overall number of pollutants.

8 On the large map that the class created using GIS data, ask the students to plot out the areas where they found evidence of pollutants, and to write onto the map whether the source of each is point or non-point. Once the photos are developed (if you

used a digital camera, you can have the students print out the photos), ask the students to add the photos to the map, placing them at the locations where they were taken. Ask the students to suggest ways to eliminate or reduce the pollution identify on the map.

Post-assessment

Based on their site survey, assign students to create a graphic organizer, such as a word web or flow chart, to illustrate the pollution they observed. Ask them to include the types of point source and non-point source pollution; the paths the pollutants take; and where the pollutants ultimately travel in the watershed. Use the “Graphic Organizer Examples” transparency to familiarize the students with how to use a graphic organizer.

Have students use a map of the Potomac River watershed or Internet resources to determine into which water body pollutants from the study site flow, and ask them to be sure to include the name of this water body in their graphic organizer. Collect students’ assignments and, using the resources throughout this Lesson, assess their understanding of point and non-point source pollutants.

Extensions

- Have the students moderate a class discussion, using the “Discussion Tips & Questions” as a guide. Give the students time to review and think about the questions based on their previous site survey. Read the discussion tips to the class and ask if the students have any questions. Select one or two student volunteers to moderate a class discussion.
- Lead students in collecting water quality data for their home or school address by visiting the Environmental Protection Agency’s “Windows to My Environment” web page (<http://www.epa.gov/enviro/wme/>).

Take Action:

Encourage students to:

- Participate in a storm drain stenciling activity in their community.
- Volunteer for a local trash cleanup.
- Write a letter to their school principal or a community representative to suggest ways, based on the site survey, to reduce pollution generated by their community.

Additional Resources:

- NOS Education Discovery Kits. “Welcome to Nonpoint Source Pollution.” National Ocean Service, NOAA. <http://www.oceanservice.noaa.gov/education/kits/pollution/welcome.html>.
- Prince William Conservation Alliance. <http://www.pwconserve.org/index.html>.
- RiverWorks Discovery. <http://www.RiverWorksDiscovery.org>.
- “Save Our Streams.” The Izaak Walton League of America. www.iwla.org/sos.
- U.S. Environmental Protection Agency. “Polluted Runoff (Nonpoint Source Pollution).” <http://www.epa.gov/nps/kids/>.