

Who Polluted the Merrimack
10.8.15

Introduction	This activity demonstrates that we are all part of the problem of pollution. It also shows that protecting the environment is not a one-time event, but requires ongoing changes to our habits.
Time	45 minutes
Lesson Preparation	Materials: Testing kits for pH, phosphates, nitrates, turbidity. 1 gallon tap water in a large, clear, wide-mouthed container. 16 labels (see attached sheet). 16 small plastic containers. Make labels for the pollutants in the small plastic containers, cut them out, and tape them to the small plastic containers. Fill the small plastic containers with ingredients (see attached sheet). Put one gallon of tap water into the large, clear, wide-mouthed container.
Prior Knowledge Required	It would be helpful for students to have knowledge of the water cycle, and familiarity with the concept of pollution.
Background Information	The emphasis in this activity is on non-point source pollution. Non-point source pollution is mostly the result of runoff. The source and extent of pollutants from runoff are very difficult to identify, measure, and control. Non-point source pollutants can lead to devastating changes to the life in a stream or river.
Vocabulary	Pollutant: any substance, as certain chemicals or waste products, that renders the air, soil, water, or other natural resource harmful or unsuitable for a specific purpose.
Anticipated Student Preconceptions/ Misconceptions	A common misconception is that pollutants are easy to clean up. Another misconception is that most pollutants are introduced into the environment by accidents and large factories.
Frameworks	Life Science, Grades 6-8, #12. Relate the extinction of species to a mismatch of adaptation and the environment. #17. Identify ways in which ecosystems have changed throughout geologic time in response to physical conditions, interactions among organisms, and the actions of humans.

Guiding Question	What are the many ways that pollutants can enter a river?
Objectives	Students will be able to: <ul style="list-style-type: none"> Describe everyday activities can have an effect on the health of the river Discuss the actions they can take to help prevent pollution.
Activity	<ol style="list-style-type: none"> Have students arrange themselves around the container of water that represents the Merrimack River. Have the students test the water for color, odor, pH, phosphates, nitrates, and turbidity.

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	<ol style="list-style-type: none">3. Distribute the set of canisters to the students representing the environmental and human factors that have an effect on a waterway.4. Students should keep the identity of the contents of their canister a secret.5. Explain that when a pollutant is mentioned as you read the story, the student with the corresponding canister should empty its contents into the river (the jar of water).6. Read the story on the attached page out loud to the class. After you have completed the story, test the water again for color, odor, pH, phosphates, nitrates, and turbidity.
Assessment	Have students write a short answer to one of the following questions. <ol style="list-style-type: none">1. What could be done to prevent pollutants from entering the river?2. What could you and I start doing right away to help improve the health of our watershed?3. What would have to be done to make this water safe for aquatic life? Safe to drink?4. How could we clean up a river?
Differentiated Suggestions	None
Adapting the Activity for Other Grades	This activity is appropriate for all grades in middle school or high school. You may want to adjust the content, and questions used to start discussions to align the lesson with your students' abilities.
Bibliography	Cherry, Lynne. <i>A River Ran Wild: An Environmental History</i> . San Diego: Harcourt Brace: 1992.

Story for *Who Polluted the Merrimack*

For many thousands of years, people have lived on the banks of the Merrimack River. They hunted in the great forests, harvested food from wetlands, and fished the river. Imagine that a jar of water was taken from this river about 500 years ago. *What would it be like to drink this water? What would it be like to swim in it? What would it be like to go boating on it? What kinds of wildlife would live in the river?*

In the 1600's, European colonists began to arrive in this area. They found a river that provided ample food and water. It was an outstanding environment for settlement, and the colonists prospered. The Merrimack River has changed a lot in the past 400 years. This is the story of its changes. Listen for the name of the role printed on your small plastic container. When you hear your role named, open the small plastic container and dump its contents into the river. Imagine now that the story is happening in the present – maybe even while we are sitting here today.

A sudden downpour drenches the area. The pounding rain is washing loose soil from a nearby CONSTRUCTION SITE into the river. High winds whip through TREES and blow leaves into the water. Imagine that the jar of water was taken from this just after a downpour. *Ask the four italicized questions again (see above).*

In a short while, the storm passes over, and the sun comes out again. People head for the river to have fun. Some zoom up and down the river in MOTORBOATS and don't notice that a little engine oil leaks into the water. A group of friends spread blankets on the shore for a BEACH PARTY. Lots of families are PICNICKING in the parks, too. Some of these people have left trash at the shore. During the next rainstorm, that trash will wash into the river. On the dock, a PERSON FISHING snags the hook on a log and breaks the nylon fishing line. Imagine that the jar of water was taken from this river now *(ask the four italicized questions again).*

Not everyone is out playing today. A FARMER has been fertilizing cornfields close to shore. The rain washed some of the fertilizer off the land and into the nearby river. The farmer also keeps pigs and other animals in the BARN YARD. As the rainwater drains out of the barnyard, it carries some of the manure into a little creek behind the farm. The creek flows into the river. Over in a nearby neighborhood, an old house is not connected to the town's sewer system. Wastewater from the house goes into a septic tank underground. The HOMEOWNER has not

maintained the septic tank, and poorly treated sewage is seeping into the river. Imagine that the jar of water was taken from this river now (ask the four italicized questions again).

Upstream a 100-car COAL TRAIN is carrying coal to an electric plant. Rainwater drained through every car as it sat waiting for permission to use the right track. This made the water acidic – like strong vinegar. Then the acid water trickled back out into the river. The ELECTRIC POWER PLANT on the river burns coal to produce electricity. The gases coming out of the smokestack combine with moisture in the air to form acids. The pollution falls back to the ground as acid rain or acidic snow. Many COMMUTERS drive their cars to and from work. Car exhaust fumes (just like the power plant fumes) cause more acid rain. If a car is not kept in good repair, it might also leak oil, brake fluid, or other fluids, which will be washed off the pavement and into the river with the next rain. Imagine that the jar of water was taken from this river now (ask the four italicized questions again).

Let's look in on some typical activities around the neighborhood. Lots of LAWN CARE COMPANIES are out working in people's yards today. Many of them are using weed killers and insect sprays to keep the lawns beautiful. The next rainfall will wash these poisons into a little creek nearby, and then into the river. There's a father teaching his daughter how to change the antifreeze in her truck. Some of the used antifreeze spills on the driveway. Some of it will make its way to the nearby creek and poison fish. Later, father and daughter WASH THE TRUCK. The soapy water rushes down the driveway into a storm drain; the storm drain empties into the river. Phosphates in detergents used to be a pollution problem because they acted like fertilizer, making too much algae grow in the river. Laws were passed to stop the use of phosphate soaps in order to help solve the algae problems. But the grease and grime on a car contain asphalt from roads, asbestos and copper from the brakes, rubber particles from the tires, heavy metals, and rust. Next door a family is cleaning out their garage. They find an old rusty can with no label, filled with a liquid. What could it be? It looks dangerous, and they want to get rid of it – but how? They pour it down a storm-drain near the curb. The liquid is out of sight, but headed for the river.

Imagine that the jar of water was taken from the river now (ask the four italicized questions again).

List of Ingredients for *Who Polluted the Merrimack?*

Construction Site	3ml dry clay soil
Trees	dry leaves, crumbled
Motorboat	1ml vegetable oil
Beach party	pull tabs, bits of Styrofoam
Family picnic	bits of paper, plastic wrap
People fishing	tangle of nylon fishing line
Farmer	2ml baking powder
Barn yard	instant coffee
Homeowner	yellow food color, water, bits of toilet paper
Coal mine	2 tablespoons vinegar
Electric power plant	2 tablespoons vinegar
Commuters	2 tablespoons vinegar
Gardeners	2ml baking soda
Antifreeze	blue and green food color, water
Washing the car	4 tablespoons of very soapy water
Mysterious liquid	red food color and water

Rubric for “Who Polluted the Merrimack”

Question: List examples of various challenges to the health of our watershed, and propose solutions to these problems.

5th Grade

	1	2	3
Describe everyday human activities that can affect earth’s resources or the environment	Lists an example of point-source pollution (sewage from a treatment plant, pollutants from a factory and/or smokestack) OR an example of non-point source pollution (e.g. agricultural runoff)	Lists at least one example of point-source <i>and</i> one example of non-point source pollution	In addition to 1 & 2, also lists one or more daily activities of individuals which directly or indirectly lead to pollution (household use of water, school bus, rides in a car, production of food)
Ways to reduce a community’s impact or an individual’s impact on earth’s resources or the environment	Describes a way to better handle or reduce amount of sewage (water conservation, separate storm-water from sewers). Design a cleaner operating factory or way to trap pollutants from manufacturing. OR describes a solution to reduce or filter non-point pollution (e.g., swales)	Lists at least one solution for point <i>and</i> one solution for non-point pollution	In addition to 1 & 2, also describes ways to reduce an individual’s household pollution or reducing amount of materials used by society

7th Grade

	1	2	3
Describe everyday human activities that can affect earth’s resources or the environment	Lists an example which ties a challenge faced by the earth’s natural resources or ecosystems to human population growth /urbanization or overconsumption of resources	In addition to 1., also lists the negative effects such as reduced water quality, depletion of mineral resources, or climate change	In addition to 1 & 2, describes how evidence, such as historical (or other) data could be used to support their answer
Ways to reduce a community’s impact or an individual’s impact on earth’s resources or the environment	Describes and evaluates a current design solution that is being used to address a current challenge	describes and evaluates two or more design solutions	Proposes a new design solution or anticipate a future challenge caused by human activity to the earth’s natural resources