



Who Polluted the Potomac

An Interactive Story of Our “Nation’s River”

Overview:

This lesson is an interactive story modeling how, as populations increase and land use changes, a river can be transformed from a valuable natural resource into a polluted waterway that is still necessary for humans and organisms alike. This graphic example demonstrates that we are all part of the problem-- and that we must be part of the solution as well.

Lesson Characteristics:

Use the table below for lesson planning purposes:

Grade	5th grade Hard Bargain Farm overnight program
Time Required	20-30 minutes
Key Science Practices	Asking Questions and Defining Problems Constructing Explanations and Designing Solutions Developing and Using Models Engaging in Argument from Evidence Obtaining, Evaluating, and Communicating Information
Key Concepts/Terms	Pollution; Runoff; Watershed
Setting	Indoor/Outdoor space with clean water access
Materials	<ul style="list-style-type: none"> ● Script ● 1 gallon clear jar ● Access to water ● Sieve/Colander <p>Each small canister is labeled with the 16 sources listed below and filled only to the one third mark with the listed contents. If there are less than 16 students, some students will get two canisters. If there are more than 16 students, a second kit will be required.</p>

Source	Canister Contents
Trees	Dead Leaves
Construction site	Dirt
Motorboats	Yellow Liquid Hand Soap

Beach Party	Trash (small cut up labels, etc)
Picnicking	Polystyrene broken into small pieces
Person Fishing	Fishing line
Farmer	Baking Soda
Barnyard	Brown Liquid (food dye)
Coal Mine	Vinegar
Electric Power Plant	Vinegar
Commuters	Vinegar
Sewer Pipes	Yellow Liquid (food dye) + Toilet Paper (Raisins <i>optional</i>)
Gardeners	Baking Soda
Antifreeze	Green Liquid (food dye)
Wash the car	Soapy Water
Mysterious Liquid	Red Liquid (food dye)

Next Generation Science Standards:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems	PS2A: Forces and Motion	Cause and Effect
Constructing Explanations and Designing Solutions	LS2A: Interdependent Relationships in Ecosystems	Influence of Engineering, Technology, and Science on Society and the Natural World
Developing and Using Models	ESS2A: Earth Materials and Systems	System and System Models
Engaging in Argument from Evidence	ESS3C: Human Impacts on Earth Systems	
Obtaining, Evaluating, and Communicating Information	ETS1B: Developing Possible Solutions	

Learning Objectives

Students will be able to...

- ...demonstrate understanding of how pollutants enter waterways
 - ...define a watershed
 - ...make connections to their daily lives and how their choices contribute to pollution in waterways
 - ...identify solutions to polluting activities
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Preparation:

Make sure small canisters have contents as described in materials. Make sure there is at least one canister per student.

Fill a 1 gallon jar $\frac{3}{4}$ of the way full with tap water.

At the end of the lesson:

The educator must clean out the jar and refill the canisters in preparation for the next group, either right after the lesson or during the clean up time before the end of the day. The jar must be emptied outside. No “polluted” water from this activity should go down any drain. Pouring the water outside will prevent soil and other small natural solid particles from clogging the drains.

To clean the jar, the educator should take the jar outdoors and pour the contents of the jar into a colander (to catch most of the solids) and over the ground outside. All contents in the colander are thrown into the trash. Once the contents have been removed, the educator should wash the jar and fill all of the canisters to the one third mark with the assigned materials. All supplies, extra jars, and canisters are stored together with the story.

Background Information:

About the activity: Although this activity conveys the story of the Potomac River, situations in the nation’s river probably parallel those in the watershed you call home. You may wish to use the story of the Potomac as an example for comparison with your local river or lake, or you may want to adapt the story to special concerns within your watershed.

This activity is designed to involve a group of 16 to 32 participants. By using labels with pictures, the lesson has been used with students as young as second grade. With some modifications it has also been successful in adult presentations. Educators in Japan and Australia found that the story of the Potomac was basically the story of their rivers too.

About the River: People along the Potomac appreciate the scenic vistas, but they also depend on the river for food, recreation, transportation--and for an abundant supply of drinking water. Unfortunately, the river is not always treated like the invaluable natural resource it is. Cities use the

flowing waters to carry away sewage and factory wastes. Chemicals leach from residential lawns and agricultural fields. Soil erodes from earth scraped bare by bulldozer or plow. Oil drips from engines; acid rain falls from the skies or seeps from abandoned coal mines. Toxic household chemicals, unsightly litter and tangled fishing line (all of which may be fatal to wildlife) are discarded thoughtlessly by citizens.

From a small fresh-water spring in the mountains, to the thundering Great Falls, to the mile-wide river flowing past Washington, DC, to its salty, ten-mile-wide mouth at the Chesapeake Bay, each section of the Potomac River has a special personality--and special problems.

Because the Potomac River is the second largest tributary of the Chesapeake Bay, pollution in the Potomac takes its toll on the Bay, too. Fifty years ago it was not safe to go near the water along some stretches of the Potomac. Today the picture is brighter. Working together, citizens and government agencies are cleaning the river. Sections are still polluted but the actions of each individual can make a difference.

This activity is designed to help individuals examine their daily habits and to visualize their impacts on the river. Then they can decide what actions to take to improve and protect the Potomac.

Procedure:

Follow the steps in the table below to conduct the activity.

Step	Action
5E's: Engage Learning Cycle: Invitation	
1	Pass out one canister to each student and have them read the label on the front. Ask students not to open their canister. The educator should read the label aloud as they hand the canister to the student.
2	Explain that you will tell a story about the river, and that each student will play a part in the story. When they hear the name of their source mentioned, their job is to come to the jar, stand behind it (so other students can see), open the canister, and empty its contents into the "river" (represented by the jar of clean water). Ask students to define the word watershed before starting the story.
5 E's: Explore Learning Cycle: Exploration	
3	Read the story and pause after questions to allow students to think and respond. Make sure that you are reading the story slowly enough that students have enough time to add their source to the jar, while maintaining an engaging pace. Check for understanding on unfamiliar terms, like antifreeze, etc.
The Story <p>For many thousands of years, people have lived on the banks of the Potomac River. They hunted in the great forests, harvested crops from the fertile (very productive) lands, and caught fish from the river.</p> <p><i>Question: Imagine that the jar of water in front of you was taken from the Potomac River by a Native American child about 500 years ago. Describe how it looks to you. Would you drink this water? Eat fish that came from it? Swim in it?</i></p> <p>Captain John Smith, one of the first English explorers to visit the Potomac River, kept a journal of his discoveries. He wrote about the Native American villages, the forests and the river itself. He described the river as "sweet waters" with it being so full of fish that he and his crew tried to scoop them up with a frying pan.</p> <p><i>How do you think Captain John Smith and his crew used the river water? Do we use the river in the same ways today?</i></p> <p>Soon colonists began to arrive. They found fertile land for farming; forests filled with wildlife and a river that provided food and water. The environment was outstanding for settlement and the colonists prospered.</p> <p>The Potomac River has changed since it was first explored. This is the story of the changes.</p>	

Listen for the name of the source printed on your canister. Remember, when you hear your source named, come to the “river”, stand behind the jar (so other students can see), open the canister, and dump its contents into the river.

High winds blow through the **trees** and blow leaves into the river. The city of Washington, DC was being built on the banks of the Potomac River. Builders filled wetlands and cut down forests to build houses and businesses. Rain and wind eroded loose soil from **construction sites** into the river.

*Is the water safe to drink? (if the response is “no” ask if the river had leaves or soil in it when Captain Smith drank it? Ask if these items are natural or human made?)
Would you swim in it? Boat on it? Is it safe for wildlife?*

As the city continued to build, more people came to live in the Potomac River watershed and more changes affected the river. Now imagine everything in this story is happening today.

On a bright sunny day people head to their local parks. Some people take **motorboats** to zoom up and down the river; they don’t notice a little engine oil leaking into the water.

A group of friends have spread blankets on the shore for a **beach party**. Lots of families are **picnicking** in the parks, too. Some of them use polystyrene plates (styrofoam) because it is easy to clean up when the picnic is over.

People start to notice clouds forming in the distance and decide to head home. As they leave, they throw their trash into the already overflowing trash cans. The wind begins to pick up and push trash out of the cans and into the river. Animals find some of the food in the trash and scatter the trash around the park and into the river. While the polystyrene breaks apart into smaller pieces, these pieces of plastic will never biodegrade (break down naturally).

Does the polystyrene sink or float? How would this floating polystyrene affect the wildlife in the river?

On the dock a **person fishing** snags the hook on a log, breaks the nylon fishing line, and leaves it in the river thinking it doesn’t really matter.

What do you think will happen to the fishing line over time? Would you drink this water now? Would you swim in it? Go boating? Is it safe for wildlife?

A **farmer** puts fertilizer on the cornfield to help the plants grow. However, they put too much which is not absorbed by the soil. The farmer also keeps pigs and other animals in the **barnyard**. A sudden rainstorm begins, with any extra fertilizer and manure running off into the river.

As it continues to rain the water drains down into a **coal mine** shaft and mixes with the piles of waste. This makes the water become acidic--sort of like a strong vinegar. Then the acid water trickles back out into the river.

Coal is burned to produce electricity to power the computers, televisions, and lights in DC and the surrounding communities. The coal is burned in an **electric power plant**. The gasses coming out of the smokestacks combine with moisture in the air to form acids. The pollution falls back to

the earth as acid rain.

As **commuters** in the city drive home from work their car exhaust adds to the acid rain. Once they are home and parked, the cars drip oil which is washed into the storm drains during the rain.

Where are the storm drains in your neighborhood? What do they look like? Where does the water go once it is in the storm drain? (Clarify, if necessary, that people often call storm drains sewers)

The storm continues to hit the Potomac River watershed. In the city, rain from storm drains combine with raw sewage (all the stuff from your toilets!) in some of the old **sewer pipes**. When the pipes were first installed there were fewer people living in and around the city, but with so many people now the pipes are too small to carry both sewage and the rain. Now, there is too much liquid in the pipe and the pipes overflow carrying the rain and the sewage right into the river.

Would you drink this water? Would you swim in it? Go boating on it? Is it safe for wildlife?

The storm ends and a family comes out to their community garden. Many of the **gardeners** are using weed killers and insect sprays that include toxic chemicals to keep their small corner of the garden pretty. The next rainfall will wash these poisons into storm drains and then into the river.

Down the street, a father is teaching his daughter how to change the **antifreeze** in her car. They pour out the used antifreeze on the driveway. Antifreeze is a vital liquid to keep cars running, but is also sweet-tasting and can poison an animal that licks it. After they change the antifreeze they begin to **wash the car**. The soapy water combines with the antifreeze and rushes down the driveway into the storm drain; the storm drain empties into the river where these liquids can poison fish.

The soapy water from washing a car can contain all sorts of pollutants, including the detergent itself, grease and dirt, gravel from the roads, chemicals from the brakes, rubber bits from the tires, metals, and rust.

At home in town, a family is cleaning out their garage. They find an old, rusty can with a CAUTION! label. They aren't sure what it is, but it looks dangerous! They decide to get rid of it by pouring it down the storm drain. The **mysterious liquid** goes down the storm drain. It is out of sight—but headed for the river.

Would you drink this water now? Would you swim in it? Go boating on it? Is it safe for wildlife?

Who polluted the Potomac?

5 E's: Explain

Learning Cycle: Concept Invention

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Conduct a brief discussion with the students. The questions that follow can help guide the discussion:

What are some things you noticed about the pollution that made its way into the river?

	<p><i>Name a few ways pollution entered the river.</i></p> <p>Some possible answers: Although some pollution may have entered the river directly by humans, such as the motorboat and beach party, most of the pollution entered the river through runoff. Rain carries pollutants from the land area of the watershed into the river. Sometimes this is directly into the river, but it can also get there through smaller bodies of water like streams, and through storm drains that lead to streams. Also, gasses entering our atmosphere, interacting with water molecules, change the chemistry of the rain coming down, such as with the power plant and the commuters.</p> <p><i>Make sure that watershed is defined and connected to this activity if it does not come out in the discussion about pollution.</i></p>
	<p>5 E's: Elaborate Learning Cycle: Application</p>
5	<p>These questions help students internalize how they impact the river.</p> <p><i>Think about the pollution contained in your canister. What could they have done differently to keep the pollution out of the water?</i></p> <p>Possible example answers: If the man and his daughter had gone to the local car wash, the water would have been treated before it was returned to the river. DC is working to fix the Combined Sewer System (CSS) by building a new system. The gardener can pull weeds instead of using weed killers.</p>
6	<p><i>Have you noticed any of this happening in your own community?</i></p> <p><i>Once pollutants have entered the river, how can we get them out? How can we clean the river?</i></p> <p><i>Do you think it is easier to prevent pollution or to clean it up?</i></p>
	<p>5 E's: Evaluate Learning Cycle: Reflection</p>
7	<p><i>What could you start doing today to help improve the health of the river?</i></p> <p>Possible answers: Turn off lights, use less water, carpool, ride a bike, not use polystyrene, use reusable containers for picnics, etc.</p>
	<p>5 E's: Extension</p>
8	<p>Have students conduct an audit of their daily activities to determine how it impacts the river.</p> <p>Have students determine how they could clean the water.</p>

	Participate in a schoolyard cleanup.
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