WHO POLLUTED THE POTOMAC?

People and the Planet
Lessons for a Sustainable Future

INTRODUCTION

The history and health of our rivers is inextricably tied to the history of the human communities that have settled along their banks. Rivers are a vital water source, home to wildlife, a means of transportation, and more. As the numbers and sizes of our communities have increased over time, the health of our rivers has suffered. Sewage, agricultural runoff, and industrial wastes are just some of the pollutants that find their way into our rivers. This activity demonstrates that, just as we each contribute to the problem, we must also be part of the solution.

MATERIALS

- Clear gallon jar or bowl of water
- Film canisters or other small lidded containers
- Canister Labels (provided)
- Canister Ingredients
- Story: "Who Polluted the Potomac?" (provided)

PROCEDURE

1. Before class, prepare and label the film canisters using the items in the chart below. Prepare enough canisters for each student to have at least one. There are 16 different canister labels, so for large classes, double some characters and some students will have identical canisters.

CONCEPT
The histories of local rivers provide insight into the effect population growth has on a natural resource and the cumulative impact of individual actions.

OBJECTIVES
Students will be able to:
- List three pollutants that can impact rivers.
- Draw connections between individual actions and the pollution of a water source.
- Develop strategies for minimizing and counteracting water pollution.
- Explain how population growth impacts the health of our nation's rivers.

SUBJECTS
Science (Earth and environmental), social studies (civics, geography, history), English language arts, family and consumer sciences

SKILLS
Critical thinking, listening comprehension, observing, role playing, identifying trends and patterns

METHOD
Through an interactive story, students experience the pollution of a local river over time and propose methods to protect the river from current and future pollution.

Character (Canister Label)	Canister Ingredients
Trees	Leaves (dry)
Construction site	Soil (dry, clayish)
Person fishing	Fishing line or dental floss
Farmers	Baking soda
Gardeners	Baking soda
Beach party	Litter, assorted
Picnicking	Litter, assorted
Barnyard	Water + instant coffee granules
Washing the car	Water + 1 drop dishwashing soap
Antifreeze	Water + 1 drop green food coloring
Mysterious liquid	Water + 1 drop red food coloring
Homeowner	Water + 1 drop yellow food coloring
Coal mine	Vinegar
Electric power plant	Vinegar
Commuters	Vinegar
Motorboats	Water + 1 drop each red and green food coloring

2. Fill a clear jar or bowl with water. Place the container in a location that can be seen by all students.

3. Distribute one canister to each student. Ask them to keep the canisters closed and upright, and not to reveal the identities of their characters.

4. Read the story "Who Polluted the Potomac" aloud to the class. Add emphasis as you read each bolded character name, and pause after each question to give the students time to think and respond.

    Note: You may want to change the name of the river to a waterway in your region that is familiar to the students.

5. Go over the Discussion Questions as a class.

DISCUSSION QUESTIONS

1. Who polluted the Potomac?

    Everyone played a role.

2. What effect did the increasing population have on the health of the river? Can you think of any ways population increases could improve a river's health?

In this situation, population growth led to increases in pollution sources and decreases in open space and in available wetlands, which filter water. However, an increase in population may also lead to stronger environmental laws, more efficient uses of resources and public services like sewage treatment plants.

3. Think about the pollution represented in the canisters. Could something be done to prevent those types of materials from entering the water in the first place? How?

Answers may include: implementing soil erosion control at the construction site, applying smokestack technology at the power plant, walking or riding a bike instead of driving, picking up trash off the ground, taking a car to the car wash, keeping cars and boats in good repair, etc.

4. Many of the pollutants were the result of an individual person's action. Is an individual the only person impacted by his or her decision? Does something added to the river in one location, stay there? Where does it go and what is the impact?

   No. Rivers are a shared resource, so individual actions and choices impact the entire community. Because rivers run through multiple municipalities and states, pollutants that enter the river at one point move downstream and the effects are felt along the river's path and across municipal and state boundaries.

5. Do upriver cities or states have a responsibility to keep rivers clean for downriver cities or states? Do you think they should?

6. Challenge students to come up with ways to clean the water in the bowl. Once these types of pollution have entered the river, how can we get them out? How can we clean up the river?

   In the classroom, solids can be strained using a kitchen strainer or netting. Students may also find coffee filters or absorbent cotton helpful. In reality, humans clean up waterways using a variety of methods. Examples include using nets to retrieve large items, treating the water with chemicals, or introducing organisms that filter or digest pollutants from the water.

7. Do you think that it is easier to prevent pollution, or to clean water that is already polluted? Have students explain their ideas. What could each of us do to help improve the health of our rivers by preventing some of this pollution?

   Preventing pollution is known to be a more effective approach to ensuring clean waterways. Answers may include: biking or walking instead of driving, conserving water, picking up litter, pulling weeds instead of spraying them, etc.

ASSESSMENT

Students complete the following sentences and share with a partner.

Water pollution happens because _____.
Water pollution can be prevented by _____.
Human population growth impacts water sources because _____.

FOLLOW-UP ACTIVITIES

1. Although this activity relates the story of the Potomac River and the history of Washington, D.C., similar situations exist in many watersheds throughout the country. You may wish to use the story of the Potomac as an example for comparison with your local river, or you may want to adapt the story to special concerns within your local watershed. Students can search for local services on a city or county web site or you can ask a local government official to visit your class and discuss your region's facilities and programs for waste and pollution management.

2. For a STEM connection, have students come up with an invention, product, or system that would minimize the impact of pollution on the river. The solution can be realistic or far-fetched but the invention should alleviate one of the pollutants and its subsequent impact on the river. Students should submit a rough draft and design of their solution.

3. Introduce your students to Mr. Trash Wheel, a water wheel located in Baltimore's Inner Harbor that sustainably cleans trash from the water. Learn more about the conservation initiative here: http://baltimorewaterfront.com/healthy-harbor/water-wheel/. A short video provides an interesting overview of Mr. Trash Wheel in under five minutes. Stream here: https://www.youtube.com/watch?time_continue=98&v=RkQbcrzyAeE.

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STORY: WHO POLLUTED THE POTOMAC?

For many thousands of years, people have lived on the banks of the Potomac River. They hunted in the forests, harvested foods from wetlands, and caught fish in the river. Imagine that the jar of water in front of you was taken from the Potomac River by a Native American about 500 years ago.

• How does the water look to you?

• Does this look like water that you might drink? Swim in? Eat fish from?

One of the first explorers to visit the river kept a journal of his discoveries. He wrote about the Native American villages, the tributaries of "sweet water," and seeing so many fish that he and his crew tried to scoop them out with a frying pan. Soon, colonists began to arrive. They found fertile land, forests teeming with wildlife, and a river that provided ample food and water. It was an outstanding environment for settlement, and the colonists prospered.

• How do you think the colonists used the river?
  Answers may include: bathing, food, drinking and cooking water, transportation, etc.

• Do we use our rivers in any of the same ways today? What are similarities and differences in the way we use the river?
  Answers will vary. Students may immediately recognize direct similarities like transportation and food, but may not realize that the water they use every day also may come from a local waterway to their tap.

But the river has changed a lot since it was first explored. This is the story of those changes. Listen for the name of the character printed on your canister. When you hear your character named, come up to the river (bowl of water), open the canister and dump in its contents.

Years went by and occasional storms drenched the area. High winds whipped through the **TREES** and blew leaves into the water.

Gradually, the city of Washington, D.C. grew on the banks of the Potomac. Developers cleared wet-lands and forests to build houses and businesses. Rains washed loose soil from **CONSTRUCTION SITES** into the river.

• Is this water safe to drink? (If the response is "no," ask if the river had leaves or soil in it when explorers first drank from it).

• Would you swim in it? Is it safe for wildlife?

At first, the city was small. Upstream, **FARMERS** planted crops to feed the city's growing population. Some of these crops grew right up against the banks of the river, and fertilizer washed off the land and into the water. Other farmers kept pigs and other animals in their **BARNYARDS**. As rainwater drained out of the barnyard, it carried some of the manure into a little creek behind the farm. The creek flows into the river.

• Would you drink this water now? Would you go swim in it? Go boating on it?

• Is it safe for wildlife?

As the city grew, more and more people began to move to the nearby countryside. These rural houses

were not connected to the city sewer system. Waste water from these houses flowed into septic tanks under the ground. One **HOMEOWNER** did not maintain the septic tank and poorly treated sewage seeped into the river.

To meet the electricity needs of the city, area officials decided that they needed to generate more power. Far upstream, a **COAL MINE** was dug. Rain water drained down into the mine shaft and soaked the piles of wastes and scraps from mining. This made the rain-water become acidic – sort of like a strong vinegar. Then the acid water trickled off the banks and back out into the river.

To burn the coal and produce the power, an **ELECTRIC POWER PLANT** was built along the river. 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 or smog.

- Would you drink this water now? Would you swim in it? Go boating?

- How could we determine if this water was safe for wildlife?
  Answers may include: noticing evidence of dead animals, testing for pH levels with litmus paper or chemical testing, viewing water samples under a microscope, performing organ-ism counts, etc.

Washington, D.C. is now one of the largest metropolitan areas in the country. Traffic congestion is a big problem for **COMMUTERS** who drive their cars to and from work. Car exhaust fumes (just like power plant fumes) cause acid rain. If a car is not kept in good repair it may also leak oil or other fluids, which will be washed off the pavement and into the river with the next rain.

And how do the residents of the city and its suburbs spend their time? In one neighborhood, **GARDENERS** are out working in their yards. Many of them are using weed killers and insect sprays to keep their lawns pretty. The next rain will wash these poisons into a little creek nearby, and then into the river.

One father is teaching his daughter how to change the **ANTIFREEZE** in their truck. They pour out the used antifreeze into the driveway. Antifreeze is sweet tasting and can poison animals that lick it. It can also get into the nearby creek and poison fish.

Nearby, a boy is **WASHING THE CAR**. The soapy water rushes down the driveway into the storm drain; the storm drain empties into the river. The grease and grime on a car can contain asphalt from the roads, rubber particles from the tires, toxic metals, and rust. If the boy had gone to a local car wash, the water would have been treated before it returned to the river.

Next door is a family cleaning out their garage. They find an old rusty can with a tattered skull and crossbones label still stuck on it. This **MYSTERIOUS LIQUID** looks dangerous and they want to get rid of it before someone gets hurt. They decide to pour it down the storm drain out by the curb. The mysterious liquid is out of sight, but it is headed for the river.

On nice days, many people head down to the river. Some zoom up and down the water in **MOTORBOATS** and don't notice that a little engine oil leaks 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 these people have left trash on the shore. With the next storm, that trash will wash into the river. Further upstream is a **PERSON FISHING**. The person snags their hook on a log and rather than untangling it, breaks off the nylon fishing line.

WHO POLLUTED THE POTOMAC?
CANISTER LABELS

Trees	**Construction Sites**	**Farmers**
Barnyards	**Homeowner**	**Coal Mine**
Electric Power Plant	**Commuters**	**Gardeners**
Antifreeze	**Washing the Car**	**Mysterious Liquid**
Motorboats	**Beach Party**	**Picnicking**
	Person Fishing	