

National Content Standards:

A: Science as Inquiry

C: Life Science

F: Science in Personal & Social Perspectives

G: History & Nature of Science

OBJECTIVE:

To foster an understanding of how human activities and land use affect water quality. To help students identify sources of pollution and how they contaminate water sources.

DESCRIPTION:

Students will learn about sources of pollution by assuming roles of property-users along the Bronx River in New York. Students will connect certain activities with the waste they create and the pollutants they discharge into water. Students will connect the hypothetical game to “real life” environmental circumstances affecting downstream communities all over the world, in particular, Luis’s neighborhood of Hunts Point, in the South Bronx. Students will read Water Stories Supplement to meet Luis. Students will explore and discuss pollution prevention, and why it matters.

MATERIALS:

- Role Playing Cards ([provided](#))
- Pollutants Chart (see below chart)
- 32 post-it notes, 3x5 cards, OR scraps of paper
- Set of color pencils or markers for each group
- Water Stories Supplement** ([provided online as handout](#)) or ([editable PDF](#)).

BACKGROUND:

How we treat our land impacts the body of water into which the land drains. Pollutants can reach the waterways by means of **runoff** (excess water from heavy rainfall, flooding or snowmelt flowing over the land towards a drain or water channel) and direct waste disposal.

Our individual actions can positively or negatively affect water quality and ecosystem health, both locally AND down the river. Understanding the consequences of our activities and the wastes we produce can lead to better decisions and more environmentally and economically sound practices.

ACTIVITY PREPARATION:

- Cut up the Role Play Card sheet into 16 individual role cards.
- Divide students into eight groups.
- Distribute two role cards to each group.
- Distribute a Pollutants Chart to each group.
- Provide each group several 3x5 cards or scrap paper and colored pencils/markers.



ACTIVITY:

1. Refer to Bronx River background information and image below from the Bronx River Alliance: <http://bronxriver.org/?pg=content&p=abouttheriver&m1=9>.
2. Review the Pollutants Chart (provided) with the class. Discuss the different types of pollutants, where they come from and how they might impact the river and the land around it.
3. Have students brainstorm what kinds of activities community members and business owners might participate in who live or work around the river.
4. Distribute two Role Play Cards to each group.
5. Provide each group several 3x5 index cards or scrap paper and colored pencils/markers.

STUDENT INSTRUCTIONS:

1. You are now members of a waterfront community on the Bronx River. Your roles will vary. Some will be business owners, some employees at local businesses, others are home owners and some will take part in recreation in and around the river. As a group, look at your two Role Play Cards and discuss your assigned roles and your (positive and negative) contributions to the riverside community. What activities do you participate in as a business owner/operator or resident?
2. As a group, look at the Pollutants Chart: Pollutants and their Impacts and discuss what types of pollutants (contaminants) are potentially associated with your activities.
3. Create Pollutant Cards: Using the 3x5 cards or scrap paper, draw pictures of these pollutants (wastes from the activities associated with your roles in the Bronx River community) – one pollutant drawing per card/scrap of paper. Label each of the cards you create with your assigned role and the associated activity (see your Role Play Cards), and the pollutant you have drawn. Feel free to brainstorm other activities that your group might also associate with your roles. Identify wastes associated with these activities and create additional Pollutant Cards.

For example, if you were assigned the role of a Landfill Manager, your Card might be a drawing of some garbage and include the following labels:

- role = landfill manager
 - activities = compacting and storing garbage
 - pollutant = household and commercial waste, industrial toxins that seep into the groundwater, petroleum products (see Pollutants Chart).
4. Your group will present to the class: describe your roles in the Bronx River community, how you use the water and the land around the river, and the pollutants you might produce.
 5. Discuss with the class and see if they agree with your hypotheses (educated guesses). You may add any new ideas your classmates offer regarding the activities associated with your role or the wastes created by your activities. Draw additional pollutant cards as needed.
 6. Have two members in your group represent your group's two assigned roles and form a straight line with the other group representatives. This line symbolizes an entire segment of the Bronx River, from upstream to downstream. Designate one end of the line as the top of the stream.
 7. Starting upstream, one by one, each representative should pass his or her pollutants (drawings) to the neighbors downstream on the Bronx River. Group representatives should state how the pollutants they are passing down might (positively and negatively) contribute to the riverside community and affect their human and wildlife neighbors.

8. Continue passing the pollutants downstream until the representative furthest downstream has collected all pollutants (drawings).

WRAP-UP AND REFLECTION:

1. How do the pollutants impact not only your property but your neighbors' properties as they flow downstream?
2. Investigate the term **social equity**, often described as the commitment to promote fairness, justice and equality in the operation of a community. Discuss: Is it fair that people downstream are affected by the activities and resulting pollutants of their neighbors upstream? Do the downstream neighbors have an equal right and expectation to clean water?
3. **Water Stories Supplement Connection:** Investigate the term **Environmental Injustice** (or Environmental Discrimination.) Environmental injustice occurs when environmentally hazardous activities and infrastructure (transfer stations, bus depots, highways, factories, landfills, etc.) are predominantly located in areas with a high concentration of minorities, and or poor people. Take a closer look at the Bronx River Background below and the following study on health in The Bronx (South Bronx Environmental Health and Policy Study) http://www.icisnyu.org/south_bronx/admin/files/NYUWagnerPhaseVIreport.pdf.

Also see Luis's story in the [Water Stories Supplement](#).

- a. Does the situation in the South Bronx fit the definition of Environmental Injustice? Why or Why not? Complete the **Water Stories Supplement** and create your own Stories, then submit them online to contribute to the growing online library of Water Stories from students and teachers around (look online in 2013).
- b. Review and discuss the following excerpt below from James K. Boyce's paper: ***"Is Inequality Bad for the Environment?"***
"How humans interact with nature is intimately tied to how we interact with each other. Those who are relatively powerful and wealthy typically gain disproportionate benefits from the economic activities that degrade the environment, while those who are relatively powerless and poor typically bear disproportionate costs. All else equal, wider political and economic inequalities tend to result in higher levels of environmental harm. For this reason, efforts to safeguard the natural environment must go hand-in-hand with efforts to achieve more equitable distributions of power and wealth in human societies."

Political Economy Research Institute, University of Massachusetts, Amherst.

http://scholarworks.umass.edu/cgi/viewcontent.cgi?article=1108&context=peri_workingpapers

4. Create a checklist of actions for each assigned role that would prevent pollution from entering the Bronx River. How can communities work together to prevent or stop these pollutants entirely? (Hint: Create community action plans and pollution regulations/laws, make better choices when purchasing materials and goods, re-use and recycle materials, etc.)
5. *Did you know?* Under the federal Clean Water Act, it is illegal to discharge pollutants from pipes, ditches, sewers, or other point sources to waters without a permit. The permits determine the amounts and types of discharges allowed. Government agencies are supposed to monitor and enforce these limits, but they can't be everywhere all the time, so **citizens need to help enforce clean water requirements. States and towns have their own Departments of Environmental Protection. Investigate how you can get involved.**

6. Suggest at least one pollution prevention behavior (see “Pollution Prevention Behaviors” below) that you and your family could do at home to reduce the amount of waste and/or pollution that you are creating.

Students may elect to do further research on this topic:

- For younger students: <http://www.epa.gov/owow/NPS/kids/whatwrng.html>.
- Older students may explore environmental health concerns associated with a variety of activities and locations at: <http://toxtown.nlm.nih.gov/index.php>;
World River pollution: <http://www.smithsonianmag.com/people-places/ganges-200711.html>;
What to do? <http://www.rivernetwork.org/we-all-live-downstream>

Pollutants Chart: Pollutants and their Impacts

- ◆ **Pesticides** - Toxic chemicals are used to get rid of pests (insects and animals that eat crops or plants). These compounds can threaten the health of both humans and aquatic species and do not decompose or break down easily, so they remain in the environment for a long time, causing harm. Organisms that ingest (eat) these chemicals have problems developing and breeding, and sometimes die.
- ◆ **Fertilizers** - Nutrients (human-made or natural) are used to enrich lawns, gardens and flowerbeds, helping them grow faster and larger. Fertilizers can introduce large amounts of nitrates and phosphates into the water, eventually decreasing the amount of oxygen available in the water, harming or even killing aquatic life. Even a small increase in phosphorus might cause numerous problems, including accelerated plant growth and algae blooms in the water. Excess algae growth blocks the sunlight needed by plants on the water's bottom, often killing them. As the plants die, they decay, using up oxygen in the water. Without this oxygen, fish and other animals can't survive. Although nitrogen is essential to all living systems, excess nitrates from fertilizers can become toxic to warm-blooded animals. When manure is spread on fields as a fertilizer, it can also spread some of the more toxic substances present in that manure, such as antibiotics or bacteria which can then seep into water. Water pollution from manure as well as synthetic fertilizers can lead to serious environmental damage and harm human health.
- ◆ **Animal Waste** - Animal waste can contain antibiotics from feed or medications and releases a lot of harmful bacteria like e-coli and coliform. Pet droppings and manure "lagoon" overflows can cause diseases and infections if they contaminate drinking water and recreation areas. Excess animal feces (poop) in water can also cause algae blooms, and the same harmful effects as manure-based fertilizer.
- ◆ **Petroleum Products** - Petroleum products are materials made from crude oil, such as gasoline or motor oil. Oil, petroleum products and other toxins from automobiles kill fish, plants, aquatic life and even people. One quart of oil will contaminate thousands of gallons of water because it doesn't dissolve. The effects of oil spills can spread for miles through ocean or freshwater sediments, groundwater leaching or through aquatic food chains and ecosystems. Animals that get caught in oil spills need to be rescued. The oil prevents them from swimming or flying.
- ◆ **Industrial Toxins** - Industrial toxins are the waste products of hazardous chemicals used to manufacture items that we use every day (i.e.: plastic drink bottles, T-shirts). Some of these toxins and metals are absorbed in various sea life and cause medical problems in people when eaten. Nitrogen and phosphorus coming from smokestacks can cause explosive growth of algae, which depletes water of oxygen.
- ◆ **Sewage Waste** - Water carrying waste away from residential, institutional, commercial and industrial establishments is known as sewage waste. Sewage is the term used for wastewater that often contains feces (poop), urine, laundry waste, even pharmaceuticals (medications) flushed down the drain. When untreated, sewage can have serious impacts on the quality of an ecosystem and on the health of people. Pathogens and chemicals in the waste can cause a variety of illnesses in both animals and people.
- ◆ **Household and Commercial Waste** - Our trash, sometimes containing toxins (for example, paint cans, plastic items, chemicals, outdated over-the-counter medicines), must be disposed of properly. Toxins can leak into the ground and ground water, harming animals and people. Plastic pieces that end up as litter on the ground or in waterways can be mistaken for food and ingested by wildlife and fish.

Pollution Prevention Behaviors include:

Pet and Human Waste

- Clean up after pets and other animals to keep feces from polluting water. Carry and use a pooper scooper and/or plastic bag to dispose of waste in the trash or appropriate location.
- Keep animals out of lakes and streams.

Yard and Garden

- Use natural fertilizers such as compost and bone meal.
- Use natural pesticides such as garlic, hot pepper, soapy water and lady bugs for aphids.
- Mulch leaves, instead of blowing and removing them.

Household Maintenance

- Do not pour household chemicals (such as cleaners, solvents, thinners and paints) onto soil or down drain.
- Research and properly handle and dispose of such wastes by recycling or taking them to a treatment facility.

Around Your Neighborhood

- Do not litter. Litter can be carried into local streams and lakes where it can harm wildlife habitat and water quality.
- Help with community clean ups to prevent litter from polluting streams/rivers.

BRONX RIVER BACKGROUND

Excerpted from The Bronx River Alliance, "About the River" <http://bronxriver.org/?pg=content&p=abouttheriver&m1=9>



The Bronx River is a 23-mile long river that runs from the Kensico Dam in upper Westchester County through 13 Westchester municipalities and through the heart of the Bronx to the confluence of the East River and the Long Island Sound. New York City's only freshwater river, it offers a slice of nature amid the strains of urban life.

The Bronx River went from a flourishing and beautiful resource to a contaminated conduit for industrial and residential wastes two centuries ago.

Natural and Social History

Although no one can be certain about the geological origin of the Bronx River, many believe that prior to the Pleistocene Period, the Bronx River was a pre-glacial stream that wound its way from its source in present-day upstate New York to the present Long Island Sound. When a glacier came through the Bronx, approximately 240,000 years ago, it blocked part of the original path of the Bronx River and subsequently reshaped and modified the path of the River. Over the past 200 years the River's course has been altered dramatically by human impact and industry.

Called Aquehung or "River of High Bluffs" by the Mohegan Indians who first lived and fished along it, the river attracted European traders in the early 1600s for the sleek, fat beaver that proliferated there. In 1639, a wealthy Swede, Jonas Bronck, purchased 500 acres from the Mohegans, and mills began to sprout up and down "Bronck's River." By the mid-1700s as many as 12 mills were manufacturing paper, flour, pottery, tapestries, barrels and snuff, powered by water from the stream. The River valley remained thickly forested well up into the 1800s. In his 1817 poem "Bronx," Joseph Rodman Drake described "rocks" and "clefts" full of "loose ivy dangling" and "sumach of the liveliest green." The water was considered so "pure and wholesome" that during the 1820s and 1830s the New York City Board of Alderman debated ways to tap into it to supply the growing city with drinking water. In 1898, when all five boroughs were integrated into New York City, the Bronx was chosen for the name of the Borough—after the Bronx River.

Bronx River Watershed

The completion of the Kensico Dam in 1915 diverted the upper reaches of the River into the reservoir near New Castle and cut off the River's water supply twenty-five percent or by one quarter. The construction of the New York Central Railroad in the 1840s turned the valley into an industrial corridor, and by the end of the 19th century the Bronx River had degenerated into what one official commission called an "open sewer." The history of the river since the 1880s has been one of efforts to reclaim and protect it from the escalating forces of urbanization.

The consolidation of various properties to form the 662-acre Bronx Park in 1888 (718.1 in 2002) provided a buffer against development on either side of the river. The Bronx River Valley Sewer, initiated by Westchester County in 1905, began absorbing some of the worst sewage. The largest project was the Bronx River Parkway, completed in 1925. The 15.5-mile ribbon of parks, lakes and limited access roadway stretching from the Kensico Dam to Bronx Park provided a landscaped recreation zone and a pleasure drive for cars passing through at low speeds. However, the areas along the river south of the Bronx Zoo were left virtually untouched/restored.

During the era of Robert Moses, the Bronx fell into a period of urban decay. The quality of life, particularly in the South Bronx decreased dramatically. Neighborhoods were fragmented by the construction of numerous highways. In particular, the construction of the Sheridan and Cross-Bronx Expressways further distanced the Bronx River communities from each other and from the River itself.

In 1974, a small band of community activists formed Bronx River Restoration and began the arduous process of cleaning up and restoring the river. Their effort gained strength and numbers in 1997, when Partnerships for Parks convened the Bronx River Working Group and brought together more than 60 community organizations, public agencies and businesses committed to reclaiming the river and improving access to it throughout the Bronx.

Efforts to restore the Bronx River took a tremendous step forward in 2001 when the Bronx River Working Group created the Bronx River Alliance as a permanent 501(c)(3) organization to continue this work for the long term. Working closely with the New York City Parks Department, which provides substantial in-kind support, they are headquartered within the Parks Department's facility on the Bronx River Parkway.

SOURCES:

New York State Department of Environmental Conservation <http://www.dec.ny.gov/26.html>

NOAA's National Ocean Service Education: Nonpoint Source Pollution
http://oceanservice.noaa.gov/education/tutorial_pollution/03pointsource.html

What is Nonpoint Source Pollution? | Polluted Runoff | US EPA
<http://water.epa.gov/polwaste/nps/whatis.cfm>

Guadalupe-Blanco River Authority: *Don't be Clueless about Water Quality* www.gbra.org

For more information about the environmental situation in the South Bronx and what is being done about it look at the following resources:

http://bronxriver.org/puma/images/usersubmitted/file/011_Ecosystems.pdf

<http://prattcenter.net/greening-south-bronx>

<http://abridgeovertroubledwater.blogspot.com/2007/10/bronx-river-history.html>