



SAN ANTONIO

RIVER AUTHORITY

HOW DOES THE RIVER BECOME POLLUTED?
Using a Model to Demonstrate Water Pollution

WHY IS THERE POLLUTION IN OUR RIVER?

Using a Model to Demonstrate Water Pollution

OBJECTIVES

- Students will identify the cause of pollution in our watershed.
- Students will model the effects of human activity on groundwater and surface water in a watershed.
- Students will understand that stormwater runoff carries the pollutants off the land into the river and ultimately to our bays and oceans.

TOPICS

- Watersheds
- Pollution

FOR AGES 9+

TEKS ALIGNMENT:

“Students will understand how human activities impact Earth systems.”

Grade 7 Science:

3. A-C, 8.C

Grade 8 Science:

7.A-C, 11.A-C

Aquatic Science

7 A-C, 12-A-C

Environmental Science

9. A, B, E

BACKGROUND MATERIAL

All living organisms need water to survive. Our Earth’s water is constantly being recycled naturally. Did you know that we are using the same water that the dinosaurs used?

There are 358 quintillion (358,000,000,000,000,000) gallons of water on our planet. 97% of this is saltwater. That leaves only 3% to freshwater, but 2.5 % is frozen in our polar ice caps or glaciers. That means that only .5% of all the water on our planet is liquid fresh water! Unfortunately, some of this fresh water is polluted. Rivers are the veins that carry the fresh water on our planet.

Prior to human settlement and urbanization, rainfall was absorbed into the soil, carried into aquifers, consumed by wildlife or evaporated as it flowed from higher elevations to lower elevation. Along the way, native grasses, trees, root systems and other features of the natural environment would slow down the flow and filter out many of the sediments, bacteria and other natural contaminants.

Today, the water travels differently through our watershed because we have replaced the natural environment with impervious surfaces, such as rooftops, driveways, parking lots, roads, highways and storm drains. As a result, more pollutants are entering our waterways.

There are two major types of pollution that affect rivers and their ecosystems: point source pollution and non-point source pollution. Point source pollution is pollution that is produced by one source, such as a pipe discharging directly into a river. Therefore, it is easier to regulate and reduce. The Environmental Protection Agency (USEPA) and the Texas Commission on Environmental Quality (TCEQ) are responsible for regulating point source pollution.



Non-point source pollution comes from the combination of many sources rather than a single source. The most significant threat to the health of the San Antonio River Watershed is stormwater runoff, which carries pollutants from the land into our storm drains and directly into our river. Some major non-point source pollutants are sediment from fields and construction sites, nutrients from fertilizers, chemicals from insecticides and herbicides, fuel and oil from vehicles or industrial facilities. Would you believe that the number one pollutant in the San Antonio River is dog waste? *Escherichia coli* (*E. coli*) is bacteria that normally lives in our intestines. It is found on pet waste and it will enter our waterways after a rainstorm if it has not been disposed of properly. Since non-point sources can come from many places and are not directly discharged into the water, they are much harder to discover and trace. It is also much harder to regulate non-point sources than it is to regulate point sources. To learn more about the health of our San Antonio River please visit: <https://www.sara-tx.org/be-river-proud/river-health>

Non-point source pollution is corrected by land use practices rather than by treating the water itself, since you cannot regulate rainfall, and it is rainfall that carries the pollutants into the stream or river. Land use practices that are effective in controlling non-point source pollution are called best management practices (BMPs). The purpose of a BMP is to reduce the amount of pollution that is being produced in the first place, and then to prevent runoff from carrying that pollution into streams. The San Antonio River Authority (River Authority) and Bexar County developed a training program for the construction, inspection, and maintenance of Low Impact Development (LID) permanent stormwater Best Management Practices (BMPs). LID is a design approach modeled after nature to manage stormwater runoff in a manner that mimics natural hydrologic processes, providing benefits for water quality and mitigating negative impacts of stormwater runoff on downstream resources including streams and rivers. Please visit <https://www.sara-tx.org/services/environmental-sciences/clean-rivers-program> to learn more about our clean river program.

In San Antonio, our storm drains are designed to prevent flooding. We live in flash flood alley. All stormwater runoff that is not absorbed by the earth will flow down the storm drains and will flow directly into the river. *E. coli* levels will remain high for 3-5 days after a rainstorm. This lesson will teach others about the causes of pollutants in our watershed which ultimately enters our rivers and eventually the San Antonio Bay.



KEY TERMS

Best Management Practices are those practices that are effective in preventing non-point source pollution.

Impervious cover is any material that water cannot infiltrate, such as concrete, asphalt, metal, or brick.

Non-point source pollution is water pollution that comes from a combination of many sources rather than a single source. Non-point source pollution usually enters the water as stormwater runoff.

Pervious cover is any material that allows water to pass through, such as natural land with grasses and trees.

Point source pollution can be traced back to a single source, such as a factory; the pollution generally flows from a single source.

Pollutant is any material that causes pollution.

Runoff is water that flows over the surface of the land when rainfall is not able to infiltrate into the soil, either because the soil is already saturated with water, because the land surface is impermeable, or because the rate of rainfall exceeds the rate of water infiltration into the ground.

Sediment is silt, sand, rocks, and other organic matter that is moved by water or wind, resulting in erosion and deposition.

Storm drains are designed to prevent flooding. The stormwater runoff from impervious surfaces, such as parking lots and streets run down the drains. This water is not treated but is released directly into the river.

Watershed is an area of land that drains to a single point, such as a river, a lake or a stream.

Urbanization is the process of creating and enlarging cities and towns.



PROCEDURES

- A. In our first lesson, “What in the World is a Watershed”, we learn that a watershed is an area of land that drains to a single point, usually a creek, stream, or river. We built a watershed model and observed the runoff. Today we are studying pollutants and how they may enter our river.
- B. Emphasize that only about one-half of a percent of all the water on our planet is liquid fresh water. But some of it is polluted. Ask if they have ever gone to a river? Show:
<https://www.youtube.com/watch?v=HXluEuAgXTY&t=1s>
- C. What types of pollutants are found in our rivers and streams? Brainstorm ideas and create a table with two columns. Label the first column “Pollutants” and label the second column “Solutions”.
- D. Teach the terms point and non-point source pollution.
- E. Explain that today we will be putting “pollutants” on our watershed and will observe what happens when it rains. Explain each of the materials that will be used and what they represent.
- F. Sprinkle the “pollutants” all over the watershed model.
- G. Predict what will happen to the “pollutants” when it rains.
- H. Instruct students to spray the watershed model with water and observe what happens to the “pollutants.”
- I. Discuss what happened. Ask, what caused the pollution to enter our river?
- J. Ask, how is this model like our natural world? How is it unlike it? Discuss pervious and impervious surfaces.
- K. Explain that what they observed with this model is really what happens with stormwater runoff in our natural world. Except, of course that in our natural world some of the rain is absorbed by the ground, which offers many natural benefits. The water will fill the empty spaces between soil particles, be absorbed by roots of plants, or trickle slowly through the soil. It is here, below the Earth’s surface that the soil, sand, and rock may serve as a filter to help clean the water before entering our aquifer.
- L. Show photo of storm drains or go outside and find storm drains in your neighborhood. Emphasize that these are **not** sewers. Storm drains were designed to mitigate flooding. Storm drains allow the stormwater to quickly flow off the streets, down through underground pipes, and finally into our river. It is **not** being treated before it enters our river. Stress that whatever is on the land may possibly enter our river just as this model has demonstrated.
- M. Show video clip of Red Solo Cup:
<https://www.youtube.com/watch?v=AuOkWanmlYQ&t=1s>

MATERIALS

- Watershed model (instructions can be found in our “What in the World is a Watershed”) lesson
- Spray bottle of water
- Need materials that can represent pollutants. Any colored powder such as Kool-aid or cocoa to represent chemicals, dog waste, and sediment.
- Any kind of liquid to represent the oil, gasoline, and antifreeze from vehicles (any cooking oil, or add food dye to water).
- Any recyclable material or trash that can easily be torn/cut into smaller pieces to represent litter.
- Photos of storm drain
- Watershed Wise Poster in English or Spanish pdf
<https://www.sara-tx.org/be-river-proud/watershed-wise/be-watershed-wise>



GUIDING QUESTIONS

- What can we do to stop pollutants from entering our river? Write solutions.
- Humans changed our environment by building storm drains to mitigate flooding. Discuss the pro and cons of storm drains.
- Why does it matter? (stay tuned for our lesson on ecosystems)

EVALUATION

Design a public awareness campaign. The goal of your campaign is to teach others what a watershed is and what is causing our river to be polluted. Feel free to reference the San Antonio River Authority's Creek Book: A Guide to Healthy Creeks and Rivers at <https://www.sara-tx.org/resources/creek-book-guide-healthy-creeks-and-rivers>

Here are a few suggestions:

- Create a movie (for social media)
- Create a billboard
- Create a comic strip
- Create a PowerPoint
- Interview an expert at the San Antonio River Authority and write an article

SUSTAINABILITY TIP

- Hang on to the watershed model, we still have a lesson on impervious surfaces.
- Recycle the aluminum foil.
- Wipe the tray clean and put "pollutants" in the garbage.



STORM DRAINS



