SAN ANTONIO RIVER AUTHORITY

IMPERVIOUS VS. PERVIOUS SURFACES

Using a Models to Demonstrate the Benefits of Pervious Cover

EDUCATIONAL ACTIVITY

WHY IS THERE POLLUTION IN OUR RIVER?

Using a Model to Demonstrate Water Pollution

OBJECTIVES

- Define what runoff is and learn how it can affect the water level in a river or stream
- Discuss how different land uses in a watershed can affect surface runoff amounts

TOPICS

- **Watersheds**
- **Pollution**
- **Land Use**
- **Stormwater**
- **Pervious Surfaces**

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

Did you ever wonder why water levels rise in a stream or river after a rain, or why some rains cause flooding and other rains do not? To understand the connections between rainfall and water levels in rivers, it is important to understand the concept of runoff.

Runoff occurs when rain falls onto the land and then flows off the surface or through the soil and enters a stream that is at a lower elevation. Runoff also occurs when more rain falls during a particular period than can be absorbed by into the soil. Thus, the amount of runoff depends on the amount of rainfall, the type of soil, the amount and type of land cover, the land slope, and the amount of water that is already in the soil because of recent rains.

Different types of land uses affect the amount and quality of runoff. Land uses include urban (cities and towns), farming, livestock grazing, transportation, and natural uses. Urban uses can result in increased surface runoff from impervious cover, such as concrete, asphalt and rooftops. Livestock grazing can result in increased runoff from overgrazed pastures because shorter grass and bare ground hold back less rain than longer grass. Urban and rural transportation uses, like roads, can disrupt the natural flow patterns of water and can result in increased runoff from impervious cover. Making drainage ditches out of streams by lining them with concrete can also increase runoff.

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. Start by asking the students what happens to streets and low water crossings during storms. Ask them what happens to water levels in streams and rivers when it rains.
B. Prepare for this activity by cutting a large opening in the smaller edge of the three aluminum foil broiling pans for the water to drain out. Then, place sponges in the bottom of two of the broiling pans – you may have to cut the sponges to get them to fit tightly and flush with the bottom of the pan
C. Ask the students to place the tile on top of one of the pans with sponges, place one carpet tile on the other pan with sponges, and place the other carpet tile on the broiling pan without sponges
D. Instruct the students to place the three broiling pans at an angle inside the larger aluminum baking pan so that each broiling pan drains into the baking pan
E. Have them pour 500 mL or another specified amount of water onto highest end of the pan containing the carpet and sponges. They should record the initial amount on the table in Student Sheet 1.
F. Instruct the students to allow the water on the carpet and sponges to drain into the drain pan for 10 seconds
G. Have the students pour the contents of the drain pan (baking pan) into an empty graduated beaker or glass measuring cup and record the amount of water that is recovered
H. Instruct the students to subtract the amount of water recovered in the drain pan from the amount of water applied initially to obtain the amount of water retained by the carpet and sponges. They should record this amount in the table
I. Have the students repeat steps 5-8 for the pan containing the now wet sponges and carpet
J. Have the students repeat the steps 5-8 for the pan containing the carpet with no sponges
K. Have the students repeat steps 5-8 for the pan containing the now wet carpet with no sponges
L. Have the students repeat steps 5-8 for the pan containing the tile and sponges
M. Ask the students to construct a graph showing the amount of runoff vs. the types of land surfaces
N. Have the students observe the aerial photographs of a site in northern Bexar County found on Student Sheet 2, and lead a discussion based on the observed differences in impervious vs. pervious surfaces.

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

EVALUATION

Start by having the students relate the observations that they made with their models to the area around their home or school. What type of land do they observe? Is it flat or hilly? Is the ground covered with grass and other plants or is there concrete and asphalt? Do they see any bare soil that could erode because of rainfall? Where do they think rainfall would infiltrate into the ground and where do they think it would run off? Then, ask the students to write a short paper about runoff and pollution in their town or area. Have them describe the geography and types of land uses that they observe in the area where they live. As their city or town grows and more homes, streets and parking lots are built, have them describe what might happen with runoff and how this might affect flooding.

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

Ground Cover	Dry carpet and sponges	Wet carpet and sponges	Dry carpet	Wet carpet	Tile and sponges
Volume of water applied (mL)					
Volume of water caught as runoff (mL)					
Volume of water retained (mL)					

STUDENT SHEET 2

These aerial photographs show an area in north-east Bexar County that recently has undergone development. Notice the increase in impervious cover in the second photograph.

1995
The Forum Site

2003
The Forum Site