Lesson Plan Information

Name: Water & Biodiversity: Stormwater Pollution
Grade: K-8 and 9-12
Topic: Learn how human activities impact surface water quality through stormwater runoff
Time: One hour to one hour and 45 minutes

Introduction:

Stormwater discharges are generated by runoff from land and impervious surfaces such as paved streets, parking lots, and rooftops during rainfall and snow events. Stormwater flows across exposed surfaces where it picks up various pollutants that could severely impact water quality. Stormwater runoff discharges into our creeks, rivers, and other receiving waters untreated. Stormwater runoff is one of the most significant pathways of water pollution.

Many human activities, such as fertilizing our lawns or washing and maintaining our cars in our driveways, contribute to stormwater pollution. Many of these daily activities are not regulated by federal, state, or local governments. Because of this, it is important to understand the impacts these activities have on our water quality downstream.

This lab activity demonstrates the effects of nonpoint source pollution and how these types of pollutants impact water quality. Additionally, this lab demonstrates some current methods to identify stormwater pollution in a community reservoir setting. There are several main groups of pollutants that can affect water quality. This lab will focus on nutrients/fertilizer (baking soda), suspended solids (confetti), oil and grease, as well as a demonstration with pH strips of how rainfall is slightly acidic and how that interacts with the pollutants in the environment.

Materials:

Kit will include:

- Basin (plastic tray)
- 500 mL squeeze bottle with rainfall cap
- Pipette dropper
- Litmus paper
- Measuring spoons
- Baking soda
- Vinegar
- Oil
- Litter (confetti)
- Turf grass
- Structure set
- Foam sheet
- Adhesive squares/dots

Additional materials needed:

- Scissors
- Water
- Paper Towels for clean up

Videos and additional Information can be found on the DFW Earth Day website

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Key Terms:

Stormwater: Water that drains off a land area from rainfall or snow and ice melt.

Acid Rain: Rainfall made sufficiently acidic by atmospheric pollution that it causes environmental harm, typically to forests and lakes.

Runoff: Precipitation that does not soak into the soil, but instead moves on the earth's surface toward a waterbody.

Waterbody: Any significant accumulation of water on the surface of the earth such as lakes, and rivers.

Water Pollution: The alteration of the chemical, physical, or biological integrity of water. Pollution is caused by activities that affect overall water quality.

Physical Contaminants: Solid particles that primarily impact the physical appearance of water. Examples are sediment or organic material caused by soil erosion.

Chemical Contaminants: Chemical elements or compounds that may be naturally occurring or human made. Examples include nitrogen (fertilizer), metals, and human or animal drugs and waste.

Pollutant: A substance that can cause pollution.

Point Source Pollution: A discharge of pollutants at a specific location, such as a pipe discharging wastewater or runoff into a stream.

Nonpoint Source Pollution: Pollutants that do not have a specific point of origin. These pollutants are generally carried by runoff. Nonpoint source pollution includes runoff that contains:

- Excess fertilizers, herbicides, or insecticides from agricultural or residential areas.
- Motor oil, grease, or toxic chemicals from urban areas (roadways, parking lots, etc.).
- Household chemicals that were not disposed of properly.

Watershed: A land area that channels rainfall and snowmelt to creeks, streams, and rivers, and eventually to outflow points such as reservoirs, bays, and the ocean.

pH: A measure of how acidic or basic a substance or solution is.

Procedure:

Identify How Pollutants in our Community Affect Stormwater Quality:

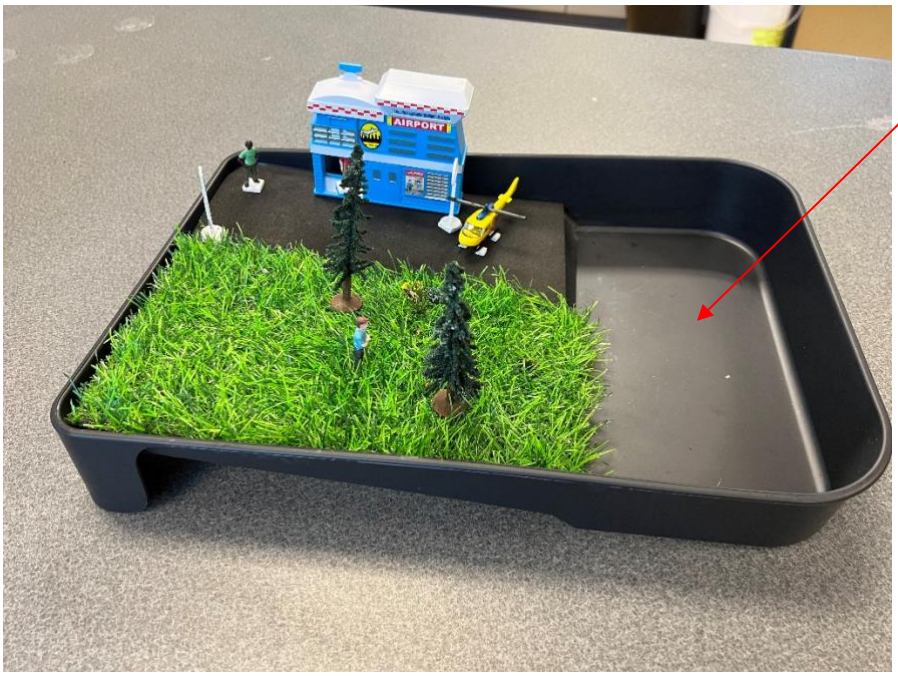
Build Your Community!

Materials needed:

- Plastic tray
- Scissors
- Turf grass
- Foam sheets
- Adhesive squares
- Structure set

Next steps:

1. Decide how you want your community to look (e.g., neighborhood home, city street, construction site, etc.)
2. Arrange and cut your foam and turf grass, then glue onto the flat surface of the tray. *Leave the reservoir empty.
3. Arrange and glue in your other materials (structure, figurines, etc.).



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Deploy the Pollutants

Materials needed:

- Pipette dropper
- Oil
- Litter (confetti)
- Fertilizer (baking soda)

1. Using the pipette dropper, apply small amounts of oil where you might find oil and grease in your community. (e.g., where cars were parked, or near a garage from mechanical equipment, etc.).
2. Sprinkle up to 2 teaspoons of baking soda on lawn or landscaped areas (represents fertilizers).
3. Sprinkle confetti wherever you may find trash or other debris that has been windblown or tossed on the ground.

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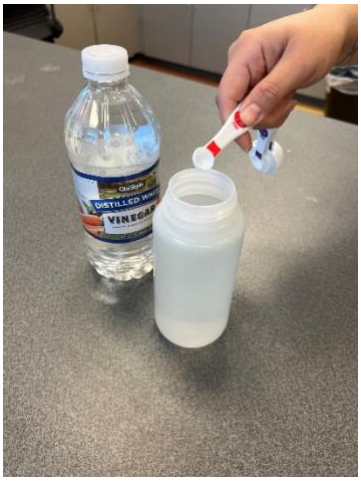
Measuring and Observing Pollutant Impacts on Stormwater

Materials needed:

- Water quality field form
- Litmus paper
- 500 mL squeeze bottle with rainfall cap
- Measuring spoon
- Vinegar

1. Fill the 500mL squeeze bottle with tap water
   - ❖ Use a litmus strip to measure the pH of the tap water.
     i. Dip the litmus strip into the 500 mL squeeze bottle for two seconds, remove, and set aside on a clean surface for about 15 seconds.
     ii. After 15 seconds, compare the color on the litmus paper to the pH color chart to determine the pH range.
     iii. This is your baseline pH range. Record the pH range of the tap water on the field form under "Baseline ph."
2. Prepare "Rainwater" solution
   - ❖ Add up to 1/8 teaspoon of vinegar to the 500 mL squeeze bottle of tap water and stir.
     i. Dip the litmus paper into the 500 mL squeeze bottle for two seconds, remove and set aside on a clean surface for about 15 seconds.
     ii. After 15 seconds, compare the color on the litmus paper to the pH color chart to determine the pH range. You're aiming for a pH range of five to six. You may have to adjust amount of vinegar added to achieve this range.
     iii. Once a pH of five to six is achieved, record the pH range on the field form under "Rainwater pH."
3. Attach the rainfall cap to the squeeze bottle.
   - ❖ Using the squeeze bottle, "rain" on your community.
   - ❖ Observe how the contaminants behave when the stormwater flows over the surface.
   - ❖ Once the "storm" is over, record the following observations of the reservoir on the field form:
     i. Repeat the steps above to measure and record the pH of the stormwater runoff.
     ii. What changes do you notice based on how much baking soda was applied?



4. Lastly, answer the Observation questions on the field form.

Conclusion:

Pollutants in Stormwater

There are several different types of pollutants that can enter our waters. Some are harmless, while others are dangerous to the environment or can cause negative health impacts to humans. Nonpoint source pollution is difficult to control because it comes from everywhere. However, these types of pollutants can be reduced. By executing best management practices, such as not overwatering your lawn, applying fertilizer and pesticides in a responsible way, and picking up after pets are all methods to reduce pollution by stormwater runoff.

Contaminant Observation

This lab demonstrates how various contaminants, such as litter debris or oils can be physically observed in stormwater, as well as how contaminants travel into reservoirs at different speeds depending what type of surface stormwater is flowing over.

pH Test

pH is a measure of how acidic water is. The range goes from zero to 14, with seven being neutral. pHs of less than seven indicate acidity, whereas a pH of greater than seven indicates a base. Rainfall is slightly acidic with a pH range of five to six. Since pH can be affected by pollutants in the water, pH is an important indicator of water that is changing chemically. pH is

reported in "logarithmic units." Each number represents a 10-fold change in the acidity/basicness of the water. Water with a pH of five is 10 times more acidic than water having a pH of six.

This lab demonstrates how the addition of a pollutant (e.g., fertilizer demonstrated as baking soda) can impact and change the pH of rainfall from the time it reaches land surface to when it gathers in a waterbody or reservoir.

Adaptations:

K-5

"Rainwater" solution can be made ahead of time and the teacher can conduct the pH measurements in front of class. Observational data can be collected by teacher and discussed with class.

Figure 1