

Rain, Drains, and Terrains

Learning about Nonpoint Source Pollution & Tennessee Waterways

Level: Grade 6-12

Subjects: Life Science, Earth Science, Environmental Science

Learning Objectives: Students will be able to:

1. Identify common pollutants coming from the landscape, also called nonpoint source pollutants, and know their sources.
2. Assess what types of pollutants are easy to remove from creeks and what kinds of pollutants are persistent.
3. Determine the types of pollutants present in their local runoff and streams.



Reference: Adapted from EPA Environmental Education

(<https://www.epa.gov/nutrientpollution/what-you-can-do-your-classroom>)

Materials:

- Large clear plastic or glass box (storage container or aquarium)
- Lid for the box with hole in middle, concave so water would drain inward
- Watering can and water
- Two clear cups or glasses
- Coffee grounds or soil
- Green and red food coloring
- Cooking oil
- Finely shredded paper
- Small pieces of Styrofoam or other floating trash
- Tootsie rolls or pellet cat litter
- Baking soda
- Cheese cloth, old sock, or coffee filter
- Potted plant, gallon size or larger with drainage holes in the bottom

Background Information:

With over 60,000 miles of creeks and rivers and with much of the state receiving nearly 50 inches of rain in a year, Tennessee is a water rich state. With all that rain, sometimes in big and intense storms, there is high risk of runoff and pollution being washed into creeks, rivers, and wetlands. This activity explores nonpoint source pollution, which comes from the landscape as a diffuse source rather than a pipe outfall or other point source. It is useful to remember that many of these substances are naturally cycling through the environment all the time. However, it is when there is an activity in the landscape that causes unnatural excess levels of these substances to end up in runoff that causes a compounding problem in waterways as they are leached from the landscape. This is when these substances are classified as pollutants that harm water quality.

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Here is a list of common nonpoint source pollutants, their sources, the issues they pose in the natural environment, and the materials that represent each pollutant in the activity below.

Pollutant – Material used to represent it	Source of pollutant	Why it is a problem in creeks and rivers
Sediment – <i>Coffee grounds or soil</i>	Land Disturbance (construction sites, agriculture, gravel roads, etc.)	Creates turbid water, degrades aquatic habitats, clogs drains and fills reservoirs
Nutrient fertilizers – <i>Green food coloring</i>	Lawn and gardens, agriculture	Causes eutrophication (excess energy/food source leading to algal blooms), visually unappealing, impacts sensitive aquatic species
Pesticides/Herbicides – <i>Red food coloring</i>	Roadside right-of-ways, lawn and gardens, agriculture	Toxic to aquatic plants, animals, and other organisms
Motor oils – <i>Vegetable oil</i>	Leaky vehicles, gas stations, poorly contained oil changes	Disrupts natural microbial activity in streams, lowers dissolved oxygen
Grass clippings/yard wastes – <i>Shredded paper</i>	Lawns, roadside right-of-ways	Non-naive organic matter and not readily broken down by decomposers, increases nutrients in streams, clogs drains
Trash debris – <i>bits of styrofoam cup</i>	Litter, non-covered waste management facilities	Visually unappealing, may release toxic byproducts
Bacteria – <i>tootsie rolls or pellet cat litter</i>	Pet waste (dogs and cats), manure fertilizer, animal agriculture	Threat to human health, causes parasites in fish and other animals
Heavy metals – <i>baking soda</i>	Vehicular weathering (tires, break lines/pads), weathering of roofing and gutter materials	Toxic to fish and other sensitive aquatic organisms, bioaccumulates in tissues

Procedure:

1. Introduce the activity with a discussion of storm drains/ditches and their purpose. Discuss where the water goes and the pollutants the water might carry with it. Ask the students to list all the things that might enter a storm drain or ditch when it rains. Describe the clear box as the creek, river, or wetland/ocean, the lid as the landscape and the hole as the storm drain or ditch that carries runoff from the landscape around it into the waterway.
2. Introduce each material that represents a pollutant. Discuss each pollutant, including its use or origin in the landscape and how it could get into a storm drain. This could be done in small group work, each group gets a pollutant to discuss and then share with class.
3. Place each pollutant onto the “landscape.” Use the watering can to create rain onto the landscape to wash the pollutants through the “storm drain/ditch” and into the “creek” (box below). Ask for observations about how the pollutants are moving and washing into the creek.
4. After all the pollutants are in the stream, ask the students to observe the creek water. Discuss how it has changed and ask them to complete the first set of questions. Discuss how the pollutant could damage the environment, who might be responsible for the pollutant getting into the stream, what happened to each pollutant as it enters the creek, and how the pollution may be stopped.

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5. Remove the lid from the box and ask the students to remove the pollutants. Ask them to answer the second set of questions. It should be easy to remove the trash/debris, paper, and perhaps some coffee grounds, while it is impossible to remove the other things dissolved into the water or dispersed throughout the creek.
6. Take a representative cup of water from the creek (be sure to get as much pollutants as possible). Now pour the creek water through the potted plant and catch the drainage into a second clear cup. Ask the students to observe the difference in color, or pollution, between the two. Discuss which pollutants would be captured as the runoff is filtered through the soil and plant roots.
7. Finally, take the students outside to the nearest storm drain or creek. Look for pollutants or signs of pollution. Ask them to complete the last portion of the activity.

Question Set 1 – before or as you complete activity.

1. What kinds of landscapes are around the school? Around your home, community, city, town? What happens in the landscape when it rains? Where does water run off the land, flow, collect? Where does the school storm drains take the runoff?
2. What pollutants could wash from the landscape? What could be washed from the school parking lot and into the storm drain, then creek or river?

Question Set 2 – after filtering activity.

3. Which pollutants were easy to remove from the creek water?
4. Which pollutants were hard to remove?
5. What can be done to stop the pollutants from entering creek?
6. What kinds of pollutants do you think you would find around your home or neighborhood?
7. What are some of the things you can do at home, at school, or in your community to help prevent nonpoint source pollution?



Go Outside:

Go outside and locate your nearest storm drain or creek (remember to always check for traffic). Look into the storm drain or creek for signs of pollutants? What do you see? Which pollutants do you see around your school or home? Check off the ones you see below and write beside them the possible source of the pollutant.

- | | |
|------------------------------------|------------------------|
| _____ Sediment or gravel | Probable source: _____ |
| _____ Trash | Probable source: _____ |
| _____ Grass Clippings | Probable source: _____ |
| _____ Fertilizers (look for algae) | Probable source: _____ |
| _____ Oils or Grease (black grit) | Probable source: _____ |
| _____ Pet Waste | Probable source: _____ |

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Extensions: – Use technology tools to explore water quality in local streams, creeks, and rivers.

1. Tennessee Department of Conservation and Recreation Division of Water Resources Map - <http://tdeconline.tn.gov/dwr/>
2. UT Extension Watershed Web Map App – <https://tiny.utk.edu/watersheds>.

Service Learning Project Ideas:

1. Conduct a stream clean up to remove trash and debris from a creek in your community. Call your local Stormwater or Engineering Department and ask about how you can help in a safe way.
2. Storm drain stenciling. Call your local Stormwater or Engineering Department and ask about storm drain stenciling. Or, find a storm drain stencil online, print, and cut out. Use weather resistant spray paint to carefully stencil the top of the storm drain. This will raise awareness in your community about how storm drains dump straight into local creeks, so they need to be protected from pollution. Notify your local government before you stencil municipal infrastructure.



Keep the Tennessee River Beautiful - <https://www.keeptnriverbeautiful.org/stormdrain>

Metro Nashville -

https://www.nashville.gov/Portals/0/SiteContent/WaterServices/docs/education/stormdrain_stenciling_info.pdf

Chesapeake Bay Program - <https://www.cbf.org/join-us/education-program/resources/storm-drain-stenciling.html>

Additional Resources:

USEPA Types of Nonpoint Source Pollution

USEPA Tennessee Nonpoint Source Pollution Resources -

<https://cfpub.epa.gov/npstbx/WhereYouLive.cfm?StateID=43>

USEPA Nonpoint Source Pollution Toolbox –

<https://cfpub.epa.gov/npstbx/index.html>