



Environmental Science

Stormwater Happens!

Project Area:
Environmental Science

Skill Level: Intermediate to Advanced

Learner Outcomes:

- ⇒ Be able to identify permeable and impermeable surfaces.
- ⇒ Be able to map a flow path of stormwater.
- ⇒ Understand the connection between stormwater and the water cycle.

Tennessee Science Curriculum Standard GLEs:

Embedded Technology & Engineering 0607.T/E.1
0707.T/E.1 0807.T/E.1

S7. The Earth 0707.7.6

Success Indicator:

Students understand the difference between a natural and urban water cycle.

Science Skills: Observe, collect data, interpret, engineer solutions

Life Skills: Observing, Reasoning

Tags: stormwater, water cycle

Materials:

- ⇒ Sidewalk chalk
- ⇒ Two glasses of water
- ⇒ Computer (optional)
- ⇒ Paper or grid paper
- ⇒ Ruler
- ⇒ Colored pens or markers

Have you ever noticed where raindrops go when it rains?

Stormwater is runoff that happens when the land cannot absorb the rain that falls onto it. Stormwater can cause flooding, carry pollutants, and harm aquatic ecosystems.

The purpose of this activity is to define key terms related to stormwater and watersheds and to get students to think about where runoff is generated, how it moves across the land, where it goes, what it can carry with it, and the impacts it may have on stream ecosystems.

Stormwater = Runoff that happens when land cannot absorb all the rain.

Watershed = The land area that drains water to a common location.

Ask your students:

- ⇒ What is runoff and where does it come from?
- ⇒ What produces more runoff — a parking lot or grass field or forest?
- ⇒ Why should we be concerned about increased stormwater in cities?
- ⇒ Where does stormwater go?

Introduce Key Concepts:

Talk about how the water cycle is changed in the urban environment (reference figure in activity). Increased impermeable surfaces in communities leads to more stormwater.

Most stormwater runoff from urban areas goes straight to streams with no filtering of pollutants.

Resultant problems are increased flooding, poor water quality, degraded aquatic habitat for fish and macroinvertebrates and decreased biodiversity.

Activity: Soak It Up!

Pour glasses of water on various surfaces around your school yard to demonstrate the difference between a permeable and impermeable surface. Before each demonstration ask your students to predict what will happen to the water (answer key above).

Activity: Where Does Stormwater Go?

Ask students to write the name of their watershed on the sidewalk in chalk. "Rain" on it with a hose or watering can and observe the flow path.

Activity: Stormwater Mapping

Students will map their home or school and the flow path of water coming off of it during a rainstorm. Have them note downspouts, drainage ditches, and permeable and impermeable surfaces.

Optional: Your students may use Google Earth to get an aerial photo of their home, allowing them to develop technology skills. If you have access to a GPS, use it to obtain your school's coordinates and ask your students to find the location and aerial photo online.

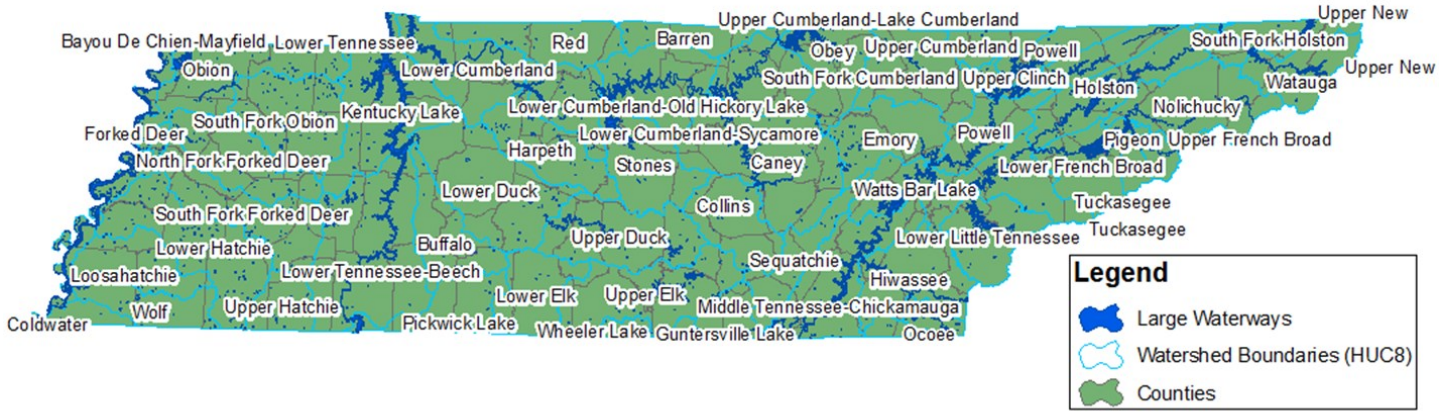
Ask your students to go outside when it rains and see where water falls on their homes and lawns. Help them complete a map of their home and show where water soaks in and where it runs off. Ask them to pretend like they are a raindrop and follow their pathway down to the nearest stream.

SURFACE	Impermeable?	Permeable?
Driveway***	X	X
Lawn		X
Flower bed	X	
House Rooftop	X	
Vegetable garden	X	
Sidewalk***	X	X
Roadside Drainage***	X	X
Barn/Shed Roof	X	

*** These may be either impermeable or permeable. If the driveway or sidewalk is made of a porous concrete mix, gravel, mulch, sod or pavers with pea gravel between, the water likely percolates through these materials, making it a permeable surface. If the roadside drainage way is grassed, then it is permeable, but if it's a concrete culvert or gutter, then it is impermeable.



Tennessee's Watersheds, Hydrologic Unit Code 12 (HUC 12)



Extension:

Install a stormwater tank at your school! Disconnect a downspout that is connected with the storm drain or falls onto impermeable surfaces and install a rain barrel or larger rain tank! The water collected from the rooftop can be used to water a garden or landscaping. This project would be a perfect complement to a school teaching garden.



Discuss and Apply:

1. What did the stormwater flow into? A culvert, storm drain, ditch or creek?
2. What surfaces were impermeable and what were permeable?
3. Where was the closest storm drain or pipe? Did you see any pollutants moving in the stormwater?
4. If more spaces at your home and in your community were permeable instead of impermeable, how would that change the amount of stormwater and pollutants that make it into our streams?
5. How can you reduce the impacts of stormwater runoff at your home? Share maps and brainstorm ways that you can direct stormwater away from impermeable surfaces onto permeable surfaces. Show how rain gardens and rain tanks are used to catch stormwater.



Environmental Science

Stormwater Happens!

Have you ever noticed where raindrops go when it rains?

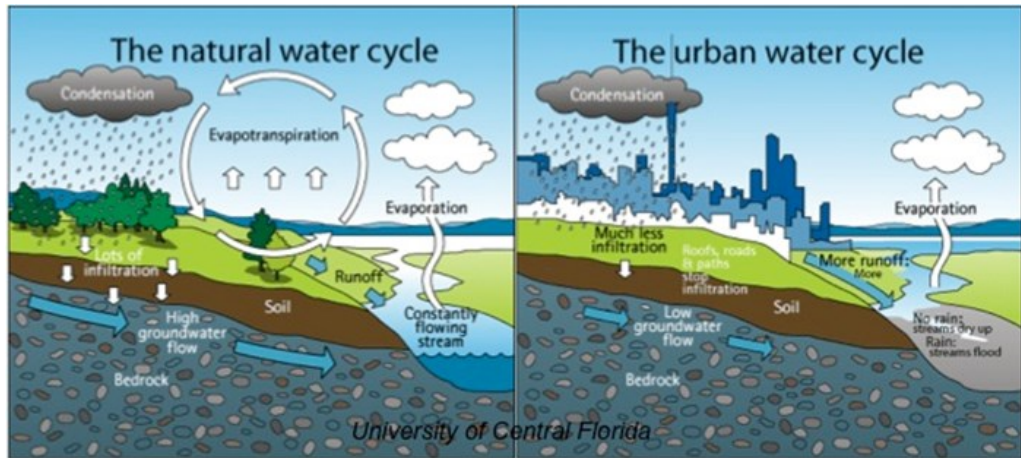
Stormwater is runoff that occurs when the land cannot absorb the rain that falls onto it.

Stormwater can cause flooding, carry pollutants, and harm aquatic ecosystems.

Since rain falls on all types of landscapes, stormwater can happen just about anywhere! Stormwater can come from parking lots, parks, building tops, cropland, forests and even your own home. Stormwater may be a particular concern in developing *watersheds*. A watershed is the land area that drains water to a common location.



Stormwater occurs when the land's ability to soak up the water is slower than the rate of rainfall, or *rainfall intensity*. The characteristic of the land surface that affects the amount of rainfall that can soak in is called *permeability*. When land is *permeable*, water can soak in and move through it, like a sponge. Water moving into the land is called *infiltration*. When land is *impermeable*, water doesn't soak in, but instead runs off of it, like an umbrella. Water that doesn't soak in is called *runoff*. Lawns and forests are permeable; pavement and buildings are impermeable. When land is changed from forest or grassland into a city with homes and shopping centers, the land is changed from permeable to impermeable. This changes the way water moves through the *water cycle*.



Changing the permeability of land surfaces may increase stormwater runoff and decrease infiltration. This process affects components of the water cycle and may have a harmful affect on aquatic ecosystems. Look at the two water cycles shown above. How are they different? List four things in the urban water cycle that are different from the natural water cycle:

1. _____
2. _____
3. _____
4. _____

Goals:

- ⇒ Be able to identify permeable and impermeable surfaces.
- ⇒ Be able to map the path of stormwater.

Words to Explore:

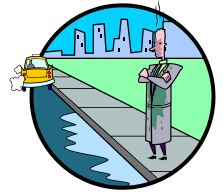
- ⇒ Stormwater
- ⇒ Watershed
- ⇒ Rainfall intensity
- ⇒ Permeability
- ⇒ Permeable
- ⇒ Impermeable
- ⇒ Infiltration
- ⇒ Water cycle
- ⇒ Pollutants
- ⇒ Sediment
- ⇒ Topography

Did You Know?

The biggest pollutant in Tennessee is *sediment* or *soil*.



Activity: Soak It Up!



Fill two glasses of tap water and go out into your yard. Pour the first glass of water onto the sidewalk or driveway. What happens?

Now, pour the second glass into the lawn or flower bed. What happens differently when the water is poured onto the lawn or flower bed?

Identify which of these surfaces found around your home and yards are permeable or impermeable. Check the box in the right column:

SURFACE	Impermeable?	Permeable?
Driveway	<input type="checkbox"/>	<input type="checkbox"/>
Lawn	<input type="checkbox"/>	<input type="checkbox"/>
Flower bed	<input type="checkbox"/>	<input type="checkbox"/>
House rooftop	<input type="checkbox"/>	<input type="checkbox"/>
Vegetable garden	<input type="checkbox"/>	<input type="checkbox"/>
Sidewalk	<input type="checkbox"/>	<input type="checkbox"/>
Roadside drainage	<input type="checkbox"/>	<input type="checkbox"/>
Barn/shed roof	<input type="checkbox"/>	<input type="checkbox"/>



This *sediment*, or washed away soil, goes through the storm drain and straight into a creek, where it will harm fish and aquatic insect habitat.

Activity: Where Does Stormwater Go?

Use sidewalk chalk to write the name of your *watershed* on your driveway in a place that is open to the sky. **What happened to your chalk drawing after it rained?**

What would happen to fertilizer or soil that is left on sidewalks or other impermeable surfaces? How would this be different if it was on a permeable surface?

Stormwater can pick up harmful substances, or *pollutants*, as it moves over the land. Pollutants can be fertilizers, soil, oil, gasoline, pesticides and other chemicals. These pollutants are carried to streams and rivers in storm drains and can harm aquatic ecosystems. Everything in a watershed is linked together by the flow of water.





Activity: Stormwater Mapping

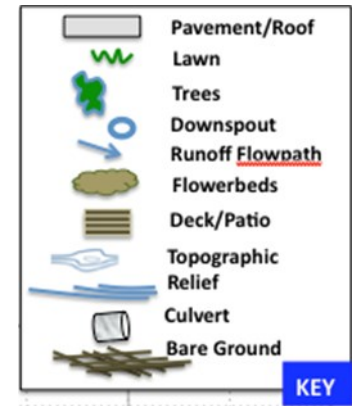
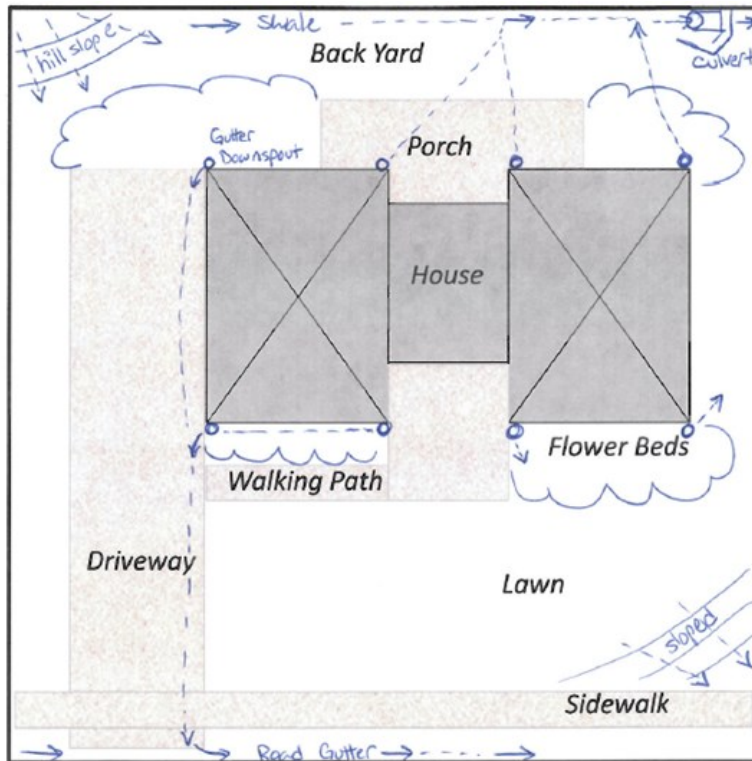
Next time it rains, go outside! Look at where rainwater is infiltrating into the ground and where it is running off. How does stormwater runoff flow through your yard? Identify the impermeable surfaces at your home and in your yard. Where does rainfall go after it falls on these surfaces? Then where does it collect and flow? And, finally, where and how does it leave your property?

Get a piece of grid paper and pencil and create a stormwater map for your home and yard. Draw a sketch of major features (roof, driveway, sidewalk, gardens, lawn, hills, etc.). Draw arrows that show where the water goes. Does the stormwater ever hit a permeable area where it can soak into the ground?

Here is an example home with a stormwater map showing where water goes when it rains.

Materials

- ⇒ Ruler
- ⇒ Grid paper
- ⇒ Pen
- ⇒ Colored pencils
- ⇒ Computer (optional)



Use the Computer!

Go online to get a raindrop's perspective on your home. Use a web-based program (like Google Earth) to find your address and look at the aerial photograph of your home or school. You can even use a global positioning system (GPS) to get your latitude and longitude coordinates to help you find your location.





Reflection

Look at the home stormwater map you created.

1. What did the stormwater flow into? A culvert, storm drain, ditch or creek?

2. What surfaces were impermeable and what were permeable?

Permeable:

Impermeable:

3. Where was the closest storm drain or pipe? Did you see any pollutants moving in the stormwater?

4. If more spaces at your home and in your community were permeable instead of impermeable, how would that change the amount of stormwater and pollutants that make it into our streams?

Extension

How can you reduce the impacts of stormwater runoff at your home? Share your map with your family and brainstorm ways that you can direct stormwater from impermeable surfaces onto permeable surfaces, so that it can infiltrate into the ground and be filtered for pollutants before making its way into streams and creeks. Do research on rain gardens and rain tanks or other ways you can catch stormwater. Ask your teacher if you can install a rain barrel at your school.



These are two rain tanks that are installed at the bottom of rooftop gutter downspouts at the Clyde York 4-H Camp, near Crossville, Tenn. These tanks catch stormwater runoff from the rooftop and store it for later when the flower beds need to be watered.

