

The Stormwater Model

The Stormwater Model helps students recognize sources of stormwater pollution and identify how human activities impact water quality. The model is a great tool to introduce students to the concept of a watershed, allowing them to visualise how rivers connect with their tributaries and the surrounding land. See a video of the model in action [here!](#)

This lesson can be adjusted depending on your group. The activity can be made more complex by examining the effects of shoreline vegetation on runoff. Instructions for this extension can be found at the end of the document.

Stormwater Vocabulary

- Effluent - Wastewater from factories that is released into the environment.
- Fertiliser - Nutrients added to the soil to help plants grow. Fertiliser can be something natural (manure) or human-made (chemical fertiliser).
- Pesticide - A chemical applied to plants to kill insect pests.
- Permeable/Impermeable - Refers to a surface through which a fluid, especially water, can flow or penetrate (permeable)/ can not flow or penetrate (impermeable).
- Pollution - The introduction of harmful substances into the environment.
- Precipitation - Liquid or frozen water that falls to earth from the atmosphere. Rain and snow are both examples of precipitation.
- Stormwater - Rainwater and snowmelt that is absorbed by the soil or that flows over the land as runoff.
- Wastewater - Water that has been used for something and leaves a building through a drain. Wastewater can come from uses at home (bathing, flushing the toilet) or in manufacturing.
- Watershed - An area of land where all of the water (runoff, small creeks and streams, groundwater) drains into a certain body of water. For example, all of the rivers in the Ottawa River watershed eventually flow into the Ottawa River.

Minds On

What makes a river different from a pond, a lake, or an ocean?

- Rivers are always flowing! Rivers flow in one direction, as water moves from an area of high elevation to low elevation.

This observation brings up an interesting question, where does all of this flowing water come from?

- Other bodies of water: lakes, smaller rivers, or streams
- Glaciers (not in the Ottawa River watershed)
- Groundwater
- Snowmelt - The volume and flow of water in a river increases significantly in spring
- Precipitation and runoff (stormwater)

Runoff is a big source of the water that feeds our rivers. Using the Stormwater Model, we will explore how runoff can spread pollution from human activities to rivers and lakes (and groundwater, though this model doesn't illustrate that very well).

What is stormwater?

Stormwater describes the water that comes from heavy rain and snowmelt. All of this water has to go somewhere, but where does it go?

- Some of it is absorbed by the soil and becomes groundwater.
- Some of it runs over the surface of the land into nearby bodies of water. This kind of water is called runoff.

The difference between permeable and impermeable surfaces

Soil is like a sponge: it's very absorbent and soaks up lots of water. In cities, we have lots of paved surfaces. Paved surfaces are the opposite of sponges, they don't absorb any water at all! For this reason, much of the rain that falls in a city becomes runoff.

The problem with stormwater

Stormwater picks up all kinds of chemicals and particles as it runs over the land, and runoff from cities and farms can be a big source of pollution in lakes and rivers. Normally vegetation and soil slow down stormwater and absorb pollutants, but surfaces in urban areas are increasingly paved. On paved surfaces, there is much more runoff, and the runoff flows faster.

Heavy rain in urban areas can cause combined stormwater and sanitary sewers to overflow, releasing untreated sewage into the river. These events are called combined sewer overflows (CSOs).

What is pollution?

Pollution describes any potentially harmful substance or chemical that is released into the environment.

Pollutants discussed in this activity include:

- Fertilisers and pesticides
- Animal waste
- Soil
- Road salt
- Oil spills
- Industrial wastewater
- Domestic wastewater (sewage)

Stormwater Model - Setup

1. Place the model onto its base. Ensure that the lake aligns with the open section of the base.
2. Put a plug into the lake and slide a shallow container into the space under it. Add water to fill the lake. When you disassemble the model, it's easiest to start by removing the plug and draining the lake into the container before wiping down the model.
3. Place all the buildings/bridges onto the surface.
4. Use clay to put up a few trees in the forest (not too many). Note: It works best to put a small ball of clay onto the surface, then stick a tree into it.
5. Connect the storm drain tube from the residential area to the stream.
6. Make sure your spray bottle and containers of powder are full.



Setup for the Stormwater Model



Storm drain tube



Trees are stuck to the model with a ball of clay

The stormwater model can be used to explore several types of pollution and their impact on the environment. More detailed information can be found in the appendix.

Stormwater Model - Storyline

Imagine a town or city you know, it could even be your town! Take a look at the stormwater model, and you will probably see some things the model has in common with your town: it has several houses, cars and roads, farmlands, and even a factory. Many towns are like the one we see in our model! The things we do in these places all have big impacts on water quality.

Like the town in our model, many towns are also built close to lakes and rivers. This makes sense because we need water for lots of things. We need water for drinking, watering crops, sanitation, transportation, and manufacturing. This town is on a big, beautiful, clear river; it looks clean to drink and to swim in!

Suburb

Let's start at home! All of the houses in this neighbourhood have big green lawns. Many people use fertiliser to keep their lawns green.

Many golf courses also use fertiliser to keep their grass green too!

Pick a volunteer to sprinkle red powder (fertiliser) on the lawns and golf course.

Have you seen a storm drain in your neighbourhood? Storm drains are covered by a metal grate. Storm drains stop the streets from flooding when it rains. Storm drains often have a fish design on them to show that they go to the river.

Sometimes people empty their pools or pour old paints and other hazardous materials into storm drains. This is very bad for the river, since stormwater isn't treated before being released into the environment!

Pick a volunteer to squeeze cocoa powder and water mixture (hazardous waste) down the storm drain.

When we build new houses, we need to cut down trees and dig up the ground to get ready for building. This stirs up lots of dirt and dust!

Pick a volunteer to remove some trees and sprinkle cocoa powder (dirt) on the ground.

When you flush the toilet at home, where does it all go? Sewage goes to a wastewater treatment plant, where the water is cleaned before it is released into the river.

Pick a volunteer to squeeze some cocoa powder and water mixture (sewage) into the wastewater treatment tanks.

When it rains, or when we water our lawns, where does everything go?

Pick a volunteer to spray the neighbourhood with water (rain).

Cars and roads

Have you ever seen a puddle with a rainbow shimmer on its surface? That's oil! Sometimes when cars have a problem they can leak oil onto the pavement. Yuck!

Pick a volunteer to squeeze some cocoa powder and water mixture (oil) under one of the cars.

During the winter, we put salt on the roads and sidewalks to keep them free of ice.

Pick a volunteer to sprinkle purple powder (salt) onto the roads and driveways.

It's important to keep the pavements safe, but did you know that salt is actually very bad for freshwater organisms? Where does all of the salt go when the ice and snow melt?

Pick a volunteer to spray the roads with water (rain and meltwater).

Farmland

Each spring, farmers dig their fields to get them ready for planting.

Pick a volunteer to sprinkle cocoa powder (dirt) on the ground.

Farmers use fertilisers to help their plants grow. All of those tasty crops growing in their fields can be a big draw for insects, so farms also spray pesticides on their fields to fend off these bugs.

Pick volunteers to sprinkle red and purple powder (fertiliser and pesticide) on the ground.

What else do we find on the farm? Livestock! Cows are big animals that need to eat a lot, so they produce a lot of waste too.

Pick a volunteer to squeeze some cocoa powder and water mixture (cow pats) onto the cow pasture.

What happens when the farmer waters their crops or when it rains?

Pick a volunteer to spray the fields with water.

Factory

There are nine pulp and paper mills in the Ottawa River watershed. These factories use lots of water to make paper goods, and an average factory releases 90-130 million litres of effluent (polluted wastewater) per day.

This wastewater can be bad for fish and other organisms that live in the river. Sometimes it can even make the water smell or taste funny.

Over the years, laws that limit the amount of pollution that factories are allowed to release into the river have made the water much cleaner than it used to be.

Pick volunteers to squeeze some cocoa powder and water mixture (effluent) into the tube at top of the factory and then spray some water into the tube to flush it out.

Extension - Shoreline vegetation

Shoreline vegetation plays several important functions in maintaining watershed health:

- The roots of shoreline plants retain soil and prevent shoreline erosion
- Shoreline vegetation helps to absorb pollution and excess nutrients in runoff that can contribute to harmful algal blooms
- Shoreline plants provide habitat for a number of species
- Vegetation helps reduce the severity of flooding

The effects of shoreline vegetation in minimising pollution can be simulated using the Stormwater Model. Before spraying water over the farm, place a few small sponges around the edge of the river next to the farm. Spray the fields with water and closely observe how long it takes for the polluted water to reach the river.

Remove the sponges and wipe down the fields with a cloth. Reapply the “dirt” and “fertiliser” to the fields and spray with water. Notice how much faster the contaminated runoff reaches the river!

Stormwater Model - Follow Up Activities

The Stormwater Model shows us how our actions affect the health of the river. Ottawa Riverkeeper hopes that students will come away from this lesson with both an understanding of stormwater pollution and a motivation to protect the health of the watershed.

Classroom Discussion

We encourage educators to engage their students in discussions of how we can reduce stormwater pollution. Some suggestions to prompt a classroom discussion are provided below.

Location	Pollution Solutions
At home	<ul style="list-style-type: none">• Don't use fertiliser, herbicides, or pesticides on your lawn• Plant native species that don't need to be fertilised and require less water• Reduce paved surfaces and plant a rain garden to absorb runoff
On the farm	<ul style="list-style-type: none">• If you can, buy local and organic produce (find your local farmers' markets and CSAs or sign up for a plot with a community garden)
Roads	<ul style="list-style-type: none">• Use less salt (only one coffee cup for a driveway, only when when it's warmer than -10°C), shovel more, or use an alternative like sand instead• Use public or active transit (walking/rolling, biking, skateboarding, roller skating, etc) - fewer cars on the road means less salt

It's important to note that while individual actions impact water quality, many of these issues require broader solutions. For instance, good infrastructure is required for active transportation or public transit to be a viable option. Some individual actions, like buying from local farming co-ops are not universally accessible. We want students to leave this discussion feeling hopeful and empowered to help protect water, so taking the approach of envisioning how we can protect water and engage our communities may better achieve this end than focusing on individual actions.

Visualisation Activity

Give your class some time to discuss the following questions among themselves.

- What does it look like to respect water?
- How could we live our lives differently to better take care of water?
- How can we redesign our community to show our respect for water? (e.g. More sidewalks to promote active transportation. Creating more green spaces to prevent flooding, increase shade and biodiversity, and make communities more beautiful.)

This simple visualisation activity will likely produce some insightful ideas. These ideas might be a great jumping off point for a broader discussion. Your class might want to embark on a project to share their ideas as a bulletin board in your school or library, at an environmental fair, or with a local representative.

Additional documentation

[Stormwater learning resource](#)

[Everything you need to know on combined sewers overflows](#)