



The Watershed Connection

Liberty Science Center

This activity outline was developed for use in a variety of informal venues. By design, it provides the content, pedagogy and strategy necessary for implementation by both the novice and experienced informal educator. It is expected that this outline will be adapted and improved upon by the user. We welcome your feedback!

Synopsis of the Activity

A 3-dimensional topographic model (Enviroscape) of a watershed with various natural and human features will be used to illustrate how our land-based actions can and do adversely affect water quality. People will be asked to consider how their actions can either harm or protect a watershed.

Audience This activity is targeted for the general public.

Setting

The activity can be done in a variety of settings, but is focused as a cart activity on a museum floor.

Activity Goals

This activity will help visitors understand better the interconnectedness of terrestrial and aquatic environments and explore what a watershed is. Visitors will develop an awareness of how our actions and societal practices on land have consequences that affect the water, humans, countless other organisms, and ultimately the planet. In addition, participants will be able to identify various sources of pollution (both point and non-point) and offer solutions to minimize negative human impacts.

Concepts

- Watersheds are an area of land where all the water drains to a particular watercourse or larger body of water.
- Water cycles through watersheds via the water cycle.
- Watersheds are a vital and integral part of local and global ecosystems.
- Point and non-point sources of pollution enter the watershed through different means and affect the ecosystem in different ways.
- There are many ways that humans can help protect the water supply from pollutants.

Ocean Literacy Principles

1. The Earth has one big ocean with many features.
 - f. The ocean is an integral part of the water cycle and is connected to all of the earth's water reservoirs via evaporation and precipitation processes.
 - g. The ocean is connected to major lakes, watersheds and waterways because all major watersheds on Earth drain to the ocean. Rivers and streams transport nutrients, salts, sediments and pollutants from watersheds to estuaries and to the ocean.

6. The ocean and humans are inextricably interconnected.
 - e. Humans affect the ocean in a variety of ways. Laws, regulations and resource management affect what is taken out and put into the ocean. Human development and activity leads to pollution (point source, non-point source, and noise pollution) and physical modifications) changes to beaches, shores and rivers). In addition, humans have removed most of the large vertebrates from the ocean.
 - g. Everyone is responsible for caring for the ocean. The ocean sustains life on Earth and humans must live in ways that sustain the ocean. Individual and collective actions are needed to effectively manage ocean resources for all.

Materials

Enviroscape model activity:

Enviroscape model and associated props (toy cars, farm equipment, animals, etc)

Spray bottles

Cocoa mix

Food coloring (red, blue, and green)

Chocolate sprinkles

Paper (to simulate litter)

Paper towels

2 buckets (1 empty, one filled with clean water)

Clean sponges

Whiteboard easel or large pad and markers.

Large Watershed map of state or local area

Prep Section

Have the Enviroscape model set-up with all associated props (including items that don't come with the kit), a spray bottle filled with water, and litter for Enviroscape, sludge mix prepared (cocoa and water), food-coloring/water solutions, paper towels, chocolate sprinkles (farm and pet animal waste).

Procedure and Set-up

Set up all of the different props, e.g. buildings, cars, tractor, farm animals, etc., on the Enviroscape model. Make sludge with cocoa mix and water in small bottles. Make simulated industrial waste (blue), fertilizer (red), and pesticides (green) with food coloring mixed with water. Have a spray bottle full of water to simulate precipitation. A few pieces of shredded paper are good to use for litter. Chocolate sprinkles can be used to represent waste from pets and farm animals. Make sure to have a roll of paper towels for quick clean-up. Have a watershed map of your respective state, so that people can locate the watershed they live in. A bucket full of clean water is used to refill spray bottles, and clean the model if it becomes excessively messy over the duration of the walk-up. The empty bucket is used to dump "dirty" water into following each demonstration. Do not dump paper towel waste into this bucket.

Optional: Damp paper towels or sponges can be available to demonstrate the role of wetlands in a watershed, by placing along and within the model watercourses. (This would be used for audiences with greater prior knowledge of a watershed system).

Guiding Questions

Who used water today? For what? Where did that water go after you used it? (Do different water sources go different places? Toilet, sink, garden hose?)

Where do we find water on Earth?

What is the water cycle?

Why is water so important? (What do we, other organisms and the Earth need water for?)

What is a watershed?

Is it important for water to be clean? If so, why?

Can your/our actions on land affect the water? If so, how?

What can you do to help protect our waterways?

Is water an important part of the local and global ecosystem?

(*See Activity Description for more Guiding Questions)

Activity Description

The Enviroscope model is a 3-dimensional topographic representation of a human-altered landscape. The model contains land elevation contours, waterways, and a variety of human settings including: a neighborhood, farm, sewage treatment plant, industrial plant, construction site, plowed fields, golf course, roads, lawns, etc. The model itself is a good hook for many visitors and they will gather around the table to have a look at what you are doing.

INTRODUCTION

As visitors gather around the watershed model, invite them to take a closer look at the Enviroscope and talk with them about what they see and what the model represents. Depending on the age of your audience, this might include identifying all of the different natural and human features. If they have not offered it already, tell the visitors that the Enviroscope is a model of a watershed. Ask them, so “what is a watershed?” Then say, “Let’s figure this out together.”

“WHAT IS A WATERSHED?” CONVERSATION

Initiate a conversation with the visitors about the ideas of a watershed where you talk with them by asking each other questions and offering to each other descriptions and explanations. This first discussion should use the model to focus on the features of a watershed. The following are some guiding questions you may want to ask, or tasks you may do with the visitors. Be sure to encourage visitors to ask their own questions.

- Where would we find water on this model?
- Where do you think the water will travel?
- Let’s trace where you think the water might travel. Ask for a volunteer.
- How is a watershed related to the water cycle?

Key ideas to address in this conversation:

1. A watershed is an area or region of land draining to a particular watercourse or larger body of water.
2. A watershed includes all the bodies of water that drain into the larger body of water.

“HOW A WATERSHED GETS POLLUTED” CONVERSATION

Proceed into the next discussion topic on how a watershed can become polluted. This second discussion should use the model to explore where and how pollution can occur. The following

are some guiding questions you may want to ask, or tasks you may do with the visitors. Be sure to encourage visitors to ask their own questions.

- What pollution can enter a watershed?
- Where does the pollution come from?
- As visitors offer a new source of pollution, allow them to apply that to the model.
 - Scraps of paper represent litter
 - Cocoa and water mixture is sludge (oil or untreated sewage).
 - Chocolate sprinkles is animal feces
 - Dry cocoa powder as loose soil
 - Blue food coloring is industrial waste
 - Red food coloring is pesticides
 - Green food coloring is fertilizers
- As each type of pollution is mentioned and added to the model, encourage visitors to consider and share with everyone. If a whiteboard is available, the list can be kept there of what kinds of pollution are on the model
 - Why that type of pollution is bad?
 - What could be in the pollution that is bad for the environment?
 - How could the pollution affect people, animals, and the environment?

Key ideas to address in this conversation:

1. Human activities on land, and far from waterways, can contribute to the degradation of the watershed.
2. Water within a watershed is not always perfectly clean and safe to drink, swim in, or use without filtering and treating the water first.

POINT-SOURCE AND NON-POINT SOURCE POLLUTION (for older visitors)

Once several types of pollution are mentioned and the model is getting trashed, introduce the concepts of point source and non-point source pollutants, and define those terms.

- *Be aware that for young audiences, point and non-point source pollution is not as important to understand if they see “all drains lead to the sea” and they can participate in trashing and cleaning up the enviroscape model. Judge your audience, above 8 years old, the pollution types is appropriate.*

Ask visitors to categorize what pollutants on the model already are (point or non-point source).

Point Source Pollutants

On the model can be blue food coloring at the factory, or cocoa sludge from the sewage treatment plant. (In the local NJ/NY area combined sewage overflow is considered non-point source since there are many overflows that can occur along rivers during a heavy rain.)

If it is appropriate for the age of the audience, you may discuss with them the concepts of a Combined Sewer Overflow or Upset, as related to the Sewage Treatment Plant (see Background Section).

Non-point Source Pollutants

On the model dry cocoa powder (soil) can be sprinkled on the farm (fallow field), or construction site etc. Pesticides (red food coloring), fertilizer (green food coloring), and animal feces (chocolate sprinkles) can be found on the farm or yards. There can be cocoa mixture to represent oil and grease on highways, roads and parking lots (only a few drops will do). Shredded pieces of paper simulate litter, which could be anywhere.

“WATERSHED IN THE WATER CYCLE” CONVERSATION

If you talked about the watershed in the water cycle at the beginning, then remind visitors that the watershed is part of the water cycle. If not, ask visitors now how they think the watershed is part of the water cycle. The following are some guiding questions you may want to ask, or tasks you may do with the visitors. Be sure to encourage visitors to ask their own questions.

- Let’s think together about how the watershed is part of the water cycle.
- Where do you think rain comes from?
- Where does the water in the clouds come from?
- Ask visitors to predict what might happen to the pollutants when it rains.
- Ask for some volunteers to share their prediction. Encourage visitors to explain why they make such a prediction. Ask if other visitors have similar or different predictions or explanations for their predictions.
- You can have a volunteer or two squirt water on the model, or do it yourself. This is a judgment call depending on the age and temperament of the audience.
- Encourage the visitors to observe what happens as rain falls on to the land. They should see that the pollutants drain into the nearest body of water, which then drains to the ocean.
- Point at the ocean, “So who is up for a swim at the beach here.” How do you think we can protect our watershed and keep these pollutants out of the water? It is good to explain that we used colored examples of pollutants on the model, but many kinds of pollution in water are not visible to our eyes in the world.

Key ideas to address in this conversation:

1. The water cycle offers an explanation of how water on Earth moves across sources (watersheds, water basins) and from sources of water (ocean, reservoirs, plants) into the atmosphere (evaporation, transpiration, water vapor), and then across and down to Earth (condensation, cloud formation) and back to the sources of water (precipitation, weather).
2. To recognize how and why the water cycle is important, we must also understand that this water moves across temporal and geographic scales where there are implications for geology, living organisms, weather, and climate. Water that returns to land moves through watersheds, and all end in the ocean. A watershed is an area of land that catches precipitation (rain and snow) and drains (or seeps) water, sediment, and dissolved materials to a common outlet (marsh, rivers, streams, lake, groundwater, ocean)

“ACTIONS I CAN TAKE” CONVERSATION

In this last discussion topic, encourage visitors to think actions they can take to minimize or eliminate pollution of their local watershed. The following are some guiding questions you may want to ask, or tasks you may do with the visitors. Be sure to encourage visitors to ask their own questions.

- Show visitors a map of local region. Ask visitors if they can find their local watershed on the map.
- Have them find any bodies of water that may be near their neighborhood and have them trace the waterways to the area where they drain. Ask if they can think of any Point Sources or Non-point Sources in their neighborhood. Ask them how those sources would affect the watershed, and any organisms, including people, living nearby.
- What do you think you and I can do to minimize or eliminate the pollution in our local watershed?
- What do you think you and I and our families can do to protect or conserve our water supply?

Possible solutions:

1. Don't litter or throw anything down storm drains. They are for rain only.
2. Keep leaves and grass out of storm drains.
3. Recycle and buy recycled products.
4. Clean up after pets.
5. Use and dispose of chemicals like oil, cleaning products, antifreeze, and paints properly.
6. Conserve water by taking a shorter shower or turning off the faucet while you brush your teeth.

Numbers 1, 4, and 5 can be done to the model as a “stop polluting” action, but if it rains again the pollution already in the watershed will continue to flow downstream, just changing your actions will not immediately clean a watershed and it takes time for the changes to happen. You can make it rain again to demonstrate this.

Additional Resources

Available upon request.

<http://www.epa.gov/owow/watershed/>
http://en.wikipedia.org/wiki/Drainage_basin
<http://www.mywatershedwatch.org/description.htm>
http://en.wikipedia.org/wiki/Water_pollution
<http://www.epa.gov/owow/nps/whatis.html>
<http://www.cfses.org/salmonid/html/water/back.htm>
<http://www.umich.edu/~gs265/society/waterpollution.htm>

Background

Non-point sources and point sources are ways in which pollutants enter our water. Point sources come from specific places and we can more easily identify and control these sources. Non-point sources come from areas that are more widespread like our neighborhoods, our communities and farms and are more difficult to control. In order to preserve the purity of our ground water, it is imperative that we all understand the sources of pollution and minimize its impact.

Point Source Pollution:

A **Combined Sewer Overflow** is when excess flow bypasses treatment. Some treatment systems in cities have storm water flowing into the wastewater treatment plant. When rainfall is

excessive, too much storm water runoff goes to the treatment plant and the excess flow is bypassed directly to the river, stream or lake.

An **Upset** is when water is not treated adequately because of a plant malfunction. Sometimes, the biological processes that are used to treat wastewater stop working, and the waste is not treated properly. Incompletely treated wastewater is discharged to the river, stream or lake.

Most **storm drains** are directly connected to storm sewers. Therefore, they are part of a piping system and are subject to federal, state and local regulation. Some storm drains are connected to a water treatment plant. If this occurs, the water tends to overflow with the water treatment during storms. However, storm drains often carry water directly off the land into the water body.

Non-point Source Pollution:

Non-point pollution does not result from a discharge at a specific, single location, but generally results from land runoff and drainage after a rain event. The pollutants come from many different sources when rainfall carries contaminants, such as soil containing fertilizers and pesticides, animal feces, oil, grease, and trash into the water supply.

In many developed areas, there is no vegetation or silt fencing to hold the soil, and it erodes or wears away and is carried by runoff, causing structural weaknesses in stream banks. Soil can be contaminated with fertilizer and pesticides, which in excess levels in water can stimulate an overgrowth of algae and aquatic plants. This can clog waterways, decrease the amount of dissolved oxygen in the water, and block light from penetrating bodies of water, all of which are detrimental to other organisms living in the water. At lawns and golf courses where too much pesticide or fertilizer is used, these chemicals can also seep into the ground reaching the groundwater. Animal feces can also cause high levels of harmful bacteria in bodies of water. Highways, roads and parking lots all collect oil and antifreeze from vehicles. Paved surfaces contain other contaminants such as salt used to melt snow and ice.

Vocabulary

Combined sewer overflow- excess sewage and stormwater flow bypasses the treatment process during heavy rain events.

Ecosystem- An ecological community together with its environment functioning as a unit.

Impervious surface- a non-permeable surface, such as a sidewalk or roadway, which water cannot flow through or be absorbed by

Non-point source pollution- pollution from a variety of sources that cannot be traced back to a specific location generally results from land runoff and drainage after a rain event. i.e. excess fertilizers, and pesticides.

Point-source pollution- pollution discharged from a specific traceable source, e.g., an industrial pipe, and smoke stack

Runoff- excess water not absorbed by a substrate that flows to the nearest body of water.

Water cycle- the cyclical movement of water on Earth, across sources (watersheds, water basins) and from sources of water (ocean, reservoirs, plants) into the atmosphere (evaporation, transpiration, water vapor), and then across and down to Earth (condensation, cloud formation) and back to the sources of water (precipitation, weather). The energy from the sun drives the water cycle.

Watershed- an area or region of land draining to a particular watercourse or larger body of water