

Lesson Plan – Week 3 – July 16 – July 18
The Natural Water Cycle and Natural Watershed
Two and One-Half Hours

Goals

- Students will learn how the hydrologic cycle works
- Students will become familiar with the processes of the hydrologic cycle
- Students will apply the concepts of the hydrologic cycle to a natural watershed
- Students will be introduced to the Delaware River watershed and Philadelphia's sub-watersheds
- Students will be introduced to the concept of stormwater runoff
- Students will learn how pollution occurs in a natural watershed

Objectives

- Students will review glossary of key words for this week's lesson
- Students will learn the processes of the hydrologic cycle through the use of a natural water cycle chart and illustration
- Students will use maps to identify the Delaware River watershed and to identify the watershed in which they live
- Students will demonstrate the principle of stormwater runoff using a hands-on natural watershed model
- Students will demonstrate how stormwater runoff carries away pollutants by using the watershed model

Related Activities for the Lesson

Activity # 1 – Vacant Lot Site work – Students will document the condition of the lot prior to its clearing. Students will record what exists on the lot, what existed on the lot in the past, and its future.

Activity #4 – What's Under the Ground? – students will review infrastructure maps of the neighborhood and trace the path of the old Mill Creek on top of the maps. What do they notice about the path of the sewer and creek?

Activity #9 – Visit to Aspen Farms – what is growing in the neighborhood – a natural patch of our urban watershed

Activity # 18 – Visit to existing community rock/flower gardens – 1622 N. 52nd Street, 52nd and Columbia Avenue and Brown and Farson Streets.

Glossary of Watershed Project Terms

Add to last week's glossary

Erosion: The gradual wearing down of a material. Wind and water aid erosion of rock and land. Vegetation helps to prevent erosion by holding soil with roots, absorbing water, and shielding the earth from wind.

Estuary: The area of water where a fresh water river enters the ocean. It is high in nutrients, making it a popular site for migrating birds, fish, and other species.

Evaporation: The transformation of water from a liquid to a vapor – or gaseous – state, usually aided by heat and/or wind.

Hydrologic Cycle (also known as water cycle): The paths that water takes through its various stages – vapor, liquid, solid – as it moves throughout the planet.

Infiltration: The seeping of water through the surface of the earth to the groundwater reserves. Some water may even infiltrate below this level to deep storage. Infiltration is important for maintaining adequate supplies and quality of groundwater reserves and to maintain a base flow for surface streams and rivers. Infiltration is also known as **Percolation**.

Precipitation: Water that condenses and falls to earth. Depending on temperatures, precipitation can be in the form of rain, snow, sleet or hail.

Respiration: The metabolic process by which organisms take in oxygen and release carbon dioxide, water and other products of oxidation.

Stormwater runoff: The rain water that flows over the land and its many surfaces - streets, parking lots, parks, yards, forests – picking up pollutants as it drains – or runs off – the land into a waterway.

Transpiration: The process by which water is absorbed by plants (roots) and is evaporated into the air from the plants' surface (leaves).

Lesson Narrative

Water

Water is all around us. It is colorless, odorless and tasteless. The air we breathe contains water. Water determines the climate of a region. Over 70 percent of the earth's surface is covered with water. Today, the amount of water on the earth remains exactly the same as it was billions of years ago – no more, no less.

Water is continually recycled through the natural water cycle, known as the hydrologic cycle. In its basic form, the hydrologic cycle can be described as the sequence in which water evaporates from lakes, streams, rivers, oceans, plants, trees and land areas into the atmosphere. The water then precipitates from the atmosphere as rain or snow, and eventually returns to the oceans through natural drainage systems consisting of streams and rivers. The heat of the sun and the pull of gravity accomplish this cycle. When water evaporates from the wet ground, or from the leaves of plants, or lakes and streams, it is carried into the air as water vapor. When water vapor condenses it transforms from a gas to a heavier liquid that falls back to the earth.

Therefore, water is a renewable resource, or one that is not “used up.” But clean, fresh water which people and other animals need for survival is not always plentiful. Although a great deal of the earth’s surface is covered with water, most of it is salt water stored in the oceans. Only 3 percent of the water on earth is fresh and a little over 2 percent of that is found in either the atmosphere or locked in ice caps at the North and South Poles and glaciers. This leaves less than 1 percent in the form that people, plants and animals can use. This small fraction of fresh water can be found in lakes, streams, ponds, rivers and in groundwater.

What’s a Watershed?

A watershed of a stream or river is all of the land that sheds water to that stream when it rains. A river’s watershed or drainage basin includes all the land surrounding that river whose rainfall runs directly or indirectly through tributaries back into the river.

Watersheds can refer to the vast areas of land or to much smaller regions. For example, the Continental Divide of the United States is in the Rocky Mountains. All the rainwater falling on the west side of the divide flows into the Pacific Ocean and all of the rainwater falling on the east side of the divide eventually flows into the Atlantic Ocean. This western portion of the U.S. would be a part of the Pacific Ocean watershed, while the eastern portion of the U.S. would belong to the Atlantic Ocean watershed. Of course, many smaller watersheds reside within these two monumental watersheds. If we further divide each side of the U.S. into smaller watersheds (called “sub-watersheds”), like carving out a slice from a big pie, we will finally whittle our way down to a watershed that we recognize, at least by name.

We live in the Delaware River watershed. The Delaware River is the major supplier of fresh water to parts of New York, New Jersey and Pennsylvania. The total drainage area of the Delaware and its tributaries, including the Lehigh and Schuylkill rivers, covers more than 13,000 square miles and includes all manmade and natural surfaces surrounding the river. The river itself is 339 miles long, stretching from New York State’s Catskill Mountains to the Delaware Bay. Although the entire drainage basin is only 0.1 percent of the nation’s land area, the river serves over 10 percent of the nation’s commercial, residential and industrial needs. This is still a fairly good-size watershed, wouldn’t you say?

Of course, the larger the watershed, the more it is affected by the people who live in it and the businesses and industries that use its resources. Pollutants entering the Delaware River can affect the drinking water supplies of Easton, PA, Trenton, NJ, Camden, NJ and Philadelphia, PA. Municipalities can create both point source pollution (coming from a single place such as a discharge pipe) and non-point source pollution (from a wide area such as soil erosion from farmland) that ends up in the river. A watershed with many people faces many challenges to stay healthy.

Stormwater Runoff

What happens on your block when it rains? Have you watched the rainwater flow across your sidewalk into the street? Did you notice how the rainwater then flows along the street curb, in what is called the street's "gutter." Sometimes the flow is so fast and full that it looks like a small river running along the sidewalk (this little river is stormwater runoff). Did you notice that the river flows downward, that is, it is pulled by gravity as it seems to charge into the nearest storm drain.

Before we built streets and houses, the stormwater flowed down hills or meadows that sloped to the nearest stream. At first, the rainwater would be absorbed into the earth, but if it rained too hard or too fast, not all of the rainwater would have the chance to be absorbed. The extra rainwater would become the stormwater's runoff, and flow through the vegetation and topsoil until it reached the stream. Whatever materials that happened to be lying on the ground, such as leaves and twigs or loose dirt, would be picked up by the stormwater runoff and carried into the stream.

Plants and shrubs and other vegetation use their roots to help keep the soil in place. Their roots and leaves and blades also act as natural filters, grabbing hold of pollutants, to dilute and clean them. Surface waters such as rivers, lakes and streams have a natural ability to clean themselves, using oxygen to break down organics. In a natural watershed, the land around the streams is often covered with trees and vegetation, which also helps to protect and clean the water. But rivers and streams can only clean themselves to a certain degree.

A Stream's Health Check-Up

Do you think our rivers and streams are well protected now? When stormwater flows through the gutters of our streets, does the water look clean or do you see trash and oil and chemicals swept up with the rainwater?

Even today the health of our rivers, streams and creeks is determined by looking at and sampling for a diverse variety of water insects, fish, plants, and the physical condition of the waterway which illustrates the impact of pollution.

How is the aquatic health of a creek measured? One way to sample is to identify and count the invertebrates (like mayfly nymphs, clams, dragonfly nymphs, crayfish) that live

in the creek. Volunteers and organizations across the nation are using simple procedures such as turning over rocks in streams to find the invertebrates that live there.

Kick Netting is also a good way to get an idea about the invertebrate diversity. One person holds the kick net facing upstream. Another person, facing downstream, picks up the rocks from the stream bottom, and while the rock is underwater, brushes the rock's surface to dislodge any clinging organisms. The stream bottom is also examined by the person carefully stirring it up with their feet. Organisms are then washed off the net with a cup or so of stream water into a collecting tray. The organisms are identified and counted and then returned to a slow moving section of the stream.

Discussion Questions

Why is it called the hydrologic cycle? (Hydro means having to do with water, *logos* is a Greek word meaning knowledge of).

Why is it a cycle? How does the cycle work? What does it mean when we say that water is constantly recycled?

Can you describe the hydrologic cycle?

What is a natural watershed?

What is the Delaware River Watershed?

What is the Schuylkill River Watershed?

How did Mill Creek fit into these watersheds?

How does it now?

What happens in a natural watershed when it rains? Where does the rainwater go?

Before Mill Creek was put into its sewer, where did the stormwater runoff from the neighborhood go?

Where does the stormwater go now?

In what direction does stormwater runoff flow? Why?

What does stormwater do when it flows over the land?

Is stormwater runoff clean water?

How can we tell?

Materials Needed

- Glossary
- Hydrologic Cycle (one poster size and handouts)

- Map of Delaware River Basin (one poster size and handouts)
- Let's Learn About Water Activity Books
- PWD Natural Watershed Model

Student Assessments

I know that

I want to know.....

I learned that....

Have students share with one another (orally) during last half-hour of class.