Curriculum Units by Fellows of the Yale-New Haven Teachers Institute
2017 Volume II: Watershed Science

Follow the Water

Curriculum Unit 17.02.02
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Introduction

As a second-grade teacher in a self-contained classroom at Edgewood Magnet School in New Haven, I find the neighborhood/ magnet setting a rewarding environment, with students coming to school each day from a variety of home circumstances and with differences in academic levels. As a result of these variables, the children have differing levels of background knowledge and life experiences. The classroom is a mixture of varied ethnicities, economic strata and social and emotional strengths and weaknesses. Edgewood provides an arts-integrated curriculum, an educational approach that supports multiple intelligence theory and uses arts education as a means to assist students to improve their academic performance and enrich their lives. Arts-integration curricula use art forms--music, visual art, theater, and dance to teach other core subjects, including math, science, reading, and language arts. This planned unit aligns with the philosophy of the school. The use of scientific inquiry allows all students at all levels to learn in an inherently differentiated environment, learning new concepts and experiencing laboratory and field demonstrations as they move through this curriculum unit on watershed science and specifically, inland waters in New Haven. My students will research and design projects to submit to the annual Science Fair that show the experiments that helped them learn about the waterways in New Haven. This unit will support the place-based learning that Edgewood Magnet school encourages. Trips to the Edgewood Park to visit the ponds and river for hands-on investigation and experimentation will be modeled on experiences from the seminar.

Rationale

People are spending increasingly more time indoors. As much as 96% of our day is spent inside so consequently we are experiencing the outdoors less and less. This is an unfortunate and unhealthy trend. Nature deficit disorder, a term coined by Richard Louv in his book, *Last Child in the Woods* , identifies a result of this extreme amount of time spent indoors. Children are not being exposed to nature on a regular basis and are not making a connection to their natural world. He points out that the children who play outside are less likely to get sick, to be stressed or become aggressive, and are more adaptable to life's unpredictable turns. [1]

My students most certainly fall into this statistic. They travel to school inside a bus or car, generally, spend many hours at school, many go to after-school programs, with many sports and activities played and experienced inside buildings: basketball courts, soccer “fields,” swimming pools. While these are all important parts of a child’s day, we need to think about moving them to the outside world. New Haven offers tremendous opportunities for outdoor experiences with its many parks and natural waterways. I want to get my students outside where they can become comfortable with exploring and investigating.

The New Haven Public School Science Curriculum includes a focus in second grade on Earth’s Materials, specifically how materials cycle through the Earth’s systems. I will begin the unit by reading *Follow the Water from Brook to Ocean* , a picture book by Arthur Dorros that introduces to primary-level students how water moves and how it has shaped our earth over time. This quick read aloud presents fundamental concepts about water. It draws the students into the action by addressing the readers (listeners) in the second-person "you." It clearly explains such terms as "brook," "stream," "river," and "delta," and illustrates such basic concepts as where water comes from, how it travels, and where it goes. An additional introductory resource is *Down Came the Rain* by Franklin Branley, a concise and informative look at the water cycle. Branley provides a elemental understanding of how water is recycled, how clouds are formed, and why rain and hail occur. A few science activities are included which could help launch a basic understanding of the water cycle, a concept students will learn more about in future grades. From these two resources, my students will have some fundamental vocabulary and conceptual understanding to begin the hands-on work that will come later in the unit.

What is a Watershed?

Every place on the earth is a part of a watershed. Homes, farms, ranches, forests, small towns, big cities and more are within a watershed. The concept of watershed is an important one because it pertains to everyone - no matter where someone lives, they live in a watershed. A watershed is defined as a region of interconnected rivers and streams which functions as a system for water transport. It is an area of land that drains all the streams and rainfall to a common outlet such as a reservoir, mouth of a bay, or any point along a stream channel. Watersheds have surface water (e.g., lakes, streams, reservoirs, and wetlands), and underlying ground water.

Watersheds come in all shapes and sizes, - some are millions of square mile while others are only a few acres. They cross county, state, and even international borders. A watershed is comprised of many living and non-living things. Larger watersheds contain many smaller watersheds. The area of land that drains water to the outflow point is the watershed for that outflow location. The stream-flow and the water quality of a river are affected by things, human-induced or not, happening in the land area "above", or upstream of the river-outflow point.

Water that is polluted anywhere in the watershed, even if it is hundreds of miles away, will eventually flow into the mouth of the river or stream. It is therefore essential for the water within the transport system to be kept clean, which will help to maintain a healthy environment for the plants and animals that live within the watershed. The benefits and services provided by healthy watersheds are numerous and include reduced vulnerability to invasive species, climate change, future land use changes and the protection of our drinking water. Healthy watersheds with natural land cover and soil resources also provide carbon storage capabilities, offsetting greenhouse gas emissions. Healthy watersheds provide habitat for mammals, fish, amphibians, birds, and insects, all contributors to a balanced ecosystem. [2]

The Hydrologic Cycle

The water, or hydrologic, cycle describes the movement of water as water molecules make their way from the Earth's surface to the atmosphere and back again, in some cases to below the surface. This gigantic system, powered by energy from the Sun, is a continuous exchange of moisture between the oceans, the atmosphere, and the land.

All water in the world is part of the hydrologic cycle – a bottle of water you just bought at the supermarket, a drop of morning dew glistening on a spider web, a rushing river, or a snowball you are about to throw. People don't make new water to sell, they simply take water from one place, such as a river or lake, clean it (we hope), and put it in a fancy bottle. The total amount of water in the system does not change. Annual water loss from the surface of the earth is equal to the total annual precipitation.

The hydrologic cycle includes the following components and showing in Figure 1:

Precipitation: Water falling to the Earth from the atmosphere in the form of rain, snow, sleet, or hail.

Surface Runoff: Water that hits the Earth and then moves along the top of the land surface via streams and river. Surface runoff carries materials from land (soil, etc.) with it.

Infiltration/Percolation: Water moving into the soil under the force of gravity. Once in the soil, the water may be taken up by living things, or it may move horizontally along flow paths within the soil under the force of gravity along slopes. Otherwise, the water moves straight down via gravity, eventually reaching the groundwater.

Evaporation: Water changing from a liquid to a gaseous state (water vapor). This requires a source of energy – usually, the sun – and results in cooling of the evaporative surface. Water vapor subsequently rises from oceans, rivers, lakes, soils, and vegetation into the atmosphere.

Transpiration: Evaporation from the stomates of plants. Water is transported from the soils through the plant and out of the stomates of leaves at the same time CO_2 is being absorbed and O_2 is being released during photosynthesis.

Condensation: Conversion of gaseous water (water vapor) to a liquid (droplets) or solid (crystals) state. This takes place when warm, moist air is cooled, either by the air itself cooling or when it comes in contact with cool surfaces. Tiny water droplets or ice crystals then coalesce to form the visible drops or flakes we see in clouds.

The components of the water cycle – atmosphere, surface water, and groundwater – are linked over "a variety of spatial scales (meters to thousands of kilometers) and temporal scales (days to millions of years)." [3]

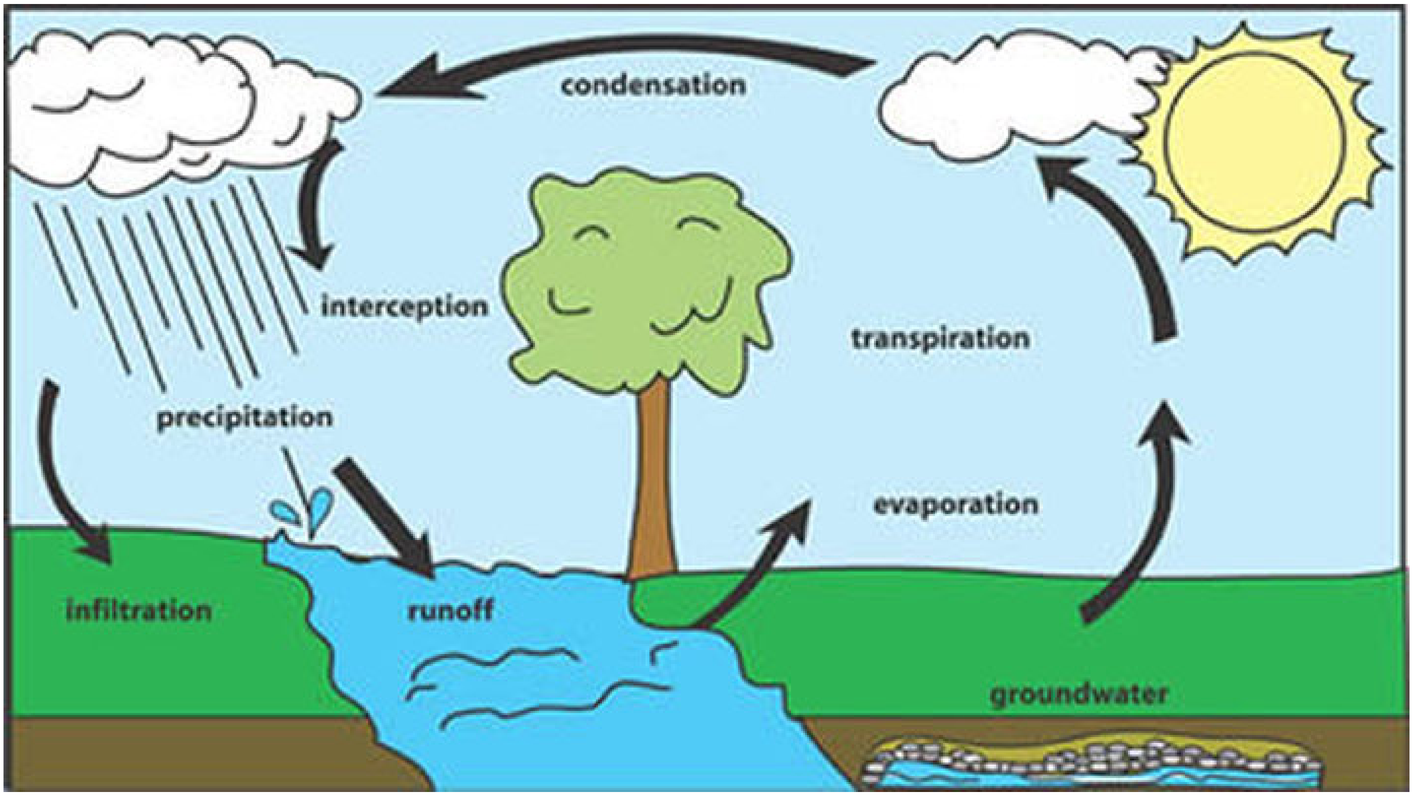

Figure 1: Components of the Water Cycle

Follow the Water Molecule through the Watershed

Let's follow the water molecule's journey through the watershed beginning as it evaporates off the ocean into the atmosphere. Most of the water molecules rain right back out on the ocean, but a few "escape" and get transported over land where they can form clouds as the water vapor cools and condenses. We can imagine that this molecule falls and travels through a forest watershed, onto the soil, to a vernal pond, into a headwater stream and then river, finds the floodplain, into an estuary, then spends some time in a salt marsh before it heads back to the ocean!

When precipitation falls over the land surface, it follows various routes in its subsequent paths. Some of it evaporates, returning to the atmosphere; some seeps into the ground as soil moisture or groundwater; and some runs off into rivers and streams. Almost all of the water eventually flows into the oceans or other bodies of water, where the cycle continues. At different stages of the cycle, some of the water is intercepted by humans or other life forms for drinking, washing, irrigating, and a large variety of other uses.

Forest Canopy

The water molecule travels through the many ecosystems in the watershed as it falls from the raincloud into the vegetation canopy. In forest ecology, canopy also refers to the upper layer or habitat zone, formed by mature tree crowns and including other biological organisms

Canopy trees are able to photosynthesize relatively rapidly due to abundant light, so it supports the majority of primary productivity in forests. The canopy layer provides protection from strong winds and storms, blocks sunlight and precipitation, which leads to a relatively sparsely vegetated understory layer.

Forest canopies are home to unique flora and fauna not found in other layers of forests. The highest terrestrial biodiversity resides in the canopy of tropical rainforests. Many rainforest animals have evolved to live solely in the canopy, and never touch the ground.

The water molecule enters the subcanopy by throughfall and stemflow. “Throughfall is defined as the precipitation that passes directly through a canopy or is initially intercepted by aboveground vegetative surfaces and subsequently drips from the canopy, whereas stemflow is the precipitation that drains from outlying leaves and branches and is channeled to the bole (or stem) of plants.” [4] So the water molecule might find its way onto the floor of the forest rather directly as leaves shed the water they have captured or by traveling down the trunk of a tree or stem of a plant.

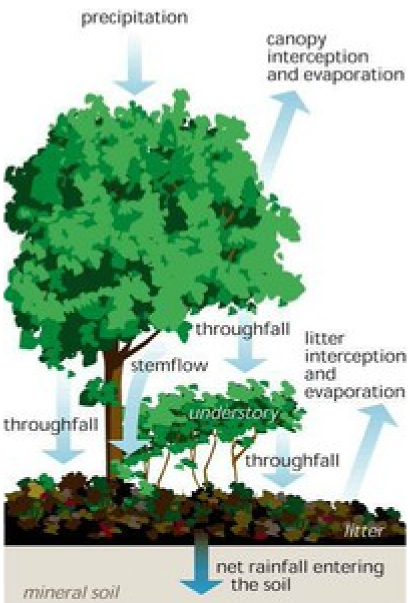

Figure 2: Water travels through the canopy

Soil

Now the water molecule has entered the forest and has found its way on top of the soil or into the soil. As noted earlier, forests filter and regulate the flow of water, in large part due to their leafy canopy that intercepts rainfall, slowing its fall to the ground and the forest floor, which acts like an enormous sponge, typically absorbing several inches of precipitation (depending on soil composition) before gradually releasing it to natural channels and recharging ground water. A portion of the water that has fallen into the forest will travel over the land as surface water, although, that trip is not necessarily rapid. Residence time of “soil water” ranges from weeks to years.

The systems that exist in the soils within the watershed have their own specific cycles. Each ecological cycle is unique, with similar elements in more than one cycle. While most move between the atmosphere (air), hydrosphere (water), lithosphere (land) and biosphere (living things), other nutrient cycles are limited to movement between rocks and soils and plants and animals. However, even the nutrients from these limited cycles, such as potassium, calcium, phosphorus and magnesium, are essential for life **.** It is important to recognize that These elements also end up in water flowing back to the ocean.

The water cycle is very dynamic as water can change from vapor to liquid to snow to ice. Soils role in the water cycle includes infiltration, storage, and transpiration. Infiltration, as discussed above, is water moving into the soil under the force of gravity. Once in the soil, the water may be taken up by living things, flow along paths within the soil, or move straight down reaching the groundwater. Storage refers to locations that water resides on land for varying periods of time. These storage places include vernal ponds, snow, groundwater, lakes, and glacial ice. Transpiration is evaporation from the stomata of plants, taking place in the inner parts of leaves at the same time CO_2 is being absorbed and O_2 is being released during photosynthesis.

Oxygen is unique in that it not only has its own cycle, it is often integrated into elements within other ecological cycles, as water (H_2O), carbon dioxide (CO_2), iron oxide (Fe_2O_3), and many others. Photosynthesis is key component of the oxygen cycle as plants take in carbon dioxide and expel oxygen for animal and human use. In water, oxygen is constantly being dissolved and consumed by microorganisms leading to balance. It is within the nitrogen cycle that soil bacteria convert nitrogen into usable elements (called nitrogen fixing) for plants, animals and humans before it is eventually returned to the atmosphere. [5]

Groundwater is found in two layers of the soil, the “zone of aeration,” where gaps in the soil are filled with both air and water, and, further down, the “zone of saturation,” where the gaps are completely filled with water. The boundary between these two zones is known as the water table, which rises or falls as the amount of groundwater changes. Residence time of the water within the category of groundwater can range anywhere from days to millions of years! [6]

When the soil cannot hold any more water, the excess water flows across the surface as overland flow. This water flows into rivers, lakes, and oceans carrying with it any contaminates it picks up along the way. Overland flow can cause flooding and erosion. Plants’ roots obtain water from the soil and their leaves release water back into the atmosphere through the process of transpiration. Plant roots help hold soil in place, reducing flooding overland flow and erosion.

Groundwater pollution can result from improper disposal of wastes on land. Some sources include industrial and household chemicals and garbage landfills, excessive fertilizers and pesticides used in agriculture, industrial waste, sewage and septic systems.

Vernal Pond

The traveling water molecule’s next stop could be in a vernal pond. These are temporary wetlands that fill each spring when the water table is high due to lots of snow melt and rain and no transpiration. They become the seasonal breeding and feeding grounds for many amphibians and insects, as well as the reptiles, birds, and mammals that depend on them for food. At the water’s edge is an entire community of creatures including salamanders, frogs, toads, and newts that have come to breed, as well as all kinds of aquatic insects and their eggs that will develop over the spring months. Jellylike masses and strings of eggs are in the water and on the pond vegetation, where salamanders and frogs have left them behind. Vernal ponds are essential to the lives of many woodland species.

As it warms and vegetation comes out and evapotranspiration kicks in, the water table often drops, draining these important ecosystems. So, this water may move back into the atmosphere, but some of it will also starts its return flow to the ocean via streams and rivers.

Headwater stream

From the vernal pond, the water molecule flows into the stream system. Headwater streams are the smallest parts of river and stream networks, but make up the majority of river miles in the United States. They are the smallest part of a watersheds stream network and furthest from the river's endpoint or mouth.

Headwaters are known as the beginning of the initial source of water. The river may be big or powerful, but the starting point does not start that way, usually. The length of the river is considered to be from the mouth to the source or sometimes to the stream which is popularly known as the source stream. Some of the headwaters are found from springs or fed by the mountain snow or start from a marshy area.

If the headwaters get affected in the upstream, the impacts are also seen in the downstream as well. There are many threats to the headwaters area including the construction of large dams, physical alterations made in the headwaters area by diverting their course or straightening them, absorption of river water for agricultural purpose, deforestation, and pollution. The protection includes conservation of the forest area, linking of the forests land and the parks, to protect watershed areas and maintenance of open space for the free flow of the water. Many headwater streams have been lost or altered due to human activities such as urbanization and agriculture, and this can impact species and water quality downstream.

Stream order is a measure of the relative size of streams. The smallest headwater streams are referred to as first-order streams, while the largest river in the world, the Amazon, is a twelfth-order waterway. First- through third-order streams are called headwater streams. Over 80% of the total lengths of Earth’s waterways are headwater streams. Streams classified as fourth- through sixth-order are considered medium streams. A stream that is seventh-order or larger constitutes a river. [7]

First-order streams are often perennial streams--streams that carry water throughout the year--that have no permanently flowing tributaries. This means no other streams "feed" them. When two first-order streams come together, they form a second-order stream. When two second-order streams come together, they form a third-order stream and so on. It is not until one stream combines with another stream of the same order that the resulting stream increases by an order of magnitude.

River

There is no strict definition to distinguish rivers from streams although “river” generally means a level of flowing water this often considered “nonwadeable.” So, obviously, rivers come in lots of different shapes and sizes, but they all have some things in common. The high point can be a mountain, hill, or other elevated area. As noted about, water from some source like a spring, snow melt, or a lake starts at this high point and begins to flow down to lower points. As the water flows down, it may pick up more water from other small streams, springs or from rain or snow melt. Small rivers may join together to become larger rivers. Eventually all this water from rivers and streams will run into the ocean or an inland body of water, such as a lake. [8]

Although river water makes up only about 0.2 percent of all the fresh water on Earth, it plays a very important role. Rivers are like roads. They carry water, organisms and important gases and nutrients to many areas. They also help drain rainwater and provide habitats for many species of plants and animals. As they make their way to the sea, rivers help shape the features of the Earth. Rivers are travel routes for people and provide the power for hydroelectric plants.

Water flow can alter the shape of riverbeds through erosion and sedimentation, creating a variety of changing habitats. The substrate is the surface on which the river organisms live. It may be inorganic, consisting of geological material like boulders, pebbles, gravel, sand or silt, or it may be organic, such as leaves, wood, moss and plants. Substrate is generally not permanent and is subject to large changes during flooding or drought events.

A variety of plants can be found growing in a river system. Some are free-floating while others are rooted in areas of slower current. Algae are the most significant source of primary food in many rivers or streams. Most of the algae float freely and so are unable to maintain large populations in fast-flowing water. Instead, they build up large numbers in slow-moving rivers or backwaters and some species even attach themselves to objects to avoid being washed away. The rivers' currents provide oxygen and nutrients for plants. Plants protect animals from the current and predators and provide a food source.

A large number of invertebrates live in river systems, including crayfish, snails, limpets, clams, and mussels with the greatest number being insects. The exist in the rivers but also rely on food, such as leaves, from the terrestrial systems. They can be found in almost every available habitat – on the water surface, on and under stones, in or below the substrate or in the current.

The ability of fish to live in a river system depends on their speed and duration they can maintain that speed, as it takes enormous energy to swim against a current. This ability varies and is related to the area of habitat the fish may occupy in the river. Most fish tend to remain close to the bottom, the banks or behind obstacles, swimming in the current only to feed or change location. Most river systems are typically connected to springs, wetlands, waterways, streams, oceans, and many fish have life cycles that require stages in other systems. Eels, for example, move between freshwater and saltwater.

A number of birds also inhabit river ecosystems, but they are not tied to the water in the way that fish are and spend some of their time on land. Fish and water invertebrates are an important food source for water birds. [9]

After time moving around in the portion of the journey, amongst the various ecosystems in the river, the water molecule continues "downhill" as it finds its way back to the ocean.

Floodplain

Once a water molecule enters a stream network, it may find itself on a floodplain. Floodplains form alongside shallow meandering rivers, a place where the water molecule can again interact with a more terrestrial landscape its journey back to the ocean. As the rivers move back and forth across the landscape, they form an area around the river where elevation of the land is lower that other areas. This lower land around the river is known as a floodplain. During times of excess precipitation, when water levels rise, water leaves the banks of the river and moves out into the floodplain.

Floods are usually seasonal and can be predicted months ahead of time. This predictability can make flood plains ideal locations to develop urban areas (Flood plains are often great for agriculture since they have lots of sediment deposited. You would only want to farm a floodplain the does not flood often, either because upriver has been damned or it is just a 50-year floodplain.) Rivers provide both a natural transportation network and source of water for irrigation and industry. The relatively level land can be developed either as agricultural fields or sites for habitation or business. Floodplains are home to some of the most biologically rich habitats on Earth. They provide spawning grounds for fish and critical areas of rest and foraging for migrating waterfowl and birds. [10]

Estuary

Once a water molecule leaves the freshwater river, it enters an estuary. Estuaries and their surrounding wetlands are bodies of water usually found where rivers meet the sea. They are tidal. Estuaries are home to unique plant and animal communities that have adapted to brackish water—a mixture of fresh water draining from the land and salty seawater.

Pollution can accumulate in estuaries. Pollution from ships, debris including fuel, garbage, sewage, can collect and have an impact on the life around that estuary. Runoff from agriculture and industrial waste and pesticides travel downstream and settle in the water and sediment of the estuary. All of this requires communities to establish regulations for residents and businesses to follow.

Many plant and animal species thrive in estuaries. The calm waters provide a safe area for small fish, shellfish, migrating birds and shore animals. The waters are rich in nutrients such as plankton and bacteria. Decomposing plant matter, called detritus, provides food for many species. Oysters are a keystone species in the estuary - filter feeders that naturally help regulate toxins in the water.

Salt Marsh

Salt marshes are coastal wetlands that are flooded and drained by salt water brought in by the tides. They are marshy because the soil is composed of deep mud and peat. Peat is made of decomposing plant matter that is often several feet thick. Peat is waterlogged, root-filled, and very spongy. Because salt marshes are frequently submerged by the tides and contain a lot of decomposing plant material, oxygen levels in the peat can be extremely low—a condition called hypoxia. Hypoxia is caused by the growth of bacteria which produce the sulfurous rotten-egg smell that is often associated with marshes and mud flats.

In the U.S., salt marshes can be found on every coast. Approximately half of the nation's salt marshes are located along the Gulf Coast. These habitats are essential for healthy fisheries, coastlines, and communities. They provide essential food, refuge, or nursery habitat for more than 75 percent of fisheries species, including shrimp, blue crab, and many finfish.

Salt marshes also protect shorelines from erosion by buffering wave action and trapping sediments. They reduce flooding by slowing and absorbing rainwater and protect water quality by filtering runoff. [11]

The water molecule has now found its way back to the ocean after an interactive trip through the ecosystems within the watershed. It can remain in the ocean for as many as thousands of years before it travels once again!

Human Impact

Pollution is the presence of substances in the air, land, or water that can degrade human health and environmental quality. These substances may come from many sources, but some of the most serious pollution problems are the result of unwanted by-products—commonly called wastes—from human activities. Waste water, ground pollution, fertilizers, road treatments, all contribute to the pollution in our waters.

Household water is carried to treatment plants where it is filtered and chemical waste is broken down. Water that has been treated is released into river, lakes and oceans. The water molecule moves back into the watershed after a trip through the treatment plant.

Classroom Activities

Activity One: Introduction to Watershed Science

Materials: *Follow the Water from Brook to Ocean* ; t-chart on chart paper prepared with question (see below); student science journals

Begin by asking students the question posted on the chart, "Where does water go when it rains?" Record any answers and ideas on the left side titled "what we know." Read aloud *Follow the Water from Brook to Ocean* by Arthur Dorros, which explains that water moves downhill and describes the waterways it may travel through before it reaches the ocean. Return to the chart of responses and on the right side section titled "what we've learned.

In their science journals, students should record the important vocabulary learned from the text that will allow them to discuss watershed science with appropriate terms: downhill, flows, brook, stream, ocean, springs, erosion, floods, dams, reservoir, mouth, pollution.

Where does water go when it rains?
What we know What we've learned

Activity Two: Tracing the Veins of a Leaf – The Structure of a Watershed

Materials: green leaves in variety of shapes and sizes, images of watershed, sharpies, plastic wrap

Display a series of watershed images on with projector or on smart board from Google or You Tube. Suggestions are www.cserc.org, water.usgs.gov, USDA Forest Service. Show the structure of each watershed and follow the water from the top of the watershed to the outlet (lake or ocean). Hand out the leaves and sharpies and have the students turn the leaves to the underside and to orient the leaf with the stem pointing toward them. With their fingers first, the students will trace the "watershed" they find in the water system of the leaf. Once they have identified the stream order, they use sharpies to highlight the water systems within their leaf. Discuss what may be located around those waterways, using their background knowledge from Activity One to make some logical suggestions. Once the students have completed their tracing, they can wrap their leaf in plastic wrap, taking care to keep the leaf flat.

Activity Three: What Dissolves and What Does Not?

Materials: small jars with lids, sand, salt, baking soda, glitter, water, student science journals

Fill the jars ¾ of the way with water. In each, introduce a spoonful of one material. Students can take turns shaking the jars to see what dissolves and what does not? Discuss the idea that we can think of these as things that are introduced to the water and what might happen if they are. Discuss how material in the water dissolves (disappears but is still there) or does not. Students should document their learning in their journals, referring to the vocabulary learned in Activity One.

Activity Four: Making Groundwater

Materials: 2 large clear glasses or vases; sand; gravel or aquarium gravel; pitcher; water; 10oz clear plastic cups, one for each student

In each of the glass containers, layer sand and gravel alternating between the two until they are about ¾ of the way full. This will create an aquifer, which the layers of rock, soil and sand that contain water. Slowly pour water into one of the containers while the students observe how the water is making its way through the small openings as it goes down.

In the first container, continue pouring until it is full (above the aquifer). Next, slowly pour water into the second container, stopping about an inch below the top of the aquifer. The level of the water in the second container is the water table. Below that, the aquifer is saturated. The glass of the container in this demonstration acts as the impermeable rock. Create what would happen if it were to rain by very slowly adding a bit more water to the second container. Students will observe and record their observations. This demonstrates the recharging of the groundwater.

Students can repeat this experiment in groups of two, recreating the two models in clear plastic cups, using sand and gravel.

Keep the containers for several weeks. Students should be able to notice that in the first container, there will not be room for more water, but in the second, as the “ground” soaks up more water over time, more water can be added as long as it is never filled above the aquifer.

Activity Five: What Travels Through the Watershed? – Velcro Paddle Game

Materials: Several sets of Velcro paddles (purchased or homemade); collection of objects, many that will stick to the paddle, some that do not (soft balls, pieces of fabric, small plastic toys, etc.)

Distribute the paddles to students and have them line each side of the hallway (or standing opposite each other in the classroom). The remaining class members chose an object. The students with the paddles represent the stream and banks, the objects represent the good and bad things that travel through the stream. Students may decide what their object is: animal or insects, leaves, rocks, paper, plastic, or other ideas.

Have the students with the paddles move around and travel down through the line of students. They try to collect the items that are held in their classmates’ hands or that have been left on the floor. Some items will “stick” and some will not.

Ask the students what the stream has collected as it moves along. Have them discuss what this might mean in our environment and what steps we could take to keep our waters clean.

Endnotes

1. Richard Louv, *Last Child in the Woods: Saving Our Children from Nature-Deficit Disorder,* 12.
2. https://water.usgs.gov/edu/watershed/
3. T.N.Narasimhan, *Hydrological Cycle and Water Budgets,* 715.
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5. https://water.usgs.gov/edu/watershed/
6. Narasimhan, 715
7. E. Wohl, *Streams* , 756-757
8. http:// nhptv.org/natureworks
9. www.sciencelearn.org.nz/resources
10. National Geographic.org
11. noaa.org

Figure 1: victoriatravis.weebly.com/process.html

Figure 2: www.fairfaxcounty.gov

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Appendix – Implementing District Standards

A INQ.1 Make observations and ask questions about objects, organisms and the environment.

Students will focus on the concept of a watershed and learn about the ecosystems that occur in their own watershed. They will learn about the plants and animals in the water and on the land that make the environment successful and vibrant.

A INQ.4 Read, write, listen and speak about observations of the natural world.

Student will engage in classroom discussions about the components of a watershed, listen to read-alouds describing the water cycle, document learning in the science journals with both words and images, and share their work in class with their group/peers.

A INQ.5 Seek information in books, magazines and pictures.

Students will use books and pictures, specifically *Follow the Water from Brook to Ocean* and *Down Came the Rain,* to discover the waterways within the watershed and the components of the water cycle.

A INQ.6 Present information in words and drawings.

Students will document the questions and learning throughout the unit in the science journals. These journals will serve as a source of informal assessment.