TENNESSEE STREAM KEEPERS

Curriculum for Water Quality Education in Hamilton County

Water, Water Everywhere!

We in the Tennessee Valley are fortunate to be surrounded by some of the most beautiful sights nature has to offer: mountains, rivers, streams, and an abundance of diverse wildlife! But our streams are in trouble: they're full of bacteria from leaking septic and sewer systems and farms, acid mine drainage from former strip mines, and sediment from poor development practices! Those streams aren't always safe for humans to play in, but the animals in those streams don't have a choice! What can we do to help clean up our rivers??

TenneSEA believes that education is the first step towards correcting our water problems, and our first stop with education is in the local classrooms! We work with school science classes to explore our watersheds, what they have to offer, and what makes them polluted.

We have put together a curriculum of activities from a variety of sources that teaches kids (and their parents!) about how their own actions can impact everyone's water. These activities are fun and informative, and we use them in summer camps and classrooms alike, and we encourage you to try them with the students in your life as well.

We're glad to have you onboard!

TenneSEA

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Part 1 — Where in the World is the Water?

Objectives

Students will be able to do the following:

- Describe several possible lifecycles for water
- Identify where water can be found in nature
- Understand why it is important to keep water clean

Grab a Globe: Toss a blow-up globe of the world around. Tell the students that they must not move their fingers once they catch the ball. Have them count how many fingers are touching water and to remember that number. After all the students have thrown and caught the globe, average the numbers together. See how close it comes to 70%, which is the percentage of the world that is covered by water.

A Thimble Full of Water: The teacher takes a big jar containing 1 gallon of clear tap water and tells students that there are over 300 million trillion gallons of water on Earth. Since 98% of it is salt water, the teacher takes a small cup and fishes out 1/3 of a cup to represent the freshwater. Since 1% of the water is in glaciers, pour half of that water into a smaller cup. Explain that that is all the clean freshwater the earth has, and that since we must share it for all our water needs, we have to work together to keep it clean.

Incredible Journey of Water: This activity uses a kit from Project WET. Set out 9 stations representing different places water is found in nature: groundwater, clouds, glaciers, ocean, rivers, lakes, plants, animals, and soil. Each station is marked by a different color and has a specific die sitting at it. Students pick a station to start at and roll the die to find out which station to visit next. They go to the next station and record their location by picking up a colored bead from the station and putting it on a string. They continue to roll dice until they have visited every station. Afterwards, have them look at their beads and explain why they spent so much time in certain stations (like glacier) or re-visited certain stations (like clouds) so often.

Story Time: Students write a story from the point of view of a water droplet. They describe the lifecycle of this water droplet, based on all the potential transitions they learned from Incredible Journey of Water. Sample water droplet journies include a water drop being swallowed by a human, a snowflake forming in the atmosphere, or a drop of dew forming on a plant leaf. Have them illustrate and share their stories.

Virtual Water: Set out note cards with different body parts drawn on them. Have students guess the ordering of percentage of water in each body part, and then reveal the answers at the end. You can use some of the following stats:

Lungs—83%

Muscle—79%

Kidney—79%

Brain—73%

Heart—73%

Liver—71%

Skin—64%

Skeleton—31%

You can do the same thing for other items such as different types of food, transportation, or electronics.

If you have internet access, students can take the National Geographic Virtual Water quiz online to find out how much water they consume in their everyday lives.

Common Water: Fill a large bucket with water and tell the students it is a shared reservoir in their community. Hand out different sized sponges to represent each "generation" of water use, starting in the 1800s and working up to modern day water use, shown in the table below. Tell each student what their role is when you hand them the sponge. Then give them 1 minute to get as much water as they want from the shared reservoir and put it into their own bucket. After the minute is up, look at how much water remains. Have everyone add their water back to the reservoir before starting the next round or "generation."

Place a few drops of food coloring on a few of the larger sponges to represent pollution going into the water supply.

Time Frame	Sponges	Water Users
200 years ago	3 small (1/4 size)	Small farms, settlers
100 years ago	4 small (1/4 size)	Small farms
	2 medium (1/2 size)	Factories
	1 large (full)	Utility company
50 years ago	1 small (1/4 size)	Houses
	5 medium (1/2 size)	Neighborhoods, farms
	6 large (full)	Factories, industry, utility company
Today	3 small (1/4 size)	Houses
	8 medium (1/2 size)	Farms, houses
	3 large (full)	Industry, farm, utility company

Part 2 — Life Underwater

Objectives

Students will be able to do the following:

- Identify several types of water pollutants
- Make a bar graph
- Define tolerant and intolerant species
- Identify several tolerant and intolerant macroinvertebrates

If Bugs Could Talk: Give out handfuls of Skittles to students. Tell them that each color represents a pollutant in their stream. Each student should make a bar graph of the types of pollutants they have. Compare the streams and see which ones might be closely located based on the presence of certain pollutants in them.

Colors represent the following pollutants:

Red—Pesticides

Orange—Toxic Waste

Yellow—Oil & Gas

Green—Fertilizer

Purple—Sediment

Macroinvertebrate Mayhem: This game is a modified version of "Sharks and Minnows." Lay out an area that represents a water body and choose one person to be the first rat-tailed maggot. Separate the remaining students into stoneflies, mayflies, caddisflies, damselflies, dragonflies, and midges. On the count of 3, all creatures must cross the pond without being tagged by the maggot. Anyone tagged turns into a maggot in the next round and helps tag. Midges are free to run normally because they are very pollution-tolerant. Pollution sensitive dragonflies and damselflies can tolerate some levels of water pollution. They must cross the pond, respectively, by skipping or running backwards. Pollution intolerant stoneflies, mayflies, and caddisflies do not flourish in polluted water. To represent their handicap, they must cross the pond, respectively, by stopping to do a push-up every 5 steps, spinning in a circle as they run, or hopping with both feet together. Continue playing until all the critters have turned into maggots.

Critters in the Creek: Take the students to a nearby creek and look for macroinvertebrates under rocks and by using a kick-net. Identify the nymphs and larvae of mayflies, stoneflies, caddisflies, hellgrammites, damselflies, dragonflies, maggots, craneflies, alderflies, and any fish or butterflies you see. Record the numbers and different types of creatures you find and decide if the creek is healthy based on the diversity.

View more benthic macroinvertebrates at the following website:

http://raritanbasin.org/Presentations/WPUPapers/Macroinvertebrate%20Identification%20Presentation.pdf

Part 3 — Water Pollution in Your Community

Objectives

Students will be able to do the following:

- Describe how upstream pollution can affect downstream inhabitants
- Suggest methods of water pollution reduction
- Identify local sources of pollution
- Understand how different substrates impact dirty water
- Design experiments to compare substrate effect on water
- Understand how different substrates impact dirty water

Sum of the Parts: Each student is given a piece of paper with part of some riverfront property on it and are asked to develop that property any way they want. After each student has drawn their design, the riverfront properties are pieced together like a puzzle. Starting from upstream, each student discusses their development and the types of pollution their property might add to the water. For each type of pollution, the student gets a piece of trash and hands it to the person downstream of them. At the end, the downstream person shows all the trash that floated down to them. As a follow-up, discuss methods each property could take to reduce their water pollution.

Enviroscape: Teachers can borrow an Enviroscape community watershed model from the Hamilton County Water Quality division. Students layout the neighborhood, complete with buildings, homes, cows, cars, and trees. Begin to "decorate" the neighborhood with pollutants they might find in their own neighborhood: kool-aid mix for pesticides and fertilizers; oregano for grass clippings; hot chocolate mix with water to represent sludge, sewage, or oil; and coffee grounds to represent dirt or poo. Leave some houses untouched to represent organic and green households. Let the students take turns making it rain using a spray bottle of water. Look at the groundwater and see how polluted it is and how even the organic households are affected by the pollutants in their neighborhood even if they didn't do the polluting themselves. Discuss things they can do in their own neighborhoods to reduce pollution.

Who Dirtied the Tennessee River?: The teacher talks about all the different sources of local pollution throughout Hamilton County's history. Students start with a jar of clean tap water and pour a "pollutant" in for each type of pollution mentioned. After each pollutant is added, the teacher asks, "Would you drink this water?" Use things such as dirt, toilet paper with food coloring for "sewage," paper and plastic pieces for trash, blue-colored water for pesticides, green-colored water for fertilizer, and sticks and leaves for natural objects.

After creating dirty water, tell the students they must figure out how to make the water clean again. For each student cut a plastic bottle in half; the base end will be used to catch filtered water, and the spout end will be placed upside down over the open end of the base. Students can select from items such as coffee filters, sand, different sized rocks, activated charcoal, cotton balls, or panty hose and layer those items in the spout end of their bottle. Dirty water is poured through the filter and is caught by the bottle's base end. After the filtering is complete, ask the students if it is easier to clean the dirty water or to keep it clean in the first place.

Edible Aquifer: A student favorite! For each student, fill a clear cup with an inch or two of ice cubes. Tell them the ice cubes represent impervious underground structures. Fill the cup just to the top of the ice cubes with Sprite or soda water, and say that it represents groundwater and an aquifer. Define all terms as you go! Then cover the ice cubes with ice cream, which is the ground.

Now the students can add their own pollutants (sprinkles) on top of the ground: brown for dirt, red for oil and car chemicals, green for fertilizer, blue for pesticides, yellow for toxic waste, mixed colors for trash, and more brown for sewage. Have the kids insert a straw into the aquifer, and then make it rain Sprite over their polluted ground. They will start to pull up pollution out of their aquifer after the water makes it sink in!

Part 3 — Water Pollution in Your Community

Objectives

- Understand how water is treated to make it drinkable
- Define erosion and runoff
- Identify erosion and potential sources of erosion
- Draw a physical map of the area
- Use age-appropriate field kits for water testing

Field Trip: Teachers can arrange a visit to the local water treatment plant, where students can see large-scale filters in action and learn about where their drinking water actually comes from in the area.

Erosion Walk: Students walk around their campus looking for sources of erosion and runoff. They create a map of the campus and pollution spots as they walk. Points of interest that should go on the map include all impervious surfaces that could contribute to runoff, downspouts from roofs and gutters, exposed pipes, sewer systems, and trash.

Water Testing: Students visit a local stream and collect water samples. They conduct pH, turbidity, and bacteria tests on the samples. Additionally, if the stream is safe enough for students to get into, students can record macroinvertebrates they locate in the water. Instructions for LaMotte field test kits are located on TenneSEA's website, and results can be shared on a county-wide map at the website.

Find additional resources at our website, http://caribbean-sea.org/tennesea


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