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The Path of Water!

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Grade Level: 5th and 6th grades

Adapted From:
1. MyScienceBox. *Watersheds & Wetlands* Lesson Plan. 6 March, 2007. http://mysciencebox.org/wetlands
2. Project Learning Tree. *Exploring Environmental Issues: Biodiversity*: *Watershed* Lesson Plan. 2006.

Time: 45-60 minutes

Overview:
As a precursor and/or concurrent experience to visiting local wetlands (like the West Eugene Wetlands), students are introduced to watersheds and the role wetlands play within them. Using a simple yet comprehensive activity, students follow the path of water to a bay/reservoir and develop an initial understanding of what watersheds are. After this basic activity, students add sponges to the borders of their bay/reservoir to simulate wetlands and compare watersheds with wetlands to those without. Students compare watersheds with wetlands to those without after a "toxic chemical spill" (colored drink mix) to see the effects of pollution throughout the watershed as well as to discover the role of wetlands in reducing the harm of severe pollutants to a bay/reservoir.

Oregon State Benchmarks Addressed:
1. SC.05.3.A.2(5), Identify effects of wind and water on Earth materials using appropriate models.
2. SC.08.3.A.2(10), Identify factors affecting water flow, soil erosion, and deposition.
3. SC.05.4.A.1(1), Make observations. Ask questions or form hypotheses based on those observations, which can be explored through scientific investigation.

Learning Objective:
By the end of this activity, participants will be able to:
1. Provide basic definitions of wetlands and watersheds.
2. Visually identify different watersheds within the created 3-D model.
3. Explain how runoff carries water, sediments (from natural areas), and pollution (from urban areas) to rivers, bays and oceans.
4. Understand that an event in a watershed affects all downstream areas.
5. Describe some of the many important roles wetlands serve in an ecosystem.
6. Inspire awareness to visit and understand wetlands and watersheds.

Background:

What is a Watershed?

A watershed is an area of land that allows water to flow over or under its surface into a particular body of water like a creek, bay, river or lake. Practically, this means that a watershed is all the land that drains into a specific body of water. Watersheds may be as large as several states (the Mississippi River watershed for example) or as small as a few city blocks.

A watershed typically begins in the tallest mountain areas where water falls as rain or snow. This water then trickles into rivulets, rivulets merge into creeks, and creeks merge into rivers on the water's way downhill. Eventually, these streams of water reach the larger body of water under study – a bay, a river, a lake, a creek. Much of this water will also seep into the ground as groundwater and may travel much more slowly through the soil and rock and perhaps underground aquifers to reach a body of water. Any land a water drop has traveled over or through to get to the body of water being studied belongs to that watershed.

One material moving through the watershed is soil. Because the rivers of a watershed are constantly engaged in the gradual erosion of the highlands that contain it, suspended sediments are part of the natural dynamics. However, human activities can accelerate this process through actions such as land clearing, dam building, farming, and industrial development. Runoff carries the loose soil into the water system, which may affect watershed quality. Significantly increased turbidity can interfere with sunlight transmission, fish respiration, and plant photosynthesis.

What is a Wetland?

Wetlands are transitional areas between land and water habitats. More specifically, the wetlands are characterized by:

- lots of water - the water table is at the surface or close to it most of the time
- hydric soil that is wet much of the time (although some wetlands are actually dry for more of the year than they are wet). The soil in the West Eugene Wetlands is very special due to its high saturation levels from the clay soil.
- specialized plants that are adapted to live in wet soils with lots of groundwater

The many types of wetlands include marshes, swamps, bogs, meadows, mud flats, and other habitats where land and water meet. In the not so distant past, up until even the 1970's, wetlands were often considered to be wasted space. While much of the wetlands of west Eugene are considered wet prairies, the wetlands in west Eugene consist of several types: marshes, ash forests, ponds, emergent grasslands, and some human-constructed ponds that may fit state and federal wetland definitions.

Wetlands serve many essential roles in the environment. They are critical habitat for many specialized plants and animals that survive nowhere else. The fender's blue butterfly is a rare species of butterfly that is supported by the upland prairies of the

Willamette Valley. The plants that live in a wetland act as a filter to soak up pollution that runs off upstream.

What is our Watershed?
Locally speaking, the Long Tom Watershed is one of the major watersheds in the upper Willamette River Basin. The headwaters of the Long Tom River originate in the forested Coast Range Mountains and foothills, flow through small farms, ranches, rural and urban areas to Fern Ridge Reservoir, and then through larger farms until it joins the Willamette River. Some of the major communities include Eugene, Veneta, Elmira, Alvadore, and Cheshire.

The Long Tom Watershed includes approximately 410 square miles, or 262,000 acres. There are approximately 140,000 people living within the watershed boundaries. Approximately 92% of the watershed is in private ownership.

Historically, the Long Tom Watershed contained vast wetlands and upland prairies. Today, there are few remaining intact native areas. Native species such as Oregon Chub, Fenders Blue Butterfly (both Endangered) exist in the watershed, and the oak savannahs and oak prairies provide habitat for native songbirds and migrating neo-tropical birds. The ecologically richest remnant of native wet prairie in the southern Willamette Valley, Willow Creek Preserve is protected as part of a local partnership that balances development with conservation. Willow Creek's native grasslands, ash woodlands and perennial streams provide the best remaining example of native wet prairie habitats in the southern Willamette Valley. More than 200 native plant, 100 bird and 25 butterfly species have been recorded on the preserve.

How does Willow Creek feed into the West Eugene Wetlands & Long Tom Watershed?
Willow Creek is a tributary of Amazon Creek, which in turn feeds into the Long Tom Watershed. The Nature Conservancy manages the Willow Creek Preserve, which is one of the most important remaining, undisturbed (in areas) wetlands in the region. The wet prairie of Willow Creek Preserve is characterized by tufted hairgrass and provides habitat for the Willamette Valley daisy, white-topped aster and Bradshaw's lomatium. Fender's blue butterfly, thought to be extinct until rediscovered in 1989, is found in an upland prairie remnant in association with the rare Kincaid's lupine, the primary food source of the butterfly's larvae. The preserve also hosts the western pond turtle, a reclusive species once common in the Willamette Valley but now rare.

Required Reading:
None, although it is suggested that the audience have a basic understanding of the water cycle.

Materials Needed:
Each team of 3 students needs:

- 1 plastic shoebox-sized container (reusable for other activities in the future)
- 1 kitchen sponge cut into 4 rectangular pieces (the yellow sponges with the green scrubbing material are cool because kids can observe a color change in the yellow

"soil" portion of the sponge while the green material simulates plants living in the wetlands)
- 1 water spray bottle
- a multi-color assortment of water-based markers

The teacher needs:
- a stack of white cardstock paper (each team will use 3 sheets)
- 1 packet of colored drink mix
- 1 spoon
- optional - map or satellite image of the school and neighboring areas showing the watershed

Everyone needs:
- a sink to clean sponges and dump dirty water
- a trash can

Activity Description:

Step 1 Getting Started/Introduction (15-20 minutes)

1. Instruct the students to imagine that it is raining. Ask the students: "Where does raindrop go after it hits the cafeteria roof? Where does it go from there? What path does it take?" They should be able to trace it to a gutter, stormwater, or sewer entrance. You may need to prompt them towards naming a nearby creek and onwards to a river, bay or ocean. You may want to draw a diagram of this path on the board.
2. Discuss the idea of a watershed. It includes all the land that water flows over and through to get to a larger body of water. Help students imagine what this means in terms of a raindrop that falls in different places in your watershed. Use a map if you want – such as a map of the watersheds of Lane County or the state of Oregon.
3. Tell the students that they will be building models of watersheds and observing what happens to their models when it "rains". Briefly demonstrate what they will be doing to make their watershed so they can see a nearly finished product before setting the kids loose.
4. Split the class into groups of 3 and have 1 member of each group collect 3 sheets of cardstock and 1 watershed tub. The rest of the group should clear everything off the tables except for a pencil for each student (they may get wet).
5. Crumple the sheet of cardstock into a ball then slowly flatten it out again. You should have a piece of paper with many valleys and ridges. Pick one end to be the top; this end will have tall mountains. The other end will be near a bay.

Timesaver: Set up the bins with the cardboard stock to save time and remove them for the next several steps.

6. First, add water to your watershed – creeks that run into rivers, lakes, ponds. Make students think about where to put these rivers. Will they be at the tops of ridges or in the valleys? Where might lakes form?
7. Next add natural areas – animals, trees, plants, rocks, sandy banks. Add urban and agricultural areas – houses, cars, schools, farms, gardens, factories, roads, cars. Make students think about where to put various things. Where would you find forests? Where would you find meadows? Where would animals want to live? Where might it be very rocky? Where would people want to build houses? How would they get to their houses? Where would they work and go to school? Where would their food come from? Would you want to build a farm at the top of a mountain? Allow 5-10 minutes for students to finish their watersheds. They should be very colorful at this point.
8. Carefully fit the watershed into the plastic bin so that the mountainside is propped up on the narrow end of the bin (the mountain end) and the land slopes gradually towards the far end of the bin (the bay end), leaving a 2-3 inch gap between the end of the paper and the bay end. Wedge the paper snugly in place leaving as little gap as possible between the sides of the bin and the paper.
9. Take one of the markers and prop the mountain end of the bin up a little. This is to make sure that a bay forms on the bay end and does not run back under the land.
10. The 3 students should take turns spraying the paper using the fine mist setting. Spray for 3-5 minutes until there is a decent sized puddle in the bay end.

OPTION: In order to better evaluate the success of the activity, use the list of questions at the end of this lesson plan. Give students the Watershed and Wetlands Questions in a handout and provide them with a few minutes to answer the first set of questions. The questions do not have to be used during class. You could use the questions to being a class discussion or use them as a homework assessment.

11. Begin a discussion of how this model represents a watershed and how different things affect the watershed. If you still have the diagram of your watershed on the board, you could add these ideas to your diagram. Some questions you may want to consider include:

    - What path did the rain take through your watershed?
    - What effect do natural areas have on the watershed? Urban areas? Agricultural areas?
    - What is “runoff”? Is runoff different in natural versus urban versus agricultural areas? It is important to distinguish erosion from urban runoff. Also, it may be interesting to think about differences in urban versus agricultural runoff.

- What affect does runoff have on the bay/reservoir?
- What is a watershed? How is this model similar to a real watershed? How is it different?

Step 2 – Adding Wetlands (10-15 minutes)

1. Tell students that they will now build another watershed. This time, we will compare watersheds with wetlands to those without. Open a discussion of what students think wetlands are:

    - Have they ever seen one?
    - What does it look like?
    - What kinds of plants and animals live there?

2. Pair teams up with one another. One team will have a wetland represented by sponges at the border between the land and the bay/reservoir; the other will do the activity exactly as before (in the third rendition, they will switch roles so that everyone has a wetland once).
3. Clean up the materials and allow groups to create a new watershed with a new sheet of cardstock paper. It should not take as much time this time nor is it necessary for the watersheds to be as elaborate.
4. Set up the bins as before, however, one team should add a tightly packed row of damp sponges to the border between the land and the bay/reservior. **THE SPONGES MUST BE DAMP**. They should not be sopping wet, nor should they be wrung out as much as possible. They should be somewhere in between so that some water could still be wrung out if you tried.
5. Place the watershed with wetlands directly beside the watershed without wetlands and prop up the mountain end with a marker.
6. Allow it to rain an equal amount on each watershed. *The students should make an effort to squirt the 2 watersheds an equal number of times.* As it rains, encourage them to notice any differences between the 2 watersheds. Stop when a decent sized bay had built up – about 2-4 minutes.

Timesaver: Combined the second and third activities into one activity to minimize the overall time.

OPTION: In order to better evaluate the success of the activity, use the list of questions at the end of this lesson plan. Give students a few minutes to answer the second set of questions. When students have finished writing their answers, begin a discussion of what the role of watersheds might be. Some questions you may want to consider include:

- Were there any differences in how quickly each bay filled?
- What does that mean about what wetlands do in times of heavy rain?
- Introduce the idea of wetlands as sponges during wet times and reservoirs during dry times to even out the flow of water.
- What happened to the color of the bottoms of the sponges? What does this represent?
- Introduce the idea of wetlands as filters for pollution.

Step 3 – Toxic Waste! (10-15 minutes)

1. Have students hypothesize what might happen to a watershed if a truck carrying pesticides crashed along a highway near a creek (such as Amazon Creek). What parts of the watershed might be affected?
2. Students will now have a chance to test their ideas on their models. As before, there will be one team with a wetland and one without, however they should switch roles. A spoonful of pesticide (colored drink mix) will be added to each watershed before it rains.
3. Clean up the materials and allow groups to create a new watershed with a new sheet of cardstock paper. Set up the bins as before, placing the watershed with wetlands directly beside the watershed without wetlands and prop up the mountain end with a marker.
4. At this point, go around and add a teaspoonful of drink mix to the middle of each watershed.
5. Allow it to rain an equal amount on each watershed. Notice any differences between the 2 watersheds. Stop when a decent sized bay had built up – about 2-4 minutes.
6. Clean up.

OPTION: In order to better evaluate the success of the activity, use the list of questions at the end of this lesson plan. Give students a few minutes to answer the final set of questions. When students have finished writing their answers, begin a discussion about the differences between non-point source pollution (runoff) and a pesticide spill. This activity should clearly illustrate how a single event in one location can affect a very large area and affects all downstream water users including wildlife in the marsh and the bay. Students will observe that while a wetland can soak up some pollution, some will also leak through into the bay/reservoir. Can it be cleaned up once it gets into the water? Emphasize that although a waste spill is far more dramatic, urban non-point source pollution accounts for the vast majority of the pollution in most watersheds.

Step 4 Assessment (5-10 minutes)

There are a number of ways to assess the success of the concepts of this lesson plan reaching your target audience:

- Have students create a flyer that encourages other students to do something to help their local wetlands and watershed. Post them around the classroom or around school.
- Have students complete questions similar to the following:

Part 1 – Building a watershed

1. Describe the path that the rain took through your watershed?
2. What happened to the drawings that represented natural areas (creeks, trees, plants, animals, wildlife)? What does this represent in nature?
3. What happened to the drawings that represented urban areas (houses, schools, factories, roads, cars)? What does this represent in the real world?
4. What effect did the runoff from natural and urban areas have on the bay that formed at the bottom of the land area?
5. The models we are using are not perfect. What is wrong with our watershed models? How are they different from a watershed in the real world?

Part 2 – Adding wetlands

1. How quickly did the bay with a wetland fill up compared to the bay without wetlands?
2. How much water is the bay with a wetland compared to the bay without wetlands?
3. Look at the underside of the wetlands. What happened? What does this represent?
4. The models we are using are not perfect. What is wrong with our wetland models? How are they different from a wetland in the real world?

Part 3 – Toxic waste!

1. The drink mix represented pesticides. What other real world toxic wastes could affect a watershed.
2. Where did the toxic waste go in your watershed?
3. What parts of the watershed were affected? What parts were not affected?
4. Describe any differences between the watershed with wetlands and the watershed without wetlands.

Step 5 Wrap Up (5-10 minutes)

Ensure the area has been properly cleaned and supplies put away. If you opted not to use the Watershed and Wetlands Questions as a formal assessment, lead a discussion using these questions about our relationship with watersheds and wetlands. Given what we've discovered about watersheds and wetlands, what can we do to help them thrive? Have students brainstorm ideas.

Additional Reading/Resources:

- Center for Watershed Protection (CWP). The Wetlands and Watershed Article Series. http://www.cwp.org/wetlands/articles.htm
- Council for Environmental Education. Oregon Project WILD Aquatic. K-12 Curriculum and Activity Guide. 2004.
- Dialogue for Kids - *Wild about Watersheds* http://www.idahoptv.org/dialogue4kids/wetlands/cleanmachine.html
- Martin, Jim. *Learning to Teach Students in the Community and Environment.* Clearing. Issue #110. Fall 2001. http://www.clearing magazine.org LearningtoTeach.pdf.
- My Science Box – *Watersheds & Wetland.* http://mysciencebox.org/wetlands
- Tolley, S. Gregory at al. *The Campus Ecosystem Model*. Journal of College Science Teaching.Vol. 31, no. 6. March/April 2002. Pg 364-369. http://www.nsta.org/main/news/stories/college_science.php?news_ story_ID=46684.