

Lesson: Land's Wonders and Worries: Pollution Solution

Topic/Essential Questions: How has human land use affected the Chesapeake Bay Watershed?

Unit/Lesson Sequence: This lesson is one of three (two for day program) in the "Land's Wonders and Worries" module based at Arlington Echo Outdoor Education Center. The lesson's focus is on preventing runoff and excess sedimentation.

Content Standards:

- **Environmental Literacy**
 - 5.A.1. Analyze the effects on human activities on earth's natural processes.
 - 1.A.5.f. Make recommendations supported by data to help address or resolve the issue.
 - 8.F.1.b. Identify actions that can be taken as individuals and those that require the involvement of other people, organizations and government.
- **Science**
 - 6.4.B.1. Recognize and describe that people in Maryland depend on, change, and are affected by the environment.
- **Social Studies**
 - 3.D.1.b Geography Describe ways and reasons people in Maryland and the U.S. modify the natural environment and the consequences of modifications.

Length of Lesson: 35 minutes

Student Learning Outcome: The student will explain the impacts of runoff from different land areas and identify the best land surfaces that minimize runoff.

Knowledge of the Learner:

- Prerequisite knowledge, skills and processes: runoff causes sedimentation problems in waterways. Students should be able to listen to instruction and follow directions.
- Student needs, interests, previous learning: These will be identified in the pre-assessment.
- Conceptual difficulties: relating pollution and sedimentation to ecological problems; building self efficacy to help solve the problems
- Differentiation: Students are 4th grade, with a diversity of backgrounds and skill levels.

Knowledge of Content:

Students will be investigating how water flows over or through different surfaces. They will see the differences in the water that pours out of the models. Through this, students will be following a simplified scientific method for discovery. Content knowledge for instructor is provided in lessons and Supplements.

- **Vocabulary:**

Runoff	Pervious surface	Impervious surface
Erosion	Sedimentation	Sediment
Outfall	Step Pools	

- Resources:

Poster of Chesapeake Bay Watershed and its states	Plastic funnel
Pictures of sediment in the Severn River	Water dead zone poster
Hurricane sediment in the Bay	Paper towels
Pictures of step pool construction	Water
Large erosion model (sand, step pools, forest)	Cups (12)

Water runoff models: (2 liter bottle model): impervious surface – road (roof shingle), construction site (clay), shoreline (sand), forest (leaves, sticks seeds), lawn (turf grass), farm (bare topsoil), golf course (green felt). Pollutants: Fertilizer (green food coloring); Road Salt (Baking Soda); Oil (thinned instant coffee); Animal waste (thickened instant coffee). Background for Instructor: See Supplement B

Algae Bloom Model: Chesapeake Bay model (plastic fish bowl, plastic aquatic plants, plastic aquatic animals, water) algae bloom model (green felt), sun model (flashlight)

Lesson Setup:

Assemble the runoff models by placing the 2-liter bottle with the ground simulation inside the bottle with the hole cut into the middle, at an angle. The cut-off top of the bottle should be turned upside down to create a funnel. Place an empty cup and a cup of water by each model. Place a paper towel in the end of the model to stop up any drips, and moisten each model.

Instructional Delivery

Module Introduction: Before the three lessons in Land's Wonders and Worries are begun, students will participate in a game that demonstrates stormwater movement.

Pre-Assessment:

1. Have students sit at the picnic tables, spread out around the erosion models so that one or two students are using each. Introduce yourself and the lesson. Have students share what they learned about stormwater based on the introductory activity
 - What did you learn about how water moves when it rains?
 - Which scenario had water sink into the ground? In which one did the water run off?

Motivation/Warm-up:

2. Share the learning outcomes with the students. Have students look at the watershed map of the Chesapeake Bay. Ask the students to name the six states and one large city within the Chesapeake Bay Watershed. Talk with the students about what a watershed is; use the plastic funnel as a visual example. Ask the students what kinds of pollution can occur within our watershed. Have students look at their model.
 - What type of land cover is it representing? Have them share their ideas with the group.

Procedure:

3. **Runoff models:** Explain to students that these surfaces collect pollutants. Have students determine what pollutants occur at their model. Place pollutants on the model as follows:
 - impervious surface – road (roof shingle): oil (thinned instant coffee), road salt (baking soda)
 - construction site (clay): nothing added
 - shoreline (sand): nothing added
 - lawn (turf grass strip): pet waste (thickened instant coffee), fertilizer (green food coloring)
 - farm (rich top soil): fertilizer (green food coloring), pesticide (red food coloring), animal waste (thickened instant coffee)
 - forest (leaves, twigs, seeds): nothing added
 - golf course (felt strip): fertilizer (green food coloring)
4. In their journals, students will write down what kind of surface they have. Have each group make a hypothesis about what will happen when it “rains” on their surface. They should write down their hypothesis in their journal (see Supplement A).
5. Make sure that the students have their empty cups below the unstopped portion of the downward-facing bottle. Have the student make it rain by pouring the cup of water into the funnel-like top. Discuss the results.
6. After the water has run through their model, students should analyze their cups and share the results with the other students. What does the water look like? Is there evidence of pollutants? Have the students write their results in their journals.
7. **Sedimentation discussion:**
 - a. **Construction pictures:** Together, look at the aerial photographs of silt in the Severn River from a construction site. Have the students figure out the point source of the sediment. Discuss the effects of sediment and sedimentation in the river, and work with the students to come up with management practices to reduce the effects of construction on the river.
 - b. **Hurricane pictures:** Together, take a look at the pre and post hurricane Irene pictures. Discuss the effects of sediment and sedimentation on the Bay, and work with students to come up with management practices to reduce the effects of runoff into the Chesapeake Bay.
8. **Erosion Discussion:**
 - a. Share the image of an eroded outfall area. Talk with the students about where stormwater comes from and where it goes.
 - b. Show students an image of the erosion effects of a poorly built outfall. Talk with the students about the effects erosion has on the land and its living things
 - c. Show students the image of the newly constructed step pools. Talk with them about how step pools work to create a natural environment that allows water to slow down and be soaked into the ground.

- d. Share with the students the picture of the same step pools a few years later, planted with native plants.
9. **Large Erosion Model:** Bring students over to the large erosion model and have them identify the three different surfaces (sand/beach, step pools, and forest).
- a. Ask the students to make a hypothesis on which surface will allow water to runoff the fastest. Use a hose/watering can on a light shower setting to make it “rain” across all three surfaces at once. Stop when the water starts to runoff the model.
 - b. After the water has run through the model students should discuss what they observed.
 - Which surface allowed water to runoff the fastest?
 - Which surface looks as though water would run off second, third?
 - Why did water runoff the beach habitat the fastest?
 - c. Talk about the importance of trees and their roots, the effects of erosion on the land and sediment caused by erosion in the water. Discuss the advantages of combining step pools and forests.
 - What can we do to stop erosion?
10. **Algae Bloom Activity:** If time allows, complete this activity to supplement the information students have already learned about how nitrogen runoff affects the Chesapeake Bay.
- a. Have one student hold the Chesapeake Bay model and describe the contents of the bowl.
 - b. Have a second student hold the sun model pointed down toward the grasses in the Bay. Discuss the importance of sunlight in the photosynthesis process. Discuss the problem excess nutrients from sources such as pet waste, fertilizer, septic tank seepage & sewage overflow has on the Bay and how it causes algae blooms.
 - c. Have a student float the algae bloom model in the bowl. Discuss what has happened to the sunlight, and how that affects the plants in the Bay along with the photosynthesis process.
 - d. Have a student push the algae bloom model down into the grasses. Discuss the dying off of algae blooms and how the decomposing organic material uses up dissolved oxygen from the water causing dead zones.
 - e. Discuss dead zones using the poster of dead zones in the Chesapeake Bay. Discuss what we can do to prevent algae blooms from occurring in the Bay.

Assessment: Ask students what they can do to help prevent erosion. Have them focus specifically on things around their houses, neighborhoods and schools. Answer the final question in their journal (see Supplement A): “Here at Arlington Echo, we are learning how to be Chesapeake Stewards who protect the Chesapeake Bay, its watershed and its living things. Chesapeake Stewards know that stormwater runoff causes many problems with pollution and sedimentation. I can help in many ways! These are some of the things I can do to help.”

Student Reflection and Closure: Invite students to think about their homes and schools. What kinds of surfaces do they see primarily? Can they identify any places where pervious surfaces have been installed?

Notes for inclement weather:

Arlington Echo encourages keeping students outdoors whenever possible—even in the rain—but in the case of severe weather (thunder, extreme cold, etc.), the rain location for this activity will be under the overhang at the lower Resource Lab.

Supplement A

Pollution Solution

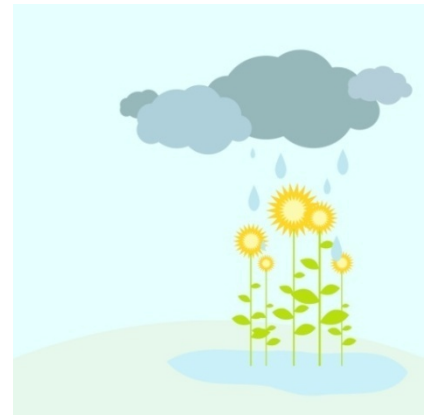
Type of surface:

Pollution:

Hypothesis:

Results:

Here at Arlington Echo, we are learning how to be Chesapeake Stewards who protect the Chesapeake Bay, its watershed and its living things. Chesapeake Stewards know that storm water runoff causes many problems with pollution and sedimentation. I can help in many ways! These are some of the things I can do to help:

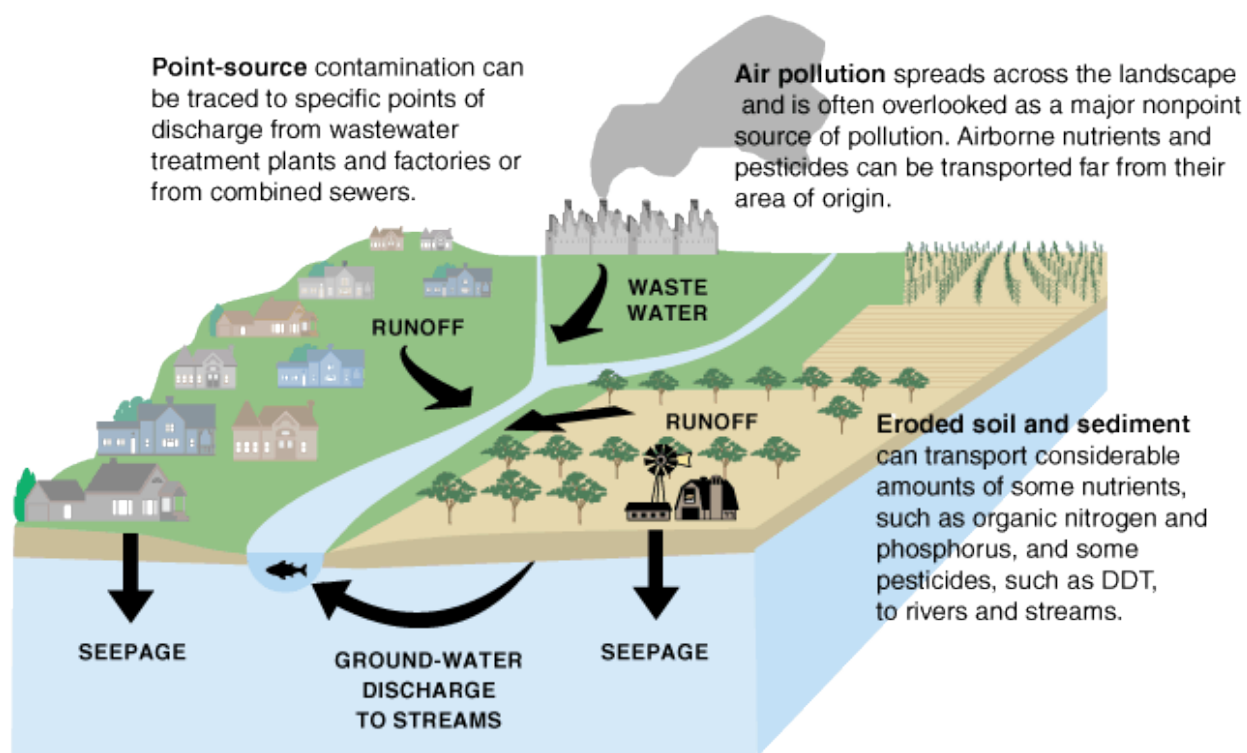


Supplement B

Background Information for Instructors

Pollution can be either point source (coming from a localized, identifiable source like oil spills, chemical plant runoff, sewer system outfalls, and stormwater outfalls) or non-point source (all other pollution, like road salt runoff, car exhaust, or irrigation runoff), for which you cannot identify a particular source, from many sources. Certain lands are able to infiltrate some of the polluted water, cleaning it, cooling it, and holding the water so it is not overflowing storm drains and tributaries. These areas include wetlands and forests with pervious surfaces that allow water to infiltrate the soil quickly. Impervious surfaces, which are those that do not allow water to soak into the soil (or, allow it to soak in only very slowly) include roads, parking lots, construction sites, lawns, playing fields, or barren landscapes.

Sources of contamination:



From the U.S. Geological Survey,
<http://ga.water.usgs.gov/edu/waterquality.html>