

**Lesson: Land's Wonders and Worries: Pollution Solution**

**Environmental Literacy Question:** How have humans affected the Chesapeake Bay and its watershed?

**Unit/Lesson Sequence:** This lesson is one of two in the “Land's Wonders and Worries” module based at Arlington Echo Outdoor Education Center. The lesson's focus is on preventing pollution problems, 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 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 for minimizing 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 and 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
- Differentiated: Students are in 4<sup>th</sup> grade, with a diversity of backgrounds and skill levels. In this lesson, students will use a variety of learning styles. The auditory learner needs will be met through the presentation, the kinesthetic learner will have the hands on aspect with the models, the visual learner will have the opportunity to see what happens to pollution as was runs over different surfaces, and the reading/ writing learners will have the use of the journal writing. There is an opportunity for social learning by working in partners for each model and as a group for the whole lesson. Students that need more guidance can use the information on the back of the cards with journal writing.

**Knowledge of Content:**

Students will be investigating how water flows over and through different surfaces. They will see the differences in the water that pours out of the models. Students will be following a simplified scientific method for discovery. Content knowledge for the activity leader is provided in lessons and supplements.

**Vocabulary**

|         |               |                    |            |           |
|---------|---------------|--------------------|------------|-----------|
| Runoff  | Sedimentation | Pervious Surface   | Sediment   | Watershed |
| Erosion | Stormwater    | Impervious Surface | Step Pools | Outfall   |

**Resources and Materials:**

**Pollution Solution Materials:**

|                                 |                           |                     |
|---------------------------------|---------------------------|---------------------|
| Runoff Model Cheat Sheets       | <b>Picture Sequences:</b> | 2 buckets           |
| Chesapeake Bay Watershed Poster | Hurricane sediment in Bay | Water               |
| Dead Zone Poster                | Step Pool Reconstruction  | Cups (12)           |
|                                 | Sediment in Severn River  | Large Erosion Model |

**Water Runoff Models (2 liter bottle models) and Materials**

|  |                                       |
|--|---------------------------------------|
| Impervious Surface/ Road- Roof Shingle and car | Construction Site- Clay and excavator |
| Shoreline- Sand with shells and beach grasses  | Forest- Leaves, Sticks, Dirt          |
| Lawn- Turf Grass with teeter totter and slide  | Farm- Bare Topsoil with farm animals  |

**Pollutants and How to Make Them**

|                                 |   |  |
|---------------------------------|---|--|
| Fertilizer- green food coloring | Oil- Thinned instant coffee or Red and Blue food coloring | Animal Waste- Thickened instant coffee |
| Road Salt- Baking soda          | Pesticide- Red Food Coloring                              |  |

**Algae Bloom Model**

|  |                 |
|--|-----------------|
| Chesapeake Bay model (plastic fish bowl, plastic aquatic plants, plastic aquatic animals, water) |                 |
| Algae Bloom- Green Felt  | Sun- Flashlight |

**Supplements:**

- A: Background on Pollution
- B: Pollution Solution Workbook Page
- C: Hurricane Sediment in Bay Sequence and picture of sediment in the Severn river
- D: Step Pool Reconstruction sequence

### Lesson Setup:

Assemble the runoff models by inserting the 2-liter bottle with the ground simulation into the bottle with the hole cut into the middle and a bag of stones in the base to weigh it down, at a downward angle. The cut-off top of the bottle should be turned upside down and placed in the top of the model to create a funnel. Place an empty cup under the spout of each model and a cup of water next to it.

### Instructional Delivery

#### Pre-Assessment:

- Have students sit at the picnic tables with one to two students at each of the 6 models. Introduce yourself and the lesson. Ask students about stormwater and watersheds to start a discussion about water movement.
  - Does anyone know what stormwater is?
    - *Any precipitation from a major storm event.*
  - Can anyone tell me what a watershed is?
    - *All of the land where all of the rivers and streams flow into a body of water.*

Discuss with the students about how our watershed covers a lot of different land types. Explain that water moving through a forest probably moves differently than water through a farm or parking lot. **(Supplement A)**

#### Motivation/Warm-up:

- Share the learning outcomes with the students. Have the students try to name the six states and one large district (National Capital) within the Chesapeake Bay Watershed. Once they have named all the states and district, have the students look at the watershed map of the Chesapeake Bay. Ask the students what kinds of pollution water can carry within our watershed.

#### Procedure:

##### 1. Runoff models:

- i. Explain to students that these surfaces collect pollutants. Have students determine which pollutants occur at their model. Place the correct pollutants on the corresponding model in front of the students. To apply the pollutants, pour a few drops (3-4) of the liquid or a shake of the "salt" onto the surface directly. **DO NOT POUR POLLUTIONS THROUGH THE FUNNEL TOP.**
- ii. In their journals, students will write down what kind of surface they have as well as the pollutants that are found on their surface. 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 **(Supplement B)**.
- iii. Make sure that the students have their empty cups below the unstopped portion of the downward-facing bottle. Have the students make it rain by

pouring the cup of water into the funnel-like top. Discuss the results.

- iv. After the water has run through their model, students should analyze the water in their cups and share the results with the other students.
  1. What does the water look like?
  2. Is there evidence of pollutants?
  3. Which cup has the clearest water? Have the students write the results for their model in their journals.
- v. Collect all "runoff" into a bucket. Show the students that this is what the Chesapeake Bay looks like after a storm from the collection of all of the stormwater. In a watershed, all of the water will lead to one place and our "one place" is the Chesapeake Bay.

## 2. **Sedimentation Discussion (Supplement C):**

- i. **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.
- ii. **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.

## 3. **Erosion Discussion (Supplement D):**

- i. Share the image of an eroded outfall area. Talk with the students about where stormwater comes from and where it goes (**Supplement B**).
- ii. 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.
- iii. Show students the sequence of images of step pool construction. 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.
- iv. Share with the students the picture of the same step pools a few years later, planted with native plants by AACPS students.

## 4. **Large Erosion Model:**

- i. Bring students over to the large erosion model and have them identify the three different surfaces (sand/beach, step pools, and forest).
- ii. Ask the students to make a hypothesis describing which surface, they believe, will allow water to runoff the fastest. Use a watering can to make it "rain" across all three surfaces at once. Stop when the water starts to runoff the model.
- iii. After the water has run through the model students should discuss what they observed.

1. Which surface allowed water to runoff the fastest?
2. Which surface looks as though water would run off second? Third?
3. Why did water runoff the beach habitat the fastest?
- iv. 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.
  1. What can we do to stop erosion?

**Assessment:**

Show the students the Chesapeake Bay bucket with all the stormwater with pollution. Ask them if they think it looks clean. Ask students what ways they think they can help prevent the Chesapeake Bay from looking like this, e.g. what they can do to help prevent erosion. Have them focus specifically on things around their houses, neighborhoods and schools. Have the students answer the final question in their journal with the ideas they came up with.

**(Supplement B):** "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 primarily see? Can they identify any places where pervious surfaces have been installed?

**Algae Bloom Activity:** If time allows, complete this activity to supplement the information students have already learned about how Nitrogen/Phosphorus runoff affects the Chesapeake Bay.

1. Have one student hold the Chesapeake Bay model and describe the contents of the bowl.
2. Have a second student hold the sun model (flashlight) pointed down toward the grasses in the Bay. Discuss the importance of sunlight in the photosynthesis process. Ask the students if sunlight is able to reach the plants in the model. 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.
3. 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.
4. 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.
5. 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.

**Module Debrief:** After the two lessons in Land's Wonders and Worries have been completed, students will participate in a game, led by an AE staff member, which exemplifies stormwater movement.

**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.

**Notes for Clean up**

Please organize and return the lesson folder, with all the supplements, the pollutants to the tray. All models should be taken apart and put back in their pans. All the pans and the tray should be loaded onto the black cart. Once the black cart is loaded, the black cart and the easel should be taken back into the Resource lab. Remember to inform the Arlington Echo Staff if you need assistance or if any materials are damaged or missing.

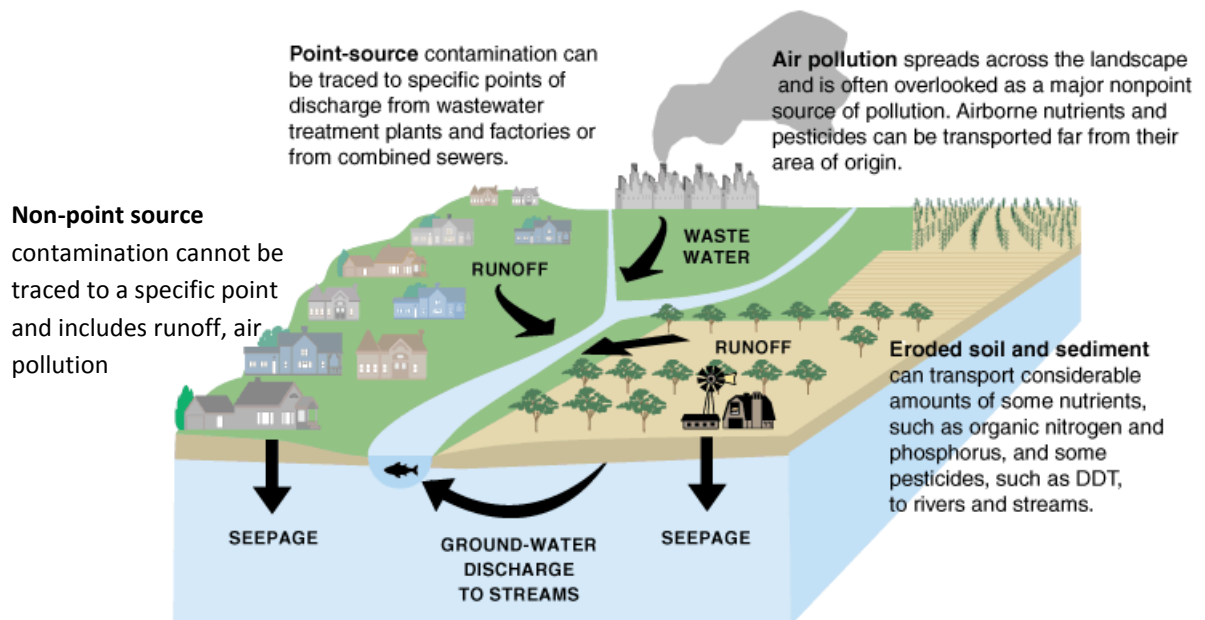
## Supplement A: Background Information

### Background Information for Activity leaders

Pollution is the presence in or introduction into the environment of a substance or thing that has harmful or poisonous effects. Pollution can be either point source or non-point source. Point source pollution is a pollution that has a localized identifiable source that is regulated by the government, e.g. chemical plant runoff, sewer system outfall, storm water outfall etc. Non-point source pollution is a pollution that does not have a localized identifiable source and is hard to be regulated by the government, e.g. road salt runoff, irrigation runoff from farms, car exhaust etc.

Pollution can be carried by stormwater runoff during heavy rain and storm events. Pervious surfaces are able to infiltrate some of the polluted water where the trees and plants or man-made materials help to clean, cool, and hold the water so it does not overflow storm drains. These pervious areas include wetlands and forests, as well as some man-made surfaces like bio-retention areas, which 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. If stormwater flows over impervious surfaces, it does not infiltrate into the ground and can instead carry pollutants from the land directly into waterways.

Sources of contamination:



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

**Supplement B : Journal Page**

# **Pollution Solution**

Type of surface:

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Pollution source:

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Hypothesis:

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Results:

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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:

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