Lesson: Land's Wonders and Worries: Stormwater Study

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

Unit/Lesson Sequence: This lesson is one of three in the "Land's Wonders and Worries" module based at Arlington Echo Outdoor Education Center. The lesson's focus is on stormwater control.

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.
- **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.
- **Science**
  6.4.B.1. Recognize and describe that people in Maryland depend on, change, and are affected by the environment.
  2.4.A.2.b. Cite evidence to show that erosion shapes and reshapes the earth's surface as it moves from one location to another.
- **Math**
  Common Core 3.MD Geographic measurement: understand concepts of area and relate area to multiplication and to addition.

Length of Lesson: 35 minutes

Student Learning Outcome: The student will investigate the Arlington Echo surfaces pictured on the map and evaluate their effectiveness in infiltrating rain water.

Knowledge of the Learner:

- Prerequisite knowledge, skills and processes: When rain hits impervious surface, it runs off into storm drains. 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: All students should be able to differentiate between some of the surfaces but some group discussion may be required to find all the stormwater controls. Students may work in pairs or small groups to identify and label these.
- Differentiation: Students are 4th grade, with a diversity of backgrounds and skill levels.

Knowledge of the Content

At the beginning of the lesson, students work with the instructor to create a thinking map of their knowledge. This creates a base on which they can root their findings. The instructor can refer back to this at the end of the lesson to reinforce the students' findings. Students work in pairs or small teams to find all the stormwater controls. They may discuss their findings along the way to improve understanding and encourage cooperation. Students use their knowledge of stormwater controls to

investigate the area. This includes application of the knowledge. After investigation, students will evaluate the effectiveness and their self-efficacy.

- Vocabulary:

Green Roof	Impervious	Infiltration	Pervious
Stormwater	Rain Barrel	Rain garden	Run-off
Vernal pool	bioretention area	erosion	rainscape

- Resources:

clipboards	map worksheets	blue and pink highlighters
3 large buckets of water	small blue buckets	yogurt cups
easel	Thinking Map Poster	thin dry erase marker
stopwatches	water	trowel

2 large cans with the top and bottom removed
Supplement A: Background for Instructor: Information on Stormwater
Supplement B: Stormwater Study Key Words
Supplement C: Stormwater Study Map

Lesson setup:

1. Fill large buckets by the boat house, field and pervious pavement with water.
2. Set out and fill the blue buckets with water and place a yogurt cup inside each. (1 per every 2 students)
3. Pair the clip boards with highlighters on the picnic table.
4. Set up easel with Thinking Map Poster, Supplement B: Stormwater Study Key Words, Supplement C: Stormwater Study Map, thin marker and wipe cloth by the picnic tables.
5. Use the trowels to place the two large cans: one in the field; one in the forest.
6. The instructor will hold the stopwatch

Instructional Delivery

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

Pre-Assessment:

1. Have students sit at picnic tables while the instructor introduces the lesson.
2. The group will create a thinking map about what they know to be PERVIOUS and IMPERVIOUS surfaces.

Motivation/Warm-up:

Impervious surface mapping:

3. Group the students into 2-3 and have each group use one clipboard/highlighter. Tell the students that they will work in pairs or small groups to investigate the pervious and impervious surfaces present on the mapped area of the Arlington Echo's campus.
4. Have the students mark the Surface type squares in pink for impervious and blue pervious.

5. Using the painted compass rose, help the students orient themselves and their maps and identify various surfaces identified on the maps.
6. Chaperones and the lesson instructor will walk between groups to help orient students and answer questions as they lead them around the area, pointing out various infiltration practices. Each pair or group will carry their small blue bucket of water and yogurt cup. Invite students to investigate the surfaces pictured on the map using yogurt cups.
7. Explain that the students are acting as scientists! They should fill the yogurt cup to the line and then pour water onto surfaces to see if they are pervious or impervious.
8. Have the students mark their findings on their maps.

Procedure:

9. The instructor will discuss infiltration at the large can in the field with the students. Invite students to hypothesize the rates of infiltration at the site.
10. They will pour a yogurt cup of water into the field can and time it. Then, the group will pour the same amount into the forest can and time it. They will then compare the times and discuss the implications. (The forest can will drain very fast since the soil is not compacted and the land cover is tree, roots and leaves).
11. Lead the students to investigate at least five different surfaces. They will use the pink and blue highlighters to map the impervious and the pervious surfaces.
12. Students may use the big buckets to refill their small blue buckets.

Assessment:

13. Students return to the picnic tables to complete coloring their maps and discuss their findings.
14. Have the students count the blue (pervious) and pink (impervious) boxes on the grids and write the totals on their journal stormwater study map. If a block is mostly colored in, they will count it as 1. If it is only partially colored, they will not count it. They should write a simple ratio of this number.
15. Use the following questions to assess the students knowledge and lead the discussion:
    - Which location allowed water to drain quicker,. The field or the forest?
    - Why? (What do the infiltration rates indicate?)
    - How many blue blocks did they count?/ How many blocks were colored pink?
    - How do the blue-colored stormwater controls help to infiltrate water?
    - Can any rainscaping projects be done at your school or home?
16. Re-examine their thinking map of pervious/impervious and make changes as they see fit.

Notes for inclement weather:

Arlington Echo encourages keeping students outdoors whenever possible—even in the rain.
If it is raining the group might meet inside the Boathouse to get some protection from the weather during the pre-assessment and then move outside for the activity. In the case of severe weather, (thunder, extreme cold, etc.), the alternative lesson: Watershed Model, will be taught in the Boathouse unless directed otherwise by the Arlington Echo Staff. The materials and lesson will be provided at that time.

Supplement A

Information on Stormwater

Stormwater is one of the biggest environmental problems in the Chesapeake Bay. The more we build over the land, the more stormwater gets displaced and cannot infiltrate into the ground. That water then runs over the land, erodes and carries pollutants and sediment to the streams that feed the Bay. The overloaded stormwater systems often flood the streams that were once ecologically balanced and place them under tremendous stress. They become deep gullies which encourage further erosion during storm events. Impervious surfaces do not allow water to infiltrate into the ground or only allow it to infiltrate very slowly. Anything paved or compacted may be considered impervious. Lawns are usually impervious due to the tight compaction and very short root structure!

Nature provides many natural systems that provide stormwater control. Some examples of these systems are: bogs, swales, vernal pools, wet meadows, ponds, marshes and other types of wetlands. Wetlands are able to retain and infiltrate much more water than dry areas and are thus extremely important to the environment. Unfortunately, many of these natural systems are filled in and paved over for shopping malls, apartment complexes, and other impervious environments. The most important thing is to catch stormwater and have it soak into the ground sooner. It is much easier to control it at the source than to control it downstream.

Stormwater rainscapes allow the stormwater to be slowed and cooled so that it may infiltrate the ground more effectively. Some examples of rainscapes include the following: green roofs, rain barrels, swales, pervious pavement and rain gardens; which include human-made bogs, ponds, and other bio-retention areas. All of these human-made systems allow stormwater to be slowed to flow into the ground even in high-traffic areas. Schools and residences can have a big impact on the health of our waterways and the bay by installing rainscapes at their locations to manage their stormwater on their site!

Supplement B

STORMWATER STUDY KEY WORDS

Runoff- The flow of water from rain, snow melt or other sources over the land. It can carry pollutants with it as it moves.

Infiltration- The slow passing of water into and through the soil to help clean the water

Pervious Surface- A surface that will absorb water

Impervious Surface- A surface that does not absorb water

Erosion- The washing away of the soil by the flow of water

Bioretention Area- Areas designed to collect and slow the flow of water so that it can infiltrate into the soil

Rainscaping- a method of landscaping designed to control stormwater runoff

Supplement C: Investigative Journal Page

Stormwater Study Map