

Lesson: Take Action

Topic/Essential Questions: How have humans affected the Chesapeake Bay and its watershed?

Unit: "Water, Ice, and Wind...Oh My!"



Content Standards:

- **Environmental Literacy**
MSDE 1.0 ENVIRONMENTAL ISSUES The student will investigate and analyze environmental issues and develop and implement a local action project that protects, sustains, or enhances the natural environment.
- **Science**
MSDE 2.0 EARTH/SPACE SCIENCES The students will use scientific skills and processes to explain the chemical and physical interactions (i.e., natural forces and cycles, transfer of energy) of the environment, Earth, and the universe that occur over time.
2.A.2. Recognize and explain how physical weathering and erosion cause changes to the earth's surface.
 - a. Investigate and describe how weathering wears down Earth's surface.
 - b. Cite evidence to show that erosion shapes and reshapes the earth's surface as it moves Earth's materials from one location to another.
- **Social Studies**
3.D.1. Describe how people adapt to, modify and impact the natural environment.
 - b. Describe ways people in Maryland modify the natural environment and the consequences of modifications.
- **Common Core**
CCSS.ELA-Literacy.RI.4.7 *Interpret* information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears.

Length of Lesson: 35 minutes.

Student Outcome: The students will demonstrate an understanding of the impact of erosion on the natural environment and ways to prevent erosion.

Knowledge of the Learner:

- Prerequisite knowledge, skills, and processes: Students must have a basic understanding of the roles of erosion and its effects on the natural environment.
- Student needs, interests, and previous learning: These will be determined during the pre-assessment.
- Conceptual difficulties: Relating sedimentation to ecological problems; building self-efficacy to help solve the problems. Learning to use project materials (i.e. shovel, gravel, native plants, etc.) properly.

- Differentiated: The instructor may pace the lesson according to the responses and participation of the students.
- Differentiated: This lesson will appeal to different types of learners. Kinesthetic learners should do well with the physical act of completing an action project. Interpersonal learners will benefit from the team dynamic required to work together. Visual learners will be able to understand the effects of erosion by seeing water move through different surfaces.

Knowledge of Content:

- Content knowledge for the instructor: Provided in the lesson plan and supplements

- **Vocabulary**

Watershed	Rain barrel	SAV
Pollution	Swale	Eutrophication
Erosion	Infiltration	Algae bloom

- **Erosion Model Supplies**

Erosion models of forest floor, graveled area, and bare dirt/sand path
 Trays to catch the water poured on each model
 Watering can

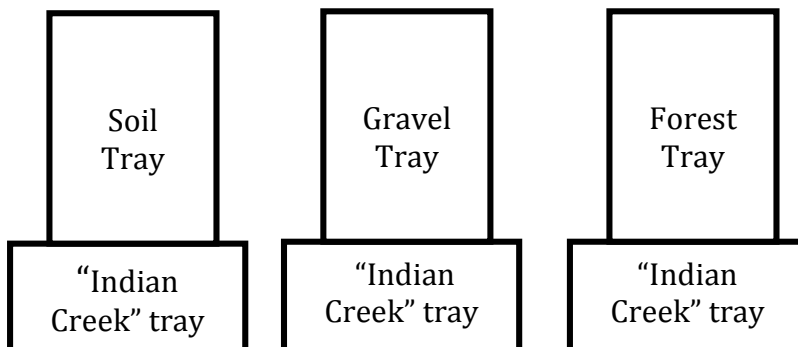
Action Project Supplies (depending on project)

Buckets	Shovels	Gravel
Wheel barrow	Hand shovels	Rain barrel halves
Plants	Gloves	

- **Supplements**

- A: The Parts of a Rain Barrel
- B: Rain Barrel Background and Maintenance
- C: Rain Barrel Project Diagram
- D: Rain Barrel Outflow Project Instructions
- E: How to Plant
- F: Who Can? Cheer

Lesson Setup: Erosion models can be set up by placing the shallow trays (“Indian Creek”) at the base of each erosion tray (there are three: forest, gravel, and bare sand/soil). This way when water is dumped on it for “rain” there is a tray to catch the water, just as the creek catches water rolling down the hills (pictured below). Action project will vary; an Arlington Echo staff member will provide instructions for setup.



Instructional Delivery

Pre-Assessment:

- Ask students: “What is erosion? Is it a problem? What causes erosion? How can we help control erosion?” *Erosion is the transport of weathered rock. Natural causes of erosion includes flowing water, waves and wind, gravity and glacier sliding. Human activities like mining, forest and native plant removal, construction and adding impervious surfaces can also cause erosion. Too much erosion can cause habitat destruction on land and pollute surrounding waters.*

Motivation/Warm-Up:

1. Welcome students to the activity and introduce yourself.
2. Have students stand in a semi-circle around the models.
3. Set the scene: “The forest around us is how most of the Chesapeake Bay watershed looked before many people came to live here. When Europeans first came to this land they saw natural areas like this. Since then, much has happened. People needed roads, places to live, and farms to grow crops. Many trees were cut down to make room for these developments. One of the problems that have occurred because of this is the washing of topsoil into rivers and tributaries (and Indian Creek!). When there is nothing covering the soil, it washes away with the rain. What is it called when soil washes away with rain?” (*Erosion*)

Procedure:

1. Erosion Model:

- Show students the three erosion model trays. Explain that they are going to perform an experiment. Each tray represents a steep slope at Arlington Echo that leads down to Indian Creek - one with gravel, one with a “forest” floor, and one with just soil/sand. The shallow trays at the base of each erosion tray represent Indian Creek at the bottom of hills around site.
- Ask students how many of them have done a science experiment before. Ask them “What is the first thing we do in a science experiment?” *Come up with a problem in the form of a question.* Have them come up with a question that we could answer after pouring water on the trays. For example- *What will happen to Indian Creek when it rains on different kinds of surfaces?*
- What is the next thing we do in an experiment? *Make a hypothesis.* Have students predict what will happen when it rains on each hill.
- Next we will test our hypothesis. Pick a volunteer to be a rain cloud; they will pour water onto the forested hill. Pick another student to be the timer. They will count out loud telling the cloud to stop when water reaches “Indian Creek”. The other students should make rain sounds. Have students describe what happens. Was their hypothesis correct?
- Repeat this process with the gravel tray and the dirt tray.
- Which water is cleaner? Which slope had more erosion? Was your prediction correct?
- Show students a potted tree. Ask them what they think will happen when you lift the tree out of the pot (will the roots hold the soil or not?). Gently lift the tree out of the pot

to show the roots to the students. Ask students, “Why didn’t the soil fall? What held the soil?” *The roots*. Point out how the roots hold the soil. Return tree to the pot.

- Explain that trees growing near the water keep it clean. The roots hold the soil in place. This helps to stop sediment from reaching the water.
- Between groups, pour muddy water into the woods where it will not drain into the cove.

2. Action Project (option A):

- Before students arrive, note the flagged area where the Action Project will take place.
- Explain that when water rushes over soil, the soil washes away with the water. This is called erosion. Ask students why erosion might be a problem for fish and other animals that live in the water. *When erosion occurs, sediment ends up in the water, making it cloudy. This makes it difficult for submerged aquatic vegetation (SAVs: plants that provide oxygen in the water) to get enough sunlight for photosynthesis; the plants will not survive. Sediment also carries high amounts of nutrients. Excess in nutrients in the water can cause algae blooms and eutrophication, leading to a significant reduction of oxygen in the water.*
- Tell the students that if we can slow down the water like we did in the experiment, we can help stop erosion. *One way we can slow down water is to use a rain barrel, which collects and stores rainwater from a roof. Rain water can be slowly released through a tube on the rain barrel instead of rushing out of a gutter.*
- Explain that today we will go over the parts of a rain barrel and use gravel/plants to control, slow, and filter water emitting from the rain barrel, giving it time to soak in.
- Show students the rain barrel they will be assessing. Go over the parts of the rain barrel **(Supplement A)** and determine if it requires any maintenance **(Supplement B)**.
- Show how a hose attached to the rain barrel leads to an underground pipe and emerges 30 feet away, where they will perform one part of the action project **(Supplement C)**.
- Give each student a hand trowel and a bucket.
- Go over the project steps and inform students what steps they will be doing. **(Supplement D)**.
- After the students finish their part, cheer and tell them that they made a big difference today!

Assessment: Ask students, “How did you help stop erosion today?” *We created a graveled area for the rain barrel outfall water to enter, slow down and soak into the soil.*

Action Project (option B): Planting.

- Before students arrive, use flags to mark areas where the plants will be planted or to pre-dig holes. Depending on the hardness of the soil and the size of the plants, the holes may need to be pre-dug before each group arrives.
- Ask the students why it is important to have native plants. *Native plants provide habitats and food for animals. They also stabilize shorelines with their roots to prevent erosion and soak up excess nutrients, preventing erosion in waterways.*
- Explain that when water rushes over soil, the soil washes away with it. This is called erosion. Ask students why erosion might be a problem for the fish and other animals

that live in the water. *When erosion occurs, sediment ends up in the water, making it cloudy. This makes it difficult for submerged aquatic vegetation (SAVs: plants) to get enough sunlight for photosynthesis; the plants will not survive which will cause a reduction in oxygen in the water. Sediment also carries high amounts of nutrients. Excess nutrients in the water can cause algae blooms and eutrophication, leading to a significant reduction of oxygen in the water.*

- Tell the students that if we can slow down the water like we did in the experiment, we can help stop erosion. *One way we can slow down water is to use a rain barrel, which collects and stores rainwater from a roof. Rain water can be slowly released through a tube on the rain barrel instead of rushing out of a gutter.*
- Explain that today we are planting _____ (determined at activity instruction training) to help soak up rain water coming from rain barrels near the buildings at Arlington Echo.
- If available and close by, show students an example of an onsite erosion problem (Identified by AE staff during training).
- Show students what the rain barrel outfall location will look like when finished **(Supplement C)**.
- Follow the directions on the planting poster **(Supplement E)**. Demonstrate how to dig a hole, remove the plant from the pot, massage the roots carefully to ensure none are removed, place the plant in the hole, and backfill the hole.
- Pair students up and give each a hand trowel and a plant.
- With the help of the chaperones have the students plant their plants.
- If there is enough time and more plants, students can plant more.
- After the students finish their part, cheer and tell them that they made a big difference today!

Assessment: Ask students, “How did you help stop erosion today?” *We planted _____ to help soak up the rain and slow down the water running across the ground.*

Action Project (option C): Constructing a Swale

- Before students arrive, use flags to mark areas where the swale will be constructed for the day.
- Explain that when water rushes over soil, the soil washes away with it. This is called erosion. Ask students why erosion might be a problem for the fish and other animals that live in the water. *When erosion occurs, sediment ends up in the water, making it cloudy. This makes it difficult for submerged aquatic vegetation (SAVs: plants) to get enough sunlight for photosynthesis; the plants will not survive which will cause a reduction in oxygen in the water. Sediment also carries high amounts of nutrients. Excess nutrients in the water can cause algae blooms and eutrophication, leading to a significant reduction of oxygen in the water.*
- Tell the students that if we can slow down the water like we did in the experiment, we can help stop erosion. *One way we can slow down water is to create a swale. A swale is a wide, short ditch with rocks in it used to slow the flow of water and direct it into a*

suitable outlet. Ask the students if anyone has ever seen a swale beside a road or sidewalk.

- Explain that today we will be working on the construction of a swale by either removing excess dirt or adding medium size stones.
- Go over the steps of building a swale, and indicate which step the students will be a part of today (**Supplement**).
- After the students finish their part, cheer and tell them that they made a big difference today!

Assessment: Ask students, “How did you help stop erosion today?” *We helped to construct a swale!*

Student Reflection and Closure: Do the “Who Can?” cheer with the students (**Supplement F**) and ask if what they learned today is a way they can change the world. How can projects like these help at their schools or in their communities?

Notes for Clean up:

Please clean, organize and return the lesson materials to their proper locations at the end of each day of instruction. Remember to inform the Arlington Echo staff if you need assistance or if any materials are damaged or missing.

Notes for Inclement Weather:

Arlington Echo encourages keeping our outdoor activities outdoors—even in the rain—but in the case of severe weather (thunder/lightning extreme cold, etc.), the rain location for this activity will be under the Main Pavilion or inside Field Hall. An alternate activity will be given to the instructor in case of inclement weather.

Supplement A: The Parts of Rain Barrel**1. Flexible Down Spout Adapter:**

Directs water from the downspout to the rain barrel

2. Netted Basket: prevents mosquitos from entering the barrel

3. Rain Barrel: collects rain water, including the “first flush,” critical rain loaded with pollutants

4. Outflow Hose with control valve: for slow drainage and ease of connecting a hose

5. Overflow Hose: directs water away from building or reconnect with drainage system

6. Brass Spigot (optional): attached at watering can height to release water into a bucket or other container.



Supplement B: Background and Maintenance Information on Rain Barrels

A **rain barrel** is a system that collects and stores rainwater from a roof at a home or school that would otherwise be lost to runoff and diverted into storm drains and streams. Rain barrels are usually 55 gallon drums, but can come in a variety of sizes.

- Rain barrels CAN reduce the amount of runoff and pollutants reaching local streams. Rainwater from downspouts drains onto driveways, sidewalks or other paved surfaces and is not able to soak into the ground. Eventually, the runoff flows into storm drains, which empty into local streams. **A surge of polluted water entering streams can cause flash flooding, and erosion and low water quality.** Rain barrels prevent this by collecting and storing rainwater
- Using a rain barrel can provide a free water source for gardens and lawns, reducing the use of city and/or well water. Rainwater is naturally soft, oxygenated and devoid of chlorine, providing a great way to help improve the health of gardens, lawns and trees.
- Water captured in a rain barrel can be used to wash your car.
- According to the Maryland Department of Natural Resources, rain barrels can save a homeowner 1,300 gallons of water during peak summer months.
- Rain barrels are NOT for storing drinking water or for water used inside your home.

Rain Barrel Maintenance

Rain barrels require periodic maintenance.

- They should be drained after each significant rainfall from April to November. As a general rule, rain barrels should be emptied every five to seven days.
- Clean the rain barrel periodically and inspect it for clogs and leaks. If you suspect mosquitoes may be a problem, a fine mesh screen fitted on the lid of the rain barrel will prevent mosquitoes from gaining access and laying eggs.
- Remove leaves and other debris from the filter screen and ensure that it is not damaged and is securely fastened.

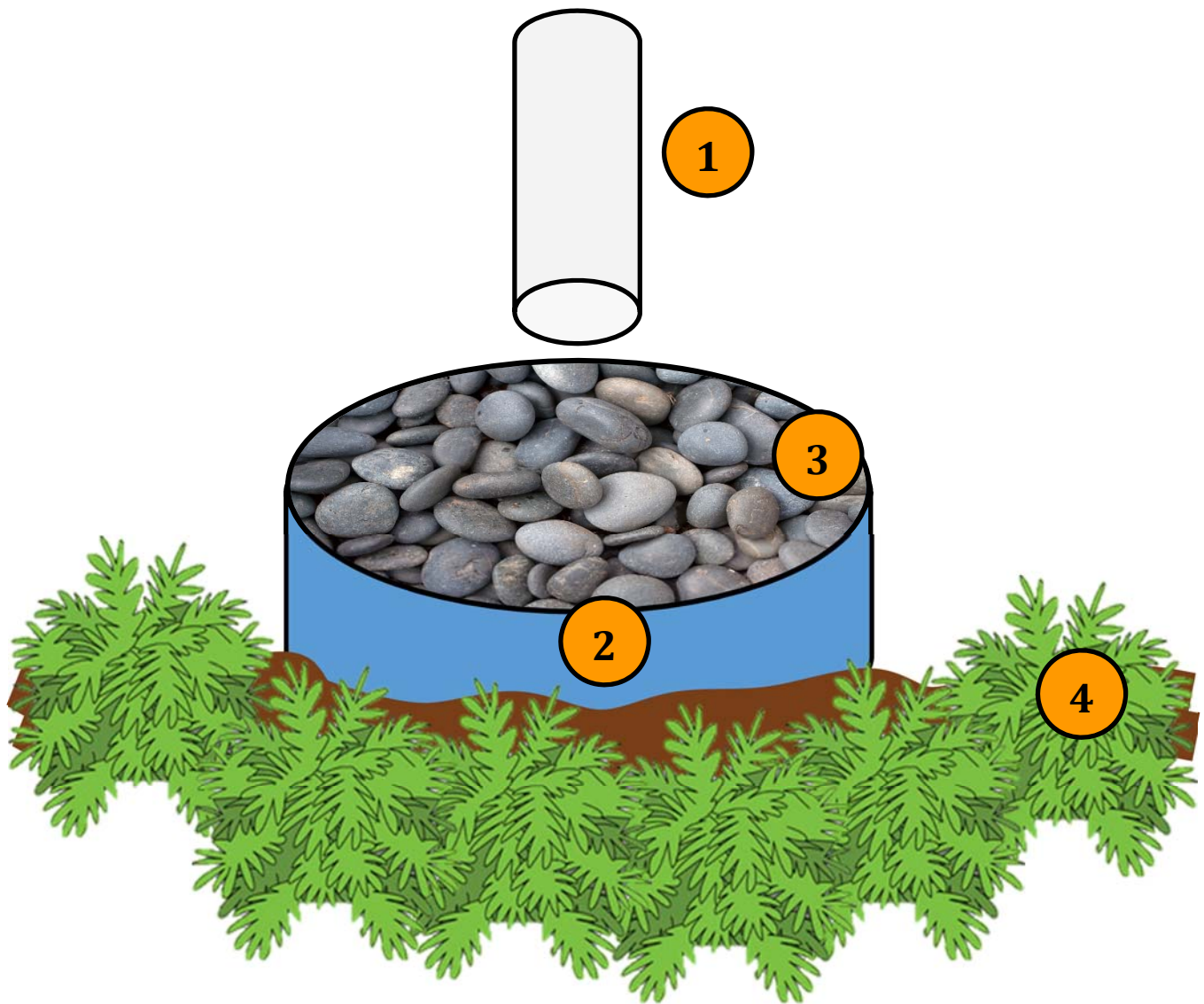
Monthly: move flexible adapter away and remove and clean netted basket. Ensure that the overflow hose is intact and is directed away from building foundation. Ensure all connections are tight.

(Source: <http://www.sandiego.gov/water/conservation/rainwater.shtml>)

(Source: EPA Environmental Assessment & Innovation Division, EPA Region 3, Philadelphia, PA)

(Source: Department of the Environment Guidelines for Rain Barrels)

Supplement C: Rain Barrel Project Diagram



1. Outfall of an underground drain pipe: carries water from rain barrels.
2. Half of a rain barrel partially buried, but rising above ground level.
3. Medium size gravel filled in the half rain barrel.
4. Native, absorbent plants.

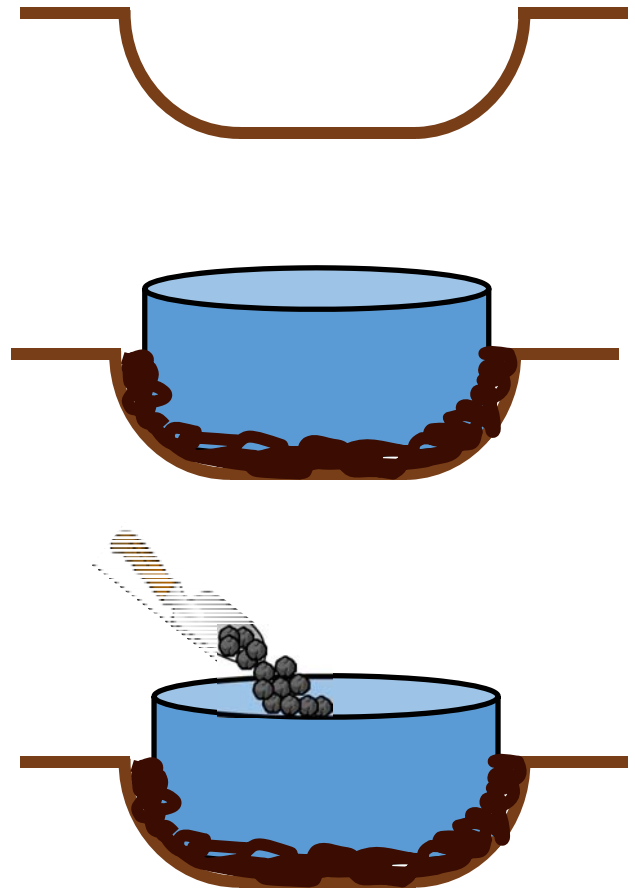
Supplement D : Rain Barrel Outflow Project Instructions

Tools List:

- Hollow rain barrel half
- Hand trowels
- Large shovel
- Gravel
- Gloves
- Native plants (optional)

Instructions:

1. Identify the location of the outfall project or the rain barrel drainage pipe. (There should be a large circle spray painted on the ground near it.)
2. Place the rain-barrel half on the circle to ensure the size matches up.
3. Using the hand trowels, have students dig up the dirt inside the circle so that there is a hole about 4 inches deep
4. Place the rain barrel half inside the circle so that half is below surface level and half is above.
 - If the rain barrel sits too deep, remove and add dirt back into the hole.
 - If the rain barrel is not deep enough, remove and dig out more dirt.
5. Once the hole is the right size, replace some of the dirt around the edge of the rain barrel and a 1 inch layer inside the rain barrel.
6. Using the hand trowels, have students scoop gravel into buckets (about 1/4 of the way full) and carry them over to the outfall site. Carefully pour the gravel into the rain barrel until it is almost full (about an inch of space at the top)
7. If indicated by Arlington Echo Staff, plant native plants on the lower side of the rain barrel using **Supplement E**.



Supplement E:

Take Action- How to Plant



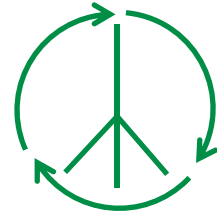
Massage roots before placing plant in ground.



Don't forget to water!

Supplement F :

Who Can? Cheer



Instruct students that when you ask “Who can?” they shout “We can!”

Say: “Who can?”

Students: “We can!”

Say: “Who can?”

Students: “We can!”

Say: “Who can change the world?”

Students: “We can change the world!”

“We are ALL connected!”

Supplement : Constructing a Swale

A **swale** is a depression of land that either soaks in stormwater runoff, or directs it to a vegetated area such as a rain garden, where it can be absorbed.

There are many types of swales including grass, concrete, gravel and bio swales. Not all swales will include plant materials. Today, you will be constructing a