Lesson: Stream Survey

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

Topic/Essential Questions: How does erosion affect stream health and the organisms that depend on the stream? What human activities cause erosion?

Unit/Lesson Sequence: This lesson is one of two interdependent lessons taught as part of the field experience at Arlington Echo, aligned in Science Quarter 4 Unit VII. The lesson prepares students for their Unit VII project. The focus is on investigating how erosion affects stream health and the organisms that live in streams. As part of this experience students learn what erosion is and how it can affect stream health. Students will determine how human activity can change the conditions of this habitat, which can help or harm the stream health. Prior to this lesson the students will have engaged in research on erosion to prepare for this field study.

Content Standards:

Environmental Literacy Standards

MSDE 5.0 HUMANS AND NATURAL RESOURCES The student will use concepts from chemistry, physics, biology, and ecology to analyze and interpret both positive and negative impacts of human activities on earth's natural systems and resources.

MSDE 6.0 ENVIRONMENT AND HEALTH The student will use concepts from science, social studies and health to analyze and interpret both positive and negative impacts of natural events and human activities on human health.

Common Core Standards

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 on Web pages) and explain how the information contributes to an understanding of the text in which it appears.

CCSS.ELA-Literacy.W.4.1 Write opinion pieces on topics or texts, supporting a point of view with reasons and information.

Science (S)

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.

Length of Lesson: 35 minutes

Student Learning Outcome:

Students will evaluate a freshwater habitat to determine whether erosion has had an effect on the health of the stream. Students will describe how humans have contributed to this impact and think of solutions to protecting the habitat.

Knowledge of the Learner:

- Prerequisite knowledge, skills and process: Students have previously researched erosion and its causes.
- Student needs, interests, and previous learning: These will be identified in the pre-assessment.
- Conceptual difficulties: Learning to use and read a turbidity tube, students' ability to identify macroinvertebrates, students' ability to identify erosion.
- Differentiated: Students are in 4th grade, with a diversity of backgrounds and skills. In this lesson, students will use a variety of learning styles. The auditory learner's needs will be met in the verbal presentation, the kinesthetic learner will have the hands on experience of sifting through the leaf litter, the visual learner will have the opportunity to learn through the stream survey and macroinvertebrate identification, and the reading/writing learner will use critical thinking to answer journal questions. There is an opportunity for social learning by working together to find and identify the macroinvertebrates and collaborate on the stream survey questions.

Knowledge of Content:

Students will be investigating human impacts on a stream environment and how erosion can affect the health of a stream. They will make observations of the stream, identify macroinvertebrates, and turbidity tests. All of these factors will help students determine how humans have impacted the stream and if erosion is occurring. They will think of negative and positive ways that humans impact the stream, and ways they can stop erosion. Content knowledge for the activity leader is provided in the lesson and supplements.

Vocabulary:

Runoff	Turbidity	Stormwater	Pervious
Nymph	Sedimentation	Riparian Forest Buffer	Impervious
Degradation	Erosion	Erosion	Macroinvertebrates
Rills	Habitat	Sediment	

Resource and Materials:

Materials:

Leaf Litter Bags	Macroinvertebrate cards	Hand Sanitizer	Clipboards
4 Trays	Macroinvertebrate posters	Magnifying glasses	2- 5 Gallon Buckets
4 Ice Cube trays	Spoons	Cups	Turbidity Tube
Flashlights	Pipettes		

Supplements:

- A: Macroinvertebrate Posters (Sensitive, Moderately Sensitive, Tolerant)
- B: Turbidity Tube Instructions
- C: Introductory Questions
- D: Macroinvertebrate Background
- E: Indian Creek Survey Erosion Assessment Journal Page
- F: Erosion Background
- G: Vocabulary List

Lesson Setup:

Students should stay in the designated areas in order to preserve the stream health as much as possible. For this reason, it is important to prepare the site and become familiar with where activities are to take place.

At the dock area place trays on the work station with magnifying glasses, pipettes, spoons, flashlights, ice cube trays, and macroinvertebrate cards. Pull the group's leaf bag from the stream and distribute leaf litter equally to each station, Arlington Echo Staff will determine which leaf bag(s) to be pulled. Collect water in a 5-gallon bucket from the stream and pour small amounts into the trays to keep macroinvertebrates hydrated, and place remaining bucket near the work station. Macroinvertebrate posters should be displayed on the plywood wall at the end of the dock so that all students can see them **(see Supplement A).**

Collect water in the bucket with the rope to use for turbidity testing. All charts should be out and ready to use. At this time you should become familiar with the testing procedures. An Arlington echo staff will show you how to go through the testing procedure **(see Supplement B).**

Instructional Delivery:

Module Introduction: Students will meet activity leader and Arlington Echo Staff in the main pavilion.

Pre-Assessment/Warm-up:

- Students start at the parking lot with the activity leader. Activity leader will ask students a series of questions, related to erosion, to prepare them for the lesson as they walk from the parking lot to the stream **(see Supplement C).**

Procedures (at the stream):

1. **Activity A: Leaf Litter Pack Activity**
   - The group will use half the allotted time of the lesson to complete this activity.

     - Verbally assess students' prior knowledge of streams and macroinvertebrates **(see Supplement D)**. Explain that we can evaluate the health of a stream based on the macroinvertebrates found. Explain that they will be looking for macroinvertebrates in bags of leaves that have been sitting in the stream for several weeks. Diversity is an indication of stream health. It's not just the number of macroinvertebrates, but the different kinds of macroinvertebrates that are the true indicators of health.
     - Introduce the students to the three posters **(see Supplement A**). The posters are titled Sensitive, Moderately Sensitive and Tolerant. Sensitive means that they can't live in polluted waters. Moderately sensitive means that they can live in some pollution in water. Tolerant means that they can live in polluted waters. Show them a sample macroinvertebrate card and ask which poster it should go on. Ask the students what

this can tell us about the health of the stream.

- Students will work in pairs to look through the leaf litter in their trays. Share with the students the different types of macroinvertebrates found in the stream. There are many types of water habitats, but a very healthy habitat can support the most diversity of macroinvertebrate life.
- As students are searching through the leaf litter pack, they will place the macroinvertebrates in ice trays. It is important that students are using the flashlights to look in the trays and their hands to gently sift through the leaves. The pipettes will be used to transfer water into the ice trays and the spoon to transfer the macroinvertebrate into the ice trays. Activity leader will demonstrate how to do so. They will identify them using macroinvertebrate cards. When a new macroinvertebrate is discovered, place its card on the poster. This should be done by the student(s) that found it.
- Once the card has been placed on the poster, hold a discussion about what this might tell us about stream health with the students.
- There are three posters. Each poster has a point value in the left hand side. Each card that is on the poster is worth the respective amount of points. For example, if students found two types of macroinvertebrates that fall on the sensitive poster, they would be worth 6 points because 2 x 3 = 6. Add up all the points from all three posters to give a score. Record the results in their investigative journals **(Supplement E).**

2. **Activity B: Turbidity Testing/Erosion Assessment**

- The group will use half the allotted time of the lesson to complete this activity and the assessment.
  - Students will be observing the stream looking at if erosion is affecting its health **(Supplement F).**
  - Students will test for turbidity levels with the activity leader **(Supplement B).** Record results in their investigation journals **(Supplement E).**
  - Students will do an erosion site observation and record results on the same journal page. They should not go off of the designated path for observations. They will use the information collected to evaluate stream health and talk about how erosion affects organisms that live there.

Assessment:

When students finish both activities, the activity leaders will lead a discussion on their findings. Have students determine whether erosion has had an effect on the health of the stream. If the stream has been affected by erosion, ask students what elements would be needed to make it a healthy habitat? Activity leaders will ask students how humans can impact erosion in our waterways, both positively and negatively.

- Negative Examples:
  - Destruction of native flora
  - Impervious materials such as pavement
  - Removing ground cover
  - Creating waves with power motors

    - Removing plant vegetation
- Positive Examples
    - Planting riparian forest buffers
    - Planting native trees and plants
    - Installing rain barrels
    - Installing pervious surfaces
    - Reducing shoreline traffic

One activity leader will lead the group back up the trail to the main pavilion and/or their next activity while the other activity leader (if there is more than one activity leader) sets the stations up for the next group.

Module Debrief:

After both groups have rotated through the Stream and Action Project lessons, they will meet back at the main pavilion to have a large group debrief, led by an Arlington Echo staff member. Students should be prepared to share their informed opinions on how humans can affect erosion.

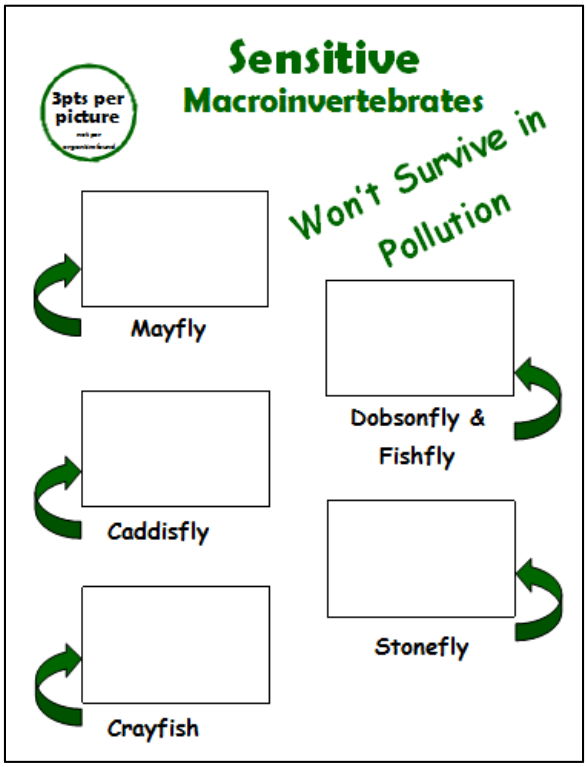
Notes for Clean Up

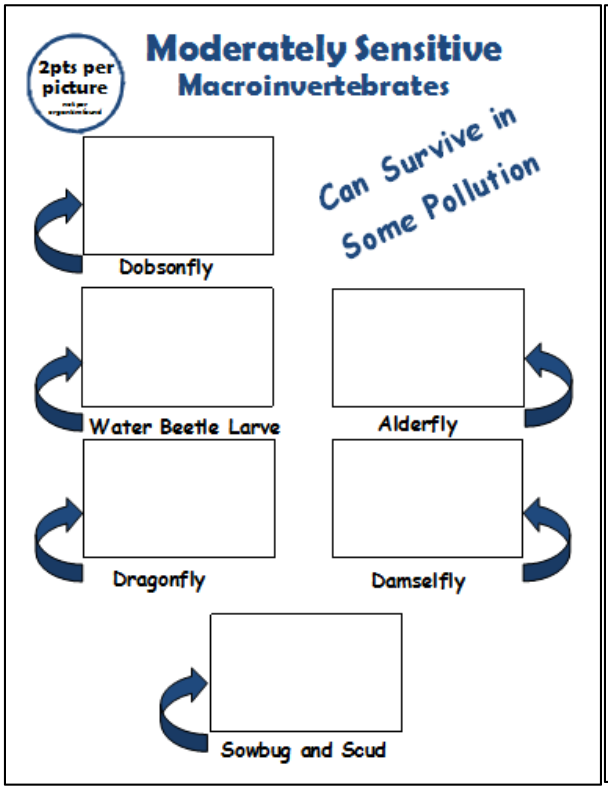
Please clean, organize and return the lesson materials to their proper locations at the end of each day of instruction. Please inform the Arlington Echo staff if you need assistance or if any materials are damaged or destroyed.

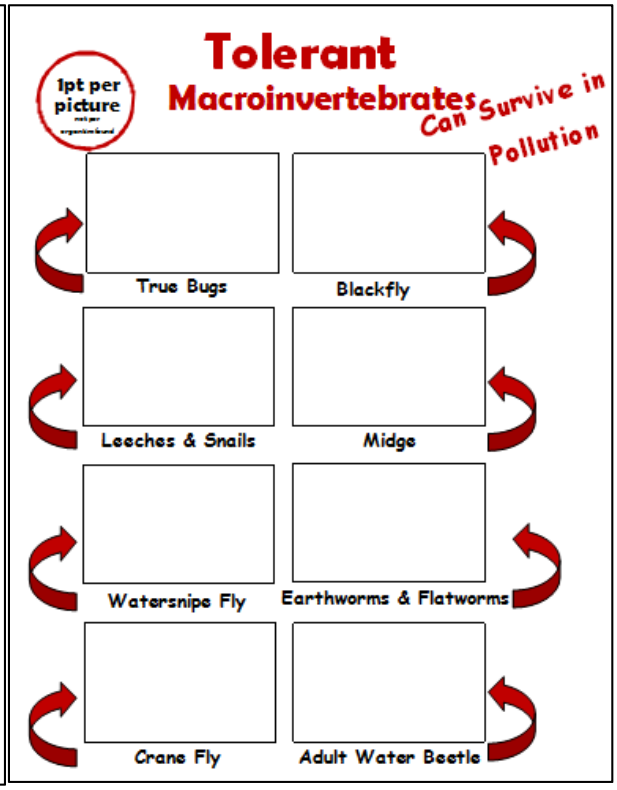
Notes for morning set up (overnight trips):

Please set up your materials prior to the morning's activities. If you do not spend the night, please check in with the AE staff assigned to the model and be at your teaching location by 9:00 a.m. This may require you to leave breakfast a few minutes early.

Supplement A: Macroinvertebrate Posters







Supplement B: Turbidity Testing Instructions and Turbidity Scale

1. Collect a sample of water in the provided bucket being careful not to scrape up excess sand from the bottom.
2. Have students look down into the tube so they can see the black and white disc (called a "Secchi Disc").
3. Hold the turbidity tube upright and fill it from the bucket using the funnel.
4. Stand so you can stare straight down into the tube.
5. Have someone else slowly start releasing water from the release hose (or by unscrewing the bottom) at the bottom of the tube.
6. Continue releasing water until the Secchi Disc **just** becomes visible.
7. Measure the water level using the markings on the side of the tube and refer to the turbidity scale to determine the turbidity.

Turbidity Scale

For use with the turbidity tube, match the depth in centimeters (marked on the tube) with the corresponding turbidity.

Visible Depth in Centimeters	Turbidity Units
Less than 6	Over 240
6 to 7	240
7 to 8	185
8 to 9	150
9 to 10	120
10 to 12	100
12 to 14	90
14 to 16	65
16 to 19	50
19 to 21	40
21 to 24	35
24 to 26	30
26 to 29	27
29 to 31	24
31 to 34	21
34 to 36	19
36 to 39	17
39 to 41	15
41 to 44	14
44 to 46	13
46 to 49	12
49 to 51	11
51 to 54	10
54 to 58	9
58 to 60	8
60 to 67	7
67 to 74	6
74 to 85	5
85-97	4
97 to 117	3
Top of Tube	2 or less

Supplement C: Introductory Questions

Start with these questions in the parking lot:

Questions:	**Answers:**
What happens to water when it rains on the parking lot?	The parking lot is an impervious surface (a surface that does not soak up water). Water does not soak water into the ground; instead it runs off, picking up speed and potentially causing erosion.
What is erosion?	The weathering away of land by running water, wind, or ice.
Why is erosion bad for the natural environment?	Erosion damages the land and pollutes waterways. If picks up pollutants including sediment, extra nutrients, salt, trash, and other toxins that may be on the land.

Ask these next questions as you are walking to the stream:

Does anyone see evidence of erosion on the path or sediment in the water?	Yes- this includes: bare patches on the path, exposed roots, brown water, water marks in the soil with piles of leaves etc.
Where does all the water that flows down the hill here lead to?	Indian Creek and the Severn River which lead to the Chesapeake Bay
What impacts might erosion have on some of the organisms that live in the water?	Erosion can cause plants to receive less sunlight leading to less oxygen in the water. With less oxygen in the water, the animals could either die or have to leave that area.
Are there ways that humans can lessen the impact of the water rushing down the hill?	Yes- slowing down water by planting native buffers near waterways and on steep slopes (a riparian forest buffer), placing sticks and branches running parallel to the slope of a hill creating diversion ditches, building step pools, and creating more pervious surfaces.

Supplement D: Macroinvertebrate Background

Background- Macroinvertebrates

What is a Macroinvertebrate?

A macroinvertebrate is an animal without a backbone and can be seen with the naked eye. This includes crustaceans, insects, worms and other arthropods. In streams, we are looking for aquatic macroinvertebrates. These macroinvertebrates live part of or all of their life cycle in the water. This can include dragonfly nymphs, caddisfly, stonefly, and midge larve. There is a high diversity of these macroinvertebrates.

What is the use of Macroinvertebrates as indicators of Stream Health?

Macroinvertebrates are broken into groups of tolerance to varying changes based on human effects on a stream. One major factor can be pollution tolerance - they are broken down into groups that can be highly sensitive, moderately sensitive, and tolerant to pollution. The Environmental Protection Agency (EPA) classifies macroinvertebrates based on their sensitivity to pollution. A healthy stream will be diverse in types of macroinvertebrates where as a polluted stream will contain only tolerant macroinvertebrates. In this stream you will find many sensitive species like caddisflies, stoneflies, dragonflies, riffle beetle adults and larvae. You may also find some tolerant species like flat worms, midges, and snails. These tolerant species can live in polluted water but, like any other animal, prefer to live in clean water.

Supplement E : Indian Creek Survey Erosion Assessment Journal Page

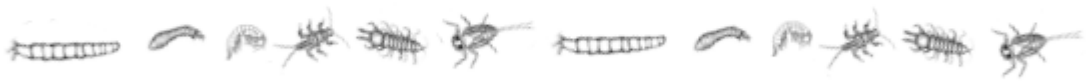
Indian Creek Survey

Erosion Assessment

Turbidity: _____ Visible Depth in cm

	A	B	C
Turbidity (clarity):	Clear	Cloudy	Very cloudy
Cracks in the soil by the river bank:	None	Some	Many
Forest Buffer:	Many Trees	Some Trees	Soil/ Grass
Exposed tree roots :	None	Some	Many
Collapsed river bank:	No	Somewhat	Yes
Top part of the bank	No	Somewhat	Yes
Stream Bottom:	Sand & Gravel	Sand & Silt	Silt & Mud

Mostly column A= Very little/no erosion **Mostly column B**= Some **Mostly column C**= A lot of erosion



Macroinvertebrate Value Score

Group total:_____

Good	Fair	Poor
16-30	10-15	9 & under

Based on your erosion assessment and macroinvertebrate diversity rate the health of Indian Creek. Circle one.

Good **Fair** **Poor**

Supplement F:

Background- Erosion

What is Erosion?

When people think of pollution, they often think of chemicals. In reality, one of the Bay's biggest pollution problems is soil. Soil washes into the Bay during a process known as erosion. Erosion is the wearing away of the land surface by running water, wind, ice, other natural causes or human induced activities. Erosion is an important natural process; it has created great land formations such as the Grand Canyon and Niagara Falls. However, when accelerated by human activities, erosion can have substantial impacts on the productivity and use of the land and the habitats surrounding it.

Causes of Erosion

Erosion is caused by three main sources- water, wind and ice. As rain falls from the sky it picks up speed and energy. Once the rain hits the ground it has enough energy to dislodge soil particles. As the soil becomes saturated, water begins to flow downhill rather than into the soil, carrying suspended particles of soil, called sediment, into rivers, creeks and streams. Human activity can intensify this process by creating surfaces that water will not soak into (impervious surfaces), and by removing vegetation, thereby decreasing the amount of water that can be soaked into that area.

Erosion Prevention

We cannot prevent erosion completely but we can help to lessen its effects. Trees and other plants are considered one of the best solutions to controlling erosion, the roots of these plants act like glue holding the soil in place. Plants protect the soil underneath them by shading and increasing the moisture held in the soil, as well as protecting the soil from wind and rainfall penetration. Steep slopes that lead to waterways often experience a high volume of erosion; both on the land leading downward and at the water edge. By planting vegetation on slopes, called forest buffers, soil and sediment are trapped by the roots stopping the pollution of the water and erosion of the land.

Impervious surfaces are another major cause of erosion, but it is impractical for our society today to have no impervious surfaces. However, there are many things we can do to catch and slow down rainwater that falls on these surfaces. Installing rain barrels, creating rain gardens next to buildings where water might run off rooftops, and placing strategic depressions in the ground to direct stormwater flow (called swales) are all excellent ways to reduce erosion impacts in an area.

Source : http://erosioncontrolpro.com/?p=32

Supplement G: Background Definitions

Background- Definitions

Runoff – Water that flows over the top of a surface, not soaking in.

Pervious – A surface that water will soak into.

Riparian Forest Buffer – An area of trees and shrubs located adjacent to a waterway.

Erosion – The weathering away of the land by water, wind or ice.

Habitat – A place a living organism makes its home.

Turbidity – The clarity of water.

Nymph – The immature form of an insect before it undergoes metamorphosis.

Impervious – A surface that water will not soak into.

Macroinvertebrates – Organisms with no backbone that are visible without the use of a microscope.

Sediment – Solid fragments of inorganic and organic matter that come from eroded land and deposits at the bottom of water.

Sedimentation – The act of suspended particles in water that settle to the bottom of that water

Stormwater – Water that comes from a major precipitation event.

Degradation – The act or process of ruining something

Rills – Channels carved into the land by the flow of water. These relate to stormwater and erosion by the rills being formed over areas of land during heavy precipitation events carving out new areas for water to flow.