ENVIRONMENTAL LITERACY MODEL ELM

# Environmental Literacy Model

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| Title | PIERS Raindrop to Runoff to Ocean Unit |
| Author | UMCES Appalachian Laboratory (Cassie Doty) |
| School, District | Garrett and Allegany Counties, Maryland |
| Audience (grade, course) | GR 5 |

## Curriculum Anchor

### Defining the Learning Objectives and Curriculum Connection

Curriculum indicators, performance expectations, and/or student learning objectives.

**NGSS**

**PE 5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.**
**SEP.** Developing and Using Models
**DCI ESS2.C.** The Roles of Water in Earth's Surface Processes
**CCC.**
- Scale, Portion, and Quality
- Systems and System models

**PE 5-ESS3-1. Obtain and combine information about ways individual communities use science to protect the Earth's resources and environment.**
**SEP.** Obtaining, Evaluating, and Communicating Information
**DCI ESS3.C.** Human Impacts on Earth Systems
**CCC.**
- Systems and System Models
- Science Addresses Questions About the Natural and Material World.

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**MD E. Lit. Standards**
**(1) Environmental Issue Investigation & Action.** Environmentally literate students investigate environmental issues in order to develop and implement local actions that protect, sustain or restore the natural environment.

**(3) Environmental Impact of Human Activity.** Environmentally literate students construct and apply understanding of the environmental impact of human activities on Earth's systems and resources.

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**Students will understand that:**
- Some land surfaces can have a negative impact on streams and rivers by increasing the amount of stormwater runoff and erosion. Other land surfaces reduce stormwater runoff and erosion by allowing rainwater to absorb into the ground.
- Stormwater runoff flows downhill and some of this water eventually reaches the ocean.

**Students will know that…**
- Rainwater cannot absorb into some land surfaces like roofs, sidewalks, roads, and hard-packed soil. Instead, this rainwater flows over these surfaces as stormwater runoff.
- We can use aerial images and maps to identify different land surfaces that produce runoff and determine where runoff flows.
- Stormwater runoff flows downhill until it reaches a stream; most runoff flows through streams and rivers until it reaches the ocean.
- Topography (mountains and valleys) determines the path that streams and runoff follow.
- Stormwater runoff causes soil erosion. Stormwater runoff carries this loose soil and other pollutants such as oil from cars, cow manure, and trash to the stream. Runoff can negatively impact on streams, dumping pollution into streams and washing away stream animals and their habitats.
- Upstream land surfaces impact downstream streams, rivers, bays, and the ocean.
- Rainscaping practices, such as rain gardens, rain barrels and green roofs, help rainwater absorb into the ground and thus decrease stormwater runoff and protect streams.

**Students will be able to …**
- Conduct an experiment.

- Conduct simple spatial analyses using GIS. Interpret 2-D and 3-D landscape models.

## Describing the Local Context

The life-relevant issue that will serve as the context for learning.

Muddy schoolyards and muddy local streams affect student activities from playing on the kickball field during recess to fishing and swimming in the local creek. Many have also seen first-hand the damaging effects of flooding.

## Identifying the Driving Question

A broad, open-ended, life-relevant question that is based on the standards/learning objectives. Guides inquiry for the investigation(s), prompts the development of actionable claims.

- Show to students pictures of brown flood waters at relatively local/familiar locations.
- Ask students about personal observations of puddles or brown stream water on or near the schoolyard (how has that affected recess after a hard rain?).
- Guide students to the driving question: How can we reduce the amount of brown stream water flowing to the Chesapeake Bay or Gulf of Mexico from our schoolyard?

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## Issue Investigation

### Asking Questions, Defining Issues and Problems

Students define the issue, problem, or phenomenon to beinvestigatedanddevelopsupportingquestionsthatarerelevantforinvestigation.

| Issue Investigation 1 | Issue Investigation 2 | Issue Investigation 3 |
|---|---|---|
| Students identify muddy streams as a problem, learn this problem is called "runoff," and are guided to ask the questions:<br>• Why do streams and rivers turn brown after it rains?<br>• How does our school contribute to runoff? | Students examine the flow of water across the land are guided to ask the question: Where does this brown water (runoff) from our schoolyard go? | Students examine various stormwater runoff solutions and are guided to ask the question: What can we do to reduce runoff from our schoolyard? |

### Planning and Conducting Investigations

Students plan and conduct investigations and classroom activities (indoor and outdoor) that actively address students' supporting questions. Students collect data that will be used to inform actionable claims.

| Issue Investigation 1 | Issue Investigation 2 | Issue Investigation 3 |
|---|---|---|
| 1. Students examine pictures of muddy floodwaters.<br><br>2. Using the scientific method, students construct sloped models in which "rainwater" flows across each of two land surfaces (parking lot or forest), across a "construction site" and down to a "stream" to determine how rainwater interacts with these surfaces. They make predictions, record their observations, and draw conclusions about how rain interacts with natural versus impervious surfaces.<br><br>3. Using the scientific method, students go outdoors to conduct infiltration experiments across their schoolyard to measure the amount of water that is absorbed by different surfaces (concrete, lawn and natural). They make predictions, record their measurements, and draw conclusions about how these surfaces may be impacting runoff.<br><br>4. Students use an online mapping tool to color areas on their school campus according to the amount of rainwater they absorb (i.e., none, some, or all of it). | 1. Students use the online mapping tool FieldScope to determine the flow path of stormwater runoff from their school and another Garrett County elementary school to the ocean (the second school is selected by the teacher and is outside of their school's watershed). They measure the length of the path. (NOTE: The FieldScope flow path tool is not available for students in other counties, so the flow path of runoff from those schools must be digitized and measured by hand in FieldScope.)<br><br>2. Students create a 3-D model (indoor with paper or outdoor with plastic sheeting) of a landscape that represents the landscape used in FieldScope; that is, an area with one long ridge, two large valleys and smaller hills and valleys. They mark where they predict streams will flow across this landscape. They also mark their school and another Garrett County school on either side of the ridge and predict where runoff from each will flow. | 1. Students review the negative impacts of stormwater runoff and brainstorm ways to reduce it based on what they have learned thus far. They then examine pictures of rainscaping (i.e., rain barrels, rain gardens and green roofs) in communities and discuss how this helps to reduce stormwater runoff.<br><br>2. Students go outdoors and walk around their schoolyard with a map. They mark areas they believe are impacted by or creating runoff, and locations where they can use rainscaping to reduce that runoff. |

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## Issue Investigation (con't.)

### Analyzing and Interpreting Data

Students analyze data through graphs, models, and other methods to reveal patterns and relationships. Students synthesize and apply evidence from their investigations to draw conclusions that address the supporting questions.

| Issue Investigation 1 | Issue Investigation 2 | Issue Investigation 3 |
|---|---|---|
| 1. Students discuss what they are looking at and hypothesize how the waterways got that way.<br><br>2. Students observe rainwater flowing across natural surfaces tends to be absorbed and slowly released, erodes very little if any of the construction site, and results in no appreciable change in stream color or volume. Conversely, rainwater flowing across impervious surfaces moves quickly and at full volume, eroding the construction site and causing the stream to be deeper and muddy. They learn the term "runoff."<br><br>3. Students discover water is absorbed at different rates on different surfaces (concrete, lawn and natural) around their schoolyard, and determine some areas of their schoolyard produce stormwater runoff.<br><br>4. Students examine the distribution of colors on their map and determine whether their campus is producing a little or a lot of stormwater runoff. | 1. Students discover that water flowing from Garrett County schools can go to either the Gulf of Mexico or Chesapeake Bay. They discuss how Garrett County schools are on either side of a large ridge called the Eastern Continental Divide, which determines whether rainwater flows to the Chesapeake Bay or the Gulf of Mexico.<br><br>2. Students use the model to examine how topography influences where water flows and test their predictions by "raining" on it and observing where the streams and runoff flow. They discover water flows downhill and carries with it pollutants that it picks up along the way. | 1. Students discuss amongst themselves the various rainscaping options they have identified. They determine which area of the schoolyard is most impacted by runoff (this can be in terms of most damage to schoolyard, greatest contribution of runoff to the nearest stream, or simply the greatest impact on their use of the schoolyard), and where and how to use rainscaping to best address that problem area. |

**Constructing and Communicating a Claim**

Students draw on the conclusions from their investigations to make a claim about the driving question and communicate these evidence-based claims to internal and/or external audiences.

| Issue Investigation 1 | Issue Investigation 2 | Issue Investigation 3 |
|---|---|---|
| Students conclude that impervious surfaces produce large volumes of stormwater runoff that erodes soil, making the water muddy, and their schoolyard has such surfaces. | Students conclude that stormwater runoff flows downhill to the nearest body of water and identify the path of stormwater runoff from schoolyards in their county to streams to the ocean. | Students conclude they can reduce stormwater runoff from their schoolyard with rain barrels, water gardens, green roofs, or a combination of these approaches, and determine which is best for their schoolyard.<br><br>Students communicate their recommendations to their principal and discuss how they can move forward with implementation of their rainscaping plan to reduce runoff from their schoolyard. |

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## Stewardship and Civic Action

### Identifying Solutions

Students identify and explore solutions that directly address the problem, challenge, or opportunity reflected in their claim. Students use decision making processes to identify the solution(s) to implement.

As a class, students determine the best location for rainscaping in their schoolyard by touring the schoolyard looking for areas where rainwater collects because it cannot absorb into the ground. They mark this location on a paper map of their schoolyard and discuss the best way to address this.

### Designing a Plan and Taking Informed Action

Students design a plan for implementing solutions through informed action in their classrooms, schools, and/or communities. The plans should include criteria for determining the extent to which the action successfully addresses the problem, challenge, or opportunity reflected in the claim. Students implement their plans.

Students develop a detailed plan for reducing stormwater runoff from their school, which they can present to their principal or school board. With permission, students implement their plan.

### Evaluating Action

Students reflect on the action and determine the extent to which it successfully addresses the problem, challenge, or opportunity reflected in the claim. Students communicate their findings and share proposals for sustaining or extending the action.

Students complete the "Reflections" questions at the end of their "student report" (i.e., worksheet) without teacher's guidance (except to clarify questions as necessary).

For subsequent academic years, students may examine the effectiveness of previously installed rainscaping efforts and either maintain, replace, or expand upon them (e.g., weeding raingardens and replacing plants that have died; adding a rain barrel).