



# Environmental Literacy Model

Title	Shifting Shorelines
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School, District	Anne Arundel County Public Schools
Audience (grade, course)	Science Grade 7

## Curriculum Anchor

### Defining the Learning Objectives and Curriculum Connection

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

#### Next Generation Science Standards (NGSS)

##### SEPs

- 2. Developing and Using Models
- 4. Analyzing and Interpreting Data
- 6. Constructing Explanations and Designing Solutions
- 8. Obtaining, evaluating, and communicating information

##### CCCs

Patterns Cause and Effect Scale  
Systems and system models  
Stability and change

#### Disciplinary Core Ideas (DCI)

**MS ESS3.C:** Human Impacts on Earth: Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. Typically, as human populations and per-capita consumption of Natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise

#### Performance Expectation (PE)

**MS-ESS3-2:** Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.

**MS-ESS3.3:** Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

**MS-ESS3-5:** Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

**MS-ETS1-1:** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

**MS-ETS1-2:** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

**MS-ETS1-3:** Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success

**MS-PS4-1:** Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.

**Environmental Literacy:**

Standard 1: Environmental Issues The student will investigate and analyze environmental issues ranging from local to global perspectives and develop and implement a local action project that protects, sustains, or enhances the natural environment.

Standard 5: 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.

**Describing the Local Context**

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

Anne Arundel County has 520 miles of shoreline on the Chesapeake Bay and its tributaries. Human impacts on wave action (through boating) and sea level rise (through climate change) threaten the health and stability of these shorelines. In turn, human modification of the shorelines threatens shoreline stability and biodiversity. Students will explore a local park to evaluate human impacts on natural processes, investigate different kinds of shorelines, and measure wave action.

**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.

How do human activities impact shorelines in Anne Arundel County?

# Issue Investigation

## Asking Questions, Defining Issues and Problems

Students define the issue, problem, or phenomenon to be investigated and develop supporting questions that are relevant for investigation.

Issue Investigation 1	Issue Investigation 2	Issue Investigation 3
<p>How have humans changed our local watershed in Anne Arundel County?</p> <p>What human activities contribute to climate change?</p> <p>Day 1</p> <ul style="list-style-type: none"> <li>Students view a video of the flooding in Ellicott City.</li> <li>Discuss pervious and impervious surfaces; leading students to ask questions about what has contributed to the extensive and repetitive flooding.</li> <li>Take students outside to assess the impact that the school has on the local watershed.</li> <li>Show students images of flooding in downtown Annapolis and the Inner Harbor of Baltimore that occurred on clear days with no precipitation.</li> <li>Discuss why flooding might occur even without precipitation (tides, wind, rising water levels).</li> <li>Look at the shorelines in Annapolis and Baltimore where this flooding occurred - connect this to our school land assessment - are these pervious or impervious surfaces?</li> <li>Lead students to wonder how shoreline design can help to control or exacerbate flooding from the water and runoff from the land.</li> </ul> <p>Day 2</p> <ul style="list-style-type: none"> <li>Students will view a series of 5 images of historical shorelines in Anne Arundel County and place them in chronological order from oldest to newest. (Each image will have one letter of a 5-letter word on it for students to self-assess)</li> <li>Students will discuss their observations of the pictures about changing shorelines with a shoulder partner. They will identify the changes in the</li> </ul>	<p>What are some examples of human impacts on the shoreline in a local park and what can realistically be done to minimize these impacts?</p> <p>Day 5 and 6</p> <ul style="list-style-type: none"> <li>Students will participate in a webquest about different types of shoreline mitigation technique               <ul style="list-style-type: none"> <li>Teacher note: Make sure to note that Living Shorelines are highly engineered compared to a planted shoreline which makes them more complex</li> </ul> </li> <li>Students skype with a ranger from one of Anne Arundel County's waterfront parks. The ranger gives them a background of the park, answers student questions, and shows them the shoreline.</li> <li>As a back-up option, use a pre-recorded video from the ranger in case skype technology fails.</li> </ul> <p><b>Teacher note:</b> <i>There are several parks with extensive shoreline in Anne Arundel County. They include: Downs Park, Ft. Smallwood Park, Beverly Triton, Annapolis Maritime Museum, Sandy Point, Beverly Triton, JugBay, and Quiet Waters Park.</i></p>	<p>How can we limit the amount of damage caused by human induced waves on the stability of the local ecosystem?</p> <p>Day 8</p> <ul style="list-style-type: none"> <li>Students view images of natural waves along Anne Arundel county shorelines and complete an I See, I Think, I Wonder activity.</li> <li>Students create a model to investigate how waves produced by human activities affect a shoreline. Using a clear, shallow container, students build a shoreline with sand along one end of the container. Then slowly fill the container with water to about 3/4 full to allow room for wave movement. Attach a piece of string around a wooden block then dunk the wooden block into the water a pre-determined number of times. Students observe the waves eroding the sand.</li> <li>Debrief questions - to connect this experiment to what students have learned about the impacts of climate change on weather and water levels:               <ul style="list-style-type: none"> <li>What happened to the beach as a result of wave action?</li> <li>What would happen if the wave energy increased?</li> <li>What do you think would happen if the water level rose?</li> <li>What would happen to the beach if there was a big rainstorm carrying run-off from the land?</li> </ul> </li> </ul>

<ul style="list-style-type: none"> <li>shorelines.</li> <li>Students will independently or with a partner read pages 1-2 of the “What we know: the reality, risks and response to climate change.”</li> <li>Students will then be assigned sections from the “The core science of global warming” section on pages 3-5 and complete a jigsaw activity within their group to investigate climate change. <ul style="list-style-type: none"> <li><a href="https://whatwknow.aas.org/wp-content/uploads/2014/07/whatwknow_website.pdf">https://whatwknow.aas.org/wp-content/uploads/2014/07/whatwknow_website.pdf</a></li> </ul> </li> <li>Student groups will generate a list of human activities that impact climate change</li> </ul>		
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**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
<ul style="list-style-type: none"> <li>Students will observe the NOAA Sea Level Rise Viewer and assess the potential impact that various sea level rise measurements will have on the park shoreline that they mapped out. <ul style="list-style-type: none"> <li><a href="https://coast.noaa.gov/digitalcoast/tools/slr.html">https://coast.noaa.gov/digitalcoast/tools/slr.html</a></li> <li>Complete the Sea level rise viewer activity</li> </ul> </li> <li>Create a timeline that shows how the frequency of flooding in the Annapolis area has changed over the last 50 years</li> <li>Students review <a href="#">the impact of the worldwide shutdown on the environment</a> and summarize the article in a one-pager.</li> </ul>	<p>Students will participate in a field trip to a local waterfront park where they will move through stations:</p> <p>Day 7:</p> <ul style="list-style-type: none"> <li>Station 1: Students assess the park for abiotic and biotic qualities and develop a list of each</li> <li>Station 2: Students identify areas in the park where humans are impacting the environment, sketch the impacts and brainstorm potential causes/solutions</li> <li>Station 3: Students will assess water quality parameters (especially turbidity) to gather additional information about human impact</li> <li>Station 4: Students will engage in a presentation by the park ranger who will summarize the history of land use for the park area</li> <li>Station 5: Students will participate in a hike/scavenger hunt to find examples of different types of shoreline at the park</li> </ul>	<p><i>Day 9 - may have to break into 2 days</i></p> <ul style="list-style-type: none"> <li>Review the experiment from the previous day where we modeled shoreline erosion on an unprotected beach.</li> <li>Students brainstorm different ways that the beach and shoreline could be protected.</li> <li>Review the types of shoreline mitigation techniques students learned about through their webquest/field trip activities</li> <li>Students discuss which of the shoreline mitigation techniques could be best for protecting the shorelines from erosion.</li> <li>Group students based on which shoreline mitigation technique they think is best (you may have to choose groups for behavior reasons and/or to ensure each type of shoreline is represented).</li> <li>Students work in their groups to design and conduct an experiment to replicate their mitigation ideas in their shoreline model and test how effective their technique is at stabilizing the shoreline (Ex:</li> </ul>

	<p><b>If school is unable to go to a park:</b></p> <ul style="list-style-type: none"> <li>● Students assess abiotic and biotic factors around their school yard</li> <li>● Students identify human impacts on the environment near their school and brainstorm potential causes/solutions</li> <li>● Show students the video compilation of the various shorelines <ul style="list-style-type: none"> <li>○ Students map out the features of the shoreline from the video. They will diagram the measurements and the abiotic and biotic features that shape the shoreline.</li> <li>○ Students will take observation notes of human activities that take place in that area</li> </ul> </li> <li>● If possible, the students assess water quality parameters (especially turbidity) water sample from a local waterway to gather additional information about human impact</li> </ul> <p><a href="https://www.dec.ny.gov/docs/permits_ej_operations_pdf/stabiltechguid.pdf">https://www.dec.ny.gov/docs/permits_ej_operations_pdf/stabiltechguid.pdf</a></p>	<p>students can measure how far the “shoreline” migrates with and without mitigation).</p>
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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
<ul style="list-style-type: none"> <li>Students analyze data including DO, Chlorophyll, Temperature, and Salinity from the NOAA Chesapeake Bay buoys located close to their school and/or the Anne Arundel county park they plan to visit and identify the impacts that climate change could have on that data.</li> </ul> <p><a href="https://aamboceanservice.blob.core.windows.net/oceanservice-prod/education/oysters-in-the-chesapeake-bay/middleschool/ms-lesson3.pdf">https://aamboceanservice.blob.core.windows.net/oceanservice-prod/education/oysters-in-the-chesapeake-bay/middleschool/ms-lesson3.pdf</a></p>	<p>Day 8:</p> <ul style="list-style-type: none"> <li>Students will break into groups to summarize the information from their field trips/schoolyard activities with a focus on developing a solution to human impacts on shorelines</li> <li>Students summarize the group data on chart paper and the class participates in a gallery walk followed by the teacher summarizing class data on Google</li> </ul>	<ul style="list-style-type: none"> <li>Students analyze data from their investigation by creating a graph to depict how well their shoreline stayed intact with and without mitigation.</li> <li>Students brainstorm the pros and cons of their chosen mitigation technique in terms of cost, biodiversity/habitat health, visual appeal, and recreational uses.</li> <li>Students present their results to the class so that each group is able to evaluate the effectiveness, the costs, and the benefits of each shoreline mitigation technique.</li> <li>Tell students that some of them will be chosen to act as an advisory board for next year's 7th graders as they move through this project. Survey your classes to gauge student interest.</li> </ul>

### 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
<ul style="list-style-type: none"> <li>Students write a CER about how humans can reduce their impact on climate change.</li> </ul>	<p>Day 9:</p> <ul style="list-style-type: none"> <li>As a class students brainstorm potential solutions to human impacts on the shoreline observed at the park. Students use these ideas to make a claim and to strategize a design solution</li> </ul>	<ul style="list-style-type: none"> <li>Students participate in a philosophical chair debate to present an argument for why their shoreline mitigation technique is best for their designated area in Anne Arundel County.</li> </ul>



## 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 choose which kind(s) of mitigation techniques is/are best for Anne Arundel County's shorelines based on their research and their philosophical chair debate.

### 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.

As a class, students create a project that reflects their choice for best practices for reducing human impact on climate change and shorelines. Possible projects include: Writing letters to local county officials, Creating a PSA, planting a living shoreline, restoring a shoreline, etc.

### 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 answer reflection questions. Since this is a 7th grade project, teachers will be encouraged to have a group of 8th graders that completed the project act as a resource for the new 7th graders. The 8th graders can act in the role of consultants in the project design for the new class.