

Environmental Literacy Model

ENVIRONMENTAL
LITERACY
MODEL ELM



Title	Wicomico River Watershed Project
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Audience (grade, course)	9th Grade Biology and Environmental Science

Curriculum Anchor

Defining the Learning Objectives and Curriculum Connection

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

Notes

Next Generation Science Standards

Performance Expectations

HS-LS2-6. Evaluate claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.

HS-LS2-7

Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.*

HS-ESS2-2 Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.

HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

NGSS Lesson Alignment by Three Dimensions

Science and Engineering Practices

Asking Questions and Defining Problems
Obtaining, Evaluating, and Communicating Information
Developing and Using Models
Planning and Carrying Out Investigations
Analyzing and Interpreting Data
Using Mathematics and Computational Thinking
Engaging in Argument from Evidence
Constructing Explanations and Designing Solutions

Disciplinary Core Ideas

LS2.C: Ecosystem Dynamics, Functioning, and Resilience
LS4.D: Biodiversity and Humans
ESS2.A: Earth Materials and Systems
ESS3.C Human Impacts of Earth Systems

Cross-Cutting Concepts

Stability and Change
Systems and System Models

Environmental Literacy 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.
- 5. Individual and Collective Responses to Environmental Change.** Environmentally literate students construct and apply understanding of individual, collective, and societal responses to human-induced environmental change.

Lesson Objectives:

<p>Students will...</p> <ul style="list-style-type: none"> - Describe the importance of biodiversity in the Wicomico River ecosystem. - Identify factors that affect the biodiversity of the Wicomico River ecosystem using graphs and other evidence. - Identify and describe the relationships between species and the physical environment in an ecosystem. - Investigate the connection between human development, water quality and biodiversity by comparing various ecosystems around Schumaker Pond. - Design a solution that involves reducing the negative effects of human activities on the environment and biodiversity, and that relies on scientific knowledge of the factors affecting changes and stability in biodiversity. - Describe* and quantify (when appropriate) the criteria (amount of reduction of impacts and human activities to be mitigated) and constraints (for example, cost, human needs, and environmental impacts) for the solution to the problem, along with the tradeoffs in the solution. - Evaluate the proposed solution for its impact on overall environmental stability and changes. - Evaluate the cost, safety, and reliability, as well as social, cultural, and environmental impacts, of the proposed solution for a select human activity that is harmful to an ecosystem. 	
<p>Describing the Local Context The life-relevant issue that will serve as the context for learning.</p>	<p>Notes</p>
<p>The Wicomico River flows from Salisbury to the Chesapeake Bay. It winds through urban, suburban and rural areas. Human activity within Wicomico County affects biodiversity within the Wicomico River and Chesapeake Bay watersheds. The students of JMB have a unique perspective on the multiple factors, cultures and pressures affecting the Chesapeake Bay as well as access to resources that could bridge the gap between economic growth and environmental sustainability. The goal of this MWEE is to help students recognize these unique perspectives and the role they can play in protecting this unique ecosystem.</p>	<p>Land Use and Pollution in the Wicomico River</p> <p>Eastern Shore of Maryland From Wikipedia, the free encyclopedia</p> <p>Salisbury city, Maryland</p>

<p>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.</p>	<p>Notes</p>
<p>How has human activity affected the biodiversity of life in the Wicomico River Ecosystem?</p> <p>Investigation 1: What factors affect Biodiversity in the Wicomico Watershed?</p> <p>Supporting Questions:</p> <ol style="list-style-type: none"> 1. How has the biodiversity of the Wicomico river changed over time? 2. Why is biodiversity important? 3. What can people do to maintain or increase biodiversity in the Wicomico River Ecosystem? <p>Investigation 2: What is the relationship between land cover, water quality, and biodiversity?</p> <p>Supporting Questions:</p> <ol style="list-style-type: none"> 1. What are the sources of pollution affecting water quality in the Wicomico River? <ol style="list-style-type: none"> a. Define the sources Nutrients, Sediments, Toxins, Bacteria 2. How has the land around the Wicomico River changed over time? 3. How does land use bring about pollution? 4. How does pollution affect biodiversity <p>Investigation 3: How do changes to the Earth’s surface affect the Wicomico River Ecosystem?</p> <p>Supporting Questions:</p> <ol style="list-style-type: none"> 5. How has the land around the Wicomico River changed over time? 6. How does land use bring about pollution? 	<p>Wicomico Environmental Trust Report - Creekwatchers Data Microsoft Word - 2019Technical_Report.docx (wicomicoenvironment.org)</p>

Environmental Literacy Model

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	Notes
<p>Question:</p> <p>What factors affect Biodiversity in the Wicomico Watershed?</p> <p>Phenomena:</p> <p>Bay 101: Food for Fish in the Chesapeake Bay - https://youtu.be/vqAVbYqJX5A</p>	<p>Question:</p> <p>What is the relationship between land cover, water quality, and biodiversity?</p> <p>Phenomena:</p> <ul style="list-style-type: none"> - Would you swim in this water? - <p>[Video] Schumaker Pond Kayak Trip https://youtu.be/0n_mytbxxvQ</p> <p>[Video] Beaverdam Creek https://youtu.be/aUTPLF-1Ehg</p>	<p>Question:</p> <p>How do changes to the Earth's surface affect the Wicomico River Ecosystem?</p> <p>Phenomena:</p> <p>Schoolyard survey of sources of runoff. https://www.cbf.org/document-library/education-resources/schoolyard-reportcard28aa.pdf</p> <p>[Video] Journey of a raindrop = https://youtu.be/-l4AysHoAE</p> <p>[Video] A Drops Life = https://youtu.be/5Ug1hravb9</p>	<p>Links to Investigation documents:</p> <ul style="list-style-type: none"> • Lesson Plan Document • Investigation 1 Student Handout

		<p>Q</p> <p>[Video] The Watershed Journey of a Raindrop = https://youtu.be/hSpOvhqN34M</p>	
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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	Notes
<p>Students will use multiple artifacts relating to biodiversity in order to identify patterns of change in the level of biodiversity in the Wicomico River ecosystem.</p> <p>Claim: Students will construct a claim that addresses the question “What factors affect Biodiversity in the Wicomico Watershed?” Claims will be collected on a shared class brainstorming board.</p> <p>Evidence:</p> <ul style="list-style-type: none"> Article 1: The Colorful (and DISAPPEARING) World of BAY 	<p>Students will visit the Ward Museum to explore changes to the local watershed and biodiversity over time.</p> <p>Claim: Students will construct a claim that addresses the following question: How does land use affect water quality and biodiversity?</p> <p>Evidence:</p> <p>Activity 1: Sources of Pollution in Wicomico River Watershed</p> <ul style="list-style-type: none"> Activity 1a: Factors that 	<p>Students will investigate how their school impacts the Wicomico River ecosystem.</p> <p>Claim: Students will construct a claim hypothesizing the impact of their individual school on the Wicomico River Watershed.</p> <p>Evidence:</p> <p>Activity 1: Students will complete the “Chesapeake Bay Watershed: Land Use and Stream Health” activity to analyze the relationship</p>	<p>Maryland Watershed Improvement Plan (2019) https://mde.maryland.gov/pr ograms/Water/TMDL/TMDLImplementation/Pages/Phase3WIP.aspx</p>

<p>BIODIVERSITY</p> <p>Strain, Daniel. "Chesapeake Quarterly Volume 12 Number 2: The Colorful (and DISAPPEARING) World of BAY BIODIVERSITY." Chesapeake Quarterly, Maryland Sea Grant, July 2013, www.chesapeakequarterly.net/V12N2/main1/ .</p> <ul style="list-style-type: none"> Article 2: Ecology Disrupted: The Chesapeake Bay Food Webs <p>"Chesapeake Bay Food Web: AMNH." Ecology Disrupted: The Chesapeake Bay, American Museum of Natural History & The City College of New York, 2018, www.amnh.org/learn-teach/curriculum-collections/ecology-disrupted/chesapeake-bay .</p> Article 3: A Living Resource Exhausted: Fishing on the Wicomico <p>Brown, Simon. "A Living Resource Exhausted: Fishing on the Wicomico." Exploring the Chesapeake's Forgotten River: Perspectives on the Wicomico, Michael Lewis; Department of Environmental Studies; Salisbury University, 2002, faculty.salisbury.edu/~mllewis/wicomico_river/chapter_eight.htm.</p> <p>Reasoning: Students will use scientific reasoning to connect the</p>	<p>contribute to pollution in Chesapeake Bay</p> <ul style="list-style-type: none"> Activity 1b: Sources of pollution <p>Optional activities:</p> <p>Water quality Lesson</p> <p>2016 esri Water Quality Report Wicomico River</p> <p>Water Pollution Gizmo</p> <p>Activity 2: Ward Museum Outdoor Experience</p> <p>Pre-lesson: Water Quality Parameters and History of Wicomico River Watershed - conducted by Ward Museum staff in a classroom visit</p> <ul style="list-style-type: none"> How did Schumaker Pond and Beaverdam Creek change over time? Overview of chemical and physical parameters Introduction to macroinvertebrates <p>Station 1 - Schumaker Pond</p> <ul style="list-style-type: none"> ➤ Intro: Human alterations and watershed health 	<p>between human population, land use and water quality.</p> <p>Activity 2: Students will quantify the effect of various surfaces on their schoolyard by conducting a runoff/infiltration investigation. https://docs.google.com/document/d/1XWozuX4YwcETGMxvgEb2zJJS9eFF8LF-T2FZmGbfLg/edit?usp=sharing</p> <p><i>Virtual Alternative: Runoff and drainage investigation</i> https://runoff.modelmywatershed.org/</p> <p>Activity 3: Students will survey their school grounds and what implemented practices are present at our school using the Schoolyard Report card. https://docs.google.com/document/d/1XWozuX4YwcETGMxvgEb2zJJS9eFF8LF-T2FZmGbfLg/edit?usp=sharing</p>	
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<p>evidence gathered from the articles and observations to justify their claim.</p>	<p>predictions</p> <ul style="list-style-type: none"> ➤ Physical assessment ➤ Chemical assessment <p>Station 2 - Beaverdam Creek</p> <ul style="list-style-type: none"> ➤ Physical assessment ➤ Chemical assessment <p>Station 3 - Macroinvertebrates Survey (samples from both sites in Hensen)</p> <p>*Have students complete a feedback/assessment survey via Google Forms for Ward Museum.</p>		
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Environmental Literacy Model

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	Notes
Students will gather evidence by analyzing text and media sources including essays, newspaper articles, model food webs and historical data on oyster and algae populations.	Students will analyze the relationship between biodiversity, land use and water quality by collecting and analyzing macroinvertebrates, water samples and physical assessment. Assessment: Lab Report (data collection, analysis and drawing conclusion)	Students will interpret maps of the Chesapeake Bay watershed and identify patterns. Students will gather data and construct graphs of various land surfaces and their rate of water infiltration. Students will quantify their schoolyard survey using a scaled report card.	

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	Notes
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<p>Students will share CER with class and add factors and solutions to brainstorming tree.</p> <p>OR</p> <p>Students will construct mini-poster presentations to share their CER with their peers in a class gallery walk. The gallery walk will be an opportunity for peers to provide feedback on positives and suggestions for improvement via sticky notes.</p> <p>Students will use CER to develop hypotheses as to the future change or stability of the Wicomico River ecosystem. Students will add hypotheses to the student Brainstorming board.</p>	<p>Students conclude that areas of greater human development contribute to greater runoff pollution; water quality is degraded when these pollutants enter the waterways; the waterways' biodiversity is impacted when these pollutants are introduced into the ecosystem.</p> <p>Students will complete CER from their field trip packet. Students will add evidence from their field trip to the Brainstorming board.</p>	<p>Students will use the Schoolyard Report card to identify areas of improvement and present or send a summary of their findings to the parties of interest, i.e. school green team, admin, grounds crew, etc.</p>	
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Environmental Literacy Model

Stewardship and Civic Action	
<p>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.</p>	<p>Notes</p>
<p>Students will use the 2020 State of the Bay progress report and the 2014 Maryland Milestones report to identify best management practices (BMP) in mitigating human impact on the Wicomico River Watershed.</p> <p>Resources: 2020 State of the Bay --- Maryland Progress https://www.cbf.org/how-we-save-the-bay/chesapeake-clean-water-blueprint/2020-state-of-the-blueprint/marylands-2020-blueprint-for-clean-water.html</p> <p>https://mde.maryland.gov/programs/Water/TMDL/TMDLImplementation/Pages/Maryland_Progress.aspx</p> <p>Maryland Milestones (2014) https://drive.google.com/file/d/1jtGMiQvvvLV3gAUF2P_yCiS5TH9HJgi4/view?usp=sharing https://drive.google.com/file/d/1SJZIQ3mvCXc5rUv5OXkX92S6W5IXMMKm/view?usp=sharing</p> <p>Creekwatchers Data Microsoft Word - 2019Technical_Report.docx (wicomicoenvironment.org)</p> <p>Best Management Practices http://faculty.salisbury.edu/~kssilaphone/MapTour_ChoptankBMPs/index.html# https://docs.google.com/document/d/1F79Np5mpQrGSOSeniC_rC4-jlYzQ0EwtGp9A3o3OXcY/edit or https://docs.google.com/document/d/1WIK01VdWzyOOnB_BUChY2wIFq7JyBxBhou7A9LghcvA/edit?usp=sharing</p> <p>Students will identify community partners and stakeholders involved in their issue investigation.</p>	<p>Drawdown Salisbury Green Team Report card - BMP</p> <p>Mapping the change in Salisbury/Schumaker Pond over time</p>

<p>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.</p>	<p>Notes</p>
<p>Students will work in teams to identify, based on their claim, what Action Plan they would like to focus on in their own community and identify a community partner that they could work with to implement their action plan. This partner could be an expert in the field already working on their identified Best management plan or a partner who would be willing to develop and implement the action plan with the student group. Students will then present their Action Plan to community and school leaders and/or implement their project.</p> <p>Action Plans could include:</p> <ul style="list-style-type: none"> ● Stormwater mitigation on new schoolyard outdoor classroom ● Habitat development of drainage ponds. ● Legislative writing - Letter to a congressman [Link HERE] ● School Public Service announcement - Student created video segment for Morning Announcement ● Youth Community Scholars exhibit at Ward Museum ● Interpretive signage 	
<p>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.</p>	<p>Notes</p>
<p>Students receive feedback via teacher and peer reviews.</p> <p>Students will present their Action Plans to relevant stakeholders.</p> <p>Students will collaborate to make a shared website or database for continued survey and analysis of water quality to measure the impact of any implemented project.</p>	