ENVIRONMENTAL LITERACY MODEL ELM

Environmental Literacy Model

Title	Monarchs for Change (A Species In Trouble - How Our Carbon Footprint is Impacting Monarch Migration)
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School, District	Harford County
Audience (grade, course)	Seventh Grade Life science

Curriculum Anchor

Defining the Learning Objectives and Curriculum Connection

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

MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. [Clarification Statement: Emphasis is on cause and effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.]

MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. [Clarification Statement: Emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems, and on defining the boundaries of the system.] [*Assessment Boundary: Assessment does not include the use of chemical reactions to describe the processes.*]

ELit **STANDARD 4: Populations, Communities, and Ecosystems**

The student will use physical, chemical, biological, and ecological concepts to analyze and explain the interdependence of humans and organisms in populations, communities and ecosystems.

Indicator 2: Analyze the growth or decline of populations and identify a variety of responsible factors.

Notes

ELit **Standard 3: Flow of Matter and Energy** The student will analyze and apply the properties of systems thinking and modeling to the study of Earth's Systems. Indicator 1: Demonstrate that matter cycles through and between living systems and the physical environment, constantly being recombined in different ways.	
Describing the Local Context The issue that will serve as the context for learning. How is the Carbon Footprint of Harford County contributing to Climate Change? How is Climate Change impacting the Life Cycle/ migration patterns of monarch butterflies? The increase in temperature due to climate change is impacting the migration patterns of the monarch butterfly.	Students will be assessing the contribution of expelling and absorbing Carbon dioxide in Harford county as it relates to the migration of Monarchs in the fall.
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) and prompts the development of actionable claims. How are the rising temperatures due to climate change influencing monarch migrations through Harford County?	

Issue Investigation	Notes

Asking Questions, Defining Issues and Problems

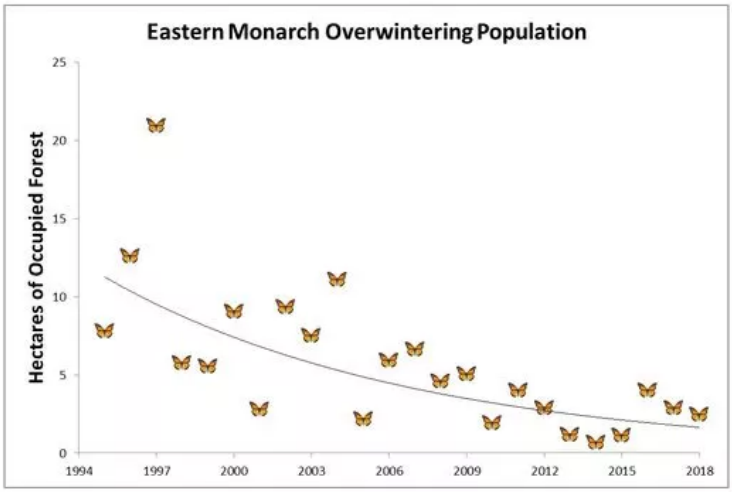
Students define the issue, problem, or phenomenon to be investigated and develop questions that are relevant for investigation.

Lesson 1: Establishing a Phenomenon - Monarch Migration Patterns

To engage students in the issue to be investigated, show the short video in the following link about the journey and struggles of the Monarch from just north of Harford County. Ask students to listen for key interactions between the Monarch and its surroundings. Reinforce how they interact with many facets of the Biosphere on their journey

https://www.yorkdispatch.com/story/life/diet-fitness/blogs/paths-according-to-pav/2016/09/13/monarch-butterflies-start-their-journey-south/90741102/

Next, show the following graph to students. Ask students to explain what is happening and ask for reasons to explain this data. Connect back to the local trek from northern Harford county through to Mexico. Ask if students can identify any issues in the biosphere that might be impacting this pattern? Possible ideas could be pollution, weather, climate change, food source, and habitat.



Finally, direct students to Journey North and allow them to peruse the MAPS of Migrations and Climate data. See if students can infer patterns from the maps to point towards warming temperatures.

- The monarchs will be brought in from an ecology unit focused on their needs for survival
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This will be an ongoing site to be revisited as students refine their knowledge about Climate Change.

Lesson 2: Cycling of Life Sustaining Materials in Earth's Biosphere

1. Once students have identified some interactions between Monarchs and the Biosphere, transition into the cycling of needed materials involved in those interactions such as water, oxygen, nitrogen, and carbon dioxide.
2. Ask students if there ever could be too much of a needed material and what effects could there be on living organisms. Perhaps review the water cycle (as learned in sixth grade) and determine when too much might impact an organism negatively.
3. Investigate the cycling of Carbon by conducting the Carbon Cycle Game showing natural and human impacted systems leading students into identifying the increasing amount of CO2 in the Earth's Biosphere. (5E lesson included) Consensus should be that most Carbon dioxide is in the atmosphere, oceans, and plants.
4. Complete the NASA Climate ACTIVITY Greenhouse Gas and Sink Manipulation lesson. Students will explore basic info about Greenhouse gases and some issues and solutions to the increasing amounts. Students will play a game that will allow them to see how carbon sinks can be manipulated to combat climate change. Ideally after the completion of the Cycle Lesson and the NASA lesson, students will begin to connect Greenhouse gases and Climate change.
5. To connect to the Migration issue, have students read all or teacher selected articles of the resources provided below to complete a CER (claim evidence reasoning) on the negative impacts that occur to organisms due to the excess carbon and other greenhouse gases in the atmosphere

Article Resources:

Climate Basics for Kids
(https://www.c2es.org/content/climate-basics-for-kids/)

EPA Climate Change Effects

https://19january2017snapshot.epa.gov/climate-impacts/climate-impacts-ecosystems_.html

Live Science – Effects of Global Warming https://www.livescience.com/37057-global-warming-effects.html WWF Effects of Climate Change (Has sections describing SPECIES being impacted) https://www.worldwildlife.org/threats/effects-of-climate-change 5. Direct students to the question on Socrative (Go to Socrative.com, create a free teacher account and search for the following quiz - SOC-33607976. Add quiz to your quizzes and launch for your students to access) to vote for which effect they feel may be the one affecting the Monarch Migration Patterns (Revisit discussion from Intro lesson and re-show Graph of decreasing population). Review responses and share data with class. 6. Have an article on how climate change is impacting monarchs and vote again on a poll which impact has the most affect. Possible Articles: https://www.worldwildlife.org/pages/monarch-butterflies-and-climate-change; https://blog.nature.org/science/2016/06/29/species-on-the-move-mapping-barriers-for-wildlife-in-a-warming-world/ https://www.researchgate.net/publication/239790384_Deforestation_and_forest_degradation_in_the_Monarch_Butterfly_Biosphere_Reserve_Mexico_2003-2009 Climate Change May Disrupt Monarch Butterfly Migration https://www.scientificamerican.com/article/climate-change-may-disrupt-monarch-butterfly-migration/ Journey North Information: Biology, migration, and overwintering http://learner.org/jnorth/monarchs Climate information: http://learner.org/jnorth/monarchs/news/fall-2017/092117-warm-fall-slow-migration https://www.learner.org/jnorth/tm/monarch/FallTempsFly.html Monarch Water: Migration, biology, tagging/citizen science http://monarchwatch.org/ World Wildlife Fund – Monarchs and Climate Change https://www.worldwildlife.org/pages/monarch-butterflies-and-climate-change Monarch Joint Venture – Climate Change https://monarchjointventure.org/threats/climate-change	

Possible outdoor education experiences that can be experienced any time after the initial Issue Determination - Preferably after the Carbon Cycle lesson. - Visit an outdoor education center to learn more about citizen science efforts for tagging and releasing monarchs and/or local impacts/solutions to climate change - Have an outdoor education center visit on site and provide an experience on citizen science efforts for tagging and releasing monarchs and/or local impacts/solutions to climate change	

Planning and Conducting Investigations Students develop plans for collecting, analyzing, and communicating information and/or data to help them answer their questions and understand the problem. Students identify and justify appropriate sources of information and/or data, and determine methodologies for the collection of information and/or data. Lesson 3: Greenhouse Gas LAB 1. Conduct the Greenhouse Gas Experiment to see what the impact of excess is on temperature Lesson 4: Monarch Development and Temperature LABS Experiment and analysis of temperature impact on Monarchs a. Using Journey North's "Temperature and Migration in our Hometown" activity, students will investigate how temperature will affect monarch migration in their hometown (https://www.learner.org/jnorth/tm/monarch/FallTempsFly.html) b. Students will conduct an experiment to determine how temperature affects monarch pupae development/emergence https://monarchlab.org/education-and-gardening/ecology-fair/sample-projects/does-temperature-affect-pupae Lesson 5: Human Role in the Carbon Cycle and Climate Change a. Students will view a NASA Climate video and analyze data from the EPA to determine effects humans have on greenhouse gas emissions. b. Students will then be asked to determine if their school is contributing or sequestering and design ways to determine data to answer the question This will ideally lead to the ideas of a school audit to determine the Carbon footprint of the school. This will include another outdoor education experience as students will determine how much the school building and grounds are contributing to excess CO2 in the atmosphere and how much is being absorbed (energy audit/carbon footprint audit) Refer to the School Grounds Audit tool in the materials provided. The following link includes a comprehensive school audit to cover additional topics such as energy and waste.	Details are in the Lesson Folder

https://www.nwf.org/-/media/PDFs/Eco-schools/Climate-Change-Audit_2012_v2_FINAL.ashx?la=en&hash=C0B13ABB278155FFEB23CF52775BFFCC38649DA6	

Analyzing and Interpreting Data Students present and share information and/or data to reveal patterns that indicate relationships. Students apply disciplinary concepts as they analyze and interpret information and/or data to make sense of the issue, problem, or phenomenon. Student teams will analyze the collected data from in class LABS to determine if there is evidence to support the claim that temperatures are rising globally and that it is impacting migration patterns. Additionally, students will analyze the data from the school audit (and potentially include school ground audits of all HC Middle Schools) to determine the local contribution to the temperature increase and migration issue	
Constructing, Communicating, and Refining Explanations Students identify, synthesize, and apply evidence from their investigations (for example, measurements, observations, and patterns) to draw conclusions about the driving question. Students will revisit the Journey North Maps and correlate the LAB and AUDIT data with patterns of migration to establish that the carbon footprint is impacting the climate which in turn impacts migration patterns. This will lead to potential action projects.	

Stewardship and Civic Action	**Notes**
Developing a Claim and Identifying Solutions Students develop a claim based on conclusions drawn in the Issue Investigation. The claim should reflect a problem, challenge, or opportunity that warrants informed action. Students identify and explore solutions to address the problem, challenge, or opportunity reflected in their claim. Students may identify: - Need for more vegetation to increase CO2 absorption and provide habitat - Examples of behavior changes from the school community to decrease CO2 emissions Resource: http://www.youngvoicesonclimatechange.com/youth-climate-videos/	-

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 may think of: - Planting appropriate habitat that also absorbs CO2 (aka butterfly garden) - No Mow Zone - No idling zone - Writing letters to local representatives to prevent or improve local development - Mentor elementary school - Social media (instagram page) - School announcements - Science fair PSA - Partner with high school - Soil/Compost Students will present their plans in a Shark Tank style format. Final project will be determined by evaluations from the presentation.	-
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 share proposals for sustaining or extending the action. Follow up evaluation on the action project conducted. For example: - doing a survey for people who have shut their car engines off before and after signs were put up outside the school - Energy/CO2 emission audit previously conducted to determine any improvements	