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| Local Adaptation of Milkweed – *Monarchs and Their Decline* |
| Introduction |
| This lesson introduces students to the recent population decline of monarch butterflies, including their anatomy, life cycle and migration pattern. Students will interpret a graph showing monarch population decline throughout the last several years. Although students will not be working with monarch butterflies, this provides an interesting segue into common milkweed, the food of choice for monarch caterpillars.  This lesson plan is a component of the *ENGAGE* stage of the 5E Learning Model for the overall curriculum. |
| Objectives |
| After this lesson, students will be able to:   * discuss the monarch life cycle and migration pattern, * interpret a line graph, and * discuss overall trends in monarch population decline.   You may also wish for students to be able to make arguments about why people care about the fate of monarchs (and milkweeds). |
| NGSS Performance Expectations Addressed |
| Standards  Middle School:   * 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.]   High School:   * HS-LS2-1. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. [Clarification Statement: Emphasis is on quantitative analysis and comparison of the relationships among interdependent factors including boundaries, resources, climate, and competition. Examples of mathematical comparisons could include graphs, charts, histograms, and population changes gathered from simulations or historical data sets.] [Assessment Boundary: Assessment does not include deriving mathematical equations to make comparisons.]   Science and Engineering Practices   * Asking Questions and Defining Problems * Analyzing and Interpreting Data   Disciplinary Core Ideas   * LS2.A: Interdependent Relationships in Ecosystems   Crosscutting Concepts   * Patterns * Scale, Proportion and Quantity * Stability and Change |
| Information for Classroom Use |
| Approximate Duration for the Task  30 minutes or half of a class period.  Assumptions  Students should know or be familiar with:   * Components of a line graph such as the x- and y-axis, units, etc.   Teachers should know or be familiar with:   * Definitions of “anthropogenic,” “biotic,” and “abiotic” causes for changes in an ecosystem * Reasons people care about monarch populations. For example, monarch populations are connected to many other organisms, like predators, pollinators, and competitors. Biodiversity in general has value that can’t be linked to any individual organism. The monarch migration is an amazing phenomenon with cultural significance. The monarch decline is related to many complex human problems, and learning to solve one will help us solve others.   Additional Materials Needed   * Computer with internet and projector capabilities * Large sheet of paper or word processing software   Supplementary Resources   * Monarch Joint Venture: <http://monarchjointventure.org/> * Project Monarch Health: <http://monarchhealth.wix.com/monarch> * The University of Minnesota Monarch Lab: <http://monarchlab.org/> * Information about the relationship between milkweeds and monarchs will be highlighted in Lesson 2, but if you’d like to look ahead, you can access it here: <http://monarchlab.org/biology-and-research/biology-and-natural-history/breeding-life-cycle/interactions-with-milkweed/> |
| Classroom Task |
| Context  As the first lesson in this lab curriculum, “Monarchs and their Decline” is intended to engage students. While many of them might have never even heard of milkweed, monarchs are ubiquitous, and their decline has been documented for years. In this section, we focus on the migrating population of monarchs. Although there are non-migrating populations, the monarch migration is a remarkable phenomenon, and the migrating population is at risk. After obtaining the necessary information on monarchs, students can then focus on one of their most important food sources: common milkweed.  Task Components  *ENGAGE*   1. Using either a projector or handouts, show students the “Total Area Occupied by Monarch Colonies at Overwintering Sites in Mexico” graph from the Monarch Joint Venture. 2. Ask students what background information they need to fully understand this graph- possible answers include monarch anatomy, life cycle, and migration patterns.   *EXPLORE*   1. Give students the Lesson 1 Worksheet. 2. Briefly introduce the monarch life cycle, then invite four student volunteers to “act out” the egg, larva (caterpillar), pupa (chrysalis), and butterfly stages. For example, the “egg” student might lie in a ball on the floor; the “chrysalis” student might pretend to hang from the ceiling. 3. Briefly discuss the migration patterns of monarchs with students. Note that not all populations of monarch butterflies migrate. There are populations in California that do not migrate to Mexico and populations in Florida that do not migrate at all. We will focus on the migrating population, because that is the one that appears to be declining, and the risk of extinction of the migrating phenomenon is concerning to conservationists. 4. Now that they have some background knowledge on monarch butterflies, have students discuss the graph in small groups. What is on the x- and y-axes? Why are they important? What trends are apparent?   *EXPLAIN*   1. Define the terms “anthropogenic,” “biotic,” and “abiotic” in the context of factors in an ecosystem that affect organisms.   *ELABORATE*   1. In small groups, have students brainstorm possible reasons for the overall decline in monarch population.   *EVALUATE*   1. Students should share their answers with the class to create a large list of reasons, either on the computer or a large sheet of paper. Separate the possible reasons into “anthropogenic causes,” “biotic causes,” and “abiotic causes.” |
| Alignment and Connections of Task Components to NGSS Performance Expectations |
| Standards  Middle School:   * MS-LS2-1. *This standard is addressed by having students interpret a graph of monarch population decline over time and discuss possible causes, which may include lack of resources.*   High School:   * HS-LS2-1. *This standard is addressed by having students interpret a graph of monarch population decline over time and discuss possible causes, which may include reaching carrying capacity.*   Science and Engineering Practices   * Asking Questions and Defining Problems – *This practice is addressed by having students question possible explanations for monarch population decline.* * Analyzing and Interpreting Data – *This practice is addressed by having students analyze and interpret a line graph depicting monarch population decline over time.*   Disciplinary Core Ideas   * LS2.A: Interdependent Relationships in Ecosystems – *This idea is addressed by having students question what factors in the monarchs’ ecosystem might be to blame for their decline.*   Crosscutting Concepts   * Patterns – *This concept is addressed by having students analyze the graph of monarch population decline over time for trends and patterns.* * Scale, Proportion and Quantity – *This concept is addressed by having students discuss the x- and y-axes of the graph.* * Stability and Change – *This concept is addressed by having students analyze the graph for changes in the trend.* |