

**Lesson 2: How MIGHT lady beetles respond to temperature change ?**

| **Unit: Adaptation and Evolution: Response to Climate Change in Lady Beetles** | **Essential Question: How can lady beetles be used as a model organism to examine responses to temperature change?** | **Duration:** 1 one-hour period |
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| **Foundational Concept for this Lesson:**  A useful, quantifiable trait in lady beetles (otherwise known as lady bugs or ladybird beetles) and their relatives is their natural ability to enter Chill Coma. (Students will learn about this trait in the “Explore” section of this lesson.) Chill coma is a reversible total paralysis; emergence from chill coma can be timed. This measurable parameter is known as Chill Coma Recovery Time (CCRT). The effect of different variables on CCRT can be tested. | | |
| **Performance Expectation(s):** *This lesson builds foundational knowledge in support of:*  HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.  *The lesson also focuses on developing Science and Engineering Practices, including:*   * Asking questions/defining problems * Planning & carrying out investigations * Obtaining, evaluating, and communicating information | | |
| **Learning Targets (Students will be able to…):**   * Develop a baseline understanding of lady beetles as a model organism * Brainstorm ideas in response to teacher questions * Propose additional questions about lady beetles’ response to temperature change * Propose ways of their testing ideas * Predict outcomes of proposed tests | | |
| **Student Evidence:**   * Completed handout (HO 2.1) * Poster (or other student product) with proposed tests and predicted outcomes | | |
| **Materials:**   * [Student Handout #1: Essential Facts and Vocabulary Worksheet, (HO #2.1)](https://docs.google.com/document/d/1C8ERkHxEJidTwqpq57oDnbvGToxdcqLUsljVjQpjsus/edit?usp=sharing) * Student access to the following online resources: * [YouTube: Five Fascinating Facts about Ladybugs](https://www.youtube.com/watch?v=OZCXGxeXj6c&t=2s) * [YouTube: Time Lapse of Lady Beetle Life Cycle](https://www.youtube.com/watch?v=wqddneGYkc4) * [Article: "Ladybug"](http://animals.sandiegozoo.org/animals/ladybug) * Poster materials for “Explore” portion of this lesson, as desired | | |
| **Re-Engage: What have you learned about ways that different organisms respond to climate change?** | | |
| Re-engage students by briefly revisiting and summarizing the Lesson 1 Learning Targets, using interactive technique of choice:   * Demonstrate understanding that climate change involves not only global warming, but also increased weather extremes and seasonal shifts. * Demonstrate understanding of Lesson 1 homework (how some insects survive the winter) | | |
| **Engage/Explain: What are lady beetles, and how do they survive cold winters?** | | |
| Introduce lady beetles and direct students to complete today’s Essential Facts and Vocabulary Worksheet, (Student Handout #1), using the following resources:   * [YouTube: Five Fascinating Facts about Ladybugs](https://www.youtube.com/watch?v=OZCXGxeXj6c&t=2s) * [YouTube: Time Lapse of Lady Beetle Life Cycle](https://www.youtube.com/watch?v=wqddneGYkc4) * [Article: "Ladybug"](http://animals.sandiegozoo.org/animals/ladybug)   Direct students to do additional research to complete the Worksheet. | | |

| **Explore: How could you test lady beetle’s response to temperature shifts?** |
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| Using an interactive technique of choice, invite students to brainstorm answers to the following questions:   * Why might we be using lady beetles as a model organism? * What kind of temperature changes might lady beetles be exposed to, and why? * How might lady beetles respond to temperature shifts? * What might be the selective advantage of the suggested responses?   Based on their discussion and foundational learning, direct students (individually, in pairs, or in small groups) to work individually or in small groups to begin **planning investigations** of lady beetle responses to temperature change (design of experiment and predicted outcome). Students can create a poster (or other product) in response to the following two questions:   * how might lady beetles’ responses to temperature change be tested? * what do you predict will happen? |
| **Explain/Evaluate: Which test(s) will we conduct? What does the data tell us?** |
| Compile proposed experiments.  Honor all suggestions, but narrow them down as appropriate, depending on the degree of inquiry that is planned for Lesson 3.  Options include:   * *High scaffolding/dry lab*:  fully directed analysis of provided data. * *Medium scaffolding/wet lab:*  teacher-directed experimental protocol; analysis of wet lab data. * *Low scaffolding/wet lab:* student-planned and conducted experimental protocol(s); analysis of wet lab data. |