MOSA MACK SCIENCE

Adaptations Lesson 1: "The Solve"

Educator's Resource Guide

The Solve contains two mini lessons: The live video lesson and the animation lesson. For the most comprehensive learning experience, conduct both. If you're short on time, choose one. Which lesson?

- For a more structured lesson, choose the animation (the lesson below).
- For a more inquiry-based lesson, choose the live video lesson and assign the animation for homework.

Objective:

In The Solve, students will:

1. Solve a mystery that demonstrates how adaptations occur over time.
2. Create a mind map to explore relationships among complex Adaptations vocabulary.
3. Communicate understanding that individuals with the traits that best fit the environment in which they live will be naturally selected for (ex: camouflage from predators, increased reproductive capacity, and survival in climate conditions), and as these individuals survive and reproduce, that adaptation will become more prominent in the population after a long period of time.

Time Required: 45-80 minutes

Materials Required	Safety Considerations	Science & Engineering Practices
• Student Guide (*includes student agenda and vocabulary handout)* • Adaptations Episode • Computer with speakers • Scissors • Glue or Tape	None	• Developing and Using Models • Constructing Explanations or Arguments From Evidence

Episode Description:

Caroline, a uniquely grey-winged moth, is frustrated with being the only grey moth amongst all her white-winged friends. Her great-great-grandfather always said there used to be tons of grey-winged moths in his day, so she calls on Mosa to help her figure out why there aren't that many now. To solve the mystery, Mosa and her team go back in time and find out that Caroline's great-great-grandfather lived during the Industrial Revolution, a time when the soot from coal factories turned tree bark dark. After seeing a robin swoop down and eat the very visible white-winged moths off the tree bark, Mosa thinks she has solved Caroline's mystery.

Inquiry Scale: Leveling Information

The Solve can be completed in various settings, including presentation-style, small groups, or individually. In the case of a flipped or blended classroom, it can be completed entirely at home.

Level 1: Most teacher-driven (*recommended for grades 4–5)*

View the animated mystery twice: once in full, and a second time along with the discussion questions, pausing the video as needed to answer the episode questions as a group. Project and complete the Mind Map as a class-wide activity. This can be done digitally or on paper. Have students informally quiz each other on the vocabulary until you feel they're familiar with the terms. Use the discussion questions at the bottom of the Mind Map to have a group discussion. Finally, have students complete the quiz digitally or on paper as an exit ticket.

Level 2 (*recommended for grades 5–6)*

View the animated mystery in full. Afterwards, have students work through the episode questions to the best of their ability in small groups. Play the mystery a second time, pausing the video to discuss each question. Direct students to complete the Mind Map in small groups, either digitally or on paper. Come back as a class to review correct answers, as needed. Have students informally quiz each other on the vocabulary until you feel they're familiar with the terms. Use the discussion questions at the bottom of the Mind Map to have a group discussion. Finally, have students complete the quiz digitally or on paper as an exit ticket.

Level 3 (*recommended for grades 6–7)*

Provide students with their student URL and have students view the animated mystery in small groups. Have students play the animated mystery once in full and then answer episode questions in their table groups to the best of their ability. Then, as a class, project the mystery, pausing, as needed, to discuss episode questions in a think-pair-share format. Have students complete the Mind Map in table groups, either digitally or on paper. Have students quiz each other on the vocabulary until you feel they're familiar with the terms. In table groups, have students go through the discussion questions on their own, and review answers as a class. Finally, have students complete the quiz digitally or on paper as an exit ticket.

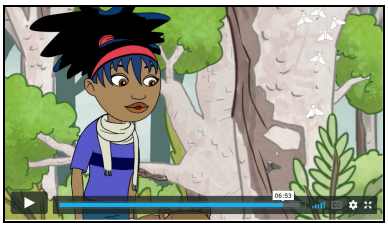
Level 4 *(recommended for grades 7–8)*

Provide students with their student URL and have students view the animated mystery and complete episode questions in pairs. Have students review their answers with a neighboring table group. Have students complete the Mind Map in pairs, either digitally or on paper. Have students quiz each other on the vocabulary until they feel they're familiar with the terms. Have these same pairs go through the discussion questions. Finally, have students complete the quiz digitally or on paper as an exit ticket.

Agenda

I. Solve the Adaptations Video Mystery (20 minutes)
Differentiation Tip: The Video Mystery can be viewed as a class, in small groups, individually, or completed for homework. For additional support, students can view the episode twice: once before completing the questions and once with teacher guidance, pausing the video to discuss each answer.

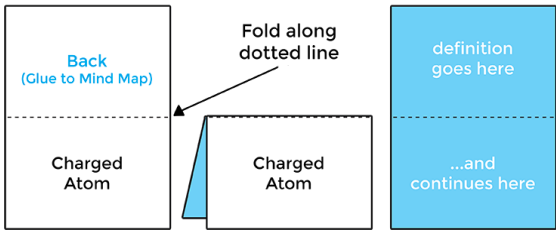
1. Play the animated Mosa Mack Mystery on Adaptations.
2. Students answer questions either digitally on the Mosa Mack platform or on paper in the Student Guide as they watch. Encourage students to cite the specific time codes in the episode to promote writing with supporting evidence. Answers can be found in the key below.
3. View the answer video to confirm student understanding.



II. Vocabulary Mind Map Activity (15–45 minutes)
Differentiation Tip: The Mind Map can be done as a class, in small groups, individually, or completed for homework. It can be done digitally or on paper.

1. Students may complete the Mind Map **digitally**. Follow directions below. (15 minutes)
    a. Go to https://mosamack.com/home/adaptation
    b. Select **Lesson 1: *The Solve***.
    c. Select **Vocabulary** and complete **Part 1:** matching terms with definitions.
    d. Complete **Part 2:** matching terms and definitions with images on a diagram.

2. To complete the Mind Map **on paper**, follow the directions below (45 minutes).
    a. Print and pass out the Student Guide: Adaptations Lesson 1: *The Solve*.
    b. Introduce the warm up task: students will be making a Mind Map of the vocabulary for this Adaptations unit.
    c. Model the directions carefully, emphasizing the following. Students should:
        - **cut** out the vocabulary cards on the solid lines only
        - **fold** the cards at the dotted lines
        - write the definition of the term on the inside of the card using definitions provided



    d. Students use the clues from the Mind Map images, definitions, and terms to place the cards in the correct location in the Mind Map.

e. Check that the students have matched their cards correctly before moving on.
f. Students use glue or double-sided tape to connect the back of the vocabulary card to the correct place on the Mind Map.
g. Students discuss the questions with their group or as a class when they have completed the Mind Map.

Teacher Tips:

- Since this is the first time many of the students will have seen these vocabulary terms, have students work together to use the images, definitions, and collaborative thinking to figure out where the terms go.
- Check in on student groups throughout this process. When you see students or groups who have placed their card in the correct place, ask a facilitating question such as, "Why do you think that term goes there?" or, "What evidence leads you to believe that term goes there?" When students explain their thinking, this is a great opportunity to provide positive reinforcement. Then, encourage them to share their reasoning to the class or to other groups who may have trouble identifying the location of that specific term.
- If you do not have access to a color printer, provide students with black and white copies and project the colored Mind Map at the front of the room so that students can reference both images.

III. Exit Ticket: Check for Understanding (10–15 minutes)

Differentiation Tip: This can be done in groups, pairs, individually, or more formally as a quiz online.

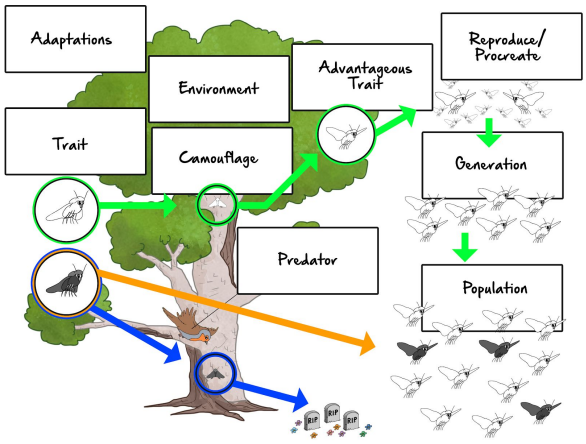
1. Students complete the exit ticket to check for understanding. This can be done online by selecting the **Quiz** button in Lesson 1 or on paper in the Student Guide. Answers are in the Answer Key section below.

Answer Key

Discussion Question

1. In the mind map, what happens to the moth that gets seen by the predator? What happens to the moth that camouflages? *The moth that gets seen by the bird predator gets eaten and dies. The moth that camouflages survives and reproduces,*
2. What is the difference between a "trait" and an "advantageous trait"? *A trait is just a characteristic, while an advantageous is a characteristic that helps the organism survive and reproduce.*
3. Make a prediction: Why do you think the population of moths has more white moths than black moths? *There are more white moths because they camouflage into the tree, survive, and pass on their genes. The black moths, however, are seen by birds and are eaten, so they don't pass on their genes.*

Mind Map



Episode Questions

1. What makes Caroline so different from her friends? (0:30) *She has dark wings instead of light wings.*
2. What mystery does Caroline call on Mosa to help her solve? (1:00) *She wants to know why more moths don't have dark wings like her.*
3. Describe what the environment looks like in 1890. What does Marvin say is causing this horrible air and turning the tree bark black? (2:29) *The air is much more polluted because this is the time of the Industrial Revolution, when factories use coal for energy. There is soot in the air and on the trees. The soot kills the white lichen and turns the tree bark black.*
4. Why does the robin eat only the two white moths out of all the moths on the tree? (3:32) *Those are the two moths that are most visible on the dark bark.*
5. What does Mosa mean when she describes Marvin's dark wings as an "advantageous" trait? (3:47) *His dark wings are advantageous because they allow him to camouflage against the background of the dark bark and not be seen by predators. This makes the trait advantageous for survival.*
6. Why is Marvin more likely to mate with other dark-winged moths? (4:17) *There are more dark-winged moths for him to mate with, so he is more likely to mate with a dark-winged moth.*
7. When Mosa returns to the present, what does she notice is different than in 1890? (6:00) *The air is much cleaner and the tree bark is white.*

8. Solve the mystery: Why are there so many light-winged moths now when there used to be so many dark-winged moths in 1890? (6:50) *During the Industrial Revolution, having dark wings was advantageous because dark-winged moths could camouflage against the dark tree bark. This means that it was harder for their predators to find them. But now, since the air is clean and the tree bark is light, light wings are advantageous.*

Quiz Answers

1. What is another word for a characteristic that an organism has?
   a. Gene
   b. Survival
   c. Generation
   d. Trait
2. Fill in the blank: A gene that helps an animal survive and _____ will get passed onto offspring.
   a. Generate
   b. Produce
   c. Reproduce
   d. Thrive
3. An advantageous trait that becomes more common in a population is also known as a _____.
   a. Trait
   b. Adaptation
   c. Gene
   d. Survival Strategy
4. What advantageous trait helped moths survive in 1890 during the Industrial Revolution?
   a. Flight
   b. Light Wings
   c. Attraction to Light
   d. Dark Wings
5. In the episode, the bird sees the dark moths against the white bark but leaves most of the white moths there. What is it called when organisms blend into their environment?
   a. Sexual Selection
   b. Camouflage
   c. Feeding Adaptations
   d. Predation
6. The Mountain hare is made up of mostly white-furred hares with only a few dark-furred hares because they rely on snow for protection during the winter time. Due to global warming, there has been a decrease in snowfall, rarely leaving any snow on the ground. How do you think this might affect the population of Mountain hares?
   a. They will all remain with the same color fur.
   b. With less snowfall, all white-furred hares will die because all are now visible by predators.
   c. There will be more dark-furred hares because those hares survive longer in their dry environment to pass on their dark fur genes to their offspring.
   d. All hares will migrate to another area.