

Evidence of Evolution Lesson 1: *The Solve* Educator’s Resource Guide

Objective

In *The Solve*, students will:

1. Solve a mystery that demonstrates the three major categories of evidence (fossil evidence, embryological evidence and anatomical similarities) supporting the theory of Evolution.
2. Create a Mind Map to explore relationships among complex Evolution vocabulary.
3. Communicate understanding that all species are related and share similar features due to sharing a common ancestor.

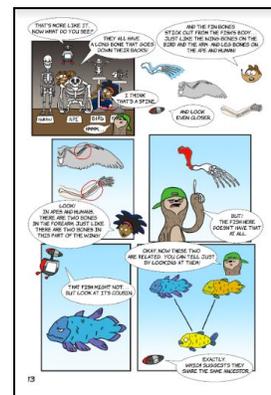
Time Required: 40-75 minutes

| Materials Required | Safety Considerations | Science & Engineering Practices |
|---|-----------------------|---|
| <ul style="list-style-type: none"> ● Student Guide (<i>includes student agenda and Mind Map</i>) ● Evolution Mystery: Comic or Video Format ● Scissors ● Glue or tape | None | <ul style="list-style-type: none"> ● Developing and using models ● Constructing explanations or arguments from evidence |

Episode Description

Evie Loo, a famous popstar, has made headline news by publicly announcing the “family” recipients of her fortune who have been written into her Will! The only problem is, her “family” includes an orangutan, a bird, and a fish. The lawyers are outraged and claim that Evie cannot leave her fortune to “family” who are not related to her in any way.

Mosa is called to the scene for help. She searches for clues to help prove how Pongo, P-Jon, and Lil’ Swimmy are related to Evie Loo in order to validate Evie’s Will. Through an extensive exploration and analysis of evidence held within the Natural History Wing of Evie Loo’s mansion, Mosa and her crew are able to link fossil evidence, embryology evidence, and comparative anatomy findings to prove how all species are technically “family” and share a common ancestor.



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.

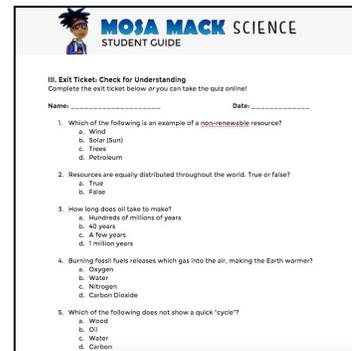
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1. Read/watch the Mosa Mack Mystery on Evolution.
2. Students answer the questions in their Student Guide as they read/watch. Encourage students to cite the specific page numbers/time codes in the Comic Mystery to promote writing with supporting evidence. Answers can be found in the key below.

II. Vocabulary Mind Map Activity (15–45 minutes)

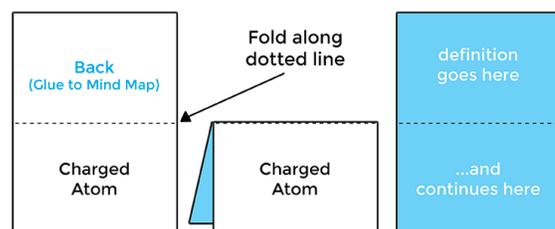
Differentiation Tip: The Mind Map can be done as a class, in small groups, individually, or completed for homework.

1. Students may complete the Mind Map **digitally**. Follow directions below. (15 minutes)
 - a. Go to <https://mosamack.com/home/evidence-of-evolution>
 - 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: Evolution Lesson 1: *The Solve*.
 - b. Introduce the warm up task: students will be making a Mind Map of the vocabulary for this Evolution 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.

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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 through this process. When you see a student or group who has placed a 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 students 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 version of the 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 key below.

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Answer Key

Mind Map Discussion Questions

- a. What similarities do you notice between the embryos shown in the embryo exhibit?

Answers may vary but could include the following: Similarities between the embryos in the exhibit include the presence of a "tail," limb buds, common head structure, and formation of a spine.

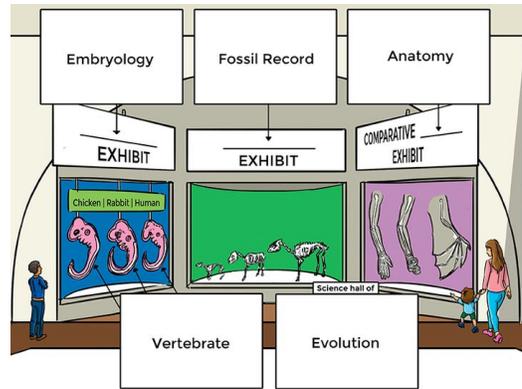
- b. View the Horse Development exhibit on your Mind Map. What can we learn about an organism by examining its fossil record?

Answer: By examining the fossil record of an organism, we can study how the organism changed over time in size and structure.

- c. What can we learn by examining and comparing the anatomy between a human arm, cat leg, and bat wing?

Answer: By studying and comparing the anatomy of each species, we can learn that the species have similar bone structures. However, each species may use these bones in slightly different ways.

Mind Map



Episode Questions

1. At the beginning of this comic, what are Evie's animals arguing about?

Answer: Evie's animals are arguing about who is Evie's family and who should inherit her fortune. (page 1)

2. Why does Evie state that P-Jon (bird), Pongo (orangutan), and Lil' Swimmy (fish) are family? *Answer: Evie states that every species is technically family because all species come from the same ancestor no matter how much they have changed over time. (page 2)*

3. Why does the lawyer believe that he will inherit Evie's fortune?

Answer: The lawyer believes that it cannot be proved that the animals are related to Evie or each other, and therefore, he will inherit Evie's fortune since he is human. (page 2)

4. What three pieces of evidence does Evie want Mosa and her team to explore?

Answer: Evie directs Mosa and her team towards the Natural History wing of her mansion in order to study embryos, fossils, and anatomy to prove how all species are related. (page 3)

5. How did studying the embryos of Pongo, P-Jon, and Lil' Swimmy reveal that they may be related? *Answer: Mosa discovered that all embryos start by looking like "roundish blobs" no matter the species. The embryos grow and their bodies form into sections and grow limbs, which makes early embryonic development appear similar, suggesting that they may share a common ancestor. (page 5)*

6. Describe the fossil record uncovered by Mosa and her crew from the simplest form of life to the most complex.

Answer: The fossil record begins with early forms of life that were only one cell in size and did not contain a nucleus. Next came moss and algae, then plants with leaves and flowers, and then animals. (page 7)

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7. When Mosa and her crew were studying the fossil record, there was a period of time when there was a massive extinction. As explained by Evie Loo's Robotic Fossil Expert, what were the factors that led to a large extinction of life?

Answer: The Robotic Fossil Expert explained that changes in the climate and environment meant that lots of species could not survive, leading to a massive extinction. (page 8)

8. How are mutations essential to the process of evolution?

Answer: Mutations help to create new traits in organisms. If a new trait is advantageous to survival and reproduction, a creature will be more fit for the environment and pass this trait onto its offspring. Over millions of years, the new traits cause such differences that the organism evolves into a new species. (page 9)

9. Based on the fossil record, place the following categories of animals in order from oldest to youngest: Amphibians, Birds, Reptiles, Fish, Mammals.

Answer: According to the fossil record, the order in which the species evolved from oldest to youngest is as follows: Fish, Amphibians, Reptiles, Birds, Mammals. (page 11)

10. What clues in the anatomy of species help to prove that all species evolved from a common ancestor?

Answer: If different species have the same structure, that is a clue that they evolved from the same ancestor. For example, when comparing the human, ape, bird, and fish, one can see that they all have a spine. By comparing the "arms" of these species (fins in fish, wings in birds), common bones and a similar arrangement of bones in the limb structure can be observed as well. (pages 13-14)

11. What did Mosa figure out in order to prove that all species are related? *Hint: What three pieces of information did she use to support her conclusion?*

Answer: After examining the evidence kept in Evie Loo's Natural History Wing, Mosa discovered three key pieces of evidence that connect all vertebrate species. First, by placing fossils in order from oldest to youngest, she could determine how species slowly evolved over time due to mutations and environmental change. Mosa also discovered that there are many similarities in vertebrate embryos that would suggest that they share a common ancestor. Last, Mosa discovered that there are many anatomical similarities between vertebrates by studying the bone structure of limbs in a variety of animals. All of these pieces of evidence suggest that species are related and share a common ancestor. (Answer Comic)

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Quiz:

- Evolution is best described as:
 - A sudden and massive loss of species on the planet due to climate change
 - A harmful mutation in a species
 - The gradual change and development of species over time, arising from a common ancestor**
 - The fossil record of vertebrate development
- True** or False: Changes in species happen gradually, over millions and millions of years.
- When comparing the embryos of a bird and a fish, the embryos have similar looking _____ that eventually turn into fins on a fish and wings on a bird.
 - Eyes
 - Tails
 - Backbones
 - Limbs**
- When creatures have *similar traits*, this is a clue that they are _____.
 - Related**
 - Different
 - Identical
 - Extinct
- Which of the following statements best describes how the fossil record shows evidence for evolution?
 - The fossil record shows the remains or traces of ancient life forms
 - Fossils exist all over the world
 - When an animal dies, its body can be covered up and preserved by layers of rock and earth, forming a fossil
 - By studying, dating, and analyzing fossils, we can learn how living creatures changed over time**
- When comparing anatomical similarities between species, you would compare which of the following:
 - Skeletal structures**
 - Digestive systems
 - Fossil records
 - Fur thickness and color
- Which piece of evidence is NOT studied to prove how species evolved over time?
 - Anatomy
 - Fossil record
 - Embryology
 - Hair color**