Objective:
In the Solve, students will:
1. create a mind map to explore relationships among complex genetic vocabulary.
2. solve a mystery involving asexual vs. sexual reproduction and communicate their findings.

Time Required: 80 minutes

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<th>Materials Required</th>
<th>Safety Considerations</th>
<th>Science &amp; Engineering Practices</th>
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| • Student Guide (*includes student agenda and vocabulary handout*)
  • Genetic Variation Episode
  • Computer with speakers
  • Scissors
  • Glue or Tape | None | • Developing and Using Models
  • Constructing Explanations or Arguments From Evidence |

Episode Description:
When algae accuse two frogs of lying about being siblings, Mosa is called to the scene. How can these frogs *possibly* be related if they look so different from one another? Mosa and her team observe the algae colony and the frog family at the genetic level to discover crucial differences in reproduction that may explain why the frog siblings look so different while the algae look exactly alike. Now, when it comes time to find the frogs’ father, it’s up to the students to select the correct one based on Mosa’s findings!
Inquiry Scale:
“The Solve” can be completed in various settings including presentation-style, small groups, individually or, in the case of a flipped or blended classroom, can be completed entirely at home.

**Level 1: (recommended for grades 4-5)**
Project and complete the vocabulary handout as a class-wide activity. 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 vocabulary chart to have a group discussion. Then, 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 questions as a group. Finally, have students complete the quiz online or on paper as an exit ticket.

**Level 2: (recommended for grades 5-6)**
Direct students to complete the vocabulary chart in small groups, coming 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 vocabulary chart to have a group discussion. Then, view the animated mystery in full. Afterwards, have students work through the questions to the best of their ability in small groups. Play the mystery a second time, pausing the video for each question to discuss. Finally, have students complete the quiz online or on paper as an exit ticket.

**Level 3: (recommended for grades 6-7)**
Have students complete the vocabulary chart in table groups and quiz each other until you feel they’re familiar with the vocabulary. In table groups, have students go through the discussion questions on their own and review answers as a class. 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 questions in their table groups to the best of their ability. Then, as a class, project the mystery pausing as needed to discuss questions in a think-pair-share format. Finally, have students complete the quiz online or on paper as an exit ticket.

**Level 4: (recommended for grades 7-8)**
Have students complete the vocabulary chart in pairs and quiz each other until they feel they’re familiar with the terms. Have these same pairs go through the discussion questions in partners. Provide students with their student URL and have students view the animated mystery and complete discussion questions in pairs. Have students review their answers with a neighboring table group. Finally, have students complete the quiz online or on paper as an exit ticket.
Agenda

I. Warm Up: Vocabulary Mind Map (45 minutes)
Differentiation Tip: The Mind Map can be done as a class, in small groups, individually, or completed for homework.

1. Print and pass out the Solve: Student Guide for Genetic Variation.
2. Introduce the warm up task: students will be making a mind map of the vocabulary for this genetic variation unit.
3. Model the directions carefully, emphasizing the following. Students should:
   - only cut on solid lines.
   - fold on the dotted lines.
   - **not** glue down their whole card, but instead make flaps over each picture.
   - check that they have matched their cards correctly before moving on to gluing or taping.
4. Students use glue, scissors, and vocabulary to create a Genetic Variation Vocabulary Mind Map. (Answer guide above)
5. Discuss the questions with their group when they are complete.

II. Solve the Genetic Variation 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 Genetic Variation.
2. Students fill out questions on student handout 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.
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.

Students complete the exit ticket to check for understanding. This can be done online by selecting this "Quiz" button or on paper in the student worksheet. Answers are in the key below.

Answer Key

Episode Questions

1. Why does the algae think that Paulie and Nicole are not siblings? (1:15) Because they have different physical traits or are not identical.

2. Where do traits come from? (2:15) Chromosomes or DNA

3. There are sections of DNA called genes. What do genes do? (2:25) Genes direct how the body makes proteins, to give it a certain color or shape, or a way of behaving

4. How do the algae make babies? (2:54) They replicate or reproduce, splitting their cells to form more cells

5. What does the chromosome suggest as one reason why the frogs look different? (3:30) A mutation, or a typo, occurred in the DNA, making them look different

6. When Mosa and her team zoom in on Rose’s eggs, what do they notice is different than the reproduction of the algae? (6:45) Genes are coming from two different sources, mother and father, and swap some genes. At 5:50, a frog sperm cell is shown fertilizing a frog egg cell (Emphasize that this sperm came from a male frog).

7. Why do the algae all look identical while the frogs look different? (Answer Video) Algae reproduce asexually, meaning all the mother’s genes are passed on to the child. Frogs reproduce sexually, meaning that the frog offspring get a mix of genes from both mother and father

8. Help Mosa solve the mystery. Which Frog did Mosa pick and why? (Answer Video) Frog #3 because that father frog had all the traits that the children had and the mother did not have.

Tip: Explain to students that the frogs have traits that are made up of a combination of their moms and dads genes. Frogs, like all organisms that reproduce sexually, get one allele from each parent.
Exit Ticket

1. What is the term for a sequence of DNA that codes for a certain protein?
   a. Chromosome
   b. Trait
   c. Gene
   d. DNA

2. The Volvox algae all look identical. What type of reproduction do they do?
   a. Asexual
   b. Sexual
   c. Individual
   d. Combined

3. Genetic variation describes offspring that have different traits, such as Paulie and Nicole. Offspring with different traits must be a result of:
   a. Asexual reproduction
   b. Sexual Reproduction

4. Why do Paulie and Nicole have so many different traits?
   a. Paulie got more DNA from their mom, while Nicole got more DNA from their dad.
   b. Paulie and Nicole both got half their DNA from mom and half from dad, but they got different genetic combinations.
   c. Paulie and Nicole are not actually related.
   d. Paulie’s DNA has a lot of mutations, which are very common.

5. What is another reason for genetic variation besides sexual reproduction?
   a. Partial mating
   b. Asexual reproduction
   c. Unequal chromosome distribution
   d. Mutation