Electricity Lesson 1: *The Solve*
Educator's Resource Guide

Objective
In *The Solve*, students will:

1. Solve a mystery of how to generate more electricity for a stronger light bulb.
2. Create a Mind Map to explore relationships among complex Electricity vocabulary words.
3. Communicate understanding that electricity is generated when electrons move from a negative charge toward a positive charge.
4. Communicate understanding that generators help to generate stronger electricity.

Time Required: 40-75 minutes

Materials Required	Safety Considerations	Science & Engineering Practices
• Student Guide (*includes student agenda and Mind Map)* • Electricity Comic Mystery • Scissors • Glue or tape	None	• Developing and using models • Constructing explanations or arguments from evidence

Electricity Comic Mystery Description

When Mosa and her team get caught in a sudden storm, they seek refuge in a nearby electrical station. Here they meet an electrical engineer and his pet, Eddie the Eel. Little do they know that what they learn about electricity from this engineer will soon come in handy!

Within minutes of a sudden blackout, Mosa gets a call from Jessie, who is having trouble getting the light bulb in her model skyscraper to light up. Utilizing what they learned from the electrical engineer, Mosa and her team help Jessie use the materials she has to generate and conduct electricity to her light bulb. But when the light bulb still won't shine bright enough, they have to turn to their electrical engineer for some help once again.

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 Electricity Mosa Mack Mystery (20 minutes)

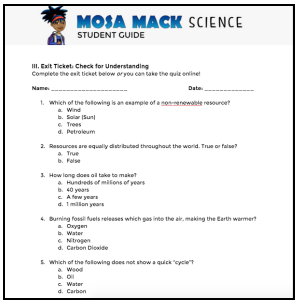
Differentiation Tip: The comic book and motion comic video can be read/watched as a class, in small groups, individually, or completed for homework. For additional support, students can read or watch the comic/episode twice: once before completing the questions, and once with teacher guidance, pausing to discuss each answer.

1. Read/watch the Mosa Mack Mystery on Electricity.
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.

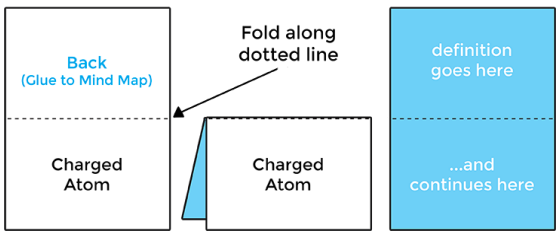
II. Vocabulary Mind Map Activity (15–45 minutes)

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/electricity
    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: Electricity Lesson 1: *The Solve*.
    b. Introduce the warm up task: students will be making a Mind Map of the vocabulary for this Electricity 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 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.

Answer Key

<u>Mind Map</u>

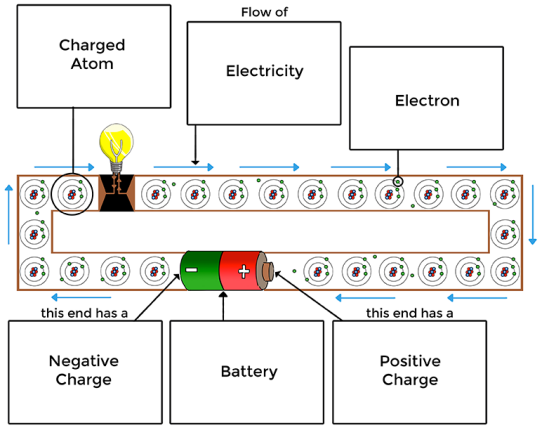
<u>Electricity Comic Mystery Questions</u>

1. What do lightning and Eddie the Eel have in common? (Page 2)

They both generate electricity.

2. When the number of electrons and protons in an atom are equal, they balance each other out and the atom has no charge. This is not what we want for electricity. What do we need to generate electricity? (Page 2)

We want negative electrons to move from one atom to another. That gives us a charge!



3. In which direction do electrons always move? What does this generate? (Page 3)
Electrons always move from where there's an excess of electrons (area of negative charge) to an area of fewer electrons (area of relative positive charge), or from negative to positive. This movement creates electric current, which we call electricity.
4. How does a battery work? (Page 4)
A battery has a negative end filled with an excess of electrons, a more positive end filled with fewer electrons, and a separator in the middle to prevent the electrons from moving toward each other.
5. What solution does Mosa propose to Jessie? (Page 5)
Instead of just hooking up the wire from the negative end of the battery to the light bulb, put a copper wire <u>through</u> the light bulb and connect it back to the positive end of the battery. This creates a closed circuit so electrons can move back into the battery.
6. Describe or draw a labeled diagram explaining electric current. (Page 6)
Inside a wire, electrons bump into each other and the charge passes along them creating energy. In other words, the electric current is the charge carried by the electrons.
7. How does a generator work, according to the electrical engineer? (Pages 7-8)
There is a copper wire going around and around a magnet that is moving back and forth. Within the copper wire electrons move toward the magnet from negative to positive. As electrons move, this creates electricity.
8. What is the result of a larger generator? (Page 8)
If the generator is larger, there are more electrons moving and thus more electricity.
9. What did Mosa figure out? How can she help Jessie make her light bulb brighter? (Answer Comic)
Jessie can add a stronger electric current generator, such as a larger battery, to increase the amount of electric current to the light bulb.

Quiz:

1. If there are more electrons than protons, it creates a/an:
    a. Positive charge
    b. Neutral charge
    c. Negative charge
    d. Electrical charge

2. True or false? Electrons always move from an area with a negative charge to an area with a positive charge.
    a. True
    b. False

3. An electric current involves energy moving along which of the following particles?
    a. Protons
    b. Electrons
    c. Electricity
    d. Neutrons

4. Which of the following would be a good medium to transfer electric current from one place to another?
    a. Protons
    b. Neutral atoms
    c. Separator
    d. Copper wire

5. Fill in the blanks: The _____ the generator, the _____ electricity is produced.
    a. Smaller; more
    b. Larger; more
    c. Larger; less

6. Fill in the blanks: The _____ the battery, the _____ electricity is produced.
    a. Smaller; less
    b. Larger; less
    c. Smaller; more
7. Which of the following is not a part that helps generate or conduct electricity?
    a. Magnet
    b. Battery
    c. Generator
    d. Copper wire
    e. All of the above help generate or conduct electricity