

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

Objective

In The Solve, students will:

- 1. Solve a mystery that demonstrates gravity as a force that directs objects down toward the earth.
- 2. Create a Mind Map to explore relationships among complex Gravity vocabulary words.
- 3. Communicate understanding that gravitational forces lead to various predictable phenomena on Earth.

Time Required: 40-75 minutes

Materials Required	Safety Considerations	Science & Engineering Practices
 Student Guide (<i>includes</i> student agenda and Mind Map) Gravity Episode Computer with speakers Scissors Glue or tape 	None	 Developing and using models Constructing explanations or arguments from evidence

Mosa Mack Episode Description

When Billy and Dullis share their summer vacation videos, they realize that gravity was responsible for their summer highlights: Billy was a first-time skydiver and Dullis was the laughing stock of the forest when he fell from a high tree. But Mosa's summer vacation video shows something odd. Upon her return from bowling, she rested her ball at the edge of a hill. When her



video camera captures her ball rolling *uphill*, Mosa and the crew have to investigate the cause behind this virtual illusion.

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 Gravity 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 Gravity.
- 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/gravity
 - 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: Gravity Lesson 1: *The Solve*.
 - b. Introduce the warm up task: students will be making a Mind Map of the vocabulary for this Gravity unit.
 - c. Model the directions carefully, emphasizing the following. Students should:
 - **cut** out the vocabulary cards on the <u>solid</u> lines only
 - **fold** the cards at the <u>dotted</u> 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.

 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

Mind Map Discussion Questions

- a. How are the terms *force* and *gravity* related? Gravity is a type of force. It is a downward force that pulls objects toward Earth's center.
- How can air resistance change the way gravity acts on an object?
 Air resistance is the opposing force that counteracts gravity and slows objects that are accelerating.
- c. Try to use the following terms together in one sentence: gravity, force, Earth.
 Answers will vary. Potential answer includes:
 "Gravity is a downward force that pulls objects toward Earth's center."



Episode Questions

1. What does Billy think is the reason he heads toward the ground when skydiving? (0:45 - 0:55) *Someone pushes him toward the ground.*

2. Mosa gives an alternate explanation: gravity. How is gravity defined? (0:57 - 1:30)

Gravity is a force exhibited by the earth that pulls you toward it.

3. Why wasn't Billy hurt when he hit the ground while skydiving? (1:42 - 2:00)

He was wearing a parachute, which provides air resistance to slow him down.

4. Gravity is acting on Dullis, even when he is holding onto the tree. What do you think would happen if there was no gravity?

He would float away!

5. Gravity acts on everything! Describe the three examples that are shown in the video. (3:35 - 3:58) *Examples include: When a frog jumps, gravity pulls it back down. Gravity keeps the roller coaster car on the track and pulls it down the track on a downhill. When Billy is launched from a skateboard, gravity pulls him toward the ground.*

6. Why is Mosa's vacation video shocking? (4:04 - 4:24)

She puts a bowling ball down on the ground and it appears to roll uphill.

7. What measurements does Mosa take to prove that the bowling ball does not defy gravity? (4:35-4:45) She takes measurements of the position at which the ball started (20 meters above sea level) and the position to which the ball rolled (18 meters above sea level).

8. What did Mosa figure out? How did Mosa's measurements prove that the ball was moving due to gravity? (Answer Video)

Though it looked like the ball was rolling downhill, that was not the case. The location where the ball started (20 meter above sea level) was higher than where it ended (18 meters above sea level). Thus, gravity is still at play, pulling the ball downhill. It was just an optical illusion.

Quiz:

- 1. True or false? Billy fell toward the ground when skydiving because someone was pushing him toward the ground.
 - a. True
 - b. False
- 2. Which of the following is the best definition of gravity?
 - a. A person that pushes objects down toward the earth
 - b. A force that pushes objects down toward the earth
 - c. A force that pulls objects down toward the earth
 - d. A force that pushes objects toward the sky
- 3. Due to gravity, a ball placed on a sloped surface will always ______.
 - a. Stay in place
 - b. Roll uphill
 - c. Roll downhill
 - d. Float away
- 4. Which sentence best describes air resistance?
 - a. The frictional force that air exerts against a moving object
 - b. The force that pulls objects toward the earth
- 5. Which of the following is an example of air resistance?
 - a. Blowing leaves down the sidewalk with a leaf blower pushes them forward.
 - b. A falling feather taking longer to reach the ground than a marble.
- 6. Billy learned that when skydiving, gravity pulls him to the ground. If Billy were to skydive again, what body position should he use while falling to help him **slow** his fall? Hint: What body position would increase air resistance?
 - a. Feet first (pencil position)
 - b. Tucked position into a ball
 - c. Head first (upside down pencil)
 - d. Spread arms and Legs
- 7. BONUS: Two identical objects of the same size and shape are dropped. One is dropped from a table, while the other is dropped from the top of a tall building. Which will hit the ground with more impact?
 - a. The one dropped from a table
 - b. The one dropped from the top of a tall building