MOSA MACK SCIENCE

Thermal Energy Transfer Lesson 1: "The Solve"

Educator's Resource Guide: Animated Mystery

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.

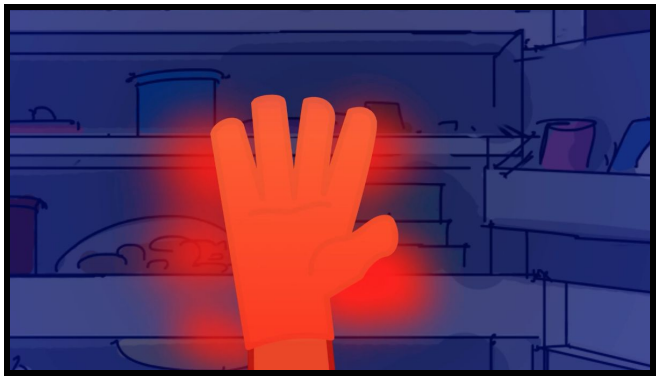
Objective:
In The Solve, students will:

1. Solve a mystery that demonstrates the understanding of how thermal energy is transferred
2. Create a mind map to explore relationships among complex chemistry vocabulary
3. Demonstrate understanding that some materials are better conductors of heat and some are better insulators.

Time Required: 45-80 minutes

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

Episode Description:
Willy is at it again! In his new infomercial for his "thin yet warm Willy Warm Gloves," Willy promises warmth, but his customers soon find out that it's Willy himself who is full of hot air. Mosa's called in to figure out why the Willy Warm Gloves aren't delivering on their promise and what material would be better suited for the ice cold air.



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.

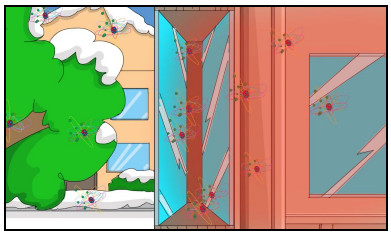
Level 4 *(recommended for grades 7–8)*

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 Thermal Energy 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.



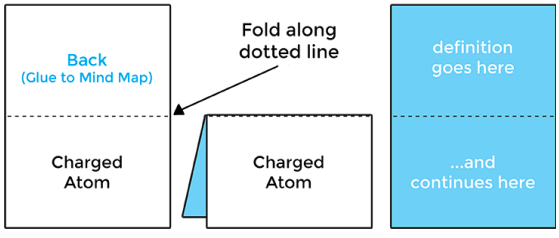
1. Play the animated Mosa Mack Mystery on Thermal Energy.
2. Students answer questions either digitally on the Mosa Mack platform or on paper in the Student Guide as they watch. Encourage students to cite the specific time codes in the episode to promote writing with supporting evidence. Answers can 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/thermal-energy
    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: Thermal Energy Lesson 1: *The Solve*.
    b. Introduce the warm up task: students will be making a Mind Map of the vocabulary for this Thermal Energy 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.

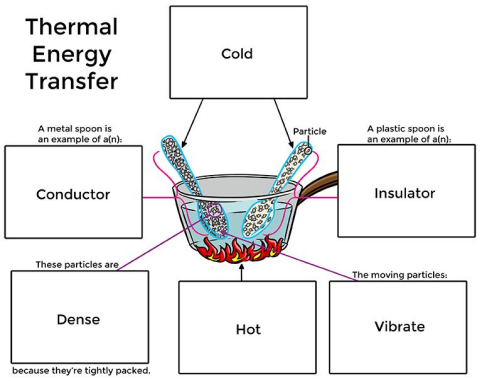
III. Exit Ticket: Check for Understanding (10–15 minutes)

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

Mind Map



Episode Questions

1. In the infomercial, Willy presents a new pair of thin, but warm gloves. Draw a picture of the cross-section he shows in his infomercial. What does he claim cannot get in the glove because of the dense fibers? *He claims that cold cannot get past the dense fibers to your hand.*
2. When Mosa puts on the glove and approaches the sub-zero freezer, what happens? *According to the thermal vision goggles, the heat leaves her hand through the glove.*
3. Willy claims that no cold can get into the glove. What does Mosa figure out is wrong with that statement? What is actually moving? *Cold air doesn't actually move into the glove; it is the heat from her hand that is leaving through the glove.*
4. When Mosa and her team use the quantum microscope on the soup and spoon, what do they see happening with the particles? Draw a diagram below using arrows to show the direction of thermal energy transfer. *The particles in the cold spoon are moving slowly, whereas the particles in the hot soup are vibrating like crazy. At the tip of the spoon, the molecules begin to vibrate more quickly.*
5. How do the particles conduct heat up the spoon? (Hint: think about the dance party!) *The faster moving particles in the soup bump into neighboring particles in the spoon, which then bump into their neighbors, and so on.*
6. Why does the metal spoon conduct heat better than the plastic spoon? *The particles in the metal spoon are denser, so it is easier to conduct motion between particles.*
7. What does Mosa mean when she says the gloves need to be made out a material that is a "good insulator"? *The gloves should be made out of a material that prevents thermal energy from transferring quickly (conducting).*
8. Why do the "Insulators" leave an air space between the two window panes when they install them? *The air will be warmed from the inside and then trapped there, keeping the house warm. Because air is not a good conductor of heat, it will not quickly transfer this thermal energy out through the other pane of glass.*
9. Help Mosa solve the mystery. Why does merino wool, with its pockets of air, make warmer gloves than the dense fibers of the Willy Warm Gloves? *The air is a poor conductor of heat, since its molecules are spread far apart, thus the heat from your hands will not conduct quickly through the gloves out into the air.*

Quiz:

1. Which direction does thermal energy transfer?
    a. Cold to hot
    b. Hot to cold
    c. Either direction
    d. Neither, they just mix
2. How does thermal energy transfer?
    a. Faster particles move past other particles.
    b. Slower particles bump into faster particles, slowing them down.
    c. Particles vibrating at a higher speed bump into those next to them.
    d. The colder particles move.
3. A metal spoon has denser particles than a wooden spoon. If both were placed in a hot pot of water, which would be a better conductor?
    a. The metal spoon.
    b. The wooden spoon.
    c. Both spoons would be equal conductors.
    d. It depends on the heat of the water.

4. The Willy Warm Gloves were an example of a good:
    a. Insulator
    b. Conductor

5. Why is air a good insulator in between windowpanes?
    a. Air on its own is warmer than all solids.
    b. Air is a gas, so the particles are farther apart and cannot conduct thermal energy as easily.
    c. Air is a gas, so its higher density of molecules allows it to conduct thermal energy more easily.
    d. Air on its own is cooler than all solids.