SUSTAINABLE
FUTURES

TEACHER-LED ACTIVITY | GRADE RANGE: 6–8

Keep It Cool

OBJECTIVES

Students will:

- Understand the difference between thermal conductors and thermal insulators.
- Analyze the current characteristics of common lunchbox designs.
- Design a lunch cooling solution.

OVERVIEW

Students will learn the difference between thermal conductors and thermal insulators. They will then put their problem-solving skills to the test when they begin the design process for an improved lunchbox. Students will conclude by making connections between their learning and larger-scale cooling solutions.

TIMING

45–60 minutes

MATERIALS NEEDED

- **Thermal Conductors and Thermal Insulators** student handout, one per student
- **Thermal Conductors and Thermal** Insulators answer key, one per volunteer
- **Lunchbox Challenge** student handout, one per student or group
- **Exit Ticket** student handout, one half-sheet per student

ESSENTIAL QUESTION

- What is the best way to keep something cool?

PROCEDURE

Engage

1. Introduce students to the upcoming concept by displaying and discussing the following essential question:

- What is the best way to keep something cool?

Learn

2. Ask students to raise their hands if someone has ever yelled at them during the winter to "shut the door, or you'll let all the cold air in!" Tell students that the phrase should

actually be, "you'll let all the warm air out," and explain that is because heat always travels from a warmer area to a cooler area.

Note: *Use any example that demonstrates the misunderstanding that cold air is what is traveling and adjust as necessary depending on the location. Another example that can be used is during the summer, "close the door—we don't want to air condition the neighborhood."*

3. Tell students that understanding the scientific principle of heat transfer will help them understand how engineers work to keep things cool. They also need to know the difference between thermal conductors and thermal insulators.
4. Distribute a **Thermal Conductors and Thermal Insulators** handout to each student. Instruct them to take notes on each one before they test their understanding.
5. Explain that thermal conductors are materials or items through which heat can travel easily. Some of the best thermal conductors are metal. Thermal conductors are used to make items that require heat to transfer easily, such as space heaters or frying pans. They can also be used to make items that cool things quickly.
6. Next, explain that thermal insulators are the opposite and prohibit heat from moving easily. Some of the best thermal insulators are wood, plastic, or fabrics like wool. Thermal insulators can keep heat in or out (i.e., keep things warm or cool), but they keep it from transferring from one area to another. A vacuum insulated water bottle will keep the water cold because it keeps the heat from travelling inside. A warm winter jacket will keep the body inside warm because it keeps the body heat from traveling outside.
7. Direct students' attention to the images at the bottom of the page. Instruct them to write a "C" next to those that are thermal conductors and an "I" next to the items that are thermal insulators. You can use the **Thermal Conductors and Thermal Insulators** answer key to provide students with the correct answers so they can check their work.

Apply

8. Distribute one **Lunchbox Challenge** handout to each student or group. Read the prompt aloud.
9. Ask for a volunteer to explain whether they should choose conductor materials or insulator materials. Reinforce that the students should focus on thermal insulators, because those will stop the heat from getting through and keep the food cooler longer. (Thermal conductors would let heat through and the food would heat up quickly.)

   Note: *It may be necessary to provide a list of thermal insulators: fiberglass, wool, polystyrene ("Styrofoam"), polyurethane foam, plastic, wood, cotton, and vacuum insulation.*
10. Give students time to discuss the materials they would choose and how they would use

them. They should record their chosen materials on their handout.

11. After deciding on their materials, students should sketch a model drawing of what their lunchbox would look like and where each material would be used. Remind them to include labels.
12. Invite students to present their innovations to the class, explaining their choice of thermal insulator.

Discuss

13. Facilitate a discussion that gives students the opportunity to discuss how the small-scale application of the principle of thermal insulation (lunch boxes) can also be applied to larger scale applications. If students do not offer suggestions, consider offering these examples: home insulation, clothing, coolers, or refrigerators/freezers.
14. Remind students that thermal insulation helps save energy, maintain temperature, and reduce overheating and freezing in both large and small applications.

Reflect

15. Distribute an **Exit Ticket Student** Handout to each student and ask them to reflect upon the activity's essential question. Collect them as students leave and use responses to determine their level of understanding. Consider taking time in a future session to address misconceptions, highlight key takeaways, or share interesting insights brought up on the tickets.

EXTENSION IDEAS FOR EDUCATORS

- Have students use materials to build prototypes of their innovative lunchbox designs.
- Set up an experiment in which students test the thermal conductivity of several materials.

NATIONAL CONTENT STANDARDS:

National Science Standards

- MS-PS3-B3: Energy is spontaneously transferred out of hotter regions or objects and into colder ones.
- MS-ETS1-A1: Consider scientific principles and other relevant knowledge when designing a solution.
- MS-ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution.

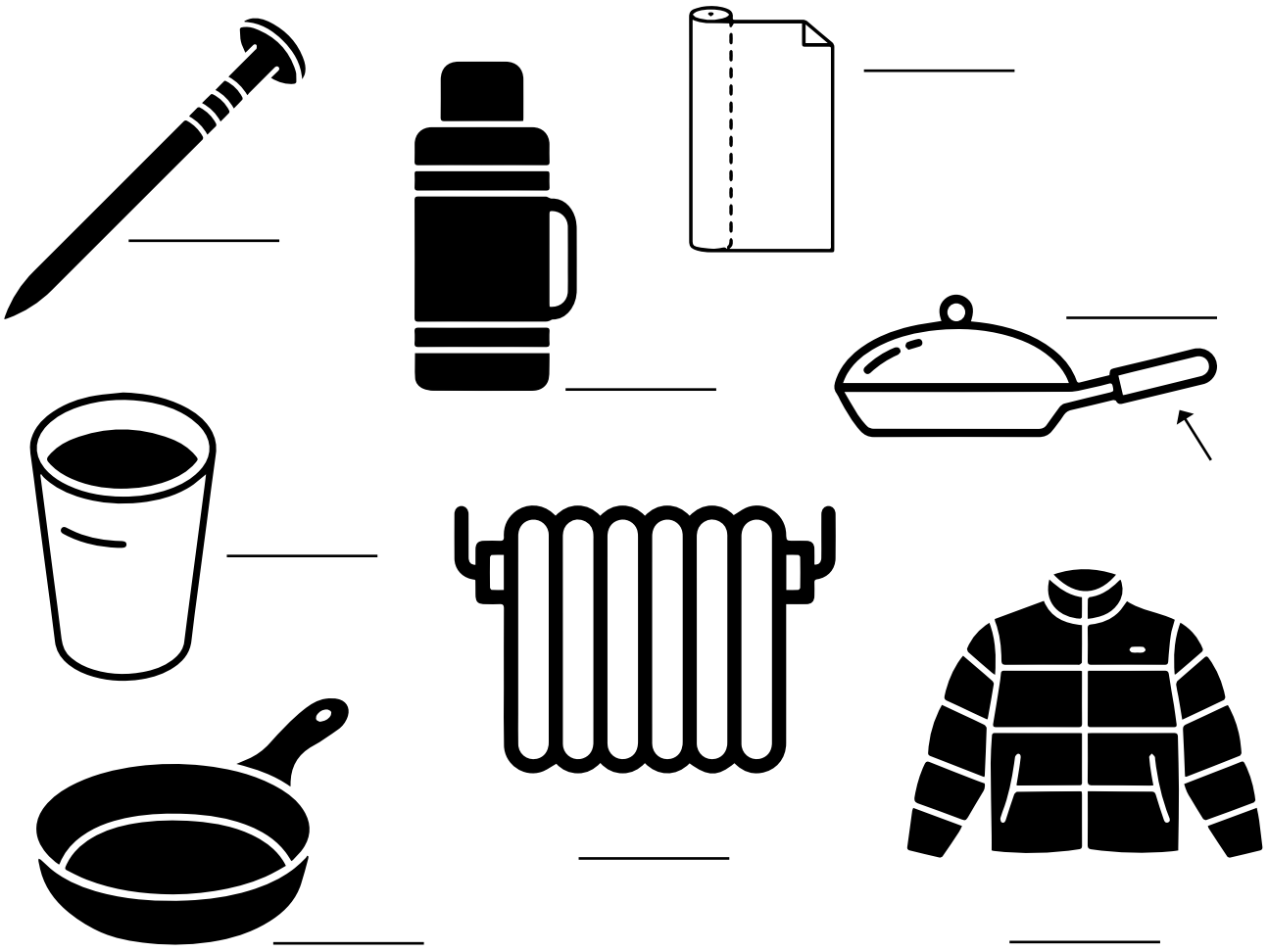
Science and Engineering Practices

- Asking Questions and Defining Problems.
- Constructing Explanations and Designing Solutions.

Thermal Conductors and Thermal Insulators

STUDENT HANDOUT

Thermal Conductors	Thermal Insulators

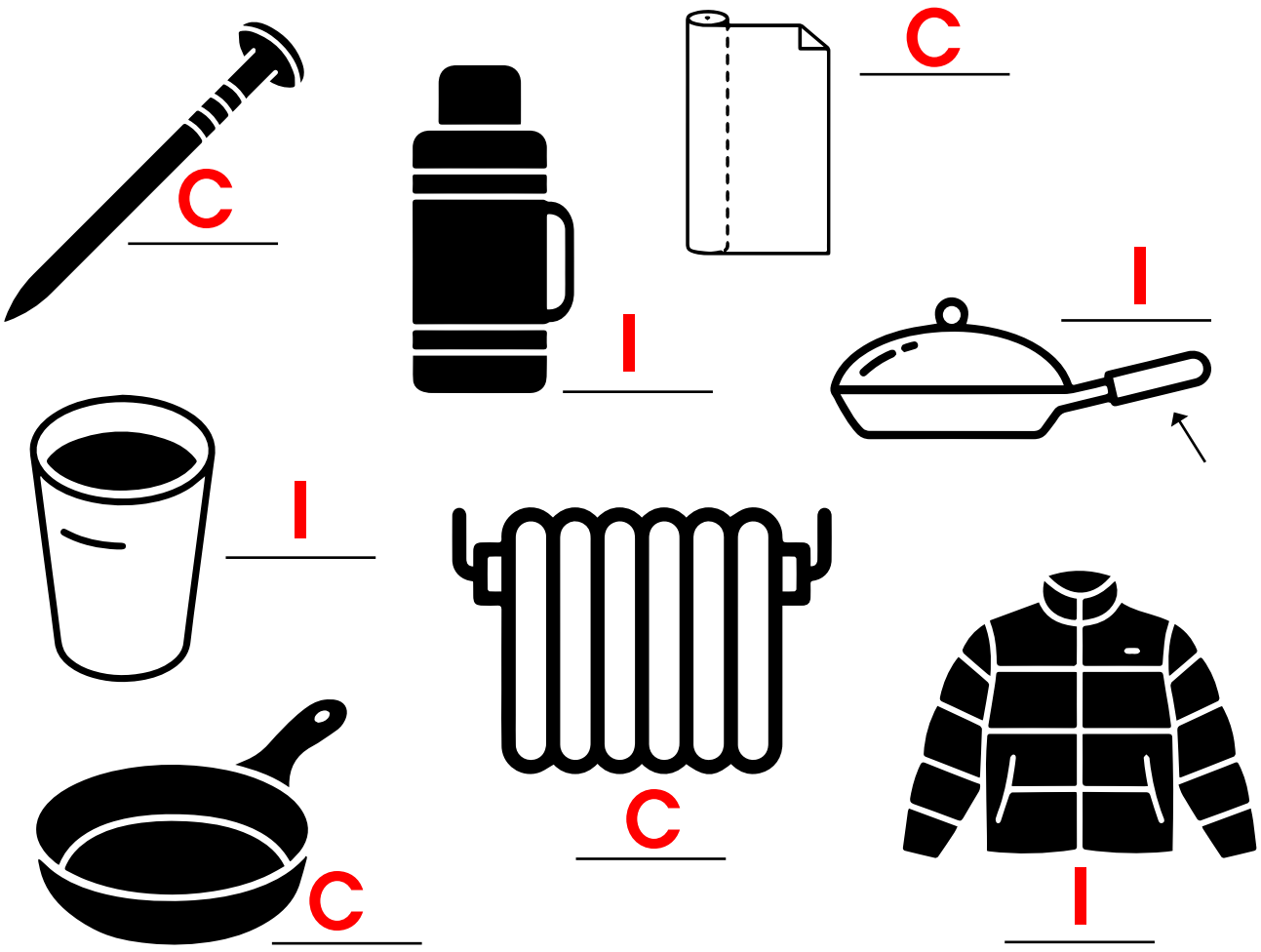


SUSTAINABLE FUTURES

Thermal Conductors and Thermal Insulators

STUDENT HANDOUT

Thermal Conductors	Thermal Insulators
• Heat can travel through them easily • Metals • Used to make things like heaters and pans • Heat and cool quickly	• Keep heat from traveling easily • Fabrics, wood, plastic • Examples: thermos, water bottles, coats • Keep things warm or cool



SUSTAINABLE FUTURES

Lunchbox Challenge

STUDENT HANDOUT

Scenario: Your team has been hired to design an innovative lunchbox that will keep kids' lunches cool like never before. You will compile a materials list, sketch and label a model drawing, and present your design to the group. Using what you learned about heat transfer, choose the best materials to make sure that the warm air from outside does not affect the cool food inside.

Materials:

Model Drawing (Don't Forget Labels!):

What is the best way to keep something cool?

What is the best way to keep something cool?