National MagLab STEM Lesson Plan:

Chocolate Conduction Lab (Grade 4)

Purpose: Investigate conduction as heat transfers from a heat source on one end through a strip of Aluminum (Al) Foil causing change to chocolate chips on the foil.

Next Generation Science Standard:

- SC.4.P.10.2:Investigate and describe that energy has the ability to cause motion or create change
- SC.4.P.11.1: Recognize that heat flows from a hot object to a cold object and that heat flow may cause materials to change temperature.
- SC.4.P.11.2: Identify common materials that conduct heat well or poorly.

Time: 30-40 minutes

Benchmarks:

- Forms of Energy
- Energy Transfer and Transformation

Materials:

- 10 chocolates kisses (or chocolate chips)
- 2 glass beakers or glass mason jars
- 2 - 18in pieces of aluminum foil
- votive candle
- lighter
- stopwatch/timer
- CHOCOLATE CONDUCTION LAB DATA SHEET (See Below)

Previous Knowledge:

- SC.4.P.10.1 – Observe and describe some basic forms of energy, including light, heat, sound, electrical and energy of motion.
- SC.4.P.10.2 – Investigate and describe that energy has the ability to cause motion or create a change.

STEM Rationale for Lesson:

Conduction is a fundamental method of heat transfer that occurs when two objects at different temperatures come into contact. By investigating conduction, students will gain insight into how thermal energy is transferred and how it affects matter, which is a critical aspect of physical science. Heat transfer principles are relevant in everyday life, from cooking to climate control in buildings. Understanding conduction can help students appreciate the science behind these processes and its

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applications in engineering, environmental science, and health. This lesson will help students connect the abstract concept of energy to tangible experiences. By observing the melting of chocolate chips, students can see firsthand how energy causes changes in state and can lead to motion (e.g., the movement of the melted chocolate).

This lesson on conduction through a simple yet effective investigation provides students with a deep understanding of heat transfer and energy transformations. By observing a real-world phenomenon, they will develop critical thinking skills, engage in scientific inquiry, and appreciate the relevance of physics in everyday life. Through hands-on learning, students will leave with a stronger grasp of essential scientific concepts and the confidence to explore more complex ideas in the future.

Lesson Activity Steps:

1. Prepare the Aluminum Foil: Tear off an 18-inch piece of aluminum foil. Make sure it is as straight as possible to ensure even heat distribution. If the foil is wrinkled, gently smooth it out to create a flat surface.
2. Create the Foil Strip: Fold the foil in half lengthwise, making a crease down the middle. Unfold it to create a guide. Fold each half inwards towards the center crease, resulting in a long, narrow strip. Press down on the folds to make them sharp. Repeat this process a third time to ensure the strip is sturdy and narrow.
3. Form the Edges: Take the ends of the foil strip and fold them downwards about 3 inches on each side. These edges will help stabilize the foil.
4. Set Up the Foil Bridge: Place the folded edges of the aluminum foil strip on each of the two glass containers. Ensure that the foil is securely resting on both jars and that the strip is straight and taut. Position the glass containers apart from each other, ensuring that the distance between them matches the length of the foil strip. This creates a "foil bridge" between the two containers.
5. Position the Chocolate: Evenly space 5 chocolate kisses (or chocolate chips) along the foil strip. Place them approximately 3 inches apart, starting from the side closest to the candle. Make sure they are not touching each other.
6. Set Up the Candle: Carefully position the candle next to one of the glass containers so that it is directly beneath the foil bridge and directly under the first chocolate piece. Make sure the candle is stable and won't tip over during the experiment.
7. Initiate the Experiment: Using a lighter or matches, carefully light the candle. Stand back and observe the setup to ensure that everything is stable.
8. Observe and Record: Watch closely as the chocolate melts. Note any changes in appearance (e.g., softening, melting) for each piece of chocolate. Record the time it takes for each chocolate piece to begin melting in your observation sheet, making note of the exact time (e.g., "Chocolate 1 melted at 2:30 minutes").
9. Data Recording and Reflection: After all chocolate pieces have melted, collect your data and review your observations. Reflect on the experiment by answering

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guiding questions: What did you notice about the rate of melting? How did distance from the heat source affect the melting time? What does this tell you about conduction? Discuss your findings with a partner or group, considering the implications of heat transfer in real-world scenarios.

10. Extension: Repeat the steps above but change the position of the candle. It can be placed directly in the middle of the foil bridge and under the middle chocolate, or anywhere along the foil bridge. Make sure you make a new hypothesis anytime you test something new.

Lesson Assessment

Reflect on the experiment by answering guiding questions:

- What did you notice about the rate of melting?
- How did distance from the heat source affect the melting time?
- What does this tell you about conduction?
- Why did this experiment use glass jars? What would happen if it used metal cans?

Discuss your findings with a partner or group, considering the implications of heat transfer in real-world scenarios.

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Heat is thermal energy on the move. We have learned that heat moves and that it moves from warmer matter to cooler matter. The three ways in which heat moves from one substance to another are called conduction, convection, and radiation.

Conduction: Have you ever grabbed the handle of a hot metal pan? Why did it feel hot to you? Heat is transferred from the handle to your body because it is in direct contact with matter than is at a hotter temperature. You are at a cooler temperature and so the heat moves to your hand. This form of heat transfer is called conduction. Conduction is the transfer of thermal energy between matter that is in direct contact.

HYPOTHESIS: Write a hypothesis about the heat transfer and how it will affect the melting of the chocolate:

_____

_____

_____

RECORD DATA: Record your data below.

Chocolate Chip	1	2	3	4	5
Distant for Heat Source	/cm	/cm	/cm	/cm	/cm
Melting Time					

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REFLECTION/FOLLOW UP:

1. Was your hypothesis correct? Explain.
2. What direction from the candle did the heat travel along the aluminum foil?
3. Describe how the heat got to each chocolate.
4. What evidence did you observe that showed heat transfer?
5. Where did the heat that melted the chocolate chips come from? Where did it go?

EXTENSTION: Move the heat source to the center. Record your data below.

Chocolate Chip	1	2	3	4	5
Distant for Heat Source	/cm	/cm	/cm	/cm	/cm
Melting Time					

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