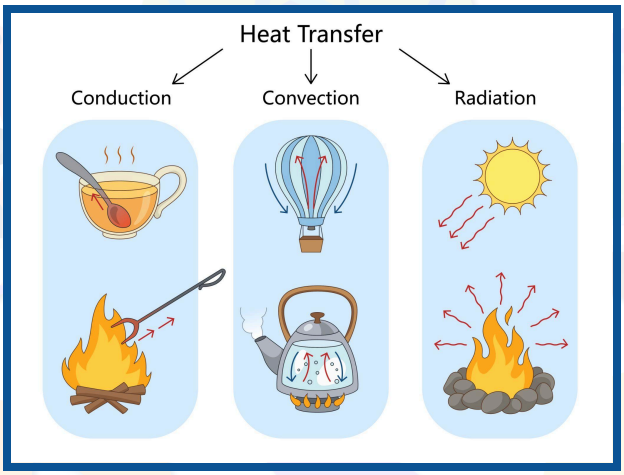
From Heat to Treat

Understanding Heat Transfer with S'mores

NAME: **DATE:** **BLOCK:**

INTRODUCTION: Heat transfer is the movement of thermal energy from one object or area to another. Thermal energy always moves from warmer objects to cooler objects. There are three main types of heat transfer: conduction, convection, and radiation.



- Conduction: Heat transfers through direct contact between two objects. When objects touch, thermal energy moves from the warmer object to the cooler one.
- Convection: Heat transfers through the movement of a fluid, such as air or liquid. As a fluid is heated, it becomes less dense and rises, while cooler, denser fluid sinks, creating a cycle that spreads heat.
- Radiation: Heat transfer through electromagnetic waves. Radiation does not require direct contact or a medium. Heat from the Sun or from heating elements can travel through empty space.

In this lab, you will make s'mores using an oven to observe how thermal energy is transferred. All three types of heat transfer are present during this process. By observing how the s'more heats and changes, you will identify where and how conduction, convection, and radiation occur in a real-world example.

PRE-LAB QUESTIONS:

1. What is **heat transfer**, and in which direction does thermal energy always move? _____
   _____
2. Which type of heat transfer occurs through **direct contact** between objects, and how does thermal energy move during this process? _____
   _____
3. Which type of heat transfer **does not require direct contact or a medium**, and what is one example of this type of heat transfer? _____
   _____

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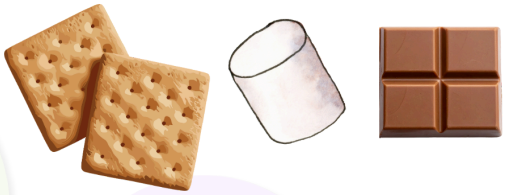
MATERIALS RECEIPT

- Graham Crackers (1)
- Marshmallow (1)
- Chocolate Square (1)
- Oven/Toaster Oven
- Baking Tray
- Aluminum Foil
- Timer (Phone)
- Oven Mitts

EXPERIMENTAL SET-UP:



PROCEDURE:.

1. Preheat the toaster oven to 350°F. Line a small baking tray with aluminum foil.
2. Place one graham cracker half with a chocolate square on the tray, and the other half with a marshmallow.
3. Position the tray on the middle rack of the oven. Close the oven door and start the timer.
4. Observe the s'more every 30 seconds, opening the oven door only briefly if needed.
5. At each time interval, record the state of the chocolate and the appearance of the marshmallow.
6. Continue observations until the chocolate is fully melted, the marshmallow reaches golden brown, or 5 minutes have passed, whichever occurs first.
7. Turn off the oven and carefully remove the tray using an oven mitt. Cool before consumption or disposal.

DATA/OBSERVATIONS:

Time	Chocolate State (solid / soft / partially melted / fully melted)	Marshmallow Appearance (no change / softening / browning / golden brown)
0:00		
0:30		
1:00		
1:30		
2:00		
2:30		
3:00		
3:30		
4:00		
4:30		
5:00		

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POST-LAB QUESTIONS:

1. Although the **chocolate** and **marshmallow** were exposed to the same heat source, they changed in different ways. Explain how and why their responses to heat differed.

   _____
   _____
   _____

2. How was **conduction** used in this lab? Identify where direct contact allowed thermal energy to transfer.

   _____
   _____
   _____

3. How was **convection** used in this lab? Describe how moving air inside the toaster oven transferred heat to the s'more.

   _____
   _____
   _____

4. How was **radiation** used in this lab? Explain how heat traveled from the heating elements to the s'more without direct contact.

   _____
   _____
   _____

5. A **physical change** occurs when a substance changes in form or state but remains the same substance. A **chemical change** occurs when a substance changes into a new substance with different properties. Provide one example of a physical change and one example of a chemical change during the s'more lab.

   _____
   _____
   _____