

Grade 4 Hands on Science
Heat Energy

Objective: To investigate the concepts of heat conductivity, insulators vs conductors of heat energy, and differences between temperature and heat.

Introduction:

- Key terms:
 - **Insulator:** something that **does not** let heat and electricity go through it easily
 - **Conductor:** something that **does** let heat and electricity go through it easily
 - **Heat Conductivity:** the measure of how fast heat travels through a material
 - **Heat:** how much energy is present in a material
 - NOTE: You can gain or lose heat energy, but you can not gain or lose “cold”. Cold is just a lack of heat energy.
 - **Temperature:** how hot or cold an object is

Part A: Conduction of Heat – Instructor's Demonstration

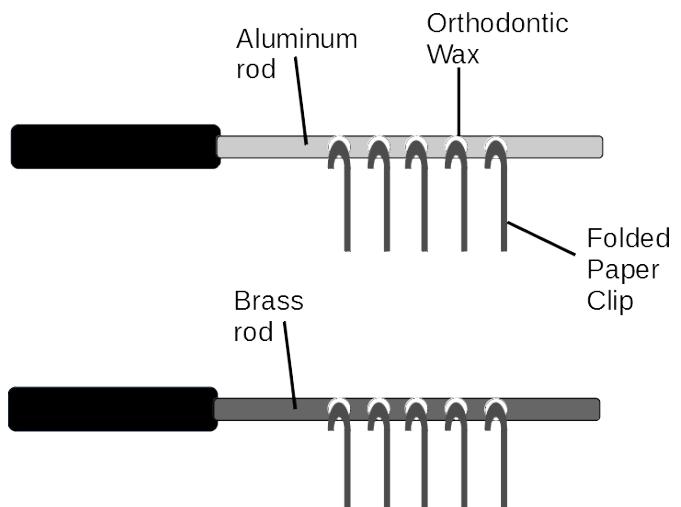
Objective:

- to visually demonstrate heat conductivity
- to demonstrate that metals, such as aluminum and brass, conduct heat at different rates
 - demo will show that aluminum has twice the thermal conductivity of brass

Materials: aluminum rod with handle, brass rod with handle, paper clips, orthodontic wax, propane torch

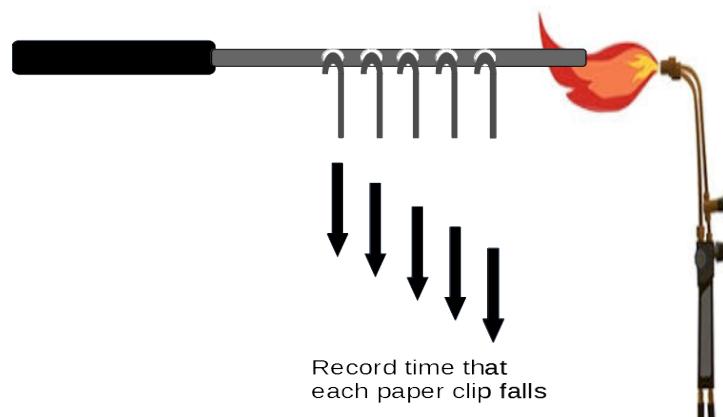
Activity (this will be done as a class demo):

- Put aluminum foil on table to protect the surface from wax and hot paper clips.
- Straighten 10 paper clips into a cane shape.
- Place a small portion of orthodontic wax on the aluminum and brass rods beginning at 5 cm from the end of each rod. Place portions of wax at every 2.5 cm intervals.
- Press the rounded ends of the straightened paper clips into the wax.
- Light the propane torch and adjust the flame so that it is about 1 inch long.
- Use a stopwatch to record time. Tell the students to record the time it takes for each paper clip to fall once the experiment starts.
- Place the end of the aluminum rod in the hottest area of the flame. Hold the rod so that the paper clips are orientated in a vertical direction (see diagram).
- As each paper clips falls, have the students record the time on their lab sheet. (NOTE: The 5th paper clip should fall within about 1.5 minutes).
- Repeat the procedure with the brass rod. (NOTE: The 5th paper clip should fall within 2.5 to 3 minutes).



Discussion:

- Ask: Which rod lost its paper clips faster? (Aluminum)
- Ask: Which metal had the best heat conductivity? (Aluminum)



Part B: Insulation

Objectives: to demonstrate how insulation slows heat loss

Materials: 2 jars – one wrapped in cotton batten, HOT water, thermometer

Activity:

- Fill 2 pint jars, one insulated and the other not, about $\frac{3}{4}$ full with HOT water.
- Record the water temperature in each jar with a thermometer and record the temperature on your lab sheet.
- Place a lid on each jar.
- Set the jars aside and move on to Part 3. You will return to Part 2 at the end of the lab.
- Activity revisited:
 - Remove the lids from the jars.
 - Measure the water temperature of each jar and record the results on your lab sheet.
 - Calculate the temperature change and record this on your lab sheets.



Discussion:

- Ask: Which jar lost the most heat over time?
- Ask: What does this tell you about the effect on insulation on heat loss?

Part C: Heat Conduction

Objectives: to determine what happens when various materials are cooled rather than heated

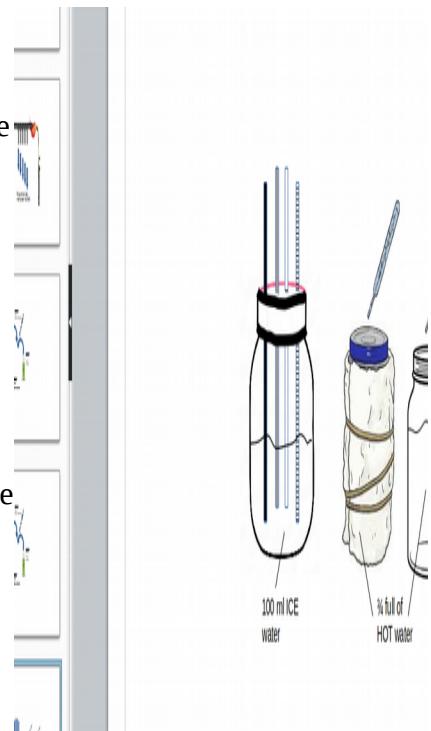
Materials: jar, wood circle with holes, ice water, rulers,

Introduction:

- As you demonstrated in Part A, different materials will conduct heat differently. Metals are better conductors of heat and electricity than non-metals. You will be looking at both metals and non-metals to determine how cold affects heat conductivity of these materials.
- Remember that cold is a lack of heat energy. You can not add or lose “cold” but you will add or lose heat energy. When you add ice to a drink of water, heat energy from the water is absorbed by the ice (which is why the ice melts) and your water will lose heat energy. As the water loses heat energy to the ice it will become cooler.

Activity:

- Fill a jar with 100 ml of ICE COLD water.
- Place the wood circle over the top of the jar for the positioning of the rods.
- Place aluminum, glass, brass, and wooden rods through the holes of the wood circle and into the ice water.
- After 2 minutes (NO LONGER!!) perform the following measurements VERY QUICKLY!!
- Remove the aluminum rod from the jar.
- Starting at the end of the rod THAT WAS NOT IN THE WATER, move your finger down the rod until you feel the place at which the rod begins to feel colder.
- Measure the distance in cm from the top of the rod to the point where it felt colder.
- Record your findings on your lab sheet.
- Quickly repeat the same measurements for the brass rod, then the glass rod, and finally for the wooden rod.
- Complete the lab worksheet



Discussion:

- In which rod did the cold move (or rather was heat lost) the fastest?
- What was the order in distances (greatest to least) that the cold moved (or rather heat was lost)?
- What does this tell you about which material conducts heat or cold better?

Part D: Heat and Temperature

Objectives: to demonstrate the relationship between temperature and heat, and to show the factors that affect the amount of heat energy in a material.

Materials: graduated cylinders, beaker, HOT and COLD water, thermometer

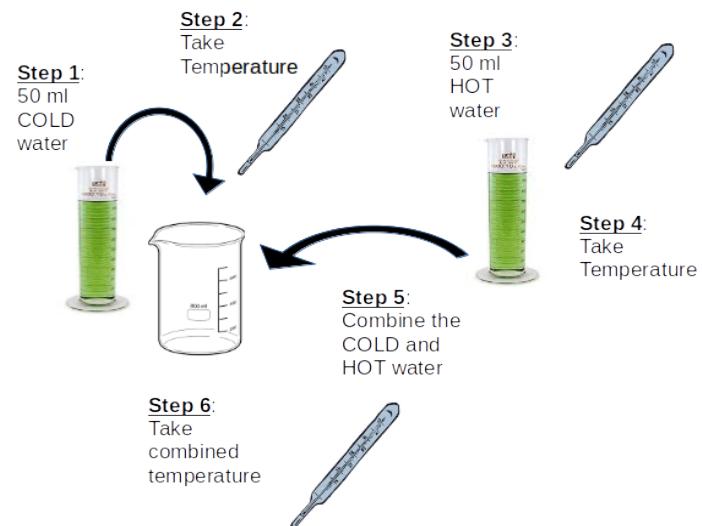
Introduction:

- Temperature and heat are not the same thing, though they are related.
- Heat is the total energy within a material and is determined by how much the tiny bits of matter within that material are moving. The more particles of matter make up the material, the types of particles (think conductor or insulator), and how fast these matter particles are moving all determines how much heat energy a material will have.
- So simply, the amount of heat energy contained in a material depends on:
 - the temperature of the material (the higher the temperature, the faster the matter particles are moving)
 - the quantity/amount of the material (the more material, the more heat energy it can contain)
 - whether the material is an insulator or conductor (the matter within a conductor will move faster with increased temperature than the matter of an insulator).
- Temperature does not depend on the size or type of material. The temperature of a small cup of water and a bathtub can be the same temperature, but the amount of heat will be different. The cup will lose heat energy and cool much faster than the bathtub will.
- Heat is energy. Temperature is just a measurement of heat energy.

Activity:

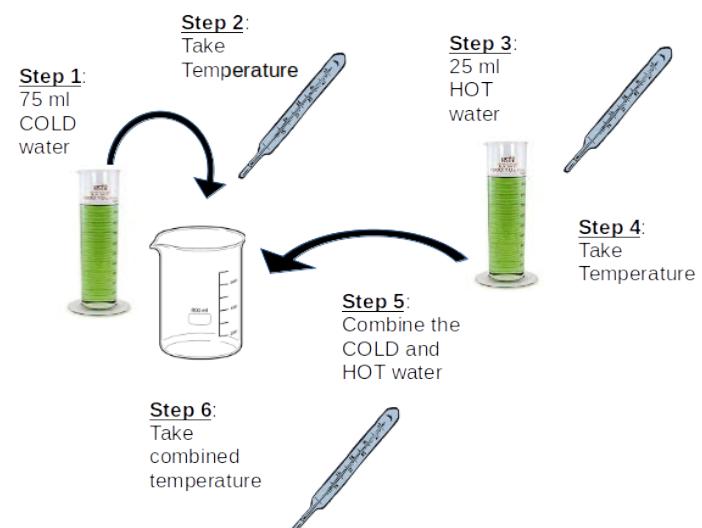
Part 1:

- Measure 50 ml of COLD water in a graduated cylinder.
- Pour the cold water into a beaker.
- Measure the temperature and record on your lab sheet.
- Measure 50 ml of HOT water in a graduated cylinder.
- Measure the temperature and record on your lab sheet.
- Pour the hot water into the beaker with the cold water. Stir.
- Measure the temperature and record on your lab sheet.



Part 2:

- Empty the beakers into the waste containers.
- Measure 75 ml of COLD water in a graduated cylinder.
- Pour the cold water into a beaker.
- Measure the temperature and record on your lab sheet.
- Measure 25 ml of HOT water in a graduated cylinder.
- Measure the temperature and record on your lab sheet.
- Pour the hot water into the beaker with the cold water. Stir.
- Measure the temperature and record on your lab sheet.



Discussion:

- Ask: Which combination [(50 COLD ml + 50 HOT ml water) or (75 COLD ml + 25 HOT ml water)] had the higher temperature? Why do you think this is the case?
- Which had the most heat energy, the 100 ml of Part A mixture or 100 ml of Part B mixture?
- Ask: If 50 ml of water and 25 ml of water have the same temperature, which one has more heat energy?
- Why don't the mixed waters have the same temperature?