Conductors of Heat

Challenge

Have a look at the following video.

Why do you think that while the wood feels warmer the ice melts more quickly on the aluminum?

What will we investigate?

We will investigate which metals (copper, iron and aluminum) and other materials (wood, glass, plastic), best transfer heat. To do this we will measure the temperature of these materials after they are submerged in hot water. We will then compare the differences in temperature and divide the materials into two groups: **thermal conductors** and **thermal insulators**. Materials which allow heat to flow through them are **thermal conductors,** materials that do not allow heat to flow through them are **thermal insulators**.

Equipment and Materials

- einstein™Tablet+ or einstein™Labmate+™ paired with a tablet
- External Temperature sensor (-40 °C to 140 °C)
- Thermos of hot water
- Glass of tap water
- Black marker
- Ruler for measuring
- 7 disposable cups
- Metal rods (try to find at least 3 and to include copper, aluminum and stainless steel)
- Rods of other materials for investigation (wood, plastic, glass)

Note: All the rods used in this investigation must be equivalent in size and shape.

Before You Begin

Predict which of these materials will conduct heat and which won't. Then divide the materials into two groups: **Thermal Conductors** (those that conduct heat) and **Thermal Insulators** (those that don't conduct heat).

Experimental Setup

Group Work

1. Turn on the einstein™Tablet+ or einstein™Labmate+™ paired with a tablet.
2. Tap the MiLAB ( ) icon to open the application.
3. Connect the external Temperature sensor to the einstein™-enabled device.

Sensor Setup

Tap the **Setup** cog ( ) and use the table below to set up the measurement parameters:

Sensor:	External Temperature (-40 to 140 ˚C)
Rate:	1 / sec
Duration:	180 Sec

Experimental Procedure

Safety Precaution: Extreme caution should be taken around very hot materials. This is especially true of hot water which can spill very easily.

1. Prepare a table like the one below to record the data.
2. Put the external Temperature sensor into the glass of tap water.
3. Measure the temperature of the tap water until it stabilizes.
4. Use the black marker to mark a line 2 cm from the bottom on all the disposable cups.
5. Carefully pour hot water from the thermos into one of the disposable cups up to the black line.
6. Insert the aluminum rod into the hot water.
7. Touch the external Temperature sensor to the top of the aluminum rod.
8. Measure the temperature for 3 minutes.
9. Record the temperatures you measured in your table.
10. Insert the temperature sensor in the glass of tap water to allow it to cool off.
11. Repeat this measurement three times.
12. Repeat this procedure for each material.

Sample Data Table

Material	Starting Temperature (°C)	Final Temperature (°C)	Temperature Difference (°C)
Copper			
Aluminum			
Stainless steel			
Plastic			
Glass			
Wood			
?			

Understanding the Measurements

1. Divide your materials into two groups: Those that conducted heat and those that didn't?

Grouping Your Materials

Thermal Conductors	Thermal Insulators

2. How does this compare to the list your predictions before the experiment
3. Look at the information in the data table. Use the difference between the starting temperature and the final temperature to rank the materials from the most to least conductive.
4. Explain what is meant by materials that conduct heat well.
5. Explain what is meant by materials that conduct heat poorly.
6. Explain why a thermos was used in the experiment.

Using What You Learned

Understanding Conductivity

1. Try to define the phenomena of conductivity, include discussion of all types of material, speed of conductivity, heat transfer. Try to come up with different characteristics of conductivity.
2. How can we benefit from conductivity?
3. How can conductivity cause harm?
4. Does the thermos conduct heat? Why?

Understanding the Science

Look at the photos below. Which items are conductors and which are insulators?

Give two examples of items that are either insulators or conductors:

_____ is a conductor/insulator
_____ is a conductor/insulator