

## Heat Transfer: Why Do Metals Feel Cold?

How efficiently can heat transfer from one container to another? Not all materials conduct thermal energy equally. This ability is an intrinsic property of a material. Materials that do this well are known as conductors. Insulators are materials that do not conduct thermal energy efficiently. In this lab, you will investigate which materials make good conductors and which make good insulators.

### Watch Video 1

Data Table —Aluminum and Copper				
Strip type	Aluminum Strip		Copper Strip	
Calorimeter	Calorimeter 1	Calorimeter 2	Calorimeter 1	Calorimeter 2
Cold/Hot Cup	Cold	Hot	Cold	Hot
Time (minutes)	Temperature (°C)	Temperature (°C)	Temperature (°C)	Temperature (°C)
0 (initial temp)	6.4	96.0	4.0	93.2
1	7.4	84.4	4.1	79.6
2	7.8	81.1	4.6	75.9
3	8.5	77.8	5.3	72.9
4	9.2	75.3	6.1	70.2
5	10.0	72.4	7.3	67.6

Data Table — Iron and Zinc				
Strip type	Iron Strip		Zinc Strip	
Calorimeter	Calorimeter 1	Calorimeter 2	Calorimeter 1	Calorimeter 2
Cold/Hot Cup	Cold	Hot	Cold	Hot
Time (minutes)	Temperature (°C)	Temperature (°C)	Temperature (°C)	Temperature (°C)
0 (initial temp)	6.6	93.6	5.0	99.4
1	7.0	81.0	6.0	87.2
2	7.1	78.4	6.2	84.1
3	7.5	76.0	6.6	81.5
4	7.9	73.7	7.0	79.0
5	8.3	71.5	7.3	76.5

### Observe

Examine the data tables. For which metal does the temperature of the hot water drop fastest? Which metal is the most efficient conductor of heat?



## Identify an Experimental Design Flaw

Remember that the piece of metal in the experiment connects the hot water to the cold water and that over time the hot water gets colder and the cold water gets hotter because heat flows from hot objects to cold objects. Why, in the experiment shown in **Video 1**, does all of the heat lost by the hot water not transfer to the cold water? Where does it go?

## Refine/Expand the Experiment

Describe an experiment you could conduct to investigate the relationship between the size of the metal piece and how fast heat is conducted by it. Identify the variable you would have to change, the variable you would have to measure, and the things you would have to keep the same.

## Watch Video 2

## Practice Scientific Reasoning

Why do you think a copper pan feels cold to the touch?

## Connect to Your World

Imagine you work for a company that manufactures cookware, such as pots and pans. Which of the metals tested in this experiment would you use to make a line of pots and pans? Explain and indicate what factors you would consider in addition to heat transfer.

## Learn More by Exploring These Links

Use this link to further explore how and why heat is exchanged between objects:

<https://phet.colorado.edu/en/simulation/legacy/energy-forms-and-changes>.

## At-Home Extension

Explore the thermal conductivities of different materials in your home, following the methods demonstrated in **Video 3**.

## Watch Video 3

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