

# Questacon at HOME

## Energy Activity sheet

# Exploring Insulation 1: Feelin' Hot!

### BACKGROUND

We often hear that insulation in our homes reduces energy costs and makes our homes more environmentally friendly – but how does insulation work? In this experiment, we will use mugs of hot water to explore how insulation helps our houses to retain heat.

### MATERIALS

- Freshly-boiled water
- Heat-resistant measuring jug
- Mugs made of different materials, e.g. ceramic, enamel, plastic, cardboard
  - Do not use glass – heat can break it!
- Lids for mugs, or a piece of cardboard to use as a lid
- Thermometer (a candy thermometer is ideal)
- Timing device
- Pen and paper
- Thermos flask or vacuum-insulated mug (optional)

### SAFETY

This activity uses liquids, which may become slip hazards. Adult supervision is recommended when preparing and handling boiling water. Thermometers can break if used outside of their temperature range – ensure yours can handle boiling water (100°C). Adult supervision is recommended for young experimenters.

### PROCEDURE

**Set up your experiment:** Arrange your mugs on a heat-resistant surface. Observe their shape and what they are made of. Make a prediction: which mug will keep water the hot for the longest amount of time? Boil some water and use the measuring jug to pour an equal volume of water into each mug: 200-250 ml is a good amount.

**Record temperatures over time:** Measure and record the temperature of the water when you first put it into each mug. Check the temperature at regular intervals (e.g. every two minutes) and write down your results. Notice the temperature changing –  
When does the water stop cooling down?

**Put a lid on it:** Try the experiment again, but place a lid over each mug.  
How does it compare??



## TIPS & TRICKS

- Use a thermometer that you can submerge - infrared thermometers only measure the temperature of the water surface, so their results may be inaccurate.
- If measuring the temperature takes too long, consider performing the experiment with one mug at a time and leaving the thermometer in the water.
- If you have one, try the experiment with a thermos or vacuum insulated mug.

## WHAT'S THE SCIENCE?

Heat is a type of energy. The way that heat energy transfers is described by the **Laws of Thermodynamics**. The second Law of Thermodynamics means that heat energy travels from warmer areas to cooler ones. The hot water in our mug will release heat energy until it reaches *equilibrium* – that is, it has reached the same temperature as the environment around it.

Heat can be transferred in three ways. In liquids and gases, **convection** means that hot air or liquid will rise, but the denser, cooler particles will sink down. Heat can travel through solid materials via **conduction** – this is why a frying pan will get hot when it's placed on a stove. Some materials conduct heat better than others. *Radiation* is when heat moves as energy waves (like light or heat from the sun).

Insulation slows the rate of heat transfer. In our mugs, a lid will prevent heat transferring into the air and escaping via convection. Choosing the right material for your mug and even adding an insulating sleeve will prevent heat escaping via conduction. A shiny surface like aluminium can help reflect radiated heat back towards our mug.

In the same way as the hot water in our mug will cool down, the heat inside our homes will flow to unheated areas like attics, garages, basements and the outdoors. By using insulation to slow the rate of heat transfer, we can save on energy costs and reduce our environmental impact!

## WHAT QUESTIONS COULD I ASK?

- Which mug of water will cool down the fastest? Why do you think so?
- How is the heat escaping the mug?
- How long do you think it will take the water to cool down?
- Do you think the water will get colder than the air in the room? Why?

## WHAT'S NEXT?

- **Graph your results!** Make line graphs of your results, with time on the x-axis and temperature on the y-axis. Do you notice any patterns? How do the graphs help you to compare your results?
- **Design challenge!** Using everyday items like cardboard, Styrofoam or fabric, try designing insulation for your cup. Which material works best? Can you improve upon your design?
- **Explore your house!** Think about how your house is or isn't insulated. Compare the air temperature near walls, doorways and windows, or on either side of a curtain. How could you improve your house's insulation?
- **Try it with cold stuff!** see some of the other Questacon-At-Home print out sheets for activities on insulation such as **Exploring Insulation 2: Keep Your Cool**. What principles are the same across the two activities? What is different? What conclusions can you draw from trying out both activities?

