Insulation is an important component of energy-efficient buildings. Insulation reduces both the energy required for wintertime heating and summertime cooling. Fiber glass, rock wool, cellulose, polyurethane foam, polystyrene foam, and foil-faced paper, polyethylene bubbles, and plastic film are common insulation materials. Basic insulation forms include blanket (batts or rolls), loose-fill, spray-applied, rigid insulation, and reflective systems.

You will monitor the temperature of a bottle of warm water as it cools for three minutes and determine its cooling rate.

After completing the activity, you will use reference sources to find out more about insulation before you choose and investigate a researchable question. Some topics to consider in your reference search are:

- insulation
- thermal insulation
- R-value
- energy efficiency
- energy-efficient technologies
- superinsulation

Later in the year, you will use the research results as you insulate a model house in preparation for a contest to see which group can make the best passive solar house, as determined by a number of criteria including lowest cooling rate.

**PROCEDURE**

1. Connect the Temperature Probe and the data-collection interface.
2. Obtain a small bottle and a one-hole rubber stopper. Insert the Temperature Probe into the rubber stopper (4 cm exposed).
3. Fill the bottle with hot tap water (greater than 55°C). Insert the rubber stopper and Temperature Probe into the bottle.
4. Observe the temperature readings. When the readings drop to 55°C, start data collection.
5. When data collection stops, use the Linear Fit function to determine the cooling rate (slope) from 60 seconds in to 180 seconds. Record the cooling rate (in °C/s).

**RESEARCHABLE QUESTIONS**

- How do the insulation properties of various insulating materials compare?
- How do the insulation properties of various liquids compare?
- How does insulation form (blanket, loose-fill, or rigid) affect heat retention?
- Is it better to have the reflective side of reflective insulation to face in or out?
- How does compression affect the insulation properties of insulation materials?

There are many more possible researchable questions. If you have a different question to test ask your instructor for approval.
YOUR RESEARCHABLE QUESTION:
HOW DOES INSULATION THICKNESS AFFECT HEAT RETENTION?

YOUR HYPOTHESIS:

YOUR PREDICTION:

YOUR INDEPENDENT VARIABLE:

YOUR DEPENDENT VARIABLE:

YOUR CONTROLS:

YOUR RESULTS:
CONCLUSION

Write a conclusion on a separate sheet of paper that answers the following questions: What is the general answer to the question you asked? What is general shape of your graph(s)? According to your data, would a doubly thick piece of insulation be twice as effective as a singly thick piece of insulation? Explain why or why not. What is an R value and how does it pertain to insulation? Name 2 ways this experiment could be improved (more replications doesn’t count). Describe a different experiment you could perform using this general procedure. Fill out another investigation sheet and bring the supplies you will need to perform your experiment with you to your next class.
YOUR RESEARCHABLE QUESTION:

YOUR HYPOTHESIS:

YOUR PREDICTION:

YOUR INDEPENDENT VARIABLE:

YOUR DEPENDENT VARIABLE:

YOUR CONTROLS:

YOUR RESULTS:

Graph your results using the computer.

APES