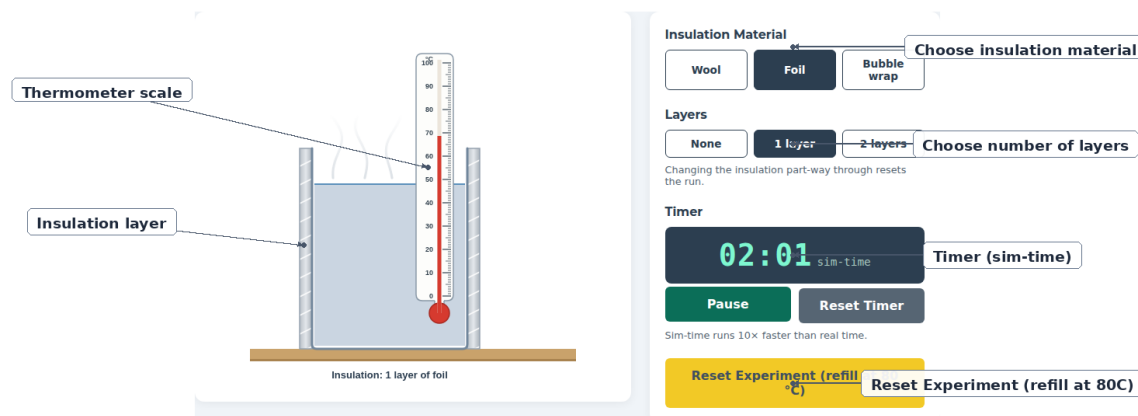


Insulation Investigation

Material, Layers and Cooling

Aim:

You are investigating how the insulating material and the number of layers affect how much a beaker of hot water cools in a fixed time, and whether adding more layers keeps doubling the effect.



Prediction:

You will compare no insulation with 1 layer of wool, foil and bubble wrap, and with 2 layers of wool. Which do you predict will leave the water hottest after 300 s of sim-time?

My prediction:

Test it in the simulation.

Method:

1. Set Layers to None. Click Reset Experiment (refills at 80°C), then click Start. When the timer reads exactly 300 s of sim-time, click Pause and read the thermometer. Record the material, layers, time and temperature in your results table.
2. Click Reset Experiment and repeat step 1 exactly, to get a second reading for "none" and check your two readings are consistent.
3. Reset Experiment. Set Insulation Material to Wool and Layers to 1 layer. Repeat the 300 s timing and record the reading.
4. Reset Experiment. Set Material to Foil, Layers to 1 layer. Repeat and record.
5. Reset Experiment. Set Material to Bubble wrap, Layers to 1 layer. Repeat and record.
6. Reset Experiment. Set Material to Wool, Layers to 2 layers. Repeat and record.
7. Choose your own combination of material and layers for the final two rows, and repeat the 300 s timing for each.
8. Away from the screen, fill in the temperature fall column for every row: 80°C minus your recorded temperature.

Results:

Material	Layers	Time (s)	Temperature (°C)	Temperature fall (°C)

Analysis:

Compare your two "none" readings. Are they consistent? Why is it useful to take this reading before testing any insulated runs?

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Compare the temperature fall for no insulation and for 1 layer of wool. How many degrees of cooling did the first layer of wool prevent?

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Compare 1 layer of wool with 2 layers of wool. How many extra degrees did the second layer prevent? Does the second layer save as many degrees as the first?

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Using your temperature fall values, rank wool, foil and bubble wrap (at 1 layer) from best insulator to worst.

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Plot number of layers of wool (0, 1, 2) on the horizontal axis and temperature fall (°C) on the vertical axis. Describe the shape of your graph — is it a straight line?

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Explaining why:

temperature fall (°C) = starting temperature (80°C) – temperature at 300 s

Why must every run start at exactly 80°C and be read at exactly the same time for your comparisons to be fair? Which of these does the sim control for you automatically?

Look at a single run: does the water lose more degrees in the first 60 s or the last 60 s? Suggest why, thinking about the temperature difference between the water and the room.

A vacuum flask keeps drinks hot for hours. Using your results, which material and how many layers would you choose for a home-made flask? At what point might adding another layer stop being worth the extra cost and bulk?
