



Bark & Soil

Insulative Property Model



Name:	Class/Period:	Date:
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Presentation Notes:

Materials:

Each group will find the following equipment at their laboratory station:

1 hair dryer	1 temperature probe system with 2 probes
5 felt fabric sheets (9" x 12")	1 stopwatch (smartphone)
1 piece of PVC pipe (3" diameter; 9" length)	1 ruler or "distance regulator"
3 rubber bands	

Group Members' Tasks/Responsibilities:

Timer	Calls out the elapsed time at 10-second intervals and also calls out "Heat off!" after 30 seconds.
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Heater	Controls the hair dryer. Aims the hair dryer towards the tips of the temperature probes while holding the hair dryer 15 cm from the probes/surface using a ruler or the “distance regulator.” When “Heat off!” is called, aim the hair dryer away from the probes and turn it off.
Recorder #1	Records the temperature of probe #1 at 10-second intervals.
Recorder #2	Records the temperature of probe #2 at 10-second intervals.

Experimental Setup:

- Determine whether tree bark or soil will be simulated with the model, and then set up the equipment accordingly. If tree bark will be simulated, choose between blackjack oak (bark thickness = 5 layers of felt) and eastern redcedar (bark thickness = 1 layer of felt). If soil will be simulated, students choose between subsurface vegetative structures that are deep (soil thickness = 5 layers of felt) or shallow (soil thickness = 1 layer of felt). Refer to the “setup images” in the activity’s slideshow if you need assistance with experimental setup.
- Assign tasks/responsibilities. Be sure the “recorders” know which probe is which!
- When the group is ready, turn on the hair dryer using the “high” setting, and let it run for 15–30 seconds without pointing it at the temperature probes.
- Timer, begin!

Data Collection:

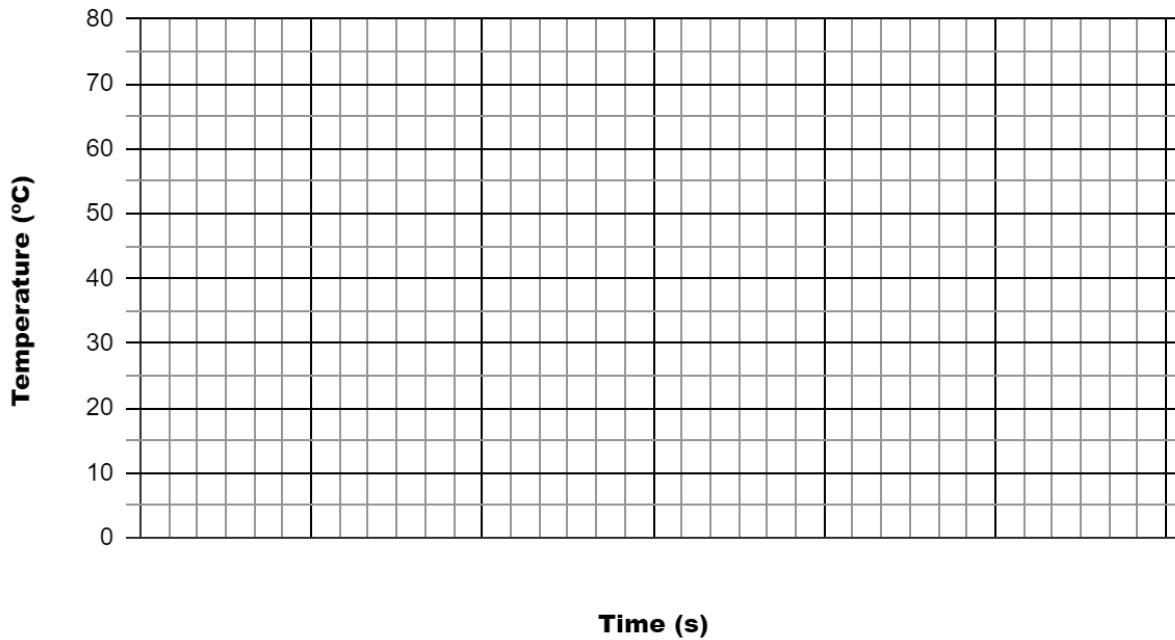
- After data has been collected, be sure to share recorded data so that all group members have a completed data table.

Time (0–150s)	Probe #1 Temp (°C)	Probe #2 Temp (°C)	Time (160–300s)	Probe #1 Temp (°C)	Probe #2 Temp (°C)
0 (HEAT)			160		
10 (HEAT)			170		
20 (HEAT)			180		
30 (HEAT)			190		
40			200		
50			210		

60			220		
70			230		
80			240		
90			250		
100			260		
110			270		
120			280		
130			290		
140			300		
150			STOP!	STOP!	STOP!

Graphical Analysis:

- Use the graph below to plot temperature vs. time data for both probes.
- Label the horizontal axis appropriately for time.
- Develop a “best-fit curve” for each data plot.
- Include a key to help distinguish between the plots for probe #1/surface and probe #2/beneath.
- If a “cambium death temperature” was provided, include that threshold on the graph.

Temperature vs. Time**Questions/Analysis:**

- 1) Describe the plot trend for “probe #1/surface” for 0-300 seconds. If a “cambium death temperature” was provided, be sure to include whether that threshold was passed.

- 2) Describe the plot trend for “probe #2/beneath” for 0-300 seconds. If a “cambium death temperature” was provided, be sure to include whether that threshold was passed.

$$\text{rate of heat transfer} \propto \frac{(\text{temp}_{\text{hot}} - \text{temp}_{\text{cold}})}{\text{thickness}}$$

3) Use the simplified “rate of heat transfer equation” (above) to explain the similarities and the differences between the two plots during 0-30 seconds.

4) Use the simplified rate of heat transfer equation to explain the similarities and the differences between the two plots during 30-300 seconds.

5) Using your understanding of natural selection, describe how thicker tree bark could develop as a trait in tree species found in fire prone ecosystems.

6) How can the physical model of tree bark/soil be used to explain how adding more insulation in a building/house can affect energy consumption?

7) If a “cambium death temperature” was provided, how does the rate of heat transfer equation explain why that threshold was passed or not for each of the probes?