Is It Getting Hot In Here?
HOW DOES A THERMOMETER WORK?

Problems
What will happen to the level of a liquid in a hollow tube as the temperature changes? Does changing the amount of liquid in a flask affect how quickly that liquid rises or falls within a hollow tube?

Research
Answer the following True or False questions:

- True/False  Thermometers only detect increases in heat.
- True/False  Temperature is a measure of internal energy.
- True/False  Celsius is the only scale for measuring temperature.
- True/False  Celsius, Fahrenheit and Kelvin are all temperature scales.
- True/False  When things heat up, their atoms move slower.
- True/False  The atoms in a gas are closer together than the atoms in a liquid.

Identification of Variables
Identify the Independent Variables, Dependent Variable, Constants and Control of this experiment:

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Dependent Variable</th>
<th>Constants</th>
<th>Control</th>
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Hypotheses
If the flask gets warmer, then the liquid in the tube will __________________________. (go up / not change / go down)

If the flask gets colder, then the liquid in the tube will __________________________. (go up / not change / go down)

If there is less liquid in the flask, then the liquid in the tube will move __________________________. (faster / the same / slower)
Procedure

1. To do this experiment, your team will need:
   • A 500 milliliter flask filled with 400 milliliters of water
   • A 500 milliliter flask filled with 200 milliliters of water
   • 2 rubber stoppers with hollow tubes inserted through each one
   • 2 clear plastic centimeter scales
   • Clear tape
   • A bowl filled with 500 milliliters of ice water

2. Tape one of the clear plastic centimeter scales to each of the hollow tubes. The smallest number on the scale should be next to the rubber stopper while the largest number on the scale should be near the top of the hollow tube.

3. Place the two stoppers into the two flasks so that the tubes are in the water. Some water will move up the straw as you do this. Try to keep the water level in the straw as low on the scale as possible.

4. Begin part one of the experiment with the flask containing 400 milliliters of water. Do not play with the other flask while you conduct the experiment.

5. Use the plastic centimeter scale to measure how high the water is in the tube. Record this initial height on the Getting Warmer data chart.

6. When you are told, have one team member place both of their hands on the flask. The instructor will tell you to record the height of the water in the tube every 30 seconds. Record the height of the water in the tube for a total of 4 minutes or until the water gets too high to read. Keep your hands on the flask at all times.

7. Repeat steps 4 and 5 with the flask containing 200 milliliters of water.

8. Give both flasks time to cool to room temperature. Once cooled, reseat the stoppers so that the water level in the tube as high as possible.

9. Begin part two of the experiment with the flask containing 400 milliliters of water. Do not play with the other flask while you conduct the experiment.

10. Use the plastic centimeter scale to measure how high the water is in the tube. Record this initial height on the Getting Colder data chart.

11. When you are told, have one team member place the flask into the bowl of ice water. The instructor will tell you to record the height of the water in the tube every 30 seconds. Record the height of the water in the tube for a total of 4 minutes or until the water gets too low to read. Keep the flask in the ice water at all times.

12. Repeat steps 10 and 11 with the flask containing 200 milliliters of water.

13. Find the Total Change in Height for each of the four trials by subtracting the Final Height from the Initial Height. If the water rose in the straw, the Total Change in Height will be positive. If the water fell in the straw, the Total Change in Height will be negative.

14. Make a bar graph of your results on the Is It Getting Hot In Here Results Graph.
Data Collection and Analysis

Directions: Record the height of the liquid inside each tube every thirty seconds over the course of four minutes. Once all of the data has been collected, find the total change in height by subtracting the final height from the initial height. Make a bar graph showing how the height of the liquid changed in each tube.

Is It Getting Hot In Here Data Chart - Getting Warmer

<table>
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<tr>
<th>Volume of water in flask</th>
<th>(initial height)</th>
<th>HEIGHT of liquid inside tube at TIME (minutes:seconds)</th>
<th>(final height)</th>
<th>Total Change in Height</th>
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<tbody>
<tr>
<td>400 mL of water</td>
<td>0:00</td>
<td>0:30 1:00 1:30 2:00 2:30 3:00 3:30 4:00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>200 mL of water</td>
<td>0:00</td>
<td>0:30 1:00 1:30 2:00 2:30 3:00 3:30 4:00</td>
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Is It Getting Hot In Here Data Chart - Getting Colder

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Is It Getting Hot In Here Results Graphs

Getting Warmer

![Graph showing the change in height for getting warmer]

Getting Colder

![Graph showing the change in height for getting colder]
Conclusions

WHEN THE FLASK WAS HEATED, THE LIQUID IN THE TUBE ________________________________.

WHEN THE FLASK WAS COOLED, THE LIQUID IN THE TUBE ________________________________.

WHEN THERE WAS LESS WATER IN THE FLASK, THE WATER IN THE TUBE ________________________________.

Questions to Think About

1. What caused the liquid level in the tube to rise when the flask was heated?

2. What caused the liquid level in the tube to fall when the flask was cooled?

3. Why does changing the amount of liquid in the flask change how the liquid in the tube behaves?

4. What are some flaws with this type of thermometer? How can they be fixed?