Lab 7: Temperature Scales

1. You have two blocks on your lab table, one made of wood and the other made of aluminum.

Without picking them up (you don't want to warm them with your hands), use the holes in the sides of the blocks to place the temperature probe in them and record their temperatures. (Open **Logger Pro** application **from Heat and Temperature** file to record temperature)

Wooden block: _____°C Aluminum block _____°C

2. Now touch each of the blocks to the inside of your wrist.

   (a) Does one of them feel colder than the other or do they feel the same?

   (b) How do you think it is possible for two objects to feel different to the touch and yet have the same temperature?

3. *Imagine* that you put one hand in ice water and the other in warm water at the same time. After letting them soak for a couple minutes, you remove your hands and place them both in room temperature water.

   (a) *Predict* what you will feel when you put your hands in the room temperature water. Explain your thinking.

   (b) Your instructor will call lab groups over one at a time to perform this activity. Was your prediction confirmed? If not, try to explain why.

   (c) Does the feeling of hotness or coldness give a reliable indication of the temperature of an object? Explain your thinking.

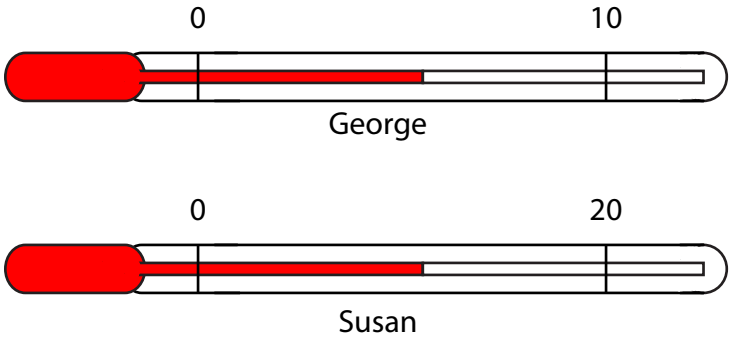
   (d) What do you think a feeling of hotness or coldness is sensing?

4. Three students (George, Susan, and Jesse) are given identical thermometers. These thermometers are unusual in that they have no marked scale or numbers to indicate temperature.

   (a) Imagine that George puts his thermometer into a beaker filled with water and the fluid level rises half-way up the length of the column. If Susan and Linda put their thermometers into the same beaker, do you think that the fluid will eventually rise to the same level as George's? Explain your thinking.

   (b) The students are given the task of defining and calibrating a temperature scale on each of their thermometers and are given two containers: one with ice water and another with boiling water. George, Susan, and Jesse do not know how to proceed with this calibration. How would you advise them to do it?

5. George decides to place his thermometer in the ice water and put a mark at the level the fluid rises to and label that as "0" on his temperature scale (we'll call this 0° on the George scale, or 0°G). He then puts his thermometer into the boiling water, marks where the fluid rises to, and labels this with a "10" (10°G). Susan does the same thing but decides that she will call that "20" (20°S) instead of "10" like George did. The thermometers as they now look are shown in the figure below.



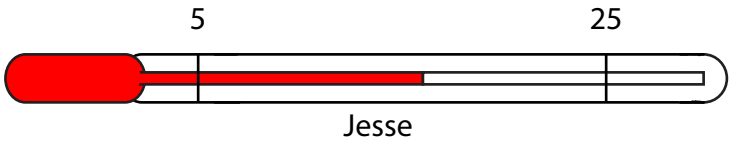
   On a sheet of graph paper, make a graph of temperature on the "Susan" scale (°S) versus temperature on the "George" scale (°G). Label the vertical axis °S and the horizontal axis °G (scale your axes to take up about half of the page).

   (a) What is the slope of your graph? What does this tell you about the relationship between readings on George's and Susan's temperature scales?

(b) Write an equation that expresses the temperature on the Susan scale in terms of the temperature read on the George scale.

(c) Which is larger, a degree on the Susan scale or a degree on the George scale? In other words, which is a larger temperature change, 1°S or 1°G? Explain how you can tell.

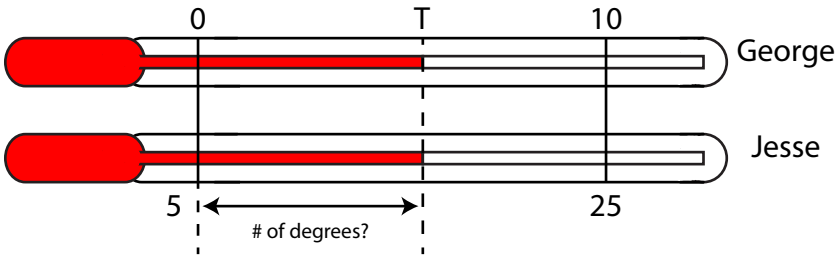
6. Now Jesse performs the experiment done previously by George and Susan, but decides to label the ice water reading as 5 and the boiling water reading as 25, so their thermometer looks like this:



On the same sheet of graph paper you used before, make a graph of temperature on the "Jesse" scale (°J) versus temperature on the "George" scale (°G). Label the vertical axis °J and the horizontal axis °G (scale your axes to take up about half of the page).

(a) What is the slope of your graph? What does this tell you about the relationship between readings on George's and Jesse's temperature scales?

(b) Imagine that Jesse's thermometer and George's thermometer are both placed in the same water bath. If the temperature reads T degrees on the George scale, write an expression for how many "Jesse" degrees there are between 0°G and T°G.



(c) Your expression above would give the "Jesse" temperature if both thermometers had the 0° mark at the same place. However, when the "George" scale reads 0°, the "Jesse" scale reads 5°. How does this difference between the temperature scales show up on the graph you made of °J versus °G?

(d) Write an equation relating the "George" temperature to the "Jesse" temperature.

(Bonus) The temperature scales defined by George, Susan, and Jesse were all based on *reference temperatures* defined by the freezing and boiling points of water. The commonly used *Fahrenheit* (°F) and *Celsius* (°C) temperature scales are also based on these reference temperatures. The freezing point is 0° on the Celsius scale and 32° on the Fahrenheit scale. The boiling temperature of water is 100°C or 212°F. Write an equation relating the Fahrenheit temperature to the Celsius temperature using the information given (do not look it up on the internet!)