Lab 02 R01
September 03, 2019
Black body radiation, Newton's law of cooling, and Evaporation.

Black Body Radiation: You probably know that it is possible to estimate the temperature of an object by looking at the color of light that is emitted from that body. You will also see that temperatures related to this are usually quoted in K. The temperature in Kelvin can be calculated from the temperature in Centigrade by:

$$T_{Kelvin}=T_{Centigrade}+273.15 \quad .$$

On the Kelvin scale, we have the following general color ranges:

1000	Red:	
3000	Light Orange	
6000	bluish white	
8000	Light blue	
12000	blue	

You will note that we often talk about an object that is “red hot” while a blue object as being cold. This means our common language description is, in fact, exactly **backwards** from the physics. Generally said, though, any of those temperatures shown will cause severe burns so don't touch red hot objects. Of course, this is not why the sky is blue. That owes to other processes.

Newton's law of cooling: Last week we looked at the cooling of a piece of white paper and a piece of black paper. We are going to analyze that data now in a different way, and only for the black paper. Mathematically, Newton's law of cooling says:

$$T_{object}=T_{environment}+\left(T_{initial}-T_{environment}\right)e^{-(\text{constant x time})}$$

where e is the base of the natural logarithms. Essentially this means that hotter things cool of faster than cooler things (assuming the environmental temperature is lower). We are going to try to fit our data from last week to get an approximate value for the constant that appears here. This constant is related to the object's surface area, a heat transfer coefficient, and the heat capacity of the object. We will talk about **heat capacity** and **specific heat** more in future minilabs.

Evaporation as a cooling phenomena: Our experiment today will be observations of a temperature change and ultimately the observation of the effect of evaporation of alcohol from a temperature sensor. I have a movie of this over a longer time period, starting with hot alcohol, and monitoring the temperature decrease. However we are interested in the very end of this movie which shows the temperature falling below the temperature of the sensor without alcohol. The cooling happens because temperature is directly related to how fast molecules are moving. Faster molecules have a higher probability of leaving the surface. What thus remains is only the slower molecules and thus the temperature is lower. Of course, if the sensor is below room temperature, energy from the room will heat up the sensor so in our observations, you will not see a huge decrease in temperature below room temperature.