Title: What’s Hot & What’s Snot

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Intended audience: high school students

Content covered: The difference between heat and temperature.

Content Guide

I. IR & Visual spectrum photographs
   These pictures can be used to demonstrate the difference between what we assume and what's real in the world of temperature. There are pictures of plants, animals, statues and really amazing intertidal ectothermic organisms. You can use these to help students understand that they are viewing the world through a lens of human perception. One very effective method is to have students predict, based on the visual photo, what they think the IR photo will look like.

II. Videos
   a. hotfeet
      When a person with warm feet walks across a cool surface, heat is transferred from their feet to the floor. This phenomenon is made visible by the IR pattern we can see here. The signal fades as the heat spreads slightly into the floor via conduction and mostly into the air via convection.

   b. conduction:
      This video is of a metal bar placed on top of a hot plate. In the beginning of the video the metal bar is fairly cool and difficult to see in the video. The point on the left of the screen with the pointer on it is on the metal bar right at the edge of the hotplate. As you watch the video you can see this temperature rise as more and more heat is conducted down the length of the metal bar. On the right edge of the hot plate you can see the movement of heat energy by the changing colors of the bar.

   c. HeatvTemp video accompanied by HeatvTempVISIBLE photo
      This picture shows the equipment we used to demonstrate the difference between heat and temperature. The first conical tube contains dry sand and air. The second tube contains damp sand and air. The last tube has fully saturated sand, a little excess water, and air. The three tubes were all placed in a hot water bath and allowed to remain there until they all reached the same temperature.
      The tubes were placed on a cardboard platform in room temperature air. As you can see from the video, the left tube cools much faster than the other two tubes. In addition, the last tube cools even slower than the middle tube although the difference is less dramatic. Can you think why this might be? At the beginning of the video each tube and its contents were at the same temperature. They did NOT contain the same amount of heat because water has a higher specific heat than air. To reach the same temperature in the beginning, the tubes
with water and sand had to absorb more heat from the water bath that the tube with sand alone.

As the tubes began to cool, they lost heat to the cardboard via conduction and the air via convection. Each of the tubes lost heat in this way at approximately the same rate, but because the tubes on the right contained so much more heat to start with its temperature changed much more slowly. In the table below, the process is demonstrated using 2 "heat meters" and comparing only the left and right tubes.
The two bars on the diagram represent "heat meters" for the left and right tubes in our experiment. The top of the meter represents the amount of heat the tubes will hold at a certain temperature (the temperature of our hot water bath).

At time 0, the two tubes are at the same temperature. As you can see, the amount of heat it takes to equal one degree is greater for the right tube, the one with the water, than for the left tube.

At Time 1, the two tubes have lost the same amount of heat, but the left tube has dropped two degrees in temperature.

Between Times 0 and 2, the tubes have still been losing heat at the same rate so they have both lost the same amount of total heat. However, the difference in temperature has become even more dramatic. The tube with only sand (the left tube) is a full 5 degrees cooler than when we began, while the tube with water has only cooled 2 degrees.