



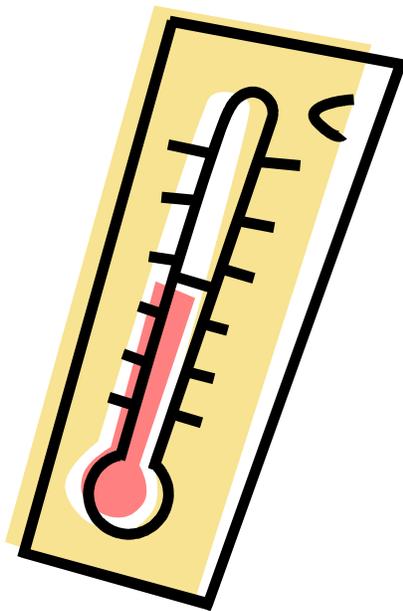
*Drexel-SDP GK-12 ACTIVITY*

**Subject Area(s):** Solar Energy

**Associated Unit:** None

**Lesson Title:** Build Your Own Thermometer

**Header:**



**Image 1**

**Description:** Cartoon picture of a thermometer

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**Grade Level** 5

## **Lesson # 1 of 1**

**Time required: 1 hour**

### **Summary**

Students will understand that heat is a form of energy and how a thermometer is used to measure that energy. Students will make thermometers and learn what happens to certain materials (i.e. liquids) when they are heated

### **Engineering Connection**

Engineers use devices to measure heat.

### **Keywords**

Solar energy, thermometer, heat

### **Educational Standards**

- Science: 3.7, 3.1.5, 3.2.5
- Math:

### **Pre-Requisite Knowledge**

### **Learning Objectives**

After this lesson, students should be able to:

- Observe that thermometers measure thermal energy
- Understand the dynamics on how a thermometer works

### **Introduction / Motivation**

The word thermometer can be broken down into the following parts, “thermo” meaning heat and “meter” meaning to measure, bringing us to what a thermometer does, measures heat. As engineers, measuring heat is something that is done on a fairly regularly bases but how that measurement came to exist is something that is rarely thought about.

As 5<sup>th</sup> graders studying solar energy, thermometers will be frequently used, but how often do we stop to thinking about why when it is hotter out the red ‘dye’ is further up the tube than when it is cold out. Why is there a bulb at the bottom of a thermometer with a narrow tube where the temperature is read?

### **Lesson Background & Concepts for Teachers**

As liquids such as water are heated, they take up greater volume (i.e. expand). If the liquid is enclosed than it will expand to fill up any vacant volume. In the case of a bulb thermometer, it has a very tube for the fluid to expand into. Because the tube is very narrow, then the liquid must expand further up the tube to reach the necessary expansion volume.

When making the thermometers, it is important to create an air tight seal so that the liquid can only expand up the tube (i.e. the straw). If the seal is not air tight, then the liquid can expand within the bulb (i.e. the jar) by pushing the air in the jar out of the non-air tight seal. Also, notice that the one end of the straw is not sealed, but open to the atmosphere. This enables the liquid to expand up the straw as it is heated. The air that exists in the straw can be pushed out by the expanding liquid into the atmosphere.

When the bulb is filled with liquid (rubbing alcohol and water) it is advised for the alcohol and water temperature to be as cold as possible before sealing the jar. If the fluids start at room temperature then the fluid will not expand as much as if the fluid started at a much colder temperature (i.e. close to freezing, 0 C).

Any jar and straw will work, but in order to see a reaction to temperature change the fastest, it is suggested to use the smallest jar (about 30 ml or less) and the smallest straw (drink stir straw) as possible.

Rubbing alcohol is used because it responds to a temperature change faster than water. However, it is not advised to use all rubbing alcohol because costs more money than water and because it can evaporate much faster.

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### Vocabulary / Definitions

| Word             | Definition  |
|------------------|---|
| Expand           | Increase in volume  |
| Bulb thermometer | Common glass thermometer                                    |
| Heat             | Sensation or perception of such energy as warmth or hotness |
|                  |   |

### Associated Activities

#### Materials

- Tap water
- Rubbing alcohol
- Clear, narrow-necked plastic bottle (smaller <30 ml jar with plastic lid is recommended)
  - o I used the small jars from my lab
- Red Food Coloring
- Clear plastic drinking straw (stir straw recommended)
- Modeling Clay
- Drill
- Small paper cups (cut down if desired)
- Something to add and measure the water, alcohol, and food coloring

#### Pre-Activity Preparation

- Put both the rubbing alcohol on ice and prepare a pitcher with ice water
- Pre-drill the holes into the lids of the jar. If desired, can drill the holes in front of the students for effect.

## With the Students

1. Start by asking the students what they know about thermometers. Have them draw a thermometer on a board and then go over the parts of a bulb thermometer and go over how the jar is the bulb, the straw is the tube, and the water/alcohol/food coloring mixture is the fluid inside.
2. Explain to never ever eat or drink anything in a “lab”. Mainly because rubbing alcohol is poisonous.
3. Have the students get into groups (3 per group) and pass out the materials.
4. One group at a time, add equal parts water and alcohol and a few drops of food coloring to their jars.
5. Students will place the lids on their jars.
6. Students will insert the straw so that the bottom end is immersed in the liquid and then use the modeling clay around the interface between lid and straw to create an air tight seal.
7. Students can warm the thermometers with their hands.
8. Pass out a small cup of warm water and a small cup of ice water. Students can move the thermometer back and forth between the two to see the changes.

## Lesson Closure

### Investigating Questions

- Why do we have to make an air tight seal?
- What will happen if we don't have an air tight seal?
- Why does the liquid go up the straw?
- What are some other ways to heat up the thermometer?
- Why did we add cold alcohol and ice water?

## Lesson Extension Activities

Students could add a temperature scale by placing their made thermometers in the same location of a “calibrated” thermometer and marking along the straw the corresponding temperature. Place both thermometers in a different temperature environment and repeat. Mark off incremental temperature marks. Thermometers could be used for additional solar energy activities.

## References

[www.wattsonschoools.com](http://www.wattsonschoools.com)

[www.howstuffworks.com](http://www.howstuffworks.com)

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