

## Canned Heat

Make a simple thermometer with a soda can and straws.

### Introduction:

By using water, a soda can and a straw one can create a thermometer that has an interesting twist.

### Materials:

- Empty can of soda
- One to three clear plastic straws
- Putty, gum or polymer clay (water tight malleable sealant)
- Room temperature water
- Food coloring
- Bowl of hot water
- Bowl of cold water
- Thermometer (optional)
- Permanent marker pen (optional)



### Assembly:

- 1) Remove the pull-tab from an empty aluminum soda can.
- 2) Fill the can to the top with room temperature water. There should be no pockets of air left inside the can. This will be the reservoir of your thermometer.
- 2) Add a drop or two of food coloring to the water in the can (this will allow you to more easily view the water in your thermometer).
- 3) Surround one end of a straw with a small ball of sealant (putty, polymer clay...). The seal between the putty and straw needs to be watertight.
- 4) Place the straw, putty-ball first, vertically into the can's mouth. This will be the thermometer's column.
- 5) You will need to get the colored water into the shaft of the straw. This will allow temperature changes to be visible in the column of the straw (you will really be viewing changes in expansion). To do this, carefully push down on the ball of sealant. As you push down, more and more colored water should rise up into the straw. Try to get the water level to be visible several inches (or centimeters) above the sealant and mouth of the can.
- 6) With a permanent marker, mark the height of the water in the straw.



Option:

7) Attach several straws together to get a longer column. At each attachment joint, smear a little sealant.

To Do and Notice:

- Place the can in to a bowl of ice-cold water or a bowl of hot water. Watch what happens.

- Have someone with warm hands, hold the can and watch what happens.

-By using a real thermometer, see if you can calibrate your homemade thermometer. Create a scale on the straw with a permanent marker and reference each mark to a specific temperature.

What's Going On?

Your thermometer measures temperature indirectly via expansion and contraction.

At the molecular level, all objects move about. When heated, this motion increases. The molecular motion in the bowl of hot water gets conducted into the can of water. As the water in the can heats-up, the increased molecular motion causes the volume of water to expand and pushes it up the column and into the straw. When cooled, water contracts so the level in the column lowers.

You might have noticed that the column of water in the thermometer temporarily lowers when the can is first placed in the bowl of hot water (the opposite effect can be seen when the can is first placed in the cold water). This is due to the expansion of the Aluminum can. When the aluminum can is immersed in the hot water it expands which increasing the volume of the can. This in turn allows some of the water in the straw to flow back into the can. After a few moments, the water begins to heat and climbs up the straw.

Etc.

Most liquid thermometers do not use water. They use alcohol or mercury as their expanding or contracting liquid. These substances work more efficiently through a greater range of temperatures (Mercury, for example is liquid in the temperature range of  $-38.9^{\circ}\text{C}$  to  $356.7^{\circ}$ ).