

Homemade Thermometer

Materials

- Plastic Bottle with cap
- Plastic straw (Clear is recommended)
- Pen (or other sharp object to puncture hole in bottle cap)
- Modeling clay/PlayDoh
- Water
- Rubbing Alcohol
- Food coloring
- Ruler
- Fine tipped permanent Marker
- 2 Bowls
- Ice water
- Hot water



Steps

1. Use a permanent marker to make small marks on the straw, from the top down, at half-centimeter intervals. These marks will serve as level marks on your thermometer.
2. Add rubbing alcohol to the bottle, about $\frac{1}{8}$ of the way full.
3. Add water to the bottle, about another $\frac{1}{8}$ of the way full.
 - a. You should have $\frac{1}{4}$ of the bottle full with equal portions of rubbing alcohol and water.
4. Add a few drops of food coloring to the bottle.
5. Secure the bottle cap. Shake well to mix the liquid.
6. Warm up your modeling clay in your hands until pliable. This will make an airtight seal around your straw on the bottle cap.
7. Punch a hole with a pen in the center of the bottle cap that will allow the straw to slide through.
8. Position the straw so that it dips into the liquid but not too low that it touches the bottom of the bottle.
 - a. Helpful tip: Have someone help you hold the straw while you place clay around the base.
9. Place the clay around the base of the straw at the bottle cap to create an airtight seal, and to help hover the straw above the bottom of the bottle.
10. Your thermometer is ready to test! Pour your hot water into a bowl, what happens to the liquid in the straw?
 - a. If the liquid rises to a level close to the top edge of the straw, take it out of the bowl and place on the table.

- b. Fluid running down the straw into the reservoir indicates a failure of the seal at the top of the bottle. If this happens, make sure the clay forms an airtight seal at the bottle's neck and around the straw and try again.
- 11. Take your thermometer out of your bowl, set it on the table. What happens to the liquid in the straw, as it approaches room temperature. This may take a minute or two.
- 12. Pour your ice water into a bowl. Place your thermometer into your bowl. What happens to the liquid in the straw?
- 13. Try moving your thermometer to different areas of your house, or around your house outside. Place it in different areas of light to make observations. Remember to give it enough time to respond to each environment- it might not happen immediately!

Discussion Guide/Extension

- How does it work?
 - Liquids contract and expand depending on the temperature. Rubbing alcohol is more temperature-sensitive than water, so the liquid changes according to temperature quicker than using only water. When it is hotter, the liquid in the bottle expands, pushing fluid up through the straw; the opposite is true for the cold. Therefore, high levels of liquid in the tube indicate a higher temperature and low levels indicate a lower temperature.
- Water facts:
 - Freezing point: 0 degrees Celsius; 32 degrees Fahrenheit
 - Boiling point: 100 degrees Celsius; 212 degrees Fahrenheit
- Why is it important that the straw doesn't touch the bottom of the bottle?
- Why do you want an airtight seal around the straw?
- What do you think could cause the fluid to flow over the edge of the straw? What could you change in your thermometer to prevent this from happening?
- How accurate do you think this thermometer is, based on the width of the straw compared to the width of a typical thermometer?
- What other items could you have used?
- For information on the discovery and invention of the thermometer, check out this video <https://www.youtube.com/watch?v=kJm6gLiSehg>