THERMOMETER: A Device to Measure Temperature

Is the oven ready for this pie? You look flushed—do you have a fever? The fish are not eating. Is it warm enough in the aquarium? The ice cream is soft. Is that freezer working?

To answer these questions, we reach for a thermometer. And these days, there are lots of different kinds to reach for.

All thermometers work the same way on a basic level: some property of a material changes as it gets hot. You may already be familiar with several kinds of thermometers. The old standby is the glass tube filled with alcohol or mercury. This is how it works.

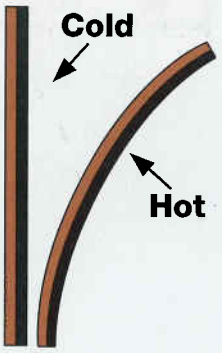
A thin, heat-tolerant, glass tube with a bulb at one end is filled with alcohol or mercury. The liquid extends partway up the tube. The tube is then sealed and attached to a backing that has a scale written on it.

When the bulb touches something hot, the liquid inside expands. The volume of liquid increases. The only place the added volume of liquid can go is into the tube. The distance the liquid pushes up the tube indicates the temperature of the material touching the thermometer bulb.

The first closed-tube thermometer, like the one described above, was invented by Grand Duke Ferdinand II in 1641. He used alcohol in the tube. During the 18th century, more precise closed-tube thermometers made it possible to conduct experiments involving fairly accurate temperature measurements.

In 1714, German physicist Daniel Gabriel Fahrenheit made a mercury thermometer and developed the Fahrenheit temperature scale. On the Fahrenheit scale, 32°F is the freezing point of water and 212°F is the boiling point of water. In 1742, Swedish astronomer and physicist Anders Celsius devised a temperature scale on which 0°C is the freezing point of water and 100°C is the boiling point. This used to be called the centigrade scale, which means "hundred steps." But in 1948, it was renamed the Celsius scale in honor of Anders Celsius.

There are other types of thermometers. Oven thermometers and some wall thermometers look a little like pocket watches. Inside is a **bimetallic strip.** Bimetallic strips are made of two metals stuck together. The two metals expand at different rates when they get hot. When the heat is turned up, the copper-colored part of the strip expands (lengthens) more than the other. The strip bends. A pointer attached to the bending metal strip points to the temperature.



Tropical-fish fanciers keep thermometers right in the aquarium. One efficient kind is a thin, flat strip of plastic, like a piece of black plastic ribbon, that has **liquid crystals** packaged inside. Liquid crystals change color within a very narrow temperature range. A liquid-crystal thermometer has a series of little pockets in the strip, each filled with a different mix of liquid crystals to indicate one temperature only. So all you have to do is look at the strip to see which number is surrounded by a green glow, and that's the temperature.

22 23 24 25 26 27 28 29 30 31 32 33

The last time you went to the doctor for a checkup, you may have had your temperature taken with a digital thermometer. These recent arrivals on the thermometer scene are very accurate and easy to use. You slip the probe end under your tongue for a few seconds. Inside the probe is a circuit with electricity flowing through it. Part of the circuit flows through a piece of wire that changes resistance as the temperature increases. When the electronic circuitry detects that the current flowing in the probe circuit has stabilized, that means the temperature is no longer changing. The electronic thermometer measures the amount of current flowing in the circuit and displays the temperature on a little digital screen.

That's just a small sampling of the many different thermometers found in common and specialized applications.

Galileo *invented one of the first functional thermometers in 1596. He filled a number of small glass balls partway with colored water and sealed them shut. The balls of colored water all floated in water.*

Galileo knew that water expands as it warms up. Warm, expanded water is less dense than cold water. He then attached a weight to each ball. The weights were adjusted to give each ball a slightly different buoyancy. The result was that when the water was cold (at its densest), all of the balls floated. As the water warmed up, becoming less dense, balls would sink.

By placing the balls in a column of water in order of their buoyancy, with the least dense on the top, Galileo produced a thermometer. If all of the balls were on the bottom of the cylinder, it was really hot.

Modern versions of the Galileo thermometer have temperatures printed on the weights. The number on the lowest floating ball shows the temperature of the system.