

# How Thermometers Work

By Cindy Grigg

<sup>1</sup> How hot is it outside? How cool will it be tonight? Do you have a fever? The way we answer these questions is by using a thermometer. People are always interested in measuring things, so it is not surprising that a device was invented to measure temperature. It is called a thermometer. "Therm" means heat, and "ometer" means a measuring device. Some of the things we measure are the temperature of the air, the temperature of our bodies, and the temperature of food when we cook. Temperature is a measure of the hotness or coldness of an object.



<sup>2</sup> Did you ever wonder how a thermometer works? A thermometer has a glass tube sealed at both ends and is partly filled with a liquid like mercury or alcohol. As the temperature around the thermometer's bulb heats up, the liquid rises in the glass tube. The glass tube is mounted on a backboard that is marked in units called degrees. When it is hot, the liquid inside the thermometer will expand and rise in the tube. The opposite happens when it is cold. The temperature on a thermometer is read by finding the level of the liquid in the tube and the number on the temperature scale across from it. The temperature is written in numbers with the  $^{\circ}$  (degree) sign. For example,  $70^{\circ}$  F is read: 70 degrees Fahrenheit.

<sup>3</sup> Alcohol is a good liquid to use in a thermometer because it remains a liquid over most of the normal temperatures found on the Earth's surface. You will sometimes use alcohol thermometers in school. The alcohol is often colored red or green so that the liquid can be seen more easily. However, alcohol is not much use at hot temperatures because it boils at about  $80^{\circ}$  Celsius ( $176^{\circ}$  F), which is too a low temperature for many things to be measured with an alcohol thermometer. For higher temperatures a different liquid is needed so mercury is used.

<sup>4</sup> Thermometers are calibrated to an exact temperature scale either in degrees of Fahrenheit (F) or Celsius (C). In the United States, we usually measure temperature on the Fahrenheit scale. Most other countries in the world use the Celsius scale. There is a third scale, the Kelvin scale, but it is usually used only by scientists to measure very cold things. The Fahrenheit scale records the freezing point of pure water at  $32^{\circ}$  F and the boiling point of water at  $212^{\circ}$  F (at sea level). The normal mouth temperature of the human body is  $98.6^{\circ}$  F on this scale.

<sup>5</sup> The Celsius thermometer records temperatures based on the freezing point of pure water at  $0^{\circ}$  C and a boiling point of water at  $100^{\circ}$  C (at sea level). The Celsius thermometer is used in most countries other than the United States because it is part of the metric system, which is based on a decimal system using multiples of ten. The normal mouth temperature of the human body is  $37^{\circ}$  C on this scale.

<sup>6</sup> There are different thermometers to measure the temperature of different things. Weather can range from 40 degrees below zero to perhaps as high as 130 degrees, depending on the season and where it's measured. A weather thermometer has a range, then, of 170 degrees. Thermometers that measure human body temperature range from 50 to 106 degrees. Thermometers used in the kitchen have different ranges depending on what is being measured. There are candy thermometers that measure liquids above the boiling point which range from 100 to 400 degrees. There are meat thermometers that range from 140 to 190 degrees that let you know how to perfectly cook a steak or make sure your chicken is done. There are thermometers that measure refrigerator or freezer temperatures that make sure your food is kept at a low enough temperature so that it won't spoil. They range from about 20 below zero to 60 degrees.

<sup>7</sup> The inventor of the first thermometer is thought to have been a very famous Italian scientist named Galileo Galilei. Galileo was born in 1564. His first thermometer was a very simple one. Like most of the thermometers in use today, it worked on the idea that as things get hot, they expand or get bigger, and as they cool down, they contract or get smaller. Water is an exception to this. Water actually expands as it freezes!

<sup>8</sup> Galileo's thermometer was open at one end which made it sensitive to air pressure changes that could cause it to be inaccurate. The first closed thermometer was invented by Ferdinand II, Grand Duke of Tuscany, in 1641. He invented the alcohol thermometer. His invention started a thermometer-making tradition in Florence, Italy. The thermometers made in Florence in the 17th century were so good that some of them were still being used two hundred years later.

## How Thermometers Work

<p>1. What is a thermometer?</p> <p><input type="radio"/> A A device that can measure sound</p> <p><input type="radio"/> B A device that can measure the temperature of something</p> <p><input type="radio"/> C The measure of the hotness or coldness of an object</p>	<p>2. When it is hot, the liquid inside the thermometer will _____.</p> <p><input type="radio"/> A Contract and shrink in the tube</p> <p><input type="radio"/> B Expand and rise in the tube</p> <p><input type="radio"/> C Stay the same</p>
<p>3. Temperature is measured in units called _____.</p> <p><input type="radio"/> A Therms</p> <p><input type="radio"/> B Angles</p> <p><input type="radio"/> C Degrees</p>	<p>4. Two liquids that are used in thermometers are _____.</p> <p><input type="radio"/> A Water and mercury</p> <p><input type="radio"/> B Water and alcohol</p> <p><input type="radio"/> C Alcohol and mercury</p>
<p>5. In most of the world, temperature is measured in _____.</p> <p><input type="radio"/> A Kelvin</p> <p><input type="radio"/> B Celsius</p> <p><input type="radio"/> C Fahrenheit</p>	<p>6. Who probably invented the first thermometer?</p> <p><input type="radio"/> A The Grand Duke of Tuscany</p> <p><input type="radio"/> B Ferdinand II</p> <p><input type="radio"/> C Galileo Galilei</p>
<p>7. What does water do when it freezes?</p> <p><input type="radio"/> A Expand</p> <p><input type="radio"/> B Contract</p> <p><input type="radio"/> C Overflows</p>	<p>8. Thermometers work because:</p> <p><input type="radio"/> A The liquids inside them contract when it gets hotter, and expand when it gets colder</p> <p><input type="radio"/> B The liquids inside them expand when it gets hotter, and contract when it gets colder</p>