

REAL WORLD APPLICATIONS**● Understanding Thunderstorms**

Lightning in a thunderstorm is dazzling and stunning. But what causes lightning? Benjamin Franklin performed an experiment that showed that lightning is electricity. Electricity, as you know, is produced when electric charges move through a conductor under the influence of an electric force.

How Clouds Become Charged

Clouds are made of water droplets and ice crystals. During a thunderstorm, charges from the water molecules become separated. When positive and negative charges separate and collect in separate regions of the cloud, an electric force is generated. Under certain conditions, these charges can result in a large potential difference between the cloud and the ground—up to hundreds of millions of volts. (The large potential difference is a result of a large electric force.)

Air under normal conditions is not a good conductor of electricity. But when the potential difference becomes great, an electric current (sometimes called an electric discharge) is created, allowing charges to flow. Because lightning consists of an intense electric current, the temperature of air where the lightning strikes becomes very hot: around 27,000°C. The hot air quickly expands outward, and the resulting pressure produces a sound wave, which we hear as thunder.

Timing Thunder and Lightning

Because the sight of lightning travels to your eyes at the speed of light, and thunder travels at the speed of sound, you can use the difference in time to calculate how far away the lightning is. If you measure the number of seconds between seeing lightning and hearing thunder, and divide this number by three, you will know how many kilometers away the lightning is. If you divide the time difference by five, you will know how many miles away the lightning is.

Your Turn to Think

1. Convert 27,000°C into Fahrenheit.
2. Why do you see lightning before you hear thunder?
3. If you count 5 seconds between the time you see lightning and the time you hear thunder, how far away is the lightning in kilometers? in miles?