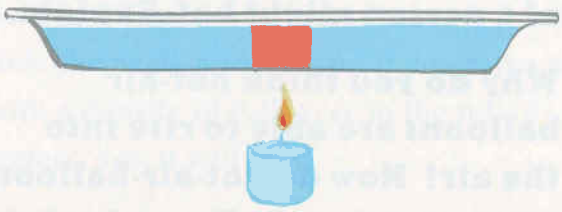
CONVECTION

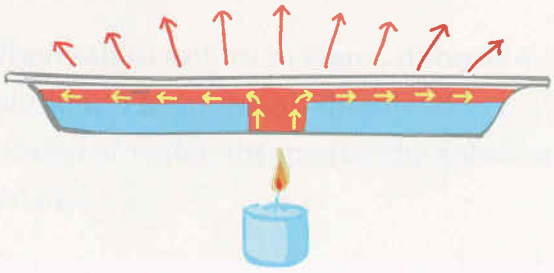
If you put a couple of centimeters of water in a metal pie pan and support it over a candle, you can slowly heat the water. The energy from the flame will heat a small area of the pan, and the heat will conduct to the water in contact with the hot metal.

A small mass of water will heat up. The question is, what happens to the hot water?

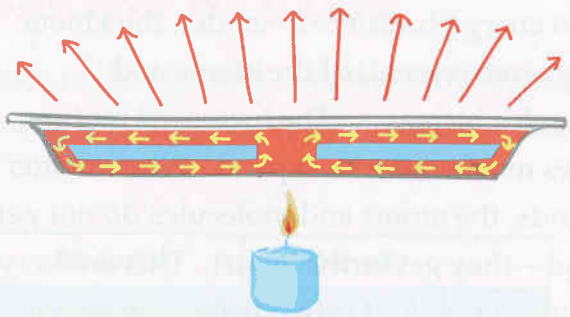
The water expands as the water molecules gain kinetic energy and push farther apart. The expanding water is less dense than the surrounding water. The warm water rises upward.



When the warm water reaches the surface, it spreads out. Water at the surface cools by radiation and conduction.



When the cool water reaches the edges of the pie pan, the water is dense. It flows down the sides of the pan, across the bottom, and back toward the center of the pan. As the water nears the hot metal, it begins to warm again. The hot water rises to repeat the cycle.



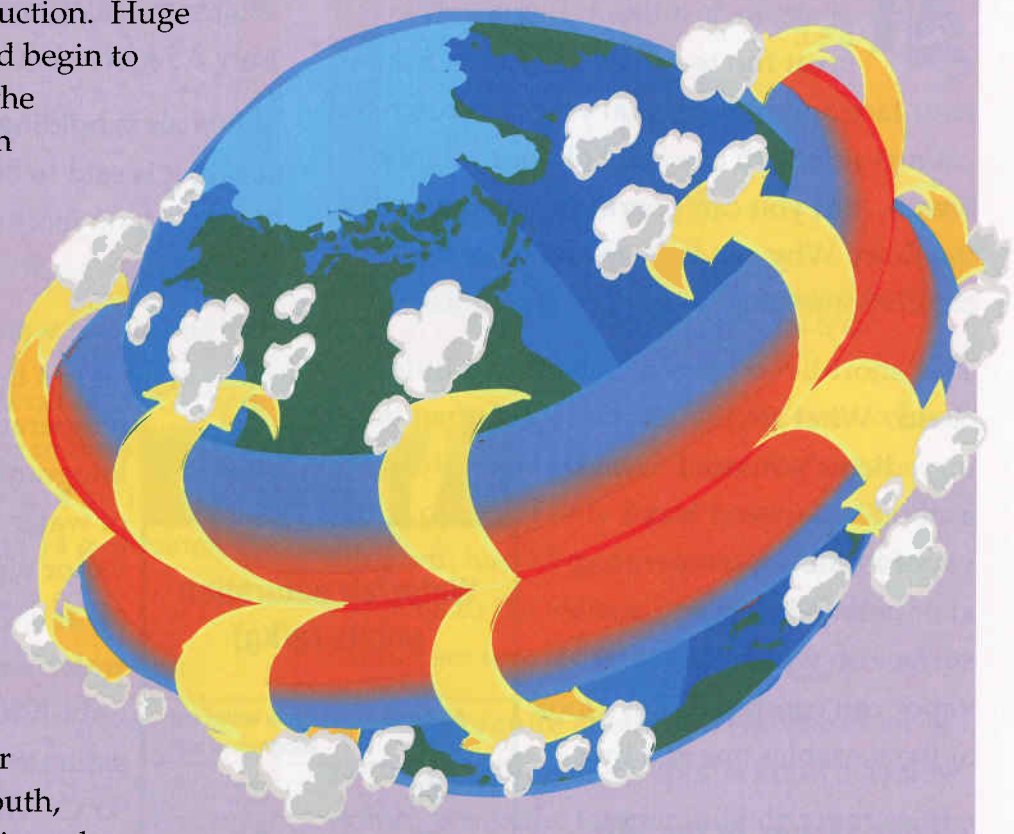
The movement of water in the pan, driven by a localized heat source, is **convection.**

Convection happens only in fluids. Fluid near an energy source heats up and expands. The hot fluid becomes less dense and rises. The energy in the molecules of hot fluid is carried to a new location. As the energy in the hot fluid transfers away from the fluid, it cools and contracts, making it denser. The cool fluid flows downward again.

The mass of fluid flowing in a circle is called a **convection cell.**

Air is a fluid. Energy can transfer to air, causing it to expand. When air expands, it becomes less dense. Less-dense air will rise in the atmosphere.

This is exactly what happens in the real world. Earth's surface is always warm in the tropics, the part of the planet near the equator. Water in the tropical oceans absorbs a lot of solar energy. Air in contact with the tropical seas receives a lot of energy by reradiation and conduction. Huge masses of air heat up and begin to rise. This is the start of the largest convection cell on Earth.



The equatorial convection cells circle the globe like two bicycle inner tubes. Because much of the energy transfer occurs over the ocean, large amounts of water vapor rise high into the atmosphere, riding along in the convection cell. The warm, moist air spreads out north and south, and it cools. When the air cools, water vapor condenses into droplets of liquid water. Large numbers of little droplets of water form clouds. And we all know what happens after clouds form—rain.

In the next few investigations, we will see how the process of convection helps redistribute water around the planet and affects wind, everything from gentle breezes to powerful, dangerous storms.