

Convection in the Environment

Uneven heating of liquid on a stove can produce convection currents. Similarly, uneven heating of air at Earth's surface can produce convection currents in the air. Large convection currents in air are called "wind."

The air feels cooler near lakes and oceans in the summer because the energy from the Sun does not heat the air over land and water evenly. Near a lake, the air above the water is colder than the air above the land because land requires much less of the Sun's energy to warm up than does water. The warm air particles above the land are more strongly heated by the warm land surface below. They move faster and spread apart. This makes the air above the land less dense (lighter) than the air over the water. The cool, dense (heavy) air above the water moves down and toward the land. This pushes the warm air over the land upwards (Figure 1). We feel this movement of cool air off the water and toward the land as a cool sea breeze. The warm air that rises high into the atmosphere over the land eventually moves over the water, cools down, sinks, and then moves toward the land again. This daytime movement of air near a body of water is caused by convection.

LINKING TO LITERACY

Synthesizing Information

When you read text that presents new information or ideas, you compare it to what you have read or already know, or compare it with other sources. Use both the text and the diagram on this page, together with what you already know, to help you understand convection in the environment.

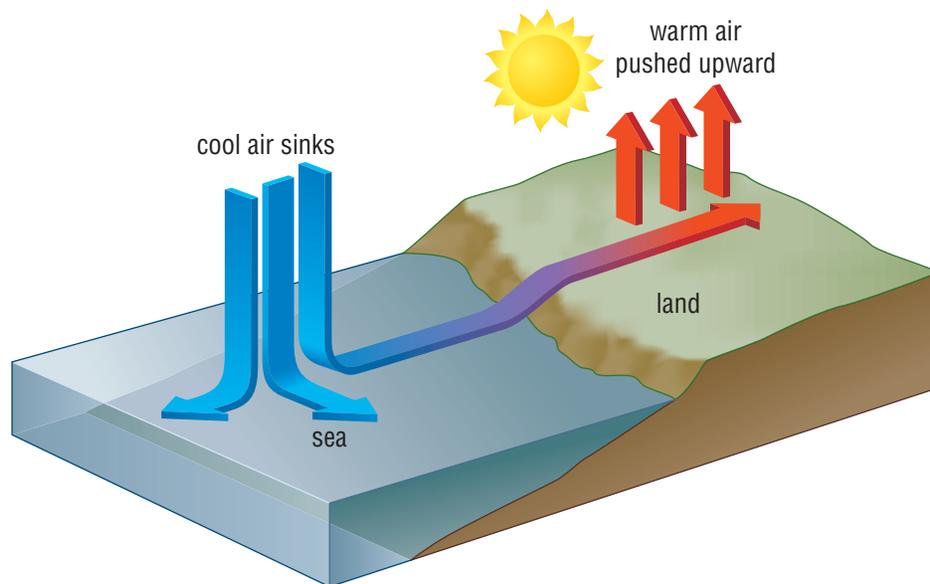


Figure 1 The uneven heating of Earth's surface creates warm and cool air, similar to the convection current in a pot of heated water or soup.

When the Sun goes down in the evening, the land cools more quickly than the water. The warm water heats the air above it, making the air less dense. The cool, dense (heavy) air over the land moves down and out toward the water. This pushes the less dense (lighter) air over the water higher into the atmosphere. A "land breeze" then moves from the land toward the water.

Thunderstorms

Thunderstorms produce lightning and thunder, and are usually associated with strong winds and heavy rains (Figure 2). Thunderstorms create severe weather such as hail, tornadoes, and hurricanes.

Thunderstorms often form on hot, humid days. Earth's surface is warmed by energy from the Sun. The energy is then transferred to the air above the surface of the ground by conduction. This warmed air is less dense than the surrounding cooler air. The warm air is rapidly pushed up higher into the atmosphere by convection, carrying water vapour along with it. As convection pushes the air higher, the water vapour cools and condenses into microscopic droplets of water that appear as large puffy clouds (Figure 3). Large amounts of thermal energy are released as the water vapour condenses. This energy warms the air, so it is pushed even higher into the atmosphere. As the warm, moist air rises higher, it spreads out and the remaining water vapour condenses, forming large clouds called thunderheads (Figure 4). The water droplets in thunderheads eventually become heavy enough to fall as rain.

Convection and Geological Processes

The temperature of Earth's mantle increases as you go deeper. So, the top of the mantle is cooler than the bottom. Over millions of years, cooler mantle rock sinks as warmer mantle rock rises closer to Earth's crust. This creates very slow convection currents. These convection currents transfer energy and may cause some volcanic eruptions.

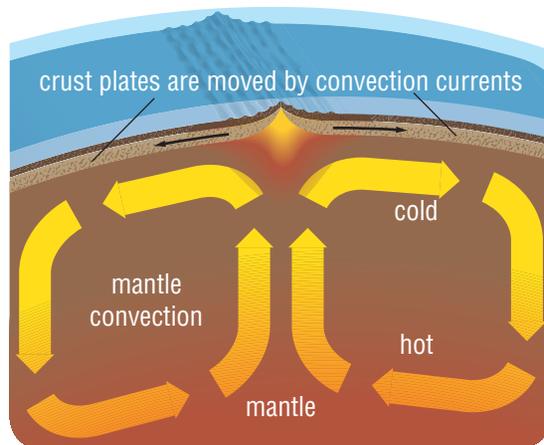


Figure 5 Convection currents below Earth's crust



Figure 2 Lightning is a common sight during thunderstorms.



Figure 3 These puffy white clouds form because of convection currents.



Figure 4 Thunderheads result as air in clouds warms and rises higher.

✓ CHECK YOUR LEARNING

1. List three natural processes that depend on convection.
2. (a) Draw two diagrams to explain land and sea breezes.
(b) Label each diagram "day" or "night," as appropriate.
3. What geological events occur because of convection currents in magma?
4. (a) For thunderstorms to occur, the air must have two characteristics. What are they?
(b) Are thunderstorms more likely to form over land or over water? Why?