

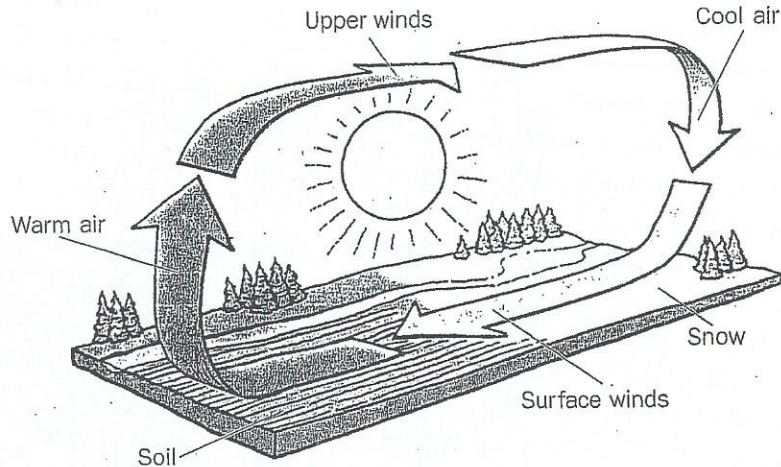
Why Does the Wind Blow?

What causes the wind to blow? From light breezes to strong gusts, winds are the result of uneven heating of the earth's surfaces.

The process begins as the sun warms the earth. As the layer of air above a warmed surface heats, it expands, becomes lighter, and rises. Meteorologists use the word "convection" to describe the movement of heat through air or water. This movement results from temperature differences: As the warm air rises, it expands and cools. Cold air moves in to replace the rising warm air. The earth warms this layer of incoming cool air and it, too, rises, and then is replaced by another layer of cooler air. This cycle goes on and on. The circulating flow of air resulting from temperature differences is called a convection current. Convection currents can form in liquids, too.

Land Breezes and Sea Breezes

Land breezes and sea breezes are caused by convection. These breezes occur where large bodies of land and water meet. The different rates at which land and water heat and cool



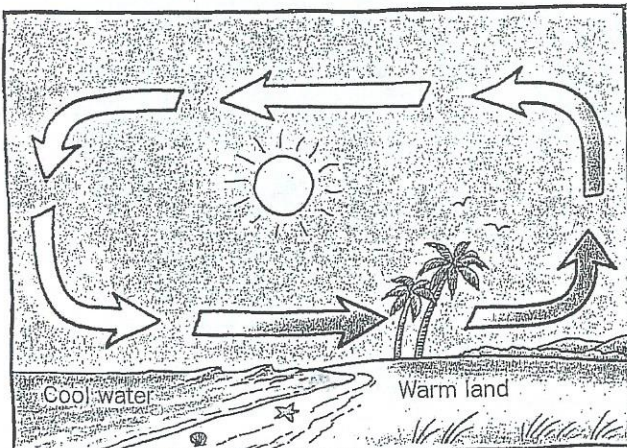
Uneven heating causes winds.

cause these winds. This happens more often in early summer than at other times of the year.

During the day, land warms up faster than the water in lakes or oceans does. Warm air rises above the land, forming an area of low pressure. In low-pressure areas, the air is warm and light, which means it is not dense. Cool air over the water moves toward the land and replaces the rising warmed air. This flow of air is called a sea breeze.

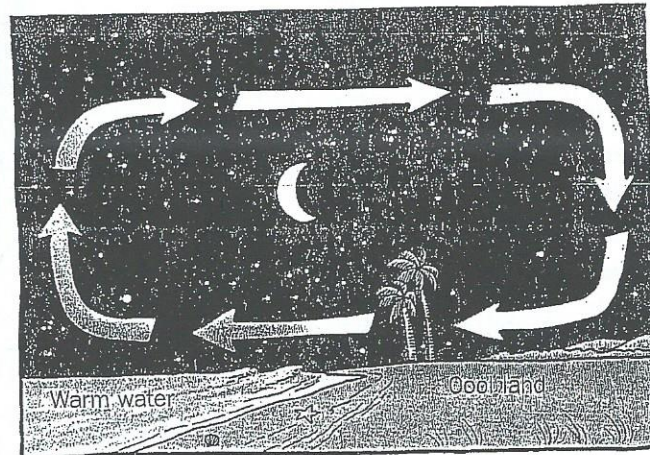
At night, the land cools faster than the water does, so the air over the land becomes cooler than the air over the water. As the warm air over the water rises, cool air from the land moves toward the water to replace it. The flow of air from land to water is called a land breeze.

SEA BREEZE



Sea breezes occur during the day.

LAND BREEZE



Land breezes occur at night.

What Are Monsoons?

Monsoons are very powerful land and sea breezes that change direction with the seasons. They occur mostly in southern Asia and are an important part of daily life there.

During the summer, the air over the land heats up. As the hot air rises, it is replaced by warm, moist air from the Indian Ocean. The water vapor in the rising air condenses, forms clouds, and produces rain. The heat in the area helps drive the monsoons, bringing long periods of rain to the region. During the summer, people grow rice and other crops that need much moisture.

In the winter, the land cools faster than the water does. Cool air over the land sinks and moves out to sea. During this time of year, southern Asia receives little rain.



Cycle rickshaws on the streets of Bangladesh during the monsoon season

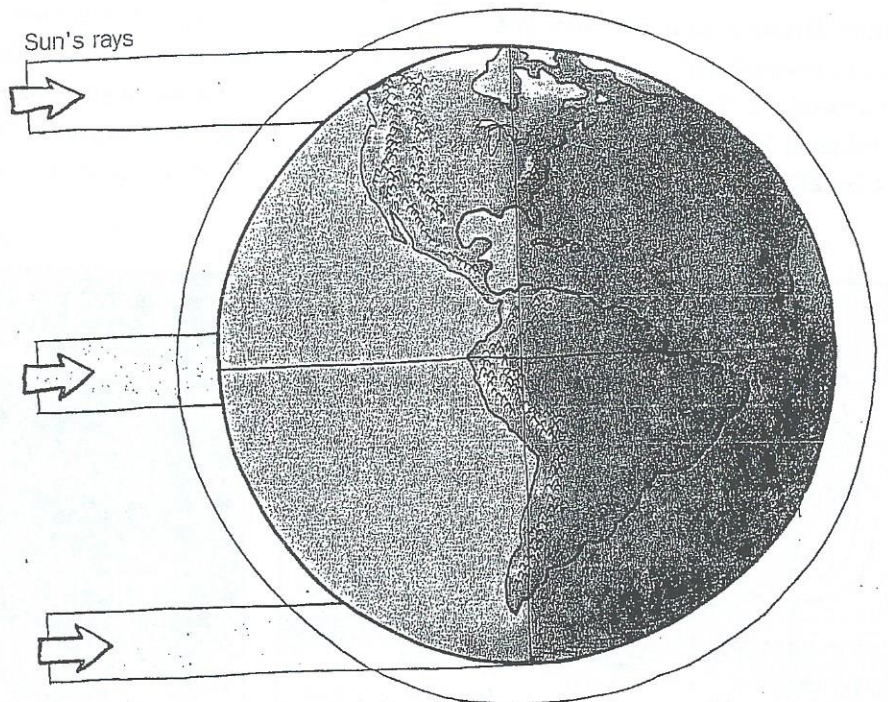
Other factors can cause local winds. One factor is color. You may already know, for example, that dark-colored clothing absorbs heat faster than light-colored clothing does. This happens on the earth, too. Dark soils absorb heat faster than light-green fields do. The air above these surfaces is warmed or cooled accordingly, and local winds result.

Global Winds

Winds don't just blow locally. They are continually forming around the earth, moving in a particular direction and traveling over long distances. These winds, which form between the equator and the poles, are called global winds.

The equator and the poles are not heated evenly. Near the equator, the sun's rays are more intense. (See the illustration.) This makes the areas nearby, called the

tropics, very warm. Near the poles, sunlight that reaches the earth's surface has to pass through more atmosphere than at the equator. Because the atmosphere both absorbs and reflects the sun's heat, the poles are not as warm.

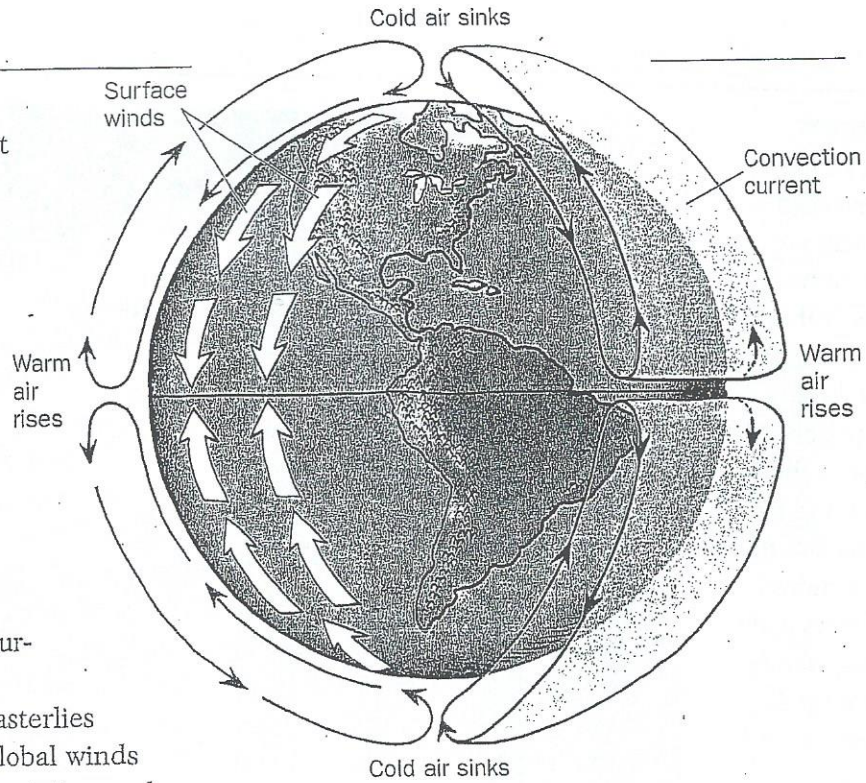


Sunlight passes through more atmosphere near the poles.

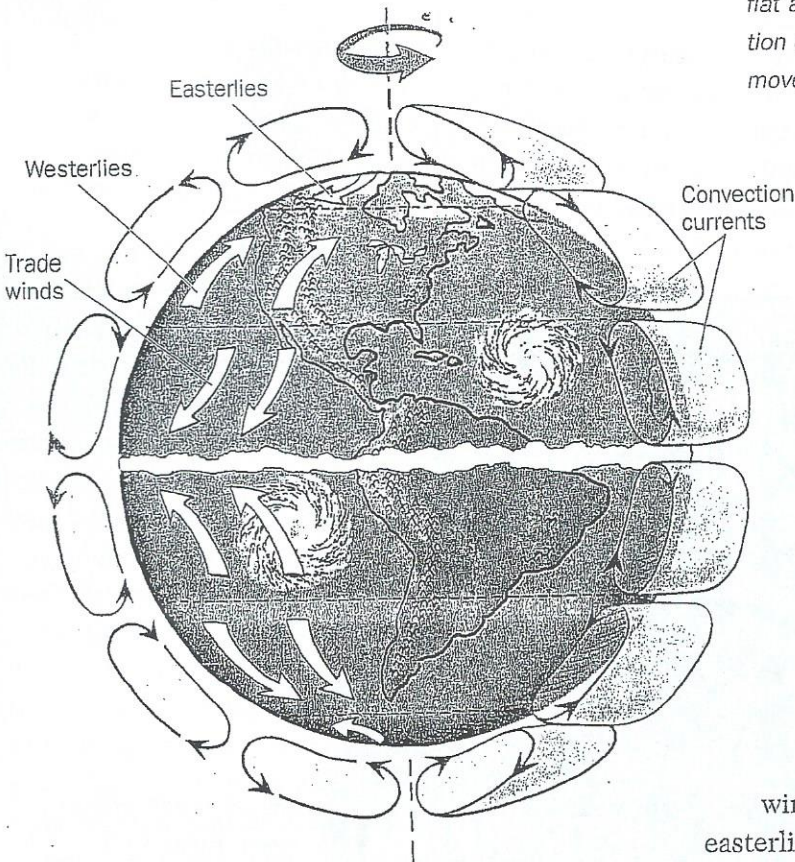
Circling the Globe

Global winds are the result of giant convection currents that circulate within the Northern and Southern Hemispheres of the earth. As warm air is heated at the equator, it rises and flows both north and south toward the poles. If the earth didn't rotate, the hot air at the equator would rise to the poles, cool, sink, and flow back to the equator again. (See the illustration, right.) But the earth does rotate, which means that air and water currents on the earth are deflected.

Trade winds, westerlies, and easterlies are names of different kinds of global winds that form because of the earth's rotation and



If the earth did not rotate and if its surface were flat and uniform, air would form perfect convection currents. Hot air would rise at the equator, move all the way to the poles, and then sink.



The earth's rotation and other factors cause convection currents to form on the earth. Winds in the Northern and Southern Hemispheres are mirror images of each other.

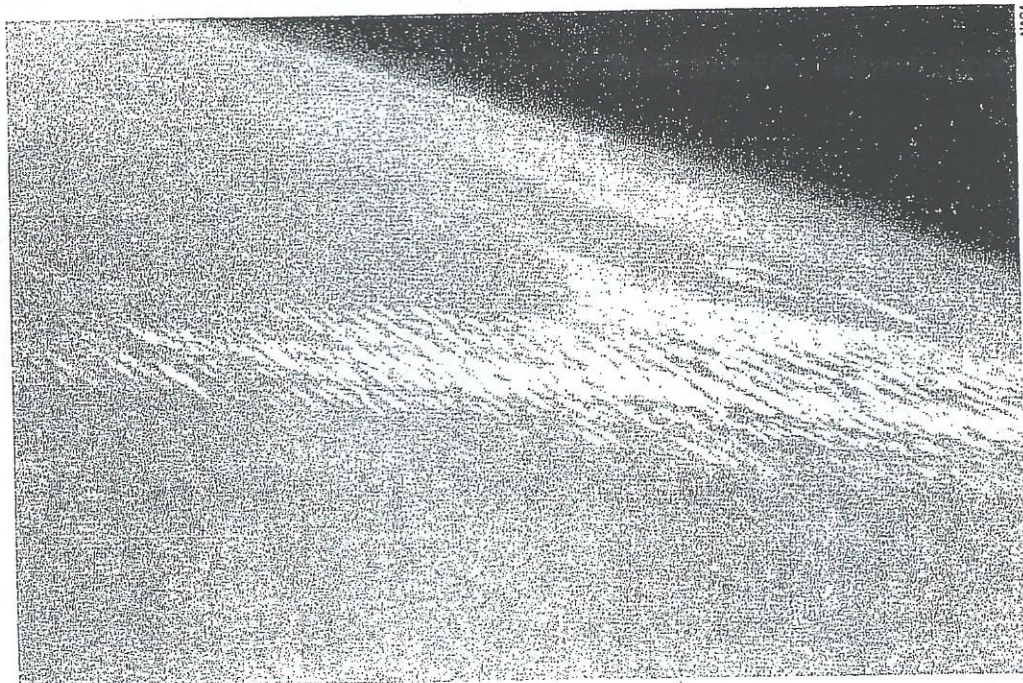
the sun's energy. Trade winds flow toward the equator, turning west as they go. Westerlies flow from west to east. These winds are called westerlies because they flow *from* the west. For example, polar westerlies are winds that flow toward the poles, turning east as they go. Easterlies flow from east to west. These winds are called easterlies because they flow *from* the east. For example, polar easterlies are winds that sink at the poles, spread outward, and turn west as they go.

What happens when these global winds meet? Where the westerlies and easterlies meet, weather changes occur. The meeting of the westerlies and easterlies has a major effect on the weather that occurs in North America.

Jet Stream

Strong winds in what is called a jet stream are long, relatively narrow "tubes" of air in the upper troposphere. Located about 10 km above the ground, the jet streams are only a few hundred kilometers wide, but they sometimes stretch halfway around the earth.

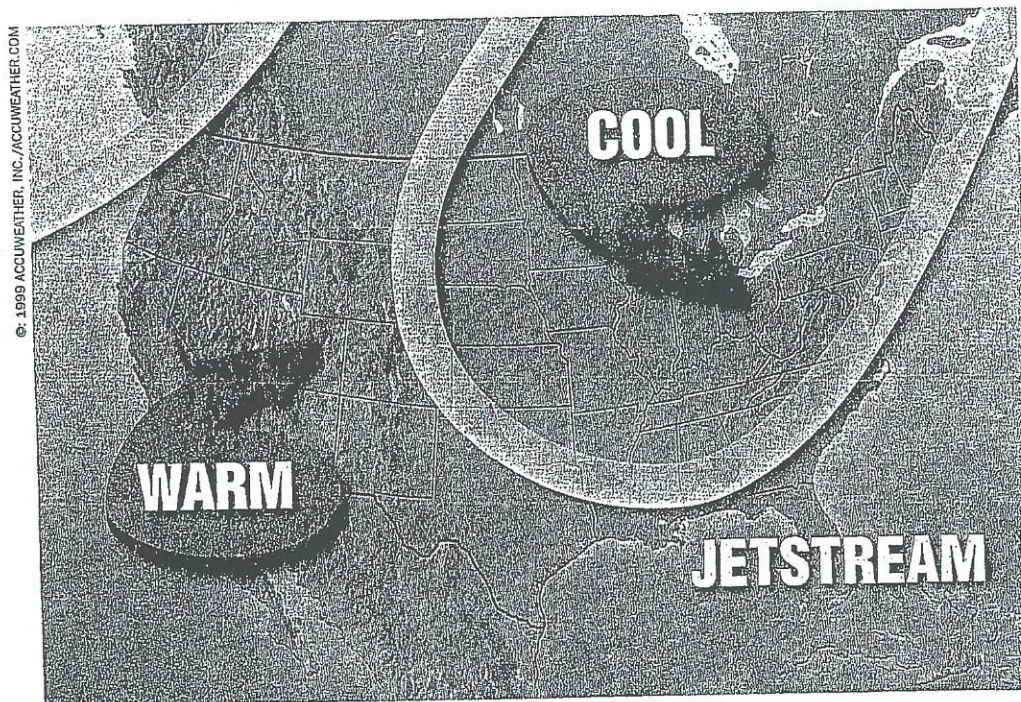
Jet stream winds usually travel at about 200 kilometers per hour, but sometimes they can move twice that fast. American pilots during World War II discovered them. Jet streams and their paths vary from day to day and season to season. These powerful winds play a



NASA

Clouds in the jet stream over the Middle East. Today, the jet streams help high-flying airplanes travel east. Planes going west try to avoid the jet stream. Can you figure out why?

large part in moving air masses around the earth. This means that they also play a big part in determining the earth's weather. Forecasters can use the path of a jet stream to predict how weather will move across the country. □



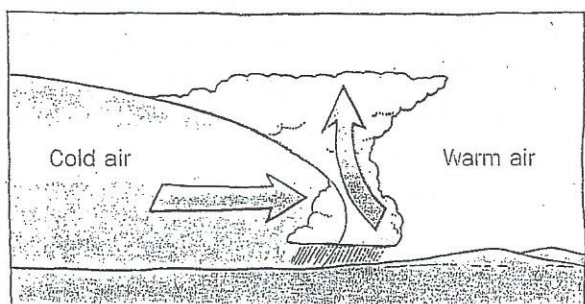
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The jet stream affects where fronts form, and it moves weather in the United States from west to east.

WEATHER FRONTS

Have you ever heard your local weather forecaster talk about “weather fronts”? Fronts bring changes in the weather. They occur when air masses of different temperature, pressure, and humidity conditions collide. A weather front forms along this boundary between different air masses.

There are several different types of fronts. A cold front is the leading edge of a moving mass of cold air. When a cold air mass pushes a warm air mass ahead of it, the dense, cold air slides under the light, warm air. The warm air gets

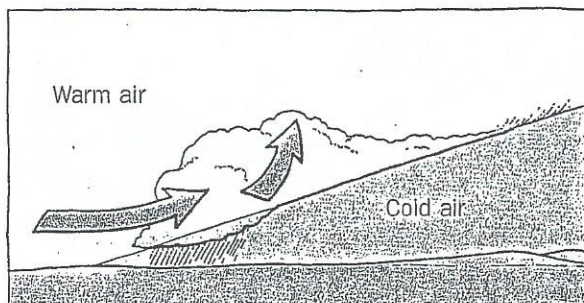


Cold front

pushed upward, which causes thunderstorms. If there is a lot of water vapor in the rising warm air, dense clouds form, and rain or snow may fall. If there is little water vapor, only clouds form. Cold fronts frequently move fast and cause abrupt changes in weather, including violent thunderstorms or tornadoes. After a cold front passes, cool, dry air moves in.

At a warm front, a moving, warm air mass overrides a cold air mass ahead of it. The warm air is less dense, so it rises above the cold air. If the warm air is dry, scattered clouds form. If the warm air is humid, rain (or light rain or snow in the winter) normally falls along the front. Warm fronts typically move slowly, so rainy weather usually stays around for days.

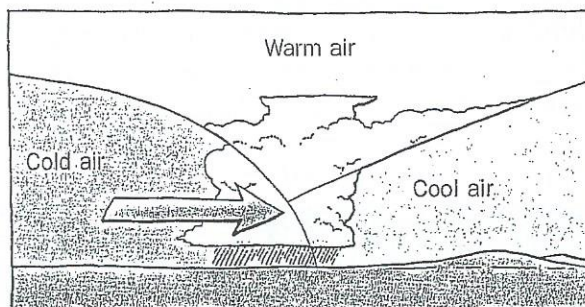
If two air masses move close to one another but neither has enough force to move the other, they both remain fixed in place. The boundary between them is called a stationary front. At



Warm front

the point where the warm air and cold air meet, water vapor in the warm air condenses into rain, snow, fog, or clouds. If the stationary front remains in place for a long time, it may bring days of clouds and precipitation.

In a more complex frontal system—an occluded front—both a cold and a cool air mass collide with a warm air mass, which becomes trapped in the center. The warm air mass is lifted upward. It is cut off, or occluded, from the ground. As the warm air cools, its water vapor condenses. Then the weather may bring clouds and rain or snow.



Occluded front

When you listen to weather forecasts from now on, pay close attention to what the forecaster says about fronts. Do you notice that one type of front tends to form in your area more than others? What type of weather and cloud cover does each front bring? The appearance of clouds will often tell you a lot about the way air is circulating in each frontal system. □