

National Weather  
Service

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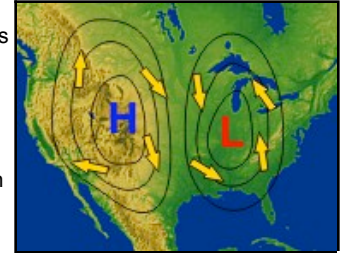
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## Origin of Wind

Wind is simply the air in motion. Usually when we are talking about the wind it is the horizontal motion we are concerned about. If you hear a forecast of west winds of 10 to 20 mph that means the horizontal winds will be 10 to 20 mph *FROM* the west.

Although we cannot actually see the air moving we can measure its motion by the force that it applies on objects. For example, on a windy day leaves rustling or trees swaying indicate that the wind is blowing. Officially, a wind vane measures the wind direction and an anemometer measures the wind speed.

The vertical component of the wind is typically very small (except in thunderstorm updrafts) compared to the horizontal component, but is very important for determining the day to day weather. Rising air will cool, often to saturation, and can lead to clouds and precipitation. Sinking air warms causing evaporation of clouds and thus fair weather.



You have probably seen a surface map marked with H's and L's which indicate high and low pressure centers. Surrounding these "highs" and "lows" are lines called isobars. "Iso" means "equal" and a "bar" is a unit of pressure so an isobar means equal pressure. We connect these areas of equal pressure with a line. Everywhere along each line is constant pressure. The closer the isobars are packed together the stronger the pressure gradient is.

Pressure gradient is the *difference* in pressure between high and low pressure areas. Wind speed is *directly proportional* to the pressure gradient. This means the strongest winds are in the areas where the pressure gradient is the greatest.

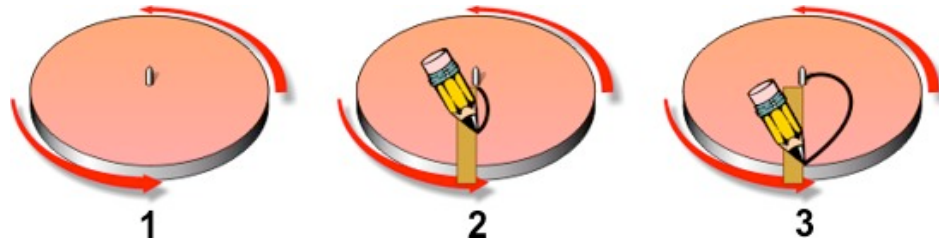


Also, notice that the wind direction (yellow arrows) is clockwise around the high pressure system and counter-clockwise around the low pressure system. In addition, the direction of the wind is across the isobars slightly, away from the center of the high pressure system and toward the center of the low pressure system. Why does this happen? To understand we need to examine the forces that govern the wind.

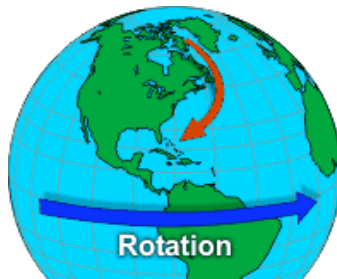
There are three forces that cause the wind to move as it does. All three forces work together at the same time.

The **pressure gradient force** (Pgf) is a force that tries to equalize pressure differences. This is the force that causes high pressure to push air toward low pressure. Thus air would flow from high to low pressure if the pressure gradient force was the only force acting on it.

However, because of the earth's rotation, there is second force, the **Coriolis force** that affects the direction of wind flow. Named after Gustav-Gaspard Coriolis, the French scientist who described it mathematically in 1835, this force is what causes objects in the northern hemisphere to turn to the right and objects in the southern hemisphere to turn to the left.



One way to see this force in action is to see what happens when a straight line becomes a curve. Picture the Earth as a turntable (see number 1) spinning counter-clockwise. A ruler is placed over the turntable (see number 2) and a pencil will move in a straight line from the center to the edge while the turntable spins underneath. The result is a curved line on the turntable (see number 3).



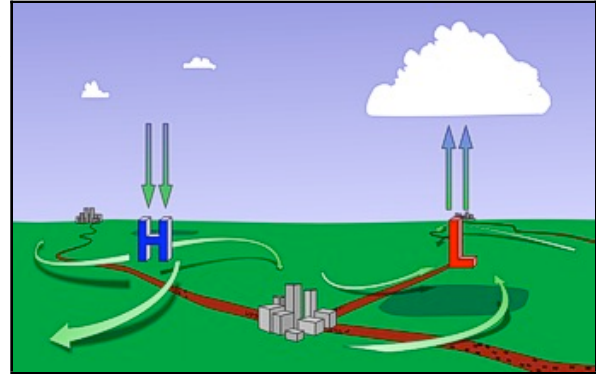
When viewed from space, wind travels in a straight line. However, when view from the Earth, air (as well as other things in flight such as planes and birds) is deflected to the right in the northern hemisphere (red arrow on image at right). The combination of the two forces would cause the wind to blow parallel to straight isobars with high pressure on the left.

So why does air spiral out from highs and into lows? There is one other force, called **Friction**, which is the final component to determining the flow of wind. The surface of the earth is rough and it not only slows the wind down but it also causes the diverging winds from highs and converging winds near lows.



What happens to the converging winds near a low? A property called mass continuity states that *mass cannot be created or destroyed in a given area*. So air cannot "pile up" at a given spot. It has to go somewhere so it is forced to rise. As it rises it cools. When air cools it can hold less water vapor so some of the invisible vapor condenses, forming clouds and precipitation. That is why there is often inclement weather near low pressure areas.

What about the diverging air near a high? As the air spreads away from the high, air from above must sink to replace it. Sinking air warms. As air warms it can hold more water vapor, which means that clouds will tend to evaporate. That is why fair weather is often associated with high pressure.



**Next:** [Introduction to weather maps](#)

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National Weather Service  
Southern Region Headquarters  
819 Taylor Street  
Fort Worth, Texas 76102

[www.srh.weather.gov](http://www.srh.weather.gov)  
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