

Highs, Lows, Winds and Jet Streams

P2K wishes to thank Glen Freimuth, Professor of Earth Science, Richland Community College, Decatur, IL, and Project DataStreme team leader, who worked with the Instructional Materials development team to create and review this Activity. The “hand-twist” procedure is also one used by DataStreme, a project of the American Meteorological Society.

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Teacher Background

It's often said that we live under an “ocean of air,” and like an ocean of water exerting great pressure at its depths, the atmosphere presses upon everything within its boundaries. Air has mass, and due to the gravitational pull of the Earth, it has weight. In fact, the weight of a column of air at sea level is equivalent to 1.0 kg per square centimeter (14.7 lbs per square inch). That's as heavy as a small bowling ball resting on your thumb!

Just as a submarine experiences less pressure from the surrounding water as it nears the surface, so air pressure decreases with an increase in elevation or altitude. With less air above, there is less mass being pulled down by gravity, resulting in lower air pressure. Air flows from regions of high pressure to regions of low pressure. These differing regions are the result of the uneven heating of the Earth's surface and variations in water vapor present. Imagine filling a bath tub with water and attempting to push the water with your hands to one end. The water quickly flows back to its original level, resisting the momentary variation in weight from one end of the tub to the other.

Like water, air always flows toward regions of lower pressure and we experience this flow of air as wind. Its speed and direction are influenced by the Earth's rotation and the surface over which it flows. In the northern hemisphere, air flows into a low pressure center in a counter-clockwise manner. This is caused by the Coriolis Effect and friction, and the resulting low pressure flow of air is called a cyclone. Air flows into the low pressure center and is carried aloft. In contrast, denser, heavier air sinks in a high pressure center and flows outward in a clockwise manner. This is called an "anticyclone." The greater the difference in neighboring pressure centers, the stronger the flow of air between them. Smaller scale examples of air flow can be caused by the uneven heating of land and water along a coastline resulting in land breezes and sea breezes. Local winds can also be triggered by variations in the heating of different surfaces such as urban concrete and rural vegetation.

Objectives

- Students will apply the “hand-twist” model to determine wind direction around high and low air pressure centers.
- Students will predict changes in surface wind direction caused by movements of high and low air pressure systems.

Materials

pencil
Worksheets

Engage

Ask your students to explain why the wind blows. (Differences in air pressure.) From which direction does a north wind blow? (Winds are always named for the direction from which they blow: a north wind is blowing *from* the north *towards* the south.) What causes the wind to blow from different directions? (Proximity to high and low pressure centers, variations in local surface heating.) What effect does a south wind have on local temperature? (For the Northern hemisphere, a south wind generally brings warmer temperatures from the Tropics.) A north wind? (Generally brings cooler temperatures unless you live in the Southern Hemisphere: weather and climate are good reminders that the Northern and Southern hemispheres experience nature's forces differently, and that we should constantly remind students that the Coriolis forces, and the rotation of winds around high and low pressure areas, vary depending on which side of the equator you may live.) In what direction does air flow in a tornado or hurricane in the northern hemisphere? (Counter-clockwise.) Distribute and review the student worksheets for this activity.

Expand/Adapt/Connect

Examine current U.S. weather maps showing low and high pressure centers. Determine the wind directions for cities surrounding these high and low pressure centers and predict changes in wind direction as the systems move eastward across the U.S. Compare your predictions to forecasts for the various cities.

Suggested URLs

Weather map needed for this activity.

http://www.comet.ucar.edu/dstreme/images/sfc_pres.gif

[http://ww2010.atmos.uiuc.edu/\(Gh\)/guides/crclm/act/prs.rxml](http://ww2010.atmos.uiuc.edu/(Gh)/guides/crclm/act/prs.rxml)

This University of Illinois activity introduces the characteristics of low and high pressure systems.

http://zebu.uoregon.edu/~js/glossary/coriolis_effect.html

Explanation of the Coriolis Effect including diagrams.

[http://ww2010.atmos.uiuc.edu/\(Gh\)/guides/mtr/fw/crls.rxml](http://ww2010.atmos.uiuc.edu/(Gh)/guides/mtr/fw/crls.rxml)

Background information on the Coriolis Effect, including a movie showing how it works using a playground merry-go-round.

<http://www.usatoday.com/weather/wdenalt.htm>

Background information on the density of air, and a link to calculate the density of air at different temperatures.