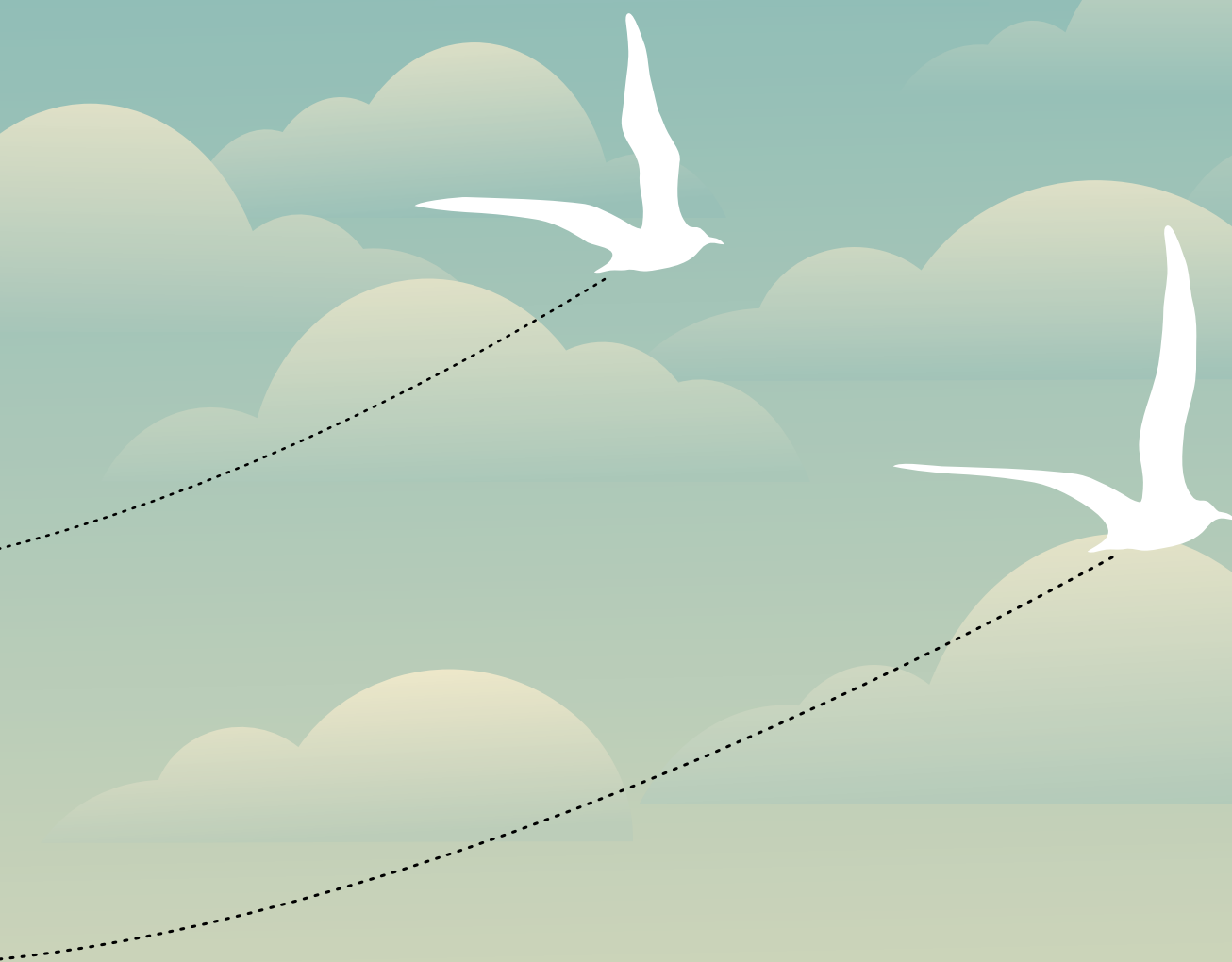
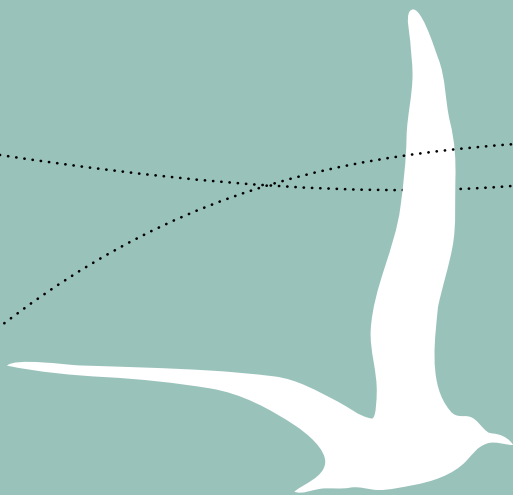


WEATHER AND CLIMATE SCIENCE





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NGSS indicates the Next Generation Science Standards for each activity. See www.nextgenscience.org/next-generation-science-standards for more information.

See Purdue Extension's Education Store, www.edustore.purdue.edu, for additional resources on many of the topics covered in the 4-H manuals.

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GLOBAL WINDS



How do the sun's energy and earth's rotation combine to create global wind patterns?



While we may experience winds blowing from any direction on any given day, the weather systems in the Midwest usually travel from west to east. People in Indiana can look at Illinois weather to get an idea of what to expect the next day. This predictable weather pattern occurs because the Midwest is in the middle latitudes where the prevailing westerlies, the region's normal winds, push the weather from west to east. The earth has definite wind patterns that are a result of how the sun heats a rotating earth. These patterns influence the different types of climate around the world.

OBJECTIVE: Describe the global wind patterns and how these patterns are a result of the sun's energy and the earth's rotation.

Weather Tote

☐ Global Winds worksheet



- 1 Read the Global Winds Information.
- 2 Complete the Global Winds worksheet.

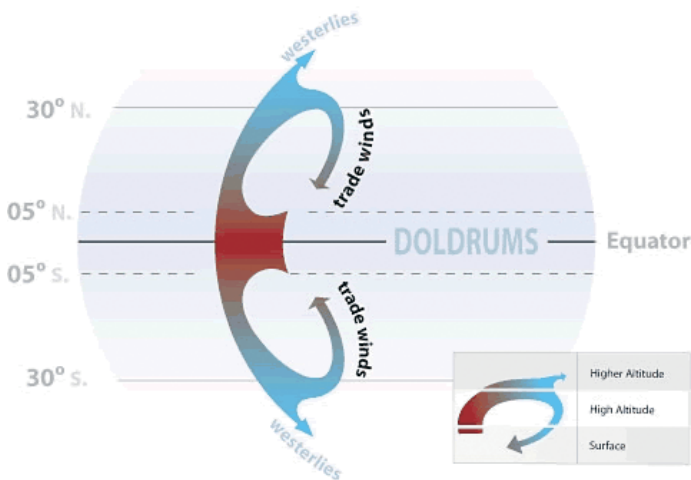
GLOBAL WINDS INFORMATION

Air that moves across the surface of earth is called wind. The sun heats the earth's surface, which warms the air above it. Areas near the equator receive the most direct sunlight and warming. The North and South Poles receive the least amount of sunlight so these areas are cooler. Warm air can hold more water vapor than cooler air. You have probably experienced very warm weather and high humidity (moisture in the air) in the summer. Cooler air is denser (heavier) than warmer air, which is often described as "warm air rises." This phrase often refers to heat rising from the floor toward the ceiling in a room, or from lower floors to upper floors in a house or apartment. This movement is also true globally. The surface at the equator is both warm and humid. The cold, dry air at the North and South Poles is much denser than the warm, humid air near the equator. So warm air tends to move northward in the Northern Hemisphere and southward in the Southern Hemisphere.

WIND PATTERNS

If global winds were affected only by the heating of the sun, they would move only toward the poles. The surfaces near the equator would become very hot and humid, causing that air to rise and flow toward the North and South Poles. The cooled air would sink and return to the region of the equator. But earth is always rotating, which prevents air from traveling in a straight line. The earth's rotation forces the air to the right in the Northern Hemisphere and to the left

GLOBAL WIND PATTERNS



Source: Source: National Oceanic and Atmospheric Administration/Department of Commerce.

in the Southern Hemisphere. But rather than one large global wind from the equator to each pole, there are six bands of circulation — three in the Northern Hemisphere and three in the Southern Hemisphere. These regions, called cells, are described below for the Northern Hemisphere. The same patterns exist in the Southern Hemisphere.

- The Hadley cell region is named after George Hadley (1685–1768), an amateur meteorologist who suggested that surface winds existed. The air rises at the equator (0°) and sinks at about 30° north latitude, moving back toward the equator at the surface. These surface winds are called trade winds, and they generally blow from east to west. Hurricanes develop within the trade winds.
- In the Ferrel cell region, suggested by William Ferrel (1817–1891), the air near the surface at 30° north latitude sinks as it also moves northward. Earth's rotation deflects this northward surface air to the right, and these surface winds begin to blow generally from west to east. In the area between 30° north latitude and 60° north latitude, the surface winds are known as the prevailing westerlies — sometimes called the stormy westerlies.

- The third latitudinal cell is known as the polar cell region. Here, air rises at 60° north latitude and moves toward the North Pole (90°), where the air cools and sinks. This results in surface winds that move generally from east to west. These winds are called the polar easterlies. The sinking air creates polar deserts, but they are not like the deserts that you may have seen or heard about in hot regions of the world. The North and South Poles do not get large amounts of precipitation, but the snow they do receive builds up year after year into deep snow packs.

This creates what seems like a uniform global system, but several factors combine to make it more complicated. Factors that affect the weather include landmasses, ocean currents, and seasonal changes, which cause otherwise orderly global wind patterns to fluctuate and make predicting weather so complicated.

HIGH AND LOW PRESSURE REGIONS

Areas of high and low pressure exist at earth's surface between each of the cell regions. They are described below.

0° latitude – the doldrums: A band of low pressure runs along the equator between the north and south trade winds. Very little surface wind is present within this band of lifting air. For this reason, sailing ships often got caught in this area and spent days waiting for enough wind to carry them out. This area became known as the doldrums, as ships slowed and floated aimlessly.

30° latitude – the horse latitudes: Along 30° N and S latitude between the trade winds and the prevailing westerlies is an area of high pressure. Within this band of sinking air is very little surface wind. As in the doldrums, sailing ships got caught in this area and spent days waiting for enough wind to carry them out. In the centuries following Christopher Columbus's voyage, sailing ships crossed this band of high pressure on their way to what is now called the Americas. They carried people and supplies, along with horses, which were essential to

the settlers but not native to the Americas. When sailing ships got caught in these windless areas and supplies began to disappear, the horses became dispensable and the travelers abandoned them. For this reason, this band became known as the horse latitudes.

Because air is sinking along this band and clouds do not form in sinking air, the major deserts of the world can be found at 30° latitude. Deserts form in areas where air is normally sinking, either along 30° latitude, north or south, or on the leeward side of mountains, which typically receives little precipitation or wind.

At 60° latitude – the subpolar lows: Along the 60° latitudes between the prevailing westerlies and the polar easterlies is a band of low pressure. This area also has no surface winds.



 **SHARE WHAT HAPPENED:** What force causes air to move?

APPLY: Name a city, town, or county that usually gets the same weather you observe in your home's area after you experience it.

GENERALIZE TO YOUR LIFE: How can understanding global wind patterns help you prepare for the next few days' weather?



Fly Higher

Look at a world map or globe. Find all of the major deserts, and explain how sinking air creates each desert.

NOTES

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

GLOBAL WINDS WORKSHEET

How might the sun have an effect on global wind patterns?

How might the rotation of the earth affect global wind patterns?

Why is the air less dense at the surfaces near the equator than those at the North and South Poles?

Why is warm, moist air rising above the surfaces near the equator?

In what direction is the surface air shown in Figure 2 moving — toward areas near the equator or those away from the equator?

In what direction is the air high above the surface moving — toward areas near the equator or those away from the equator?

| Cell Region | Location in Latitudes | Name of Surface Winds | Direction of Winds |
|-------------|-----------------------|-----------------------|--------------------|
| Hadley | | | |
| Ferrel | | | |
| Polar | | | |

Fill in the table above.

What prevents simple global surface winds from blowing from the North and South Poles to the equator?

Describe how air moves in the Hadley cell region:

Describe how air moves in the Ferrel cell region:

Describe how air moves in the polar cell region:

Why is the area along the equator known as the doldrums?

Why do deserts form along 30° latitudes?

Indicate the locations of the following in Figure 5.

- Doldrums
- Horse latitudes
- Subpolar lows

Show the general wind direction for the following regions in the figure below:

- Polar easterlies
- Prevailing westerlies
- Trade winds

LATITUDE LINES (30 AND 60) [FIGURE 5]

