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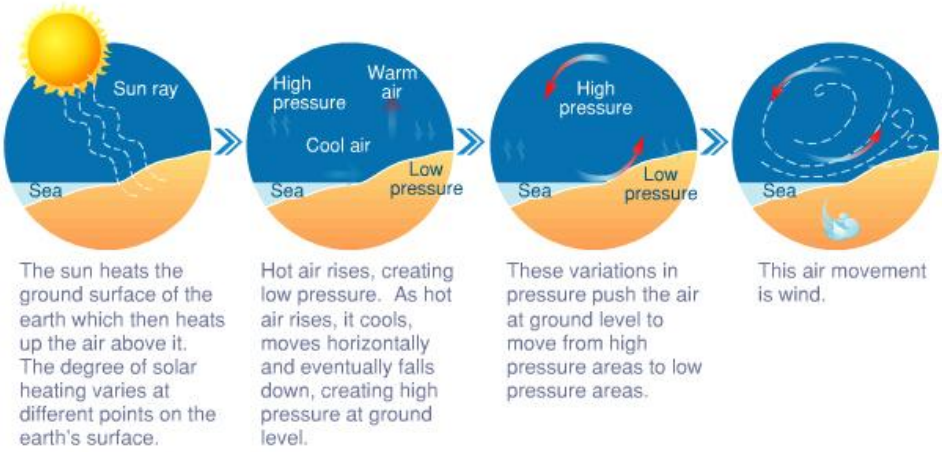
Wind Fact Sheet

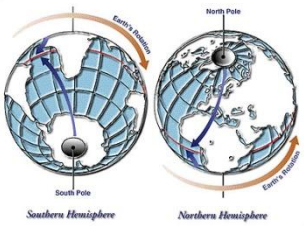


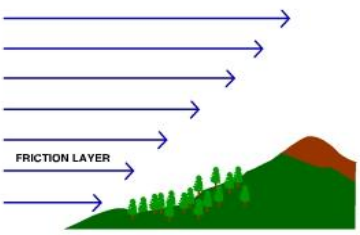
What causes the wind to blow?

As the sun warms the Earth's surface, the atmosphere warms too. Some parts of the Earth receive direct rays from the sun all year and are always warm. Other places receive indirect rays, so the climate is colder. Warm air, which weighs less than cold air, rises. Then cool air moves in and replaces the rising warm air. There are 3 main causes for wind:

1) **Pressure gradient**—**Air pressure** is created by the motion, size, and number of gas molecules present in the air. This varies based on the temperature and density of the air mass. Pressure differences occur in the atmosphere due to differences in the density of air. Warm air is less dense than cold air. The height of the atmosphere (thickness) is higher when the air is warm. As air warms the volume of the air increases and this causes an expansion of the air. Cooling air contracts (gets smaller). When warm air is placed next to cold air the density differences between the air masses sets up a pressure difference also. When cold dense air is placed next to warm, less dense air, wind results by nature trying to balance the pressure differences at each level in the atmosphere between the two air masses.
    a. **High Pressure**—air in the high cools it becomes denser and moves toward the ground. High pressure systems are associated with clear skies and calm weather. Indicated by an **H** on a weather map.
    b. **Low Pressure**—atmospheric pressure is lower than that of the area surrounding it. Low pressure systems are usually associated with high winds, warm air, and atmospheric lifting. Because of this, lows normally produce clouds, precipitation, and other bad weather such as tropical storms and cyclones. Indicated by an **L** on a weather map.

2) **Corolis Effect**—if the Earth didn't rotate, winds would travel either north or south due to differences in temperature and pressure at different latitudes. But since the Earth does rotate, the Coriolis force deflects these winds to the right in the Northern Hemisphere and to the left in the Southern Hemisphere. This usually creates westerly winds moving from subtropical areas to the poles.





3) **Friction**—Generally speaking wind speed increases with height above the surface as the frictional force of surface diminishes with height. The friction imposed on air mechanically slows the wind and diverts its direction. The ***friction layer*** is the layer of air that is influenced by friction caused by the surface. The friction layer varies in height across the Earth, but for the most part lies within about a kilometer of the surface.

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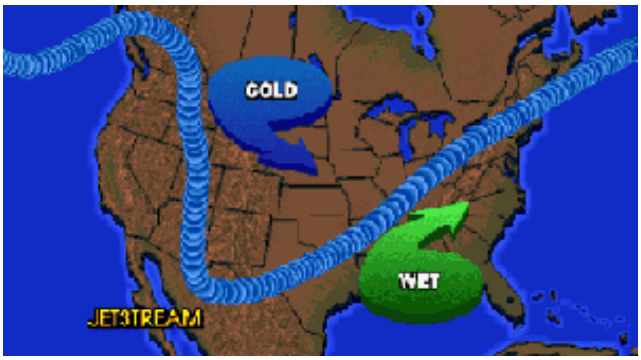
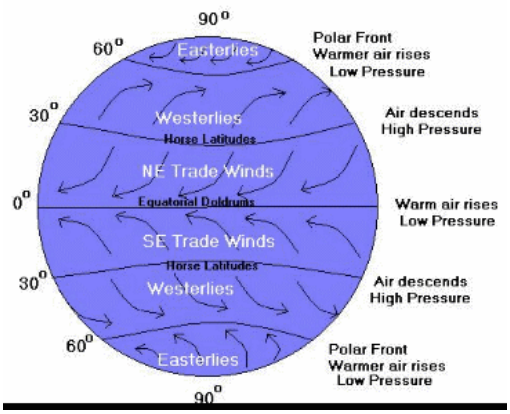
What is the jet stream?

The jet stream is a fast flowing, river of air found in the atmosphere at around 12 km above the surface of the Earth just under the tropopause. They form at the boundaries of adjacent air masses with significant differences in temperature, such as of the polar region and the warmer air to the south. Because of the effect of the Earth's rotation the streams flow west to east, serpentine (snake-like) or wave-like manner at lower speeds than that of the actual wind within the flow.



What are the global wind patterns?



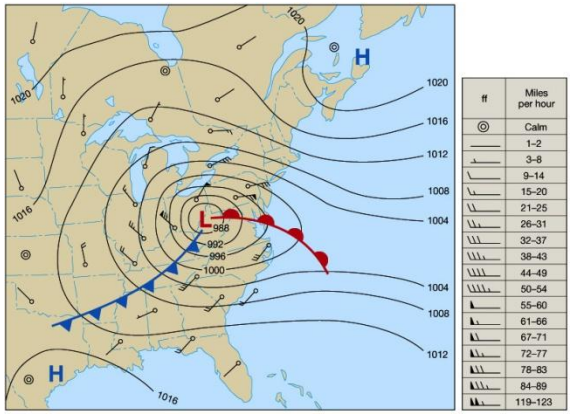
The equator receives the Sun's direct rays. Here, air is heated and rises, leaving low pressure areas behind. Moving to about thirty degrees north and south of the equator, the warm air from the equator begins to cool and sink. Between thirty degrees latitude and the equator, most of the cooling sinking air moves back to the equator. The rest of the air flows toward the poles. The doldrums is an area of calm weather—little to no wind. Prevailing Westerlies in the Northern Hemisphere are responsible for many of the weather movements across the United States and Canada. The prevailing Westerlies join with the Polar Easterlies to reduce upward motion. The Polar Easterlies form when the atmosphere over the poles cools. This cool air then sinks and spreads over the surface. As the air flows away from the poles, it is turned to the west by the Coriolis Effect.

Measurement

Wind speed is measured with an **anemometer** and its direction is determined with a wind vane.

Do you get it?

1) Wind forms when air moves from areas for _____ pressure to areas of _____ pressure.
2) Winds deflected from their typical path because of the Earth's rotation on its tilted axis will travel from tropical areas towards the poles instead of straight up and down. This is the result of the _____ Effect.
3) Upward and downward currents of air which result from the uneven heating of the air are called _____.
4) Looking at the Global Wind Patterns, which area has the least amount of wind…you don't want to be caught here in a sailboat. _____
5) With the pressure gradient in mind, where are the greatest areas of concern (what elevation—use the contour line to state that) and explain how you know based on your understanding of winds and air pressure?



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For Fun—Try one or both of these and experiments and share your results when you have completed them!

Activity—Lab Experience "WHAT'S IN THE WIND"

MATERIALS:

- a few plastic lids
- petroleum jelly
- magnifying glass
- paper punch
- yarn
- windy day

PROCEDURE:

1) Punch a hole at one end of each lid.
2) Thread each hole with a length of yarn and knot the ends of the yarn together to form a loop for hanging.
3) Spread petroleum jelly over one side of each lid.
4) Take the lids outdoors on a windy day and hang them in various areas.
5) Leave them outside for about an hour or two to collect what may be blowing in the wind.
6) Retrieve the lids and see what they have collected.

OBSERVATIONS: Use the magnifying glass for further observation.

EXPLANATION: Why do you suppose you found what you did?

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Activity—Lab Experience "How to Make an Anemometer"

Materials:

- five 3 oz. plastic cups
- two plastic soda straws
- one pencil (with unused eraser)
- single
- hole paper punch
- scissors
- tape
- one push
- pin
- permanent magic marker

Procedure:

Step 1 Take four of the plastic cups and punch one hole in each, about ½ inch (1.5 cm) below the rim.

Step 2 Take the fifth cup and punch two holes in it, directly opposite from each other, about ½ inch (1.5 cm) below the rim. Now punch two more holes in the cup, each ¼ inch (1 cm) below the rim that are equally spaced between the first two holes.

Step 3 Using the push-pin and the scissors, make a hole in the center of the bottom of the cup with four holes in it. The hole should be large enough that the pencil can fit easily through it.

Step 4 Slide one of the straws through the hole in one of the cups that has only one hole in it. Bend the end of the straw that is inside the cup about ½ inches (1.5 cm) and tape it to the inside of the cup.

Step 5 Place the other end of the straw through two of the holes in the fifth cup and then trough the hole in one of the other cups. Tape the end of the straw to the inside of the cup as you did earlier, making sure that the openings of the two cups face opposite directions.

Step 6 Repeat steps 4 and 5 with the remaining two cups, sliding the straw through the remaining two holes in the fifth cup. Make sure that the opening of each cup faces the bottom of the cup next to it (in other words, no two openings should be facing each other). Each of the four cups should be facing sideways.

Step 7 Insert the pencil with the eraser facing up through the bottom of the fifth cup. Carefully push the pin through the two straws and into the eraser on the pencil.

Step 8 Take the permanent magic marker and draw a large X on the bottom of one of the cups. Your anemometer is now ready to use! Take it outside and hold it in front of you in an open area where the wind is blowing. Look at the X on the bottom of the cup as it spins around. Count the number of times it spins around (revolutions) in 10 seconds. Use the table below to estimate the wind speed.

Revolutions in 10 seconds	Wind Speed in Miles per Hour (mph)	Wind Speed in Kilometers per Hour (kph)
2 - 4	1	2
5 - 7	2	3
8 - 9	3	5
10 - 12	4	6
13 - 15	5	8
16 - 18	6	10
19 - 21	7	11
22 - 23	8	13
24 - 26	9	14
27 - 29	10	16
30 - 32	11	18
33 - 35	12	19
36 - 37	13	21
38 - 40	14	23
41 - 43	15	24
44 - 46	16	26
47 - 49	17	27
50 - 51	18	29
52 - 54	19	31
55 - 57	20	32

Observations: What was your wind speed on 3 different days?

Day 1:	Day 2:	Day 3:

Explanation: Look at your local weather forecast on the news or in the newspaper. What explains the reason for your wind in your area? Do you notice any pressure systems or fronts responsible for the air movement?