WIND
WHAT CAUSES IT?
Where does it come from? Where is it going? Why?

STUDENT EXPECTATIONS

Upon completion of this unit, students will be expected to know or have an understanding of:

- What causes the wind?
- Why the wind behaves as it does.
- The early cultural beliefs about the wind.
- High and Low pressure systems.
- How pressure gradients affect wind flow and speed.
- Basic fluid dynamics.
- Units of measurement for wind.
- Lift is caused by a difference in high and low pressure.

STATE STANDARDS

The Following **Colorado** Model Content Standards for Science will be met or exceeded. (Unless otherwise noted, the standards for grades 5 through 8 are used.)
Standards 1,2, 2.1, 2.2, 2.3, 4.1, 4.2, 4.3 5, and 6

The following **Texas** Essential Knowledge and Skills for Science will be met or exceeded: (Unless otherwise noted, the TEKS for Middle School Science are used.)
TEKS: 6.1A,B, 6.2A,B,C,D,E, 6.3A,C,E, 6.4A, 6.6A,C 6.8b, 6.9A,B, 6.12B, 6.14C, 7.1A,B, 7.2A,B,C,D,E, 7.3A,C,E, 7.4A,B 7.6A,B, 7.14A,B, 8.1A,B, 8.2A,B,C,D,E, 8.3A,C,E, 8.4A,B, 8.5A,B,C 8.7A, 8.10A,B,C

TEACHER NOTES

(YOU MIGHT WANT TO PUT SOME OR ALL OF THIS INFORMATION ON THE STUDENT WORKSHEETS.)

You can't see it, but you feel it, you can't touch it, but it touches you. It has been called the "Breath of the Gods", or a killer and the giver of life, gentle and fierce, friendly and enemy, angry and happy. The Native Americans called it Moriah, and Snow Eater (Chinook). The Japanese call it kaze and in Russia it is called veter. It can shatter homes, or wake a child from a peaceful sleep or bring relief in times of need. It can spread the most dreaded diseases, or bring a welcome freshness. Of course we are talking about the wind.

Other names given to the wind or specific winds are:

- Khamsin (Egypt) - Hot, dry, dusty south or southeast wind.
- Harmattan (Africa) - Northeast trade wind over the Sahara.
- Baguio (Philippines) – A cold wind with driving snow, in North America it would be called a blizzard or possibly in Texas a "Norther".
- Zephyr (Mediterranean) – a gentle westerly breeze.
- Tramontana (Italy) A brisk cool wind blowing southward from the Alps.
- Squall (North America) – Very sudden increase in wind speed caused by advancing cold air possibly involving a line of thunderstorms.
- Pampero (Argentina) – very similar to squall.
- Whirlwind – Rotating mass of air **not** connected to a thunderstorm and **not** tornadic. Usually very weak when compared to a tornado. Sometimes called a dust devil, sand devil or waterspout.

Probably the first (on record) scientist to say there is a scientific reason for wind was the ancient Greek philosopher Anaximander. Before him most people were happy with the "breath of the Gods" explanation. When the Gods were happy, the wind was kind, when the Gods weren't so happy, the wind got wicked and fierce.

The Japanese word kaze really becomes special when we find that the word kami means "spirit", "ghost," or "divine". Put them together and we have kamikaze or divine wind. This term originated when Mongolian ruler Kublai Khan sent his navy to invade Japan. The Mongolian Navy was very strong and indeed should have been able to very easily overrun the island nation, but a giant storm (possibly a typhoon) came up and destroyed much of the Mongolian navy and Kublai was forced to retreat. The storm was said to come from the gods to save Japan and was therefore called "kamikaze", or divine wind. Many World War II pilots would fly with the divine wind to their death.

Simply put, wind is the motion of air, but we must go further. Why does it move in the first place and why does it move as it does.

Some people, when asked what causes wind, will say it is due to the uneven heating of earth. Others will say it is due to different pressures causing air motion. Who is right? Both in a way, but neither are completely correct. It is a combination of both. The uneven heating **causes** different pressure areas, and wind is simply air that travels from high to low pressure.

If we could imagine a perfect system, with an earth that was one constant color, and the sun was shining over the equator at a constant rate it would be a good place to start our lesson on wind. The air over the equator would become warm and it would rise being replaced by more dense cooler air from the poles. As the air rose, it would cool and sink over the poles. We would end up with a constant convection of air from poles to equator and back to the poles.

The low pressure would be at the equator where the air from the north and south poles converged and were lifted. The high pressure would be where the dense air was sinking over the poles, moving downward to the equator again and this would go on forever.

Well, we don't have that perfect system. Our Earth is tilted in such a way that the sun does not shine on the equator constantly, so we end up with seasons which will make the heating variable from season to season. This causes the constant convection to become variable.

The next variable is that the Earth is spinning. We can say the Earth is spinning counterclockwise as seen from the North Pole and clockwise as seen from the South Pole. This causes our convection cell to be deflected and form areas around low pressure systems to spin counterclockwise in the Northern Hemisphere and high pressure systems to spin clockwise. This is known as the Coriolis effect. It is just the opposite in the Southern Hemisphere.

If that isn't enough, the next consideration we need to make is that the Earth is not one constant color. Dark colors absorb more heat energy and light colors reflect the heat energy from the sun. Because this is another variable, we have areas that produce their own low and high pressure areas simply due to the absorption or reflection of heat energy. Now we are just beginning to understand why wind is so variable and hard to predict.

In fact, there are many more variables that affect the wind flow and direction, however, we are going to work just with the basics here.

Wind is air movement, air movement is caused by differences in pressure and differences in pressure are caused by uneven heating. If your muscles contract your lungs with enough force, you form a high pressure that will fill a balloon. If the balloon bursts the air moves in all directions away from the area of high pressure. This is the same in the atmosphere. High pressure systems have the sinking air that

when it hits the surface spreads in all directions and due to the spin of our planet they go in a clockwise form (Northern Hemisphere)

If you have a vacuum hose pulling in air (like a low pressure system), it comes from all directions. We say it converges at the center of the low pressure area and moves upward. (It can't go into the ground!) It must also spin counterclockwise in the northern hemisphere.

So in essence, the sinking high pressure air moves into the low pressure area and is lifted, and it is deflected by the Coriolis effect. The closer the high and low pressure areas are together, the higher the pressure gradient, so the higher the wind speed. If the high and low pressure areas are far apart, then a low pressure gradient, thus wind speeds are low.

ACTIVITY DESCRIPTION

It is suggested that students work in pairs for this activity, but they must decide who gets the kite after the activity is completed before they start, or both of them make a kite and take turns flying their kites then add an extension in their results about which kite flew best and why. Before doing this activity, make certain you have an area that is away from power lines and trees.

Instructions on how to build inexpensive kites are found at:
http://www.skratch-pad.com/kites/make.html or
http://www.aloha.net/~bigwind/20kidskites.html

Explain to the students that for a kite to fly, high pressure builds up on the front of the kite, low pressure behind the kite, so because of the difference, the kite is given lift.

MATERIALS, ALONG WITH METHODS/PROCEDURES ARE ON THE WEB SITES.

RESULTS/CONCLUSIONS

1. Did your kite fly? Why?

2. The difference between high and low pressure gave _____ to the kite.

3. Why is a tail required on many kites?

4. Explain how wind can be your enemy as well as your friend.