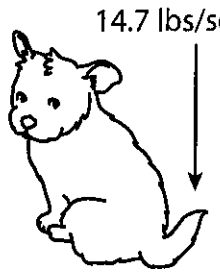
READING PASSAGE

The common definition of wind is that it is air flowing from high pressure to low pressure.



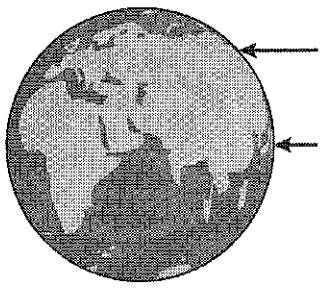
A column of air, one square inch in cross section, measured from sea level to the top of the atmosphere would weigh approximately 14.7 pounds. If you think about how many square inches your body has, that is a lot of weight! Why don't we feel it?

What causes differences in pressure? The closer air is to the ground, the more pressure it is under because air above pushes down on air below. Air is made of gas molecules, which have weight, and it is this weight that causes pressure. A 1 square inch column of atmospheric air pushing down creates approximately 14.7 lbs of pressure at sea level. At higher altitudes, the pressure is less simply due to the fact that there are fewer air molecules above.

Pressure varies in different places and at different times of the day because of the way energy from the sun is distributed. As the Sun's rays hit the Earth, land, water, and vegetation absorb the energy, some of which is given off as heat, which then heats the surrounding air. When air molecules heat up, they vibrate more and move farther apart as they collide with each other more often. This causes them to increase the amount of space (volume) they take up. When air molecules cool down, they come closer together, taking up less space (volume). As the volume of the air molecules increases, the density decreases. Conversely, as the volume of the air molecules decreases, the density increases. This change in the air density causes it to move. Denser, cooled air will fall, and less dense, heated air will rise. As air rises and falls in different places, it creates differences in pressure. Air moves from areas of higher pressure to areas of lower pressure and creates wind.

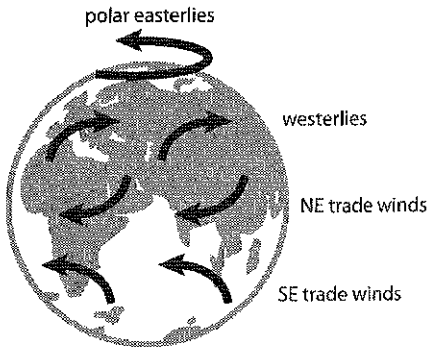
The Earth's spherical shape, topography, vegetation, and water bodies all ensure that every part of the Earth receives different amounts of energy. There will be differences in air pressure due to different temperatures, causing variation in the amount of air rising and falling and therefore variation in wind velocity and direction. For example, sea water heats more slowly than land, creating a major difference in pressure between land masses and oceans. Friction with the ground surface is also a factor, especially where mountain ranges create barriers to wind.

Differences in pressure represent part of the explanation of what causes wind. The second part is related to the Earth's rotation. As the world turns from west to east, the atmosphere turns, too, and in the same general direction. It is for this reason that the prevailing winds in most places blow from a westerly direction generally toward the east. Different levels of air in the atmosphere are affected differently by the Earth's rotation. Air high up in the atmosphere is not affected as much as air below, setting up a situation where air can flow in opposite directions at different altitudes. (You may have seen clouds moving in different directions at different heights.)



The Sun hits the Earth at different angles in different places. This creates uneven heating.

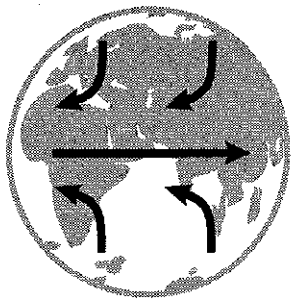
Latitude affects how much solar radiation is received each day. Tropical latitudes receive direct warming from the sun, whereas "high latitudes" (toward either pole) receive solar energy at an oblique angle due to the curvature of the Earth. Tropical latitudes, therefore, warm more easily than high latitudes and so there is a fairly constant rising of air away from the tropics (low pressure), which causes air from surrounding areas to move toward the tropics. Sailors call this constant air flow the "trade winds," which are very reliable.



Trade Winds

Land, water, topography, and the types of vegetation affect how much sunlight is absorbed and reflected. Snow cover plays a major role by reflecting back into space most of the solar radiation it receives. This creates cool air over the extreme northern and southern latitudes as well as over extensive mountain ranges. Cool air is denser than warm air and sinks to the surface, creating large areas of high pressure. This sets up many of the winter storms experienced in northern states such as New York when cold arctic air spreads south due to this high pressure.

Another concept related to wind formation is the Coriolis effect. Large masses of moving air, such as those described above, are pulled into circular rotation due to the Earth's rotation. Instead of air moving in direct lines from high pressure areas to low pressure areas, it is bent into curves. In the northern hemisphere, this causes air to flow clockwise around high pressure areas (anti-cyclones) and counter-clockwise around low pressure areas (cyclones). Severe storms are cyclones with very low pressure. These flows are reversed in the southern hemisphere.


Coriolis Effect

Since differential temperature is the major factor that affects pressure, it is common for large areas of warm air (originating from closer to the equator) to come into close proximity with large areas of cooler air (usually originating closer to the poles). Warm and cold air masses do not readily mix, and where they meet the cold air will push under the warm air, forming a "front." A front can create windy and rainy weather, sometimes with thunderstorms and tornadoes.

This reading passage was adapted from material found on two websites:

- "Exploring What Causes Wind." Robert Leverton. http://kwind.me/b8x
- "Weather Dudes." http://kwind.me/k2m