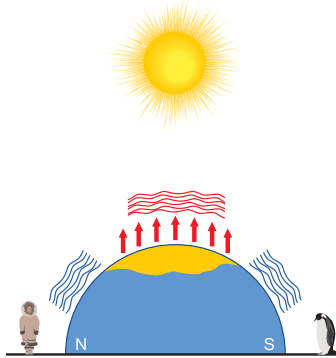


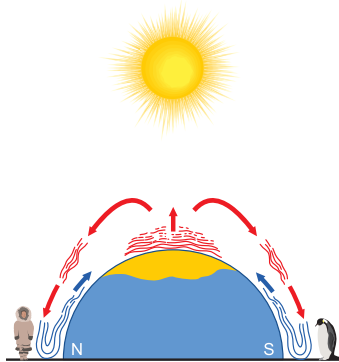
First Picture on Chart

The sun's rays are perpendicular to the equatorial zone. Hot air rises at the equatorial zone; the arrows are pointing up.



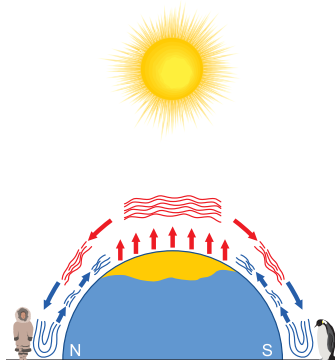
Second Picture on Chart

Cold air comes from the poles to fill in the space left by the rising of the hot air. (This is a simplified statement. These two phenomena happen simultaneously.) This air is heated, rises, and pushes the air which rose before it towards the poles.



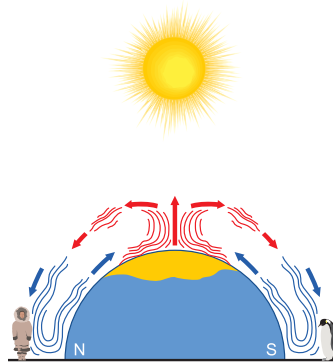
Third Picture on Chart

The process continues: when the air reaches the poles, it becomes cold and heavy. It sinks towards the earth and the pressure is high.



Fourth Picture on Chart

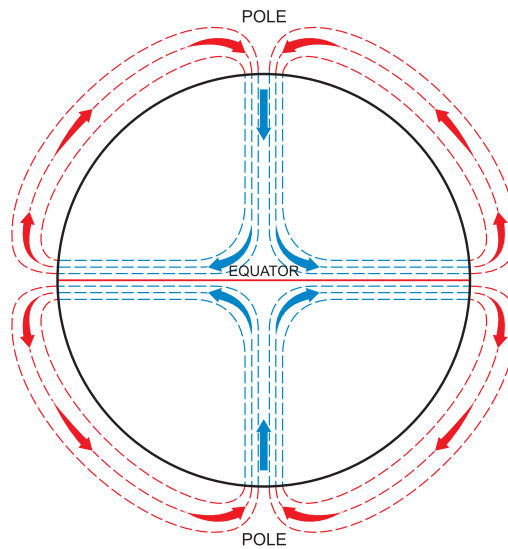
The complete cycle is shown. A warm area, where the air is heated and rises, is a low pressure area. A cold area where the air descends is a high pressure area.



There are air currents near the earth and air currents which are high above the earth.

We see the total cycle of the basic movement of pressure in the pictures. Low pressure areas contain warm air. High pressure areas contain cold air. There are air currents close to the surface of the earth and air currents high above the earth.

In reality, the movement of the winds is more complex – mountains and other situations alter the movements of the winds.



Low and High Pressure: Formation of Winds

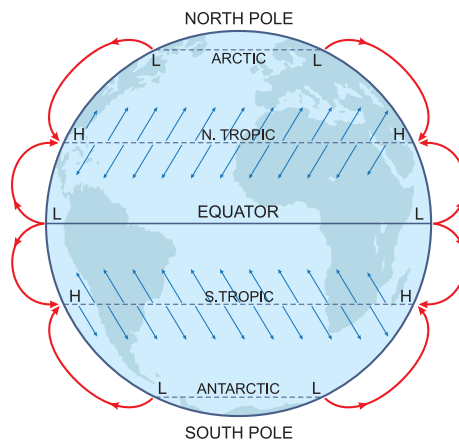
30

CHART 30: LOW AND HIGH PRESSURE: Formation of Winds

On Chart 30, hot air is represented by red lines and arrows; cold air by blue lines and arrows; and the earth by a circle, with a red line for the equator.

Air that is heated, expands, and rises. When it gets cold, it contracts and sinks. Chart 30 shows the complete cycle around the earth: hot air rising at the equator, moving to the poles, becoming cold, and descending, then returning to the equator. This is represented in four cycles (or currents) on Chart 30. In reality, there are many of these cycles on earth. There are regular winds, those that are shown on Chart 30. There are variable winds, those that do not have a pattern.

Wind is air that is in motion. The general winds make up the circulation of the atmosphere. They arise from two principle causes: 1) The unequal heating of the earth's surface by the sun, thus causing heat transport from the equator to the poles; and 2) The rotation of the earth that causes moving objects to be deflected to the east (clockwise direction) in the northern hemisphere and to the west (counterclockwise direction) in the southern hemisphere.



Regular Winds:
Areas of High and Low Pressure

31

CHART 31: REGULAR WINDS: Areas of High and Low Pressure

In Chart 31, the earth is represented only as a circle. On it are marked the tropics, equator, and poles. It is better to reconstruct Chart 31 gradually on the chalkboard: earth, equator, tropics, polar circles, and poles. The air above the equator is heated, expands, and rises (add arrow). This causes cooler air to move from the tropics toward the equator (add arrow). When the air from the tropics reaches the equator, it becomes heated and rises. When it rises, it pushes the air that preceded it towards the tropics (add arrow). When this air approaches the tropics, it becomes cooler, descends (add arrow), and begins to move again towards the equator. We must remember that the air near the equator is also humid, so when it rises and moves towards the tropics, it provokes the equatorial rains.

Some of the air from the equator moves beyond the tropics, towards the poles. At the same time, a cold mass of air is moving from the poles towards the tropics, at a low altitude because it is heavy (arrow). These two currents of air collide and cause a current which rises (arrow). Some of this air moves towards the poles and some moves towards the equator (arrow).

Note: Use the terms high and low altitude air, because obviously the air represented in red near the poles is not as hot as the air at the equator. So we say, “Let’s color

in red the air that travels at a high altitude and in blue, the air that travels at a low altitude.”

The blue arrows indicate the direction of winds: north from the Tropic of Cancer, SW to NE; north from the Tropic of Capricorn, SE to NW; south from the Tropic of Cancer, NE to SW; and south from the Tropic of Capricorn, NW to SE.

It is important to remember that the poles are areas of high pressure, because the cold air descends. The tropics are also areas of high pressure as air is descending. The equator and polar circles are areas of low pressure as air is rising. When the wind rises vertically, we cannot feel it. These areas are called calm zones. Zones of low pressure are called cyclonic zones, because the constant replacement of air brings rains and bad weather. Areas of high pressure are called anti-cyclonic zones. Usually when there is high pressure, there is good weather (stable weather).

General winds include the Polar Easterlies, the Westerlies, and the Northeast and Southeast Trade Winds, each named after the direction FROM WHICH IT IS BLOWING.

Also included is a zone of doldrums astride the equator, so named because the winds are light and variable with frequent calms. The general winds make up the general circulation of the atmosphere. The poles are areas of high pressure. The equator is an area of low pressure, of vertically rising air. Zones of low pressure are cyclonic zones. In these areas the clash of winds brings storms and rains. High pressure usually brings good weather.

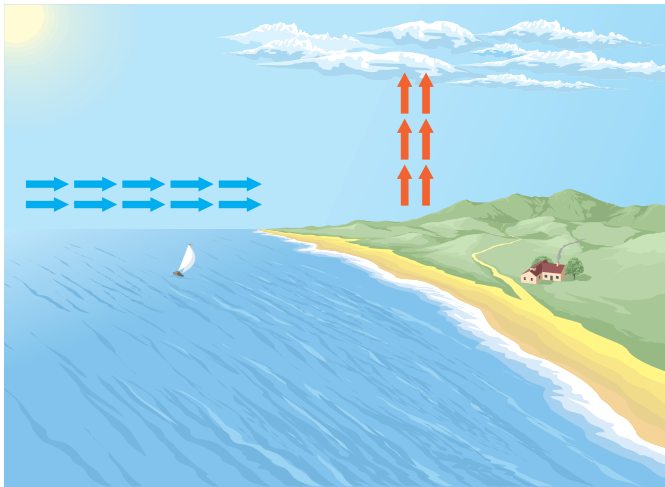
Experiment 24: The Rapidity of Cooling Depends on the Nature of the Body

Materials: Two pans of equal size, black sand, water, two thermometers

Procedure: Half-fill one pan with black sand, and the other with water. Allow the temperature to equalize in the room. Place the pans in the sun outside. Measure the temperature of each every 15 - 30 minutes for the whole day. Chart and graph the results.

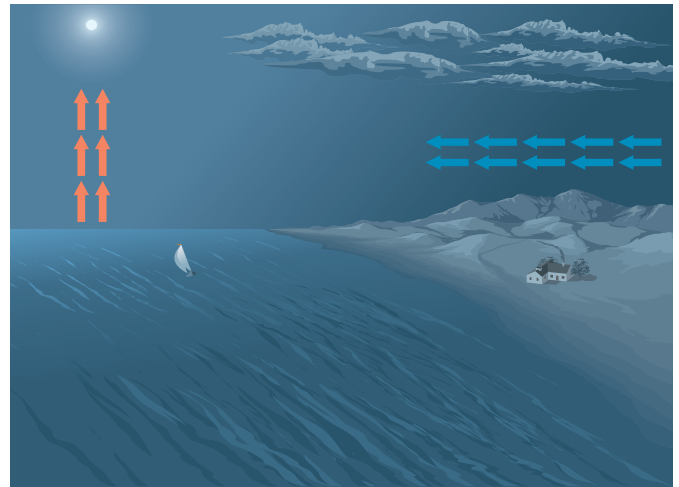
Extension: After three to four hours in the sun, place both pans in the shade. Measure the temperature of each every 15 - 30 minutes to see which one cools the fastest. Chart and graph the results.

Observations: Record your observations.



Local Winds: Sea Breeze

32



Local Winds: Land Breeze

33

CHART 32: LOCAL WINDS: Sea Breeze

CHART 33: LOCAL WINDS: Land Breeze

Charts 32 and 33 are done together.

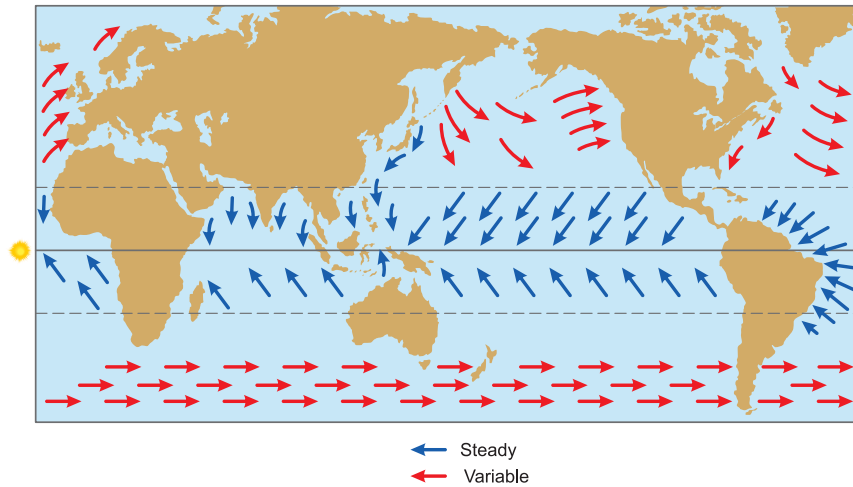
In Chart 32, we examine the sea breeze. With experiment 24, we verified that the land is heated more quickly than the water during the day. The temperature of the water is lower with respect to the land. But we have also seen that the water retains its heat longer. We have also verified this fact: warm air is lighter than cold air, and in nature, no space can remain empty. During the day, the land is heated more quickly than the water. The air over the land heats and rises. The ‘empty space’ created is filled by the cooler air over the water, which moves in over the land. This is why there is a sea breeze during the day.

In Chart 33, we examine the land breeze. During the night, the opposite phenomenon happens. The water heats more slowly during the day, but retains the heat longer at night, while the land cools more quickly. As the water is warm, the air over it is heated and rises, creating a ‘space’ into which the cooler air over the land moves. This is why there is a land breeze at night.

Charts 32 and 33 can be constructed on the chalkboard: draw the coast, sea, with a house on the land and a ship in the water. Make two identical pictures. In Chart 32,

say, "It is day, the sun is shining, the breeze moves toward the shore and the boat moves towards the land; the smoke from the chimney moves inland."

In Chart 33, say, "It is night; the breeze moves out to sea, the fisherman sets out to sea, and the breeze pushes his boat. The smoke from the chimney also moves out to sea." (Another interesting way to present this is on a flannel-board, with prepared cut-outs.)

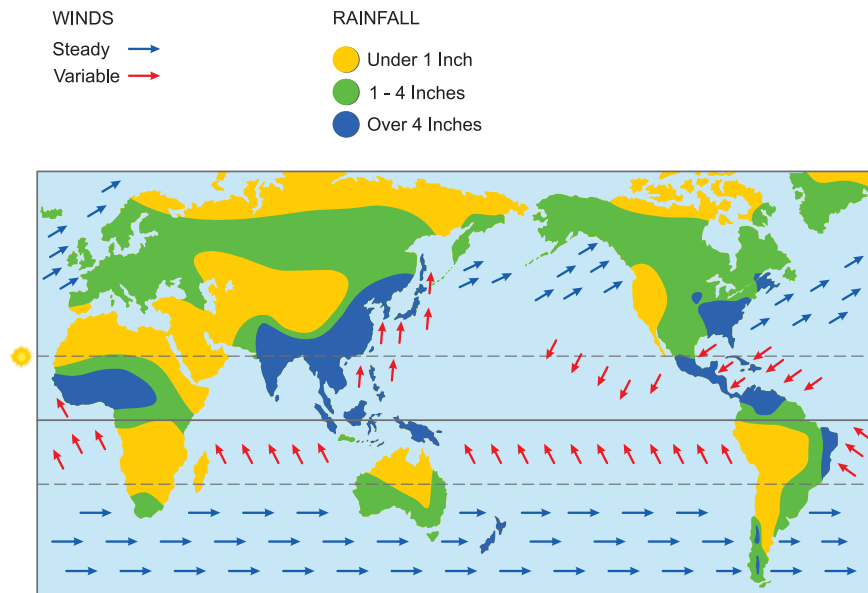


Winds and Their Direction Due to the Equinox

34

CHART 34: WINDS AND THEIR DIRECTION DUE TO THE EQUINOX

Chart 34 shows the winds and their direction during the equinox when the sun shines perpendicularly on the equator. The seasons would be spring or autumn. The blue arrows represent steady winds and the red arrows represent variable winds. The winds change course during the year, so that Charts 35 and 36 show the changes during summer and winter in the hemispheres.



Winds and the Distribution of Precipitation During the Summer in the Northern Hemisphere

35

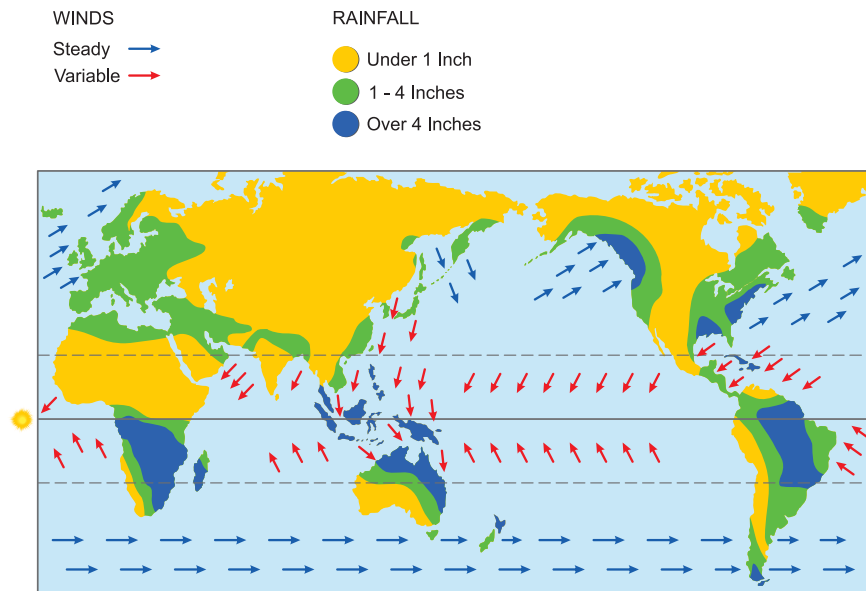
CHART 35: WINDS AND THE DISTRIBUTION OF PRECIPITATION DURING THE SUMMER IN THE NORTHERN HEMISPHERE

Chart 35 shows the distribution of precipitation during the summer in the northern hemisphere when the sun shines perpendicularly on the Tropic of Cancer. Chart 35 shows the relationship between winds and rain. The blue arrows represent steady winds and the red arrows represent variable winds. It is hot in the northern hemisphere. Because the sun sends more heat to the northern hemisphere, it provokes certain changes. In particular, there are some winds that change according to season. One of these types of winds is the monsoons that blow over the Indian Ocean. During the summer, the winds blow from the ocean to the land, because the land is hotter in the summer. But this wind is very humid and causes the monsoon rain.

Dr. Montessori spent an extended time in India and took the monsoons into consideration because of this. We can also examine other winds in other parts of the world. Chart 35 shows the distribution of precipitation by using different colors.

When the sun shines perpendicularly on the Tropic of Cancer, the winds are more regular. During this time the exchange of air masses from the tropics to the equator is regular because the sun is in this position. However, there are other winds and it would be very complicated to represent them all. Chart 35 is designed merely to give the child an initial concept of winds.

The winds that move between the equator and the tropics are called trade winds. The winds in the northern hemisphere are called the Northeast Trade Winds. The winds in the southern hemisphere are called the Southeast Trade Winds. They are named for the direction from which they are blowing.



Winds and the Distribution of Precipitation
During the Summer in the Southern Hemisphere

36

CHART 36: WINDS AND THE DISTRIBUTION OF PRECIPITATION DURING THE SUMMER IN THE SOUTHERN HEMISPHERE

Chart 36 shows the distribution of precipitation during the summer in the southern hemisphere when the sun shines perpendicularly on the Tropic of Capricorn. Chart 36 shows the relationship between winds and rain. The blue arrows represent steady winds and the red arrows represent variable winds. It is hot in the southern hemisphere. Because the sun sends more heat to the southern hemisphere, it provokes certain changes. In particular, there are some winds that change according to season. Chart 36 shows the distribution of precipitation by using different colors.

When the sun shines perpendicularly on the Tropic of Capricorn, the winds are more regular. During this time the exchange of air masses from the tropics to the equator is regular because the sun is in this position. However, there are other winds and it would be very complicated to represent them all. Chart 36 is designed merely to give the child an initial concept of winds.