Wind and Air Pressure

When air moves above the surface of the Earth, it is called **wind**. Wind is caused by differences in air pressure. When a difference in pressure exists, the air will move from areas of high pressure to areas of low pressure. The larger the pressure difference, the faster the air will move.

Globally, the two major factors driving large scale winds are the differences in heating between the equator and the poles, and the rotation of the planet (see Coriolis Effect, below).

Wind direction is reported by the direction from which the wind originates. For example, a north wind comes from the north, but is actually moving south.

Wind speed is typically described using the **Beaufort scale**. This scale provides a description of wind speed based on observed sea conditions.

The Beaufort Scale

This scale of wind speeds devised in 1805 by Sir Francis Beaufort is still in use today.

Force	Speed		Conditions
	knots	km/h	
0	<1	<1	Calm, sea like a mirror.
1	1-3	1-5	Light air, ripples only.
2	4-6	6-11	Light breeze, small wavelets (0.2m). Crests have a glassy appearance.
3	7-10	12-19	Gentle breeze, large wavelets (0.6m), crests begin to break.
4	11-16	20-29	Moderate breeze, small waves (1m), some white horses.
5	17-21	30-39	Fresh breeze, moderate waves (1.8m), many white horses.
6	22-27	40-50	Strong breeze, large waves (3m), probably some spray.
7	28-33	51-61	Near gale, mounting sea (4m) with foam blown in streaks downwind.
8	34-40	62-74	Gale, moderately high waves (5.5m), crests break into spindrift.
9	41-47	76-87	Strong gale, high waves (7m), dense foam, visibility affected.
10	48-55	88-102	Storm, very high waves (9m), heavy sea roll, visibility impaired. Surface generally white.
11	56-63	103-118	Violent storm, exceptionally high waves (11m), visibility poor.
12	64+	119	Hurricane, 14m waves, air filled with foam and spray, visibility bad.

Wave heights quoted are approximately those that may be expected in the open sea. In enclosed waters the waves will be smaller and steeper. Fetch, depth, swell, heavy rain and tide will also affect their height, and there will also usually be a time lag between any increase in the wind and the consequent increase in the sea.

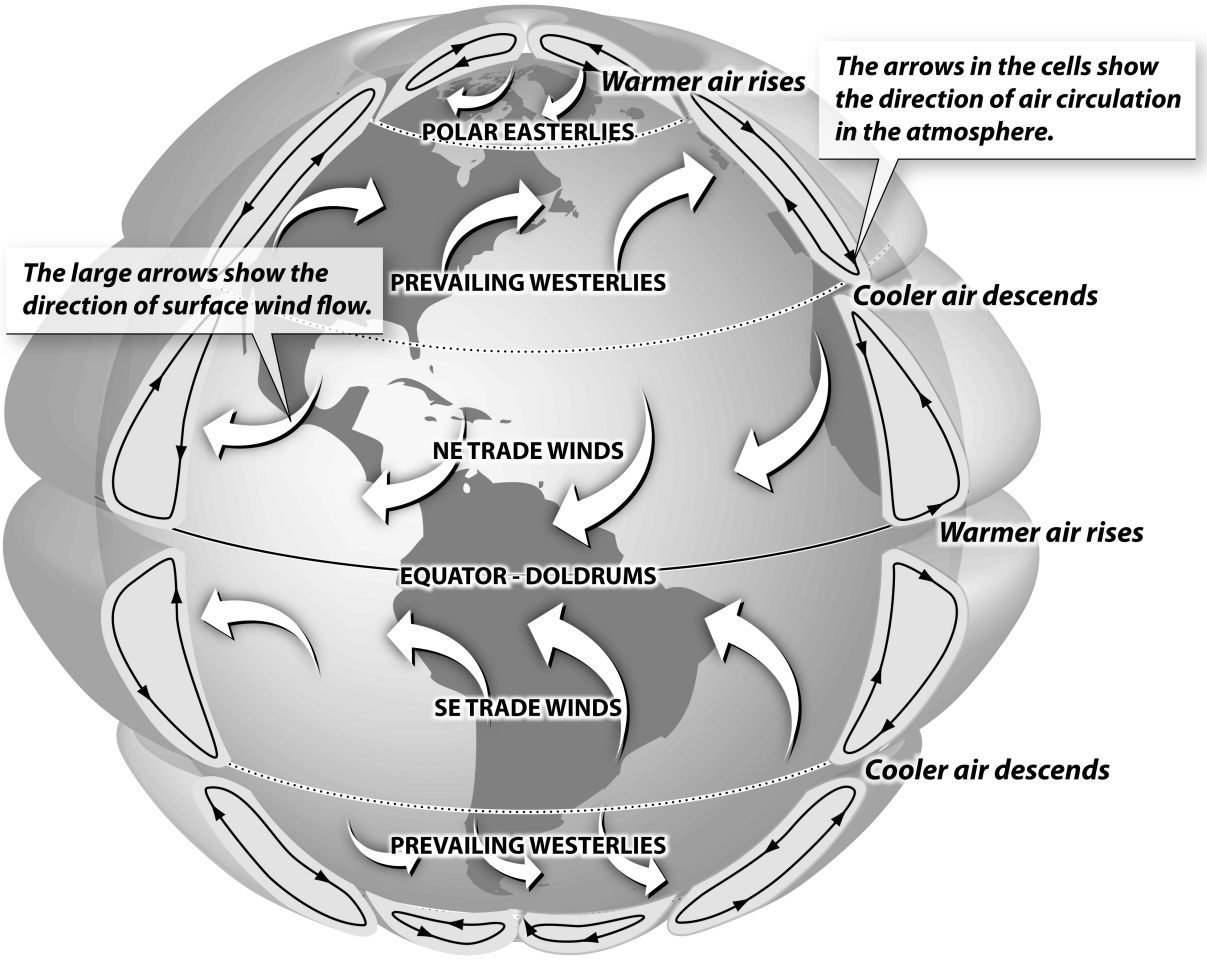
Prevailing Winds

The various regions of the Earth are each dominated by specific wind patterns, called **prevailing winds**.

The **trade winds** are the prevailing pattern of easterly surface winds found in the tropics (the area near the equator — from 0 to 35 degrees). These winds blow from the northeast in the Northern Hemisphere and from the southeast in the Southern Hemisphere.

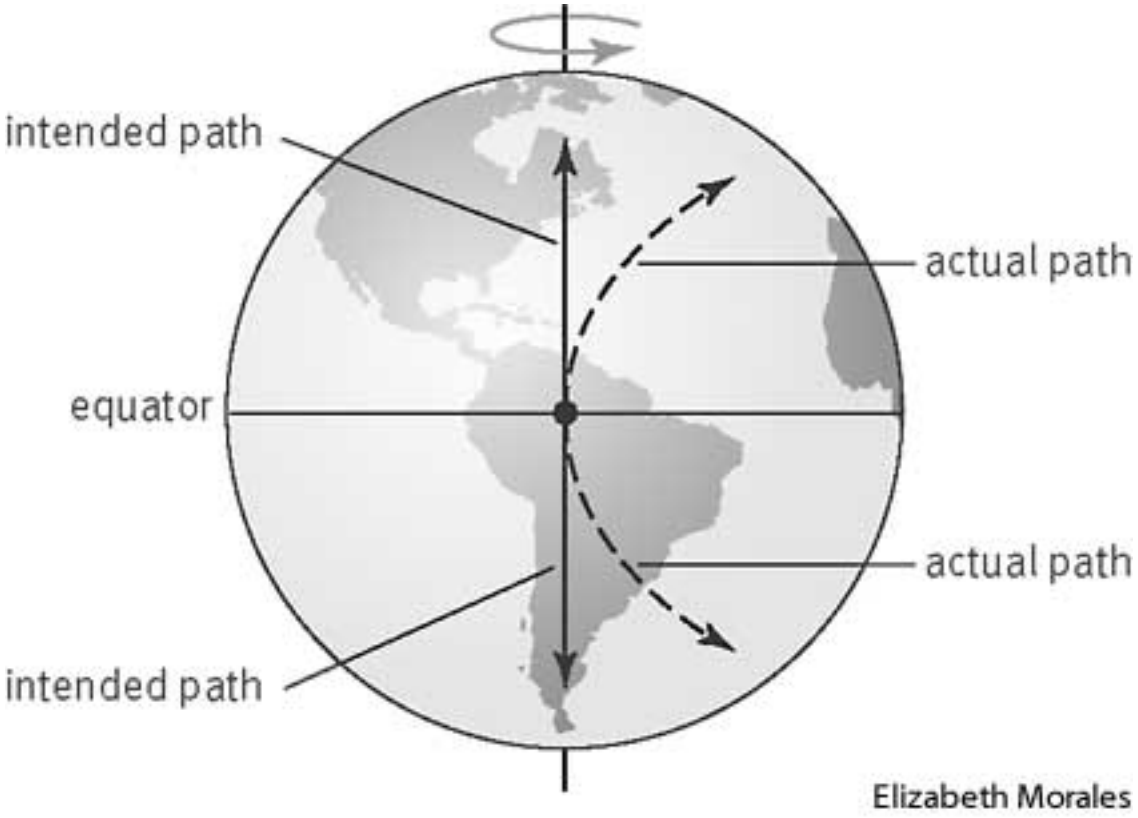
The **westerlies** are the prevailing winds in the middle latitudes (between 35 and 65 degrees). These winds blow from the west to the east. They are predominantly from the southwest in the Northern Hemisphere and from the northwest in the Southern Hemisphere.

The **polar easterlies** are dry, cold prevailing winds that blow from high pressure areas at the poles towards low pressure areas within the westerlies. These winds blow from the east to the west, and are found in the polar latitudes (65 to 90 degrees).



The Coriolis Effect

The **Coriolis effect** is the apparent deflection of objects (such as airplanes, wind, missiles, and ocean currents) moving in a straight path relative to Earth's surface. The diagram below illustrates this.



Cause

The Coriolis effect is caused by Earth's rotation. As the Earth spins, anything flying or flowing over a long distance above its surface is deflected. This occurs because as something moves freely above the Earth's surface, the Earth is moving east under the object.

As latitude increases, the speed of Earth's rotation decreases (because a point on the surface travels less distance in the same amount of time). This results in an increase in the Coriolis effect (a larger deflection). Thus, objects moving above the equator would experience no deflection, but the farther north (or south) of the equator the object goes, the more deflection it would experience.

The direction of the deflection from the Coriolis effect depends on the object's position on Earth. In the Northern Hemisphere, objects deflect to the right. In the Southern Hemisphere, they deflect to the left.

Impact

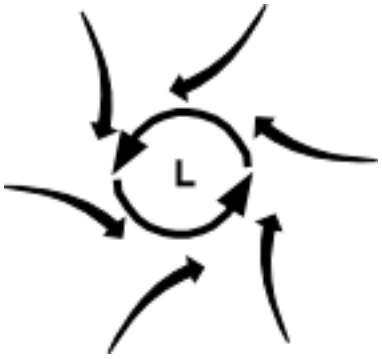
One of the most important impacts of the Coriolis effect is the deflection of winds.

In the Northern Hemisphere, cool air that is moving south from the pole will be deflected to the right (west). This gives rise to the polar easterlies. Warm air moving north from the tropics will be deflected right (east), giving rise to the westerlies in the middle latitudes. Finally, cool air moving south from the middle latitudes towards the equator will be deflected right (west), giving rise to the trade winds.

In the Southern Hemisphere, similar deflections (only to the left, instead of the right) give rise to the same prevailing wind patterns.

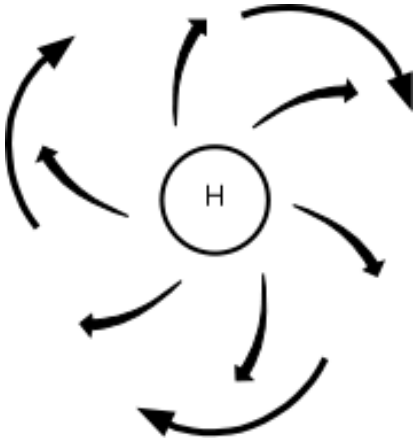
The Coriolis Effect and Pressure Systems

Recall that air (wind) always moves from areas of high pressure to areas of low pressure. In the Northern Hemisphere, this results in air moving towards a low pressure system from all directions. As this air moves, it will be deflected to the right, as shown below.



This deflection to the right prevents the air from reaching the center of the low pressure system. Instead, the air circulates around the system in a counterclockwise direction.

Similarly, as air move away from a high pressure system it is also deflected to the right, as shown below.

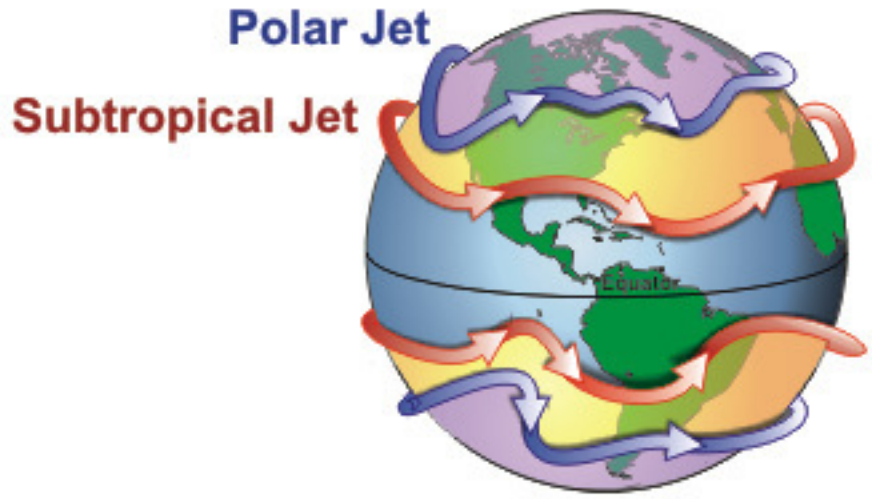


In the Northern Hemisphere, this will result in air circulating clockwise around a high pressure system.

In the Southern Hemisphere, the deflection of the air would be to the left instead of to the right. This would result in the direction of rotation being reversed in both of the above cases. Thus, in the Southern Hemisphere, air would circulate clockwise around a low pressure system, and counterclockwise around a high pressure system.

Jet Streams

Jet streams are fast moving, narrow air currents found in our atmosphere. They are located at the transition from the troposphere to the stratosphere. On Earth, the jet streams flow east. Their paths have a meandering shape, as illustrated below.



The jet streams are caused by the rotation of the Earth and atmospheric heating.

Worksheet

1. Define the term wind.

2. Air moves from _____ to _____ pressure.

3. What are the trade winds? Where do they occur? In what direction do they move in the Northern Hemisphere?

4. What are the prevailing westerlies? Where do they occur? In what direction do they move in the Northern Hemisphere?

5. What are the polar easterlies? Where do they occur? In what direction do they move in the Northern Hemisphere?

6. The Coriolis effect is a result of the _____ of the Earth.

7. Objects in the Northern Hemisphere are deflected to the _____ by the Coriolis effect.

8. Objects in the Southern Hemisphere are deflected to the _____ by the Coriolis effect.

9. Winds near the equator will be deflected _____ than winds near the poles.

10. In the Northern Hemisphere, air flows around a low pressure area in a _____ direction.

11. In the Northern Hemisphere, air flows around a high pressure area in a _____ direction.

12. What are the jet streams? Where does the jet stream occur? In what direction does the jet stream move?

_____

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