Pressure Systems & Wind Patterns

Essential Standard 2.5

Understand the structure of and processes within our atmosphere.

Learning Objective 2.5.2

Explain the formation of typical air masses and the weather systems that result from air mass interactions.

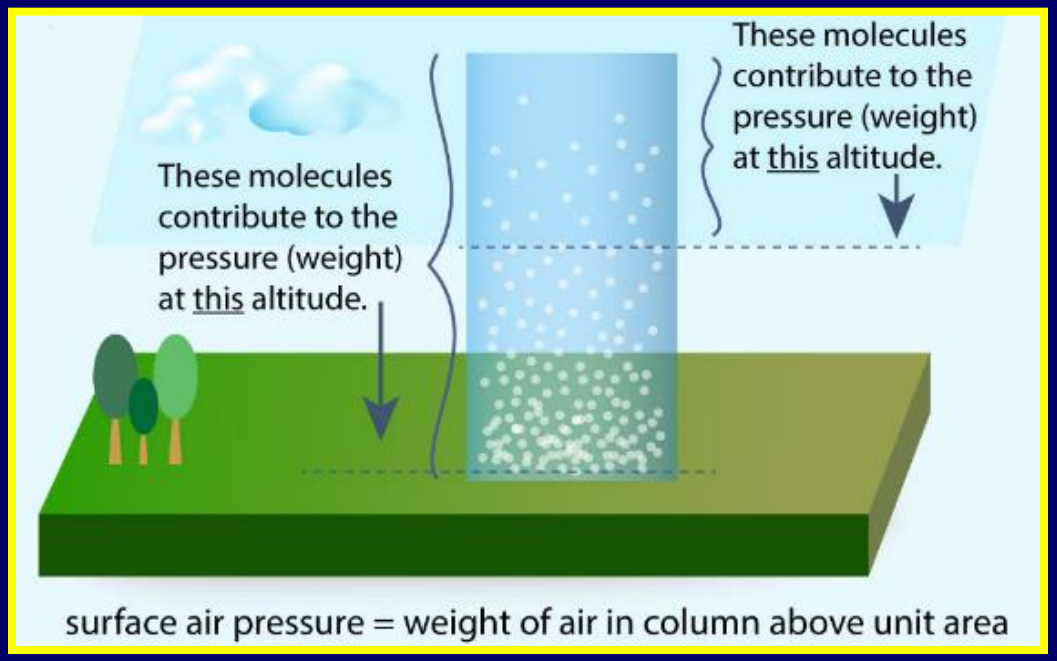
I Can Statements

At the end of this lesson, you should be able to say, with confidence:

- I can distinguish between high and low air pressure systems and explain how they are created.
- I can list and explain what creates the three major global convections cells.
- I can describe each of the major global wind systems and list some of their characteristics.
- I can explain what jet streams are and how they affect Earth's weather

Air Pressure

Air pressure is the weight of the air molecules in the atmosphere pressing down on Earth.

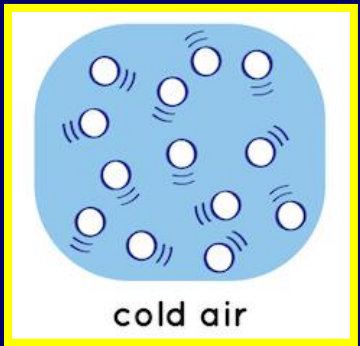


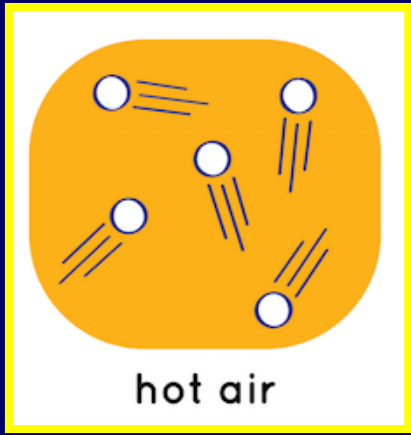
At higher altitudes, the amount of air molecules decrease resulting in lower air pressure.

At lower altitudes, the amount of air molecules increase resulting in higher air pressure.

Convection Cell

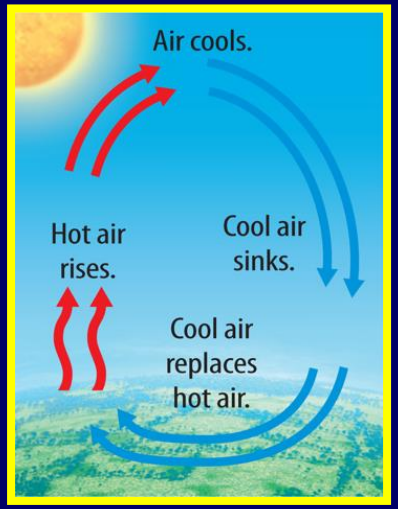
When air is cooled the molecules condense, making the air more dense, which causes the air to sink.





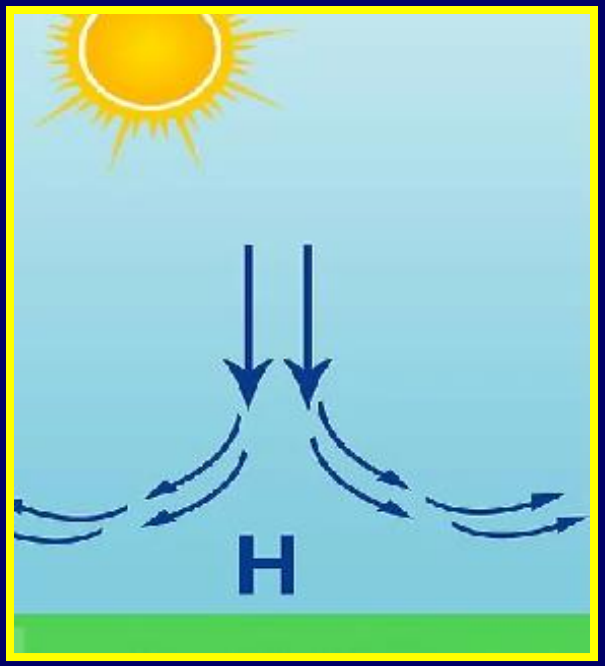
When air is heated the molecules spread out, making the air less dense, which causes the air to rise.

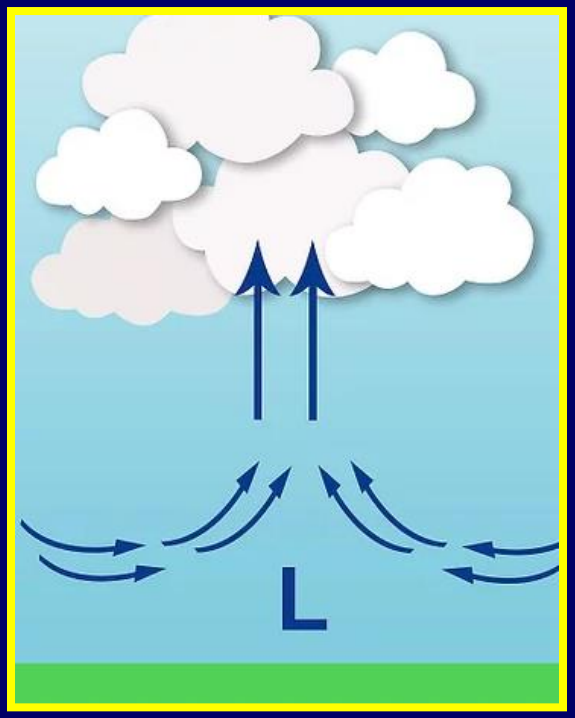
The rising and sinking of air creates a convection cell.



Pressure Systems

As cool air sinks, more air molecules are being added near the ground, resulting in an area of high pressure.

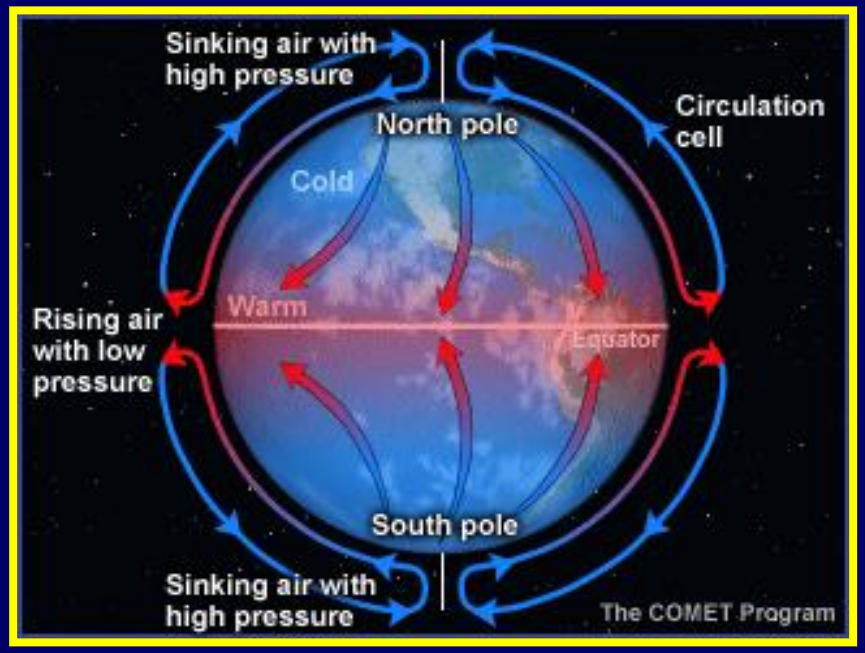




As warm air rises, air molecules are being removed from the ground level, resulting in an area of low pressure.

Global Convection Cells

At the equator, the air becomes very hot and rises, creating areas of low pressure all along the equator.

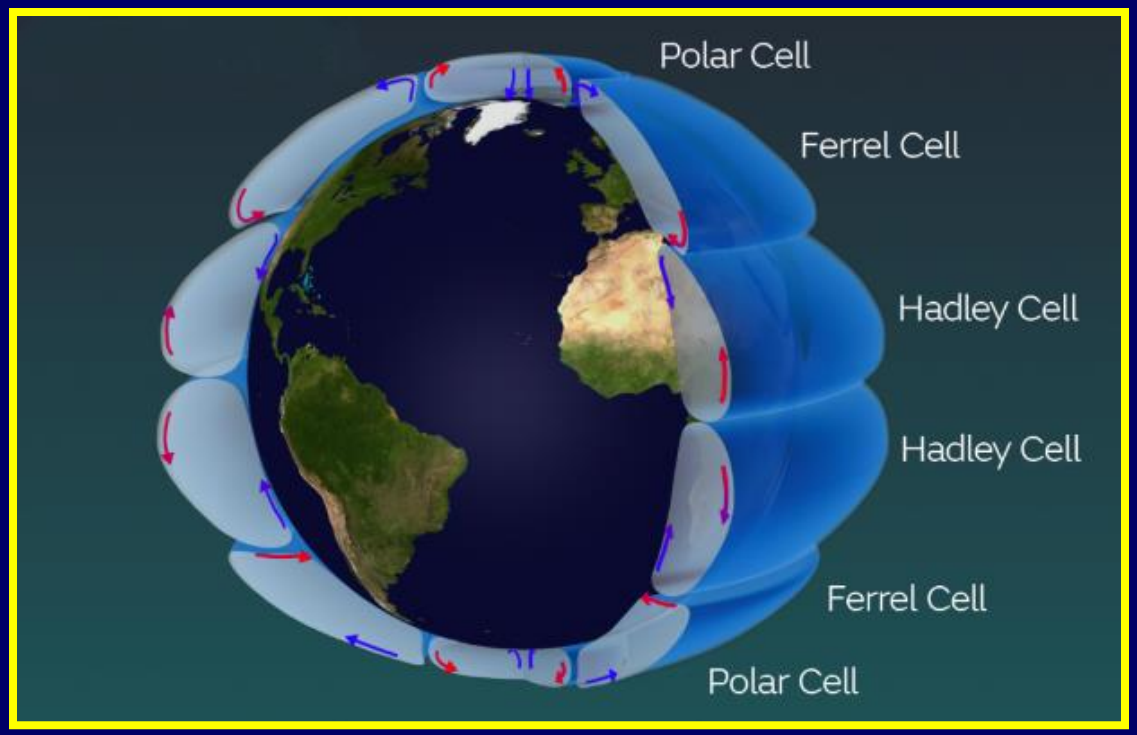


As the air approaches the poles, the air cools and sinks, creating areas of high pressure.

The end result from the rising and sinking of air creates a system of global convection cells along with global areas of high and low pressure systems.

Global Convection Cells

Because the rising air doesn't have to travel all the way from the equator to the pole, before it cools, there are actually a series of three global convection cells in each hemisphere.



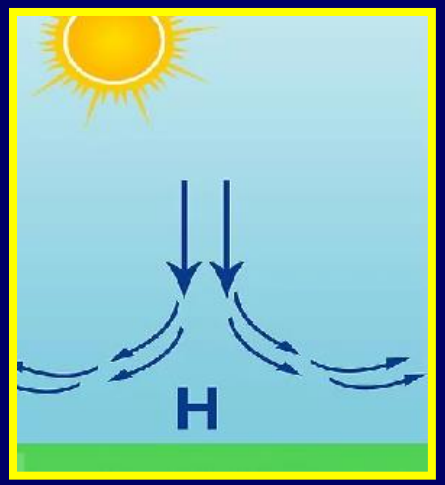
Polar Cell
Poles – 60^{o} Latitude

Ferrel Cell
60^{o} – 30^{o} Latitudes

Hadley Cell
Equator – 30^{o} Latitude

Wind

In a high pressure system, the cool, sinking air moves outwards as it approaches the ground.

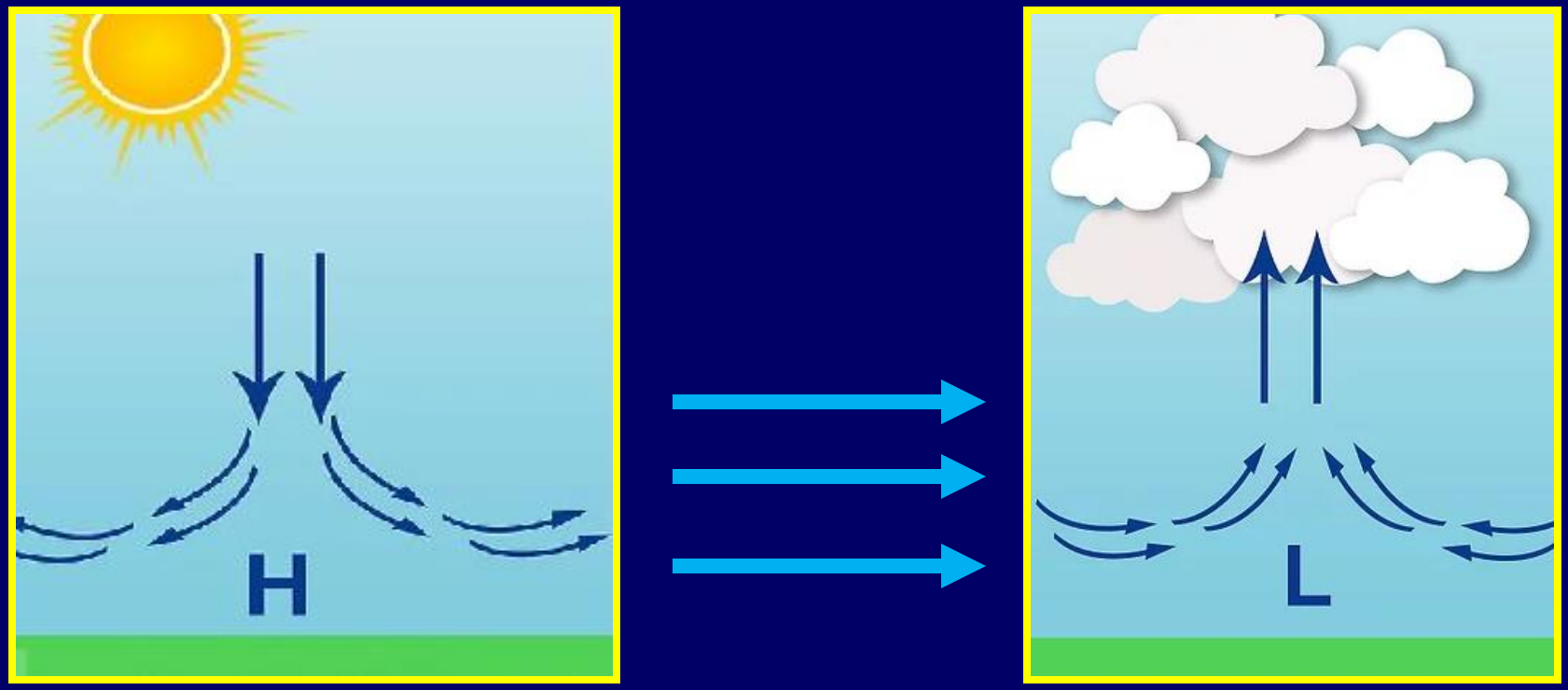


As the air moves over the ground it is warmed and then rises upwards in a low pressure system.

The movement of air from a high pressure system to a low pressure system is called wind.

Wind

The larger the difference in pressure between the high pressure system and the low pressure system, the stronger to the wind.

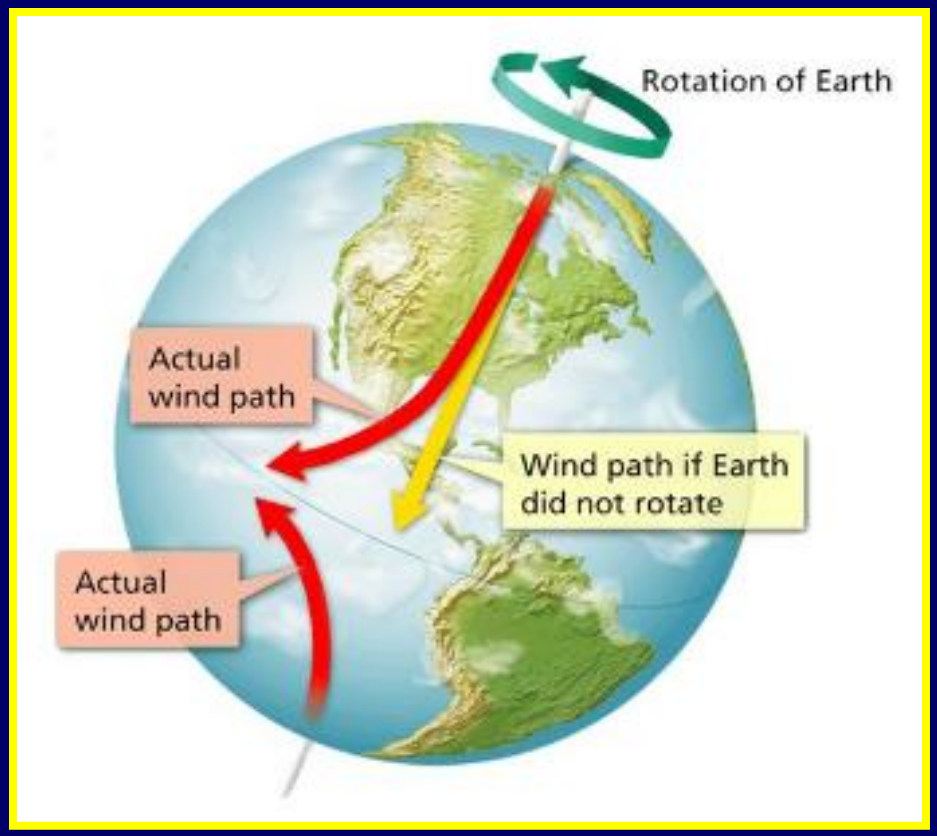


High Pressure

Low Pressure

Coriolis Effect

Because Earth rotates, ocean currents and winds are deflected to the right in the northern hemisphere and to the left in the southern hemisphere.

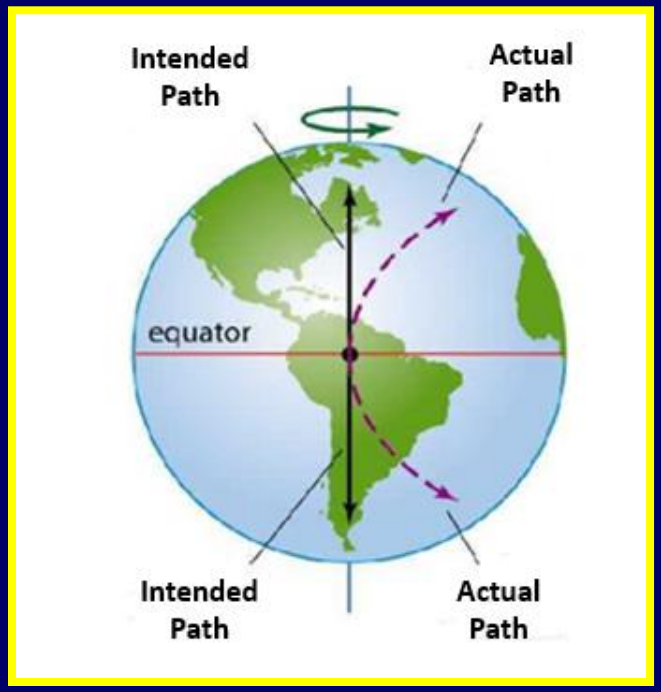


This deflection of the wind is called the Coriolis Effect.

Winds moving towards the equator travel towards the west.

Coriolis Effect

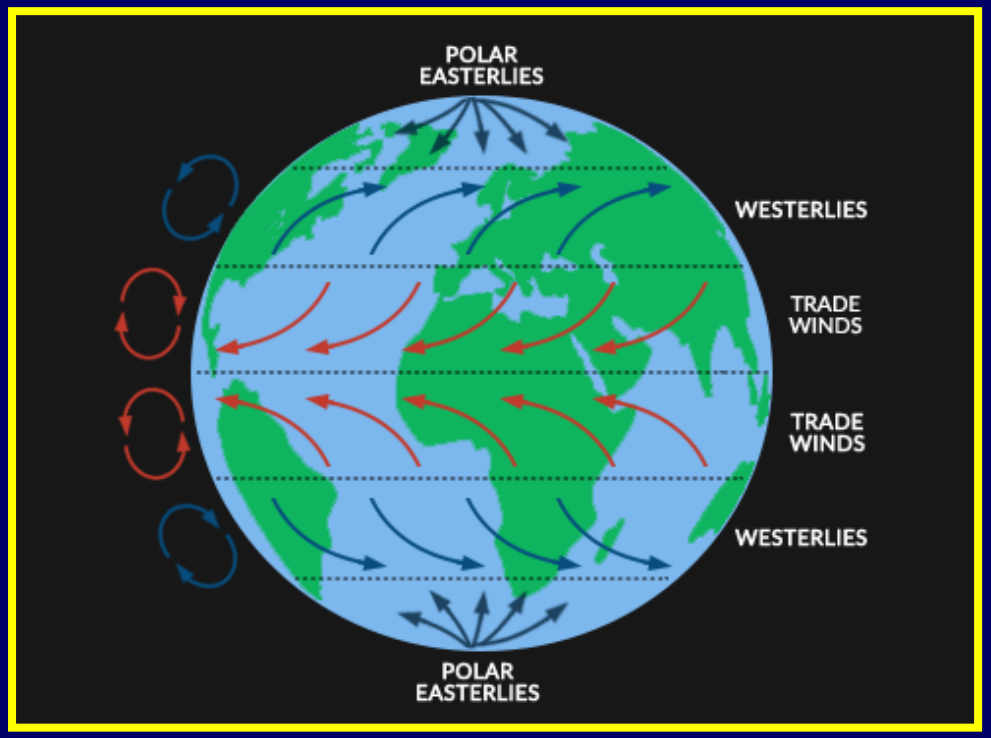
Winds and currents traveling from the equator towards the poles are still deflected to the right in the northern hemisphere and to the left in the southern hemisphere.



But now the winds are traveling towards the east, instead of the west.

Global Wind Systems

This Coriolis Effect combines with the high and low pressure systems created by the global convection cells to form distinct global wind systems.



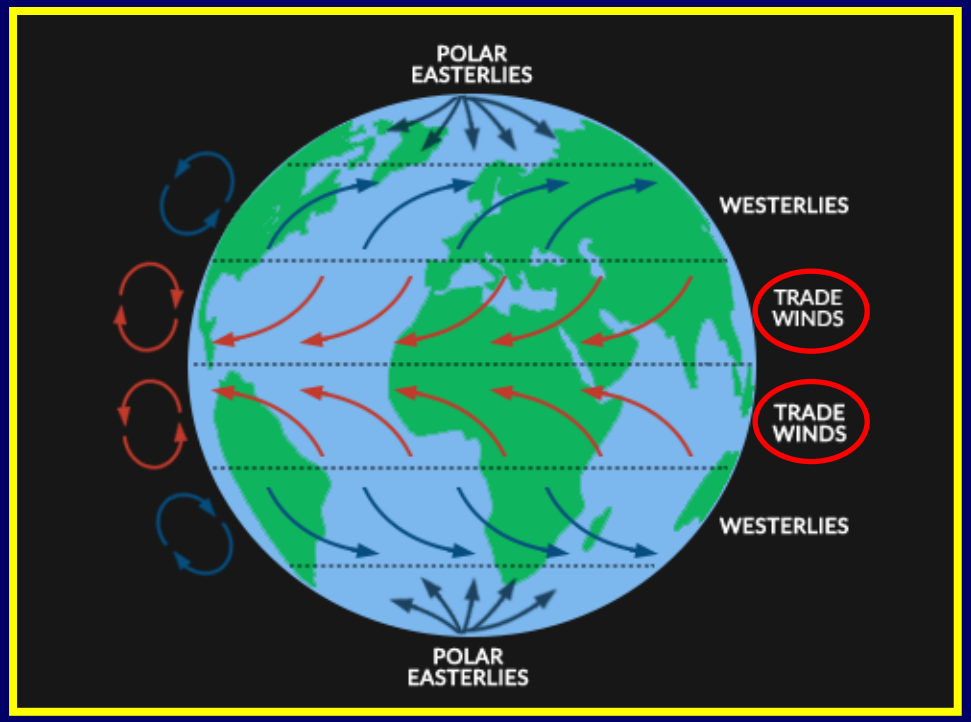
Polar Cell
Poles – 60^{o} Latitude
Polar Easterly Winds

Ferrel Cell
60^{o} – 30^{o} Latitudes
Prevailing Westerlies

Hadley Cell
Equator – 30^{o} Latitude
Trade Winds

Trade Winds

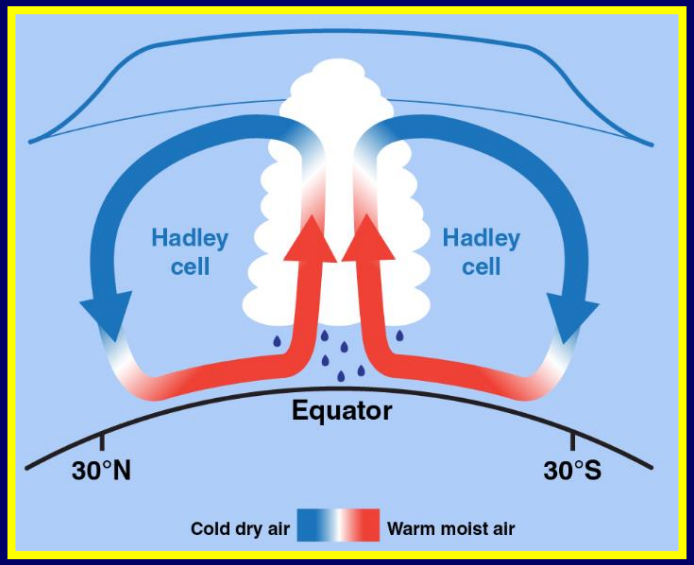
The trade winds blow from the high pressure system at 30^0 north and south latitude towards the equator, in a westerly direction.

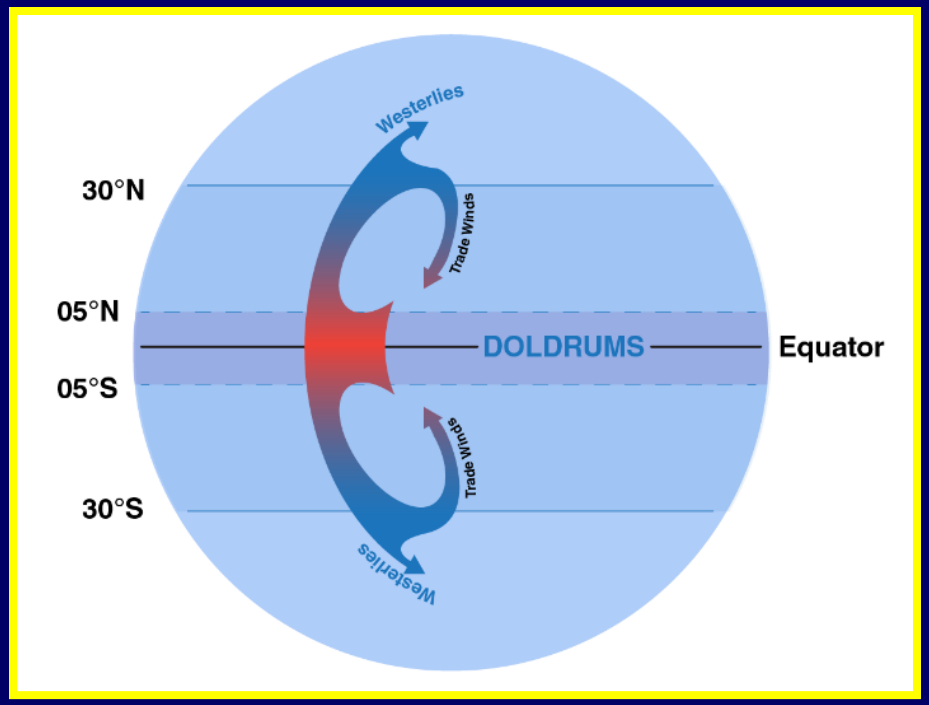


Because these winds were so reliable, sailing ships that were engaged in trade used them to travel.

Doldrums

Near the equator, the air is warmed and begins to rise.

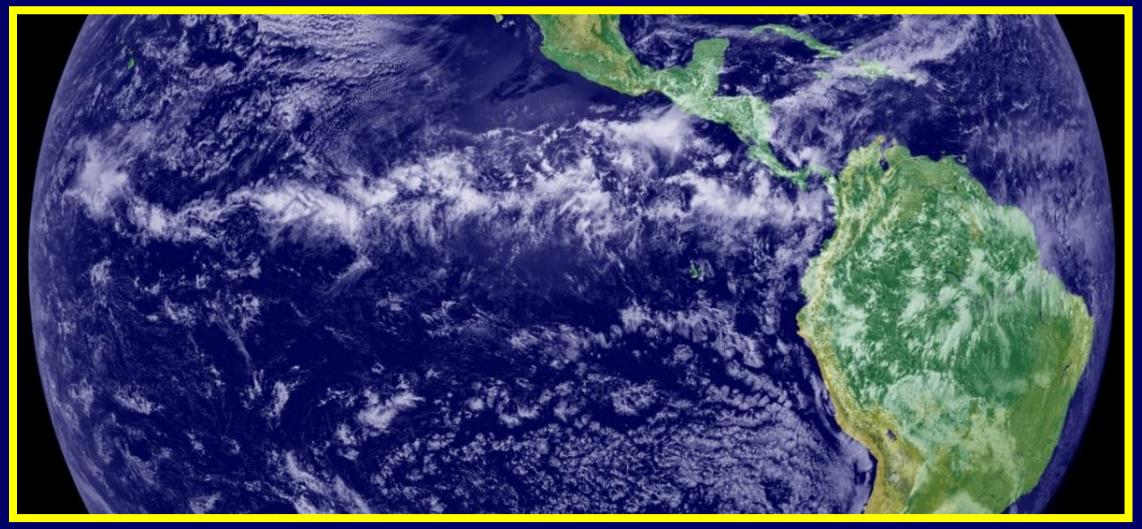


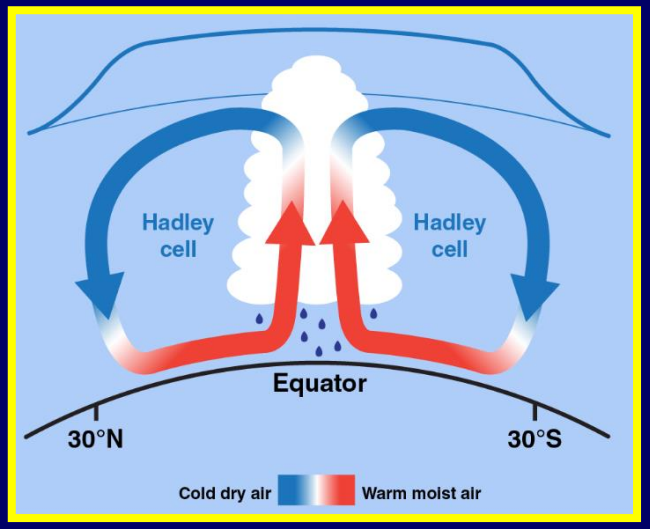


Because the air direction is upward, there is a not a lot of surface wind, so sailors called this region the doldrums.

Warm, Moist Rising Air

Along the equator, it is mostly ocean with only a small amount of land mass.

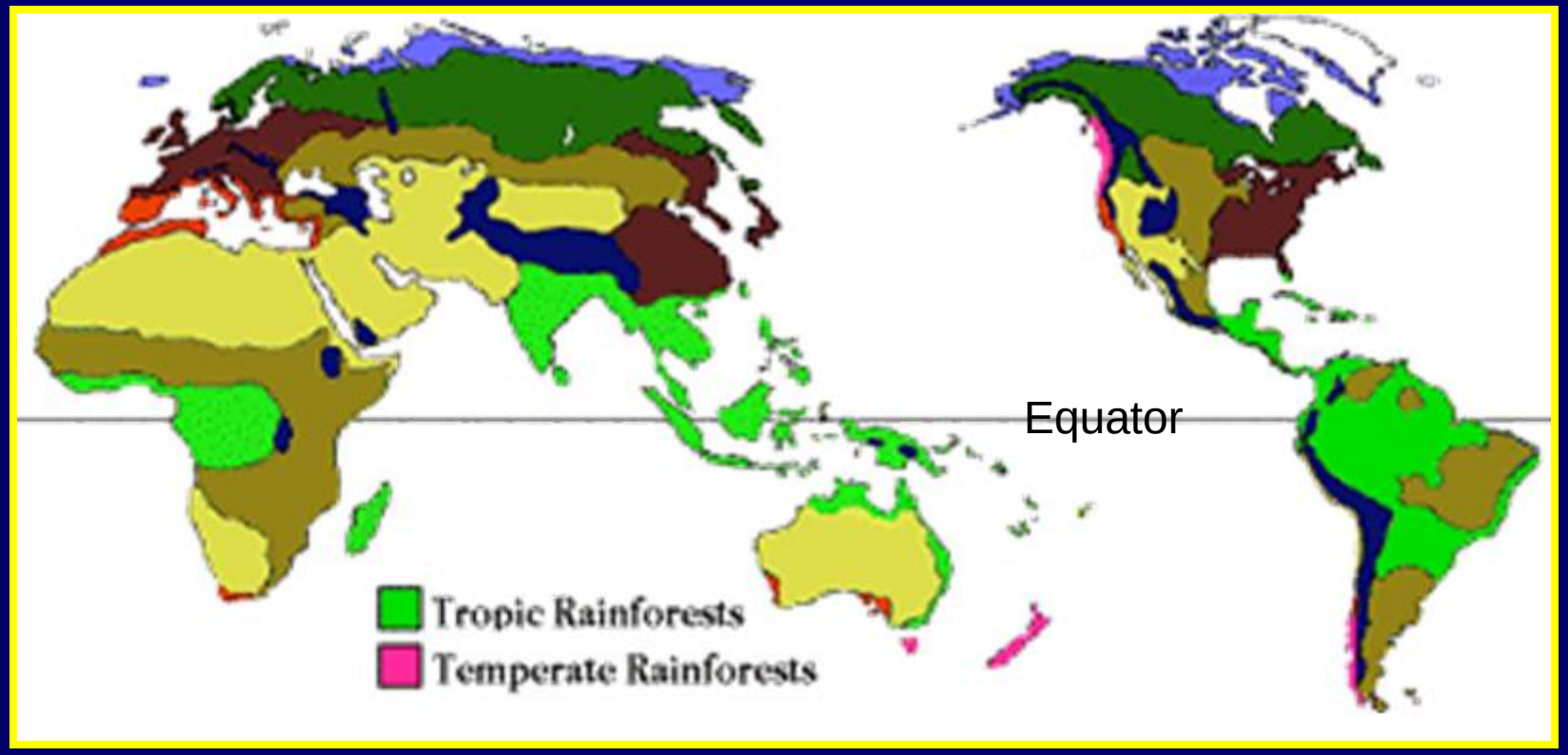




As the warm, moist air rises at the equator and begins to move towards the poles, it cools and condenses, resulting in a high amount of precipitation.

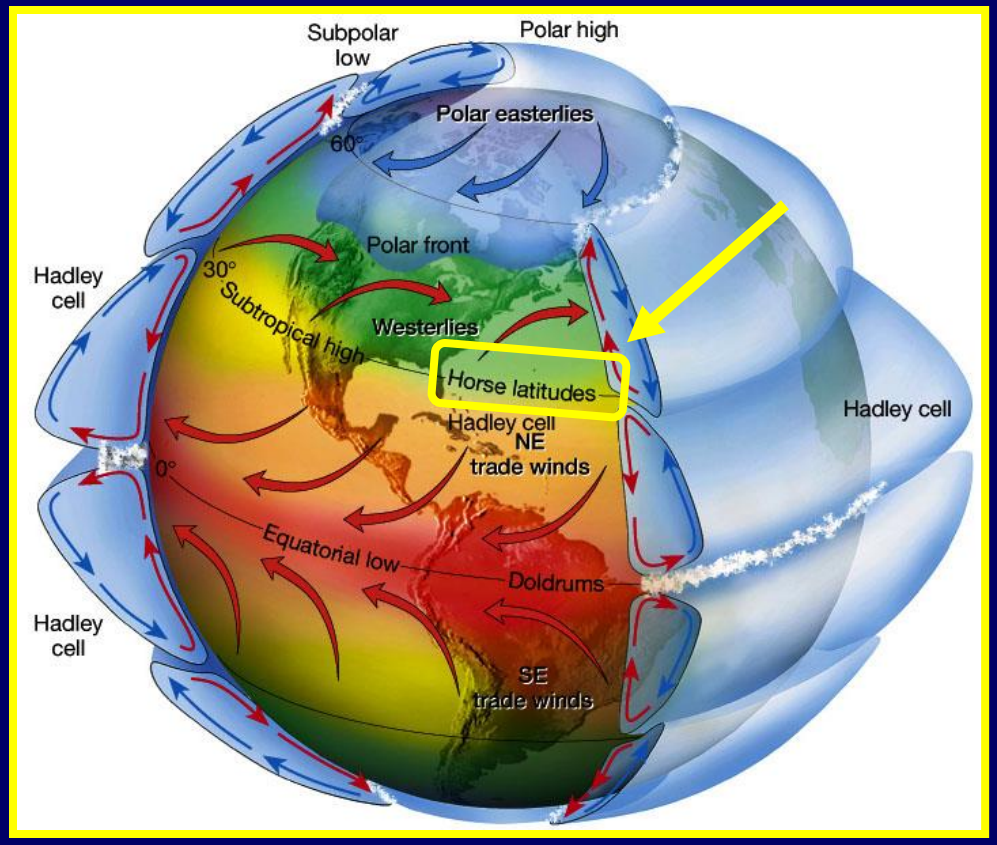
Tropical Rainforests

All of the world's tropical rainforests are located within this region or between 0^{o} latitude and 30^{o} latitude.



Horse Latitudes

At around 30^0 latitude, dry, cool air sinks to create an area of high pressure.

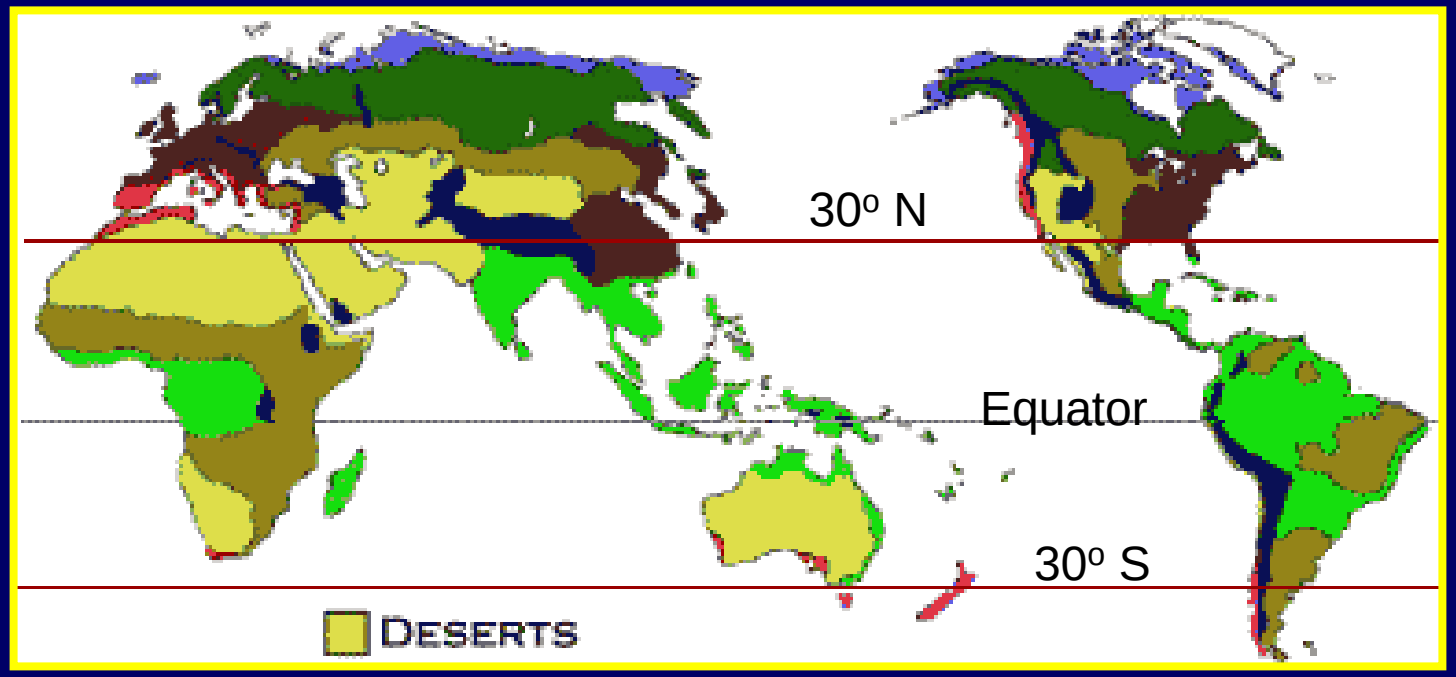


High pressure regions are associated with calm, dry winds, and sunny skies.

Sailors often became stuck in this region for weeks. Running low on water supplies, horses on the ship often died and were thrown overboard.

Deserts

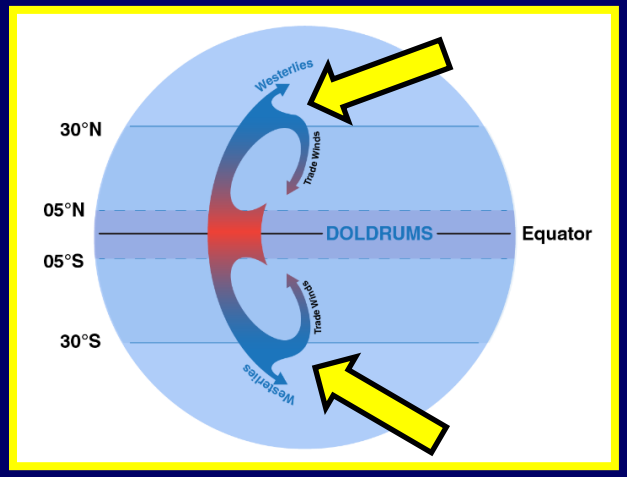
Because the cool, sinking air has already released all of its water, the descending air is very dry.

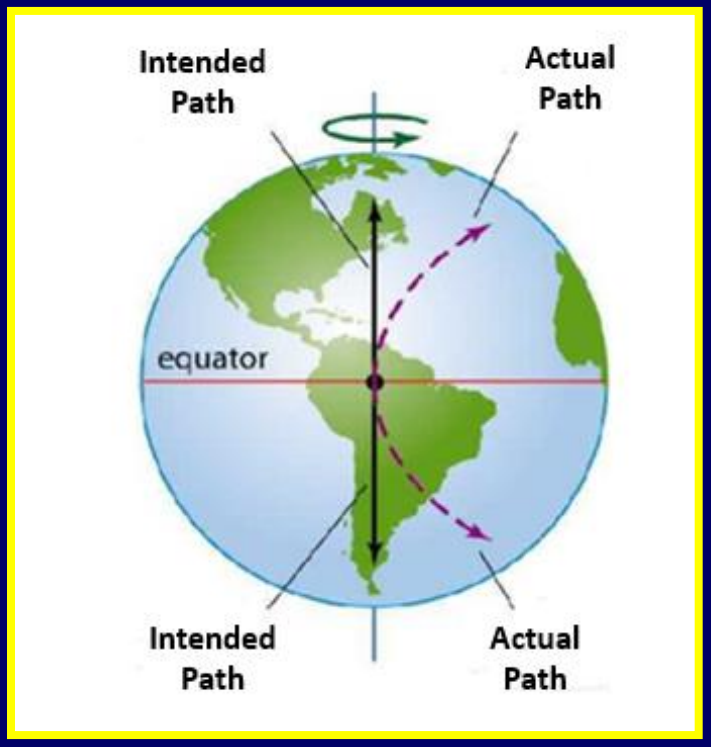


Near 30° north and south latitudes, are where most of the world's deserts are found.

Westerlies

At 30º latitude, the winds that do not flow southward, flow northward to about 60º latitude.



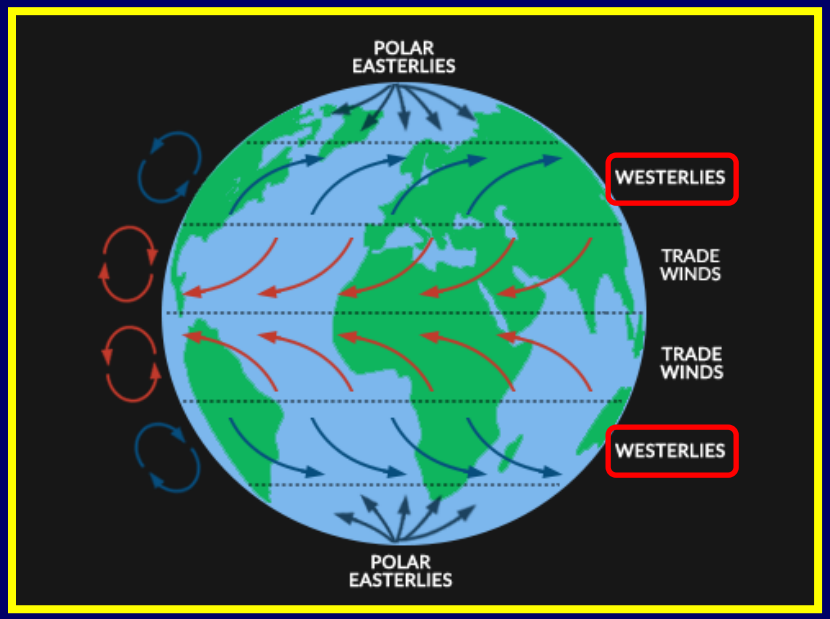


Due to the Coriolis effect, the winds are deflected to the right and travel from east to west.

Because winds are named according to the direction they blow from, these winds are called prevailing westerlies.

Prevailing Westerlies

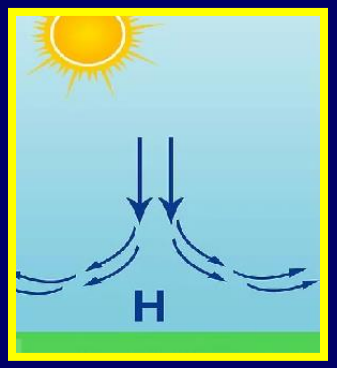
The winds that blow between 30º and 60º are called the prevailing westerlies are the winds we experience in the United States.

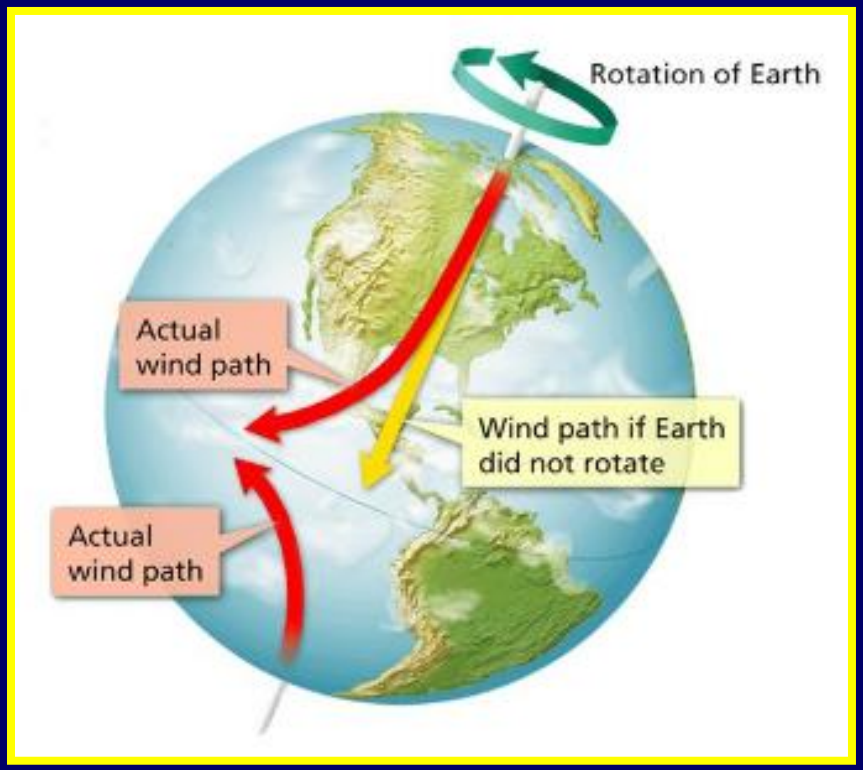


This why our storms usually come from the southwest.

Polar Easterlies

At the poles, the cold, denser air sinks and moves southward towards the equator.



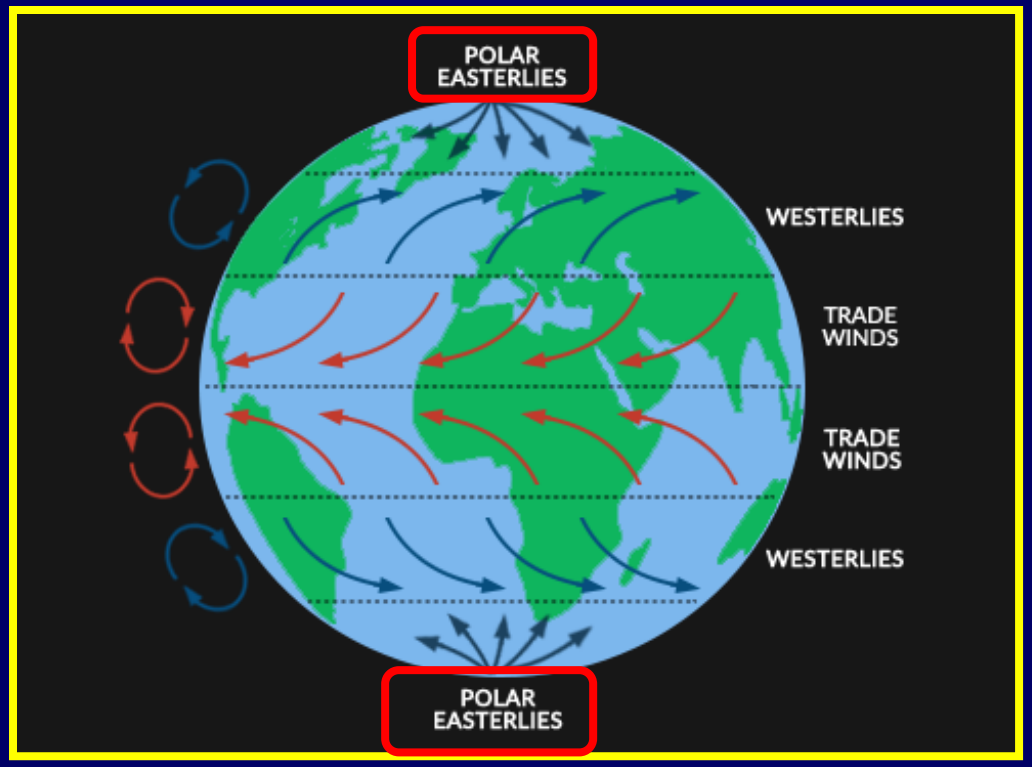


Due to the Coriolis effect, as the winds move south, they are deflected to the right or towards the west.

But because they originate in the east, they are called the polar easterlies.

Polar Easterlies

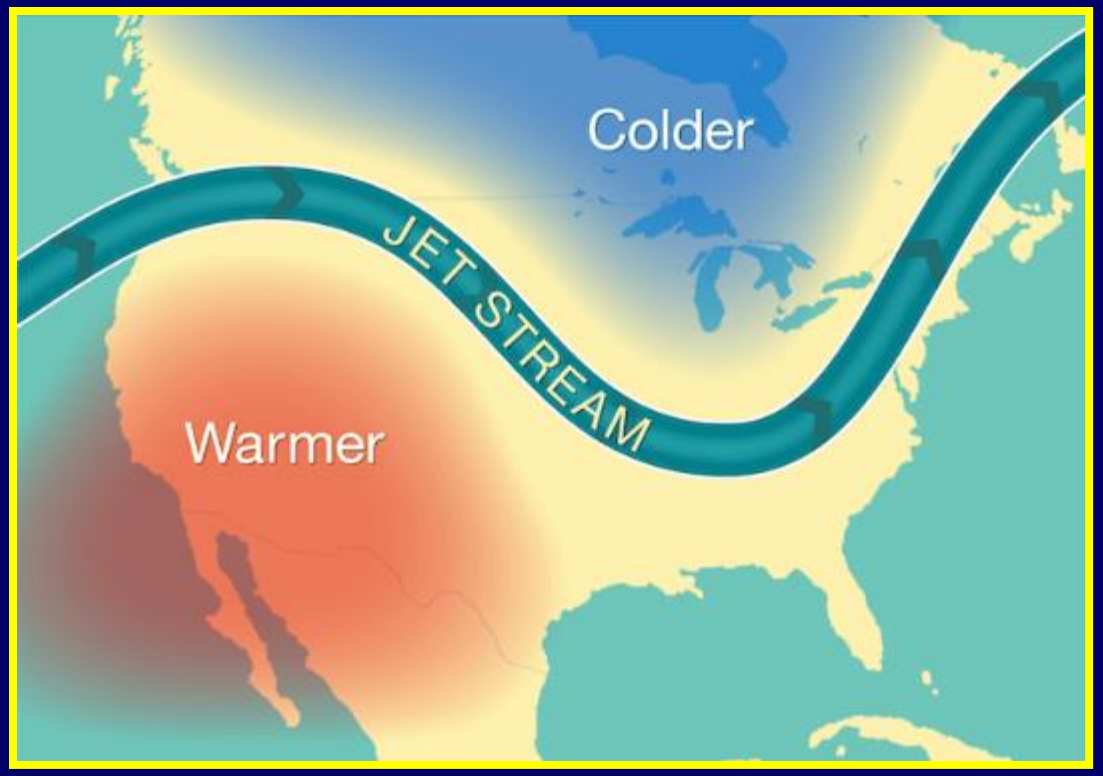
The polar easterlies blow from the poles to about 60^0 latitude.



Between 60^0 latitude and both poles, there is a lot of precipitation in the form of snow, which is where Antarctica and Siberia are located.

Jet Streams

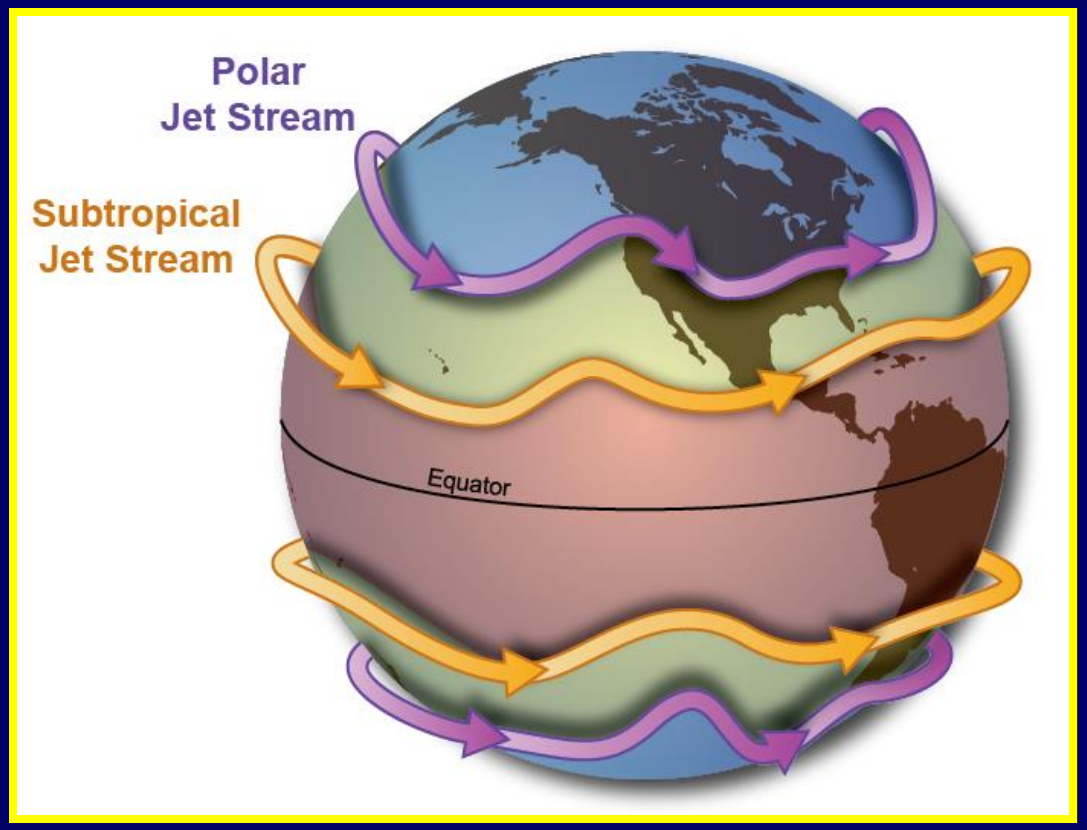
High in the atmosphere, above the global wind systems, differences in the temperature of air masses dominates air flow.



When a warm air mass meets a cold air mass, at the top of the troposphere, narrow bands of fast moving winds are created called jet streams.

Four Global Jet Streams

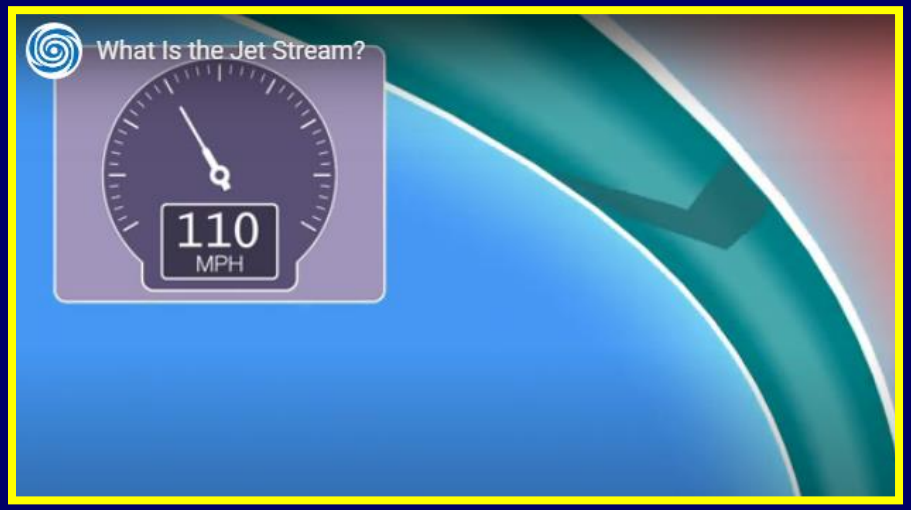
Earth has four major jet streams. Near each pole are the Polar Jet Streams and at about 30º north and south latitude are the Subtropical Jet Streams.



All four jet streams travel from east to west.

Speed of Jet Streams

The speed of the jet streams can reach 110 mph to 250 mph, especially in the winter when the difference in temperature between the air masses increases.

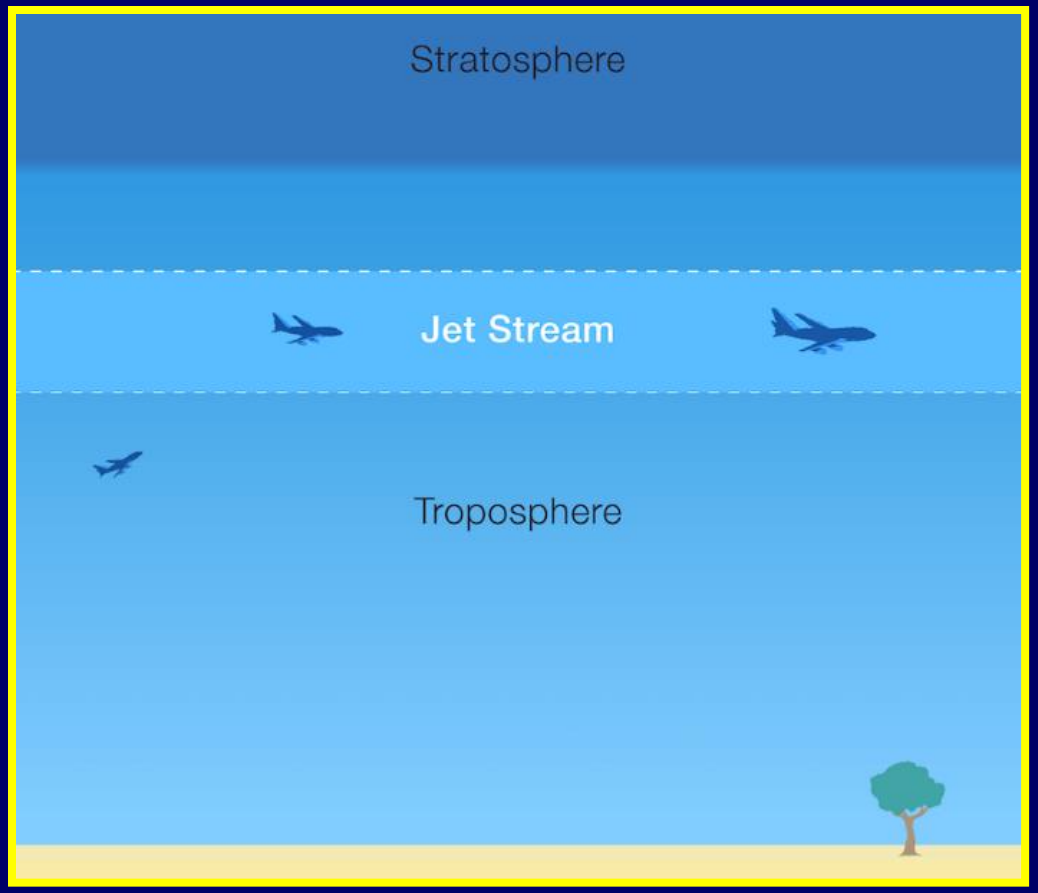


Summer Months

Winter Months

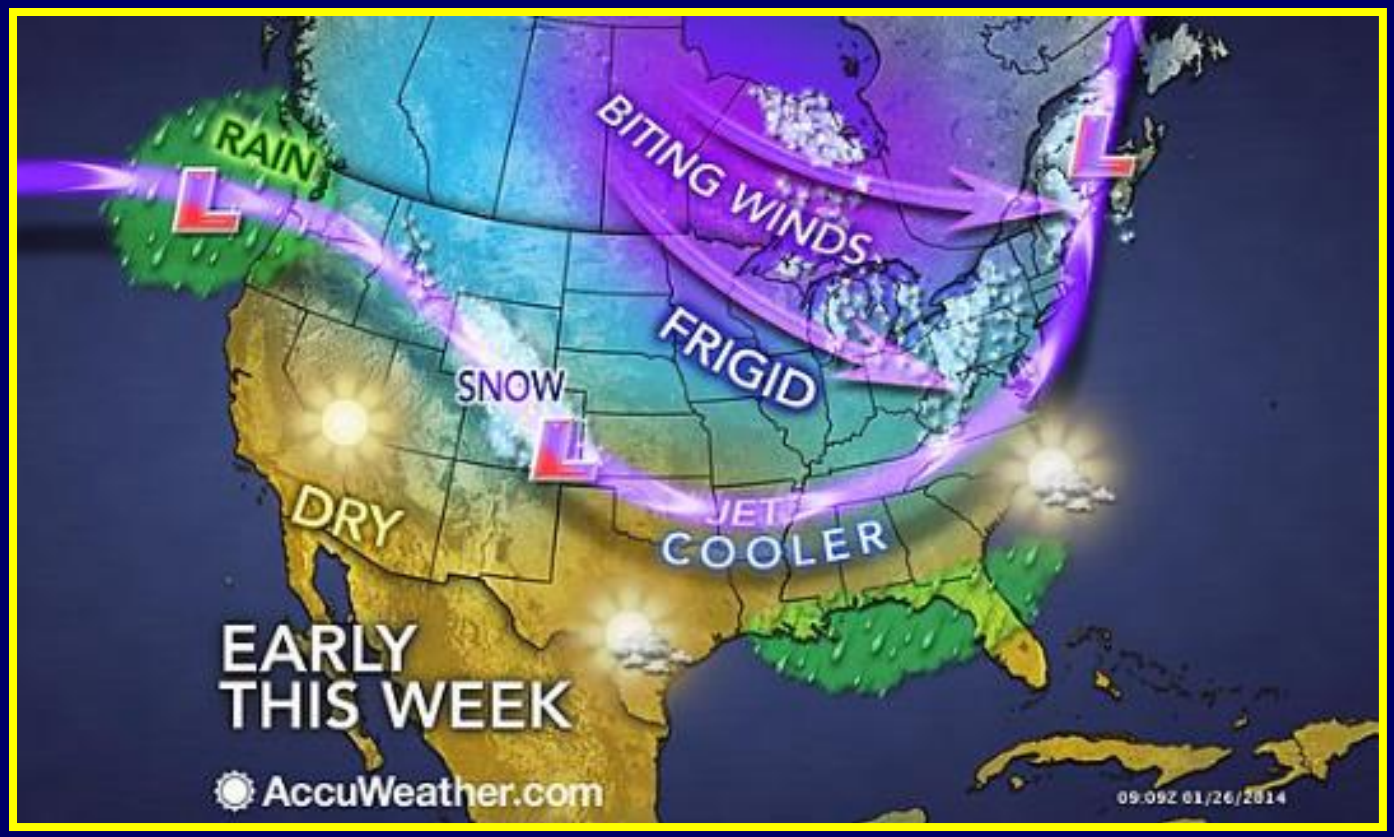
Airplanes

When airplanes are traveling in the same direction as the jet streams, they will fly in the jet stream to boost their speed and reduce their air travel times.



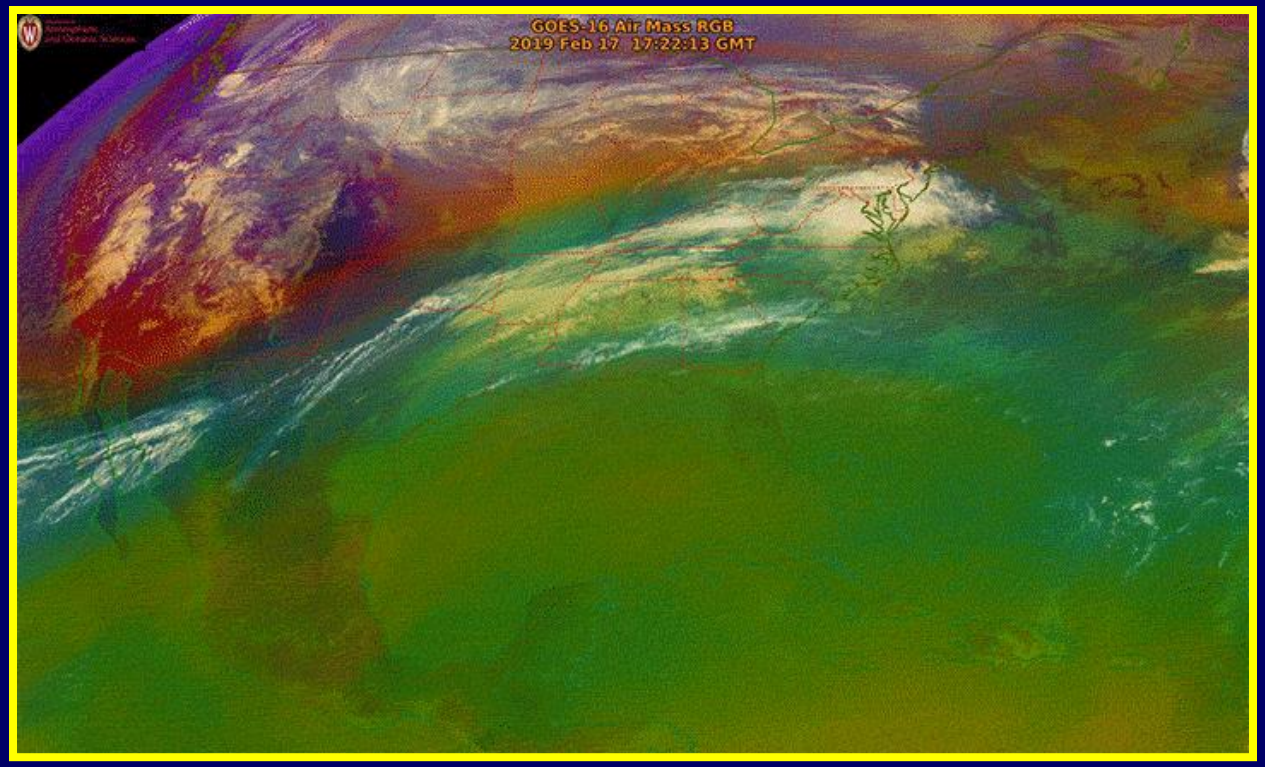
Jet Streams and Weather

When the polar jet stream dips southward, especially in the winter, it will cause large areas to experience extremely cold temperatures, cold rain, or snow storms.



Jet Streams and Weather

In this video the green area is warm, moist tropical air, while the orange and red areas are cold, dry polar air. The moving band of air between the two is the polar jet stream.



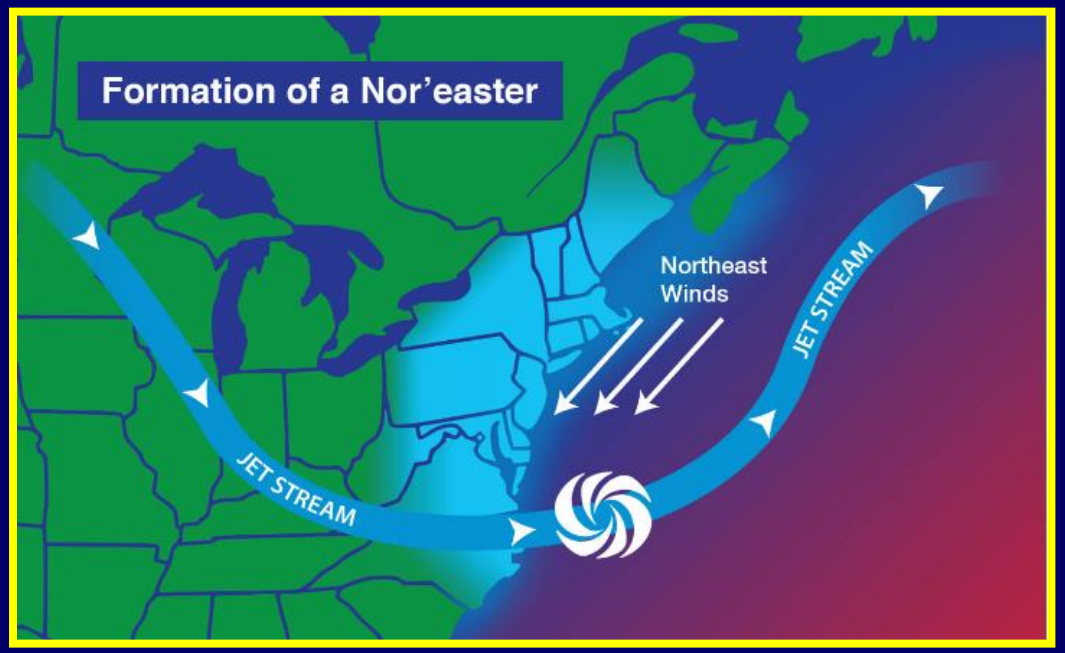
Nor'Easter

A Nor'Easter is a storm that blows from the northeast over the northern New England and Mid-Atlantic states.

The storms can bring large rain or large snow storms to these regions.

Nor'Easter

Nor'Easters form when the jet stream brings cold air down from Canada over the warm Atlantic Ocean waters.



When the cold air and warm water meet, a low pressure system forms.

The low pressure system causes clouds to develop and often results in snow storms.

The End