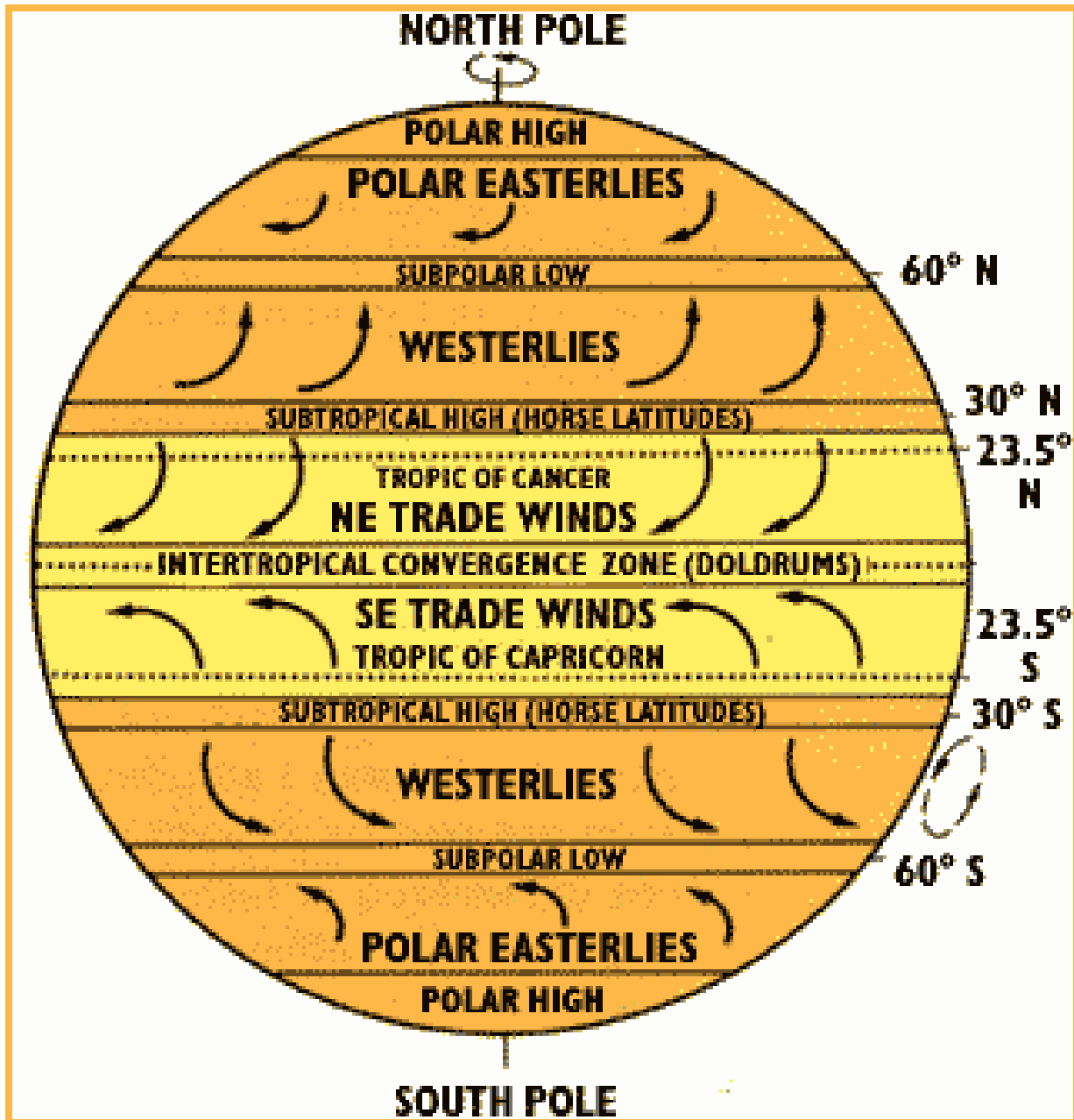
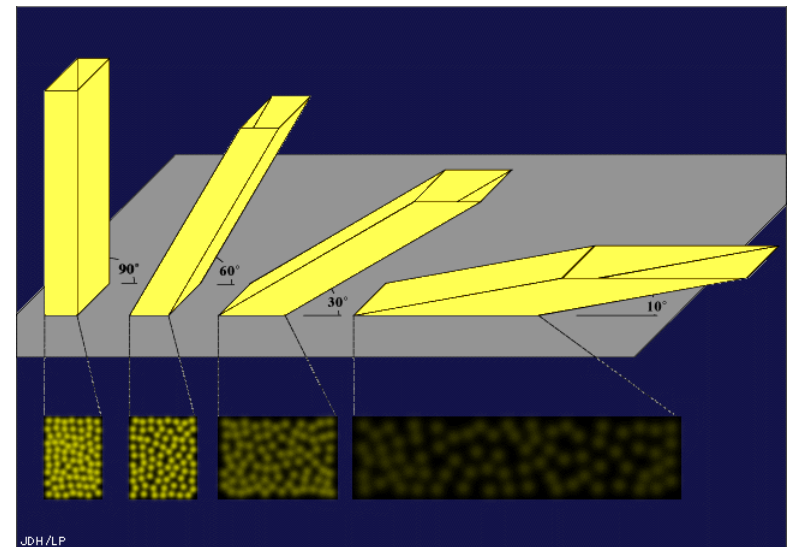
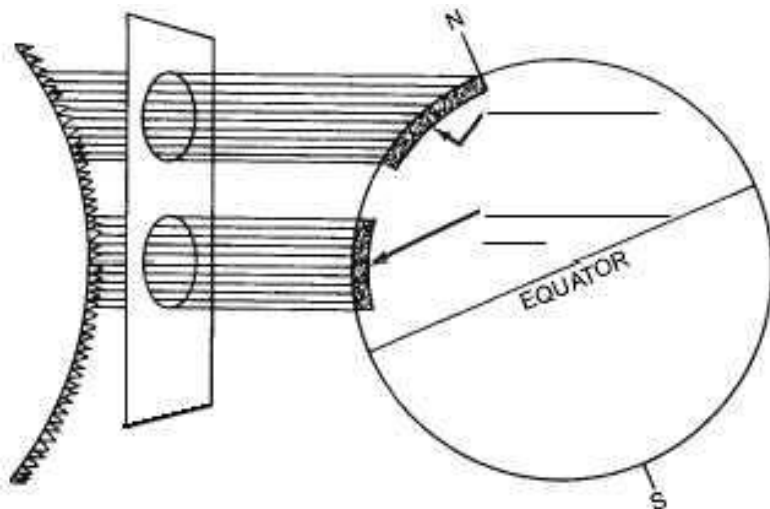
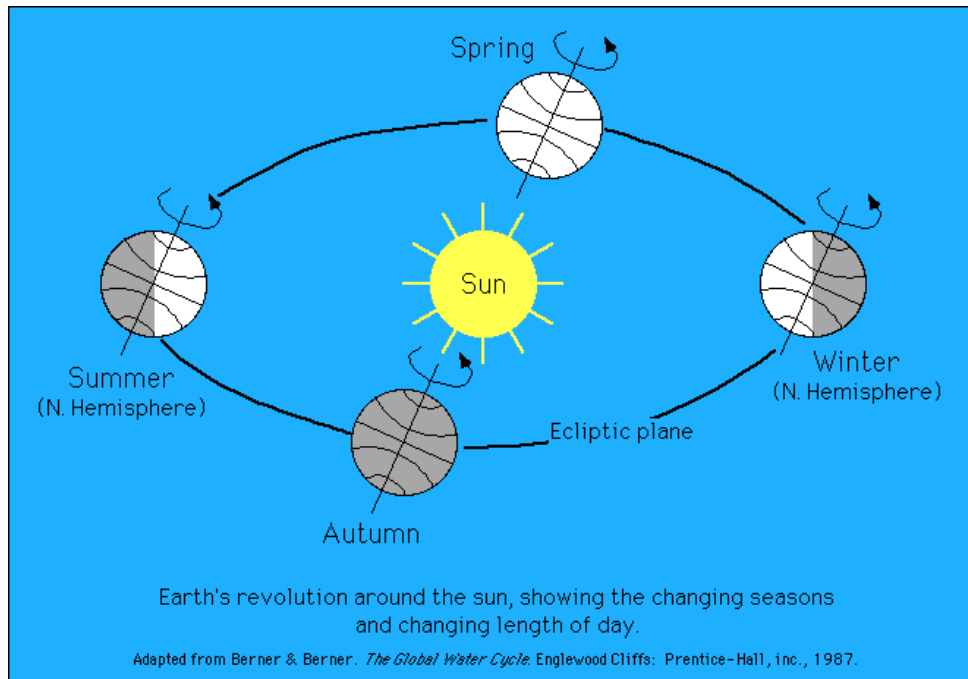


# **ATMOSPHERE, WEATHER & CLIMATE**

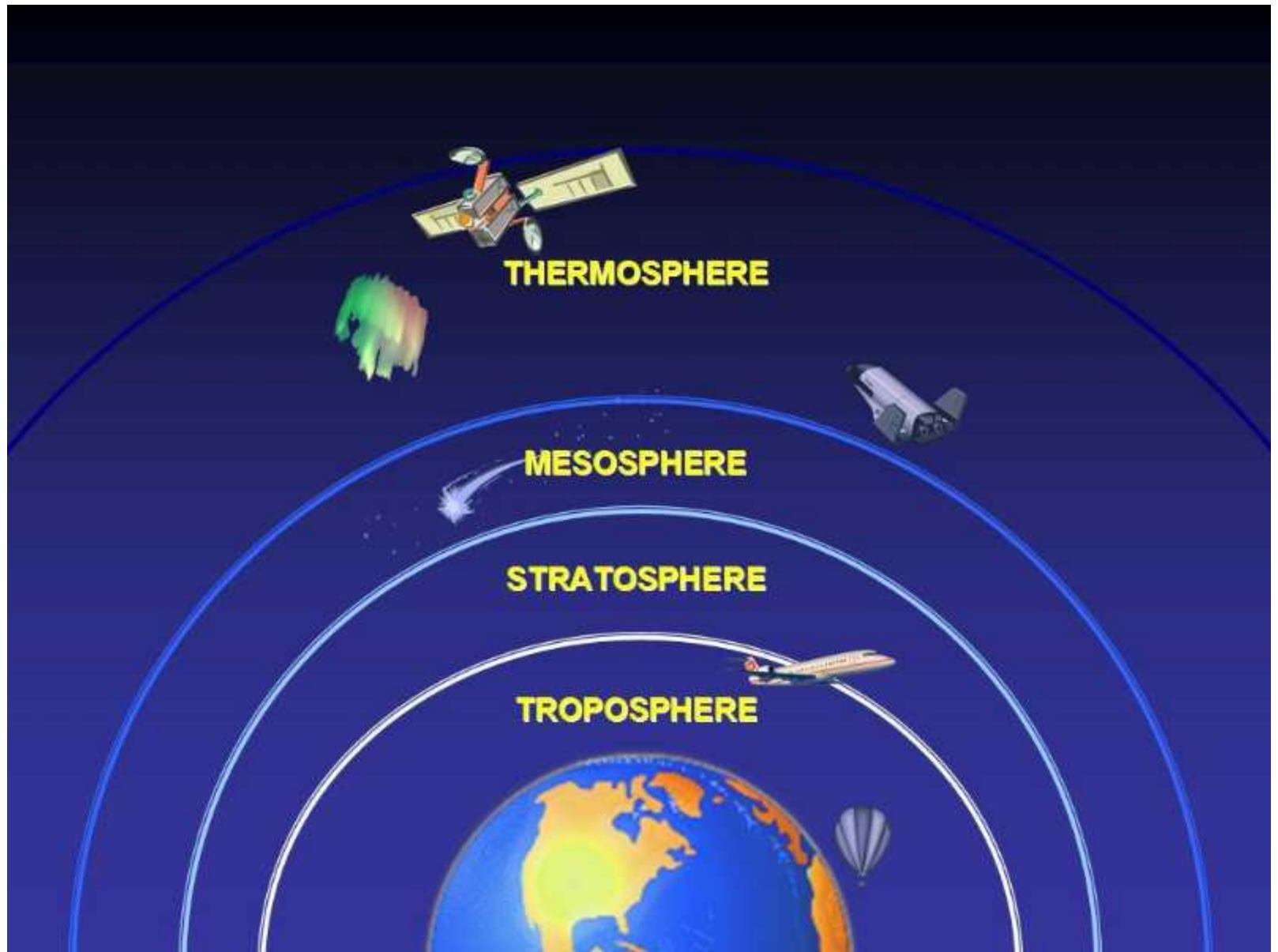


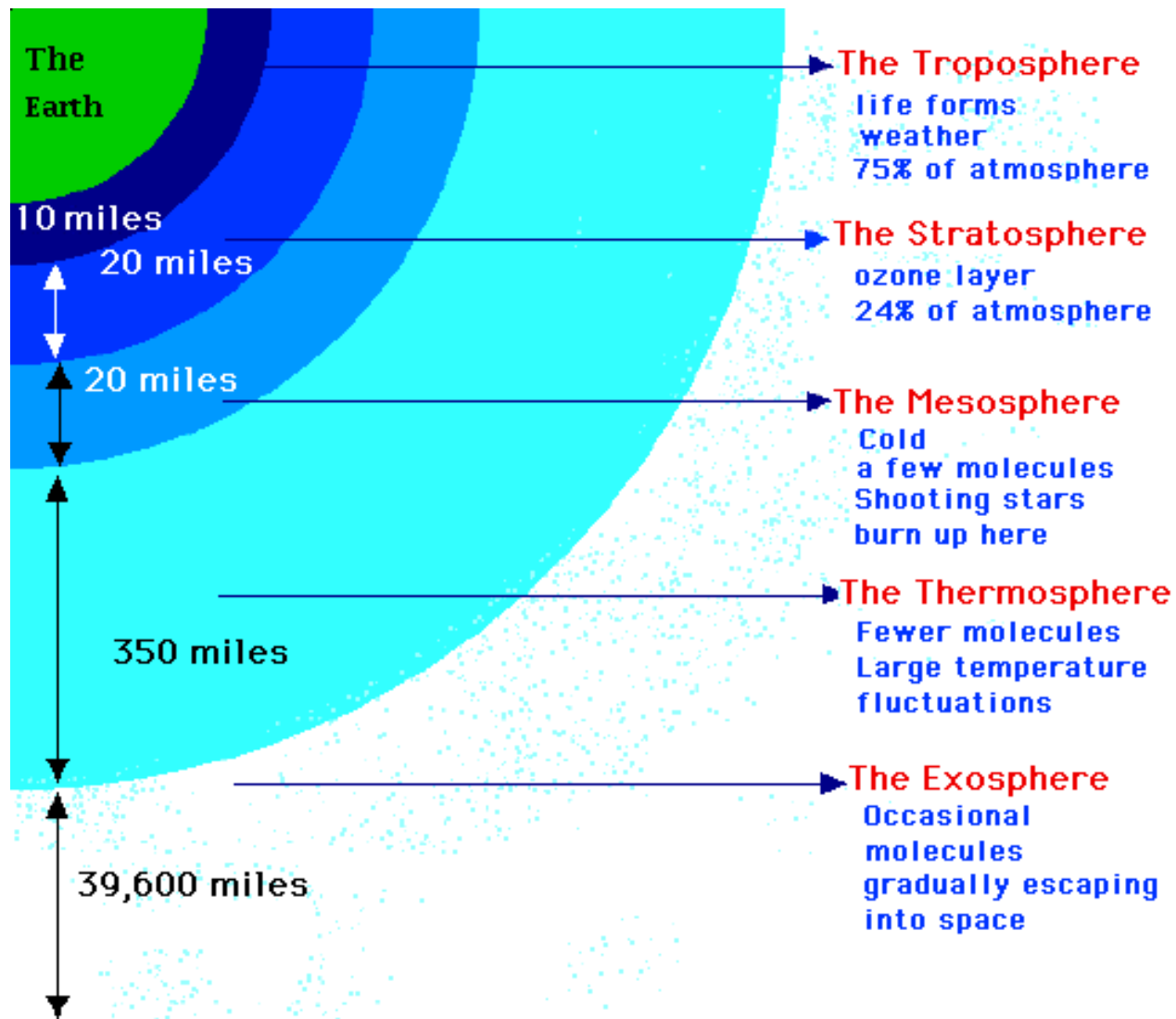


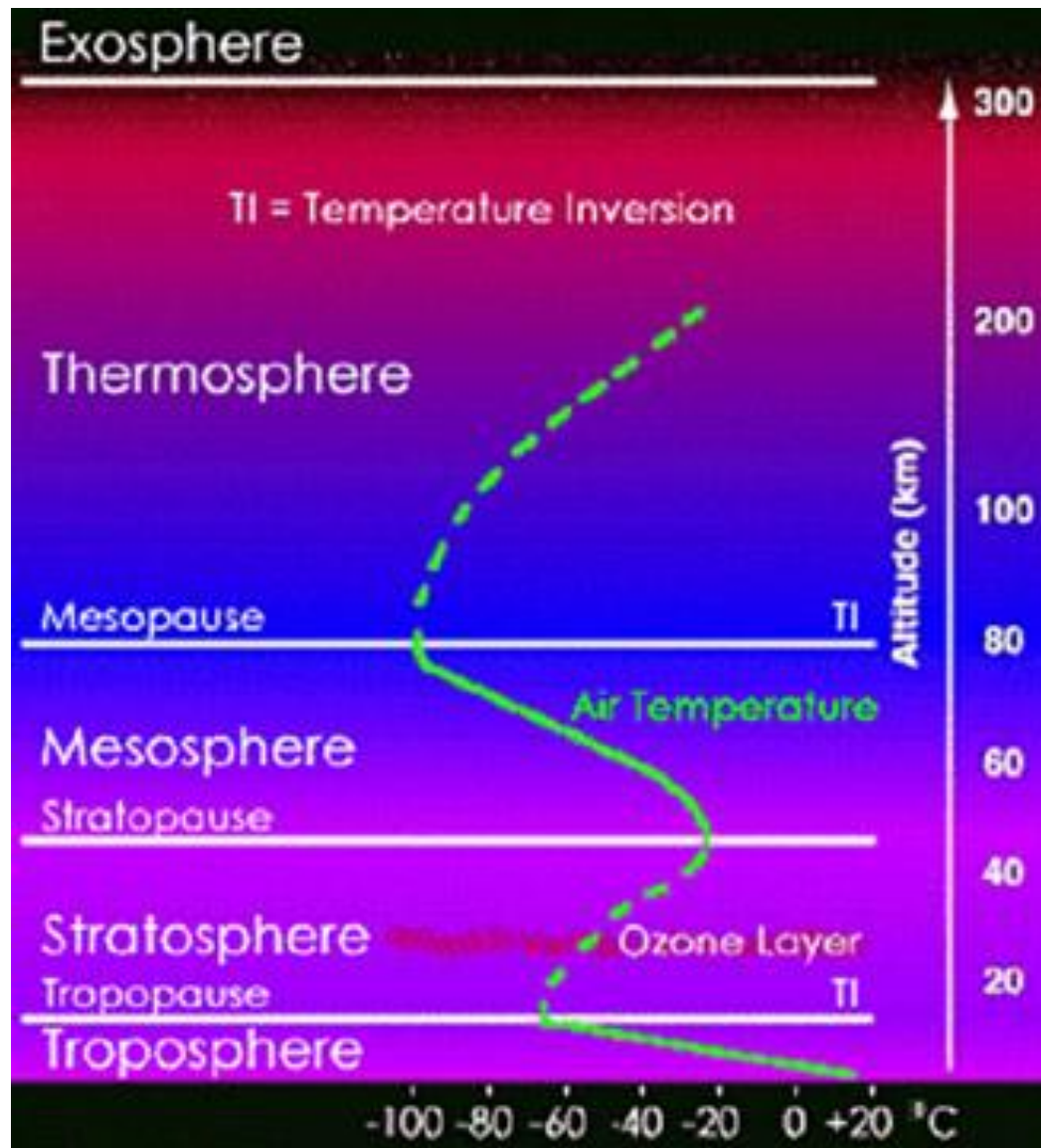




## Differential heating of the Earth







The atmosphere is divided into five main layers plus the ionosphere. It extends over 430 miles (700 km) into the sky.

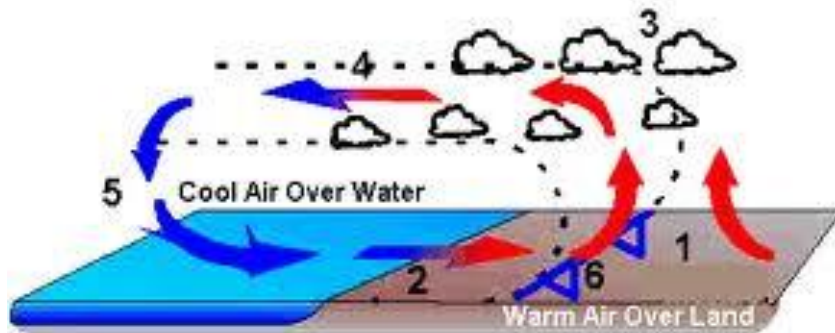
## ADIABATIC HEATING & COOLING

**In an adiabatic process an increase in temperature is due only to COMPRESSION when the air sinks or subsides. A decrease in temperature is due only to EXPANSION when air rises, as with convective currents or air going over mountains. There is no addition or subtraction of heat involved. The changes in temperature are due to the conversion of energy from one form to another.**

**Environmental Lapse Rate : (ELR)**

**Generally this is about 6.5 C per 1000 m. This rate does vary and depends on local air conditions.**

## Sea Breeze Circulation

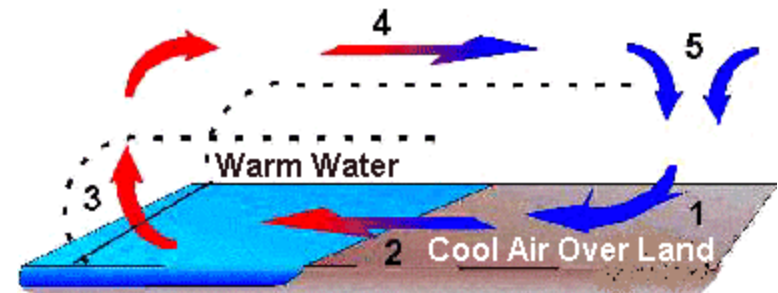


**During the day: Warm air over land rises creating Low pressure.**

**Cooler, heavier air over the water moves toward the land.**

**During night: Warm rising air over the ocean rises creating Low pressure.**  
**Cooler, heavier (H) over land moves toward the water.**

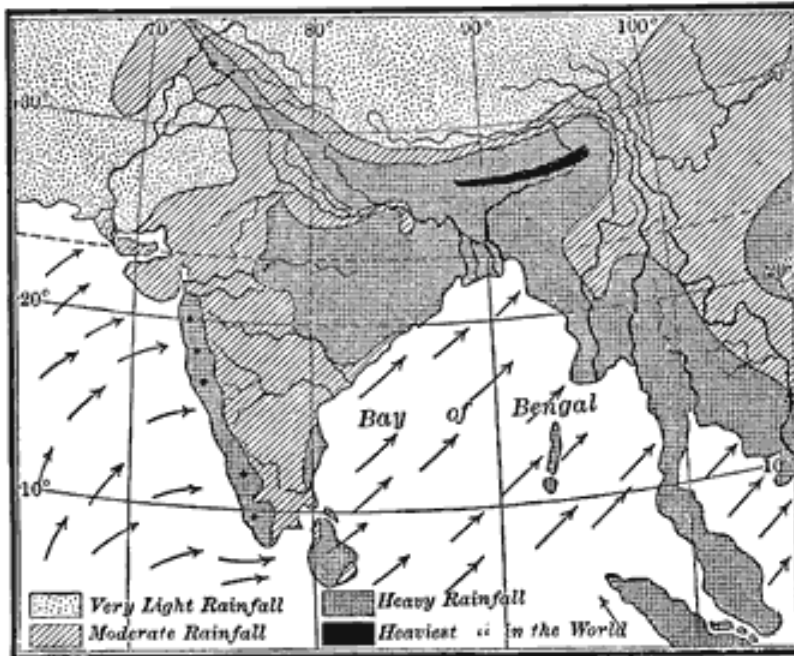
## Land Breeze Circulation



**India's climate is dominated by monsoons. Monsoons are strong, often violent winds that change direction with the season. Monsoon winds blow from cold to warm regions because cold air takes up more space than warm air. Monsoons blow from the land toward the sea in winter, and from the sea toward land in the summer.**

**India's winters are hot and dry. The monsoon winds blow from the northeast and carry little moisture. The temperature is high because the Himalayas form a barrier that prevents cold air from passing onto the subcontinent. Additionally, most of India lies between the Tropic of Cancer and the equator, so the sun's rays shine directly on the land. The temperature can reach as high as 110°F during the Indian winter.**

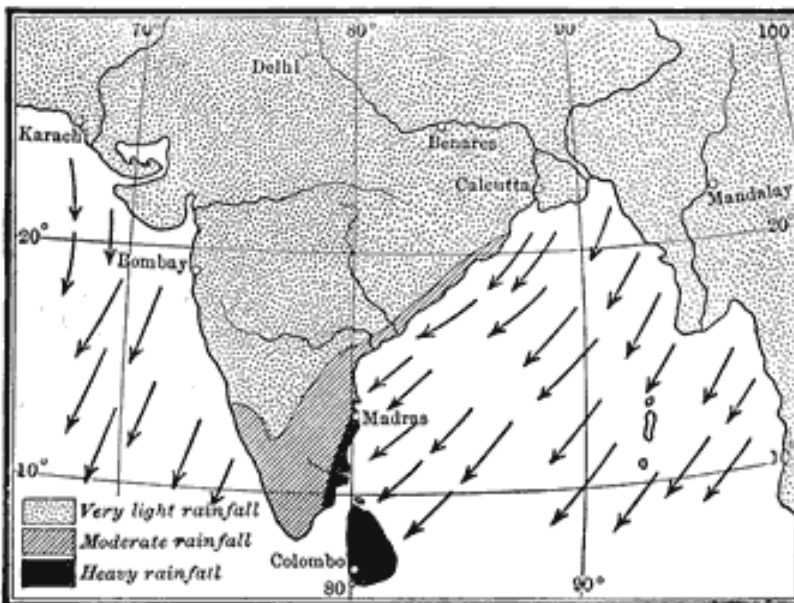
**The summer monsoons roar onto the subcontinent from the southwest. The winds carry moisture from the Indian Ocean and bring heavy rains from June to September. The torrential rainstorms often cause violent landslides. Entire villages have been swept away during monsoon rains. Despite the potential for destruction, the summer monsoons are welcomed in India. Farmers depend on the rains to irrigate their land. Additionally, a great deal of India's electricity is generated by water power provided by the monsoon rains.**



[http://www.classzone.com/books/earth\\_science/terc/content/visualizations/es2402/es2402page01.cfm?chapter\\_no=visualization](http://www.classzone.com/books/earth_science/terc/content/visualizations/es2402/es2402page01.cfm?chapter_no=visualization)

[http://upload.wikimedia.org/wikipedia/commons/archive/f/f7/20080526172354%21India\\_Southwest\\_monsoon\\_animation.gif](http://upload.wikimedia.org/wikipedia/commons/archive/f/f7/20080526172354%21India_Southwest_monsoon_animation.gif)

## SUMMER MONSOON WINDS



## WINTER MONSOON WINDS

## ADIABATIC HEATING & COOLING

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**Environmental Lapse Rate : (ELR)**

**Generally this is about 6.5 C per 1000 m. This rate does vary and depends on local air conditions.**

**The Santa Ana's develop when the desert is relatively cold, and are thus most common during the cool season stretching from October through March. High pressure builds over the Great Basin (e.g., Nevada) and the cold air there begins to sink.**

**1. This air is forced down slope which compresses and warms it at a rate of about 10C per kilometer (29F per mile) of descent.**

**As its temperature rises, the relative humidity drops; the air starts out dry and winds up at sea level much drier still.**

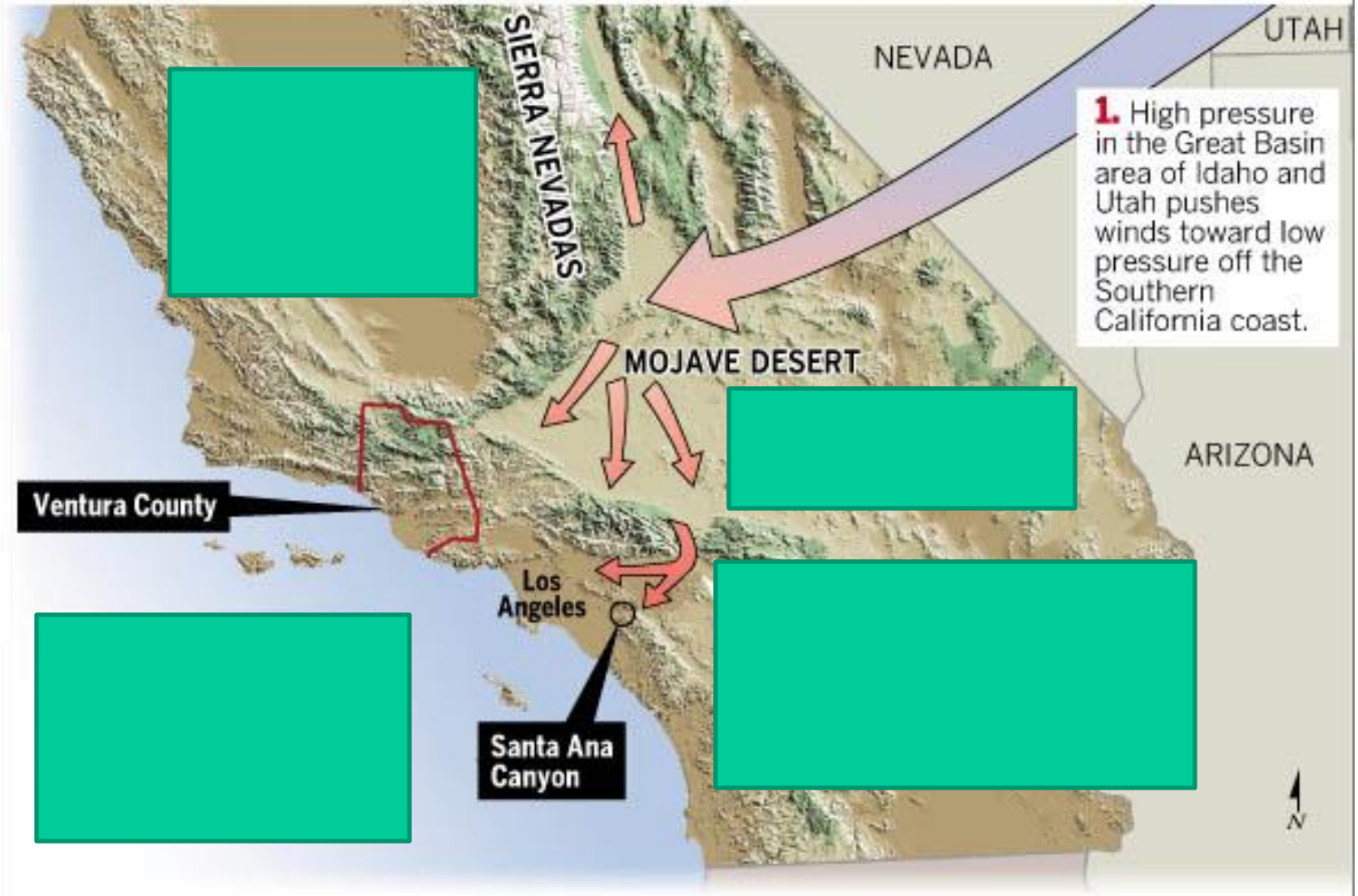
**The air picks up speed as it is channeled through passes and canyons.**

**Santa Ana's can cause a great deal of damage. The fast, hot winds cause vegetation to dry out, increasing the danger of wildfire. Once the fires start, the winds fan the flames and hasten their spread. The winds create turbulence and establish vertical wind shear (in which winds exhibit substantial change in speed and/or direction with height), both posing aviation hazards.**

<http://www.chemistry.wustl.edu/~courses/genchem/LabTutorials/Thermochem/Fridge.html>

# The Santa Ana winds

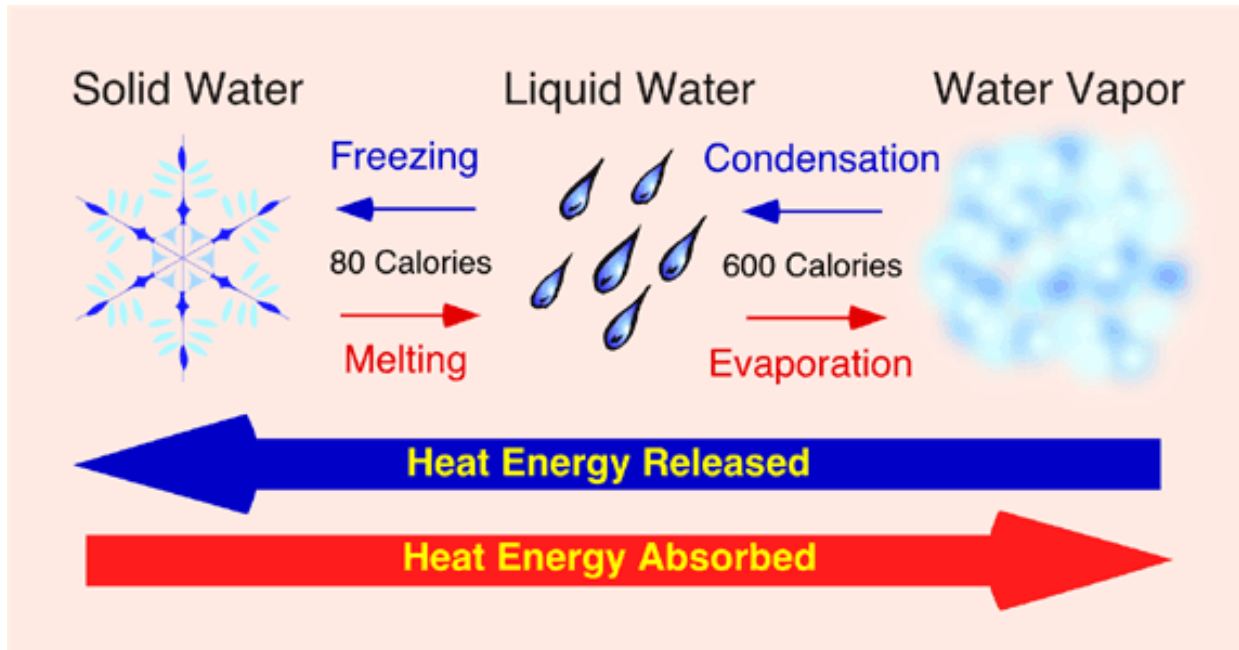
Santa Anas are dry, sometimes hot winds in Southern California that blow westward through canyons toward coastal regions. They typically occur from October through March, tending to peak in December, but often spread wildfires in the fall across areas that have gone for months without rain.



Sources: UCLA and UC San Diego research studies

Steve Greenberg / Star staff

## •LATENT HEAT:



**Latent temperature change: Change of temperature due to a change of state.**

**Heat that added to change a liquid to a gas will be returned when changing back from a gas to a liquid.**

# Objectives:

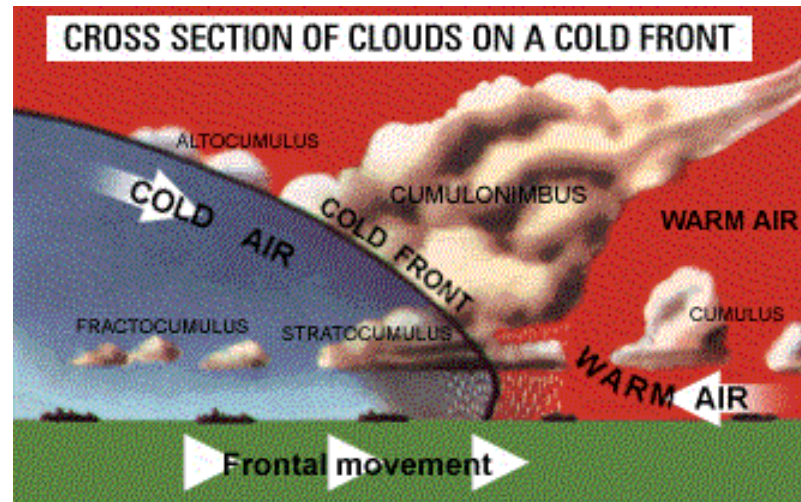
**SWBAT describe the formation fronts and tornados.  
Begin the science of climate change.**

## Warm Up:

**Under which circumstances do hurricanes form? Dissipate?**

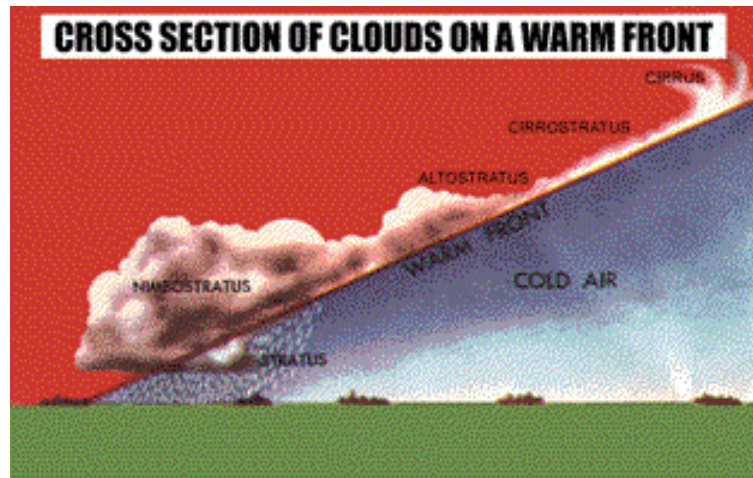
Fronts are named according to which front is overtaking another.

## COLD FRONT



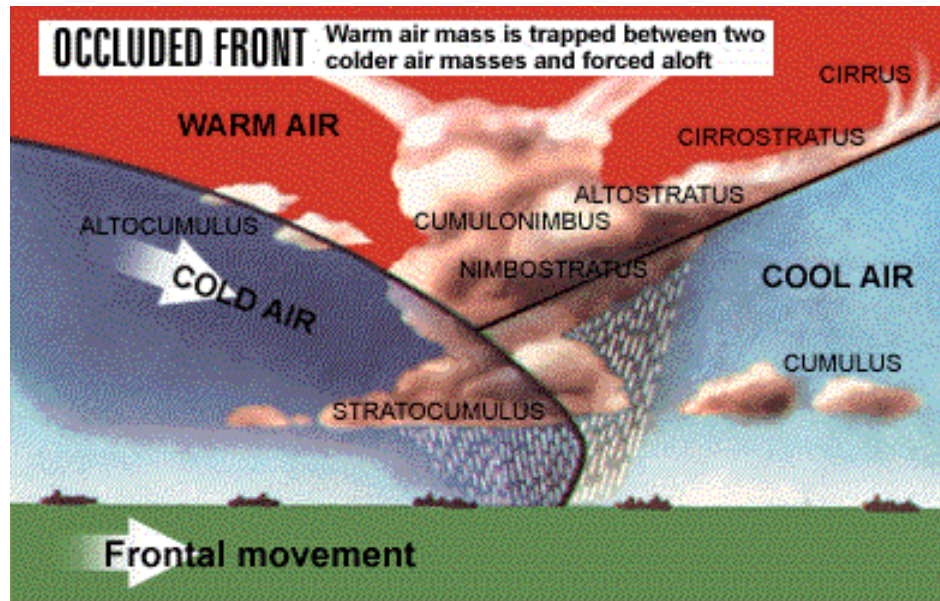
As the cold air forces the warm air to rise, the warm air cools and cumulonimbus clouds are formed. Heavy precipitation and gusty winds result. The belt of stormy weather is 10 to 50 miles in width. Cold fronts move from 20 to 35 miles per hour. A complete change in weather occurs within a few hours. A wind shift from a southerly to a northerly direction and a rapid rise in pressure occur as the front passes.

# WARM FRONT



Warm frontal clouds map appear 500-600 miles in advance of the point on the ground which marks the position of the front. The first signs are thin wisp of cirrus clouds. Cirrostratus and altostratus then appear. The altostratus gradually develop into nimbostratus and precipitation falls. Low stratus clouds, fog and drizzle frequently accompany a warm front. Thunderstorms may be found ahead of a warm front

# OCCLUDED FRONT



When a cold and warm front merge into one front, it is known as an occluded front, or occlusion. The warm air mass becomes strapped between two colder air masses, one from the west and one from the east, and is forced aloft. Occluded means "closed in." A broad belt of bad weather accompanies the occluded front. Warm front weather will be followed by cold front weather in all occlusions.



A tornado or twister is a very destructive, whirling storm of small diameter with rapidly rising winds at the center, often exceeding 300 mph. The funnel cloud builds down from above and its path on the ground usually less than 25 miles in length.

The Fugita Scale is used to describe the destructiveness of tornados.

# Fujita Scale to measure tornado damage.

	<p>F-0: (Light Damage) Chimneys are damaged, tree branches are broken, shallow-rooted trees are toppled.</p>
	<p>F-1: (Moderate Damage) Roof surfaces are peeled off, windows are broken, some tree trunks are snapped, unanchored manufactured homes are overturned, attached garages may be destroyed.</p>
	<p>F-2: (Considerable Damage) Roof structures are damaged, manufactured homes are destroyed, debris becomes airborne (missiles are generated), large trees are snapped or uprooted.</p>
	<p>F-3: (Severe Damage) Roofs and some walls are torn from structures, some small buildings are destroyed, non-reinforced masonry buildings are destroyed, most trees in forest are uprooted.</p>
	<p>F-4: (Devastating Damage) Well-constructed houses are destroyed, some structures are lifted from foundations and blown some distance, cars are blown some distance, large debris becomes airborne.</p>
	<p>F-5: (Incredible Damage) Strong frame houses are lifted from foundations, reinforced concrete structures are damaged, automobile-sized debris becomes airborne, trees are completely debarked.</p>

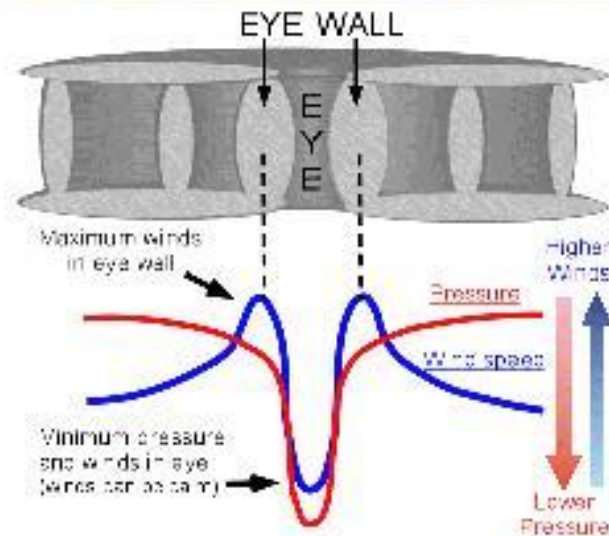
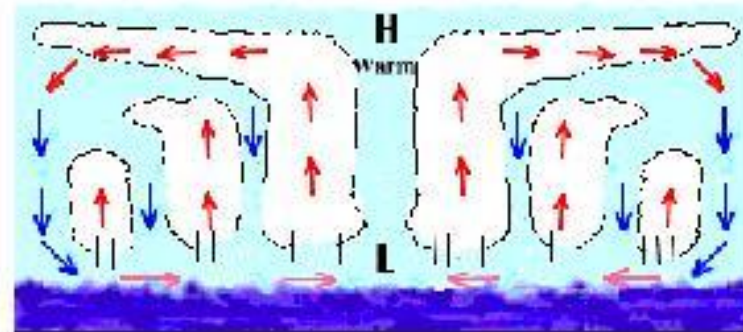
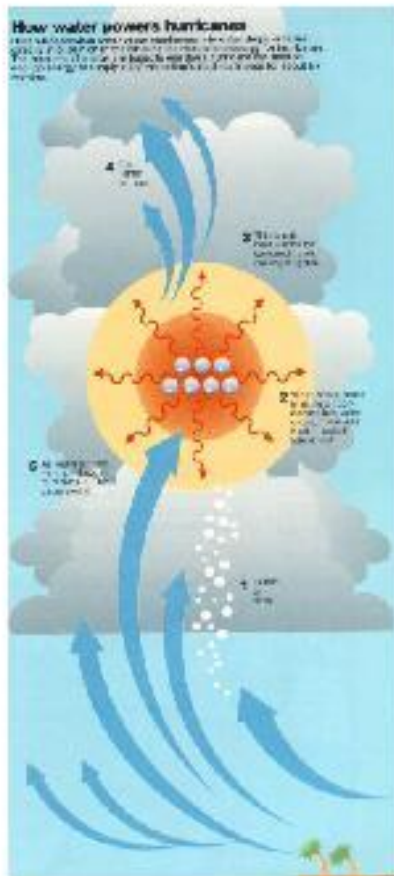
## **Hurricane Formation and Decay**

Hurricanes form over tropical waters (between 8° and 20° latitude) in areas of high humidity, light winds, and warm sea surface temperatures (typically 26.5°C [80°F] or greater). These conditions usually prevail in the summer and early fall months of the tropical North Atlantic and North Pacific Oceans and for this reason, hurricane "season" in the northern hemisphere runs from June through November.

Few things in nature can compare to the destructive force of a hurricane. Called the greatest storm on Earth, a hurricane is capable of annihilating coastal areas with sustained winds of 155 mph or higher and intense areas of rainfall and a storm surge. In fact, during its life cycle a hurricane can expend as much energy as 10,000 nuclear bombs!



# Formation & Development of Hurricanes 1









## Saffir-Simpson Hurricane Scale

Category	Wind Speed	
	mph	knots
5	≥156	≥135
4	131-155	114-134
3	111-130	96-113
2	96-110	84-95
1	74-95	65-83

## Non-Hurricane Classifications

Tropical Storm	39-73	34-64
Tropical Depression	0-38	0-33

## Beaufort Wind Scale

Beaufort Number (Force)	Wind Speed (mph)	Effects observed on land
0	under 1	 Chimney smoke rises straight up
1	1-3	 Smoke drifts gently
2	4-7	 Leaves rustle, wind felt on face
3	8-12	 Leaves & twigs on trees move
4	13-18	 Dust & paper blow on the ground
5	19-24	 Small trees start to sway

**Tropical cyclones with maximum sustained surface winds of less than 17 m/s (34 kt, 39 mph) are called "tropical depressions" This is not to be confused with the condition mid-latitude people get during a long, cold and grey winter wishing they could be closer to the equator ;-)). Once the tropical cyclone reaches winds of at least 17 m/s (34 kt, 39 mph) they are typically called a "tropical storm" and assigned a name. If winds reach 33 m/s (64 kt, 74 mph)), then they are called:**

**"hurricane"** (the North Atlantic Ocean, the Northeast Pacific Ocean east of the dateline, or the South Pacific Ocean east of 160E)

**"typhoon"** (the Northwest Pacific Ocean west of the dateline)

**"severe tropical cyclone"** (the Southwest Pacific Ocean west of 160E or Southeast Indian Ocean east of 90E)

**"severe cyclonic storm"** (the North Indian Ocean)

**"tropical cyclone"** (the Southwest Indian Ocean)

<http://www.sciencecourseware.org/eec/GlobalWarming/Tutorials/Milankovitch/>

**MILANKOVITCH CYCLE-** The earth's climate (specifically ice ages) depend on the precession, obliquity and eccentricity of the planet.