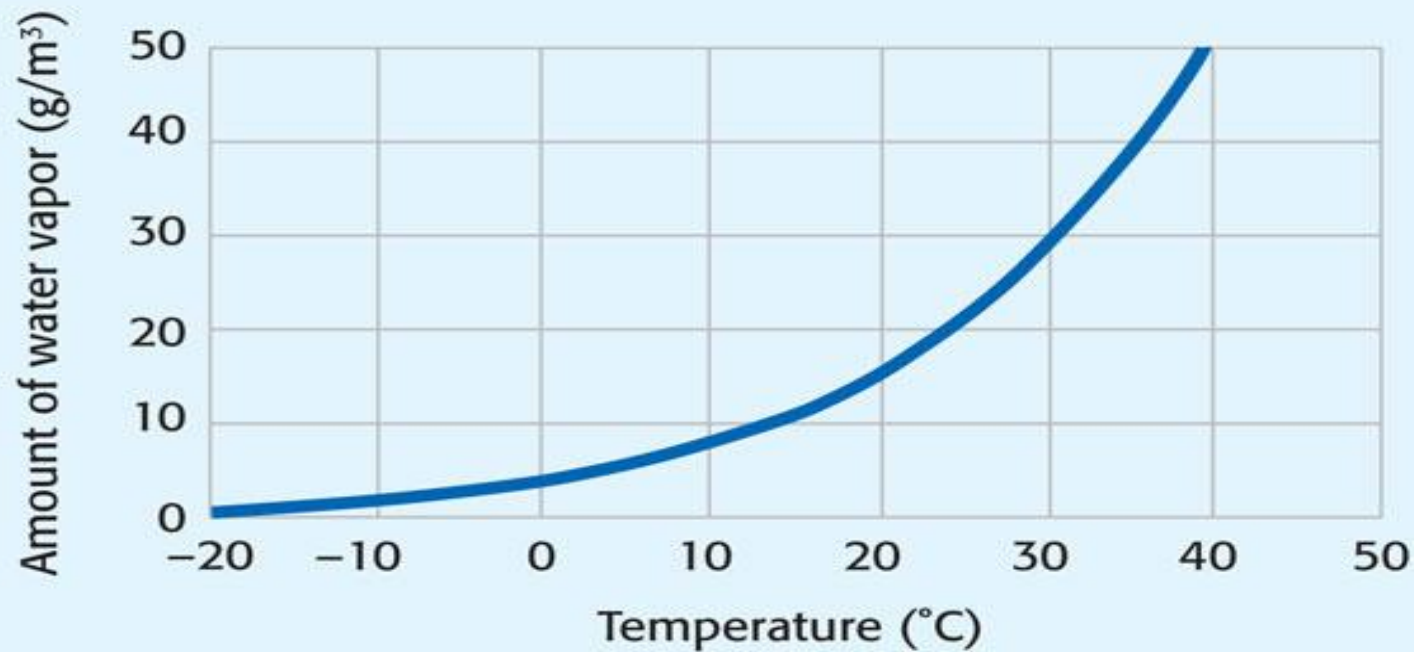


# Humidity

- Humidity

- Amount of water vapor in the air
- Air's ability to hold moisture
- changes as temperature changes

**Amount of Water Vapor Air Can Hold at Various Temperatures**



- Relative Humidity

$$\frac{\text{actual water vapor content (g/m}^3\text{)}}{\text{saturation water vapor content (g/m}^3\text{)}} \times 100 = \text{relative humidity (\%)}$$

- Amount of water vapor in the air compared to maximum amount air can hold

- Psychrometer



- Instrument used to measure relative humidity
- Consists of dry bulb and wet bulb
- Difference in temperature indicates amount of water vapor in the air

## Determining Relative Humidity

Find the relative humidity by locating the column head that is equal to the difference between the wet-bulb and dry-bulb readings. Then, locate the row head that equals the temperature reading on the dry-bulb thermometer. The value that lies where the column and row intersect equals the relative humidity. You can see a psychrometer below.

Relative Humidity (%)								
Dry-bulb reading (°C)	Difference between wet-bulb reading and dry-bulb reading (°C)							
	1	2	3	4	5	6	7	8
0	81	64	46	29	13			
2	84	68	52	37	22	7		
4	85	71	57	43	29	16		
6	86	73	60	48	35	24	11	
8	87	75	63	51	40	29	19	8
10	88	77	66	55	44	34	24	15
12	89	78	68	58	48	39	29	21
14	90	79	70	60	51	42	34	26
16	90	81	71	63	54	46	38	30
18	91	82	73	65	57	49	41	34
20	91	83	74	66	59	51	44	37

- Condensation
  - Dew Point
  - Cloud
- Process by which a gas becomes a liquid
  - The temperature at which a gas condenses to a liquid
  - Collection of small water droplets or ice crystals
  - Forms when air is cooled and has particles to cling to (dust)
  - Classified by form and altitude



# Cloud Types Based on Form and Altitude



**Cumulus clouds** look like piles of cotton balls.



**Stratus clouds** are not as tall as cumulus clouds, but they cover more area.



**Cirrus clouds** are made of ice crystals.

# Types of Clouds

- Cumulus Cloud



- Means "Heap" and "Mass"
- Puffy, white clouds
- Flat bottoms
- Fair weather
- Sunny days

- Stratus Cloud



- Form in layers
- Broad and flat
- "Spread Out"

- Cirrus Cloud



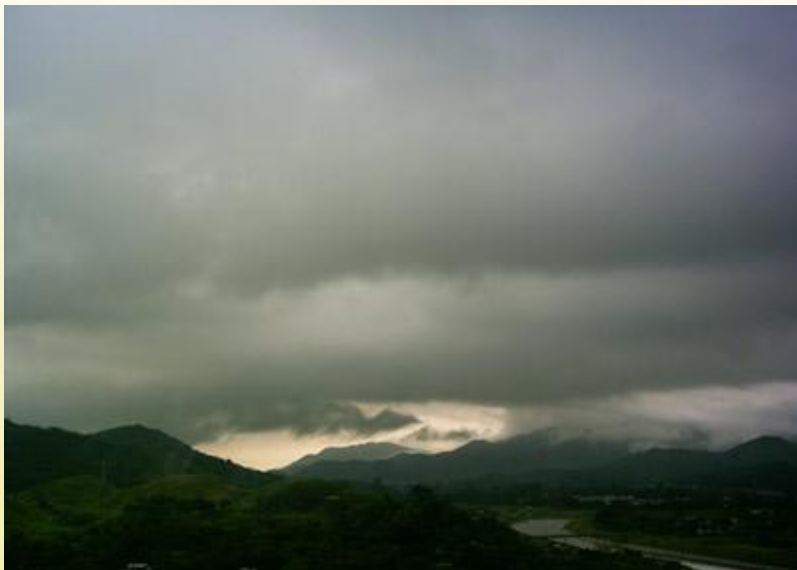
- “Curls of Hair”
- Thin, feathery, wispy
- White clouds
- Found at high altitudes with very low temperatures
- Made of ice crystals



- Cumulonimbus



- Nimbostratus



- Thunderheads
- Nimbus means "rain"
- Can reach altitudes of 20 km
- Produces lightening, rain, hail, wind
- Light to heavy rain, sleet, snow
- No lightening

- Cirro-
- Alto-
- Low Clouds
- Prefix used to describe high clouds
- Prefix used to describe middle clouds
- No specific prefix

## Cloud Types Based on Form and Altitude

**High Clouds** Because of the cold temperatures at high altitude, high clouds are made up of ice crystals. The prefix *cirro-* is used to describe high clouds.

**Middle Clouds** Middle clouds can be made up of both water drops and ice crystals. The prefix *alto-* is used to describe middle clouds.

**Low Clouds** Low clouds are made up of water drops. There is no specific prefix used to describe low clouds.

8,000 m Cirrocumulus

Cirrus

Cirrostratus

6,000 m

Altostratus

Cumulonimbus

4,000 m

Alto cumulus

Cumulus

2,000 m

Stratocumulus

Nimbostratus

Stratus



# Precipitation

- Rain
- Sleet
- Snow
- Hail



- Most common
- rain falls through a layer of freezing air
- Cold temperatures
- Water vapor changes directly to solid
- Lumps of ice that fall from clouds

# Air Masses and Fronts

- **Air mass**
  - -huge body of air
  - -similar temperature, humidity, and air pressure at any given height
  - -move, but do not mix
- **Types of Air Masses**
  - -N. America influenced by: maritime tropical, maritime polar, continental tropical, & continental polar



- **Continental**

- -forms over land
- -drier than maritime

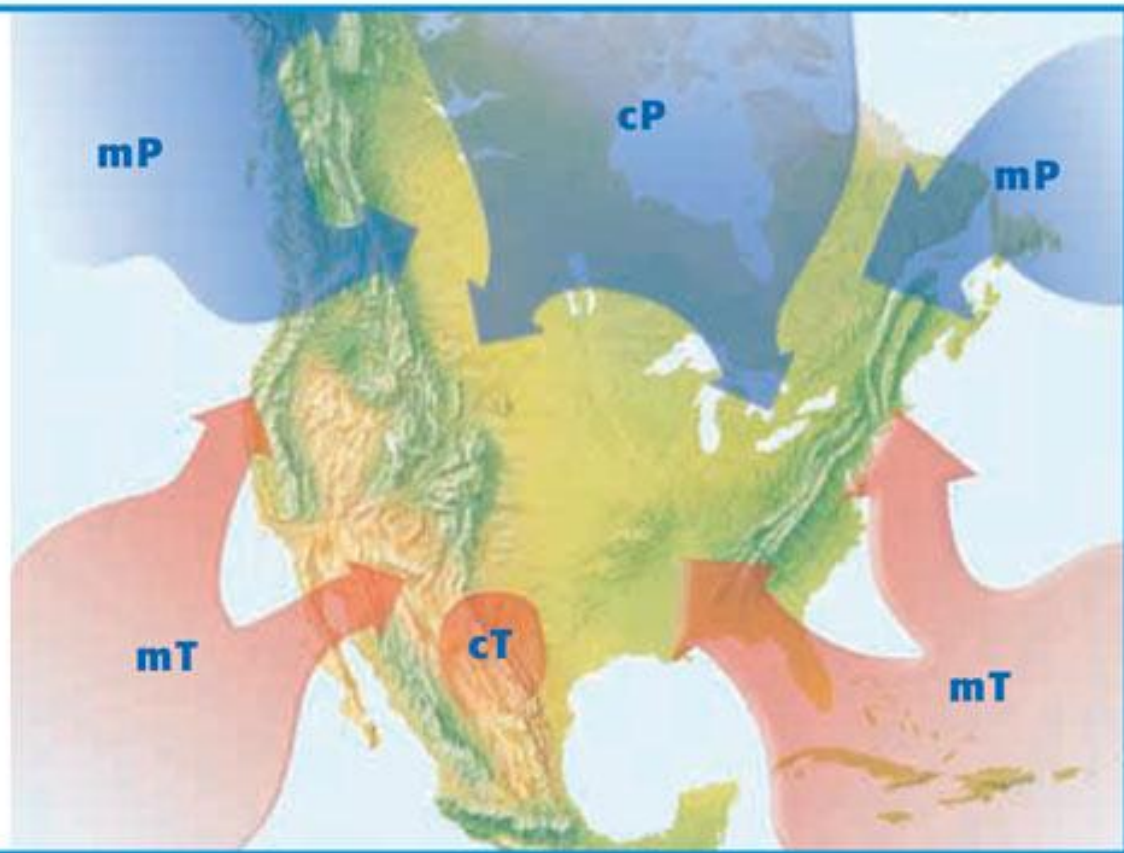
### Air Masses That Affect Weather in North America

**maritime (m)**  
forms over water;  
wet

**continental (c)**  
forms over land;  
dry

**polar (P)**  
forms over the  
polar regions; cold

**tropical (T)**  
develops over the  
Tropics; warm



- **Tropical**

- -warm
- -form in tropics
- -low air pressure

- **Polar**

- -cold
- -form at high latitudes
- -high air pressure

- **Maritime**

- -forms over oceans
- -air can become very humid

- **How Air Masses Move**

- -moved by prevailing westerlies and jet streams

- **Front**

- -boundary where two different air masses meet
- -do not easily mix
- -usually associated with storms and changeable weather

- **Cold Front**
- -cold air mass meets warm air mass
- -denser, cold air pushes warmer air up quickly
- -quickly rising, warm, moist air form cumulus and cumulonimbus clouds
- -short periods of severe rain or snow
- -as front passes, temperature drops

- **Warm Front**
  - -warm air mass meets cold air mass
  - -warm air rises above cold air
  - -first indicator: cirrus clouds
  - -as warm air cools, thicker lower stratus clouds form
  - -may be periods of snow or rain from nimbostratus clouds
  - -as front passes, weather is likely to be warm and humid



- **Stationary Front**

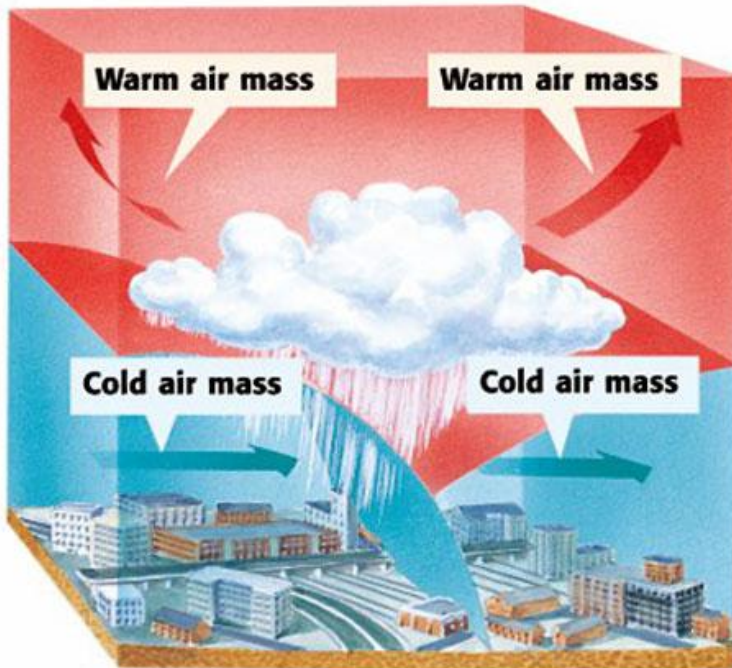
- -cold and warm air masses meet, but neither one can move the other
- -may bring days of clouds and precipitation
- -water vapor in warm air condenses into rain, snow, fog, or clouds

- **Occluded Front**

- -warm air mass gets caught in between two cooler air masses
- -characteristics of both warm and cold fronts
- -periods of heavy thunderstorms
- snowstorms may follow behind light rain or snow

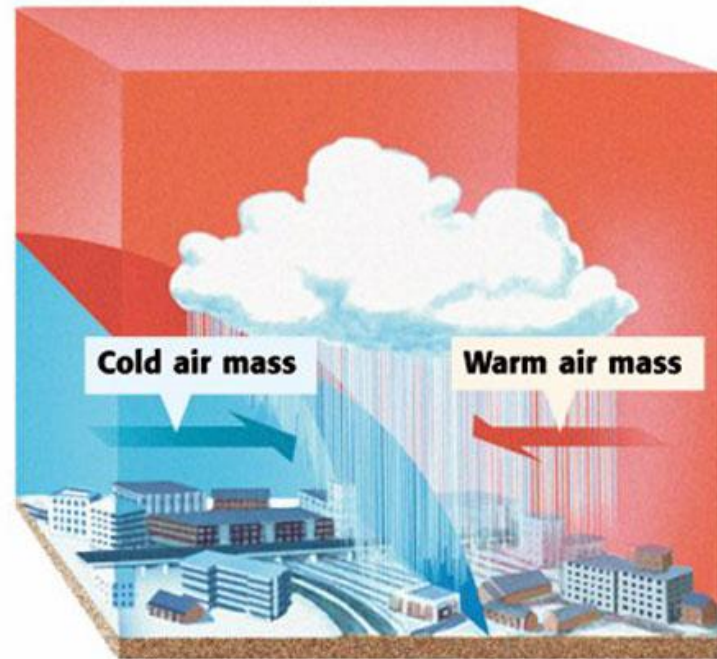
# Occluded and Stationary Fronts

Occluded Front



Direction of front

Stationary Front

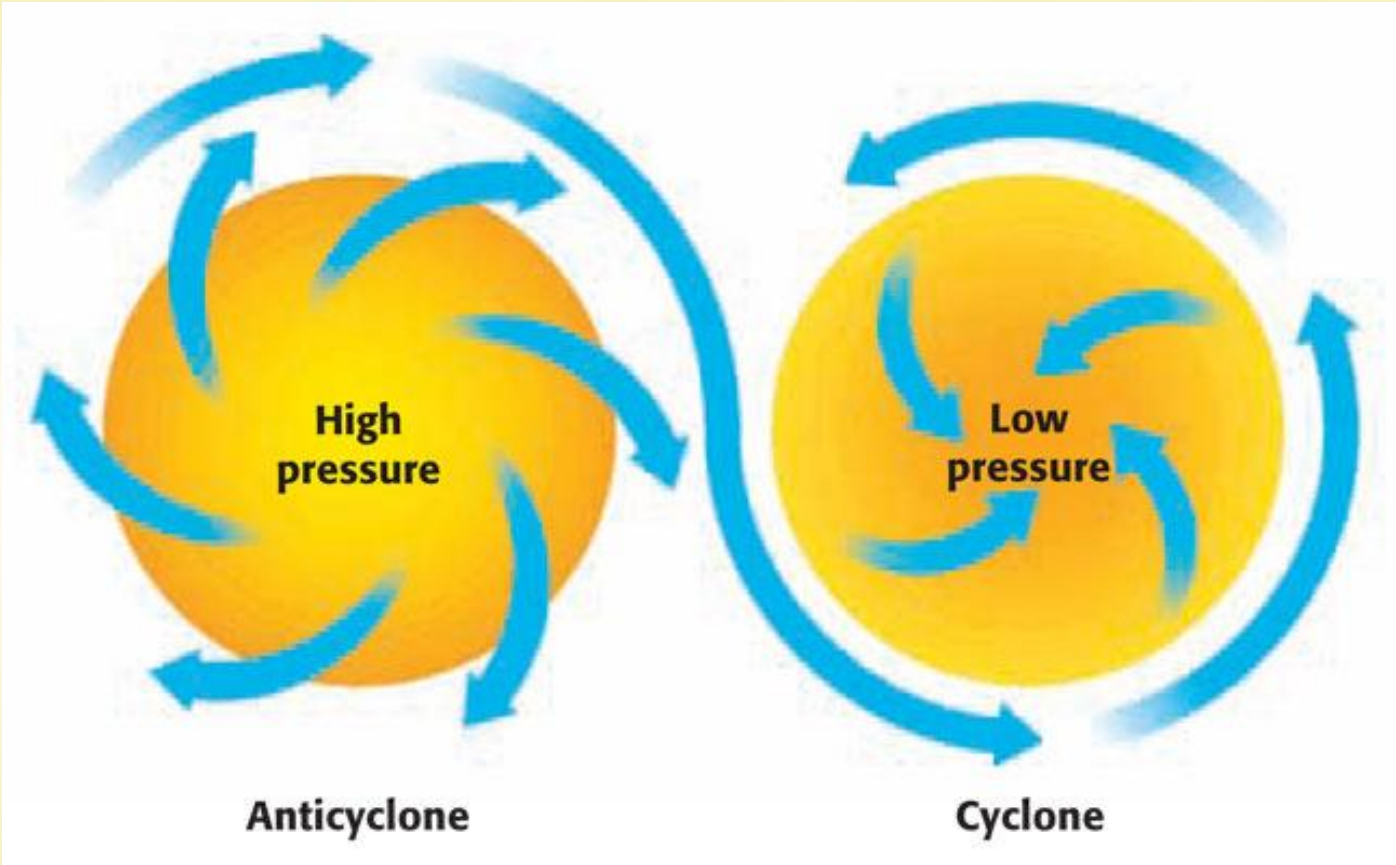


- **Cyclones**

- area of lower pressure than surrounding areas
- winds spiral toward center

- **Anticyclone**

- areas of higher pressure
- air moves apart and sinks
- dense air moves out toward low pressure





# Severe Weather

# Thunderstorms

- Lightning



- Electric discharge

- Occurs between a positively charged area and negatively charged area

- Thunder

- Sound that from a rapid expansion of air along the lightning strike

## • Tornado



- Small, spinning column of air
- Low central pressure
- High wind speeds
  
- Starts as a funnel cloud at bottom of a cumulonimbus cloud
  
- It's a tornado when it touches Earth's surface

## How a Tornado Forms



- 1** Wind moving in two directions causes a layer of air in the middle to begin to spin like a roll of toilet paper.



- 2** The spinning column of air is turned to a vertical position by strong updrafts of air in the cumulonimbus cloud. The updrafts of air also begin to spin.



- 3** The spinning column of air moves to the bottom of the cumulonimbus cloud and forms a funnel cloud.



- 4** The funnel cloud becomes a tornado when it touches the ground.

# Hurricanes

- Forming of a Hurricane



- group of thunderstorms over tropical waters
- Winds traveling in two directions meet and cause the storm to spin
- causes damage when it moves onto land
- Wind speeds range from 120 to 150 km/h



# Parts of a Hurricane

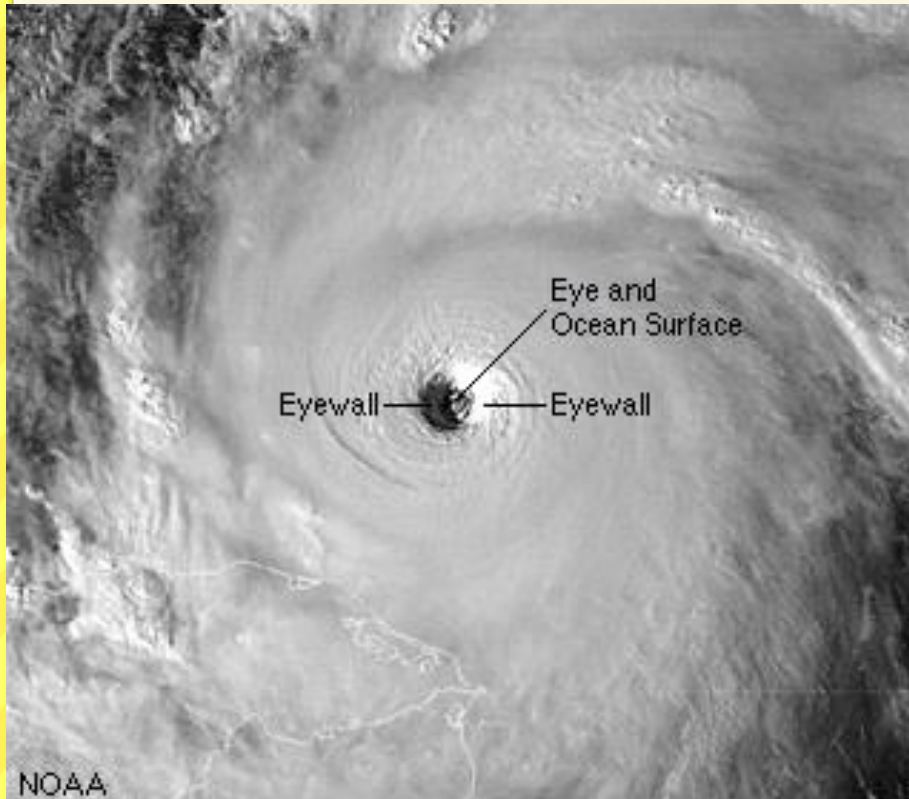
- Eye Wall



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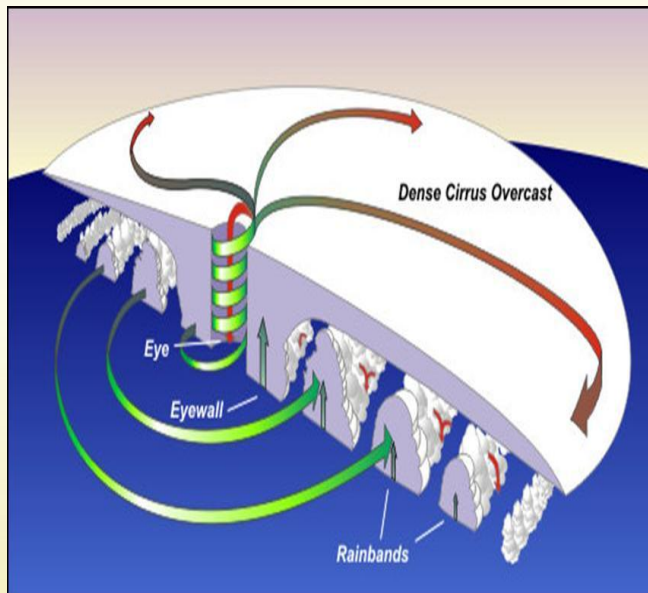
- Strongest part of a hurricane
- Group of cumulonimbus clouds that produce heavy rains and strong winds
- Up to 300 km/h

- Eye



- Center/core of the hurricane
- Warm, relatively calm air
- Low pressure and light winds

- Rain Bands



- Spiraling bands of clouds beyond the eye wall
- Produce heavy rains and high winds
- Wind speed decreases as distance from the eye wall increases

## Cross Section of a Hurricane

Surrounding the eye is the **eye wall**—a group of cumulonimbus clouds that produce heavy rains and strong winds. The winds can reach speeds of 300 km/h. The eye wall is the strongest part of the hurricane.

At the center of the hurricane is the **eye**—a core of warm, relatively calm air with low pressure and light winds.

Beyond the eye wall, spiraling bands of clouds called **rain bands** circle the center of the hurricane. The rain bands produce heavy rains and high winds. Within this area of the hurricane, wind speed decreases as the distance from the eye wall increases.

Updraft

Downdraft



# Forecasting the Weather

- Weather Forecast
  - prediction of weather conditions over 3-5 days
- Meteorologist
  - person who observes and collects data on atmospheric conditions
  - use instruments to measure conditions



- Weather Balloon



- measures conditions high in atmosphere
- up to 30 km high
- measures temp, air pressure, humidity

- Thermometer



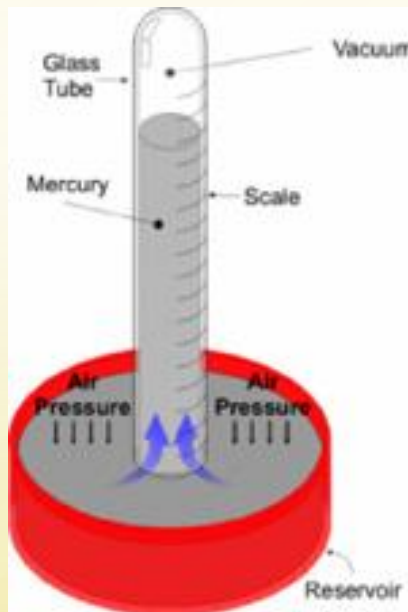
- measures air temp
- most use liquid
- as temp increases, liquid expands and moves up glass tube



- Barometer

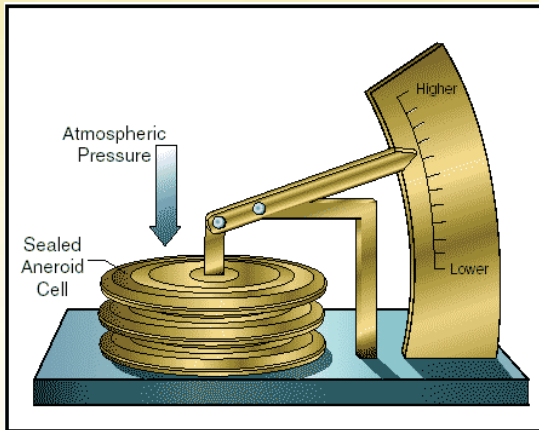
- measure air pressure
- mercury and aneroid

- Mercury Barometer



- glass tube open at bottom end and partially filled with mercury
- when air pressure increases, mercury rises in tube
- measured in inches of mercury

- Aneroid Barometer



- airtight metal chamber
- aneroid means “without liquid”
- when air pressure increases, walls of chamber are pushed in
- when drop, walls bulge out
- measured in millibars
- (1 in. = 33.87 millibars)

- Wind Vane



- measure wind direction

- Anemometer

- measures wind speed

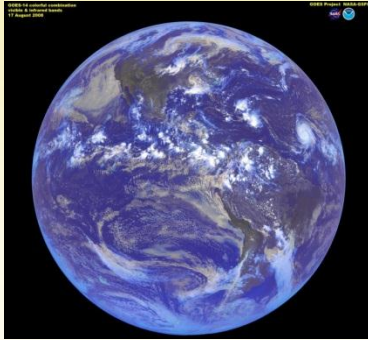
- Radar



- used to find location, movement, and amount of precipitation

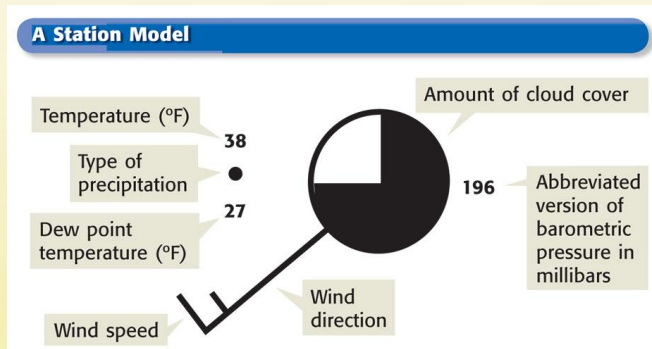
- local TV uses "Doppler Radar"

- Weather satellites



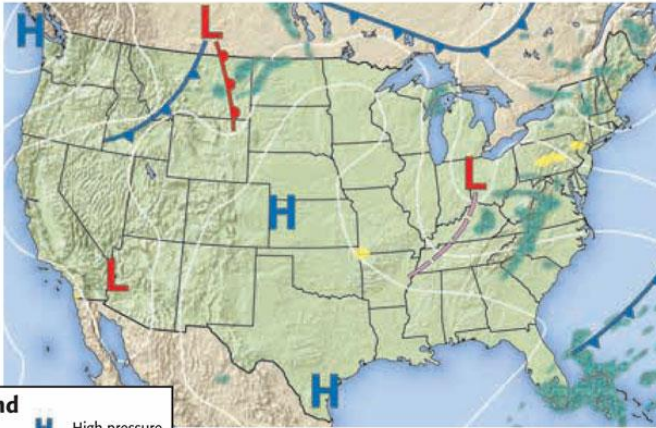
- orbit Earth
- take images of weather systems
- can track storms, measure wind speed, humidity, temp at diff altitudes

- Weather Map



- info about weather across U.S.
- include isobars

- Isobars



Legend	
	Cold front
	Warm front
	Low pressure trough
	Isobar
	High pressure
	Low pressure
	Rain
	Fog

- lines that connect points of equal air pressure
- closed circles = high or low pressure
- marked as H or L
- fronts also labeled

# Symbols for Precipitation



SQUALL



HAZE



LIGHT FOG



HEAVY FOG,  
ICE FOG



SLIGHT RAIN,  
INTERMITTENT



SLIGHT RAIN,  
CONTINUOUS



DRIZZLE



SLIGHT FREEZING  
DRIZZLE



MODERATE RAIN,  
INTERMITTENT



MODERATE RAIN,  
CONTINUOUS



HEAVY RAIN,  
INTERMITTENT



HEAVY RAIN,  
CONTINUOUS



PRECIPITATION  
during Past Hour



ICE PELLETS  
(Sleet)



SNOW



PRECIPITATION NOT  
REACHING GROUND



PRECIPITATION  
landing far from station



PRECIPITATION  
landing near station



SHOWERS



HAIL



RAIN SHOWERS,  
moderate or heavy



RAIN SHOWERS,  
violent



SLIGHT SHOWERS  
of SNOW PELLETS



SLIGHT SHOWERS  
of HAIL