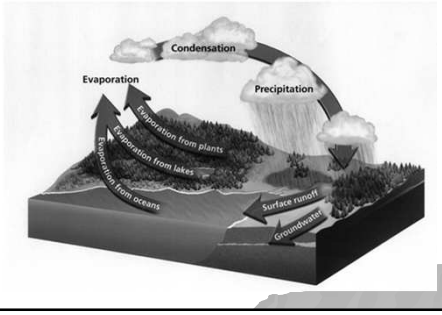
Earth Science

Chapter 8 Weather

Water in the Atmosphere

- **Remember: The type of "Weather" is determined by 2 things:**
  - **The uneven heating of the atmosphere causing high & low pressure systems trying to reach equilibrium**
  - **The amount of water vapor in the air**
- **Water Cycle**:
  - E**vaporation → Condensation → Precipitation → Runoff**



Humidity vs. Relative Humidity

- **Humidity** is the amount of water vapor in the air. In daily language the term "humidity" is normally taken to mean relative humidity.
- **Relative Humidity-** The amount of water vapor the air can hold at a certain temperature
  - **Saturation** – The maximum water vapor air can hold at a certain temperature. Warm air holds more water than cold air, beyond this point … it rains!
  - **Evaporation** – When water evaporates it cools (removes heat) the object. Perspiration evaporates from the skin & cools your body.
  - **Psychrometer:** device w/ two thermometers, one w/ a wet bulb the other w/ a dry bulb. The wet bulb is cooled by evaporation there its temperature is lower. The difference between these two temps can be converted into relative humidity

Relative Humidity

- **Dry Bulb Temperature**

  The dry bulb temperature is the air temperature measured using a standard thermometer. It is the temperature reported in daily weather forecasts and is sometimes referred to as the ambient air temperature.

- **Wet Bulb Temperature**

  The wet bulb temperature also uses a standard thermometer; however, a wet piece of cloth covers the bulb of the thermometer. As air passes over the wet cloth, the water in the cloth evaporates, drawing heat out of the thermometer. (cools it)

  If the air is very humid (moist), only a small amount of moisture will evaporate from the cloth. This means the wet bulb temperature will only be a little lower than the dry bulb temperature.

  Conversely, if the humidity of the air is low (dry), the moisture will evaporate from the cloth quickly. This means that the wet bulb temperature will be much lower than the dry bulb temperature.

  If it is raining or there is heavy fog, the air is saturated, and the dry bulb temperature will be equal to the wet bulb temperature

Relative Humidity

- Use the table to the right to determine the relative humidity:

Day	Dry Temp.	Wet Temp.	Relative Humidity
Mon.	22°	21°	92%
Tue.	23°	21°	
Wed.	21°	19°	
Thur.	19°	18°	
Fri.	18°	15°	
Sat.	19°	15°	
Sun.	17°	13°	64%

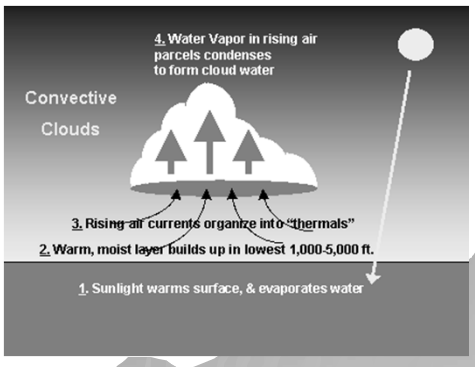
22 – 21 = 1

17 – 13 = 4

Dry bulb temp. °C	Difference between wet and dry temperatures 1°	2°	3°	4°	5°	6°	7°	8°
16°	90	81	71	63	54	46	38	30
17°	90	81	72	64	55	47	40	32
18°	91	82	73	65			41	34
19°	91	82	74	65	58			
20°	91	83	74	66	59	51	44	
21°	91	83	75	67	60	53	46	39
22°	92	83	76	68	61	54	47	40
23°	92	84			62	55	48	42
24°	92	84	77			56	49	43
25°	92	84	77	70	63		50	44
26°	92	85	78	71	64	58	51	46
27°	92	85	78	71	65	58	52	47

How Clouds Form

- **Dew Point** – The dew point temperature is the temperature at which the air can now longer hold all of its water vapor, and some of the water vapor must condense into liquid water.
- We know the dew point on ground (sometimes the grass is wet in the morning, sometimes it's dry) but when that temp is reached in the sky, clouds form



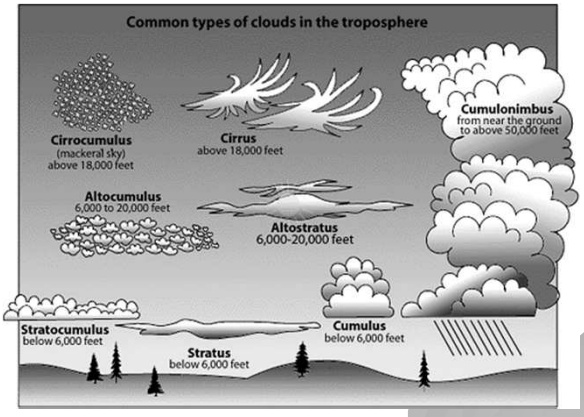
Cloud Types

- Three main types of clouds classified by **SHAPE**
- **Cirrus –** high wispy, feathery **Cumulus –** Fluffy, cotton balls
  Stratus – long flat layers

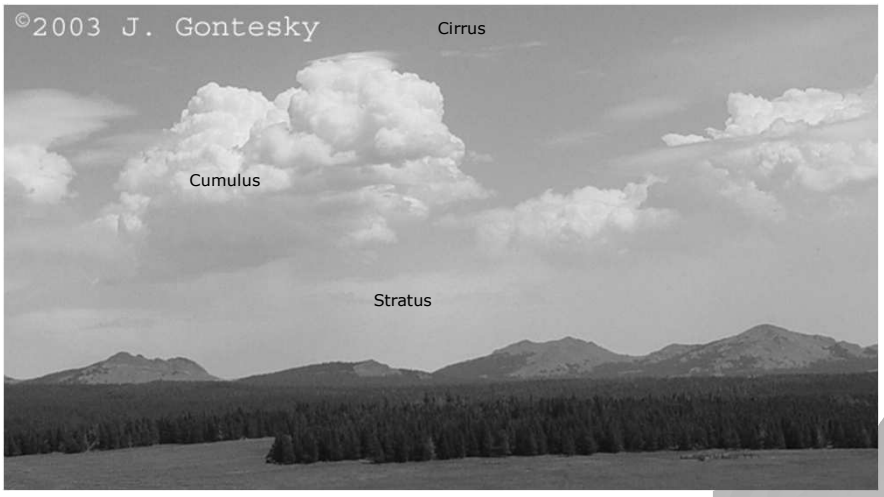
Clouds are named using combinations of these cloud shapes & terms:

Descriptive Terms:
Nimbus – rain & snow producing
Alto – mid level clouds

Clouds are classified into a system describing height of cloud base and shape of cloud



3 Main Cloud Types

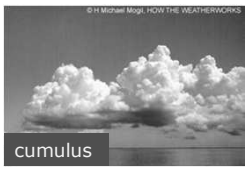


Cloud Types - Photos


altocumulus


stratocumulus


nimbostratus

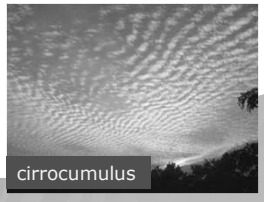

cumulus


stratus


cirrus

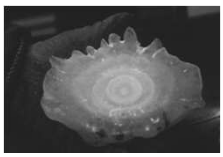

cumulonimbus

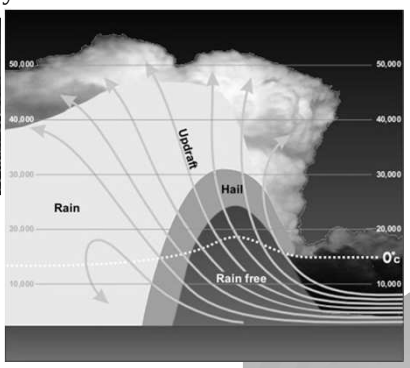

stratonimbus


cirrocumulus

Precipitation

- **Rain** – most common type of precipitation, > .5 mm in diameter. Smaller droplets are drizzle or mist.
- **Hail** – forms only in cumulonimbus clouds during thunderstorms. Strong updrafts lift the ice particle up into the cloud adding layers of ice. Makes it heavier, updraft lifts it until it's too heavy and falls thru the cloud





Precipitation

- **Snow** – water vapor converted directly into ice crystals, all are six sided and unique in shape.

i. Dry air produces powdery snow

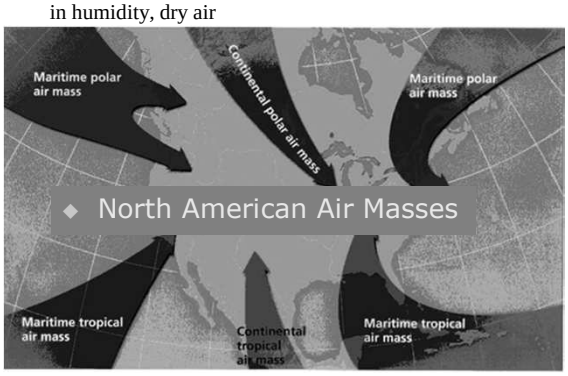
ii. Humid air produces moist clumps of snow (good for snowballs and snow men!)

- **Sleet -** as rain falls to the ground it sometimes hits layers of cold air below freezing. The water freezes on its way to the ground. These are usually < 5mm in diameter.
- **Freezing rain** – rain (water) that hits very cold ground structures on the surface freezes. Thick layers of ice can form, breaking branches, power lines, etc.

Air Mass

A huge body of air that has similar temperature, humidity and air pressure

- **Tropical** – warm air masses & lower pressure
- **Polar** – cold air masses & higher pressure
- **Continental** – form over land therefore are low in humidity, dry air



Maritime Tropical – forms over the Pacific and Caribbean/ Atlantic Oceans. They come up from the equatorial regions, are warm air masses, high in humidity and low in pressure. They bring in heavy rains and showers.

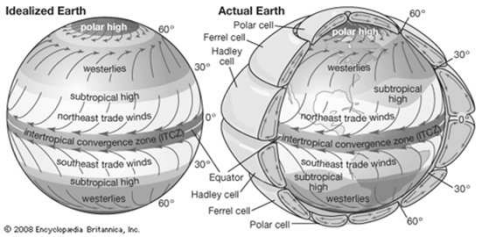
Maritime Polar – Cool humid air masses form over the North Pacific and North Atlantic Oceans. They bring high pressure & precipitation

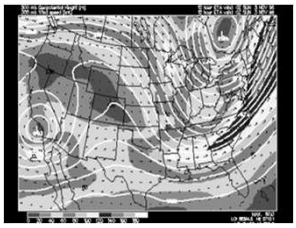
Continental Tropical – Hot dry air masses coming up from Mexico to the southern plain states. Usually are smaller in size and low in pressure.

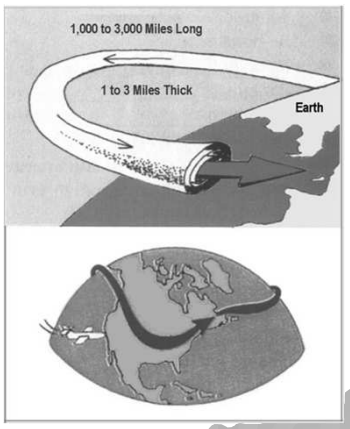
Continental Polar – Form over Canada & Alaska, air masses are cold and dry.

How Air Masses Move

- Prevailing Westerlies and the Trade winds
- Jet Stream – high speed winds blowing from West to the East about 10 km high

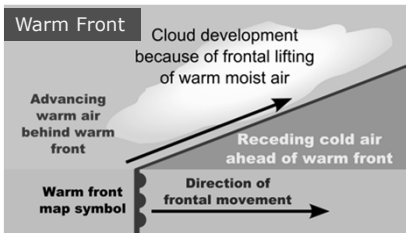


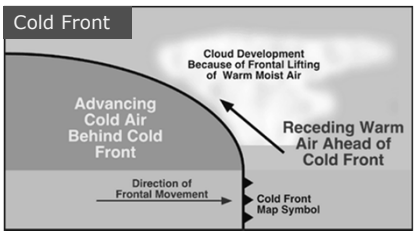


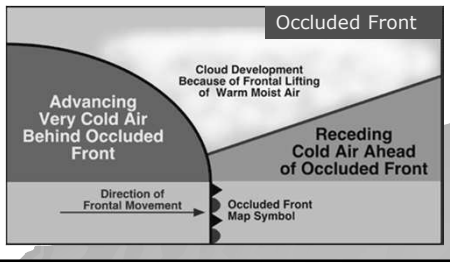


Front - the boundary where two air masses meet.

- They do not mix easily.
- Less dense air masses push over top of heavier more dense fronts.
- Storms and weather changes occur at fronts
- Types of Fronts
  - Cold Front,
  - Warm Front,
  - Stationary Front
  - Occluded Fronts

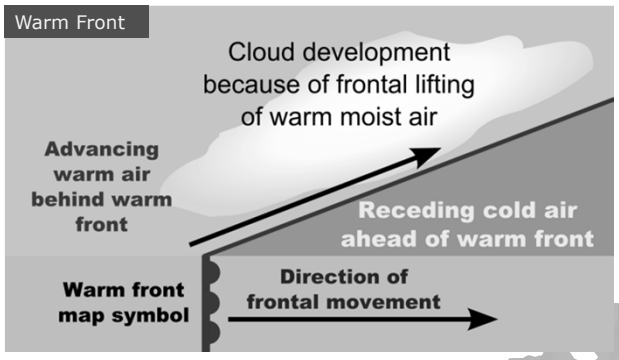






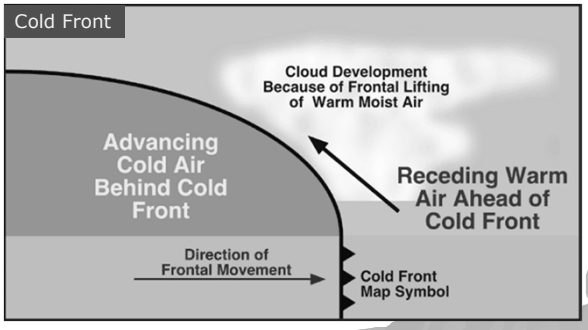
Warm Fronts

a. **Warm Front** – warm front moving faster than a cold front, over takes it and pushes up over the cold front. (Warm air less dense than cold air and "floats" on the cold air mass).
   i. If warm air is humid, light rain or snow fall.
   ii. If warm air is dry, scattered clouds form
   iii. After warm front passes, the weather will be warm & humid.



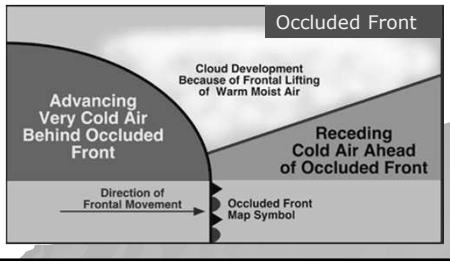
Cold Front

- **Cold Front** – When Rapidly moving Cold Mass collides w/ slow moving warm air mass, the more dense cold air slides under the warmer air mass.
  - As warm air is pushed up higher, the air begins to cool & holds less water vapor – precipitation occurs.
    - if warm air mass has high humidity – heavy rain & snow.
    - If warm air is less humid, then just cloudy hih clouds form.
    - Cold fronts move quickly – bring w/ them abrupt weather changes.



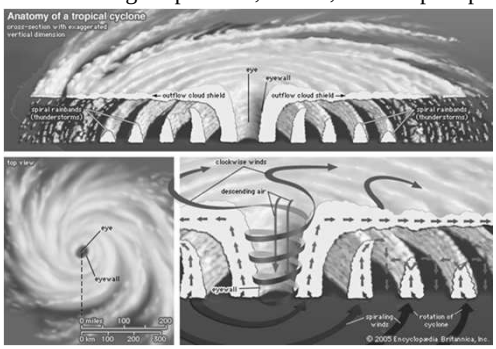
Stationary & Occluded Fronts

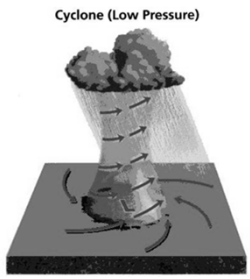
a. **Stationary Front** – when warm & cold air masses meet and neither is moving fast enough to over power the other. If there is high humidity then there can be several days of rain until the stationary front slowly breaks up and moves away.
b. **Occluded Front** – occlude means "to be cutoff from". These fronts occur when a warm air mass is caught between to cold air masses. These are the most complex of the weather systems. Weather may be cloudy w/ rain or snow.

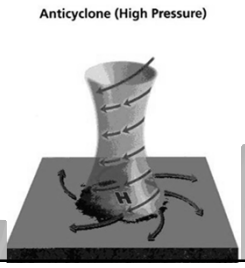


Cyclones & Anticyclones

- **Cyclone** – associated w/ Low pressure systems. Warm winds at the center rise & spin upward in a counterclockwise direction (looking from above) associated w/ decreasing air pressure, clouds, wind & precipitation







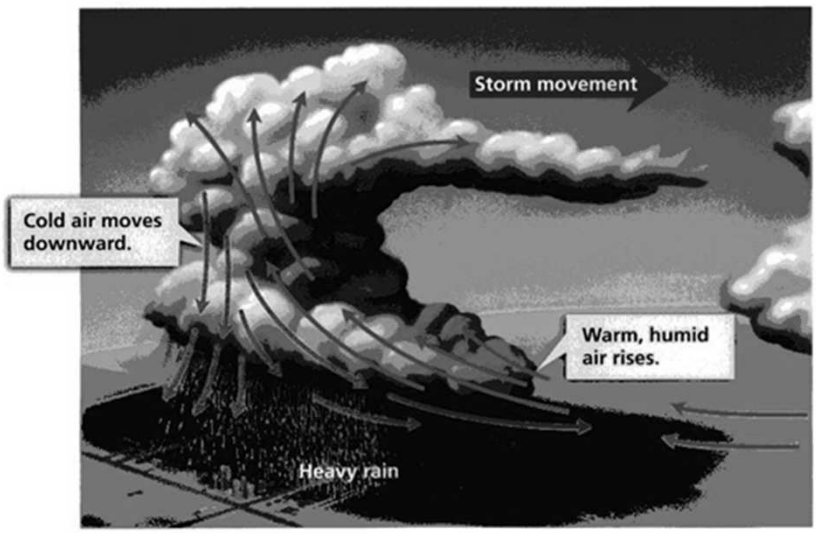
Anticyclone – the opposite of cyclones. High pressure systems that spiral down ward and contains dry air. They rotate in a clockwise direction (when looking from above). Associated w/ clear dry sometimes windy weather

Storm – a violent disturbance in the atmosphere

A. **Thunderstorm** – a small storm w/ heavy precipitation & Thunder and lightning.
   a. Form in Cumulonimbus clouds called thunderheads.
   b. Lightning – Static electricity build up w/ electrical discharge jumping between clouds or the clouds & the ground.
   c. Thunder – caused from the rapid expansion of air after lightning bolt (30,000 degrees C) cuts thru the atmosphere rapidly heating the air

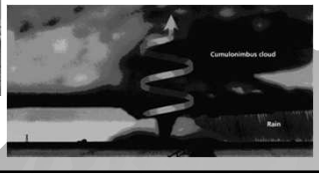



Thunderstorm Formations



Tornadoes

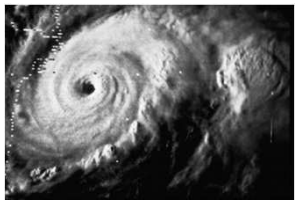
- **Tornadoes** – rapidly swirling funnel shaped cloud reaching down from a cumulonimbus cloud to the ground. Usually occur in the Great Plains – Tornado Alley. Occur as a result of Cold dry Polar Continental Air Mass collides w/ Warm & Humid Tropical Maritime air mass off the Caribbean.

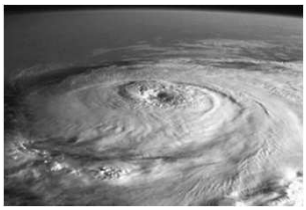


Hurricanes

- **Hurricanes** – a huge tropical **cyclone** that has winds in excess of 75 mph or 119 kmph or higher.
- They are found in the Atlantic, Pacific and Indian Oceans. (in the western Pacific they are called typhoons)
- They begin over warm water areas as a low pressure system or depression. As it obtains energy from the warm water it becomes stronger and turns into a tropical storm, as winds speeds increase it can turn into a hurricane.
  i. Warm moist air rises around the eye in spiraling bands of clouds.
  ii. Air flows outward near the top of the hurricane
  iii. Cool dry air sinks in the eye, the center of the hurricane
- They are pushed along by the trade winds and build up strength as long as they are above warm water. Once they hit land or cold water they start to breakdown.

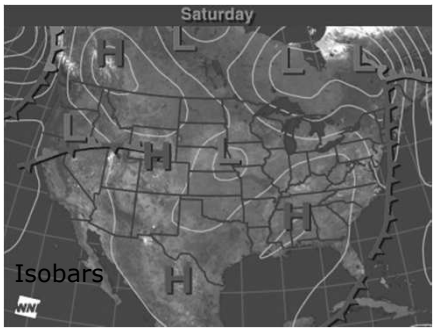
Hurricanes

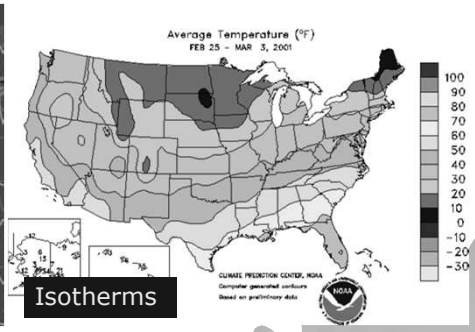




Predicting the Weather

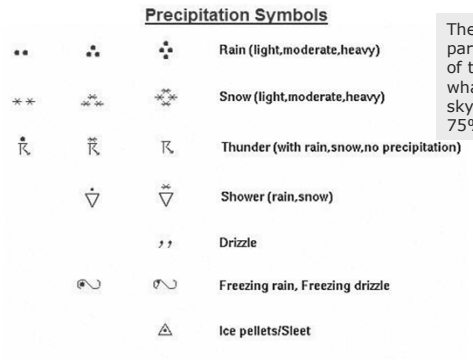
- **Meteorologist** – a scientist who studies the causes of weather.
- **Weather Maps** – show: fronts, type of precipitation, hi & low pressure areas, wind speed and direction, cloud cover and temperature.
  - **Isobars** – (same as contour lines) – except they mark areas of same atmospheric pressure. Barometric pressure is measured in "inches of Mercury" or "millibars". Remember: **1" of Mercury = 33.87 millibars**
  - **Isotherms** – lines joining w/ the same temperature





Weather Maps

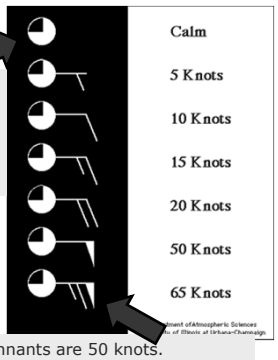
- Weather Map Symbols – show types of precipitation, Wind speed, wind direction, air pressure, fronts etc.



Wind Speed are given in Nautical Miles per hour "Knots"

1 Knot = 1.15 Miles Per Hour (MPH)

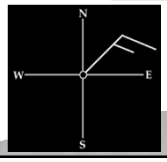
1 Knot = 1.9 Kilometers Per Hour (KM/HR)



The white part(the part that is covered) of the circle indicates what fraction of the sky is cloudy. Ie 75%

In this case the white part is the covered part of the circle, on our worksheets, the covered part is black .

Pennants are 50 knots. Therefore, the last wind example in the chart below has a wind speed of 65 knots. (50 knots + 10 knots + 5 knots).



Remember: Winds are named by stating the direction from which the wind is coming. This diagram indicates a 15 knot **Northeastern** wind

All Done!!