Atmospheric Moisture

- The atmosphere always contains some amount of water vapor
- This water vapor can undergo a number of processes from which it can change state
  - Evaporation - liquid water to water vapor
  - Condensation - water vapor to liquid water
  - Freezing - liquid water to solid water
  - Melting - solid water to liquid water
- Other less common processes
  - Sublimation - solid water to water vapor
  - Deposition - water vapor to solid water

Humidity

- Humidity
  - The amount of water vapor in the atmosphere
- Two ways to measure humidity
  - Absolute - the actual amount of water vapor in a given parcel of air
  - Relative

$$\frac{\text{the actual amount of water vapor in a given parcel of air}}{\text{the amount of water vapor a parcel of air can absorb (capacity)}}$$

Humidity

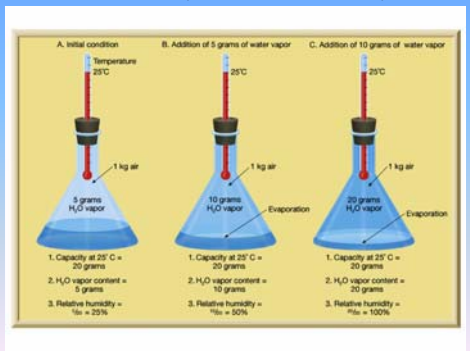
- Humidity can change in two ways
  - Add or remove water vapor to the atmosphere
    - This occurs through the processes of evaporation (add water) and condensation (remove water)
  - Change the temperature of the air
    - The temperature of the air is directly related to the capacity of the air
    - As the temperature of the air increases, so does it's capacity
    - Helps explain why we feel more humidity during the summer months than the winter months

Humidity Relationships

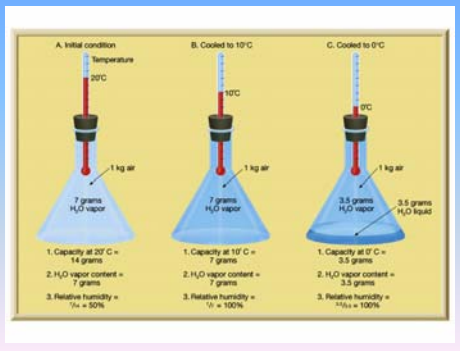
- Relative humidity provides a better measure for how much water vapor is in the atmosphere because it is expressed as a ratio between the actual amount versus the capacity

  RH = AH/Capacity
- RH is the relative humidity, AH is the absolute humidity, and Capacity is how much water vapor a parcel of air can hold
- Relative humidity and absolute humidity are directly related: assuming capacity (and temperature) stays the same, as AH increases, so does RH
- Relative humidity is inversely related to capacity (and temperature): assuming AH stays the same, if Capacity increases, RH decreases

Humidity Relationships



Humidity Relationships



Humidity Relationships

- The relative humidity for a given parcel of air can be determined using the given formula
- For example
  - A parcel of air has a temperature of 75° and an absolute humidity of 6 grams
  - At 75°, the capacity of the air parcel is 15 grams

RH = AH/Capacity*100
RH = 6g/15g*100
RH = 0.4*100
RH = 40%

Condensation

- As the temperature of a parcel of air falls, the relative humidity will rise (assuming absolute humidity stays the same)
- At 100% relative humidity, the air is saturated with water and cannot absorb any more
  - No evaporation takes place
- If the temperature continues to drop and the relative humidity exceeds 100%, condensation occurs
- On the ground, condensation of the water vapor is evidenced by dew (or fog if condensation occurs near the ground)
- In the atmosphere, condensation manifests itself as clouds

Dew Point

- The dew point is the temperature at which a parcel of air must be cooled in order for condensation to begin
- As the surface air temperature drops, condensation of the water vapor may occur thus producing dew
- If the surface temperature is below 32° F, the water vapor will undergo deposition and produce frost

Adiabatic Temperature Changes

- Adiabatic temperature changes occur when air is compressed or expands
- If air is compressed, the temperature of the air will increase
- If air expands, the temperature of the air will decrease
- As air rises through the atmosphere, it will expand and cool adiabatically
  - Conversely, air that descends undergoes heating adiabatically

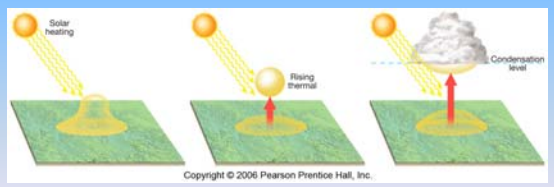
Adiabatic Temperature Changes

- An example of air cooling adiabatically is the contents of a pressurized can being released
- The contents of an aerosol can are under pressure but when the nozzle is pressed, the pressure is relieved, and the material flows outward (all material flows from areas of relatively high pressure to areas of relatively low pressure)
- If you place your hand in front of the nozzle, the contents will feel cool because as the material comes out, it expands and cools adiabatically

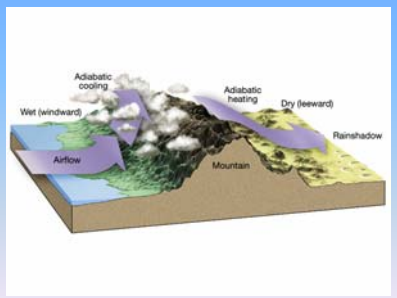
Rising Air

- Air can be forced to rise under three conditions
  - Absorption lifting
    - Air absorbs terrestrial radiation, is heated, and rises
  - Orographic lifting
    - An air mass encounters a mountain range and is forced upward
  - Frontal lifting
    - A relatively warm air mass encounters a relatively cooler air mass and is forced upward
  - Convergence
    - Two air masses collide and force each other upward

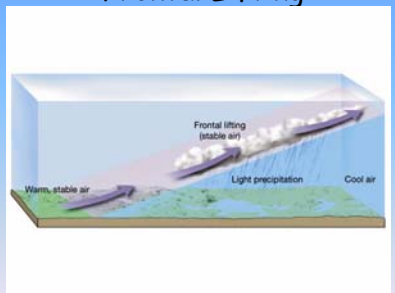
Absorption Lifting



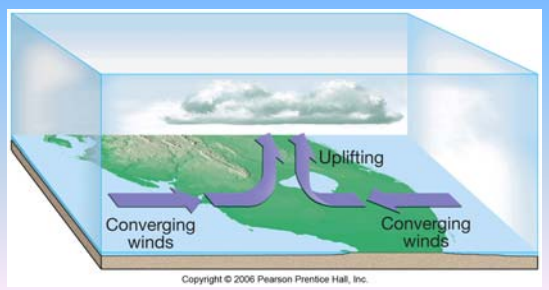
Orographic Lifting



Frontal Lifting



Convergence



Clouds

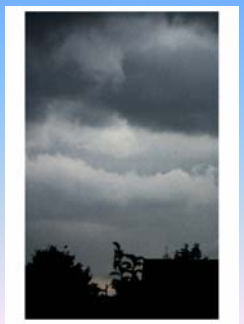
- Clouds are one of the most common atmospheric features
- Composed of millions of extremely tiny water droplets
- Clouds that form close to the surface of the earth is referred to as fog
- Clouds are typically classified according to height of formation and appearance

Classification of Clouds

- Height
  - Low altitude: 0-2000m
  - Mid altitude: 2000m-6000m
  - High altitude: 6000m and above
- Appearance
  - Cirrus
    - Usually form at high altitudes
    - Wispy, veil-like
  - Stratus
    - Thick clouds that cover much of the sky
    - Blanket-like
  - Cumulus
    - Puffy and globular
    - Cottonball-like

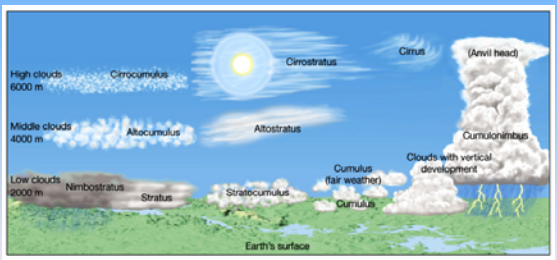
Cirrus Clouds

Stratus Clouds



Cumulus Clouds

Cloud Types



Precipitation

- Rain
- Snow

Precipitation

- Sleet
  - Rain that freezes while descending to the earth

http://www.jeyping.dynip.com/journal/images/sleet.jpg

Precipitation

- Glaze
  - Rain that freezes upon contact with the earth

Precipitation

- Hail
  - Balls of ice that form from the successive condensing and freezing of water when subjected to wind currents in a cumulonimbus cloud
  - Can cause serious damage