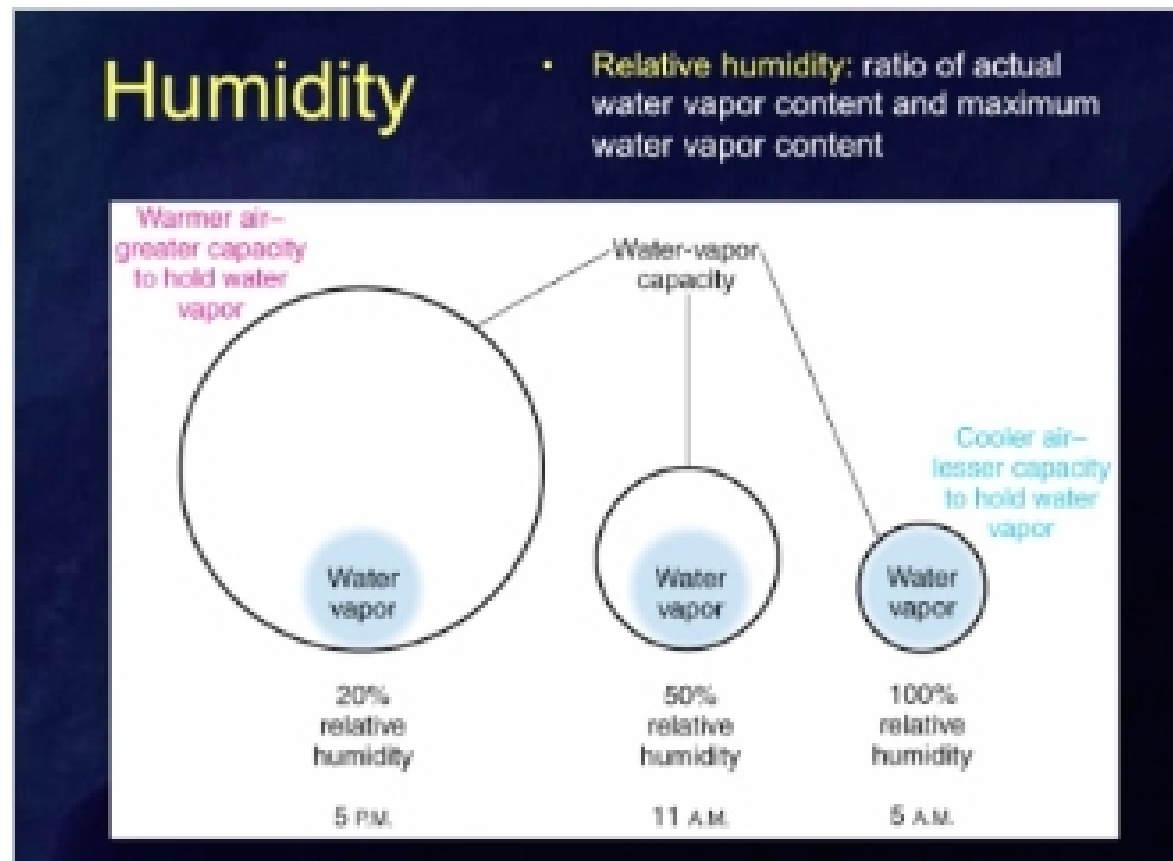
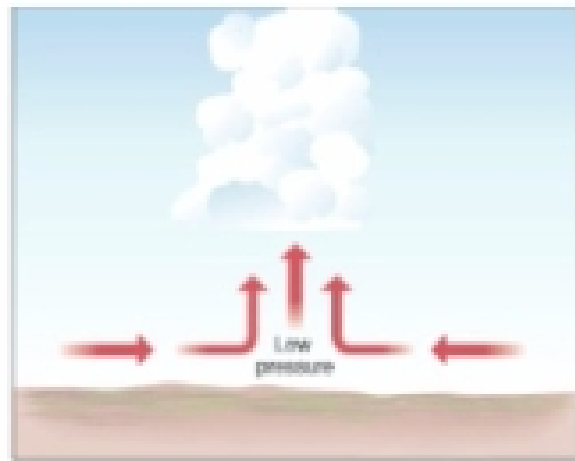


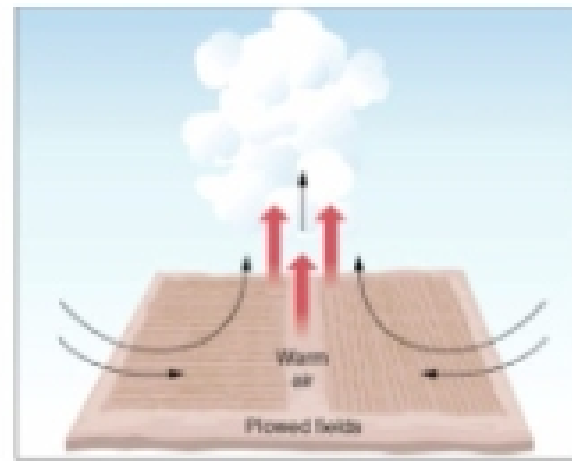
## Rain and Clouds



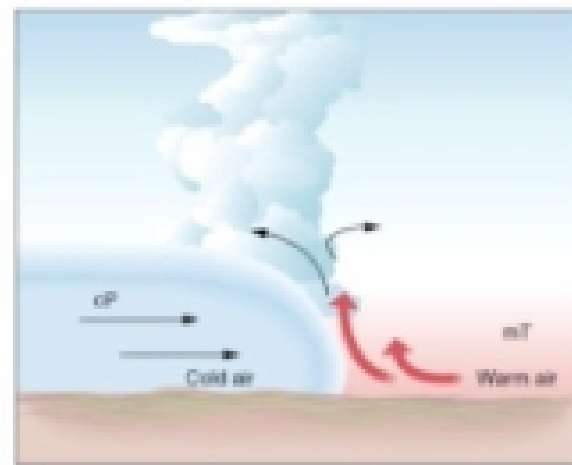
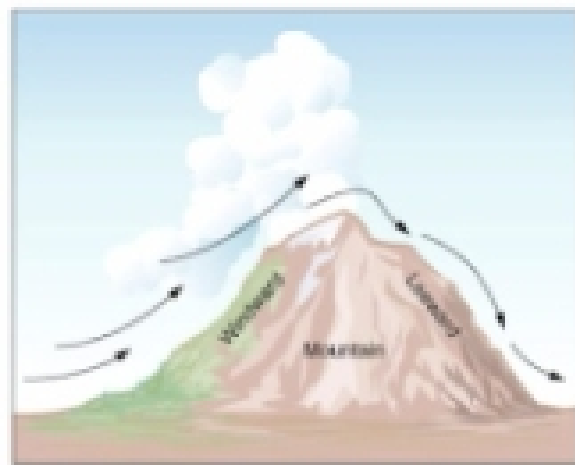
- Clouds form when the air reaches 100% saturation and can no longer hold anymore water
- We measure the moisture content with a relative humidity
- Which is relative to the amount of water in the air to the amount of water the air can hold
- Warm air can hold more water than cold air
- The warmer the environment the more evaporation and transpiration that will occur
  - We call this evapotranspiration
- Dew point temperature: temperature at which air reaches saturation and same volume in your "bucket" as the air in the atmosphere 100% saturation
- Any further cooling, water will begin to overflow out of your bucket - condensation
- Warmer at the end of the - can hold more water
- Less warm at 11 - smaller bucket
- 5 AM - 100% saturation
  - Fog could be present



(a) Convergent



(b) Convective (local heating)



- You can also cool your air by lifting your air, convergence with local jet stream, convection associated with local heating of the surface, forcing of air to rise up and over a mountain, a cold frontal system moving across the US
- In general, air cools as you move away from the surface of the earth

## Adiabatic Processes

- **Normal lapse rate:** average decrease in temperature with altitude
  - 6.4°C/1000 m (3.5°F/1000 ft)
- **Environmental lapse rate:** actual decrease in temperature with altitude
- **Adiabatic:** warming and cooling of air through compression and expansion

(a) Cooling by expansion

(b) Heating by compression

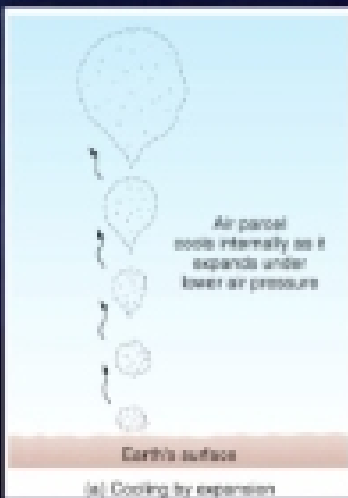
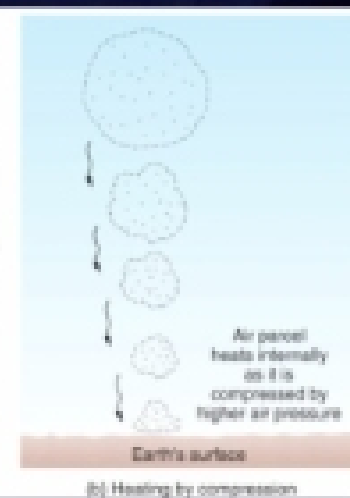
↑ Decreasing air pressure

- On average, it cools at 3.5 deg F / 1000 ft
  - o We call this the Normal Adiabatic lapse rate
- The environment lapse rate is the rate at which the air cools locally

- If you take all the environmental lapse rates around the world, you would get the normal lapse rate
- Adiabatic refers to the warming and cooling of air through compression and expansion
- As you lift air from the surface the pressure gets lower
- As the air expands it cools as air sink it warms

## Adiabatic Processes

- **Dry adiabatic lapse rate:** rate at which dry air cools by expansion or warms by compression
  - 10°C/1000 m
  - 5.5°F/1000 ft
- **Moist adiabatic lapse rate:** rate at which moist air cools by expansion or warms by compression
  - 6°C/1000 m
  - 3.3°F/1000 ft

(a) Cooling by expansion      (b) Heating by compression

- Dry and warm air cool at a different rate when lifted from the ground
- The cooling air causes the water vapor to change from a gas to a liquid and releases energy
- The release of this energy slows the rate at which it cools
  - o Negative feedback

## Stable Conditions

- Environmental lapse rate **smaller** than DAR and MAR
- Dry and moist air both more dense than the surrounding air so it will not move

