



Why does the wind blow?

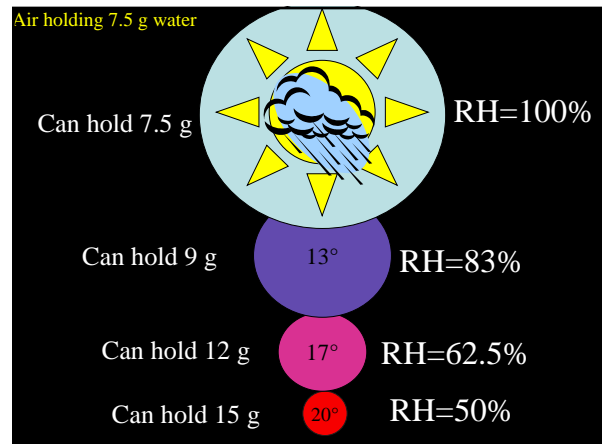
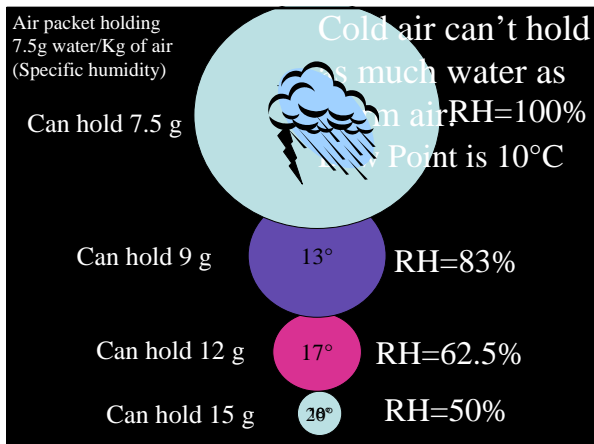
- Air moves from high to low pressure.
- Differential pressures caused by differential heating.
 - Small scale = lake effect
 - Larger scale = sea breeze
 - Global scale = wind belts

Which is heavier: hot air or cold air?

- As air is heated, it expands and becomes less dense.
 - Hot air is lighter than cold air.
- Being less dense, it will tend to rise.

Which is heavier: moist air or dry air?

- Most of the atmosphere is made of:
 - O_2 (32 amu)
 - N_2 (28 amu)
 - CO_2 (44 amu)
- Water molecules displace air
 - H_2O (18 amu)

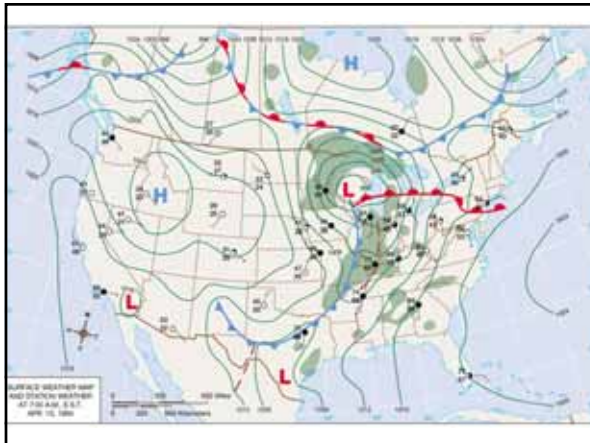


Meteorology summary

- As a parcel of air rises it will:
 - Expand
 - Cool
 - Be able to hold less water
 - relative humidity rises
 - If RH reaches 100%, water condenses
 - Continued condensation leads to precipitation

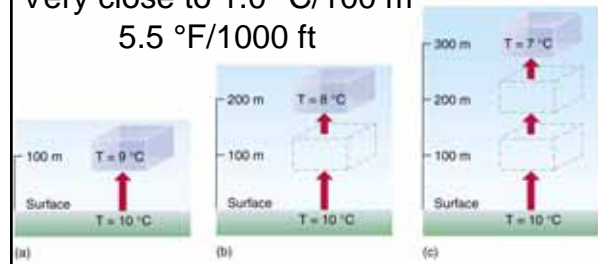
Generalized meteorology

- Rising air is associated with
 - low pressure (at the surface)
 - clouds and precipitation
- Sinking air is associated with
 - High pressure (at the surface)
 - Clear skies



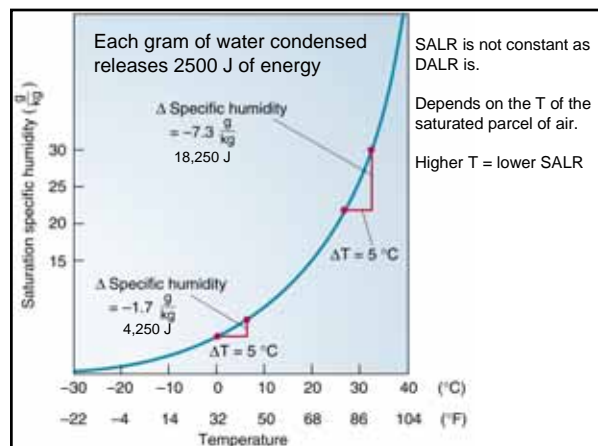
Dry Adiabatic Lapse Rate (DALR)

Very close to 1.0 °C/100 m
5.5 °F/1000 ft



Saturated Adiabatic Lapse Rate (SALR)

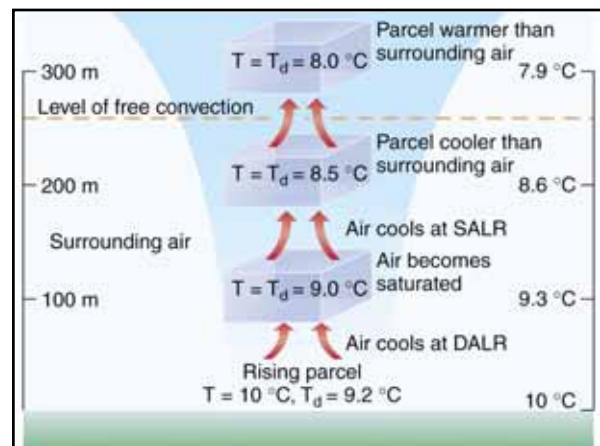
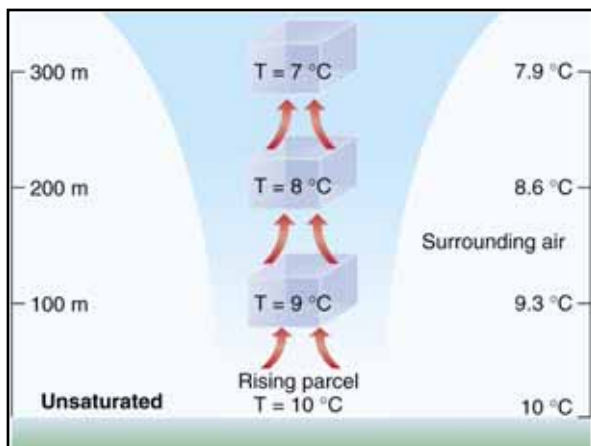
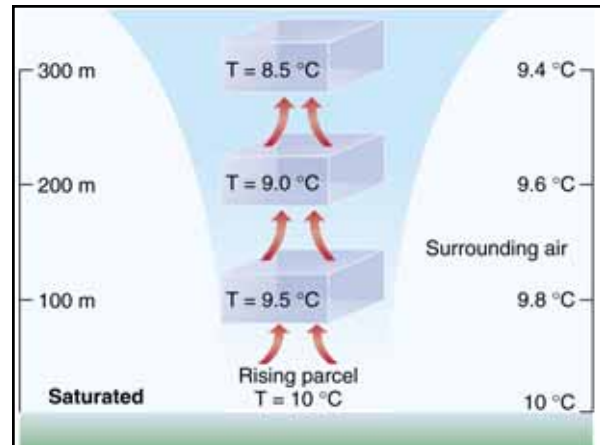
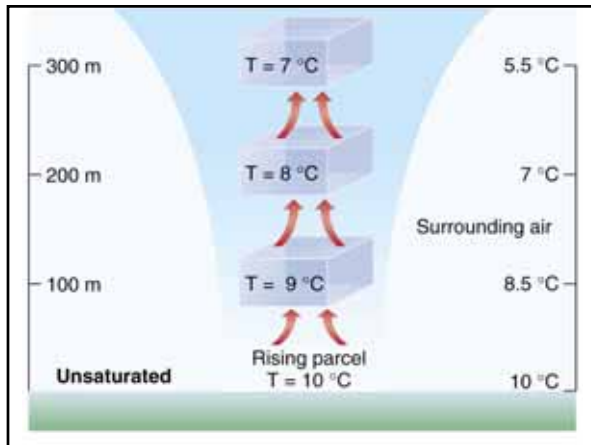
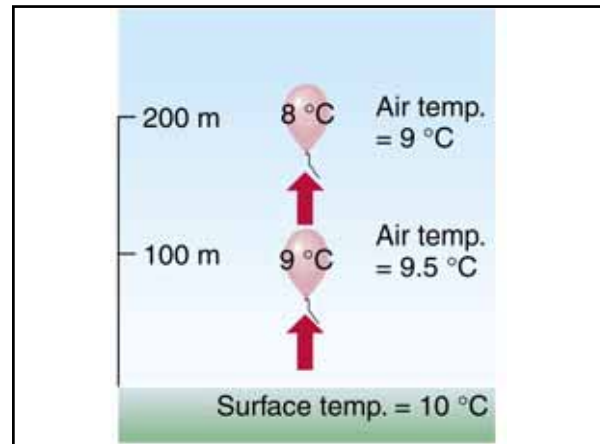
- Once the water in the air begins to condense, it releases its latent heat.
 - Begins to condense at the **lifting condensation level (LCL)**.
- If the air continues to rise, it will gain sensible heat from the latent heat released and cool from expansion at the SALR.
- About 0.5 °C/100 m
- 3.3 °F / 1000 ft.



Introduction to Environmental Science 12:008/159:008
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Will a parcel of air begin to rise, and if it does will it continue to rise?

- As a parcel of air rises it expands and cools.
- As air rises the temperature of its surrounding air falls.
- Temperature of the air parcel must remain warmer than the surrounding air to continue rising.
- Temperature of the surrounding air as a function of altitude is known as the **environmental lapse rate (ELR)**.

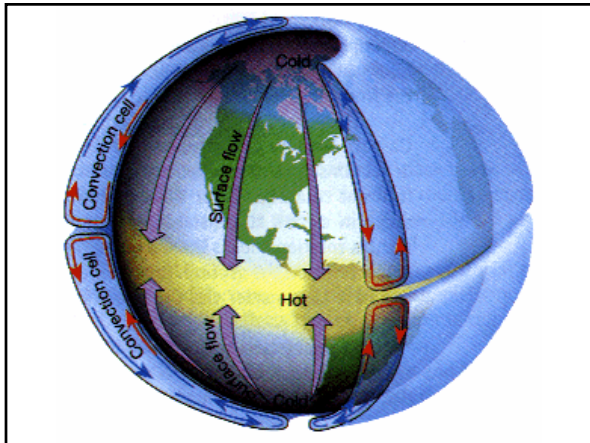


How to cause air to rise

- **Global convection cells**
- Local convective heating
- Orographic lifting
- Weather fronts
- Surface convergence and upper level divergence

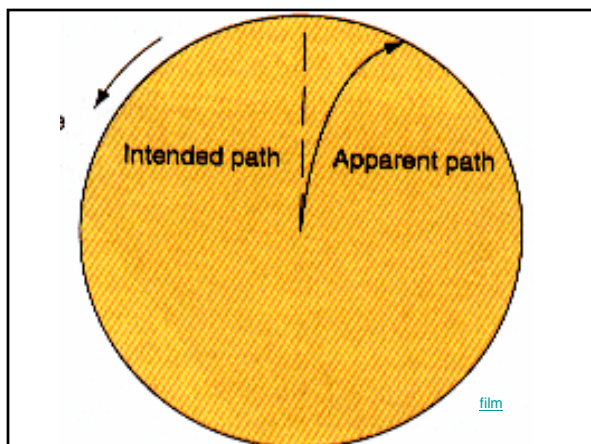
Troposphere - Air Circulation

- Warm light air at surface rises and dense cold air from upper troposphere sinks - Convection.
- Warmer temperature in tropical/equatorial areas due greater energy. High moisture content in warm air.
- Moisture transported from low latitudes to high latitudes.



Coriolis Force

- An apparent force proportional to velocity
- Deflects objects to the right in the Northern Hemisphere and to the left in the Southern Hemisphere
- Holds for baseballs, air-masses, space-ships, tornadoes, bullets, etc.
- Not very effective for toilets
- Strongest at the poles, weakest at equator



Troposphere - Air Circulation

- Coriolis effect (due to earth's rotation) disrupts/distorts convective cells.
- West moving winds along tropics/equator (trade winds or easterlies) and along polar regions (polar easterlies).
- East moving winds along the mid-latitude (30 to 60° - westerlies)

The Coriolis effect and wind direction.

