



### Why does the wind blow?

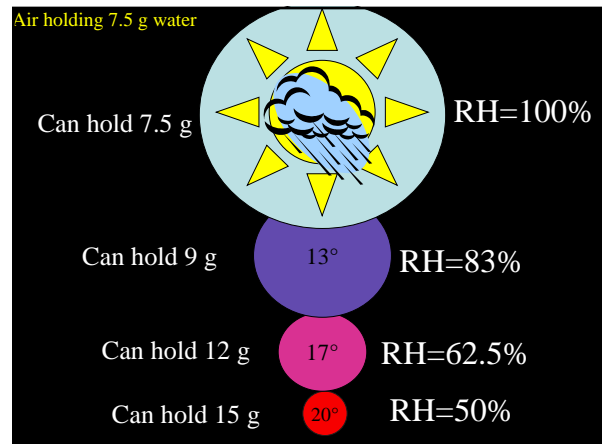
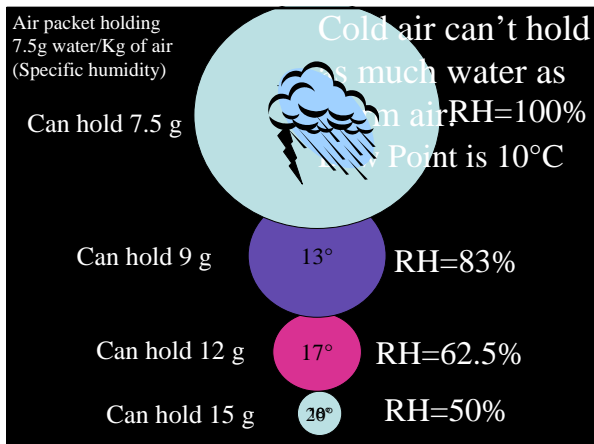
- Air moves from high to low pressure.
- Differential pressures caused by differential heating.
  - Small scale = lake effect
  - Larger scale = sea breeze
  - Global scale = wind belts

### 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)

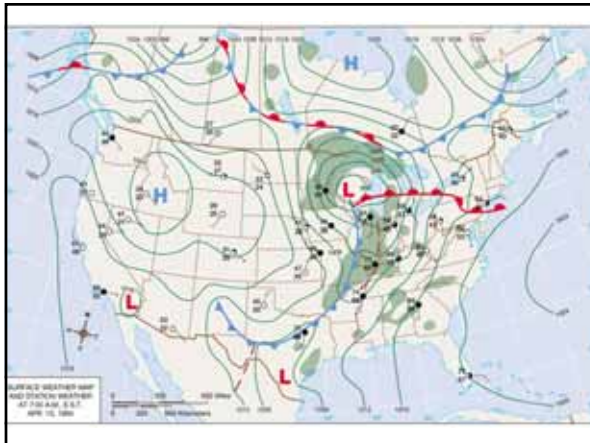


### Meteorology summary

- 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

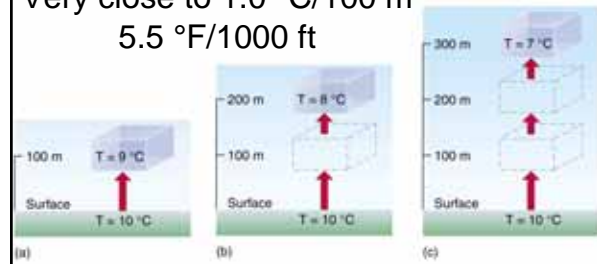
### Generalized meteorology

- 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



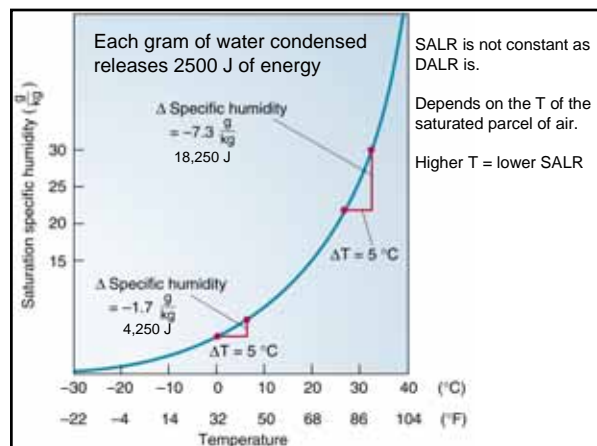
### Dry Adiabatic Lapse Rate (DALR)

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



### Saturated Adiabatic Lapse Rate (SALR)

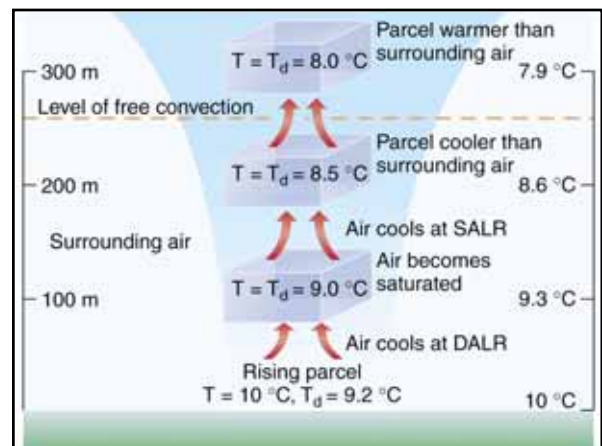
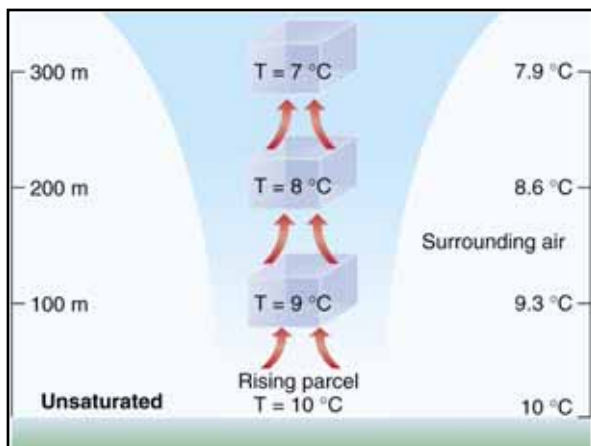
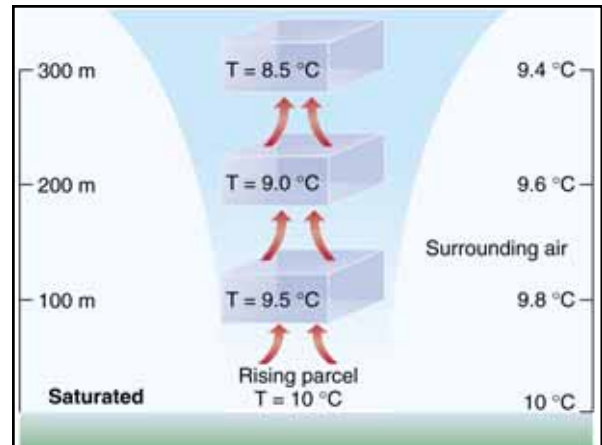
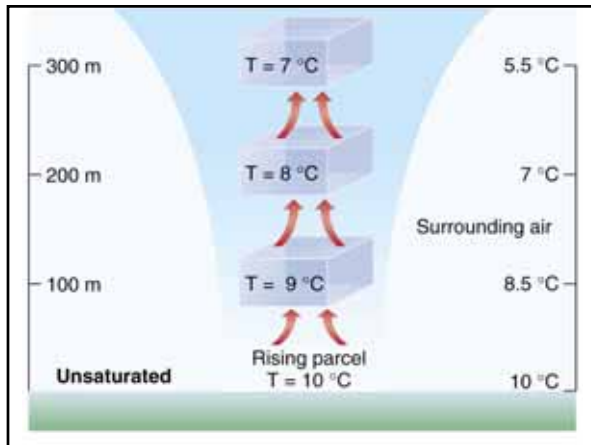
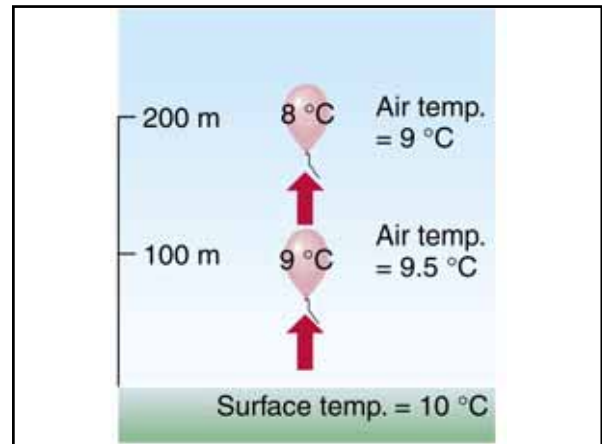
- Once the water in the air begins to condense, it releases its latent heat.
  - Begins to condense at the **lifting condensation level (LCL)**.
- If the air continues to rise, it will gain sensible heat from the latent heat released and cool from expansion at the SALR.
- About 0.5 °C/100 m
- 3.3 °F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



# Introduction to Environmental Science 12:008/159:008 Spring 2002

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)**.

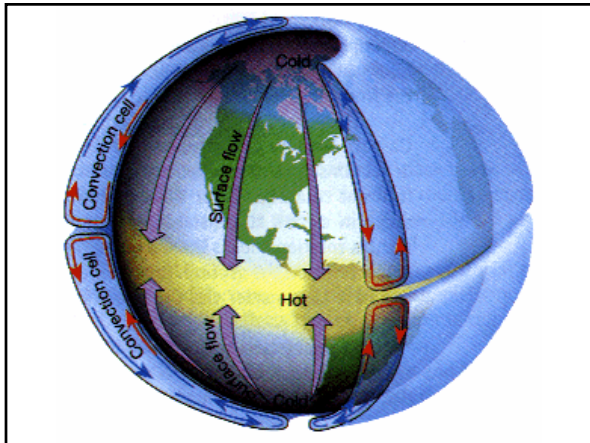


## How to cause air to rise

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

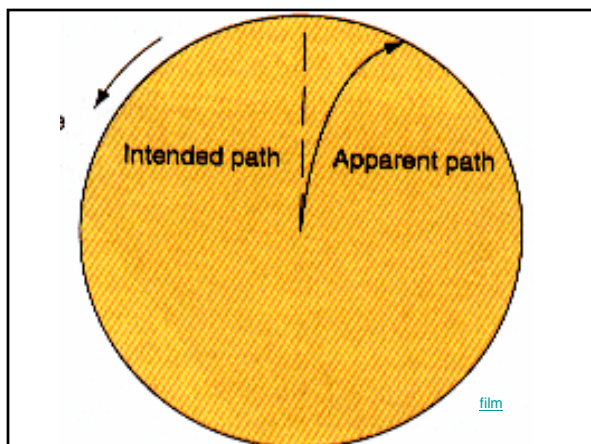
## Troposphere - Air Circulation

- 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.

