Water in the Atmosphere

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Water is the most important substance on Earth

Earth is the “Goldilocks Planet”
Temperatures are just right to make it possible for Earth to have vast amounts of water as liquid, solid, and gas

Water’s Changes of State/Phase

As water gains or loses energy, it changes its state or phase:

- **Solid** → **Gas/Vapor** → **Liquid**
Solid ⇄ Liquid

- Melting
  solid to liquid
  energy absorbed
  latent heat: $+334 \text{ joules/gm}$

- Freezing
  liquid to solid
  energy released
  latent heat: $-334 \text{ joules/gm}$
Liquid ↔ Gas

- Evaporation
  liquid to gas
  energy absorbed
  latent heat: + 2,260 joules/gm

- Condensation
  gas to liquid
  energy released
  latent heat: - 2,260 joules/gm
Solid ↔ Gas

• Sublimation
  solid to gas

  best example: ice in a freezer “disappears”

• Deposition
  gas to solid

  best example: frost
Humidity

• Measurement of how much water vapor is in air
• “Saturated” = holds as much as it could at that temperature
• Most familiar term is “relative humidity” how much $H_2O(g)$ in a “parcel of air” compared with how much it could hold at that temperature when saturated
Water Vapor and Changes in Temperature

If a parcel of air has a certain amount of H$_2$O$_{(g)}$ in it, when the

- temperature cools, the RH increases (and may reach 100%/saturation)
  We see this when drops form on the outside of a glass of cold water or iced tea
- temperature warms, the RH decreases
  We use this to “defog” a car windshield
Dew Point

• Temperature to which a parcel of air must be cooled to reach saturation
• Often as air cools in the evening, drops of dew form on surfaces when the temperature reaches the dew point
Measuring Humidity

• Sling psychrometer

• Hygrometer
Finding RH & DP

- Start by checking to see if the dry-bulb and wet-bulb temperatures are equal when they’re dry
- If not, you’ll have to adjust the wet-bulb to the dry-bulb
- Dip the wet-bulb in water
- CAREFULLY spin the psychrometer for about 20 – 25 seconds
- Record the dry-bulb and wet-bulb readings
- Subtract the wet-bulb from the dry-bulb to get the difference
- Use the Reference Tables to find RH and DP