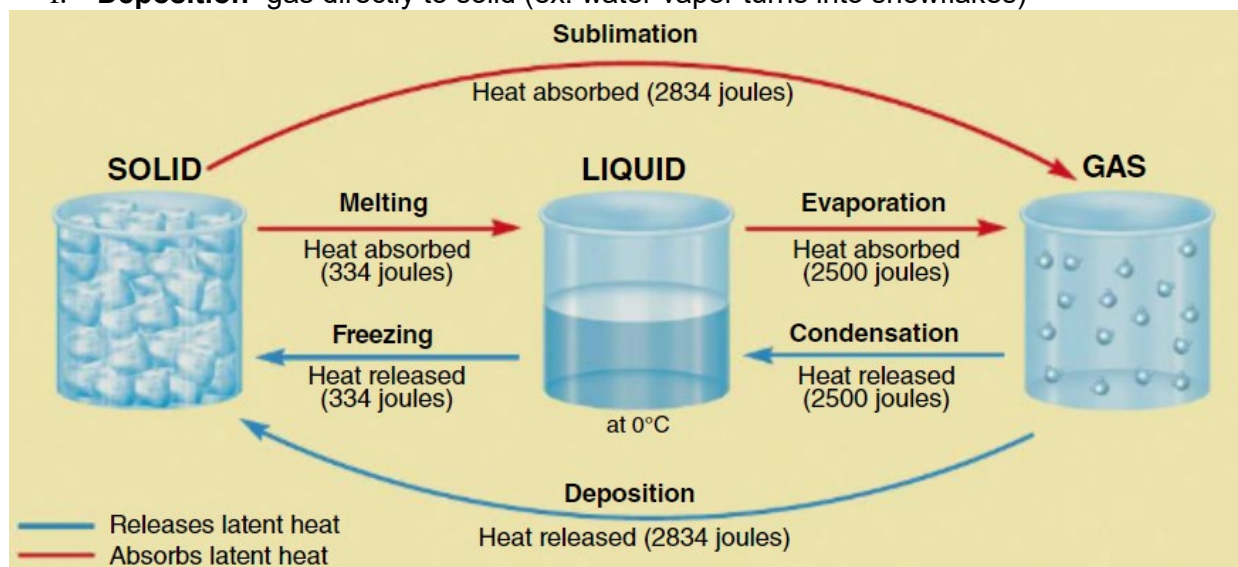


18.1 WATER IN THE ATMOSPHERE

I. **Precipitation**-any form of water that falls from the atmosphere, including snow, sleet, graze, hail, rain, drizzle, graupel

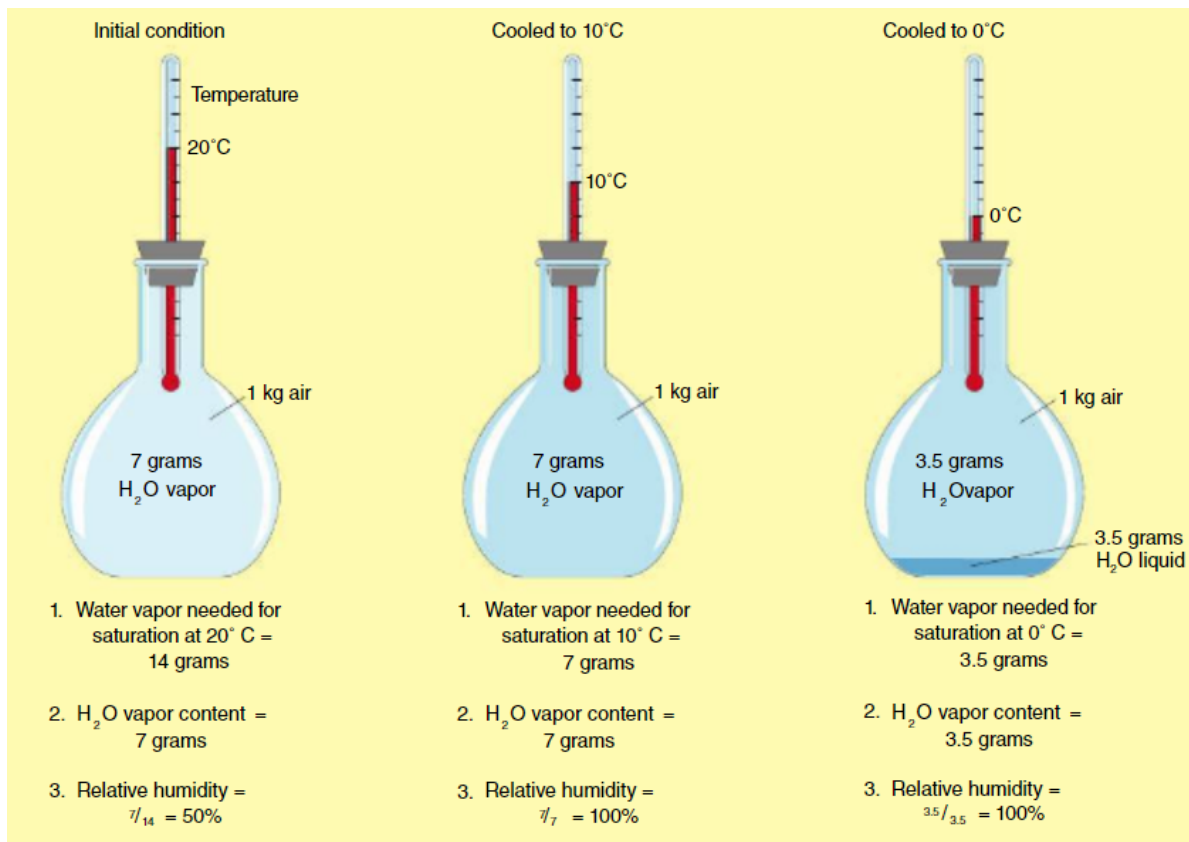
II. STATE CHANGES

- Melting**- solid to liquid (heat absorbed)
- Evaporation**- liquid to gas (heat absorbed)
- Sublimation**- solid directly to gas (heat absorbed) (ex. Snowbanks shrink even if there is no melting)
- Condensation**- gas to liquid (heat released)
- Freezing**- liquid to solid (heat released)
- Deposition**- gas directly to solid (ex. water vapor turns into snowflakes)



III. **Humidity**- water vapor (moisture) in the air

- Saturated** - when no more water can fill the air
- Relative humidity** - The amount of water vapor in the air compared to how much the air can hold at that temperature and pressure.. A percentage
- Dew point** - the temperature you need to get down to for the air to become saturated (If you get cooler than this temperature then clouds form and precipitation happens)
- Hygrometer**- the tool used to measure humidity in the air. Can be digital or done by hand (psychrometer)



18.2 CLOUD FORMATION

IV. CLOUD FORMATION

- Air compression**- pushing molecules closer together
- Air expansion**- allowing air molecules to spread apart

V. **Adiabatic** temperature changes—temperature changes that happen even though heat isn't added or subtracted

- Adiabatic cooling**- air rises then expands (because there's less pressure) creating cooling
- Adiabatic heating**- air sinks, then compresses (because there's more pressure) creating heating

VI. PROCESSES THAT LIFT AIR

- Orographic lifting**-air goes up a mountain slope, air cools, makes clouds, then precipitation
- Frontal wedging**-warm and cold air masses collide, and the warm air rises up over the cold one. Air cools, makes clouds, then precipitation
- Convergence**- two air masses collide and (because they can't go down) rise up. Air cools, makes clouds, then precipitation
- Localized convective lifting**-unequal heating of earth, causes air to rise (because nearby air sinks) Air cools, makes clouds, then precipitation.

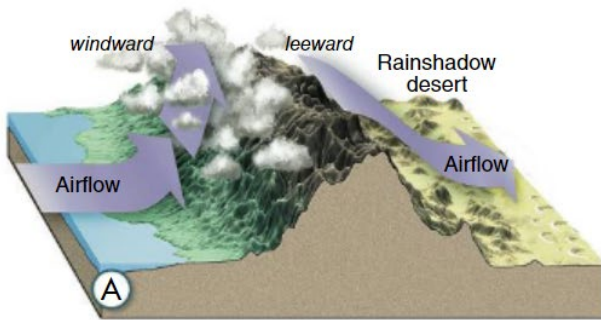
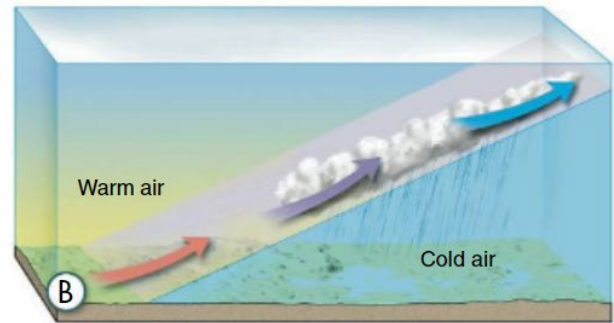
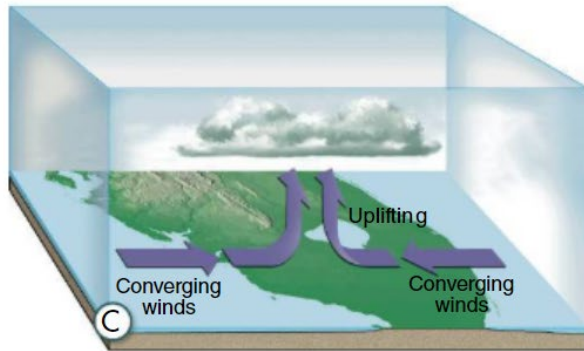


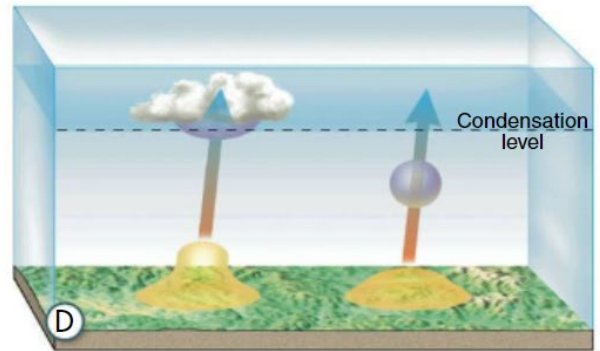
FIGURE 8
A Orographic Lifting Mountains are a barrier to air flow and force air to ascend.



B Frontal Wedging Warm, less dense air rises above cooler, denser air.



C Convergence Air is forced to rise when two air masses collide.



D Localized Convective Lifting Unequal heating of Earth's surface causes parcels of air to rise.

VII. STABILITY

- a. **Stable** air- remains in it's original position (warm is higher, and cold is lower)
When lifted it creates thin widespread clouds with light drizzle
- b. **Unstable** air- tends to rise, (usually happens because much warmer air is lower (less dense) and cooler air is above (more dense and wants to sink))
When lifted it creates thicker cauliflower shaped clouds and thunderstorms

VIII. CONDENSATION--When water vapor changes into liquid

- a. Tiny water droplets
- b. The air must be saturated
- c. Individual water molecules hit a particle, and cool (slow down)
- d. Particles are called **condensation nuclei** (dust, smoke, microorganisms, ash, salt, pollution)
- e. More water molecules slow down, collide and make the droplet bigger
- f. When too big to float, the droplets finally fall

18.3 CLOUD TYPES AND PRECIPITATION

- IX. CLOUD TYPES- based on their shape and height
- a. By shape:
 - i. **Cirrus**- high, streaky, thin clouds that are made of ice crystals (even in summer)
Do not make precipitation
 - ii. **Cumulus**- fluffy puffy shape like a cotton ball
If white= nice weather
If grey (so thick sunlight can't penetrate)= brings precipitation
 - iii. **Stratus** - smeary, foggy like clouds that form in flat layers and often cover the whole sky
Associated with sprinkly weather that lasts for many hours
 - b. By height:
 - i. **Cirro**- high
 - ii. **Alto**-medium height
 - c. By weather type:
 - i. **Nimbo**- "rainy"
- X. FOG- a cloud on the ground
- a. Can form when the ground is cooler than the air, condensing out the water
 - b. Can form by evaporating water from lakes and rivers
- XI. HOW PRECIPITATION FORMS
- a. Cold clouds – **BERGERON PROCESS**—**supercooled** water droplets (they are colder than freezing temperature, but not frozen) stick to ice crystals making them big enough to fall. They may later melt into raindrops.
 - b. Warm clouds – **COLLISION-COALESCENCE PROCESS** – droplets move through the cloud, collide with smaller droplets and eventually get big enough to fall
- XII. FORMS OF PRECIPITATION
- a. **Rain**-large condensation droplets (at least .5 mm)
 - b. **Drizzle**-tiny condensation droplets (smaller than .5m)
 - c. **Snow**- solid formed directly from water vapor
 - d. **Sleet**- rain that falls through a freezing layer of air forming small particles of ice
 - e. **Glaze**- (aka freezing rain) Supercooled water hits a surface and turn to ice
 - f. **Hail**- ice pellets that are lifted by updrafts over and over, freezing multiple layers of ice
 - g. **Graupel**- tiny snowpellets, "soft hail" (looks like dippin dots) formed when supercooled water sticks to snowflakes