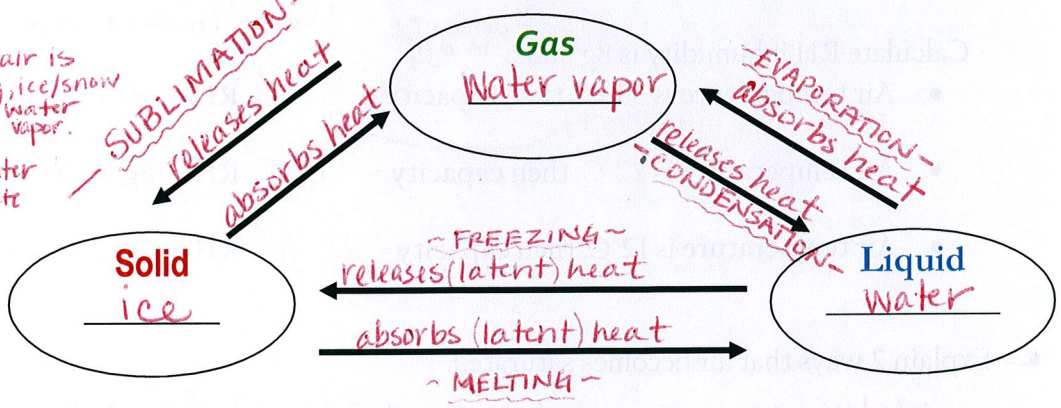
Humidity, Clouds, & Precipitation
Ch 24 Notes - Earth Science

Name: Key
Date: _____ Hr: ____

7.01 Phase Changes *(use p. 479 in your book for help)*

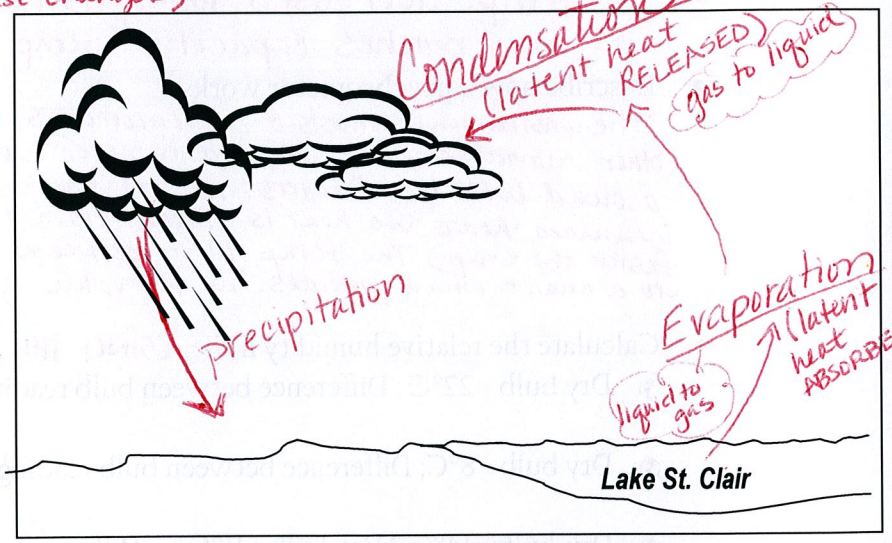
Complete the diagram below showing how H_2O changes state.

Sublimation
- solid to gas - when air is dry & below freezing, ice/snow may sublimate into water vapor.
- gas to solid - ex: water vapor can sublimate into ice (frost)



- Define **latent heat** *(p. 480)*: latent = "hidden"; energy absorbed & stored in the molecules, or released by molecules. (typical ex ⇒ phase changes)
- When latent heat is absorbed by H_2O...
  (include on the diagram above)
  absorbed & stored in molecules — Evaporation, ~~frost~~, sublimates (to gas), melts
- When latent heat is released from H_2O...
  (include on the diagram above)
  water condenses, freezes or ~~thaws~~ sublimates (frost)
- *Diagram* how H_2O changes state in the atmosphere.

p. 243



7.02 Humidity

Define **humidity**: Amount of water vapor actually IN the air

Define **water vapor capacity**.
Amount of water vapor that the air is able to hold.

limited by its temp
Warmer air is able to hold more WV than colder air

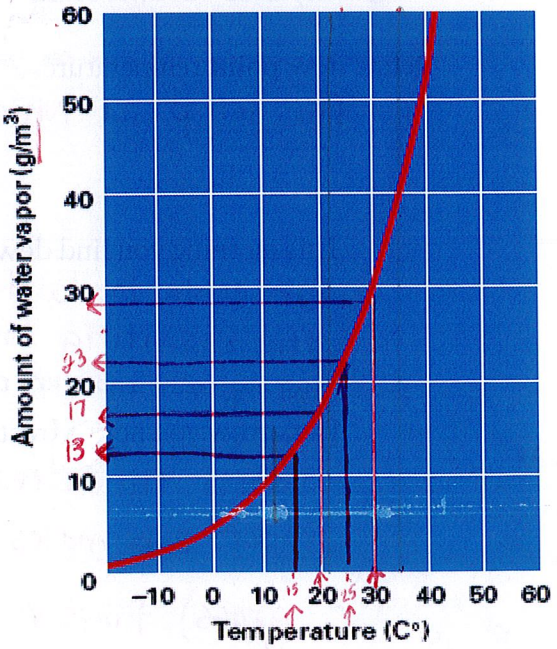
Measure how **capacity** changes with temp

Capacity at 15°C = 13 g/m³

Capacity at 20°C = 17 g/m³

Capacity at 25°C = 23 g/m³

Capacity at 30°C = 29 g/m³



Humidity, Clouds, & Precipitation

Ch 24 Notes - Earth Science

Name: _____

Date: _____ Hr: ____

- **Relative Humidity** (RH) = (mass of W.V. / capacity) x 100 = %
  (specific humidity: actual amount in air; capacity: (amt. (mass) of W.V air can hold)

  Calculate RH if humidity is 8g and...
  - Air **temperature** is 35°C, then **capacity** = 40 g/m³ **RH** = 8g / 40 = 20 %
    (Plug 35°C into chart)
  - Air **temperature** is 22°C, then **capacity** = 18 g/m³ **RH** = 8g / 18 = 44 %
  - Air **temperature** is 12°C, then **capacity** = 10 g/m³ **RH** = 8g / 10 = 80 %

(answers may vary slightly)

- Explain 2 ways that air becomes saturated.
  - Water vapor is added to the air (evap.) & fills it to capacity. (temp stays same)
  - temp. decreases, losing its ability to hold water vapor & thus reaches capacity (temp. reaches dew point)
- Describe how a **psychrometer** works.
  The instrument consists of 2 thermometers. One is covered w/ a damp wick, the other remains dry. The psychrometer is whirled around & air is circulated around both thermometers. The wet one experiences evaporation, which requires heat, so heat is w/drawn from the wet one. (the dryer the air, the faster the evap.) The temp. DIFF. between the 2 thermometers is applied to a chart which provides the RH value of the air.
- Calculate the relative humidity if the: USING THE RH CHART IN LAB BOOK
  - Dry bulb = 22°C ; Difference between bulb readings is 5° 60 %
  - Dry bulb = 8°C; Difference between bulb readings is 2° 74 %
  - Dry-bulb = 14°C, Wet-bulb = 11°C Diff = 3 ° 69 %
  - Dry-bulb = 2°C, Wet-bulb = -2°C Diff = 4 ° 36 %

Define **dew point** temperature.

The temp. at which air is cooled to its saturation point.

This morning you find **dew** on your grass. ***Describe how it formed.***

Air cools to its dew point when it touches something cool - the resulting form of condensation is called Dew.

"we squeeze moisture out of the air by cooling temp down"

Tomorrow you notice **frost** on your grass. ***Describe how it formed.***

When the dew point temp. is below freezing, water vapor sublimates into frost when it touches something (like grass) that's very cold (below freezing)

When dew freezes, it's in the form of frozen water droplets; frost is when water vapor turns directly to a solid

Humidity, Clouds, & Precipitation
Ch 24 Notes - Earth Science

Name:_____
Date:_____ Hr:____

7.03 Cloud Formation

Clouds are made of which 2 states of matter?
Clouds are visible masses of liquid water droplets or ice particles

Describe **condensation nuclei** - suspended particles of ice, salt, dust, etc in the troposphere.

Explain how they help the formation of clouds.
For condensation to occur, a solid surface (like condensation nuclei) must be available.

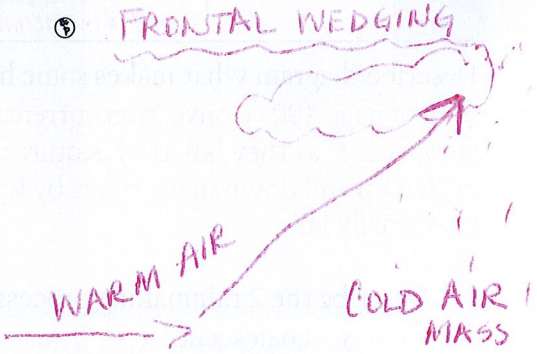
Describe other ingredients needed for cloud formation:
- Saturated air (water vapor)
- Cool temps
- low pressure (convection)

- In your own words, describe **convective cooling**:
warm air rising into the atmosphere meets lower pressure, so it expands & cools

Forceful lifting forms clouds. Diagram 2 ways this occurs.

OROGRAPHIC LIFTING

FRONTAL WEDGING



Describe how FOG forms.
Just like clouds' Layer of air in contact w/ the Earth cools to its dew point & water vapor condenses.

Contrast radiation fog and advection fog.
Radiation fog - usually forms on calm, clear nights (thickest in low places). Often thick around cities b/c of more sources of condensation nuclei. (smoke, dust)
Advection fog - when warm, moist air from above water moves over cooler land surfaces
Which one is more common along coastal areas like Grosse Pointe?

Outline the basics of cloud classification:

Cumulus
puffy, vertical-growing

Alto
term describing middle altitude clouds
strato - low altitudes
cirro - high altitudes

Stratus
layered, sheet-like
Low & cover large area

Nimbo/nimbus
term to classify as precipitating

Cirrus
wispy, feathery
highest clouds

7.04 Precipitation

Describe the characteristics of the following forms of precipitation:

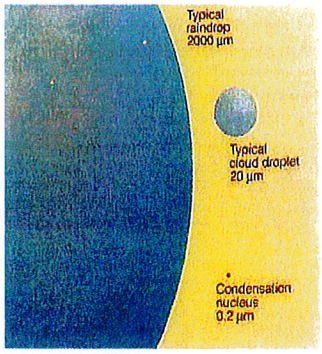
Type	*Liquid or Solid?*	*Physical Description + How it forms*	*What season does it form?*
Rain	*liquid*	*Liquid droplets= between .5-5mm in diameter ; (if <.5mm=drizzle) condensed droplets of water fall to the ground*	*Spring, summer, fall, sometimes even in warmer winters!*
Freezing Rain	*Liquid till it hits a freezing surface*	*Rain that freezes as soon as it lands on a cold surface near the ground*	*winter*
Snow	*solid*	*Ice particles that usually take the form of snowflakes;(small at low temps, lg at higher temps b/c there's more moisture in warmer air)*	*Fall, winter*
Sleet	*solid*	*Clear ice pellets that form when rain falls through a layer of freezing air*	*Fall, winter, spring*
Hail	*solid*	*Lumps of ice; convection currents in clouds carry rain drops to high levels, where they freeze. This ice pellet gets carried up again and again. Each time this happens, the layer of ice gets thicker until it eventually falls to the ground.*	*summer*

Describe/diagram what makes some hailstones small, while others much larger.

(top of page 490) Convection currents within the clouds carry raindrops to high levels, where they freeze. as they fall, they acquire additional raindrops which freeze to them. These can be cycled up and down many times by updrafts in the cloud, creating ever larger hailstones until they finally fall.

Describe the 2 rainmaking processes

- coalescence (p.491) as large *cloud* droplets fall through a cloud, they collide and combine with smaller droplets. When they get too big to be supported by the air, they fall as *rain* droplets. The most common rainmaking process in the tropical regions.



- supercooling (p.491) At temps below freezing, clouds are made up of "supercooled" water droplets. (dangerous for planes!) Water evaporates from these supercooled droplets and condenses onto ice crystals which are also in the cloud. They become heavy enough to fall and usually melt on the way to the ground and reach us as rain droplets. Most commonly the process for making rain and snow in the mid to high latitudes.

Describe cloud seeding and how is it used. (p.492-493) Cloud seeding is the process of spreading either dry ice, or more commonly, silver iodide aerosols, into the upper parts of clouds to try to encourage growth of new ice particles (for water droplets to condense upon). Seeding is performed on clouds that look like they have a potential to rain.