CC **Topic VII**

W E A T H E R

I. History of the atmosphere

A. Earth's early atmosphere formed as the result of **outgassing** of water vapor, carbon dioxide, nitrogen, and lesser amounts of other gasses from its interior.
   1. Earth's **oceans** formed as a result of precipitation (rain mostly) due to this water vapor over millions of years.

B. The evolution of life caused dramatic changes in the composition of the earth's atmosphere.
   1. Free oxygen did not form in the atmosphere until oxygen producing organisms (plants) evolved.
   2. The ozone layer then formed in the stratosphere from this newly-added oxygen. (ozone absorbs ultraviolet rays from sun)

II. Weather - day to day conditions of the atmosphere

III. Temperature - measured with a thermometer

A. **Isotherms** – lines of equal *temperature* on a weather map.
(space between them can be colored)

B. Most heat is from long-wave infrared radiation **from the earth**, which is then absorbed by water vapor, carbon dioxide, & methane
   1) heat **released** from condensation and sublimation (vapor to ice)
   2) heat is transferred by wind and air currents throughout earth

C. RISING and SINKING AIR

   1) As a gas expands, it cools. Less air pressure as you **go higher** causes air to **expand and cool**.
   2) As a gas compresses, it warms. More air pressure as you **go lower** causes air to **compress and warm**.

      a) See Ref. Tables ... p. 14, showing the **higher you go**, **the colder** it gets in the troposphere. (Is why we have snow-capped mountains.)

IV. **Atmospheric Pressure (air pressure)** - measured with a barometer

A. **Isobars** – lines of equal *air pressure* on a weather map
   1. See Ref. Tables, for conversion chart for the two air pressure scales: **inches** and **millibars**

B. Air pressure changes affect all other weather conditions

**** AIR PRESSURE . . . O P P O S I T E S ****

... means that whatever the air pressure does, moisture in the air and temperature of the air will do the **OPPOSITE**!!

1) Poles are cold, so are areas of *high* pressure.
2) Equator is hot, so is an area of *low* pressure.

V. **Wind** - direction measured with a wind vane
- speed measured with an anemometer

A. **Caused by differences in air pressure** (resulting from the uneven heating of the earth).

B. Wind ***ALWAYS*** goes ***from*** the HIGH pressure area ***to the*** LOW pressure area!
   1) **PRESSURE GRADIENT** – is the ***difference*** in air pressure between a high and a low.
      a) shown on a weather map by **how close together** the **isobars** are. (closer together means a *steeper* pressure gradient)
      b) The ***STEEPER*** the pressure gradient, the ***STRONGER*** the winds!!!!!
      c) Winds are always named for the direction that they **come FROM**. (a SW wind means it is coming from the southwest)

C. Land and Sea Breezes
   1. During the day (sunny & clear), wind blows from cool ocean (high pressure area) to warm land (low pressure area) -- SEA BREEZE
   2. During the night (clear), wind blows from the cool land (high pressure area) to the warm ocean (low pressure area) -- LAND BREEZE

D. Coriolis Effect – due to earth's rotation... causes winds in the **northern** hemisphere to veer to the **right**.
(southern) (left)

E. **GLOBAL WINDS**

1) Caused by **convection** as a result of uneven heating of the earth's surface (hot air rising, replaced by sinking cold air).
2) ***ALL*** weather patterns (HIGHS, LOWS, STORM FRONTS) follow these global winds.
3) New York State is in a **southwest planetary wind** (all weather patterns come from the southwest toward the northeast).
4. SEE REF. TABLES p. 14, for **Global (Planetary) Winds Diagram**
5. These global winds and jet streams (rivers of air at top of troposphere) **shift** with the seasons.

VI. **Atmospheric Moisture** - measured with a psychrometer

A. Sources of water vapor:

1) mostly **evaporation from the world's oceans**
2) transpiration- water vapor given off by living plants
EVAPOTRANSPIRATION – combination of both words

B. Evaporation – continues until air is saturated with water vapor. An **equilibrium** is then reached, so that as many water molecules that evaporate into the air will also condense out of the air.

C. **Warm air** has ***more space*** for water vapor than **cold air**!!!

D. Factors affecting the **rate of evaporation**:

1) energy available in air (more on **hot, windy days**)
2) surface area of water (more when water is **spread out**)
3) moisture content of air (more if the air is **drier**)
(*also* called vapor pressure)

F. **RELATIVE HUMIDITY**

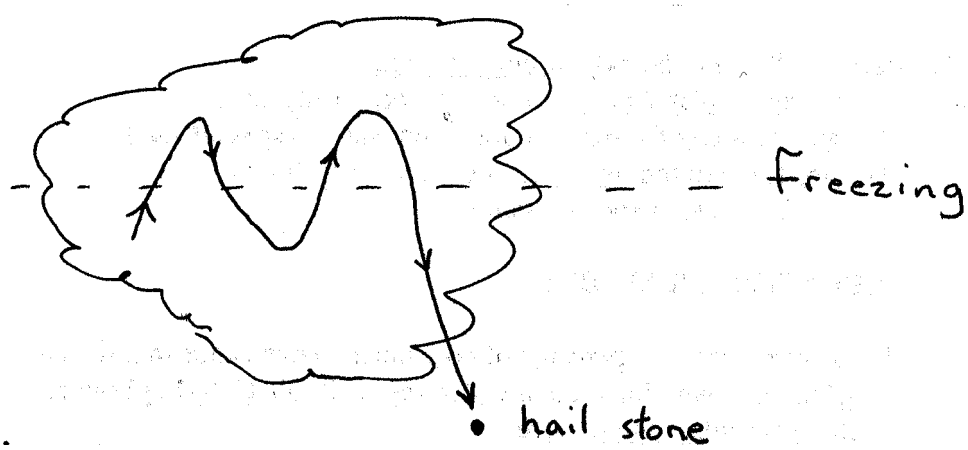
1) a comparison (in percent) of how much water vapor that the air **IS** holding with how much water vapor the air **COULD** hold at that particular temperature.
2) When air is holding all the water vapor that it can, then the **relative humidity is 100%**. This can happen by:
    a) ad**ding more water vapor** to the air
    b) **lowering the air temperature** (making ***less*** room for water vapor)
3) **DEW POINT TEMPERATURE** – the temp. at which the rel. humidity reaches 100%. ***Condensation*** **starts** and ***clouds*** form in the sky (if **condensation nuclei are present**) (dust, pollen, aerosols)

G. Measuring Relative Humidity and Dew point Temperature

1. Use a **sling psychrometer**... has a wet bulb and a dry bulb thermometer.
2. Once wet and dry bulb readings are obtained (**in ^{o} C**) the use **chart** in Ref. Tables ... p. 12 to determine the relative humidity and the dew point temperature.

H. Precipitation – ***ANY*** moisture that ***falls*** from the sky (*not* fog or frost)

1. measured with <u>precipitation gauges</u>
2. many **<u>aerosols</u>** (dust, pollen, condensation nuclei) are removed from the air through this process, thus cleaning the air.
3. Can include:
   a) rain
   b) snow
   c) drizzle - very small, slow-falling rain drops
   d) hail - forms in violent thunderstorms, where updrafts blow the falling rain back up above the freezing elevation in the cloud. (repeating this cycle results in larger hail stones)



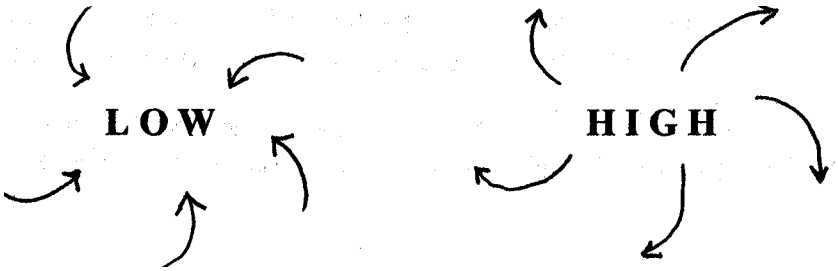
VII. **Air masses**

A. Air masses get their characteristics from the <u>source regions</u> (land or water) they are above. ex. cP, cT, mT, mP (see Ref. Tables)

B. **Lows** (cyclones) and **highs** (anticyclones)

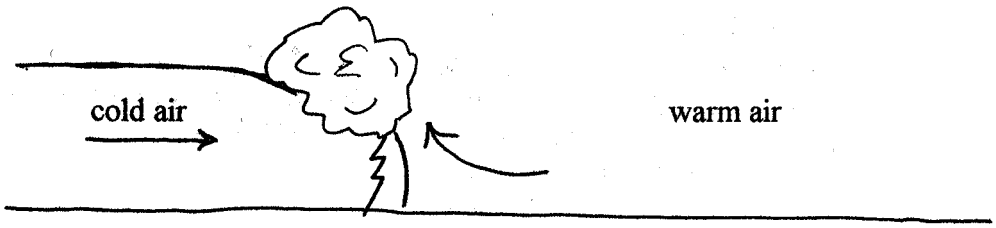
1. High pressure rotates to the **right** (*CLOCKWISE*)

2. Low pressure rotates to the Left (COUNTER-CLOCKWISE)



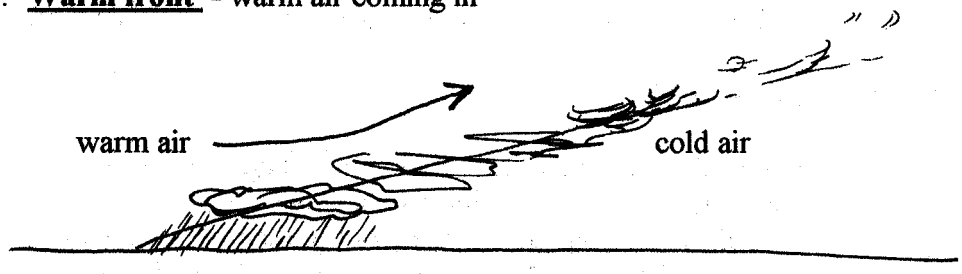
VIII. **Fronts** - boundaries between air masses

A. **Cold front** - cold air coming in



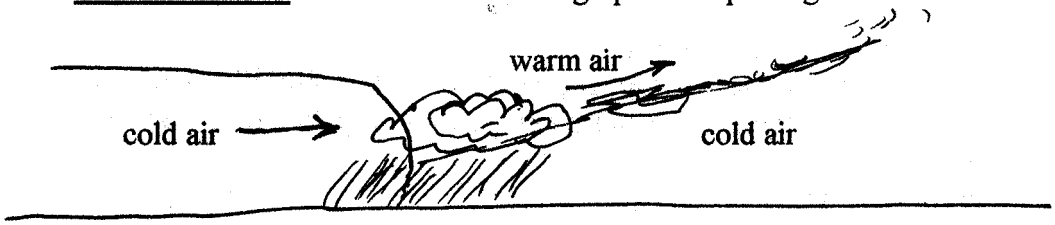
1) moves FAST
2) THUNDERSTORMS along leading edge
3) once it passes, air pressure ↑ , moisture ↓ , air temperature ↓

B. **Warm front** - warm air coming in



1) moves SLOW
2) long, steady rain along edge
3) once it passes, air pressure ↓ , moisture ↑ , air temperature ↑

C. **Occluded front** - a cold front catching up to and passing a warm front



D **Stationary front** - ***no*** motion of the air masses

IX. **Clouds and Fronts**

A. When air is forced upward, it cools, the dew point temp. is reached, and clouds form.
B. Are moved by the global winds
   1) **jet streams** - "rivers of air" found at the top of the troposphere (see Ref. Tables. p. 14) moving at 300 mph.
      a) polar front jet stream
      b) subtropical jet stream

X. **The weather map**

A. Isobars - lines of equal air pressure on a weather map
B. Front symbols - given on Ref. Tables, p. 13
   1) The "arrows and bumps" point in the direction the front is moving.

XI. **Weather station models**

A. Use Ref. Tables, p. 13 as a guide. Information is always located at the same location on any station model circle

1) ***NOTE***: For barometric pressure (air pressure), if the number shown is ***LESS*** than **500**, put a **10** in front of it, and a decimal point between the last two digits. If it is **500 or *GREATER***, put a **9** in front of it, and a decimal point between the last two digits.

XII. **Properties of the atmosphere**

A. Use Ref. Tables, p. 14
   1. In the **troposphere**, as elevation ***INCREASES***, everything else (temperature, air pressure, water vapor) ***DECREASES***.

XIII. **Predicting weather**

A. Extensive technology is used to gather data on current weather conditions.
   1. weather instruments
   2. weather balloons
   3. radar
   4. satellite photos

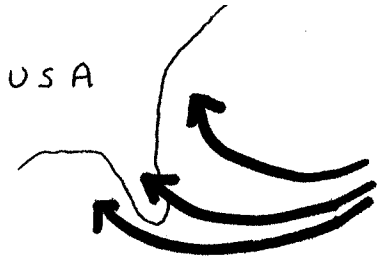
B. **Computers** are used to predict future weather by determining the weather that resulted from similar conditions in the past.

XIV. **Weather hazards**

A. **Thunderstorms** - due to warm, moist air being forced upward
   1. Include lightning, hail, strong winds, and even tornadoes.

B. **Tornadoes** - small, short-lived spinning air with ***very*** low pressure. (winds greater than 300 mph)

C. **Hurricanes** - areas of low air pressure that form above low latitude oceans. Heat from warm water and solar energy causes them to grow in strength and size. Once wind exceeds 74 mph, it is a hurricane.
   1. They rotate counter-clockwise.
   2. Typical paths:



   3. When hurricanes cross over land, their source of energy is deprived, and they weaken into just storms.

XV. **Emergency preparedness**

A. Ways to minimize loss of property, personal injury, and loss of life:
   1. Be aware of current and predicted weather conditions.
   2. Have emergency supplies on hand.
   3. Seek shelter in a building or vehicle.
   4. If severe, cover glass windows, secure outside items, and evacuate.