Ch 18.1 Water in the Atmosphere

• Water vapor is the source of all **condensation** and **precipitation**. Precipitation is any form of water that falls from a cloud, such as rain, snow, sleet, and hail.

• When it comes to understanding atmospheric processes, water vapor is the most important gas in the atmosphere.

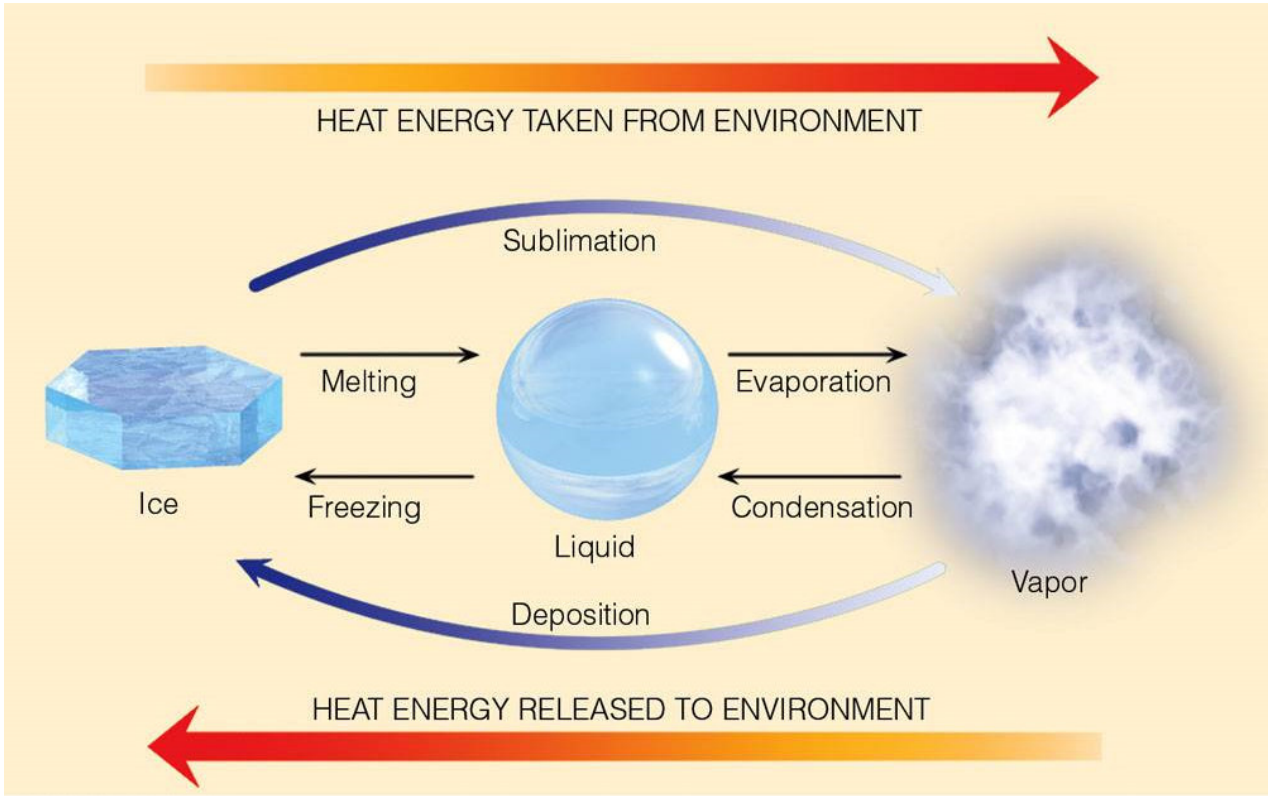
• Water vapor is only a small fraction of gases in the atmosphere – 0 to 4 percent by volume, but its importance is great.

Water's Change of State

• The three states of matter are **solid**, **liquid**, and **gas**. Water can change from one state of matter to another. This unique property allows water to freely move between the different states creating the water cycle.

Solid to Liquid

- The process of changing state requires that energy is transferred in the form of heat. Add heat to ice, the temperature of the ice remains constant 32 F until all of the ice has melted. Heat breaks apart the crystal structure of ice.
- The heat used to melt ice does not produce a temperature change, so it is referred to as **latent heat**.
- ***Latent*** means "hidden". Energy is stored in the liquid water and is not released as heat until the liquid returns to a solid state (ice).
- Latent heat is the major source of energy for thunderstorms, tornadoes, and hurricanes.



Liquid to Gas

- **Evaporation** is the process of changing a liquid to a gas. Evaporation is the main process of how water becomes water vapor.
- The energy absorbed by the water molecules during evaporation gives them the motion needed to escape the surface of the liquid and become a gas.
- **Condensation** is when water vapor changes to the liquid state. Condensation is what generates clouds and fog.
- During condensation, water molecules must release their stored heat energy to form water. This release of energy plays a major role in producing violent weather and can transfer great quantities of heat from tropical oceans toward the poles.

Solid to Gas

- **Sublimation** is the conversion of a solid (ice) directly to a gas, without passing through the liquid state.
- **Deposition** is the conversion of water vapor directly to a solid. This occurs when water vapor is deposited as frost on cold objects.

Humidity

•When water evaporates due to the warm temperature, it goes into a gas state or water vapor.

• **Humidity** is the amount of water vapor in the air.

• Humidity can also be known as relative humidity and dew-point temperature.

• **Saturation** is when water begins to evaporate and water vapor molecules are added into the air. As more water vapor escape into the air, there will be a balance where vapor molecules return to the surface, it is said to be **saturated**.

• Warm air contains more water than cold air.

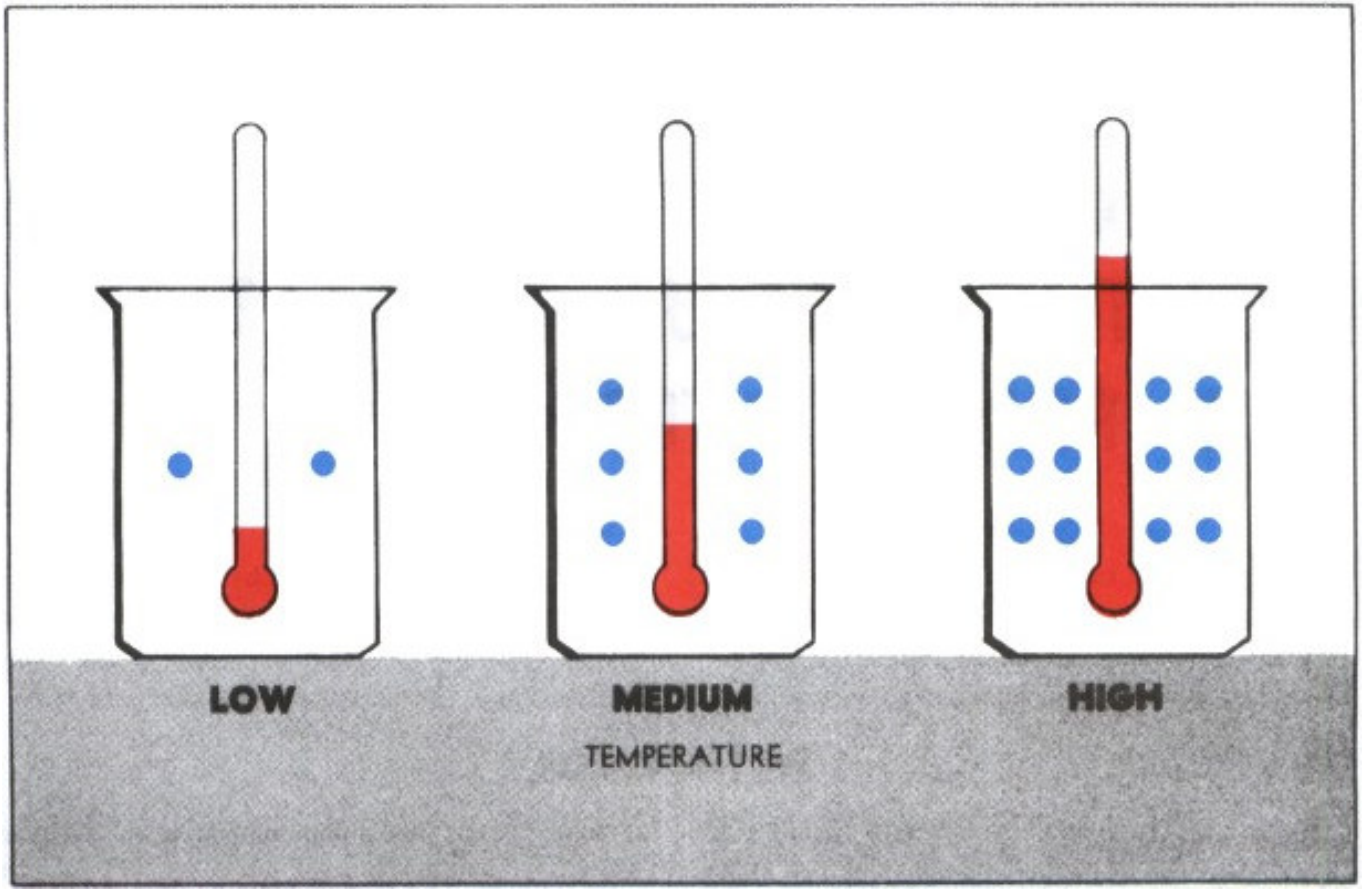
Relative Humidity

• **Relative humidity** is a ratio of the air's actual water-vapor content compared with the amount of water vapor air can hold at that temperature and pressure.

• To find relative humidity: Dry-bulb temp. – Wet-bulb = Difference of the Wet bulb then cross index difference to the Dry-bulb temp. on the table.

Relative Humidity

- Relative humidity routinely is expressed in percent. As the term suggests, *relative humidity* is "relative." It relates *the actual water vapor present to that which could be present.*
- Temperature largely determines the maximum amount of water vapor air can hold. As figure below shows, warm air can hold more water vapor than cool air.



Dew Point

- Dew point is the temperature to which a given parcel of air must be cooled to reach saturation. The condensed water is called **dew**. The dew point is a saturation point.
- The dew point temperature is the temperature at which the air can no longer hold all of its water vapor, and some of the water vapor must condense into liquid water. The dew point is always lower than (or equal to) the air temperature.
- If the same air is cooled further, the air's excess water vapor would condense as fog or clouds.

Measuring Humidity

- Relative humidity is commonly measured by using a hygrometer. One type is called a **psychrometer**.
- A psychrometer has two identical thermometers mounted side by side. One thermometer is a dry-bulb and the other is a wet-bulb, which has a thin cloth wick tied round the end at the bulb.
- The wet-bulb is saturated with water and air is continuously passed over the wick by swinging the instrument.
- Water evaporates from the wick, heat is absorbed by evaporating water makes the temperature of the wet-bulb drop, and lowers the wet-bulb thermometer reading.
- The amount of cooling that takes place is directly proportional to the dryness of the air.
- The drier the air, the more moisture evaporates and the lower the temp. of the wet bulb. No evaporation, the air is saturated – high humidity.