I. Energy

A. Insolation

1. incoming solar radiation (radiation from the Sun)
2. main source of energy for the Earth's atmosphere
3. three factors affect the amount of insolation received by the Earth:

(a) Angle of insolation

- the more direct (vertical) the rays, the warmer the temperature
- highest angle at equator; lowest angle at the poles

(b) Duration of insolation

- the more hours of the day the sun shines, the warmer the temperature
- always 12 hours day/I 2 hours night at the equator

(c) Reflection, refraction, or absorption of insolation

- during the day, clouds block insolation, therefore cooler temperature
- during the night, clouds insulate, therefore warmer temperature
- dark and rough surfaces tend to absorb insolation
- light and smooth surfaces tend to reflect insolation

B. Energy Transfer

1. Conduction - transfer of heat energy through a solid (ex: dirt or rock)
2. Convection - transfer of heat energy through a liquid (ex: water) or a gas (ex: air)
3. Radiation - transfer of heat energy through the void of space

II. Weather Variables

A. Weather

1. the present short-term condition of the atmosphere
2. daily cycle (day/night) controlled by the rotation of Earth on its axis
3. seasonal cycle (winter, spring, etc.) controlled by revolution of the Earth around the sun

B. **Atmospheric Variables** are all interrelated: a change in one results in a change in one or more of the others. Include: temperature, air pressure, humidity, and wind

1. Temperature

(a) a measure of the average kinetic energy of a substance
(b) measured in degrees Celsius (°C), degrees Fahrenheit (°F), or degrees Kelvin (°K)
(c) a good conductor of electromagnetic energy is also a good radiator of electromagnetic energy

2. Air Pressure

(a) a measure of the weight of the overlying atmospheric gasses
(b) highest at sea level (15 pounds per square inch)
(c) air pressure decreases as elevation increases
(d) a barometer measures air pressure in either 1) inches of mercury or 2) millibars
(e) cold air is relatively heavy; therefore pushes more on the Earth -> HIGH pressure
(f) warm air is relatively light; therefore pushes less on the Earth -> LOW pressure

3. **Humidity**
   (a) water vapor is the gaseous form of water and consists of extremely tiny droplets
   (b) humidity is the measure of the total amount of water vapor in the air
   (c) warm air can hold more water vapor than cold air
   (d) when air is holding the maximum amount of water vapor it can, it is called saturated
      - the temperature at which the air is saturated is the dewpoint temperature
      - when the temperature and dewpoint temperature are the same = 100% Relative Humidity
         - as temperature increases, relative humidity decreases
         - as temperature decreases, relative humidity increases

   (e) when air cools down below dewpoint temperature, (the air can not hold excess water vapor) condensation occurs (gas to water)
      - condensation nuclei provide a solid surface for condensation to occur
      - condensed water vapor forms clouds
      - usually forms precipitation (rain, snow, sleet, etc..)

   (f) Formation of clouds
      - Warm moist air rises, expands and cools to the dewpoint temperature
      - Condensation occurs (on condensation nuclei / dust particles)

   (g) when air is holding less than maximum, it is expressed as a percentage - relative humidity

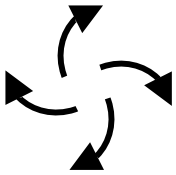
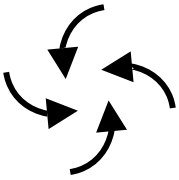
   (h) Determining Relative Humidity and Dew Point Temperatures
      - a sling psychrometer is an instrument that uses two thermometers to measure relative humidity and dewpoint temperature
         - Contains a "dry bulb" thermometer and a "wet bulb thermometer"
         - dry bulb temperature is normal air temperature
         - wet bulb temperature is lowered due to the cooling effect of evaporation
         - wet bulb depression is the difference between dry and wet bulb temps

4. **Wind** - the horizontal movement of air,
   (a) due to the uneven heating of the atmosphere – some materials heat up faster than others
   (b) differences in amount of insolation received – depends on location
   (c) Coriolis effect bends winds in the N. Hemisphere to the right; S. Hemisphere to the left

   (d) Density of Air
      - volume for volume, water vapor weighs less than other atmospheric gasses
      - warm air contains more water vapor, therefore is less dense, and rises
         - if the air is moving up, the weight of the air is less = low pressure
      - cool air contains less water vapor, therefore is more dense and sinks
         - if the air is sinking, the weight of the air is more = high pressure

   (e) wind blows from High pressure(coder air) to Low pressure (warmer air)
   (f) specific heat of land versus water – water has a higher specific heat – takes longer to heat up and cool down
      - sea breeze occurs during the day- air over land is warmer and air over water is cooler
         - blows from sea (HIGH) to land (LOW)
      - land breeze occurs during the night- air over land is cooler and air over water is warmer
         - blows from land (HIGH) to sea (LOW)

III. Air Pressure Table

High Pressure	Wind blows →	Low Pressure
Air moves down (sinks, falls)		Air rises
Air moves outward (away from the center of the high - divergent)		Air moves inward (toward the center of the low – convergent)
Air is cold		Air is warm
No clouds (comfortable)		Clouds (humid)
No precipitation (dry)		Precipitation (wet)
Air moves clockwise		Air moves counter clockwise
		

IV. **Meteorology** – the study of the short term conditions of the atmosphere (weather)

A. <u>Air Mass</u> - a large body of air having uniform temperature, humidity, and pressure

1. named based upon two factors:

(a) Moisture content
- (c) continental: dry air formed over land
- (m) maritime: moist air formed over water

(b) Temperature
- (T) tropical: warm air formed in more equatorial latitudes
- (P) polar: cold air formed in mid latitudes
- (A) arctic: very cold air formed in more polar latitudes

B. <u>Fronts</u> – the boundary between two air masses - may be several hundred miles in length

1. Four types:

(a) <u>Cold front</u>
- when a cold air mass moves into a region occupied by warm air
- due to its density, cold air acts like a snow plow and pushes warm air up
- warm air cools quickly to dewpoint and quickly releases precipitation
- strong storms but short-lived over several hours

(b) <u>Warm front</u>
- when a warm air mass moves into a region occupied by cold air
- due to its density, warm air gradually flows on top of cold air
- warm air cools slowly to dewpoint and slowly releases precipitation
- gentle storms but long-lived over several days

(c) Occluded front
- when a warm air mass is caught in between two cold air masses
- a combination of a cold front uniting with a warm front
- warm air squeezed upward and reaches dewpoint
- strong and gentle storms produced over several days

(d) Stationary Front
- cold air mass and warm air mass not interacting directly, but sliding past one another in opposite directions
- no precipitation produced

C. Weather Station Model

1. a single diagram that summarizes ten pieces of weather information
2. commonly found on synoptic weather maps
3. when dewpoint and air temperature are close together, increased chance of precipitation
4. when dewpoint and air temperature are farther apart, decreased chance of precipitation
5. barometric shorthand (3 digits) is used instead of real barometer readings (4 or 5 digits)

D. **Synoptic Weather Map**

- a weather map that shows atmospheric variables coded as weather station models

1. Isotherms: connect points of equal temperature
2. Isobars: connect points of equal barometric pressure
   (a) where isobars are spaced closely, high pressure gradient -> strong wind
   (b) where isobars are spaced far apart, low pressure gradient -> calm wind
   (c) pressure gradient can be calculated mathematically

3. Wind direction
   (a) shows divergent wind for high pressure weather system
   (b) shows convergent wind for low pressure weather system

4. Precipitation patterns
   (a) active precipitation denotes location of a front separating two air masses

E. **Hurricanes and Tornadoes** - very severe storms caused by LOW pressure weather systems

Hurricane	Tornado
- fueled by warm and moist air mass (mT) evaporated from the ocean - averages 400 miles across - winds spin counter-clockwise at speeds exceeding 75 MPH - center of hurricane called the eye = area of lowest pressure - when over land, hurricane loses its source of warm and moist air rising, therefore wind speed and pressure gradient decreases - very good warning system (days in advance)	- created when warm and moist air mass (mT) traveling north meets a cold and dry air mass (cP) traveling south - winds spin counter-clockwise at speeds exceeding 300 MPH - not a good warning system – little time to prepare