The Atmosphere and is its importance to the Earth

1. The atmosphere what is it?
   a. A thin envelope of gases that surrounds the Earth
2. What does it do?
   a. Controls the weather, hydrologic cycle, and the climate of the Earth.
   b. Allows for life to exist on Earth
3. Ancient Atmosphere
   a. Composition
      i. Carbon Dioxide
      ii. Sulfur Dioxide
      iii. Water vapor
      iv. Nitrogen
   b. What is the source of the atmosphere?
   c. Could not support life – no oxygen
   d. Conditions changed 3.8 Ga (billion years before present)
      i. Water could condense (precipitation occurred)
      ii. Life was generated (amino acids - aquatic microorganisms)
      iii. CO_2 dissolves in water and is used by MO – tied up in rocks
      iv. Oxygen enters atmosphere
      v. Nitrogen remains – does not react with other chemicals
4. Present Atmosphere
   a. Nitrogen 78%
   b. Oxygen 21%
   c. Argon ~ 1%
   d. All other gases > 0.04%
5. Layers of the Atmosphere
   a. Temperature stratifies the atmosphere
   b. Troposphere
      i. Lowest layer – 0 to 15 km
      ii. Contains 80% of the mass of the atmosphere.
      iii. Layer where weather occurs.
      iv. Temperature decreases with height.
   c. Stratosphere
      i. Occurs between 15 and 50 km above the surface.
      ii. Temperature increases with height.
      iii. Contains ozone (O_3) that shields the surface from ultraviolet (UV) radiation and result in the warming of the layer.
   d. Mesosphere
      i. Temperature decreases with altitude
      ii. Fewer ozone molecules to retain heat
   e. Thermosphere
      i. Outermost layer
      ii. Blocks cosmic radiation
      iii. Radiation increases temperature > 1000^oC
6. Energy Balance

7. Pressure
    a. Air Pressure – the weight of the overlying air
        i. Measured in atm or bars (1 bar = 0.986 atm)
        ii. 1 atm is the weight of the atmosphere at sea level ~ 1,035 g/cm^2
    b. Mixture of gases in the atmosphere is not uniform
    c. Air pressure decreases as one moves away from the Earth's surface
    d. As the pressure increases the density of the air increases
8. Water Vapor
    a. Water content in the atmosphere is called the: **humidity**
    b. Composition varies as a function of temperature.
        i. Warm air holds > 40 g H_2O/Kg air
        ii. Cold air holds < 1 g H_2O/Kg air
    c. Addition/removal of water to the atmosphere requires/generates energy.
    d. Importance to climate – water vapor transfers heat from warmer to colder regions
    e. Latent heat – heat released or absorbed when matter changes state.
9. Latent Heat Cycle
10. Energy and the Atmosphere: Pressure, Water Vapor, & Weather
    a. What drives energy within the Atmosphere?
        i. Uneven Heating of Earth Surface
        ii. Solar energy is a function of both
            (1) Location
            (2) Time of year
        iii. Warm air rises
            (1) As air rises it enters a lower pressure area and expands
            (2) Expansion cools the air – the cold air hold less water
            (3) Condensation occurs – clouds form (latent heat)
11. Global Air Circulation
    a. Air masses move from high pressure areas to low pressure areas
    b. Air Circulation Around a Pressure Low
    c. Coriolis Effect
12. Wave-cyclones & Mid-Latitude Storms – Low and High Pressure Systems
    a. Low Pressure
        i. Air moves up
        ii. Weather cloudy
        iii. Usually associated with a cold front
    b. High Pressure
        i. Air descending
        ii. Little to no clouds – sunny
13. Frontal Systems
    a. Cold Front
        i. Air mass in cold behind the front.
        ii. Advancement forces the warm air up – clouds form
    b. Warm Front –
        i. Air mass is warm behind the front
        ii. Warm is relatively stable – move slower than cold front
        iii. Stationary Front – front is moving very slowly

iv. Occluded front – cold front has caught the warm front

c. Thunderstorms
   i. As warm humid air rises condensation occurs when the air mass temperature reaches the dew point– releasing energy.
   ii. Precipitation falls; some of the precipitation is carried high into the clouds by warm up drafting air. This increases the cloud growth and the energy of the system.

14. The Greenhouse Effect
    a. Concentrations of Greenhouse Gases – Modern Era
    b. Link between CO_2 and Global Temperature?
    c. CO_2 in the Atmosphere
    d. Temperature during the Industrial Revolution
    e. Carbon Cycle
15. Acid Rain
    a. All rain is acidic
    b. Caused by elevated concentrations of NOx and Sox
    c. Industry is the source of NOx and Sox