I. Radiation

A. Can travel through solids, liquids, gas and empty space

B. Radiation is identified / classified through wavelength, frequency and amplitude
   1. Electromagnetic spectrum (ESRT) shows the relative wavelengths of each type of radiation
   2. Notice that visible light is located between ultraviolet and infrared on the spectrum

C. 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 angle (in degrees) of the sun above the horizon
          • how high the sun is in the sky
          • the more direct (vertical) the rays (higher in the sky), the warmer the temperature
          • Depends on . . .
            1) Time of day – lowest angle at sunrise – cooler temperatures
               - highest angle at solar noon - warmer temperatures
            2) Latitude - highest angle at equator (0˚) - warmer temperatures
               - lowest angle at the poles (90˚N & 90˚S) – colder temperatures
            3) Seasons – lowest in the winter (December) – cooler temperatures
               - highest in the summer (June) – warmer temperatures

      (b) Duration of insolation
          • How long the sun is above the horizon
          • The longer the sun is above the horizon at a specific location, the warmer the temperatures
          • the more hours of the day the sun shines, the warmer the temperature
          • Depends on . . .
            1) Latitude - Equator (0˚) – has 12 hours of daylight every day - warmer temperatures
               - The poles (90˚N & 90˚S) – have 6 months of darkness, 6 months of daylight - colder temperatures
               * remember – at the poles the angle of the sun's rays is very low so it never really heats up, even with 6 months of daylight
            2) Seasons
               - Summer - “longer” days – duration of insolation is longer – warmer temperatures
               - Winter – “shorter” days - duration of insolation is shorter – cooler temperatures
(c) **Atmospheric Transparency** – how much insolation reaches Earth’s surface

- **Depends on reflection, refraction, or absorption of insolation**
- **Clouds:**
  - during the day, clouds block insolation, no sun, no heat - therefore cooler temperature
  - if it is sunny during the day and cloudy at night, the clouds insulate Earth (like a blanket) and helps keep the surface warm - therefore warmer temperature
- **Texture and Color**
  - dark and rough surfaces tend to absorb more insolation and reflect less
  - light and smooth surfaces tend to absorb less insolation and reflect more
- **absorption of insolation** a good absorber of electromagnetic energy (HEAT) is a good radiator of electromagnetic energy – In other words if an object heats fast, it will cool down fast
- **Specific heat** – front page of the ESRT’s - the specific heat of an object is the amount of heat required to raise the temperature of that object 1˚ Celsius
  - the higher the specific heat the more energy it takes to heat it up (so it takes longer to heat up and cools down
  - the lower the specific heat the less energy it takes to heat it up (so it takes less time to heat up and cool down)

D. **Greenhouse effect** - short wave radiation passes through Earth’s atmosphere and heats Earth’s surface. Earth’s surface than re-radiates the heat energy in long wave radiation – infrared, which is then absorbed by the greenhouse gasses in our atmosphere.

- carbon dioxide and water vapor are the two main greenhouse gasses

**Solar Radiation**
- The sun’s energy reaches Earth (short wave radiation)
- most of the insolation that reaches Earth is visible light radiation – you SEE it
- ultraviolet radiation (UV rays) are dangerous and can cause skin cancer

**Terrestrial radiation**
- Radiation from Earth (long wave radiation)
  - Earth’s surface absorbs the Sun’s radiation and re-radiates it in long wave (infrared) radiation

**II. Conduction**

A. Heat transfer from molecule to molecule (touching)
B. Most common in solids (rocks, dirt, heat on a pan)
C. Earth’s surface heats the air that is “touching” the ground
III. Convection

A. Transfer of heat energy through a fluid (ex: water) or a gas (ex: air)
B. Due to differences in density (convection currents form)
   1. Warm air rises (because it is less dense) cold air sinks (because it is more dense)
   2. Warm water rises, cold water sinks
C. This is how Earth’s atmosphere transfers heat energy

**Energy Transfer Summary:**

*refer to the diagram to the right*

A – Conduction – water touching the pan
B – Convection – hot water rising, cold water sinking
C – Radiation – fire is radiating heat to the atmosphere

IV. Properties of Water

A. front page of the ESRT’s – gives you the amount of heat gained or lost during a change in phase
B. It takes more heat energy to evaporate water then to melt it (vaporization)
C. Latent Heat: When water is undergoing a phase change there is NO CHANGE in temperature because the heat added its being used to change either melt the ice or evaporate the water.
D. Once ice is melted, temperatures rise at a constant rate, until boiling