SOME NOTES FOR WEEK 3

1. Factors affecting absorption of radiant energy:
   1. The radiative properties of the material (most are selective in the wavelengths they absorb
   2. The amount of time the object is exposed to the emitted energy. The longer it is exposed the more energy it can absorb
   3. The amount of the material. Very think objects may transmit and not absorb all the energy reaching them. Increasing thickness can increase the amount of energy it can absorb
   4. How close the object is to the source of the energy. The further away, the less radiation reaches it. The less energy that reaches it the less it can absorb.
   5. The angle at which the radiation is striking the object. Direct radiation is more concentrated than oblique and is absorbed more effectively

When radiation reaches an object it may be transmitted through the object (e.g. through a window) or it can be absorbed, reflected or scattered

ABSORPTION

Absorption transmits the energy into kinetic energy (energy cannot be created or destroyed)

REFLECTION:

Whatever energy is not absorbed or transmitted is reflected (eg white clothing reflects most the visible radiation that hits them, dark clothing absorbs it and hence becomes warmer.

With solid opaque surfaces whatever is not absorbed is reflected. A red object absorbs most visible radiation except red light which is reflected back in all directions and we see the object as red.

ALBEDO is the term that is the fraction or percentage of incoming light that is reflected by an object or surface.

SCATTERING:

Radiation hitting something other than a uniform flat surface is not reflected the same way when it hits atoms and molecules which causes the radiation to be deflected in various directions – i.e. scattered.

Cloud droplets are large enough to scatter light effectively in all wavelengths and hence they appear white.

Molecules and aerosols preferentially scatter light and hence cause the sky to appear blue and sunsets appear red. (At sunset the light travels through more atmosphere and most of the blue light has been scattered away leaving only the red end of the spectrum

RADIATION

Varies by sunlight striking the Earth which is affected by millennia (Milankovitch cycles), time of year (seasons), time of day (daylight, nighttime)

Different parts of the earth are lit differentially with the sun being directly overhead at least 1 day a year anywhere from 23.5 degrees S to 23.5 degrees N

The electromagnetic spectrum goes from long waves to short waves with the waves having more energy as they get shorter.

WAVELENGTHS (see images)

Short wave (more energetic) than long wave (less energetic)

TEMPERATURE AND RADIATION

$E=\sigma T^4$

A small increase in temperature yields a great increase in radiation

Depending on the heat of a body, the area of the spectrum where the majority of the radiation will occur. (See Images for example)

The Sun radiates SHORT wave radiation, the Earth radiates LONG wave

"Visible light" lies between 0.4 and 0.7 μm (μm means micrometer – one millionth of a meter) and the sun emits about 44% if its radiation in this zone with the peak at the blue-green wavelengths. Red light is about .7 μm and is longest of the visible light for us. Beyond that is infra red. Blue green is at the shorter end and beyond that is ultra violet.

UV is dangerous and Weather service has an index to show danger (see images)

“Black bodies” absorb and emit all wavelengths. Earth and Sun act like black bodies. Atmosphere does not so it is “selective” as to what it does and does not absorb. Images shows absorption wavelengths for “greenhouse gases”

Because of the greenhouse gases energy radiating from the Earth is “bounced back” to the Earth thereby heating it. Greenhouse gases are crucial in keeping the Earth warmer. Without those gases the atmospheric temperatures would be about 0 F instead of about 59 F.

If the amount of these gases increases then the overall average Earth temperature would increase (Global warming)

A quick diversion into weather maps to show what kind of fronts there are.

There is more radiation reaching the area around the equator than at the poles. Hence between 38 degrees N and 38 degrees S have a surplus of energy; whereas north and south of that there is a deficit. Hence something needs to move the heat around the Earth. These are ocean and air currents.

Hadley, Ferrel and Polar cells do some of this as do ocean currents like the Gulf stream These are impacted by the Coriolis effect.