Ay 10 - Section Worksheet 3
Some Sun-Earth Connections

The Greenhouse Effect, It's So Hot Right Now

1. In class you heard about the greenhouse effect on Earth (or will soon). Briefly summarize the key steps. Include a diagram.

2. Suppose the Earth's atmosphere were transparent to infrared radiation and opaque to visible radiation (the opposite of the actual situation). Would the surface temperature of this hypothetical Earth be cooler or warmer than our Earth? Explain and include a diagram.

'Tis the Seasons

Let's set the lamp in the middle of the room (or at least near the middle of the room), this will be our Sun. Now let's put the big black globe thing on a different table, this will be the Earth at some point in its orbit. Let's note a few things about our Earth. First, it has awesome sketches of the continents on it thanks to Onsi and Anna. Second, it can rotate around it's axis (the line connecting the North and South Poles). Third, the axis is tilted (23.5 degrees away from straight up and down).

Now we can move the Earth in its orbit around the sun, but we have to be a little bit careful here and follow a couple rules. First, we must keep the Earth in a flat plane called the **ecliptic plane** as it orbits the Sun. This is easy since we can just place the globe on different tables that are all the same height off the ground, thus the Earth stays in the same plane during the entire orbit. Second, the axis of the Earth must remain fixed in space. This just means that the North Pole must always point at the same far away star (or in our case, the same spot on the ceiling, such as right above the big Earth flag) wherever it is in its orbit.

Finally, quickly note that Earth is actually much much farther from the Sun than it is in our setup and that the Sun is much much larger than the Earth (which is not how our setup looks, thus we say it's "not to scale").

Anyway, for each of the following annual occurrences we will first move Earth into the corresponding position in its orbit around the Sun. Next we will draw a diagram of the setup as we observe it from the ecliptic plane (i.e. how does it look when your eyes are in the same plane as the Sun and Earth). We also want to figure out what part(s) of Earth are hottest and coldest and what season it is on different parts of the planet. Finally, we want to think about how long daytime and nighttime lasts on different parts of the planet.

1. The beginning of summer in South Africa
   What annual astronomical event is this?
   Hottest place(s) on Earth:
   Coldest place(s) on Earth:
   Which seasons are where:
   Length of daytime and nighttime in Berkeley:
   Length of daytime and nighttime in Australia:
   Diagram:

2. Around Jeff's birthday (August 1)
   What annual astronomical event is a few weeks before this?
   Hottest place(s) on Earth:
   Coldest place(s) on Earth:
   Which seasons are where:
   Length of daytime and nighttime in Berkeley:
   Length of daytime and nighttime in Australia:
   Diagram:

3. Autumnal Equinox
   Hottest place(s) on Earth:
   Coldest place(s) on Earth:
   Which seasons are where:
   Length of daytime and nighttime in Berkeley:
   Length of daytime and nighttime in Australia:
   Diagram:

4. Using the above observations, why is Alaska nicknamed the Land of the Midnight Sun? Is it **always** Land of the Midnight Sun?

Atmospheric Scattering - Blue Skies Smiling At Me

In class we discussed why the sky is blue and why the sun at sunset is reddish (remember that we used the fact that light is **scattered** by Earth's atmosphere to explain both phenomena). Just to remind ourselves:

1. What color of visible light does the atmosphere scatter the most?
2. What color of visible light does the atmosphere scatter the least?

   This specific type of scattering is sometimes referred to as Rayleigh scattering, named after the British physicist who first discovered it (although you don't have to remember his name). Also, the details of why certain wavelengths of light scatter more than others are unimportant for now.
3. Using Rayleigh scattering, explain why the sky is blue. Include a diagram.

4. Using Rayleigh scattering, explain why the sun at sunet is reddish. Include a diagram.

Milk, It Does a Body Good, Pass It On!

Here we have a clear container full of water and we're going to shine a light through it.

5. What color does the light appear before it enters the container?
6. What color does the light appear after it's gone through (most of) the container?

   Now we'll add a few drops of milk to the water.
7. Now what color does the light appear when the light source is behind the container?
8. Now what color does the light appear when the light source is to the side of the container?

   Now we'll add a bunch of milk to the water.
9. Now what color does the light appear after it's gone through (most of) the container?
10. Finally, use Rayleigh scattering again to explain your observations of the water and milk in the container. Include a diagram.