

**Homework #13**  
**Due in class on December 6, 2011**

Go to: <http://astro.unl.edu/naap/motion3/animations/sunmotions.html>

Familiarize yourself with the “Time and Location Controls” and with the “General Settings”

1. What does the white line represent?
  
2. What does the yellow line represent?

Note that if you click and drag on the frame, you can change your view. Drag it so that you are looking directly down on the observer. This happens when the faint white N/S and E/W lines meet right at his feet.

3. From this view, what does the point where the N/S and E/W lines cross represent? (it has a special name, which we discussed in class)
  
4. Change the observer’s latitude to match ours here in Tucson and run the animation over the course of a whole year (you may wish to play with the animation controls so that you don’t have to watch it run for 20 minutes). Does the sun ever pass through that point for us? If yes, when (what day/time)? If not, when does it get closest?
  
5. Click “trace analemma” and place it (and the sun) on the meridian (the N/S line... do this by setting the time to noon). Change your animation settings to “step by day”. Stop it when the sun is at the top, bottom, and each time it passes the center of the figure eight. What do these points represent (hint: these are the only four days of the year when the sun is directly on the meridian at “noon” clock time)?

Draw an analemma below and label each of the above points with the dates on which they happen, then label the equinoxes and solstices.

6. With the animation still running, drag the latitude south until you reach a point where the sun does touch the point right below the observer's feet (look for the point when the top of the analemma touches it). This latitude marks the tropic of Cancer. What is significant about this number (hint: does the number look familiar/is it close to another significant number for the Earth)?
  
7. The analogous location for the southern hemisphere is the Tropic of Capricorn. What is different about the path that the sun takes through the sky in the "tropics" (between these two) relative to more extreme northern/southern latitudes?
  
8. Where on earth does the sun pass through this point at exactly noon on the equinoxes? Does its location surprise you? If so, where on Earth did you expect it to be?
  
9. At 0 degrees latitude, where does the East-West line cross the analemma at 12 noon on the equinox? Why might this be?
  
10. Is the sun right at the zenith at that time? If no, what time is it at the zenith for each equinox and why do you think there's a discrepancy? (Hint: Think about why the analemma might have the asymmetrical shape that it does. Are there any asymmetries that you can think of in the earth's orbit about the sun?)

*Now change your view of the observer and his horizon so that you're looking at him from the side (you can see the whole stick figure standing upright). Tilt this view just slightly so that you can see the N/S/E/W directions on his horizon.*

11. Move your observer to the North Pole (90 degrees north latitude). Under "Animation Controls" choose "step by day". Under General Settings, deselect "show underside of celestial sphere" but make sure that "show month labels" is selected. Start the animation. If you were to live at the north pole, how long would your days and nights be?
  
12. What is the maximum altitude that the sun reaches in the sky for this observer (It is given in the "information" box. Is this number familiar? What does it correspond to?)
  
13. Stop the animation on the day when the sun reaches the highest point in the sky (Hint: it should be on an equinox). Select "continuous" under "Animation Controls" and replay it. This shows how the sun moves over the course of a day at the North Pole. Describe its motion in the sky over the course of a 24 hour period.
  
14. Extra Credit Option:  
Write down a question of your choice about how the sun moves in the sky and investigate it with the Sun Simulator. Write down your results here.