AST101IN Fall, 2011 Follette Name:___________________________

# Celestial Motions Lab

Part 1: Motion of the Stars

Work with a partner and take turns manning the computer controls for each applet. Take your time with the questions and answer each one thoroughly. You may find it useful to refer back to the position and motion lecture tutorials that we completed in class.

Go to: http://sirius.bu.edu/withers/teaching/as101_summer1_2006/Explore_Celestial_Sphere.swf

Sketch what you see and label what each circle and line represents. What does the bright half of the globe represent? The dark half? (Hint: the answer is not the daytime and nighttime side of Earth!)

Look up the latitude of Tucson and move the slider at the bottom to match it. Sketch the new image that you see on the screen and label the horizon and the celestial equator. Describe how and why the view changed when you did this.

Play around with the sliders for declination and right ascension and the “hide sight line” and “show sight line” buttons and, once you are familiar with the workings of the applet, answer the following questions:

**WARNING:** This applet can lead to some misconceptions so it is important to keep in mind throughout that a star’s right ascension and declination never really change!! In this exercise when you “change” the right ascension of a star, you are really just rotating the earth. In other words, you are causing the star to rise or set. What this applet calls “right ascension” is properly referred to as the “hour angle” of a star, and NOT it’s “right ascension”. Similarly, when you move the “declination” slider, you are really looking at different stars at different declinations, even though the applet shows the same star sliding freely along the celestial sphere.

1. What happens when you hit +90 or -90 degrees declination?

2. If you fix the declination at +90, what happens when you move the right ascension slider (remember that this is equivalent to rotating the earth)?

   What does this spot represent (there’s a special name for it)?

   What might you find here in the “real” sky?

3. Now slide the declination marker back to zero. And click “zoom in”. How does this view differ from the previous one? Sketch it.

4. Click “show graticule” and examine what it reveals. Label the meridian, zenith, and cardinal directions on your sketch from #3.

5. Over how many degrees of "right ascension" is the star visible in the sky at a declination of zero? To find this, slide the right ascension bar all the way to the left and write down the value, then slide it to the right until the "Star not visible" warning pops up and record that value. Subtract the two and you get the number of degrees over which the star is visible. Does your answer make sense? Why or why not?

6. Do the same for a star at + and – 30 , 45 and 60 degrees declination and record the range of visible RAs below.

7. Using your data from 5 and 6, describe the trend in the degrees of RA over which a star is visible as you move North (+ declination) and South (- declination) of 0 degrees declination.

8. Explain the cause of the trend that you recorded in 7 (hint: study the "declination arc" traced out in red/white).

9. Through this entire exercise, you were considering the sky for an observer *in Tucson*. Repeat steps 5 and 6 for an observer at the equator (latitude=0) and the north pole (latitude=90). Does the trend that you recorded in 7 stay the same? In what ways is it similar and different?

10. Find the minimum northern declination for which a star will be circumpolar (will never set below the horizon) for at least 5 different latitudes *in the northern hemisphere* and record your results below.

    Latitude    Minimum Declination for Circumpolar

11. How are the two related and why?

12. Do the same for the maximum southern (negative) declination for which a star will never even pass above the horizon of an observer (will always stay in the dark half of the sphere regardless of it's "RA"). Do this at the same set of northern latitudes you used in 10.

    a. Latitude    Maximum Declination

13. How are these two related?

14. What is the (mathematical) relationship between your answers to #11 and #13? Does this make sense geometrically? Explain.

15. Now let's consider in more detail what the sky would look like for an observer at the North Pole (90 degrees north latitude). If Santa Klaus walked out of his workshop at the north pole and watched the stars move over the course of the night, what would he see?

16. Where is the north star for such an observer?

17. What range of declinations are visible in this sky?

18. What percentage of the total celestial sphere can be seen from the north pole over the course of a night?

19. How would the sky appear and/or move differently for an observer at the <u>south</u> pole?

20. Repeat your study for an observer at the equator (0 degrees latitude). Over what range of declinations can they see stars?

21. What percentage of the celestial sphere is visible to an observer at the equator at any given instant?

    Over the course of a whole night?

22. What do your answers to questions 18 and 21 imply for astronomers wanting to observe certain parts of the celestial sphere?