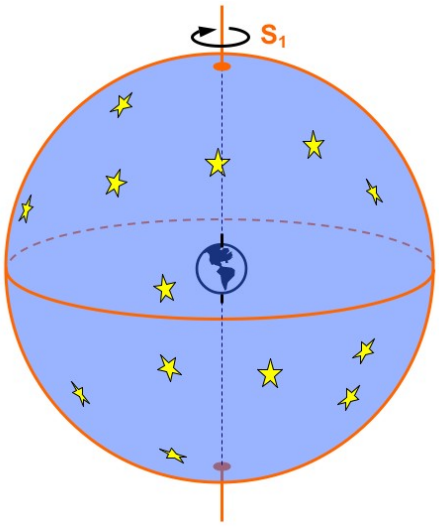
AST 120 Activity 5
The Two Sphere Universe

We have now finished our observations of the stars and sun. We are ready to explore how early astronomers made sense of these observations. What did the Ancient Greeks make of what they saw in the heavens? Actually, different astronomers in Ancient Greece had different theories about what happens in the sky. But by the Fourth Century BC there was a general consensus on at least the broad outlines of a theory. The major components of this theory are two spheres which form the boundaries of the Universe. The inner boundary is provided by the sphere of the Earth, while the outer boundary is provided by the Celestial Sphere. In this activity we will try observe certain consequences of this model, which is illustrated in the diagram below.



1. Go to a computer and run Stellarium.
2. In the Locations window (compass rose on left) set the latitude to "N 90". This takes you to the North Pole.
3. Stop the flow of time (7) and set time to now (8).
4. Turn off the atmosphere (a) and fog (f).
5. Set your view toward the horizon. Increase the flow of time (l) until the motion of the stars is clearly visible. Draw a picture or otherwise describe what you see in the space below.

6. Set your view toward a different point on the horizon and observe the motion of the stars. Draw a picture or otherwise describe what you see in the space below.

7. Set your view toward your zenith and observe the motion of the stars. Draw a picture or otherwise describe what you see in the space below.

8. Turn on the azimuthal grid (z) and then turn on the equatorial grid (e). Observe these two grids as you look toward the zenith. Which coordinate grid moves, and how does it move relative to the other grid?

9. Now turn off the two grids. Are your observations at the North Pole consistent with the predictions of the Two Sphere model? Briefly explain.

10. How would the motion of the stars through the night sky be different if you viewed the sky from the South Pole? Try to predict this based on the Two Sphere model.

11. In the Locations window, set the latitude to "S 90". This takes you to the South Pole. Set your view to the North and observe the motion of the stars. Draw a picture or otherwise describe what you see in the space below.

12. Set your view toward your zenith and observe the motion of the stars. Draw a picture or otherwise describe what you see in the space below.

13. Turn on the azimuthal grid (z) and then turn on the equatorial grid (e). Observe these two grids as you look toward the zenith. Which coordinate grid moves, and how does it move relative to the other grid?

14. Now turn off the two grids. Did your observations from the South Pole match the predictions of the Two Sphere model?

15. Now try to use the Two Sphere model to predict how the stars will appear to move when they are viewed from Earth's equator. Briefly describe the predictions below.

16. In the Locations window set the latitude to "N 0". This takes you to the equator. Set your view to the North and observe the motion of the stars. Draw a picture or otherwise describe what you see in the space below.

17. Set your view toward the East and observe the motion of the stars. Draw a picture or otherwise describe what you see in the space below.

18. Set your view toward the South and observe the motion of the stars. Draw a picture or otherwise describe what you see in the space below.

19. Set your view toward the West and observe the motion of the stars. Draw a picture or otherwise describe what you see in the space below.

20. Turn on the azimuthal grid (z) and then turn on the equatorial grid (e). Observe these two grids as you look toward the zenith. Which coordinate grid moves, and how does it move relative to the other grid?

21. Are your observations from the Equator consistent with the predictions of the Two Sphere model? Briefly Explain.

22. If you have time, download and run the CelestialGlobe program. Try to determine whether or not this program (which is essentially a visual implementation of the Two Sphere model) successfully reproduces all of the observations you made above from the North Pole, the South Pole, and the equator. The key idea here is that at different latitudes on Earth we see different portions of the celestial sphere in our night sky. Explain why this is so using the Two Sphere model (with particular reference to the shape of Earth). (Hint: draw a diagram of the two sphere model and then try to draw the horizon line - the line separating the visible and invisible parts of the celestial sphere - for observers at different latitudes.)