

Lab #5b: Orientation with SkyGazer (Jan-Feb)

Computer software can be great help in finding objects, stars, constellations, and even planets in the sky. It is called “planetarium software” because it presents on the screen something remotely resembling the artificial sky of a planetarium. You can simulate the sky at any time, from any location on Earth, and switch interesting and uninteresting objects on and off at will. In this laboratory you’ll get familiar with the menus and options in one of these programs (called SkyGazer), and, on the way, you will learn about the names, the brightness and colors of stars, in addition to finding constellations and planets.

This piece of software comes with the textbook (if you bought it new), and you may install it on your computer without a fee. Your instructor may arrange to lend you an installation CD if you request it.

The computers in the lab are all Macintosh, and those of you only familiar with Windows machines should be prepared for minor differences. The first point of difference you will see is that the SkyGazer application does not quit if you close its window. If you find your computer in that state, double-clicking of your setting file will still start up the program the same way as it would in Windows.

In case the lecture has not yet covered the concepts of magnitudes, right ascension and declination, equator and ecliptic, ask your lab instructor to give an introduction.

PROCEDURE AND LAB REPORT

Date: _____ Your name: _____ Partner’s name: _____ Section: ____/____

Maximum two students may work together as partners!

1. **Start up SkyGazer** (quit it first if it is running!) by double clicking on the setup file *Orientation.vgr*, located in the *AstroLabs/AstroDocuments* folder.

2. On the time panel click *Now*. Then drag the hand of the clock to 10 pm. Many stars show up, colored, and it is very hard to make sense of them now.

3. Use the sliding tabs in the bottom and on the right to turn towards North and experiment with looking high up or lower down. Stop in direction of North. Use the pop-up compass if you need to. Straight North, not very high over the horizon, you’ll find the North Star (Polaris). Click on it. The data panel pops up. Find out the North Star’s data: it is in the constellation of _____, and it is a ____ magnitude star, ____ light years away from us. Center it by clicking *Center*. Compare it to a few other stars: is it the brightest star in the sky? ____.

4. On the display panel, switch on the constellations (click on ). The contours of some constellations pop up. Find the familiar shapes of the Big Dipper and the Little Dipper. In which one of these is Polaris? _____



5. Switch on the constellation figures (click on). You'll see that the Dippers are actually bears, and Draco (which is a kite rather than a dragon) is between them.

Now turn South again. Drag the hand on the clock until the bright constellation of Orion is not far from South. (This will happen at different hours in the night depending on the season.)

Find, Canis Maior, and Taurus. Find the names of the two brightest stars in Orion, and also the brightest star in the sky, located in Canis Maior, and read off their data:

α Orionis is named _____, _____ light years away, _____ magnitudes;
spectral type _____, color _____;
 β Orionis is named _____, _____ light years away, _____ magnitudes;
spectral type _____, color _____;
 α Canis Maioris is named _____, _____ light years away, _____ magnitudes;
spectral type _____, color _____;
the brightest of these is _____ with _____ magnitudes; its magnitude is the _____est number.

6. Look straight up into Zenith, and find the Twins, the star Capella, and the Seven Sisters.

Find these stars and read off their data:

α Geminorum is named _____, _____ light years away, _____ magnitudes;
spectral type _____, color _____;
 β Geminorum is named _____, _____ light years away, _____ magnitudes;
spectral type _____, color _____;
 α Aurigae is named _____, _____ light years away, _____ magnitudes;
spectral type _____, color _____.



Now switch on the constellation boundaries .

The Seven Sisters, officially named the Pleiades, are within the constellation of _____.

7. Now switch off the constellation figures, and switch on the Milky Way (click on). Follow it from horizon to horizon, and write down which constellations it crosses in the sky (list only the ones that are visible at 9 pm tonight). Notice that the names of small constellations show up only if you zoom in (use to zoom): _____

_____.

8. Now look at Polaris again, set the time skip to *1 min*, and *start* the clock. You will see that the sky revolves around Polaris as time passes. What is special about the daily motion of Polaris? _____.

9. Look South, set the clock to *9 pm tonight*, and *zoom* to a 120° view. Turn on the ecliptic and the equator by clicking on . The ecliptic (the path the _____ travels once a _____) is the _____ line, the equator is the _____ line. (Fill in the colors.) Find all the planets that are up. They are all located close to the _____. Give the name of each, then their magnitude in parentheses together with words “bright” or “faint” like *Sun* (-26.3^m , *very bright*):

_____.

10. Set the clock to now. Give the name of two conspicuous constellations that are high up in the South *now*: _____ and _____.

11. Find a planet that is *not up now*: _____. Click View→Center Planet→(Your planet); do not use the Sky Atlas mode.  on the planet, then drag the clock and watch at what time it rises. To observe a planet conveniently it needs to be at least 25° over the horizon (i.e. its altitude on the data panel must be at least 25°). You find that your planet is observable only after from _____ to _____. (Give the hours; use common sense in judging when the planet is actually observable!) Drag the clock further to find out when your planet is best observable; that is, when it is highest over the horizon. This occurs at _____ o'clock, and at that time your planet is in the _____ (fill in the cardinal direction). Today, your planet is as bright as _____ magnitudes, which means, in words, _____. It is located in the constellation of _____. Is it close to the ecliptic? _____.

12. Find the Moon. The Moon is _____ days old today, it is in the constellation of _____, and it rises at _____ and sets at _____. Is it close to the ecliptic? _____.

13. Use Right Ascension (α) and Declination (δ) to locate objects in the sky. Astronomers use these coordinates to communicate positions in the sky; they work in the sky like geographical latitude and longitude work on the terrestrial globe. Open (double-click) the settings file called *EquatorialGrid.vgr*. In these settings the equatorial (α - δ) coordinate grid has been turned on. The concentric circles are like geographical latitude lines, the angle on them is declination (e.g. $\delta=50^\circ$ declination); the radial lines are like geographical longitude lines, except that the readings on them are in hours (e.g. $\alpha=10^h$ right ascension). Use the coordinate grid to

locate the star at right ascension $\alpha = 5^{\text{h}}17^{\text{m}}$, declination $\delta = 46^{\circ}00'$. Click on it; what is the star's name? _____. Now turn the clock an hour or two worth. You'll notice that the coordinate grid turns with the stars. So, how do your star's coordinates change over time? _____. Use the *grid* to read off Polaris' coordinates: right ascension $\alpha =$ _____, declination $\delta =$ _____.

Next find the objects:

1. at $\alpha = 3^{\text{h}}47^{\text{m}}$, $\delta = 24^{\circ}07'$: _____, in the constellation of _____.
2. at $\alpha = 6^{\text{h}}45^{\text{m}}$, $\delta = -16^{\circ}43'$: _____, in the constellation of _____.

14. The Epoch. Find out what is at the origin of the coordinates, i.e. at $\alpha = 0^{\text{h}}00^{\text{m}}$, $\delta = 0^{\circ}00'$. To do this, navigate to the area and click the closest star you can find; **Center** it and zoom on it down to a 5° view. Notice that the $\alpha = 0^{\text{h}}00^{\text{m}}$, $\delta = 0^{\circ}00'$ point, which is also called the *vernal equinox*, is the intersection of two lines that you have already met in this lab: the _____ and the _____.

That is where the Sun is in the sky at the start of spring (March 21).

Now change to **Star Atlas** view (in the bottom left) and **Lock** on the star. Click the advance button  on the time panel to jump one year ahead each time. You'll notice that the vernal equinox actually moves over the years (this is due to *precession*, the change in the direction of the axis of Earth, mainly caused by the gravity of the Moon). By jumping 10 years' worth (go from 2000 to 2010), you can read off from the data panel how much the right ascension changes in 10 years. You find _____ seconds per 10 years. For precisely telling the coordinates of a star (important not to confuse one faint star with another), you must tell the *epoch* (the year to which the coordinates refer). For example, if your star is HD 2 in Pisces, its coordinates are $\alpha = 0^{\text{h}}05^{\text{m}}03^{\text{s}}$, $\delta = -0^{\circ}30'$ (2000.0) but $\alpha = 0^{\text{h}}05^{\text{m}}36^{\text{s}}$, $\delta = -0^{\circ}27'$ (2010.0). The difference is 33^{s} and $3'$, which in arc minutes is $8'$ by $3'$. In an area of that size, even far from the Milky Way's band, there are 13 stars of 14^{mg} or brighter (visible in an amateur telescope) to mix them up. When you 'buy' a star and the "respectable seller" does not give you an epoch, you are scammed: you won't ever know which star you have 'bought'.

15. Quit SkyGazer by clicking -Q, then restart your computer.