Lab #5c: Orientation with SkyGazer (May-June)

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, viewed 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 you will learn, on the way, about the names, the brightness and color of stars, and how to find 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 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 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*, switch off *Auto*, 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 shape 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.

Find Leo; then starting with the broken handle of the Big Dipper, continued in an arc, find Boötes (the Herdsman) and Virgo. Find the names of the brightest stars in these constellations, and read off their data:

α Leonis is named___________, ____ light years away, ___ magnitudes; spectral type ____, color ____;

α Boötis is named___________, ____ light years away, ___ magnitudes; spectral type ____, color ____;

α Virginis is named ______, ____light years away, ___magnitudes; spectral type____, color ____;

the brightest of these is _________ with ___ magnitudes; its magnitude is the ____est number.

The sky at this time has few bright stars and the Milky Way is hidden: it follows the horizon. For this reason, grab the handles of the clock and turn them to 3:00 am.

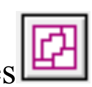
6. Look high up towards Zenith and find the constellations of the Lyre (Lyra) and the Swan (Cygnus). Find the two brightest stars of the Swan and the brightest of Cygnus. (Vega, Deneb and Altair form the Summer Triangle.)

Find these stars and read off their data:

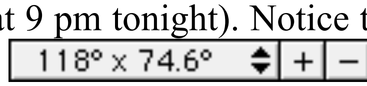
α Cygni is named___________, ____ light years away, ___ magnitudes; spectral type ____, color ____;

β Cygni is named___________, ____ light years away, ___ magnitudes; spectral type ____, color ____;

α Lyrae is named ______________, ____ light years away, ___ magnitudes; spectral type ____, color ____.

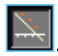
Now switch on the constellation boundaries .

Pluto is presently in 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^{mg}, 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. Lock 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 from ____ to ___. (Give the hours; use common sense use common sense in judging when the planet is actually observable!) Drag the clock farther 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. δ=50º 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 $\alpha = 5^h 17^m$, declination $\delta = 46^o00'$. Click on it; what is the star's name? __________. Now turn the clock an hour or two forward. 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 α =_____, declination δ =______.

Next find the objects:

1. at $\alpha = 3^h 47^m$, $\delta = 24^o07'$:______________, in the constellation of _______________.
2. at $\alpha = 6^h 45^m$, $\delta = -16^o43'$:______________, in the constellation of _______________.

14. The Epoch. Find out what is at the origin of the coordinates, i.e. at $\alpha = 0^h 00^m$, $\delta = 0^o00'$. To do this, navigate to the area and click the closest star you can find; **Center** it and zoom in on it down to a 5º view. Notice that the $\alpha = 0^h 00^m$, $\delta = 0^o00'$ 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 $\alpha = 0^h 05^m 03^s$, $\delta = -0^o30'$ (2000.0) but $\alpha = 0^h 05^m 36^s$, $\delta = -0^o27'$ (2010.0). The difference is $\Delta\alpha = 33^s$ and $\Delta\delta = 3'$, which in arc minutes is $\Delta\alpha = 8'$ and $\Delta\delta = 3'$. In an area of that size, even far from the Milky Way's band, there are, on average, 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, and then restart your computer.