Introduction to Astronomy	**Laboratory Exercise #1**
Name _____	Date _____
Partners _____	Section _____

Intro to the Sky

Purpose:
To develop familiarity with the daytime and nighttime sky through the use of Stellarium.

Equipment:
Computer Stellarium Software

Stellarium

Ephemeris tables list the locations of celestial bodies for regular time intervals. With the advent of the personal computer, software for locating the positions of the planets became quite common. The program Stellarium is an advanced version of stellar navigation software. It not only displays the location of the stars in the sky from any location on earth at any time, but it also simulates the motion of the planets, asteroids, comets, etc. You can also change your vantage point to any moon and planet in the solar system.

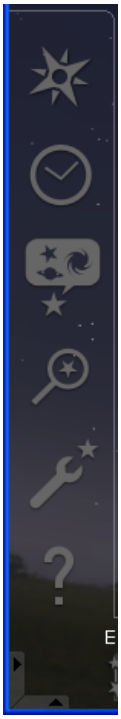
Stellarium is an open source software project located at http://stellarium.org/. Executable programs are available for Linux, Mac and Windows systems. For this execise it will be assumed that the software is already present on your system. If this is not true, go to the Stellarium web site and download the appropriate program and follow the installation instructions.

Basic Navigation

Once Stellarium is started, the program has a *main window* and two *popup palettes*. By default the observer's location is on the earth at the present time. If it is daytime, you will see blue skies and not any stars. During the night time you will see stars, planets and other astronomical objects with names of the most significant objects. To navigate around the sky hold the mouse button down and drag the cursor. This can also be accomplished by using the *arrow keys*. Simultaneously pushing the *arrow keys* and the *shift key*, will move the cursor at a slower rate. If the *control key* and the *up arrow* are pushed, the program will zoom in on the center of the screen. The *Control key* and the *down arrow* will zoom out.

Left clicking the cursor will result in the nearest celestial object being selected. Its statistics will appear in the upper left corner of the screen. The most significant information for our purpose is the relative magnitude (how bright is appears in the sky), the spectral type and the distance in light years for stars and AUs for objects within the solar system. *Right clicking* will unselect the object and remove the information.

Change Settings



When the cursor is placed over the left side of the main window a *Settings Palette* will appear as illustrated to the right. This palette contains six icons with associated accelerator keys. Going from top to bottom the options are *Change Location[F6]*, *Change Date/Time[F5]*, *Viewing Options[F4]*, *Search [F3]*, *Configuration [F2]* and *Help [F1]*. The popup palette will disappear once the cursor is moved away from the left side of the window. If you want the palette to remain on, click the right pointing arrow at the bottom left of the palette.

Begin by setting your default location to Dayton, OH. To do this click on the *Change Location* icon. A location dialog box will appear with a map of the earth. You can click on the appropriate location on the map or select Dayton USA from the scroll box to the right. To dismiss the location dialog box, click on the 'X' in the upper right corner. If you have a daytime sky, you should change the time to 9:00 PM or later. Click on the *Change Date/Time* icon and change the time. Notice the time is given in military time (0-24 hr). The sky will change as you change the time or the date. To dismiss the dialog box click on the upper right corner.

The *Viewing Options* brings up a dialog box with four tabs. The first is the most important and lets you change how the sky and labels appear on the screen. The *Search* icon is useful. With its dialog box you can type any star or planet name and it will be centered on the screen. The *Configuration* icon gives you access to more advanced options and the *Help* icon gives a summary of the accelerator keys for the different options available through Stellarium.

The *Control Palette* illustrated above appear when the cursor is placed over the bottom of the window. It can be locked on by clicking on the upward pointing arrow in the bottom left corner. The controls contained in this palette give access to the most common options available in Stellarium.

The controls are grouped into common function and will be described going from left to right. The first group toggles constellation lines, labels and pictures on and off.

The second group toggles an equatorial and azimuthal grid on and off. An equatorial grid is a projection of our earth's latitude and longitude outward into space. The azimuthal grid divides the sky up with vertical and horizontal lines. The vertical lines are labeled in degrees and go from 0^O for north, 90^O for east, 180^O for south and 270^O for west. The horizontal lines begin with 0^O at the horizon and 90^O straight overhead (azimuth). The third group turns the horizon, cardinal points (N, E, S, W) and atmosphere on and off. The fourth group controls nebula and planet labels.

The fifth group are controls that are useful when doing a night time observation. The first icon switches perspective between an equatorial and azimuthal mounted telescope. The second moves the selected object to the center of the screen and keeps it there. The third toggles between a color display and a night mode (red), which does not interfere with your night vision. The last icon switches between a windowed and a full screen version of the program.

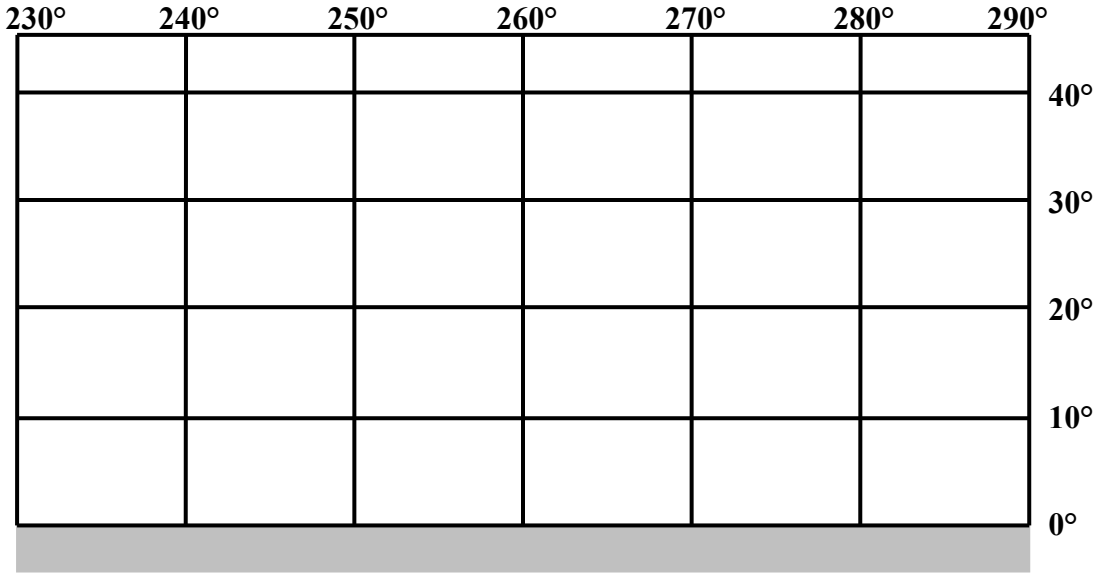
The last group allows you to speed up and slow down the time clock. The double arrows to the left cause time to run backwards. Clicking on this icon multiple times will speed up the progress of time. The single arrow to the right resets the timer to progress at a normal rate. The arrows pointed together reset the clock to the present time. The double arrows to the right cause time to procede in the forward direction at increasing rates. The final icon exits the program Stellarium.

Exercises:

I. The Setting Sun

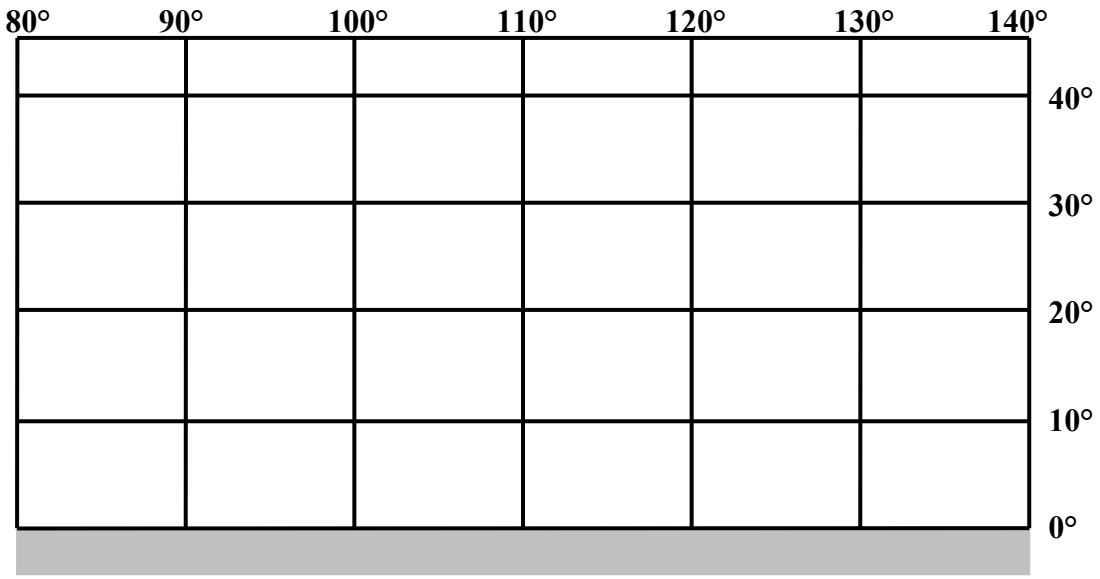
With the location set for Dayton and the time set to the current day, increment the time until the sun is just setting. Orient the view so you are facing west. As the sun sets the landscape will become darker. However, it is hard to determine the exact time of sunset because the of the scenery. To avoid this problem, change the scenery to ocean by clicking on the *Viewing Option* icon and the *Landscape* tab. Now adjust the time until the top of the sun is just below the horizon. Turn on the azimuthal grid so you can determine the location of the setting sun.

On the diagram given below, draw the location of the setting sun and write down the date and the time. Now increment the date by 14 days. Notice that the sun is already below the horizon. Adjust the time until the sun is just setting. Again, record the location, the date, and time of the setting sun on the diagram given below. Repeat this process until you reach the end of December.



II. Mean Solar Day

The mean solar day is the average time it takes the earth to rotate on its axis with respect to the sun. Because the earth is orbiting the sun as it rotates, there is a slight difference between the mean solar day and the time between sunsets on subsequent days. This difference changes as the year progresses. To see this effect change your view so you are facing to the southeast. Next change the date to today and the time to 10:00 AM. The azimuthal grid should still be turned on. On the diagram given below plot the location of the sun and label the date for 14 day increments. *Do not make any adjustment in seconds*. You want to see the difference in the length of days. The figure you generate is call the *analemma*. (Note: If you change the date using the Date/Time dialog box, the sun will suddenly shift positions two times during the year. This corresponds to the change in daylight savings time. To avoid this problem use the following two accelerator keys. **]** (right square bracket) will increment the time by one solar week and **[** (left square bracket) will decrement the time by one solar week. Stellarium does not take Daylight Savings time into account when using these controls.)



III. The Evening Sky

Go to the current date and change the time so that the sun has set by 1 hour. At this time only the brightest objects in the sky are visible. If you see a black sky, you either have the wrong time or you do not have the atmosphere turned on. To turn the atmosphere on, select the cloudy icon on the bottom palette.

There should be a number of stars visible in the sky at this time, but five will be brighter than the others. In the table provided below, record the names of the stars, their magnitude, their constellation, and their distance from earth. This information can be obtained by left clicking on the star. The top line is the star's name, the second line is the star's magnitude, the second to last line is the distance between the earth and this star. The constellation is a three letter abbreviation in paraenthesis after the star's name. To

make identifying the constellation easier, turn on the constellation names using the icon on the bottom palette. If there are any planets visible, record them at the end of this table.

Stars:

Name	Magnitude	Constellation	Distance

Planets:

Name	Magnitude	Constellation	Distance

The ecliptic is the path the sun takes across the sky over the course of a year. This option can be turned on inside the *Viewing Options* icon and the *Markings* tab. The shortcut accelerator is the *comma* character *[,]*. Using the night sky, which you are currently viewing, write down the names of the constellations through which the ecliptic passes.

Ecliptic Constellations: _____
_____
_____
_____
_____

IV. From the Earth to the Moon

The next thing I want you to do is visit the moon. Select the *Location* icon and choose the moon from the drop down menu in the bottom right. Next select a location in the middle of picture representing the moon's surface. Dismiss the *Location* dialog box and you should be on the moon's surface. Your scenery will still be the earth, but the location should be correct. If you positioned yourself correctly, the earth should be directly overhead. Click on the earth and select the centering icon on the bottom palette. This will keep the earth at the center of the screen. Now increase the time rate until you see the earth align in the same direction as the sun. Stop the timer and record the date. You will notice that this side of the earth is completely in shadow. For someone on earth below you, it is night and they will be looking at a full moon. Now increase the time rate and observe the earth. You will notice that it goes through phases. Wait until the earth is opposite of the sun and is fully lit. This corresponds to the moon being aligned with the sun from the earth's perspective. This position corresponds to new moon. Record this

date. Now run time forward until the earth blocks out the sun. This corresponds to a lunar eclipse from the earth's perspective. Record this date.
*What is the date for the next full moon?*_____

*What is the date for the next new moon?*_____

*What is the date for the lunar eclipse?*_____

Now turn on the costellation lines and labels and find Orion. The two main stars for this constellation are Betelgeuse and Rigel. Click on each of these stars and record their spectral type. Also record the color the stars appear to be.

Betelgeuse Spectral Type _____ Color _____

Rigel Spectral Type _____ Color _____

V. Titan

Now change your location to Titan, which is one of Saturn's moons. Select a region on the map that is to the left and middle side of the image. This will place Saturn directly overhead. If the planet labels are turned on, the name of Saturn and some of its moons will be displayed. Record the names of the five moons that are labeled. Run the clock forward and determine the time for one of Saturn's moons to make an orbit from Titan's perspective. One orbit will be completed when the moon returns to its original position. (The actual orbital period is different than this because Titan is also orbiting Saturn at the same time.) Having the azimuthal grid on is useful because it provides reference points.

Saturn's Moons
Name _____ Orbit Period_____

Name _____

Name _____

Name _____

Name _____