Name: ________________________________

Astro 101 – Lab #2

Lab objectives

1) Learn about how the Sun's path, through the sky, changes with the changing seasons.
2) Learn about how the Sun's path changes while viewing it at different locations on the Earth.
3) Learn about the orbit of the Moon and how it relates to the month.
4) Learn about the motion of the Sun and the planets while viewing them on the Moon.

Setup

This lab will be performed in the Stellarium (version 0.10.2 or newer) planetarium program. You can access the Stellarium Planetarium program on specific computers at the following computer labs

- OC Bremerton: ST 122 Computers: 1-4
- OC Poulsbo: OCP 106 Computers: 11-13
- OC Shelton: OCS PA2 Computers: 1-2

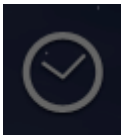
or you can download a free copy at http://www.stellarium.org/. Instructions for installing the program and system requirements can be found in the user's guide.

1) Path of the Sun during different seasons

Start up the Stellarium program.
If you do not remember how to use the user interface, please refer to Lab#1 or the user's guide.

Set Location:
Click on the *Compass icon* on the ***Left***-*Toolbar* to bring up the *Location pop-up window*.
Type *Seattle* in the search window and then click on the Seattle option.

Click on the ✕ to close the *Location pop-up window*.



Click on the *Clock icon* on the ***Left**-Toolbar* to bring up the *Date and Time popup window*.

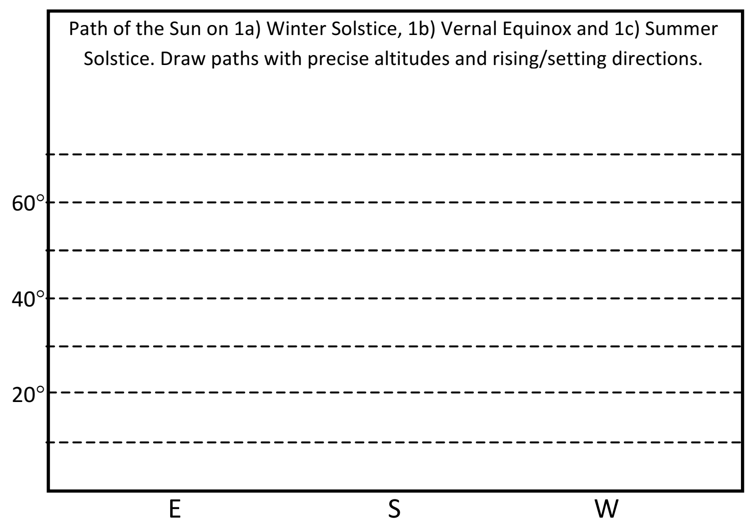
The year, month, day, hour, minutes and seconds can be modified by typing in new values, by clicking the up and down arrows, and by using the mouse wheel.

1a) Set the date to the **Winter Solstice (12/21)**.

- Advance time to record when Sunrise and Sunset occurred. Fill in the times in the table below. (Hint: *Zoom in* on the Sun to reduce the glare and use the **horizon** to determine sunrise/sunset times)
- Calculate the amount of daylight and fill in the table (round to the closest hour or half-hour).
- Measure the highest altitude that the Sun reached on this day (Hint: it is not always at noon). Move the cursor over the Sun and *left-click* to bring up information about the Sun. Altitude (Alt) is given in degree° arcminute' arcsecond" (1° = 60', 1' = 60"). Record the Altitude in the table (round to the closest degree). *Right-click* on the mouse to remove the information.
- Calculate the highest Altitude that the Sun will reach on the Winter Solstice from the equations given in class (use **47.5°N** as the Latitude of Seattle). Fill in the answer in the table (do not round off).
- In the box, draw the Sun's path, through the sky, from Sunrise to Sunset (draw the Sun's path with the correct **altitude**, and with precise rising and setting **directions**).

1b) Repeat the 5 steps in (1a) for the **Vernal Equinox (3/20)**

1c) Repeat the 5 steps in (1a) for the **Summer Solstice (6/21)**



	Sunrise	Sunset	Daylight	Measured Altitude of Sun	Calculated Altitude of Sun
Winter Solstice					
Vernal Equinox					
Summer Solstice					

1d) How well does the Measured Altitude of the Sun compare with the Calculated Altitude of the Sun?

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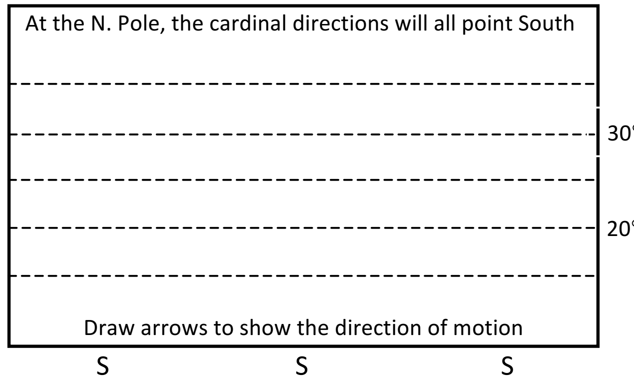
2) Path of the Sun on different latitudes on Earth

Set Location:
Click on the *Compass icon* on the ***Left**-Toolbar* to bring up the *Location pop-up window*.

2a) At the **North Pole** on the **Summer Solstice (6/21)**

- Change the Latitude to: **N 90°** and press enter. (Do not change Longitude. The landscape will not change, so it will not look like the North Pole.)
- In the box, draw the Sun's path, through the sky, on the **Summer Solstice**.
- Draw arrows to indication the direction of motion.

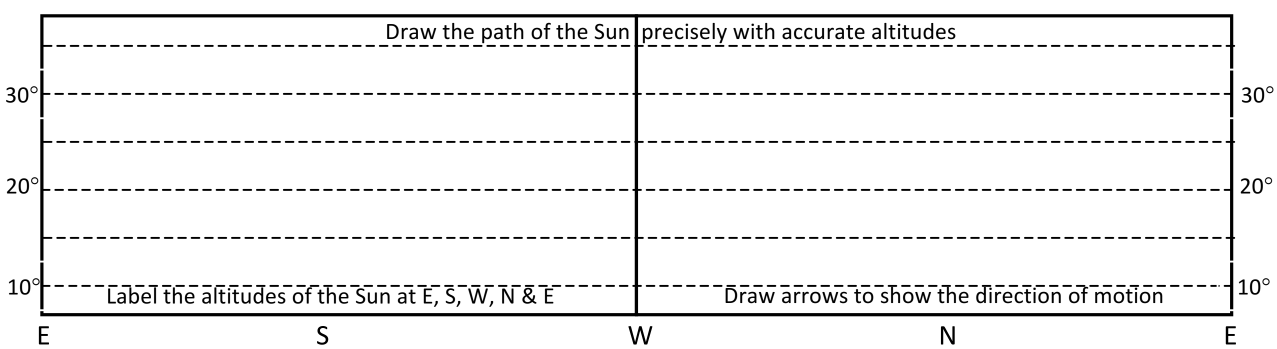


2b) At the North Pole on the Summer Solstice, measure the highest ***Altitude*** that the Sun will reach on this day: __________________

2c) Calculate the highest ***Altitude*** that the Sun will reach from the equations: _________________

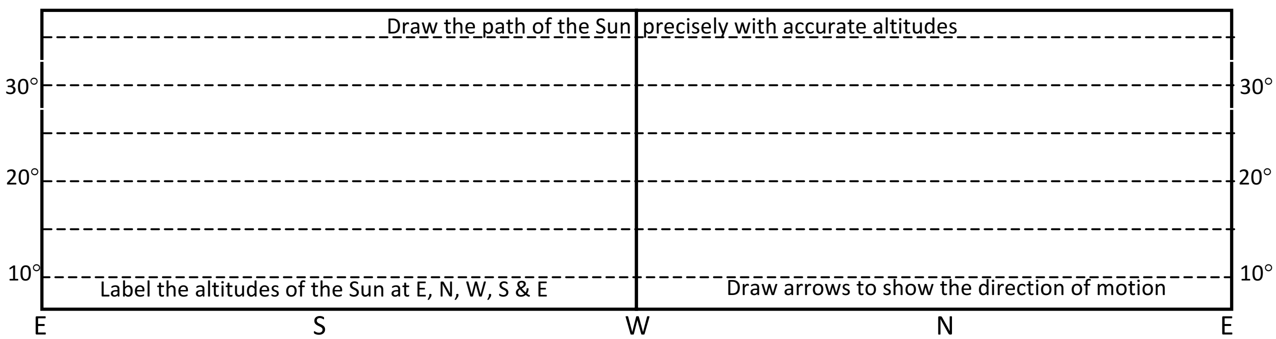
2d) In the **Arctic Circle** on the **Summer Solstice (6/21)**

- Change the Latitude to: **N 80°** and press enter. (Do not change the Longitude. The landscape will not change, so it will not look like the Arctic.)
- Observe the Sun's path, through the sky, on the **Summer Solstice** (over a 24 hour period). *Left-click* on the Sun and then click on the *Center on selected object icon*  on the *Main-Toolbar* to follow the movement of the Sun across the sky.
- In the box below, draw the path of the Sun from East – South – West – North – East.
- Label the **altitudes** of the Sun (in degrees) when it is pointed East, South, West, North & East.
- Draw arrows to indicate the direction of the Sun's motion. You can toggle on the *Azimuthal Grid*  to better see the changing Altitudes.



2e) In the **Antarctic Circle** (in the southern hemisphere) on the **Winter Solstice (12/21)**

- Change the Latitude to: **S 80°** and press enter.
  (Do not change the Longitude. The landscape will not change, so it will not look like the Antarctic.)
- Observe the Sun's path, through the sky, on the **Winter Solstice** (over a 24 hour period).
- In the box below, draw the path of the Sun from East – North – West – South – East.
- Label the **altitudes** of the Sun (in degrees) when it is pointed East, North, West, South & East.
- Draw arrows to indicate the direction of the Sun's motion.



2f) On the **Vernal Equinox (3/20)**, which **directions (N-E-S-W)** does the Sun **rise:** ______ and **set**: ______
(Hint: Use the **horizon** to best determine the rising and setting directions of the Sun)

2g) Compare the path of the Sun in the **Arctic Circle** (2d) and in the **Antarctic Circle** (2e).

Describe two similarities: ____

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Describe two differences: ____

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3) Motion of the Moon and the Month

Click on the *Compass icon* on the ***Left***-*Toolbar* to bring up the *Location pop-up window*.
Set the Location to: **Seattle**

Click on the *Clock icon* on the ***Left***-*Toolbar* to bring up the *Date and Time popup window*.
Set the Date and Time to: **2010-09-01 00:00:00**

3a) Which constellation is the Moon in: ________________________________

3b) How long does it take the Moon to complete one full orbit around the Earth:
__________days and ________ hours (round to the closest hour)
(Hint: *Left-click* on the Moon and then click on the *Center on selected object icon* on the *Main-Toolbar* to follow the movement of the Moon across the sky. Use the nearby stars in the constellation as points of reference. Toggle off the *Atmosphere* and Toggle off the *Ground.*)
(Hint 2: The answer is not about 1 day – that is the Earth's rotation around its axis.)

3c) Set the Date and Time to: **2010-01-14 23:37:00**
Zoom in on the Sun to where you have a 2° FOV (field of view).
Toggle off the *Atmosphere* and toggle off the *Ground*.

What type of event is this (***be very specific***): _____________________________ (make sure you ***Zoom in!***)

3d) What is the lunar phase: _________________ (make sure you are viewing the moon and not the sun)

3e) Roughly, about how long will it take the Moon to return to the same lunar phase: ___________days

3f) Explain why there is a difference between the orbital period of the Moon (3b) and the time to complete one lunar phase cycle (3e): ____

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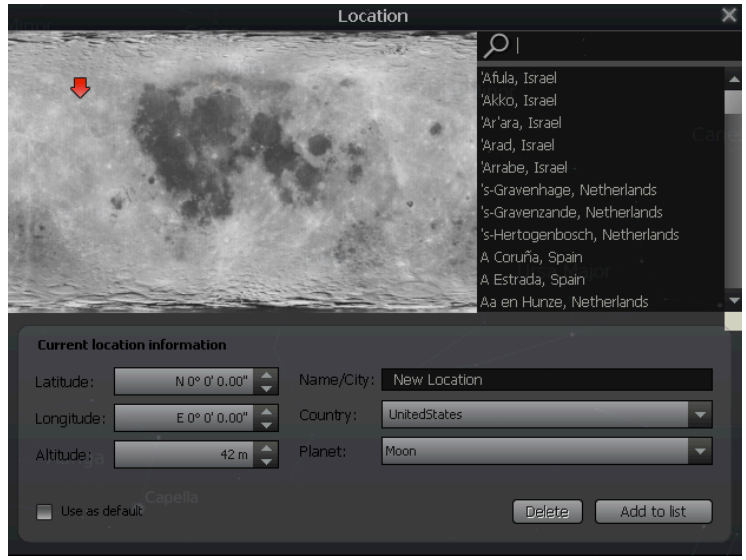
(Hint: What must the Moon be nearly realigned with to complete a full orbit around the Earth? What must the Moon be nearly realigned with to complete a full lunar phase cycle? Why is there a time difference, of over 2 days, between these two events?)

4) Trip to the Moon

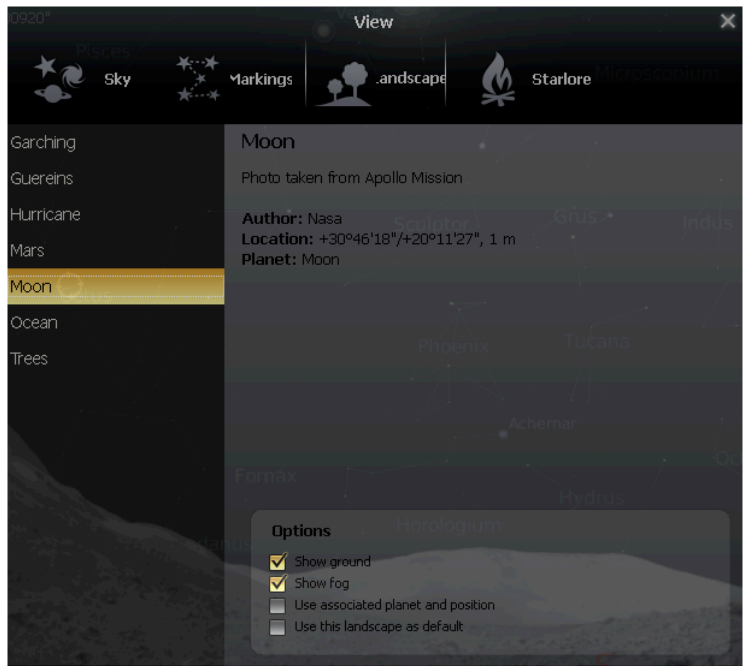


- Click on the *Compass icon* on the ***Left***-*Toolbar* to bring up the *Location pop-up window*.
- Set the Planet to: **Moon**
- Change the Latitude to: **N 0°** and press enter.
- Change the Longitude to: **E 0°** and press enter.

- Set the Date to: **2010-01-01**

- Toggle on the *Ground* (the landscape will not change, so it will not look like the Moon).

- To change the landscape click on the *Sky Viewing Options icon* on the ***Left***-*Toolbar* to bring up the *View pop-up window*.



- Next, click on the *Landscape* option on the top bar of the *View pop-up window*.

- Then click on the *Moon* option on the left. Now you appear to be on the Moon.

- Take a look around.

4a) Roughly, about how long is one full ***Lunar Day*** on the Moon: __________ Earth days
(Hint: measure the length of time beginning from Sun***rise*** and ending with Sun***rise*** the next Lunar day)

4b) The length of the ***Lunar Day*** is similar to the length of the: ____________________________________
(Hint: The answer is not one month)

4c) Find the Earth and advance time to see the motion of the Earth, Sun, planets and constellations over the course of one Lunar day. What is odd about the ***motion*** (not rotation or phase) of the Earth in comparison to the ***motion*** of the Sun, planets and constellations? Explain why this is happening:

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