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 0.16.1 or newer) planetarium program. You can access the Stellarium Planetarium program on specific computers at the following computer labs

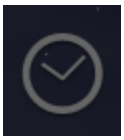
- OC Bremerton: ST 122 Computers: 1-4 and 41-50
- OC Poulsbo: OCP 106 Computers: 11-13
- OC Shelton: OCS PA2 Computers: 13-14

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*.

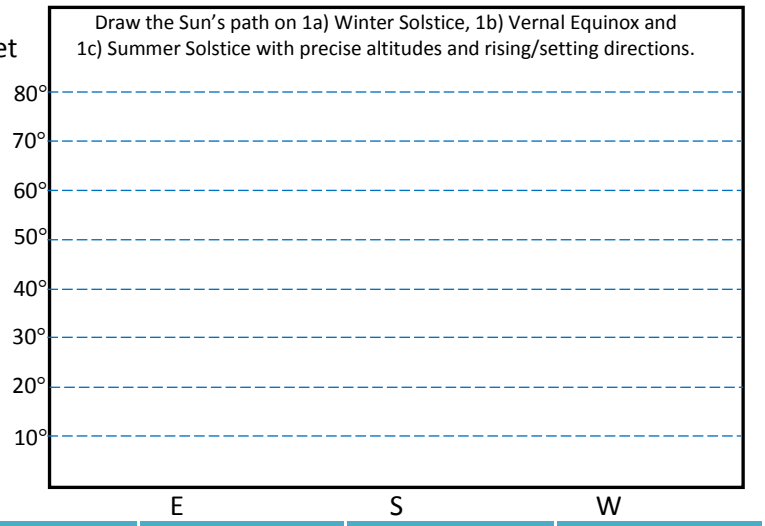


Click on the *Clock icon* on the ***Left**-Toolbar* to bring up the *Date and Time popup window*.

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 the Sunrise and Sunset times in the table below with 24-hour time. (Hint: *Zoom in* on the Sun to reduce the glare & use the **horizon** to best determine the sunrise/sunset times)
- Calculate the amount of daylight (***round*** to the closest hour or half-hour).
- Measure the highest altitude that the Sun will attain 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. Look for the *Az/Alt* line. The first set of numbers is the *Az*(Azimuth*)* and the second set of numbers is the *Alt*(Altitude) of the Sun 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 (24h time)	Sunset (24h time)	Daylight (round off)	Measured Altitude of Sun (round off)	Calculated Altitude of Sun (don't round)
Winter Solstice					
Vernal Equinox					
Summer Solstice					

Use Seattle Lat=47.5°N

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

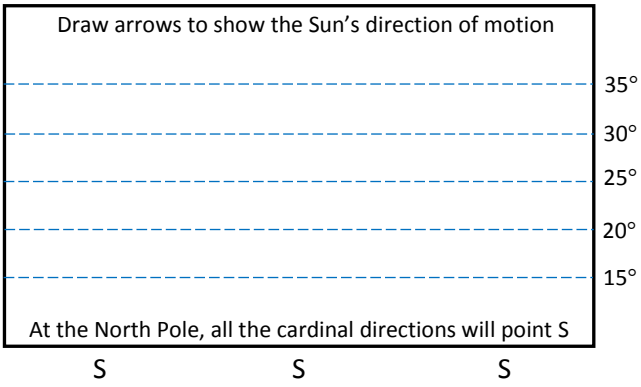
_____

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)**

- Set Latitude to: **N 90**° (type **+**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 Sun's direction of motion.

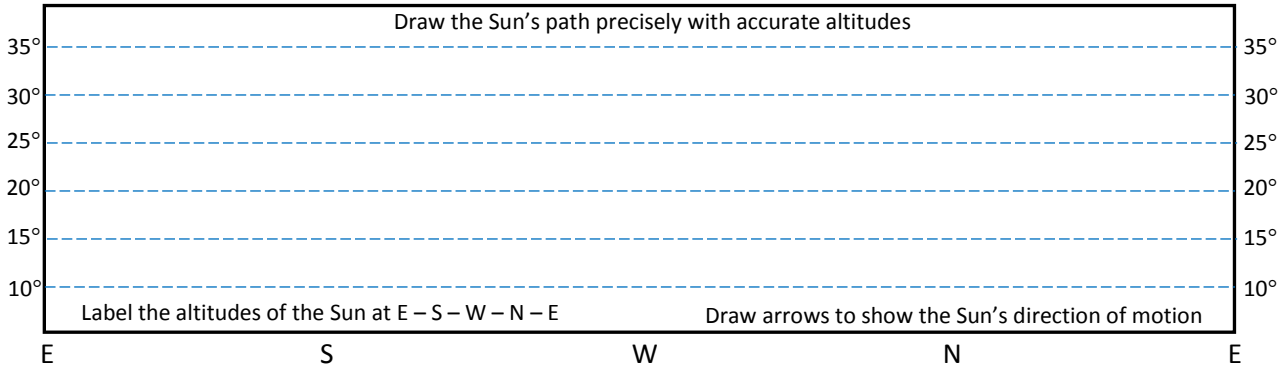


2b) At the North Pole, on the Summer Solstice,
the highest measured ***Altitude*** that the Sun will attain is _____

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

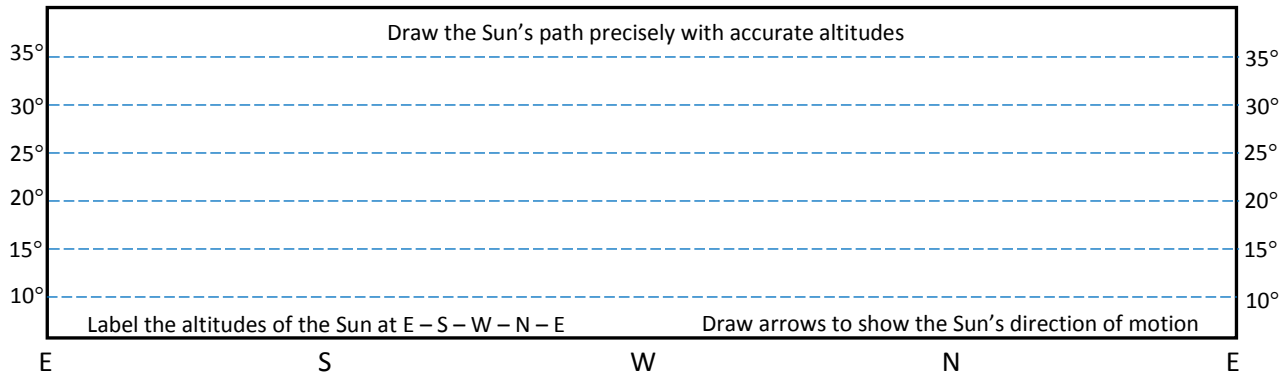
2d) In the **Arctic Circle** on the **Summer Solstice (6/21)**

- Set the Latitude to: **N 80**° (type **+**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, over a 24 hour period on the **Summer Solstice**.
  Left-click on the Sun and then click on the *Center on selected object icon*  on the M*ain-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 **E – S – W – N – E**.
- 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)**

- Set the Latitude to: **S 80°** (type -80 and press enter).
- 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 **E – S – W – N – E**.
- Draw arrows to indicate the direction of the Sun's motion.



2f) On the **Vernal Equinox (3/20)**, the Sun ***rises*** in the direction: _____

and the Sun ***sets*** in the direction: _____

(Hint: Use the **horizon** or 0° Altitude to best determine the rising and setting directions of the Sun)

2g) Compare the two ***paths*** 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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2h) Explain the phrase "land of the midnight sun" including when and where this event is visible:

_____

_____

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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) The Moon is in the constellation: _____

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.)

Set the Location to: **Salem, Oregon**

- Set the Date and Time to: **2017-8-21 10:13:30**
- Locate the Sun and *zoom in* to where you have a 20° FOV (field of view).
- Toggle *on* the *Atmosphere* and Toggle *on* the *Ground*.
- Advance time slowly to witness what happens over the next 10 minutes.

3c) What type of event is this (***be very specific***): _____ _____ _____

3d) What is visible during this event that was not visible before or after the event? List 3 types of things including solar features: _____

3e) What is the lunar phase: _____ (Hint: *zoom in* to a 1° FOV to clearly see the phase)

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

3g) 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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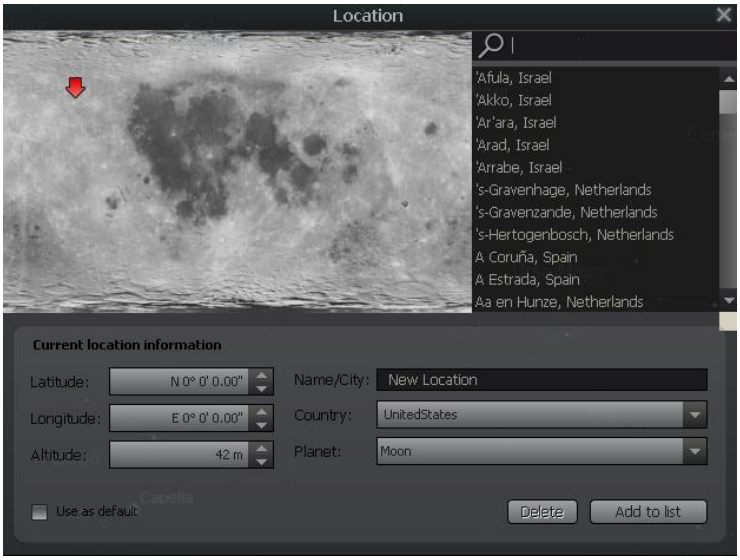
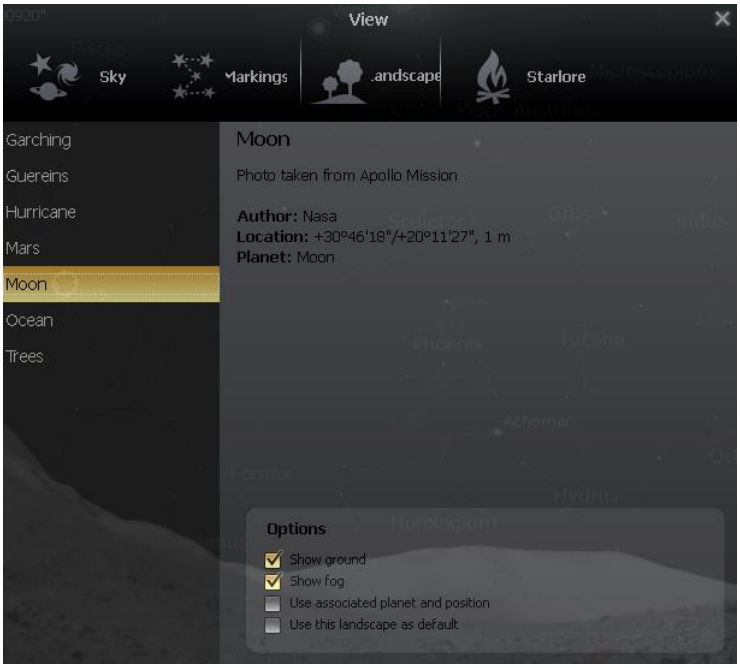
(Hint: What must the Moon be nearly realigned with to complete a full orbit around the Earth? What two objects must the Moon be realigned with to complete a full lunar phase cycle? Explain why is there a time difference, of over 2 days, between these two events? Refer to the textbook for help.)

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: **2018-01-01**
- 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) One full ***Lunar Day*** on the Moon is roughly about _____ Earth days (Earth day = 24h)

(Hint: Advance time to sun***rise*** on the Moon. Use the lunar horizon as the reference point. 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. Look over part 3.)

4c) Find the Earth and advance time to see the motions 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 ***motions*** of the Sun, planets and constellations? Explain why this is happening.

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