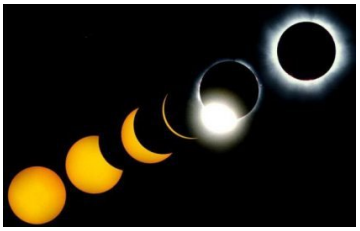
Name: _____
Partner(s): _____
1101 or 3310: _____
Desk # _____
Date: _____



Eclipses

Purpose

- Describe the orbit of the Moon.
- Explain the differences between the types of solar eclipses.
- Explain the differences between the types of lunar eclipses.

Equipment

- Starry Night College
- Assorted spheres
- Flashlight or other light source
- Cardboard paper
- Scissors

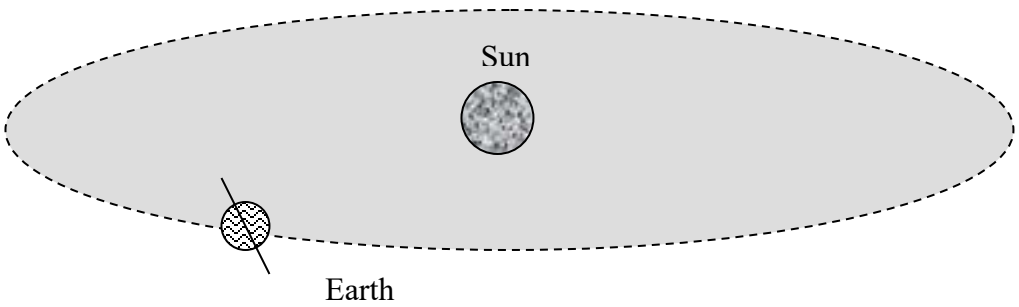
Question 1: Orbit of the Moon. Search Earth, click the "Center" button and check the "Orbit Mode" at the left bottom corner. Zoom out to see all the orbits of planets and moon. Uncheck "Show Planets" under Solar System in Settings. Show the Ecliptic.

Search Moon and click the "Center" button to track the Moon to draw its orbit. Play time with a step of 1 hour.

a) What is the maximum angular distance between the Moon and the ecliptic?

b) How often does the Moon cross the ecliptic?

c) Nodes are the two diametrically opposite points at which the orbit of the Moon intersects the ecliptic. Draw the orbit of the Moon and its nodes:

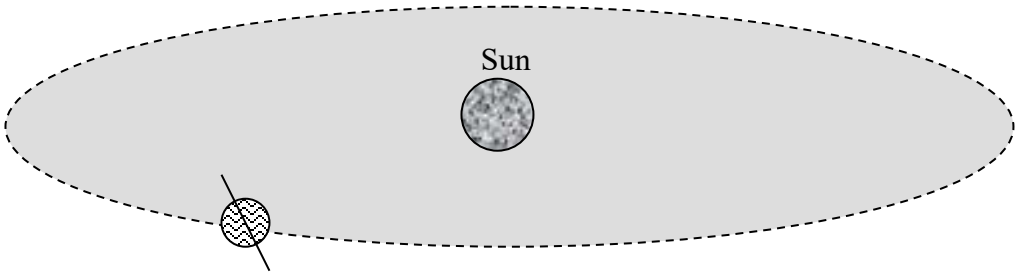


Question 2: The **Saros cycle** can be used to predict eclipses. One Saros after an eclipse, the Sun, Earth, and Moon return to approximately the same relative geometry, and a nearly identical eclipse will occur.
Press the "Home" button. Show the Moon's orbit (under Settings → Solar System → Orbits) and the ecliptic. Start with a time step of 10 sidereal days. Observe carefully the drift of one of the two nodes and measure the duration of the Saros cycle which is the time it takes that node to return to the same position in the sky (relative to the stars). Remember that there are two nodes 180° away from each other and you are only tracking one.
Record the day you started your observation and the day the node returned to the same position. Subtract those two dates and give you answer in number of years and months (e.g. 17 years and 4 months).

Question 3: Solar Eclipses. Set the date to August 1st, 2008. Go to 75°N and 59°E on the Earth around 12:00 noon. Play time with a step of 1 minute. Observe what is happening to the Sun.

a) At what exact time does the solar eclipse reach totality at that location? Round off to the nearest minute.

b) On the diagram below, draw the position of the Earth, Sun and Moon during a total solar eclipse.



c) To watch the solar eclipse from the Moon, set your viewing location to be the Moon on August 1st, 2008 around the time when solar eclipse reach totality. Play time with a step of 1 minute. *What do you see moving on the surface of the Earth?* You may have to zoom into the surface of the Earth. The zone of total darkness, the umbra, is the tiny dot at the centre of the large penumbra.
(You can find another example of solar eclipse at SKYGUIDE > UNIT A: Earth, Moon and Sun > A12: Lunar and solar eclipse > 7: Solar eclipse seen from the Sun.)

d) Could everybody on Earth see that solar eclipse? Explain.

e) Draw a diagram of the Sun's rays reaching the earth during a solar eclipse. Keep in mind that each point of the Sun emits rays in all directions.

f) How long did people at 75°N and 59°E on the Earth spent in the umbra (i.e. in total darkness)? Round off to the nearest second.

Question 4: An interesting coincidence. Use the clock hanging on the wall to symbolize the Sun. Cut a disk of paper with the proper diameter so that when you extend your arm, you can hide the clock with the disk. This disk symbolizes the Moon.

a) What is the ratio between the diameter of the clock and the diameter of the paper disk?

b) What is the ratio between the eye-to-clock distance and the eye-to-disk distance?

c) Conclude from (a) and (b).

d) Using the data table below, calculate the ratio of the diameter of the Sun to the diameter of the Moon.

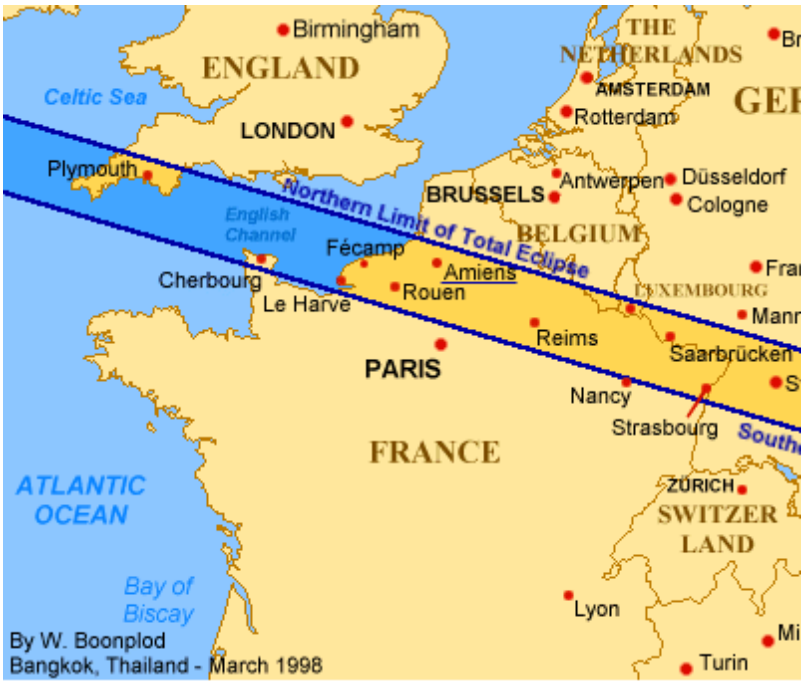
	Sun	**Moon**
Diameter	1.4 million km	3474 km
Distance to the Earth	149 598 000 km	385000 km

e) What is the ratio of the Earth-to-Sun distance over the Earth-to-Moon distance?

f) As seen from the Earth, what is the angular diameter of the Moon compared to the angular diameter of the Sun? Comment based on the values you found in (d) and (e).

Question 5: The map on the right shows the **band of totality** of the 1999 solar eclipse from where the eclipse appeared total.

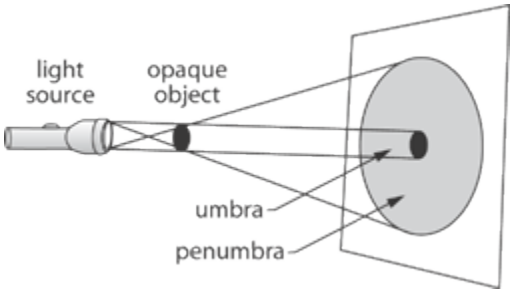
a) Give the name of two places in France where you could have travelled to see the eclipse if the weather was good.



b) What do people standing on the edge of the band of totality see of a total eclipse? Hint: Use the paper disk and the clock.

Question 6: Umbra and penumbra.

a) On the following diagram, what symbolizes the Sun, the Moon and the Earth?



b) Indicate on the diagram where you should stand on the cardboard to see a partial solar eclipse.

Question 7: Annular eclipse. Ask somebody to hold the paper disk in front of the clock further away from you than your arm can reach.

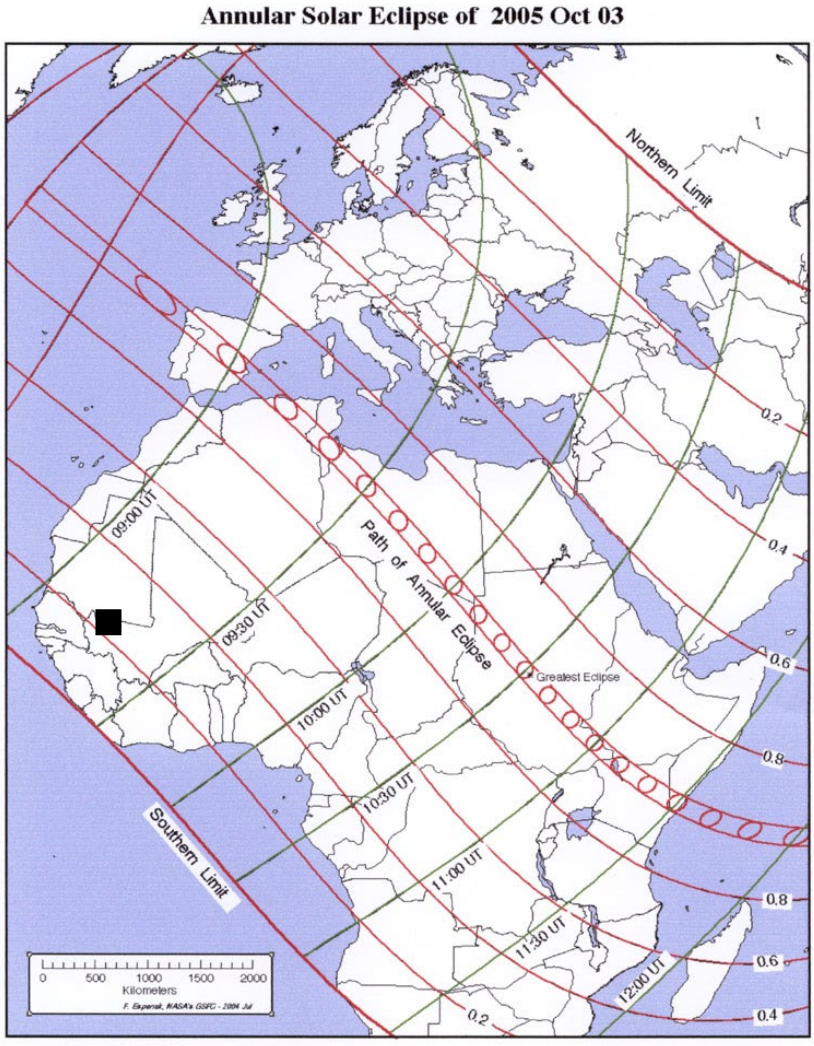
a) Draw what you would see of the clock.

b) Use the software to check if the angular size (or apparent diameter) of the Moon is constant as seen from the Earth. The angular diameter is given in the "Show Info" (Right click on Moon). What are the maximum and minimum values that you observe?

c) Explain what an annular eclipse is.

Question 8: Partial solar eclipse.

a) Think of a configuration where the solar eclipse is partial for everyone who sees it from Earth. Hint: use the paper disk and clock. Answer with a diagram.



b) The above image is a map of the 2005 solar eclipse. Draw what people living in the black square saw of this eclipse at its maximum.

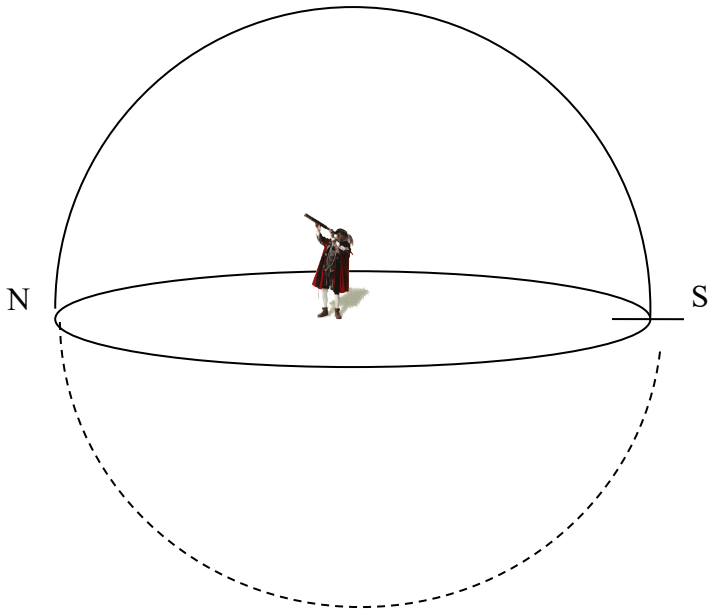
Question 9: Lunar Eclipse. Go to Vancouver on May 26th 2002, at 2:42 am solar time (no Daylight Saving Time). Remove the horizon and Center on the Moon. Play time with a step of 1 min.

a) Is that a partial or total lunar eclipse?

b) Whose shadow is crossing the disk of the Moon?

c) What are the local coordinates (Altitude and Azimuth) of the Moon and the local coordinates of the Sun during this eclipse (at 4:00am)?

d) Using the information in (c), draw the position of the Moon and the Sun in the sky of Vancouver on 5/26/2002.



e) Use a flashlight and two objects to symbolize the Sun, Moon and Earth and try to reproduce the eclipse of the Moon. Draw a diagram of the Sun, Earth and Moon that explains a lunar eclipse (both total and partial eclipse). Include a drawing of the umbra and penumbra of the Earth.

f) What do you see during a total lunar eclipse from the near side of the Moon?

g) What do you see during a total lunar eclipse from the far side of the Moon?

Conclusion: Write a 3 to 5-line (complete sentences) conclusion about this lab.