

Activity 3: Observing the Moon

Print Name:

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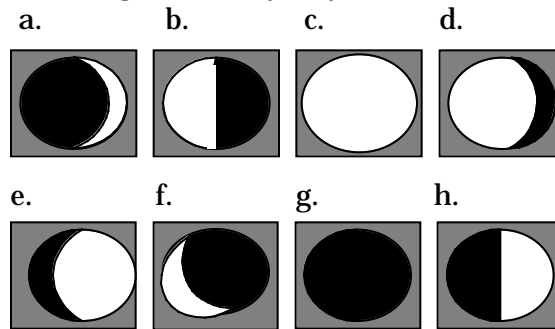
4.) _____

Activity:

Since the dawn of time, our closest neighbor the moon has fascinated humans. In this activity we will explore the phases of the moon. As we have discussed in class, the phases of the Moon are caused by the angle between the Sun, Moon and Earth. By understanding this relationship, one can determine a model for the phases of the Moon. By the end of the activity, you should be able to do the following by simply observing the moon: name the phase, determine if it is waxing or waning, predict what the moon will look like at a later time and date, determine the time of observation, as well as determine the geometry of the Earth, Sun and Moon necessary to produce the phase.

Part 1: Observing the Moon from Earth:

Throughout the month, the Moon appears to change its appearance. Ancient civilizations used the Moon's cycle as the basis for their calendars. If you were to observe the moon, through out its cycle you would observe the following phases.



Of course these are not arranged in the correct order.

Complete Part 1 without consulting your textbook. The purpose of this portion is to get you thinking about the phases of the moon, not simply looking up the answers. If you get caught using your textbook, one point will be deducted from your grade on this activity.

1) **What do you think? What is the correct order of these Phases?**

Any Answer Acceptable

2) *What do you think?* Why did you order the phases in the way that you did?

Any Answer Acceptable

3) *What do you think?* After you have observed the phases, attempt to label the different phases.

Astronomers use the following terms to describe the shape of the moon.

New - Completely Dark

Crescent - Small amount present

Gibbous - Large amount Present

Full - Completely Full

Quarter - Half of the Moon Lit

In addition, Astronomers use the following terms to describe if the Moon is getting larger or smaller.

Waxing - Getting Larger

Waning - Getting Smaller

Moon	Phase Label	Moon	Phase Label
A.	Any Answer Acceptable	E.	Any Answer Acceptable
B.	Any Answer Acceptable	F.	Any Answer Acceptable
C.	Any Answer Acceptable	G.	Any Answer Acceptable
D.	Any Answer Acceptable	H.	Any Answer Acceptable

4) Your instructor will now give you a Moon Phase Poster to determine what the correct order of phases. How do your predictions (From Questions 1 and 3) compare to the actual results?

An easy way to remember if a moon is waxing or waning, is to look at its shape. If the Moon appears to form a "D" it is waxing, while if it appears to form a "C" it is waning.

5) *What do you think?* What do you believe causes the Moon to change its shape?

Any Answer Acceptable

6) *What do you think?* The moon orbits around the Earth, what direction does the Moon orbit the Earth?

Any Answer Acceptable

7) *What do you think?* How long does it take the Moon to orbit the Earth?

Any Answer Acceptable

Part 2: Observing the Moon, Earth and Sun from Above

To better understand lunar phases, one must be able to switch between two different views of the Earth-Moon-Sun system. The first view is a geocentric horizon view, while the second view is a solar system view. The *geocentric* perspective is the view from Earth looking up into the southern sky. The *Solar system* perspective is the view of the Solar System looking down from above.

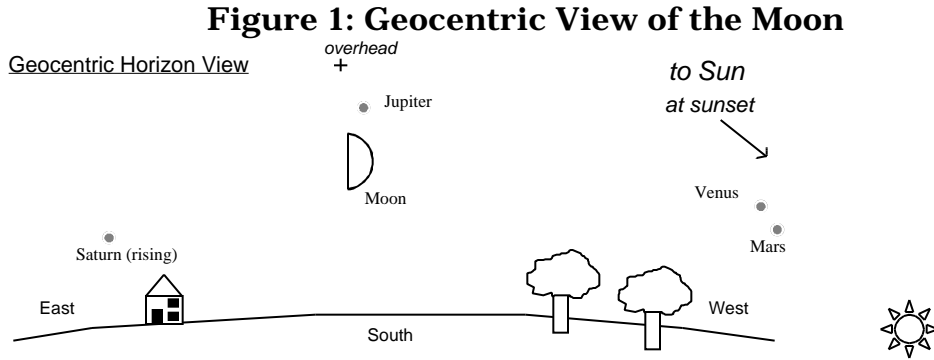


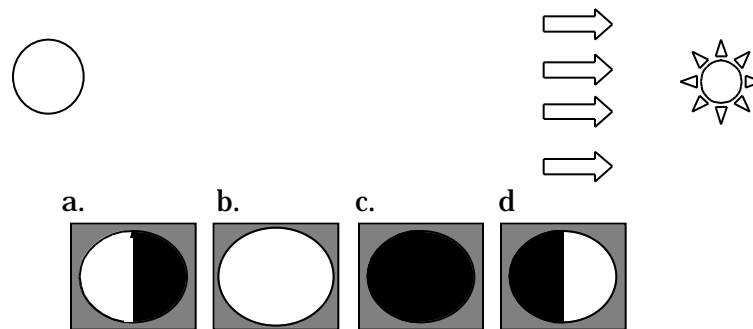
Figure 2: Solar System Perspective Not Drawn to scale!



- 8) Using Figures 1 and 2, measure the angles between the Earth, Moon and Sun. How does the angle between the Earth, Moon and Sun compare for the two different views? To measure the angle on a geocentric view, measure the angle between the meridian and the Sun.

The angles in each representation are 90° . The angles are the same.

- 9) *What do you think?* On the below Solar System view, place a moon where the Moon needs to be to produce the following different observed phases. Label the positions with the appropriate letters.



10) *What do you think? Why did you place the phases where you did on the above chart? Discuss your reasoning.*

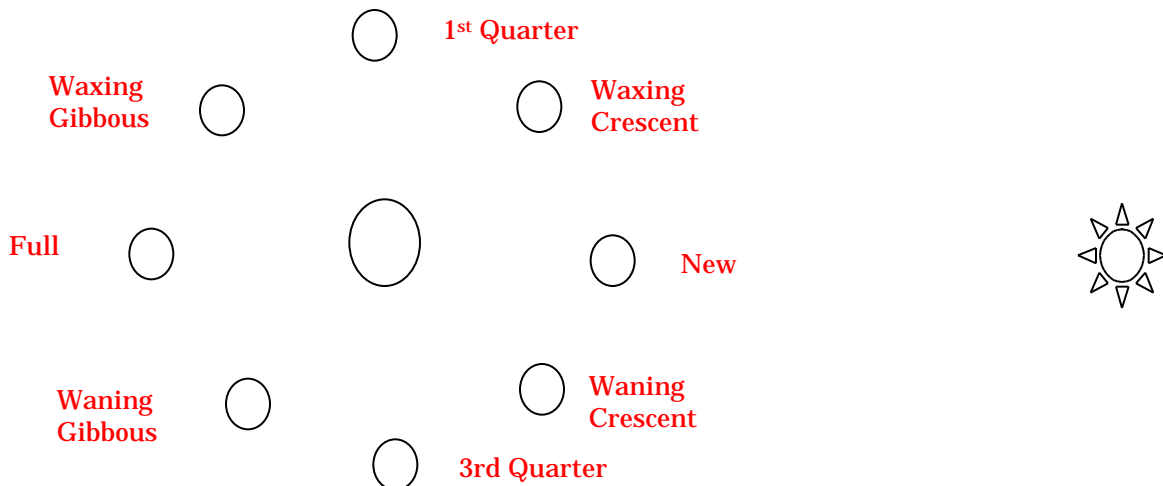
Any Answer Acceptable

In this section, you will convert Geocentric observations of different phases of the Moon to a Solar System view. You will do this by calculating the angle between the Moon, the Earth and the Sun.

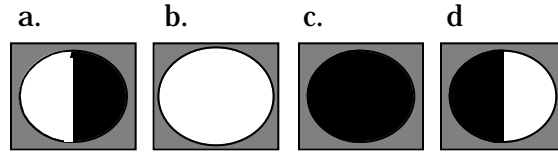
11) For each of the different geocentric views of the Moon in Figure 3, measure the angle between the Moon, Earth and the Sun. Figure 3 is located at the back of this handout. To do this draw straight lines from each the Sun and the Moon to the Southern horizon. Use your protractor to measure this angle. Record your measured angles below.

Day	Phase	Angle
1	New	0°
3	Waxing Crescent	~45°
7	1 st Quarter	90°
10	Waxing Gibbous	~ 135°
14	Full	180°
17	Waning Gibbous	~225°
21	3 rd Quarter	270°
28	Waning Crescent	~315°

12) Using your measurement of the Moon in question 13, determine which position of the Moon in the diagram below corresponds to each phase. To do this convert your Geocentric observations to a Solar System view, remembering how the angles relate between Geocentric and Solar System views correspond. Label each lunar phase in the diagram below.



13) Where are the following moons located? How does this compare to your answers to question 9? Discuss possible reasons for differences.



14) What direction does the Moon orbit the Earth? How do you know?

The moon orbits the Earth in a Counter-Clockwise direction. You know that the cycle of phases follows a certain order. By studying the positions of these different shaped moons, the moon must orbit in a counter clockwise direction.

15) How long does it take the Moon to orbit the Earth? How do you know?

Over the course of one revolution around the Earth the Moon goes through a complete cycle of phases. Therefore, the time to complete the phases is equal to the orbital period of the Moon, or 28 days.

Part 3: Determining the Time of Moonrise and Moonset

One of the goals of understanding the phases of the moon is to be able to tell the time of observation from the observed phase of the Moon and the location of the Moon in the Sky. You should already have some understanding of telling time observation from you work with the Sun and converting between Geocentric and Solar System views in Activity 1.

16) For the following Solar System view of the Earth, Moon and sun, calculate the time that the Moon will rise, cross the meridian and set. You might find it helpful to draw an imaginary figure on your Earth.



Rise: NOON Cross Meridian: 6 PM Set: Midnight

17) Using the diagram for question #12, fill in the following table with the times of Moonrise, Moon crosses the meridian and the Moonset for the various lunar phases. Consider that the Sun rises at 6:00 AM, the Sun crosses the meridian at noon, and the Sun sets at 6:00 PM.

Day	Phase	Moonrise	Moon Meridian	Moonset
1	New	6 AM	Noon	6 PM
3	Waxing Crescent	9 AM	3 PM	9 PM
7	1 st Quarter	Noon	6 PM	Midnight
10	Waxing Gibbous	3 PM	9 PM	3 AM
14	Full	6 PM	Midnight	6 AM
17	Waning Gibbous	9 PM	3 AM	9 AM
21	3 rd Quarter	Midnight	6 AM	Noon
24	Waning Crescent	3 AM	9 AM	3 PM

18) Based on your observations in question 17, how does the time of Moonrise change over the course of the Month?

The Moon rises later and later each day of the month.

19) Based on your observations in question 17, how does the time of Moonset change over the course of the Month?

The Moon sets later and later each day of the month.

20) Based on your observations in question 17, on average how long does the Moon lag behind the Sun each day? (Hint: Consider the time it takes to complete a cycle of phases and the total time the Moon lags behind the Sun.)

Approximately 1 hour a day. Over the course of 28 days it lags behind a full 24 hours, so it lags 0.86 hour (51.42 minutes) behind the Sun.

21) A *Solar Eclipse* occurs when the Moon blocks out the Sun. Based on your observations, what phase must the moon have for this to occur?

The Moon must be at the New Phase, because the moon would be in between the Earth and the Sun.

Figure 3a: Day 1 – New Moon

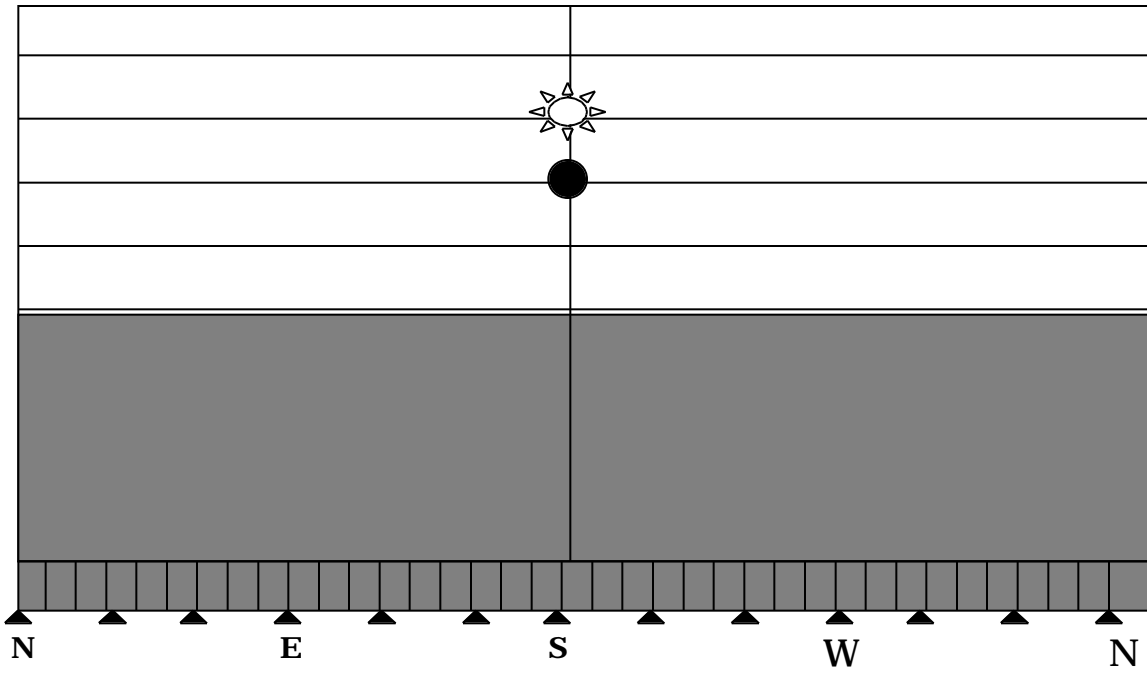


Figure 3b: Day 3 – Waxing Crescent

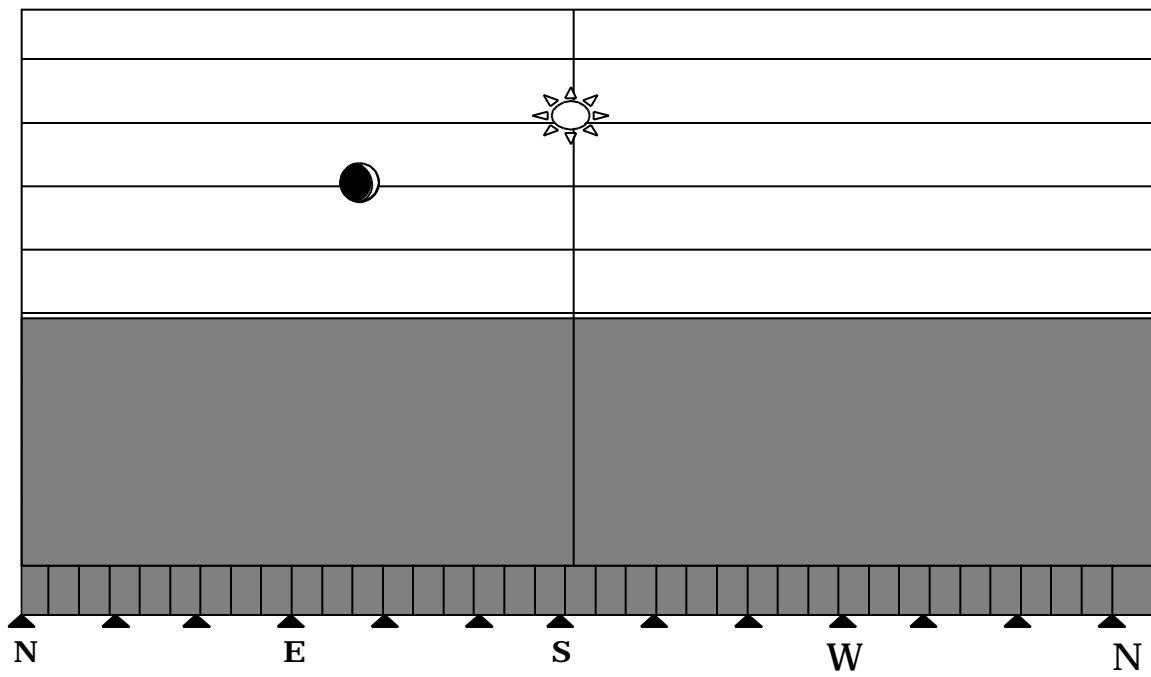


Figure 3c: Day 7 – 1st Quarter

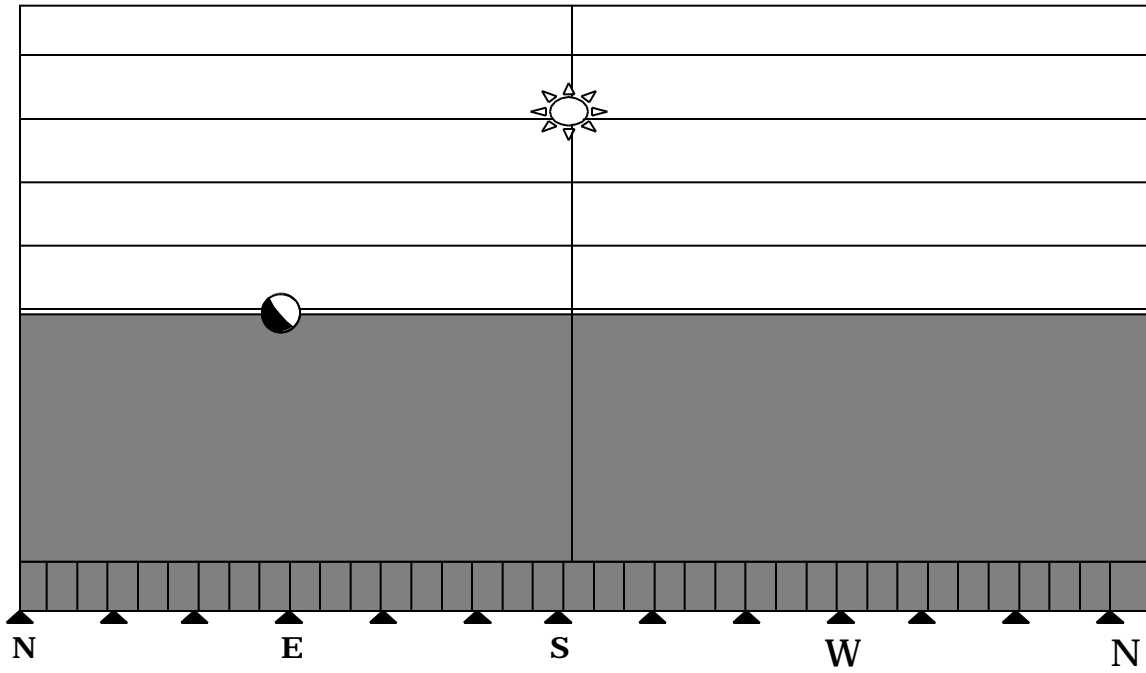


Figure 3d: Day 10 – Waxing Gibbous

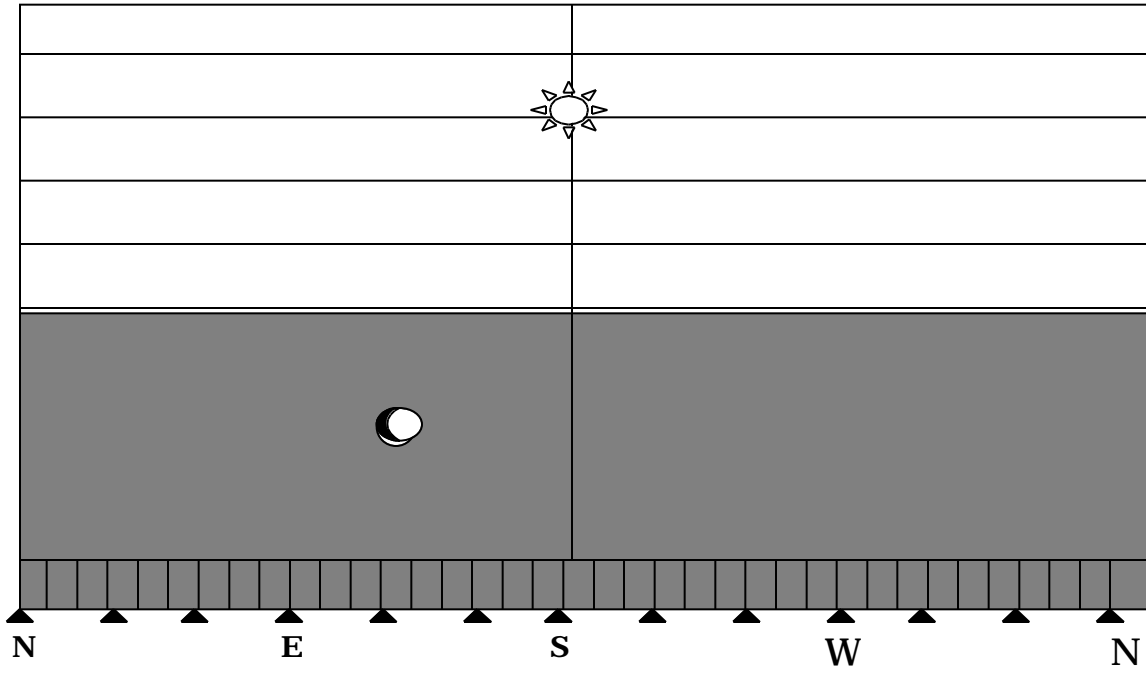


Figure 3e: Day 14 – Full Moon

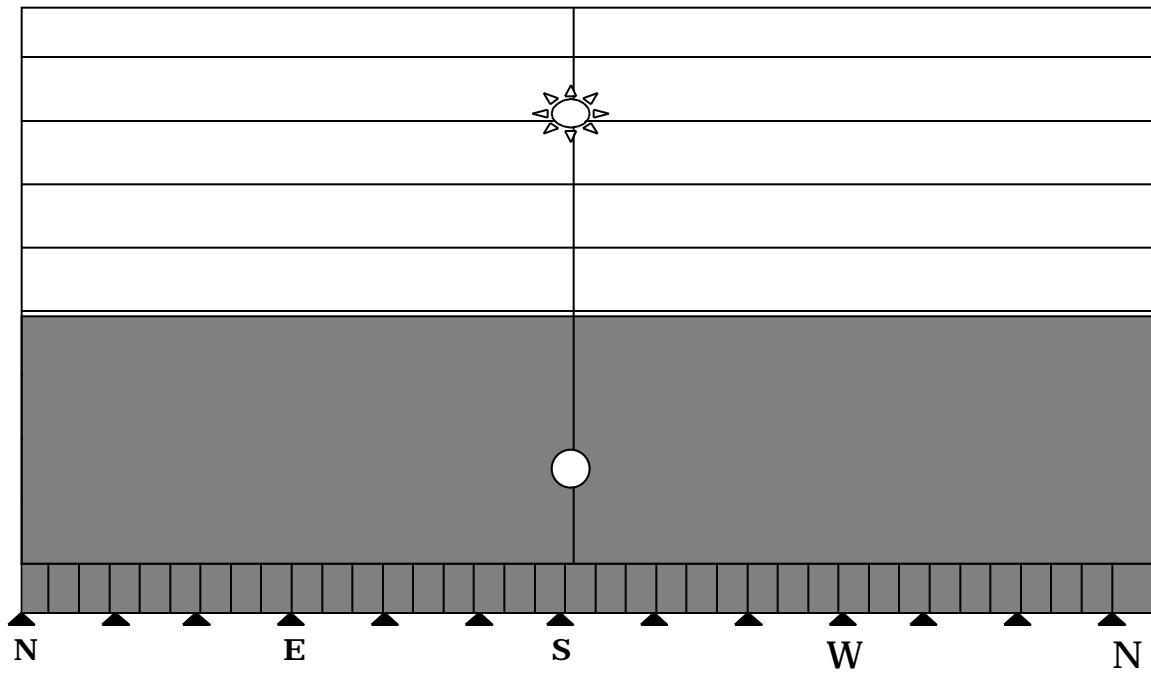


Figure 3f: Day 17 – Waning Gibbous

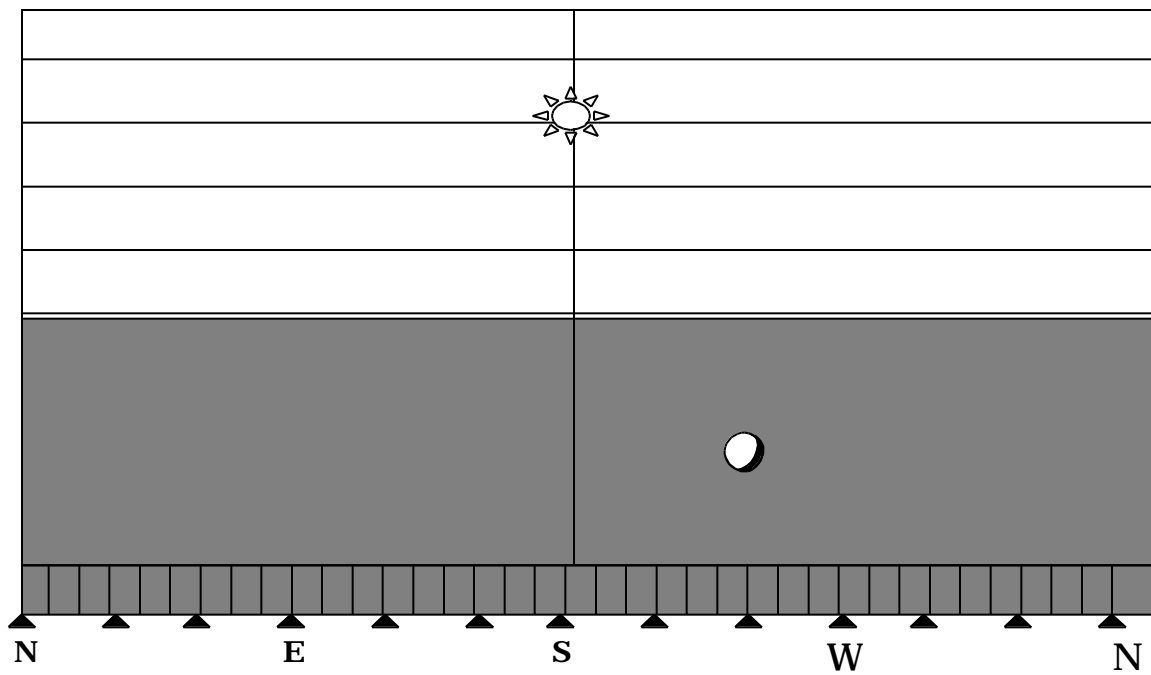


Figure 3g: Day 21 – 3rd Quarter

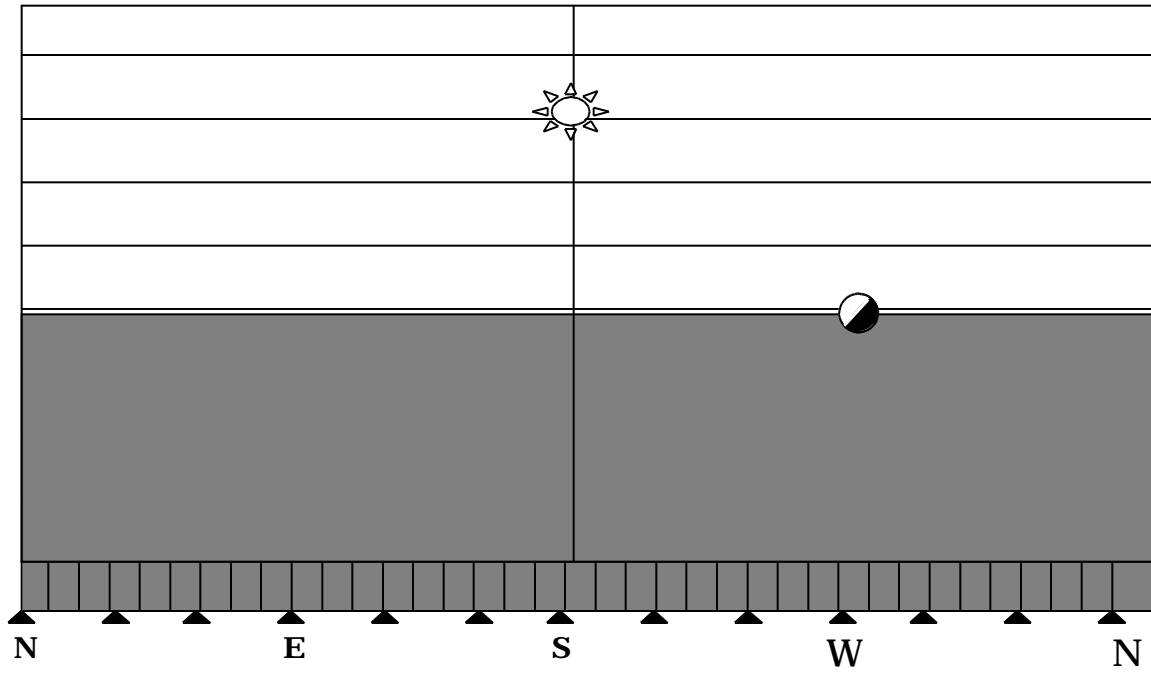
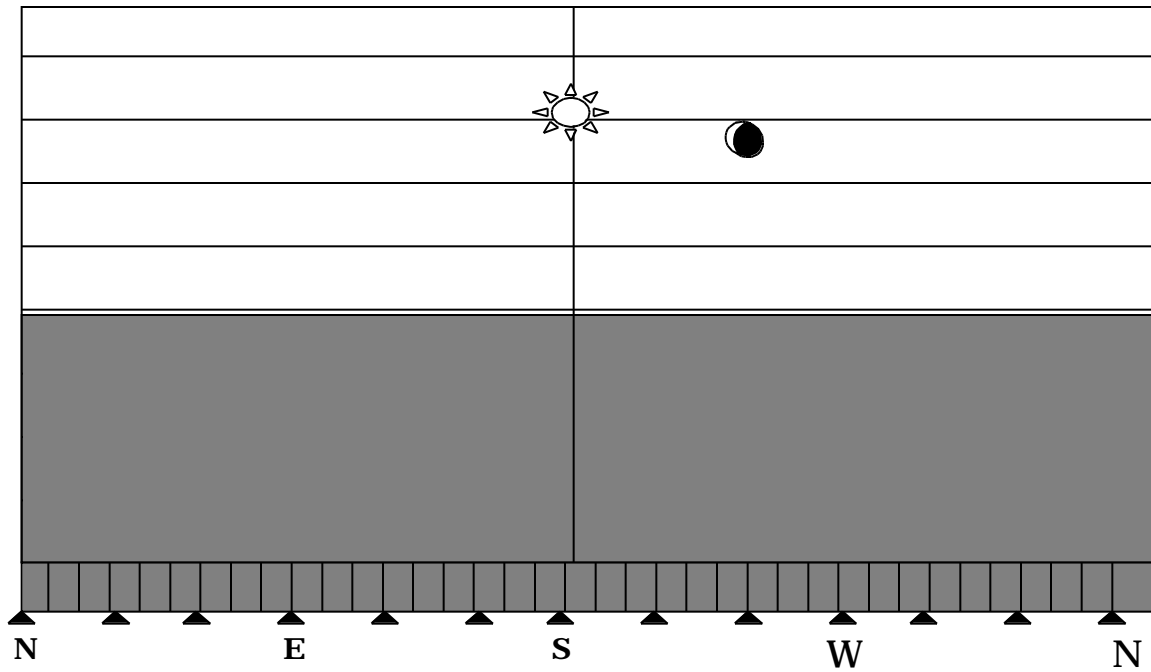
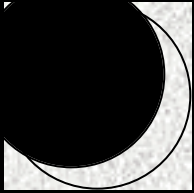
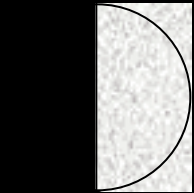
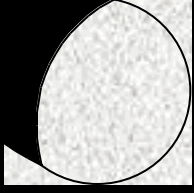
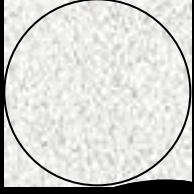
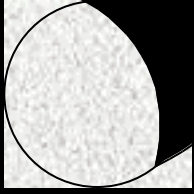
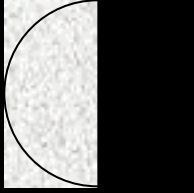
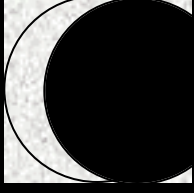



Figure 3h: Day 24 – Waning Crescent



Day 28 – New Moon

Moon Phase Poster

	New Moon	Day 0 and Day 28
	Waxing Crescent	Days 1-6
	First Quarter	Day 7
	Waxing Gibbous	Days 8-13
	Full Moon	Day 14
	Waning Gibbous	Days 15-20
	Third Quarter	Day 21
	Waning Crescent	Days 22-27

