

Name _____

Section _____

Partner(s) _____

Date _____

WHERE DO LUNAR PHASES COME FROM?

Introduction

When you look up in the night sky will you always see the moon? Explain.

When you do see the moon, is it always the same shape? Explain.

Why does the moon appear to change shape?

The phases of the moon have fascinated people for thousands of years. They appear in myths, art, medicine, and science writings. The fact that there are phases on the Moon permitted Galileo to postulate the presence of mountains on the lunar surface. How do phases originate? The activity below allows you discover how they are generated.

Procedure

1. Set up a bright light at one end of a darkened room. Face the light holding a foam ball on a stick at arm's length between you and the light. The light represents the Sun, the ball is the Moon and you are an observer on Earth. How much of the Moon's surface you see is illuminated? Record it on the first blank moon (circle) on the chart below. Shade the dark area, that is, shade the unilluminated part.
2. Rotate in place 90° to your left. Observe again and sketch what you see. Since the Earth rotates counter-clockwise on its axis you move to the left to simulate its rotation.
3. Rotate 90° to your left again. You should now have your back to the light and are 180° from your starting position. You may have to raise the ball up to get it out of your shadow. Record your observation.
4. Rotate 90° to your left one more time. You have now rotated 270° from your starting position. Record your observations below.

ROTATION	0°	90°	180°	270°
ILLUMINATION SKETCH				
PHASE				

Can you label the phases for each positions above? If so, place your responses in the chart above.

- Repeat the rotating and recording procedure again but this time turn only 45° to your left each time. Label each phase that you can in the section provided.

ROTATION	0°	45°	90°	135°
ILLUMINATION SKETCH				
PHASE				

ROTATION	180°	225°	270°	315°
ILLUMINATION SKETCH				
PHASE				

6. Go back to the 90° position and slowly rotate through to 270° . What happens to the amount of illumination? What is different before and after the fully illuminated moon?

Discussion

The first position (facing the light) represents the **new moon**. The next 90° position gives the **1st quarter moon**. At the 180° position you see a **full moon**. At the 270° position you see a repeat of position 2, called the **3rd quarter moon**. Between new and quarter phases you see the **crescent phases** when less than half of the lunar surface you see is illuminated. Between quarter and full you see the **gibbous phases** when more than half of the lunar surface turned to the Earth is illuminated.

We distinguish between first and second occurrences of the crescent and gibbous phases by noting how the illumination is changing. If the amount of illuminated surface increases we say the Moon is **waxing**. If the illuminated surface decreases from night to night we say the Moon is **waning**.

Can you see every phase of the Moon at the same time during the day or night? Explain.

Now, let's look at the question about when you see different phases of the Moon. You will rotate in place to simulate the Earth's rotation as you did before. We will assume that when you face the Sun (light source) it is noon; when your back is to the Sun, it is midnight. What time would it be if you rotated 90° to the left of the noon position?

7. Place the "Moon" on an object that will hold it at the first quarter position or have someone hold it in the first quarter position with respect to you (Earth) and the light source (Sun). Turn to face the "Moon". As you may have guessed above it is now about 6 PM on the Earth. Slowly turn to the left, simulating Earth rotation. Keep your head facing forward but you can move your eyes. As you lose sight of the Sun it is sunset. Without turning your head can you still see the "Moon" at sunset? Would it be high in the sky or near a horizon? How can you tell? (Hint: in front is high in the sky)

Rotate to the midnight position. Can you still see the first quarter moon? Explain.

Rotate to the 6 AM position. Can you see the first quarter moon?

8. Move the moon ball to full phase position and stand facing it. Is it day or night on Earth?

Rotate yourself to the left and right keeping the "Moon" in the same position. Determine the approximate time range when the full moon will be visible.

When will it be highest in the sky?

When will it be at the horizons?

9. Could you see a crescent Moon at night? Why or why not?

If you can see it would it be high in the sky or nearer the horizon?

DISCUSSION

How much of the moon's surface is actually illuminated at any given time?

Half of the surface is always lit by sunlight. However, because of our position with respect to the Sun and Moon we will see a varied amount of illumination.

As you have discovered, certain phases will be prominent at different times of the day. Most

people remember a full moon because it is most striking late at night when it is very dark. On the other hand, a new Moon is hard to see because it is visible during the day when the light of the Sun overwhelms the sunlight reflected from the Moon. In fact, when you see a new Moon, you are seeing earthlight (not sunlight) reflected from the surface of the moon. Crescent phases are best seen in early morning. Gibbous phases are prominent in early evening

If you see a full moon from Southern Maryland, what phase will people in South Africa see during their next night? Explain.

Remember that the Moon revolves around the Earth about once every 28 days while the Earth rotates on its axis once every 24 hours. South Africans will see the same phase that we do. In the next twelve or so hours the Earth will turn on its axis but the Moon will move very little. The Sun-Earth-Moon alignment will be almost the same, resulting in about the same phase.

THERE'S MORE THAN LUNAR PHASES...

The moon is not the only celestial body to show phases. We use the same terms (full, new, crescent, and gibbous) to describe the phases of any celestial body.

1. Thinking about what you observed with the Moon-Earth and Sun alignments and phases, can any of the planets show phases to an Earth-based observer? Explain. You can use a model of the solar system with moveable planets to help.

Both of the inner planets (Mercury and Venus) show phases but because of their distance from us they are harder to detect. There are no phases for the outer planets. Why?

2. Suppose you are an astronaut on the Moon and you are gazing out at Earth. What a sight! Your parents on Earth are looking at the Moon and are seeing a gibbous phase. What phase of the Earth are you seeing from the Moon? Explain.

If the phase of the Moon is full from the Earth, what phase of the Earth will you see from the Moon?

Can you say anything in general about the simultaneous phases of the Moon viewed from Earth and Earth viewed from the Moon? Explain.

The phases of the Earth and Moon will be opposite of each other. When the Moon looks like a crescent the Earth will be in a gibbous phase. When the Moon is new, the Earth will be full.