

Lunar Phases

Overview: The Moon appears to change in the sky. One moment it's a big white circle, and next week it's shaped like a sideways bike helmet. There's even a day where it disappears altogether. So what gives?

What to Learn: The sun illuminates half of the Moon all the time. Imagine shining a flashlight on a beach ball. The half that faces the light is lit up. There's no light on the far side, right? For the Moon, *which* half is lit up depends on the rotation of the Moon. And which part of the illuminated side we can see depends on where we are when looking at the Moon. Sound complicated? This lab will straighten everything out so it makes sense.

Materials

- ball
- flashlight

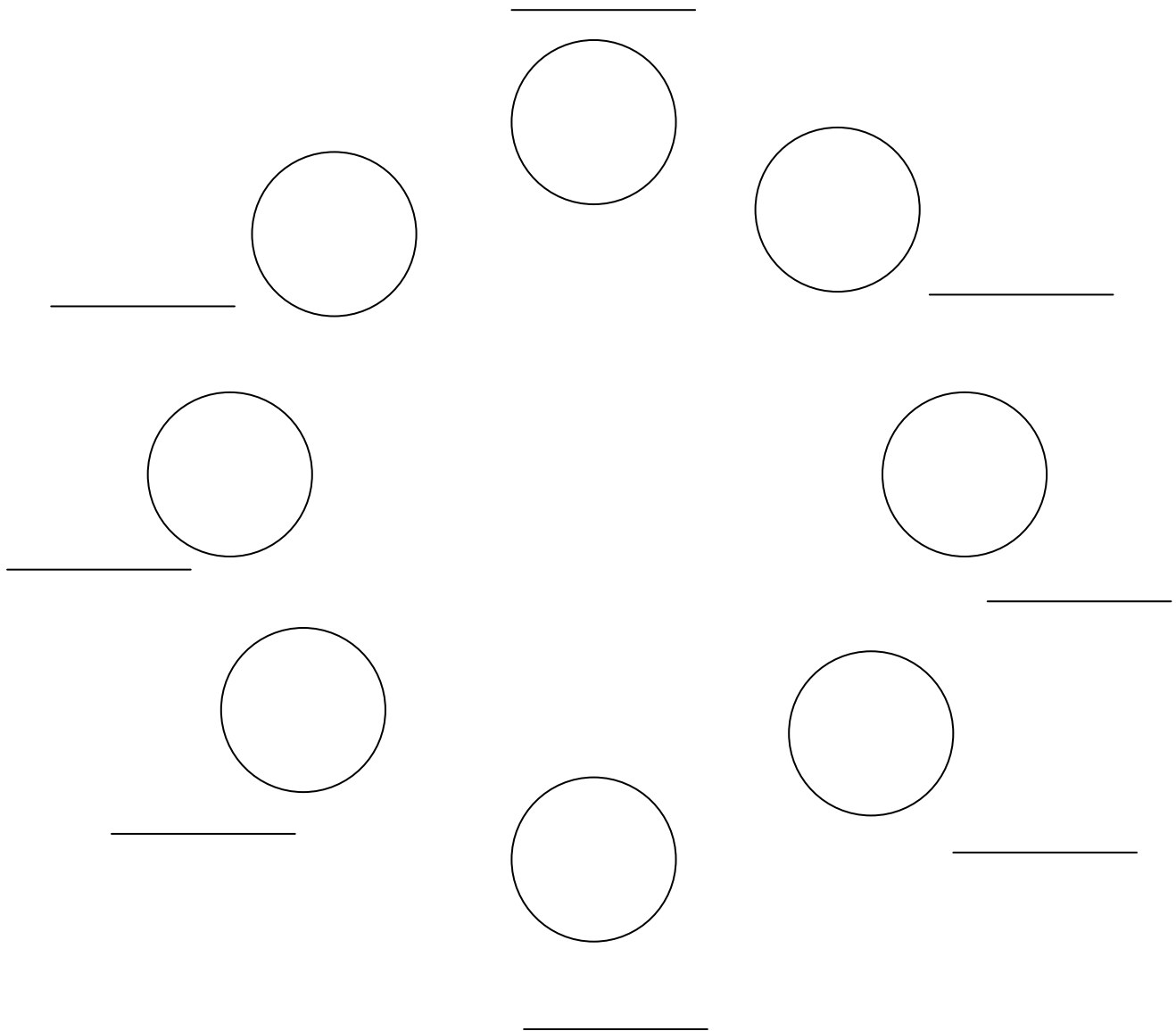
Experiment

1. Assign one person to be the sun and hand them the flashlight. Stay standing up about four feet away from the group. The sun doesn't move at all for this activity.
2. Assign one person to be the Moon and hand them the ball. Stay standing up, as you'll be circling the Earth.
3. The rest of the people are the Earth, and they sit right in the middle (so they don't get a flashlight in their eyes as the Moon orbits).
4. Start with a new Moon. Shine the flashlight above the heads of the Earth. Move the Moon (ball) into position so that the ball blocks all the light from the flashlight. Ask the Earth kids how much light they can see on their side of the Moon (should be none). Which phase of the Moon is this?

5. Now the Moon moves around to the opposite side of the Earth so that the Earth kids can see the entire half of the ball lit up by the flashlight. Ask the Earth kids how much light they can see on their side of the Moon (should be half the ball). Which phase of the Moon is this?

6. Now find the positions for first quarter. Where does the Moon need to stand so that the Earth kids can see the first quarter Moon?
7. Continue around in a complete circle and fill out the diagram. Color in the circles to indicate the dark half of the Moon. For example, the new Moon should be completely darkened.

Lunar Phases Data Observations



1. Now it's time to investigate why Venus and Mercury have phases. Put the sun in the center and assign a student to be Venus. Venus gets the ball.
2. Venus should be walking slowly around the sun. The sun is going to have to rotate to always face Venus, since the sun normally gives off light in every direction.
3. The Earth kids need to move further out from the sun than Venus, so they will be watching Venus orbit the sun from a distance of a couple of feet.

4. Earth kids: what do you notice about how the sun lights up Venus from your point of view? Is there a time when you get to see Venus completely illuminated, and other times when it's completely dark?
5. Draw a diagram of what's going on, labeling Venus's full phase, new phase, half phases, crescent, and gibbous phases. Label the sun, Earth, and all 8 phases of Venus like we did on the board for the Earth at the beginning of this lesson:

Reading

The sun illuminates half of the Moon all the time. Imagine shining a flashlight on a beach ball. The half that faces the light is lit up. There's no light on the far side, right? So for the Moon, *which* half is lit up depends on the rotation of the Moon. And which part of the illuminated side we can see depends on where we are when looking at the Moon. Sound complicated? This lab will straighten everything out so it makes sense.

One question you'll hear is: *Why don't we have eclipses every month when there's a new Moon?* Good question. The Moon's orbit around the Earth is not in the same plane as the Earth's orbit around the sun (called the ecliptic). It's actually off by about 5° . In fact, only twice per month does the Moon pass through the ecliptic.

The lunar cycle is approximately 28 days. To be exact, it takes on average 29.53 days (29 days, 12 hours, 44 minutes) between two full moons. The average calendar month is $1/12$ of a year, which is 30.44 days. Since the Moon's phases repeat every 29.53 days, they don't quite match up. That's why on Moon phase calendars, you'll see a skipped day to account for the mismatch.

A second full Moon in the same month is called a *blue Moon*. It's also a *blue Moon* if it's the third full Moon out of four in a three-month season, which happens once every two or three years.

The Moon isn't the only object that has phases. Mercury and Venus undergo phases because they are closer to the sun than the Earth. If we lived on Mars, then the Earth would also have phases.

Exercises

1. Does the sun always light up half the Moon?
2. How many phases does the Moon have?
3. What is it called when the Moon appears to grow?
4. What is it called when you see more light than dark on the Moon?
5. How long does it take for a complete lunar cycle?

Answers to Exercises: Lunar Phases

1. Does the sun always light up half the Moon? (Yes. We don't always get to see it, which is because the Moon has phases.)
2. How many phases does the Moon have? (eight)
3. What is it called when the Moon appears to grow? (waxing)
4. What is it called when you see more light than dark on the Moon? (gibbous)
5. How long does it take for a complete lunar cycle? (about 29 ½ days)