

## Earth/Space Lab Investigation: Phases of the Moon

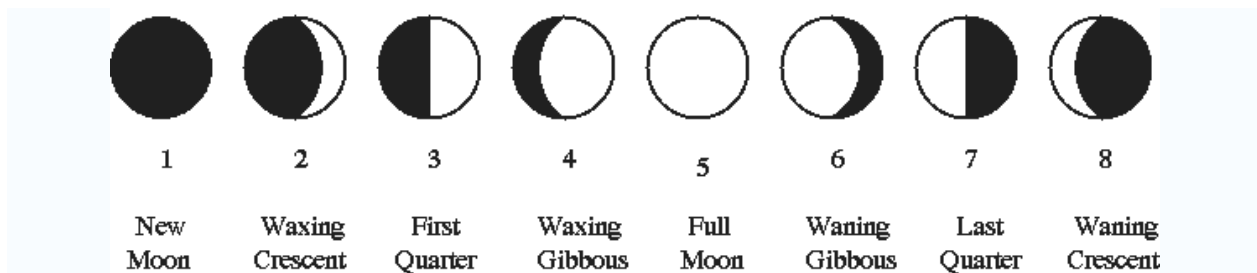
### *What causes the phases of the moon?*

**Introduction.** Since ancient times, every civilization has studied the Moon. Not only does the Moon appear to be the brightest object in the night sky, its location and appearance changes nightly in a predictable way, making it easy to track. Ancient people watched the Moon each night and learned to predict its phases and movements, even if the reasons for those motions were not understood at the time.

The first person to correctly explain the phases of the Moon is unknown to us now, but by the time Pythagoras wrote in 600 B.C., the ancient Greeks knew that the Moon is spherical and that it revolves around the Earth. The Greeks understood how that motion causes the monthly changes in the Moon's appearance. In fact, they even had pretty good measurements of the Moon's relative size and distance from the Earth.

**The Task.** The phases on the moon follow a predictable pattern (see Figure 1). Your goal is to determine what causes this pattern and then develop a model that explains why we see this pattern.

Figure 1. Phases of the Moon



To accomplish this task, you will need to create an explanatory model for the moon phases. Your model will need to take into account how the Sun, Earth, and Moon move relative to each other over time. You will be able to use objects that represent the Sun, Earth and Moon in order to develop, test, and refine your model. Once you have created your model, you will need to be able to provide evidence that it is consistent with the behavior of the moon in the sky over time.

The guiding question of this investigation is: **What causes the phases of the moon?**

**Materials.** You may use any of the following materials during your investigation:

- White Boards/Markers
- White Volley ball
- Flashlight
- Earth Beach ball
- Masking Tape
- Meter stick
- Calendar with moon phases and moon rise and set times

**Safety Precautions.** Be aware of the movement and location of other students in the room, as the room will be dark. Also, remember not to shine the flashlight directly into the eyes of another person.



Investigation Proposal Required:     Yes             No

**Getting Started.** Before you can design and carry out your investigation, you must determine what type of data you will need to collect, how you will collect it, and how will you analyze it.

To determine **what type of data you need to collect** think about the following questions:

- How does movement of celestial objects affect the phases of the moon?
- What is happening to other celestial bodies during those moon phases?
- How does position of other celestial objects affect moon phases?

To determine **how you will collect your data**, think about the following questions:

- What materials will you need to collect your information?
- How will you record your data appropriately?

In order to determine **how you will analyze your data** think about the following questions:

- How will you display your data (drawing, table, etc.)?
- What type of visuals do you need to help others understand your data (graphs, charts, etc.)?
- What calculations will help you to understand your data?

**Connections to Crosscutting Concepts and the Nature of Science and Scientific Inquiry.** As you work through your investigation, be sure to think about:

- The importance of patterns in science.
- The relationship between cause and effect.
- The role of data and evidence in science and,
- The role of observation and inference in science.

**Initial Argument.** Once your group has finished collecting and analyzing your data, you will need to develop your initial argument. Your initial argument needs to include a claim, evidence to support your claim, and a justification of your evidence. The claim is your answer the guiding question. The evidence is your analysis and interpretation of your data. Finally, the justification of the evidence is why you think your evidence matters. The justification of the evidence is important because scientists can use different kinds of evidence to support their claims. You will create your initial argument on a whiteboard. Your whiteboard should include all the information shown in Figure 1.

The Guiding Question:	
Our Claim:	
Our Evidence:	Our Justification of the Evidence:

Figure 1. Argument Presentation on a Whiteboard

**Argumentation Session.** To share your initial argument with others, we will be using a modified **Gallery-Walk** format. This means that one member of your group will stay at your lab station to share your groups' argument while the other members of your group go to the other lab stations one at a time in order to listen



to and the critique the arguments developed by your classmates. This is similar to how scientists present their arguments to other scientists at conferences. If you are responsible for critiquing your classmates' arguments, your goal is to look for mistakes in your classmates' arguments so these mistakes can be fixed and they can make their argument better. The argumentation session is also a good time to think about ways you can make your initial argument better. Scientists must share and critique arguments like this in order to develop new ideas.

In order to critique an argument, you might need more information than what is included on the whiteboard. You will therefore need to ask the present lots of questions. Some good questions to ask might be:

- What did you do to collect your data? Why do you think that way is the best way to do it?
- What did you do to make sure that the data you are using is accurate?
- Is there other data that you would like to have? If so, what is it?
- What did you do to analyze your data? Why did you decide analyze your data that way?
- How do you know that your calculations are correct?
- What other ways of analyzing and interpreting your data did your group talk about?
- Why did your group decide to present your evidence in that way?
- What other claims did your group discuss before you decided on that one? Why did your group abandon those alternative ideas?
- How sure are you that your claim is accurate? What could you do to be more sure about it?

Once the argumentation session is complete, you will have a chance to meet with your group and revise your initial argument. Your group might need to gather more data or design a way to test one or more alternative claims as part of this process. Remember, your goal at this stage of the investigation is to develop the best argument possible.

**Report.** Once you have completed your research, you will need to prepare an *investigation report* that consists of three sections. Each section should provide an answer for the following questions:

1. What question were you trying to answer and why?
2. What did you do during your investigation and why did you conduct your investigation in this way?
3. What is your argument?

Your report should answer these questions in 2 pages or less. This report must be typed and any diagrams, figures, or tables should be embedded into the document. Be sure to write in a persuasive style; you are trying to convince others that your claim is acceptable or valid!

