Is It Lunar or Lunacy?

Summary

Learn all about the moon, its phases and even how to make a model.

Materials

One 4" foam ball to represent Earth
One foam ball to represent moon (1/4 size of the Earth)
Twelve wooden Skewers pointed on each end
Black paint
Red paint or red permanent marker
Heavy foam board measuring 26" X 26" between 3/4" to an inch" in thickness
Hula hoop
Protractor
Straw
String
Two small washers

- *Galileo*
- Moon Phase Chart
- The Rising and Setting of the Sun Table
- The Rising and Setting of the Moon Table
- Instructions for Making Moon Model

Additional Resources

Books

- *Earth, Moon, and Sun--Earth Science Delta Science Module*
  , Teacher's Guide. ISBN# 0-87504-166-3
- *Earth, Moon, and Stars*
  -- LHS GEMS, Teacher's Guide ISBN# 0-912511-18-4
- *The Moon Book*
  , by Gail Gibbons
- *Galileo*
  , by Leonard Everett Fisher ISBN# 0-02-735235-8
- *The Universe at Your Fingertips--An Astronomy Activity and Resource Notebook*
  Project ASTRO Astronomical Society of the Pacific (415) 337 - 1100 ISBN# 1-886733-00-7

Videos

- *How and Why--The Moon and the Universe*
  , Volume 4. 1-888-661d-8104 www.mediakids.com

Background for Teachers

When Buzz Aldrin first stepped on the lunar surface and looked around at the alien landscape, he exclaimed: "Magnificent desolation!" It was a perfect description of the stark, inhospitable lunar surface which has no atmosphere or water. Standing on the Moon's surface, the astronauts saw a barren vista of rocks, boulders and fine dust. In the distance, rounded hills and mountains reaching toward an utterly black sky, whether it was day or night.
Earth has one natural satellite, the Moon, which is our closest celestial neighbor. It is an airless little world less than one-fourth the size of Earth. We only see the Moon because Sunlight reflects back to us from its surface. It has no light source of its own. The visible side of the moon's surface texture has

irregularities consisting of craters, mountain like mounds, enormously deep canyons, along with an abundance of rocks and dust. With no atmosphere to carry sound, the moon is completely silent and its surface is either extremely hot or cold. The moon has many large 'maria' (Latin for seas). Marias are extensive flat plains made of dark volcanic rock and they cover one third of the visible face of the moon.
Because of these surface irregularities are just the right size, Sunlight arriving at different angles is reflected back to Earth equally well. This special fact about our moon is not true of other moons in the solar system. By possessing the correct size and distributed surface material, a consistent visual effect is created. Amazingly, the moon appears as bright in the center as it does at the edges! Without this special property, the moon would appear very bright in the center and rather dark along its edges. The moon gives consistent light to Earth's surface throughout throughout its monthly cycle.
The Moon has become 'locked' into a special kind of motion around Earth. It rotates counterclockwise when viewed above the North Pole and always exposes only one of its sides (the nearside) to Earth. It wasn't until the 1960's when satellites were sent to orbit the moon and study its gravitational field that this mysterious behavior was finally understood. Lunar scientists discovered that the moon is lopsided. The farside of the moon is very different from the visible side. The farside of the Moon is always facing the Sun and is always illuminated; however, this side of the Moon never faces Earth. On the Moon's farside side, however, there are virtually no maria. Instead, it is composed almost entirely of ancient highlands, the cratered and mountainous terrain that reflects two to three time more reflected Sunlight than the visible side. Its crust is considerably thicker on the farside. Because the moon's crust is unevenly distributed, Earth's gravitational field holds the moon in one position relative to Earth. As a result, the time it takes the Moon to rotate once on its axis is exactly equal to the time it takes the moon to revolve once around Earth. To us on Earth, relative to the Sun, the moon's complete cycle is 29 and 1/2 days. Since time on Earth is figured relative to the Sun, we see the moon return to the same place in the sky at the same time of day every 29 and 1/2 days.
Our Moon is unusual and unique compared to other moons throughout the Solar System. It is capricious because its orbit is elliptical and eccentric, looking bigger at certain times than others, rising above and below the horizon. It also has an unusual orbit around Earth. If Earth's moon were in geosynchronous orbit, it would only appear in the sky over one of Earth's hemispheres. But the Moon has a non-equatorial, non-geo-synchronous orbit, so that it can be seen anywhere on Earth. Another major difference in our Moon is its orbital path around Earth. Almost every major moon in our solar system orbits its planet close to, or exactly, in the plane of its planet's equator. Our Moon's orbit is tilted with respect to Earth's equator by plus or minus 5º. In combination with the tilt of the Earth's axis (which is 23 and 1/2º) the moon can appear between 18 and 1/2º and 28 and 1/2º above or below the celestial equator -- the line in the sky which is an extension of Earth's equator outward into space. What this means for us here on Earth is that our Moon dominates a larger portion of the night sky than it would otherwise do.
To understand the significance of this, consider the situation where a moon orbits directly above the equator of its respective planet. That moon could not be seen from the higher latitudes and polar regions of that planet. This is because the curvature of the planet blocks the view. This means that from high latitudes or near the poles, the moon never rises or sets, or is too close to the horizon to be easily seen. In comparison, because of our Moon's unique tilted orbit, it can rise to a significant altitude above the horizon and be seen anywhere on Earth, including the polar regions.
Another amazing feature of our Moon, is it appears to change shape, but in reality it doesn't. We see different amount of light being reflected from the Sun illuminating parts of the Moon in a predictable pattern. These different shapes we observe are called 'phases of the moon'. Beginning with the New Moon, the Moon is 'waxing' as it increases its illumination to a Full Moon. After the Full Moon phase the Moon decreases in its visible illumination and 'wanes'. These different amounts of moon illuminations on its surface are visible to us in different parts of its orbit. When the moon is full, it is on

the opposite side of Earth from the Sun. A new moon is moving approximately between Earth and the Sun so the side toward Earth and cannot be seen. Earth's shadow plays no role in the phases of the Moon.

Intended Learning Outcomes

1. Use Science Process and Thinking Skills.
3. Understand Science Concepts and Principles.
4. Communicate Effectively Using Science Language and Reasoning.

Instructional Procedures

Invitation to Learn

Give each student a blackline outline of the moon. Have them sketch a view of a full moon from memory. Use a black colored pencil for sketching and shading.

Have students read the short excerpt from Galileo. Have a class discussion about the reading excerpt, asking open-ending questions about Galileo's approach to learning about the world around him.

Have students look through a simple model of a refracting telescope or binoculars at a poster-sized, actual photo of a full moon on the other side of the room. With the aid of the telescope or binoculars, add additional details to your sketch using a brown colored pencil.

Using the Moon Map references, identify any major your sketch and the moon map and label.

KWL (Pre-Assessment)

Have students individually write what they know about the Moon, also include at least three questions they have about the Moon.

Have each group share their information to compile a group list of information and the top three questions they want answered.

Each group shares with the class their list of facts about the Moon and their top three questions.

Teacher will record a Master Class List of Moon Facts to be kept posted in the room and the top five questions to investigate.

Have students complete a pre-assessment using the *Moon Phase Chart* .

Instructional Procedures

Activity #1 - What's Your Angle?

Making simple tools, such as a sextant, will help students make their data and evidence gathering more accurate.

Making a Sextant

Tape a drinking straw along the straight edge of the protractor.

Pull and tie a string through the hole on the straight edge.

Attach a washer to the end of the string giving it weight enough to dangle towards the 90º marking and to swing freely as the angle changes.

Activity #2 - Up Close and Personal

Beginning at a New Moon Cycle, have students make nightly observations in the changing of the Moon's appearance over a three-week period of time.

Strongly encourage students to observe the Moon at approximately the same time of night and the same location.

Using their sextant, record the Moon's angle to the horizon. Record where it is rising, from the west or east, and whether it is higher or lower from the horizon.

Sketch changes in the Moon's appearance each night.

Indicate how much of the Moon is being illuminated (a sliver, a quarter, half, full, not seen) and from which side the reflected Sunlight is being reflected from left or right?

Record the date, time, and sky conditions.

Extensions:

Record other objects in the night sky that are visible and how their positions seem to change over the three weeks in relationship to the Moon's position. (Venus and common constellations are good ones to observe.)

Use digital photography instead of sketches.

Full Moon Fest - Invite students and their families back to school at night just shortly before the rising of a Full Moon. Encourage students to bring telescopes or binoculars with them. Have students share their knowledge and experiences of observing the moon up to this Full Moon phase. It's also fun to have hot chocolate and donuts (hopefully donated by the parents) to end the evening.

Activity #3 - Wanted: A Lunar Model

Discuss the advantages and limitations of using models.

Show students the model that will be used to illustrate the phases of the Moon. Discuss its particular advantages and limitations.

Discuss the model and what is being represented. (e.g., The hula hoop is the orbital path of the Moon around Earth, Earth is set on its axis and is always facing the light source, the eight wooden skewers represent the major phases of the Moon, the arrows represent the direction of reflected Sunlight, and the numbers represent where to begin, at #1 and go counterclockwise.)

Have students work with the model in small groups of four to six students. Ask probing questions to check their understanding of moon phases and misconceptions. After a student gives a possible answer to a question, have the other students respond to it. Do you agree? Why? Do you disagree? Why? Are you not sure? How can we find out? Questions might include:

How does the relative position of the Sun, Earth, and Moon affect the amount of illuminate light on the Moon?

How does the tilt of Earth and the Moon's unique orbital path effect the different phases?

Which side of the Moon is being illuminated during its 'waxing' phase? Its 'waning phase'?

Most moons have their orbital path along the equatorial line of its planet, generally our Moon does not. However, if our Moon did orbit about Earth's equator, how would this affect the phases?

(*Both models representing the Moon and Earth should be facing the light source.) Set the model of the Moon on position #1. Have two students at a time come up to the model and stand directly behind position #5 and look straight across the model to where the Moon has been placed. Have student describe what they are seeing, the relative position of Earth, Moon, and Sun, and identify the phase. If there is a disagreement between the students, this opens up a discussion for the rest of the students. (*With this particular model a light source or a darkened room is not necessary, but adding a bright light source makes the phases even more evident.)

Reset the Moon to position #2 and have the pair of students then rotate to position #6. Repeat process until they have completed a full rotation of the moon phases. Then have another pair of students go through the same process.

Have students return to their seats and record in their Science Journals their observations. They also need to write a summary why the Moon goes through phases, how the tilt of Earth's axis and the Moon's unique orbit affects the amount of light illuminated, and relative position of the Sun, Earth, and Moon and how it affects the Moon phases. Also have students use a detailed labeled diagram in their summaries.

Activity #4 -- Moon Predictions

Using data chart of the Sun and Moon rising and setting, have students predict the next new moon cycle. Use The Rising and Setting of the Sun Table and The Rising and Setting of the Moon Table.

Give each student a copy of both charts. Review a New Moon that cannot be seen from Earth

because it rises and sets with the Sun.
Ask students how they would determine the next New Moon by analyzing the times of the rising and setting of both the Sun and the Moon. Students should conclude that a New Moon times of rising and setting be very close to the Sun's rising and setting.

* The blanks on the charts indicate that the Moon is below the horizon and times cannot be calculated.

Bibliography

Research Basis

Sequeira, P.V. (Summer 2001) What About Homework?. *National Association of Elementary School Principals*, Volume 19, Number 4, p. 1.

"Homework becomes effective and meaningful when the assignments are as important as the work completed in class . . . An effective homework assignment determines whether a student can apply the skills learned in class to everyday situations . . . A successful homework assignment also depends on a built-in mechanism for review and discussion in the classroom . . . Finally, for homework to be effective, teachers should examine and correct assignments before returning them with comments or grades."

Marzano, R.J., Pickering, D.J., & Pollock, J.E, (2001). *Class instruction that works: research-based strategies for increasing student achievement*

"It is no exaggeration to say that homework is a staple of U.S. education. Homework extends learning opportunities beyond the confines of the school day. It can provide students with opportunities to deepen their understanding and skills relative to content that has been initially presented to them . . . The purpose, expectations, and instructions of the homework assignment should be clearly identified and clearly articulated to students . . . Not all homework should be the same. It should be designed with a specific purpose which correlates to the curriculum being studied in class . . . Homework can be designed for practice, preparing students for new content, or elaborating and extending content that has been introduced."

Shepardson, D.P., & Britsch, S. J. (February 1997). Children's science journals: Tools for teaching, learning, and assessing. *Science and children*, p. 13.

"To expand our understanding of children's science learning, we need to expand our science teaching methods. One way of expanding our methods is to incorporate science journals into our lessons. These journals provide an opportunity to access and take note of changes in children's understands and thinking, identify misconceptions, and provide a more complete picture of children's understanding of science phenomena (Dana, Lorsback, Hook, and Briscoe, 1991). To do this, we need to examine what children create with their drawings and writing as they construct and represent their understandings in science journals (Doris, 191)."

Worsley, D., & Mayer, R., (1989). The art of science writing. *Teachers and writers collaborative.*

"To permit writing is to permit thinking. Writing can be used as a method of solving problems. It is a mirror of the mind to writers and a window of the mind for readers, allowing both to see how well learning is taking place . . . It is a way for students to ask questions that they might otherwise be unable to ask. It captures elusive but valuable ideas. Writing not only develops existing knowledge, it also creates new knowledge on the part of the writer . . . It is the currency by which people acquire ownership of ideas; ideas owned are ideas remembered, and ideas remembered are ideas learned . . . It transforms boredom into curiosity."

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