

SNC1D/1P The Study of the Universe/Space Exploration

Student Activity: Modelling the Phases of the Moon

Topics	Timing
phases of the Moon	preparation: 10 min activity: 25 min

Specific Expectations

SNC1D

A1.10 draw conclusions based on inquiry results and research findings, and justify their conclusions

D3.5 explain the causes of astronomical phenomena (e.g., the aurora borealis, solar eclipses, phases of the moon, comets) and how various phenomena can best be observed from Earth (e.g., solar eclipses should be viewed through a suitable solar filter or by projection, not with the naked eye)

SNC1P

A1.10 draw conclusions based on inquiry results and research findings, and justify their conclusions

D3.5 describe the causes of major astronomical phenomena (e.g., the aurora borealis, solar/lunar eclipses) and how various phenomena can best be observed from Earth (e.g., solar eclipses should be viewed through a telescope equipped with a solar filter, not with the naked eye)

Introduction

The Moon is visible at some point during most nights. If you observed the Moon from one night to the next you would notice that the Moon rises 50 min later each night. With close observation you would see a little bit more or a little bit less of the Moon each night, depending on its phase.

The Moon orbits Earth in 28 days. The Moon's location, relative to Earth and the Sun, determines how much of the Moon is visible to us. Half of the Moon is always illuminated by the Sun, while half is always dark. When the Moon is directly between Earth and the Sun, the illuminated side is facing away from Earth and the Moon is not visible in the night sky. At this time the Moon is directly in the same ecliptic longitude with the Sun. This is called the "new moon" phase. As the Moon orbits around Earth more of the illuminated side is visible each night and the Moon is said to be "waxing". The waxing crescent phase leads into the First Quarter phase when the right half of the Moon is illuminated and hence visible on Earth. The Moon continues its orbit and there is a gradual succession through the waxing gibbous phase. About 15 days after the new moon, the Moon is on the opposite side of Earth relative to the Sun and the entire illuminated side is visible: the full moon phase. As the Moon continues to orbit from this point, less of the illuminated side is visible each night and the Moon is said to be "waning". It will proceed through the waning gibbous, Third Quarter, and waning crescent phases before again becoming a new moon.

In this activity students will model the phases of the moon and record their observations.

Materials

bright flashlight
white ball (20–30 cm diameter)

“Phases of the Moon” student diagram (see
Diagram Master below)

Safety Considerations

None

Procedure

Organize students into pairs.

- Predict**
Ask the class to consider what we would see when viewing a ball, illuminated on one side, from different locations.
- Hand out one copy of the “Phases of the Moon” diagram to each pair of students.
- Observe**
Darken the room and place a bright flashlight on one side of the room. Student 1 stands with his/her back to the light.
- Direct student 1 to hold the ball (Moon) up in one hand—away from the light—so that the ball is slightly overhead (position 1 on the student diagram and Fig.1). There should be no shadow on the ball. Student 1 should describe his/her observations of the illuminated and shadowed parts of the visible ball surface.

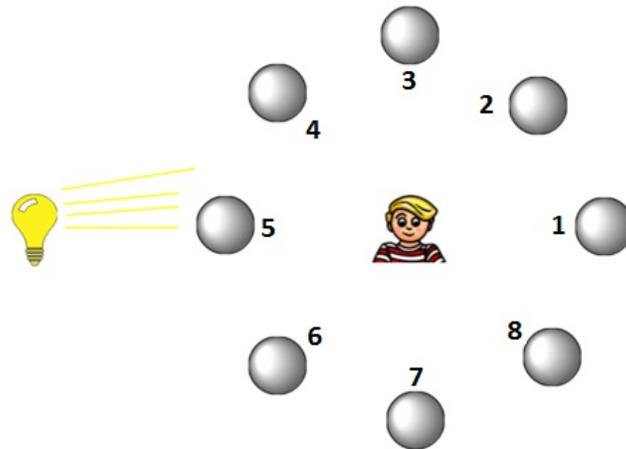


Fig.1 Student 1 representing Earth as the Moon revolves

- Instruct student 2 to shade in, on the “Phases of the Moon” diagram, the part of the ball that appears in shadow from student 1’s perspective.
- Student 1 then rotates 45° counter-clockwise, corresponding to position 2 on the diagram. Again the students observe the lighted and shadowed parts of the visible ball surface and record the observations by shading the diagram.
- Repeat Step 6 until all 8 positions (phases) have been observed and diagrammed.
- Explain**
Have students share their drawings. Ask them to explain why the shadows change as they rotate. Encourage them to relate this model to the real situation of the Moon revolving around Earth.

Disposal

Store the balls and flashlights for reuse.

What Happens?

Looking at the ball from student 1's point of view, at position 1 the entire visible surface is illuminated and none of the circle is shaded (in shadow). As the student rotates through positions 2, 3, and 4, progressively less of the Moon is visible until, at position 5, the entire visible surface of the Moon is in shadow. From this stage, as the student continues to rotate, gradually more of the Moon becomes visible through position 6, 7, and 8.

How does it work?

The half of the ball facing the light is always illuminated. However, not all of this illuminated portion is always visible to the person holding the ball. Sometimes the visible portion is all illuminated; sometimes most of the illuminated surface is turned away from the observer. For example at position 3, half of the visible surface of the ball is in shadow and half is illuminated (Third Quarter). This is because the rest of the illuminated surface of the Moon is on the opposite side of the sphere. As the student continues to rotate, more and more of the illuminated surface is on the opposite side of the ball from the student so more of the visible surface is in shadow until position 5. At this point the entire illuminated side is on the opposite surface from the viewer and the entire visible surface is in shadow. This represents the new moon. The process continues through positions 6, 7, and 8, with more of the illuminated surface becoming visible.

Teaching Suggestions/Hints

1. The light source must be on one side of the room and at the same height as the ball. If the light source is too high, the "wrong" portions of the ball will be illuminated.
2. Mention the meaning of the phrase "once in a blue moon," referring to the occurrence of two full moons in the same month.
3. An alternative to this activity is explained in the Canadian Space Agency modules. (See Additional Resources, below.)

Next Steps

A discussion of tides and eclipses would be an appropriate next step, as these phenomena are directly connected to the phases of the Moon.

Additional Resources

1. Canadian Space Agency – a series of short lesson plans to address space-related topics including "The Earth and the Moon":
<http://www.asc-csa.gc.ca/eng/educators/resources/astronomy/plans.asp>
2. Moon Connection diagram – "Understanding The Moon Phases":
http://www.moonconnection.com/moon_phases.phtml
3. NASA Starchild – sketches answering the question "What are the phases of the Moon?":
<http://starchild.gsfc.nasa.gov/docs/StarChild/questions/question3.html>

Diagram Master

Phases of the Moon

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