Maynard F. Jordan Planetarium

MOON SHADOWS

Edited by Jenny Worster

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Mission Statement:
The mission of the Maynard F. Jordan Planetarium of the University of Maine is to provide the University and the public with educational multi-media programs and observational activities in astronomy and related subjects.

Cosmic Classroom

Looking for fun and interesting space activities? The planetarium staff has prepared a collection of materials we call the Cosmic Classroom for you to use before and/or after your visit. These materials are entirely for use at your own discretion and are not intended to be required curricula or a prerequisite to any planetarium visit. The Cosmic Classroom is one more way that the Jordan Planetarium extends its resources to help the front line teacher and support the teaching of astronomy and space science in Maine schools.

The lessons in this Cosmic Classroom have been edited and selected for the range of ages/grades that might attend a showing of this program at the Jordan Planetarium. Those activities that are not focused at your students may be adapted up or down in level. Our staff has invested the time to key these materials to the State of Maine Learning Results in order to save you time.

The State of Maine Learning Results performance indicators have been identified and listed for the program, the Cosmic Classroom as a package, and each individual activity within the package. The guide also includes related vocabulary and a list of other available resources including links to the virtual universe. We intend to support educators, so if there are additions or changes that you think would improve, PLEASE let us know.

Thank you, and may the stars light your way.

The Maynard F. Jordan Planetarium Staff

The Program – *Moon Shadows*

One small step represented a giant leap forward in 1969. *Moon Shadows* is a program that takes a look at our nearest neighbor and the roles that it has played throughout history. The exploration begins with the first people to notice the changing phases of the moon tens of thousands of years ago. Along the way, there are stories and legends that cultures have used over the years to remember and teach the changing phases of Moon.. Other concepts like tides, and eclipses, and the experience of the Apollo 11 journey from the Earth to the moon are highlighted.

We are very glad that you have chosen to visit our planetarium with your group. We hope that this guide either will help you prepare your group or help you review their experience at the University of Maine's sky theater.

State of Maine Learning Results Guiding Principles

The lessons in this guide, in combination with *Moon Shadows*, will help students to work towards some of the Guiding Principles set forth by the State of Maine Learning Results. By the simple act of visiting the planetarium, students of all ages open an avenue for self-directed lifelong learning. A field trip encourages students to think about learning from all environments including those beyond the schoolyard. A Jordan Planetarium visit also introduces visitors to the campus of the largest post-secondary school in Maine and encourages them to think of this as a place which holds opportunities for their future education, enjoyment and success.

Other sites on the University campus, including three museums, explore a variety of subjects, and the Visitors Center is always willing to arrange tours of the campus. A field trip can contribute to many different disciplines of the school curriculum and demonstrate that science is not separate from art, from mathematics, from history, etc. The world is not segregated into neat little boxes with labels such as social studies and science. A field trip is an opportunity for learning in an interdisciplinary setting, to bring it all together and to start the process of thinking. For a more complete discussion of field trips, please visit the Jordan Planetarium web site at http://umainesky.com.

If used in its entirety and accompanied by the Planetarium visit this guide will help students to:

Become **a clear and effective communicator** through

A. oral expression such as class discussions, and written presentations
B. listening to classmates while doing group work, cooperation, and record keeping.

Become **a self-directed and life long learner** by

A. introducing students to career and educational opportunities at the University of Maine and the Maynard F. Jordan Planetarium.
B. encouraging students to go further into the study of the subject at hand, and explore the question of "what if?"
C. giving students a chance to use a variety of resources for gathering information

Become **a creative and practical problem solver** by

A. asking students to observe phenomena and problems, and present solutions
B. urging students to ask extending questions and find answers to those questions
C. developing and applying problem solving techniques
D. encouraging alternative outcomes and solutions to presented problems

Become **a collaborative and quality worker** through

A. an understanding of the teamwork necessary to complete tasks
B. applying that understanding and working effectively in assigned groups
C. demonstrating a concern for the quality and accuracy needed to complete an activity

Become **an integrative and informed thinker** by

A. applying concepts learned in one subject area to solve problems and answer questions in another
B. participating in class discussion

State of Maine Learning Results Performance Indicators

In conjunction with the Maynard F. Jordan Planetarium show *Moon Shadows*, this guide will help you meet the following State of Maine Learning Results Performance Indicators in your classroom.

Grades Pre. K-2

Science and Technology –

C. The Scientific and Technological Enterprise:

C1. Understandings of Inquiry

a. Describe how scientific investigations involve asking and answering a question.

b. Point out the importance of describing things and investigations accurately so others can learn about them or repeat them.

D. The Physical Setting:

D3. Matter and Energy

a. Describe objects in terms of what they are made of and their physical properties

b. Describe changes in properties of materials when mixed, heated, frozen, or cut.

Grades 3-5

Science and Technology –

A. Systems:

A2. Models

a. Describe ways in which toys and pictures are like the real things they model.

A3. Constancy and Change

a. Describe the size, weight, color, or movement of things over varying lengths of time and note qualities that change or remain the same.

B. The Skills and Traits of Scientific Inquiry and Technological Design:

B1. Skills and Traits of Scientific Inquiry

a. Pose investigable questions and seek answers from reliable sources of scientific information and from their own investigations.

c. Use simple equipment, tools, and appropriate metric units of measurement to gather data and extend the senses.

d. Use data to construct and support a reasonable explanation.

e. Communicate scientific procedures and explanations.

B2. Skills and Traits of Technological Design

b. Propose a solution to a design problem that recognizes constraints including cost, materials, time, space, or safety.

c. Use appropriate tools, materials, safe techniques, and quantitative measurements to implement a proposed solution to a design problem.

C. The Scientific and Technological Enterprise:

C1. Understandings of Inquiry

a. Describe how scientists answer questions by developing explanations based on observations, evidence, and knowledge of the natural world.

D. The Physical Setting:

D1. Universe

a. Show the locations of the sun, Earth, moon, and planets and their orbits

b. Observe and report on observations that the sun appears to move across the sky in the same way every day, but its path changes slowly over the seasons.

c. Recognize that the sun is a star and is similar to other stars in the universe.

D2. Earth

a. Describe the effects of rotation of Earth on the day/night cycle, and how that cycle affects local temperature.

e. Recognize that the sun is the source of Earth's surface heat and light energy.

D4. Force and Motion

a. Predict the effect of a given force on the motion of an object.

c. Describe the path of an object.

Social Studies -

E. History:

E1. Historical Knowledge, Concepts, Themes and Patterns

b. Identify various major historical eras, major enduring themes, turning points, events, consequences, persons, and timeframes, in the history of the community, Maine, and the United States.

English Language Arts –

A. Reading:

A2. Literary Texts

a. Make inferences about characters' actiolns and explain how their behaviors affect the plot and/or theme.

E. Listening and Speaking :

E2. Speaking

a. Explain ideas clearly and respond to questions with appropriate information.

Grades 6-8

Science and Technology -

B. The Skills and Traits of Scientific Inquiry and Technological Design:

B1. Skills and Traits of Scientific Inquiry

f. Communicate, critique, and analyze their own work and the work of other students.

B2. Skills and Traits of Technological Design

b. Design a solution or product.

C. The Scientific and Technological Enterprise:

C3. Science, Technology and Society

a. Describe how science and technology can help address societal challenges including population, natural hazards, sustainability, personal health and safety, and environmental quality.

b. Identify personal choices that can either positively or negatively impact society including population, ecosystem sustainability, personal health, and environmental quality.

c. Identify factors that influence the development and use of science and technology.

C4. History and Nature of Science

b. Describe a breakthrough from the history of science that contributes to our current understanding of science.

D. The Physical Setting:

D1. Universe and Solar System

a. Describe the different kinds of objects in the solar system including planets, sun, moons, asteroids, and comets.

b. Explain the motions that cause days, years, phases of the moon, and eclipses.

c. Describe the location of our solar system in its galaxy and explain that other galaxies exist and that they include stars and planets.

D2 . The Earth

f. Give examples of abrupt changes and slow changes in Earth Systems.

D4. Force and Motion

c. Describe and apply an understanding of how the gravitational force between any two objects would change if their mass or the distance between them changed.

E. The Living Environment:

E5. Evolution

a. Explain how the layers of sedimentary rock and their contained fossils provide evidence for the long history of Earth and for the long history of changing life.

Social Studies -

History.

E1. Historical Knowledge, Concepts, Themes and Patterns

b. Identify and analyze major historical eras, major enduring themes, turning points, events, consequences, and people in the history of Maine, the United States and various regions of the world.

E2. Individual, Cultural, International, and Global Connections in History

b. Identify and compare a variety of cultures through time, including comparisons of native and immigrant groups in the United States, and eastern and western societies in the world.

9 – D

Science and Technology -

D. The Physical Setting:

D1. Universe and Solar System.

a. Explain why the unit of light years can be used to describe distances to objects in the universe and use light years to describe distances.

c. Outline the age, origin , and process of formation of the universe as currently understood by science.

D4. Force and Motion

a. Describe the contribution of Newton to our understanding of force and motion, and give examples of and apply Newton's three laws of motion and his theory of gravitation.

b. Explain and apply the ideas of relative motion and frame of reference.

c. Describe the relationship between electric and magnetic fields and forces, and give examples of how this relationship is used in modern technolotgies.

E. The Living Environment:

E1. Biodiversity

b. Describe the role of DNA sequences in determining the degree of kinship among organisms and the identification of species.

Performance Indicators Snapshot

The Show

Grades Pre. K-2.

Science and Technology
C1.a,b; D3.a,b

Grades 3-5.

Science and Technology
A2.a; A3.a; D1.a,b; D4.c
Social Studies. History
E1.b
English Language Arts
A2.a; E2.a

Grades 6-8.

Science and Technology
C3.a,b,c,d ; C4.b; D1.a,b,c; D2.f; D4.c; E5.a
Social Studies – History
E1.b; E2.b

Secondary

Science and Technology
C3.b,c; D1.a,c; D4.a,b,c

The Guide

Grades 3-5.

Science and Technology
B1.a,e,d,f; B2.b; C1.a; D1.a,b,c; D2.a

Grades 6-8.

Science and Technology
B1.f; B2.b; D1.a,b

Grades 9-Diploma.

Science and Technology
E1.b

Hunters and Gatherers

Objectives and State of Maine Learning Results Performance Indicators:

1. Learners will be able to understand the relationship that other cultures see between Earth and the Moon. (3-5. Science and Technology. D1.a.) (6-8. Science and Technology. D1.a) (9. Social Studies. History. E1.b)
2. Learners will be able to describe how Native Americans used legends, stories, and actual events to name the phases of the moon. (3-5. Science and Technology. C1.a)

The General Idea:

Native Americans of different tribes and nations invented names for each Full Moon of the year. These names helped them to keep track of the full moons of each season. So the December full moon would be called the Long Night Moon, since days are at their longest during this month of the year. Other names for the Full Moons of the year come from activities that the tribe would have been doing during that time of year.

What To Do:

1. Look at the list below to try and imagine what activity would have been described by the Full Moon names for each month. Hints: Native Americans treated the animals of the woods and prairie as other people of the Earth and members of their society.

January	--	Moon After Yule, Old Moon
February	--	Snow Moon, Hunger Moon, Wolf Moon
March	--	Sap Moon, Crow Moon, Lenten Moon
April	--	Grass Moon, Egg Moon
May	--	Planting Moon, Milk Moon
June	--	Rose Moon, Flower Moon, Strawberry Moon
July	--	Thunder Moon, Hay Moon
August	--	Green Corn Moon, Grain Moon
September	--	Fruit Moon, Harvest Moon
October	--	Hunter's Moon
November	--	Frosty Moon, Beaver Moon
December	--	Moon Before Yule, Long Night Moon

2. The full moon closest to the autumnal equinox is often called the Harvest Moon. For some, the Harvest Moon is that which occurs on or after the autumnal equinox. In either case, this means that the October full moon may end up being the Harvest Moon.

What To Discuss:

1. Americans at the beginning of the 21st century may not be as close to nature in their everyday lives as the Native American who invented these names. Have students discuss the life of the community from season to season, from month to month, and invent their own names for the full moon of each month of the year. Have them write a short description to explain how the full moon name describes the activities of the community or their families.

Building a Lunar Settlement

Objectives and State of Maine Learning Results Performance Indicators:

1. Learners will be able to recognize (brainstorm) needs for human survival in space. (3-5. Science and Technology. B1.a,e.)
2. Learners will be able to design and build a model lunar settlement. (3-5. Science and Technology. B1.d, B2.b) (6-8. Science and Technology. B2.b)
3. Learners will be able to communicate their design concepts and ideas with other students. (3-5. Science and Technology. B1.e) (6-8. Science and Technology. B1.f)

The General Idea:

Here is a chance for you to use up some of those interesting scraps and snips of things that most people throw away, but could make perfect components for a model lunar settlement. In this activity, students first think of everything they would need to survive for years on a lunar settlement, and then design and build a model of such a settlement from various easy-to-find parts.

This activity can take on different meanings with different age groups. For older students, the question of what is necessary to survive in space can have special significance, since they soon may be candidates for space missions themselves. For younger students, this activity is more of an open ended creative process of building a home on the moon.

Getting Ready:

- Gather supplies listed below.
- Arrange all building materials on a large table and in boxes beside the table.

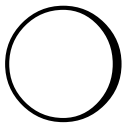
What You Need:

Board of 1/8" plywood or poster board, about 1' x 1- 1/2'
Cardboard
Poster board
Straws
Cardboard tubes
Pins
Corks
Tape
Glue
Plastic cups
Paper cups
Styrofoam cups
Plastic wrap
Aluminum foil
Plastic bags
Wire
Filter material
Styrofoam or Dylite balls (various sizes)
Styrofoam packing blocks (cut to interesting shapes)
Scissors
Doodads, whatever else you can think of.

What To Do:

1. Tell students that they are going to build a model moon settlement.
2. Pretend that they are going to live on the moon for at least a year, possibly 5 to 10 years! What will they need to have on their space settlement on the moon in order to survive and be happy? Have students record the needs on paper.
3. You can record a summary of student responses on a large sheet of flipchart paper or on the blackboard. Individual student's lists of needs do not have to be identical, but they should all include provisions for basics such as food, air, communication, bathrooms, etc.
4. The settlement will be built on a piece of poster board or plywood representing the moon's surface. If you wish, you may opt to build a free standing or orbiting settlement, in which case you probably will not need the board on which to build.

What To Discuss:



1. What things will you NEED to have on the moon?
2. Are there things that you would WANT to have? Are those things feasible to take along?

Continuations/Extensions:

1. Watch part of the NOVA video “To the Moon” and discover what the Apollo astronauts carried along and why.

The Maynard F. Jordan Planetarium - Cosmic Classroom Activity

A Month of Moons

Objectives and State of Maine Learning Results Performance Indicators:

1. Learners will be able to explain that the motion of the moon around the Earth causes the phases of the moon (6-8. Science and Technology. D1.b)
2. Learners will be able to make predictions of upcoming moon phases (6-8. Science and Technology. D1.b)
3. Learners will be able to discuss the scientific and practical aspects of the activity (3-5. Science and Technology. B1.e)

The General Idea:

Long ago people invented the word "MONETH" to describe the length of time it takes for the moon to show all of its different phases. By carefully watching the changing appearance of the moon, you are watching time pass. Some people know the moon so well, they can tell how many days have gone by since the last time they looked at the moon. You can begin to know the moon by keeping a record of the changing moon as the month, or moneth, goes by.

Getting Ready:

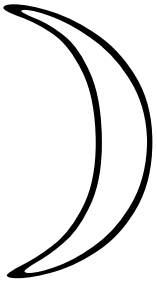
- Talk with your students before they begin their moon journals so that they understand the things that they need to look for and what they need to write down.

What You Need:

Notebooks for moon journals
Pictures of the moon for reference

What To Do:

1. On every clear night for one whole month, have students try to find the moon in the sky.
2. If it is there, make a drawing of the way that it looks. Use a pencil or crayons to draw the shape of the moon and color the markings that you see on the moon.
3. If it is a dark sky and they can see stars near the moon, put the stars in their drawing with larger dots for brighter stars, and smaller dots for dimmer ones.
4. Under each drawing, have them write the month and day and time when they saw the moon, how high up in the sky it was (a good way to have them measure this is by “stacking” their fists at arm length, so the moon would be “four fists” off the ground), and where it was in relation to sunset (it was close to where the sun sets, it was opposite where the sun sets, etc.).
5. If they see the moon in the daytime, they better draw it then. It may not be in the sky by the time it gets dark!
6. Compare students’ drawings of the Moon. Together, you can make a calendar of the moon and the way it looks for one entire month (or moneth). For this part of the activity, you can use the Moon Phases worksheet provided.



What To Discuss:

1. Is there a pattern to the changing moon?
2. Can you see the moon in the same place at the same time every night?
3. Based on your moon calendar, when is the next full moon?

Stars Give Off Light

Based on Stars give off light. The moon and planets reflect light. by Susan Reynolds and Onondaga-Cortland-Madison Board of Cooperative Educational Services math, Science and Technology.

Objectives and State of Maine Learning Results Performance Indicators:

1. The learners will be able to explain that stars give off light (3-5. Science and Technology. D1.c)
2. The learners will be able to demonstrate an understanding that moons and planets get their light from stars. (3-5. Science and Technology. D2.a)
3. The learners will be able to show that the Sun is a star(3-5. Science and Technology. D1.c).
4. The learners will be able to describe the effects of sunlight on how we see other stars during the day.

The General Idea:

To the untrained eye, the night sky is ablaze with the light of thousands of tiny dots. From here on Earth it is sometimes hard to tell the stars from the planets. This activity will help students understand that while both the stars and planets appear to shimmer in the night sky, they are very different objects indeed.

Getting Ready:

- Provide half of the students with Styrofoam balls of varying sizes and the other half with flashlights of varying brightness.

What You Need:

Styrofoam ball
Flashlights
Slide projector
Penlight

What To Do:

1. Hand out the Styrofoam balls and flashlights
2. Darken the room
3. Have the students with the flashlights (the “Stars”) shine away from the Styrofoam balls (the “planets”)
4. Now have the “stars” shine ON the “planets”

What To Discuss:

1. Are the “planets” easy to see?
2. Is it easier to see the “planets” with the “stars” shining on them?
3. Do moons and planets give off light of their own?

What To Do:

1. Have a student hold a penlight next to a an unlit slide projector
2. Ask the students how easy it is to see the light from the penlight (easy)
3. Turn on the slide projector (warn students NOT to look into the light from the slide projector because it could hurt their eyes)
4. Ask the students if it’s still easy to see the penlight or if they can see it at all now (no)

What To Discuss:

1. Why couldn't we see the penlight as well when the projector was on?
2. If the slide projector is the Sun and the penlight is a star, what effect does the Sun have on our ability to see stars during the day?
3. Why can't we see stars during the day?

Extensions/Continuations:

1. Have students create "legends" about why we cannot see stars during the day, perhaps putting them together into a class book or a book for the library.

The Maynard F. Jordan Planetarium - Cosmic Classroom Activity

Telling Time by the Phases of the Moon

Objectives and State of Maine Learning Results Performance Indicators:

1. Learners will be able to tell time by the phase and position of the moon using a Moon Phaser (3-5. Science and Technology. D1.a.) (6-8. Science and Technology. D1.b)

The General Idea:

The silvery moon high in the sky is a beautiful and familiar sight. But did you know that the moon actually follows a very rigid pattern in its trip around the Earth? By using a Moon Phaser you can determine the time of day by comparing the sun and the moon positions. This activity, and subsequent uses of the Moon Phaser, will help student to recognize the moon's repetitive path around the Earth.

Getting Ready:

- Make photocopies of the attached Moon Phaser pattern
- It's good to do this activity on a day when the moon is visible during the school day

What You Need:

A copy of the Moon Phaser Pattern for each student
Scissors for each student
A hole punch
A paper fastener for each student

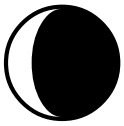
What To Do:

1. Hand out a copy of the Moon Phaser Pattern to each student
2. Have the students cut out both parts of the Moon Phaser and punch a hole in the appropriate place on each piece.
3. Connect the two pieces with a brass paper fastener (with the Horizon Card on top).
4. When the students are finished making their Moon Phasers, take the class outside to a place where the moon is viable.
5. Hold the moon Phaser so that the half circle Horizon Card has the word HORIZON right side up.
6. To find the time that a phase of the moon rises, rotate the horizon card until the desired phase is at the "E" (East). The "To the Meridian" arrow will point to the time of rising.
7. To determine when the moon phase crosses the meridian (when it is at its highest point in the sky as it travels from East to West), rotate the Horizon Card until the desired phase is lined up with the "To the Meridian" arrow. Read the time pointed to by the "To the Meridian" arrow.
8. To find the time that a phase of the moon sets, rotate the Horizon Card until the desired phase is at the "W" (West). The "To the Meridian" arrow points to the time of setting for that phase.
9. To tell time by the moon's phase and sky position, locate the moon in the sky. Rotate the Horizon Card until the Moon Phaser matches the sky. Read the time that the "To the Meridian" arrow points to.

What To Discuss:

1. How is it possible to tell time by the phase and position of the moon?
2. What causes the phases of the moon to change?
3. How accurate are the Moon Phasers that the class made?
4. Is that as accurate as they can get?
5. How might they be made more accurate?

Continuations/Extensions:



1. The moon rises about an hour later each day as a result of the moon's orbit around the Earth and the Earth's orbit around the Sun. This means that more of the moon's surface becomes visible to us as each day passes. About seven days after the new moon the first quarter moon rises. Have students determine when the first quarter moon rises, when it sets, when it crosses the meridian, etc. You might also want to have students find out information such as where the moon will be when the sun sets, etc. You can also repeat these steps with other moon phases. Then have students look for the moon at that time on that day to see if their predictions where correct.

Vocabulary List

Axis	An imaginary straight line around which an object rotates.
Astronomical Unit - AU	The average distance from the Earth to the Sun, 93million miles.
Constellation	A grouping of stars, considered by humans to form a picture in the sky. Often related to mythology.
Day	The time it take for a planet to make one full rotation (on Earth, 24 hours).
Diameter	The distance from one side of an object to another as measure through the center.
Galaxy	A cluster of stars, dust, and gas held together by gravity.
Gravity	The force of attraction between two objects which is influenced by the mass of two objects and the distance between the two objects.
Hubble Space Telescope	the most sophisticated optical observatory ever placed into orbit around the Earth.
Light	Radiation that can be detected by the human eye.
Milky Way galaxy	large spiral galaxy consisting of several billion stars, one of which is the Sun.
Moon	A natural satellite orbiting a planet.
Orbit	A specific path followed by a planet, satellite, etc.
Phase	The name for the different appearance of the moon over the course of a month. The phases change because of the changing position of the moon as related to the sun.
Planet	A massive object orbiting a star.
Revolution	The circling of a smaller object around a larger object.
Rotation	The spinning of an object on its axis.
Scale	Reducing all objects and distances by a percentage so that they are within a workable size.
Solar System	The system of planets, moons, and other objects revolving around a star (in our case, the Sun).
Star	A massive, self-luminous celestial body of gas that shines by radiation derived from its internal energy sources.
Sun	Sol, the star that is closest to Earth and from which we get heat and light energy.
Universe	The vast expanse of space which contains all of the matter and energy in existence.
Year	The time it take for a planet to make one full revolution around a star, in our case, the Sun (on Earth, 365.25 days).

Some good books to use with *Moon Shadows*

Apollo on the Moon and Moon Rocks
Cooper, H. 1970, Dial.
Accounts of the Apollo 11 mission and the material they brought back from the lunar surface.

The Earth's Moon
Asimov, 1. 1988, Gareth Stevens.
Examines the many facets and puzzles of our Moon

Exploring the Moon Through Binoculars and Small Telescopes
Cherrington, E. 1984, Dover.
Good guide to a variety of lunar observations.

The Moon
Moore, P. 1980, Rand McNally.
A reference atlas.

The Moon
Simon, Seymour. 1984, Four Winds Press

Moon
Sorensen, Lynda. 1993, Rourke Corp.
Photographs and text present information about the surface, orbit, and phases of the moon.

The Moon
Tesar, Jenny E. 1998, Heinemann Interactive Library.
Introduces the Earth's moon, discussing its surface, far side, tides, phases, and eclipses.

The Moon Book
Gibbons, Gail. 1997, Holiday House.
Identifies the moon as our only natural satellite and discusses how we have explored it.

The Moon Observer's Handbook
Price, F. . 1989, Cambridge University Press.

The Moon: Our Sister Planet
Cadogan,P. 1981, Cambridge University Press.
A somewhat technical but clear introductory text.

So That's How the Moon Changes Shape!
Fowler, Allan. 1991, Childrens Press.
A simple explanation of the moon and why it changes shape throughout the month.

Where Does the Moon Go?
Rosen, Sidney. 1992, Carolrhoda Books.
Follows the moon through its twenty-eight-day trip and identifies its different phases.

Where No Man Has Gone Before
Compton, W. 1989, NASA SP - 4214.
History of Moon exploration.

Countdown to the Moon
Gold, Susan Dudley. 1992, Maxwell Macmillan International.
Describes the genesis, growth, and realization of America's plan to land men on the moon.

First to the Moon

Bay, Timothy. 1993, SRA School Group.
Discusses the first flight to the moon and the importance of the space program.

Man on the Moon
Suen, Anastasia. 1997, Viking.
Describes in illustrations and simple text the Apollo 11 mission to the moon.

Science project ideas about the moon.
Gardner, Robert. 1997, Enslow Publishers.
Introduces the phases and other characteristics of the moon.

Some good web sites to use with Moon Shadows

seds.lpl.arizona.edu
Created by Students for the Exploration and Development of Space (SEDS) at University of Arizona.

tycho.usno.navy.mil/vphase.html
View the phases of the moon at any time on any date, site maintained by the U. S. Navy Observatory.

nssdc.gsfc.nasa.gov/planetary/lunar/apollo_25th.html
The Lunar Exploration page by the national Space Science Data Center.

Lessons from The World Wide Web

Also, a wide variety of lesson plans and activities can be found on the World Wide Web. These sites are dedicated to lesson planning in a variety of subjects.

cse.ssl.berkeley.edu
The Center for Science Education at U. C. Berkeley Space Science Laboratory home page with a link to the Science Education Gateway, Lesson Plans

btc.montana.edu/ceres
Maintained by the Burns Telecommunications Center, this page links to educational activities and classroom resources.

spaceplace.jpl.nasa.gov/spacepl.htm
This California Institute of Technology and NASA Jet Propulsion Laboratory site for kids offers information and activities .

school.discoveryeducation.com/
This Discovery Channel education site allows teachers to search for lesson plans by grade and subjects.

www.eduref.org/cgi-bin/lessons.cgi/Science
Science lesson plans from the Educator's Reference Desk.

www.thegateway.org
Sponsored by The U.S. Department of Education's National Library of Education and ERIC Clearinghouse on Information & Technology, this site offers lesson plans for all subjects and all grades.

Astronomy Web Sites Worth a Visit

www.galaxymaine.com
The Maynard F. Jordan Planetarium and Observatory home page.

www.galaxymaine.com/SA/SA2.htm
The teacher resources and bibliography page on the Maynard F. Jordan Planetarium web site

space.jpl.nasa.gov
NASA's Jet Propulsion Laboratory web site

ssd.jpl.nasa.gov
A site about our solar system maintained by the Solar System Dynamics Group of the Jet Propulsion Laboratory.

www.clearsail.net/students.htm
School/Student links from the ClearSail student fun and research site

hawastsoc.org
The Hawaiian Astronomical Society's home page

www.nss.org/
The National Space Society webpage

stardate.org
Learn what's going on TODAY in astronomy on the "Star Date" web page, maintained by the University of Texas' McDonald Observatory

The Maynard F. Jordan Planetarium does not guarantee that the information given on the above web sites to be accurate, accessible, or appropriate for students.

Activities/Worksheets

Moon Phaser Pattern
Moon Phaser Calendar