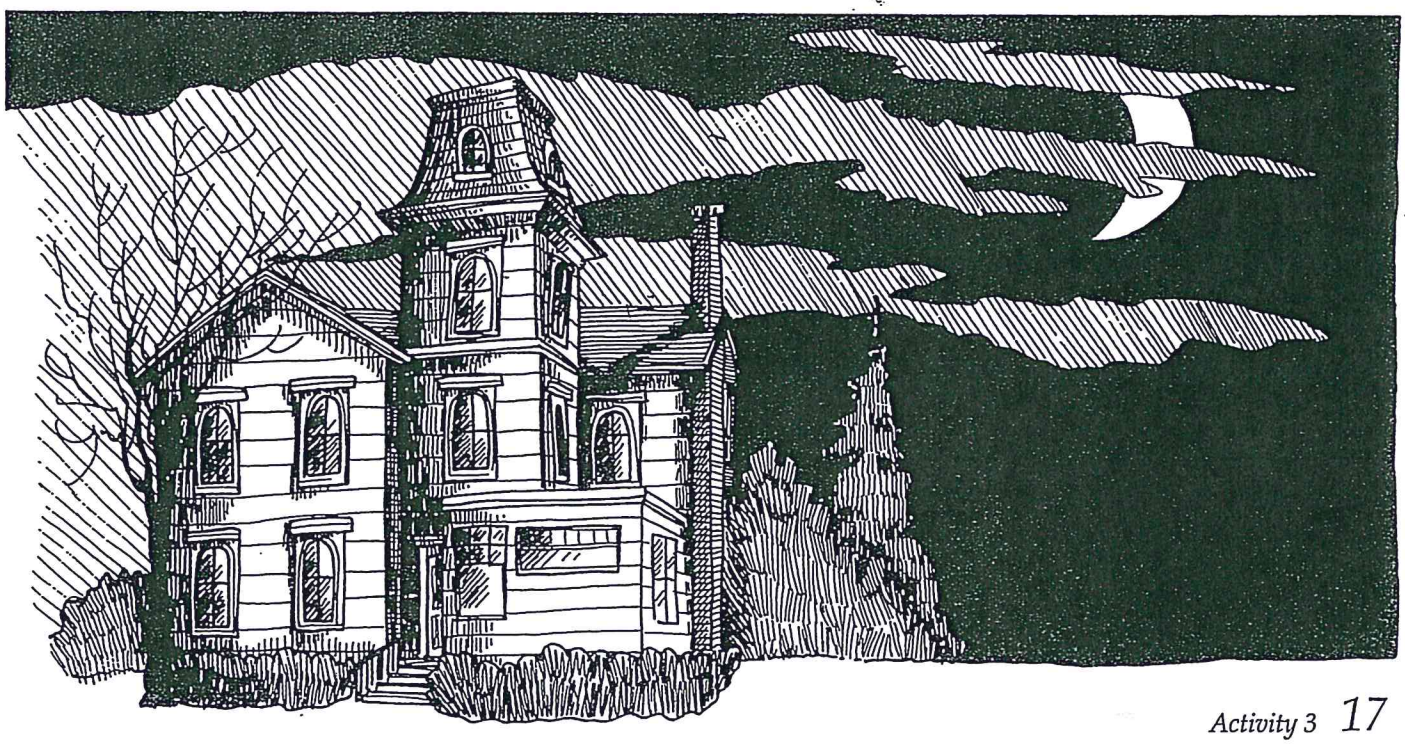
Activity 3: Observing the Moon

Introduction

When asked why the Moon has different shapes at different times, your students are likely to give a variety of answers. Some commonly expressed ideas are: "clouds are covering the Moon," or "the Earth's shadow is in the way." These ideas are reasonable since clouds do cover the Moon sometimes and the Moon does pass into the shadow of the Earth occasionally. However, they are not correct explanations for the phases of the Moon. Furthermore, students who can explain the reason for the Moon's phases correctly may nevertheless have some difficulty supporting their explanations with evidence.

In this activity your students observe the important clues that made it possible for the first astronomers, over 2,000 years ago, to figure out that phases of the Moon are caused by the Moon's position relative to the Sun. Through their own observations, students come to realize that the lighted portion of the Moon is always on the side facing the Sun. They also observe that the farther the Moon appears from the Sun in the sky, the greater the lighted portion—the crescent phase when the Moon appears closer to the Sun, through full phase, when the Moon appears farthest from the Sun.



Time Frame

Part I:	Measuring in Fists one 40-minute session
Part II:	Observing the Moon six 15-minute sessions
Part III:	Summarizing the Data one 40-minute session

Knowing a few things about the motion of the Sun and Moon in the sky will help you plan times for your class to observe the Moon in the daytime.

1. The Moon, like the Sun, is visible for an *average* of 12 hours per day—sometimes longer, sometimes shorter.

2. The Moon, like the Sun, rises from the eastern horizon and sets toward the western horizon. (The rising point is not necessarily due east; the setting point not necessarily due west.)

3. Because the Moon orbits around the Earth, its position in the sky changes continuously. The Moon moves one full moon diameter every hour, 24 hours a day. Because of this orbital motion, the rising and setting times for the Moon change every day. It can rise and set at any time, day or night!

4. The Moon rises and sets an *average* of 50 minutes *later* each day.

You can use this information to schedule this activity so that the Moon is visible in the sky during the daytime. First, check a newspaper or calendar to find out the date of the next full moon. Also, find out the time of sunrise (within 15 or 20 minutes is fine). Now, make a quick calculation:

1. The full Moon will set in the west just about when the Sun is rising in the east.

2. One day later, the Moon will be higher in the west and set about 50 minutes *after* sunrise.

3. Two days later, the Moon will be higher still and will set about one hour and 40 minutes (100 minutes) *after* sunrise.

4. Three days later, the Moon will set about 2.5 hours (150 minutes) *after* sunrise.

5. And so on ...

If your class is going to "measure fists" during the early morning, you may only need to wait three or four days after the full moon to start observing. If your class is going to make measurements in the afternoon, you will need to wait a greater number of days for the Moon to be visible when you go outside. Moon observations do not have to be made at the same time every day, because your students will measure the separation of the Sun and the Moon, not where they are in relation to the horizon.

If you teach science in the late afternoon, you may want to start observations about a week after new moon, instead of a few days after full moon. In that case, you will see the Moon some distance to the east of the Sun during the school day. However, as days pass, the Moon will be visible only in the evening, so students would have to make the observations as homework.

What You Need

For the class:

- ❑ 2 large sheets of butcher paper
- ❑ 1 felt-tipped marker or crayon
- ❑ 1 roll of masking tape

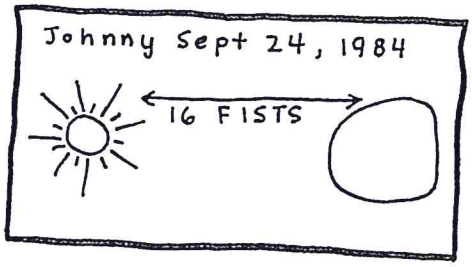
For each student:

- ❑ 1 pencil
- ❑ 10 sheets of paper
- ❑ 1 manila folder
- ❑ 1 calculator (optional)

Getting Ready

1. Just before the first class, go outdoors and find the Moon, to make sure it is not obscured by clouds, trees, or buildings. It will appear as almost full (called a gibbous moon), on the opposite side of the sky from the Sun. If it is cloudy, plan to begin on the next clear day.

2. Make sure you have paper, pencils, and manila folders on hand.



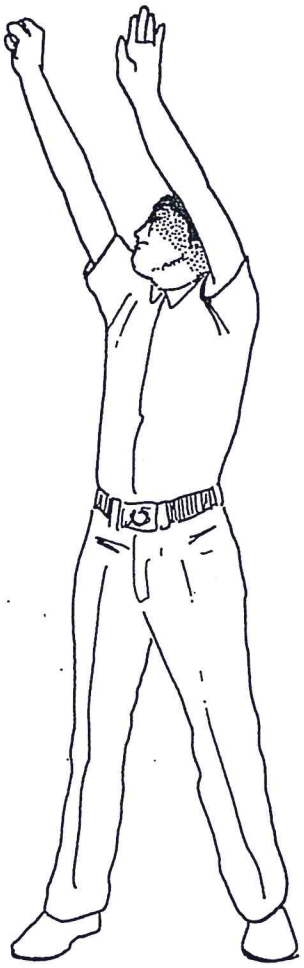
Part I: Measuring in Fists

1. Ask the following questions:

- Did anyone see the Moon this morning?
- If yes, what shape was it?
- Do you think the Moon will be visible tonight? Tomorrow morning?
- If yes, what shape do you think it will be?

2. Explain to your students that they are about to begin observing the Moon for a month They will learn the answers to these questions from their own observations.

3. Provide your students with paper, pencils, and manila folders (to use as writing surfaces). Then go outdoors and find the Moon!



4. Gather the students in a spot where they can see the Sun and the Moon. Ask them to describe the shape of the Moon, and to notice which side of the Moon faces toward the Sun.

5. Ask the students to draw the Sun and the Moon just as they appear in the sky. Give them time to complete their drawings, and have them put their names and the date on the paper.

6. Show the students how to measure the distance between the Sun and Moon in "fists" as follows:

a. Hold one hand over the Sun to shield your eyes. Or, stand in the shadow of a building so the Sun is just barely hidden.

b. Make the other hand into a fist, and hold your arm out straight.

c. Hold your fist so the wide part points toward the Sun.

d. Move your fist toward the Moon one "fist-width" at a time, counting as you go. With practice, your students' measurements of the number of fists between the Sun and Moon will become more consistent.

7. Ask your students to measure the distance between the Sun and the Moon three or four times, until they get about the same number each time. Then quickly poll the entire class to find out how many fists they measured. Help individuals whose measurements differ from the group average by more than three fists.

8. Instruct your students to write the number of fists they measured next to the drawing of the Moon. Then tell the students to put their drawings into their folders.

Part II: Observing the Moon

1. As possible, take your students outdoors every day or every other day to make a new drawing, on a new sheet of paper, of the Sun and Moon. Each drawing should show how the Sun and Moon appear in the sky, the distance between them in fists, and the date. If it is cloudy for a day or two, go out on the next clear day. A total of five or six measurements is adequate.

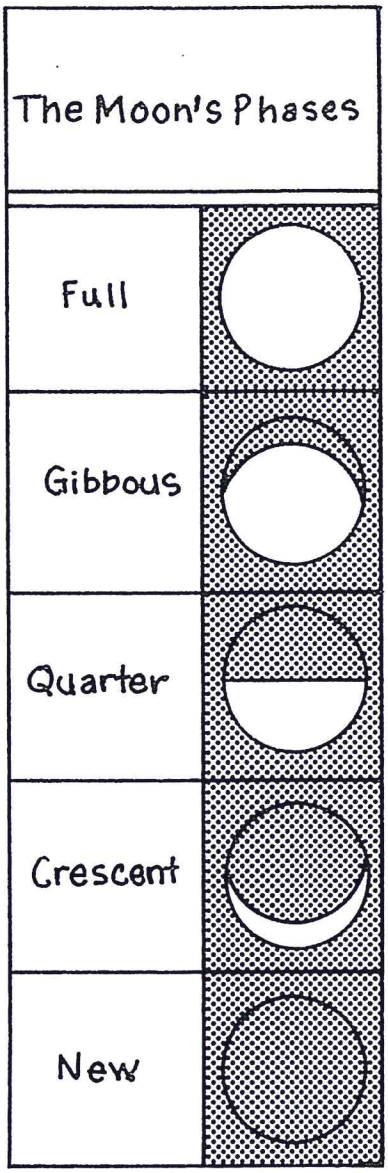
2. After you return to the classroom following each observation, spend a few minutes discussing how the Moon has changed shape, and its distance from the Sun. Each time, ask the students to notice which side is facing toward and away from the Sun. Ask your students to predict what shape the Moon will be in two or three days, and how many fists from the Sun it will be.

3. You may wish to introduce the terms for the phases of the Moon as they are needed. When the Moon disappears from vision altogether it is called a *new moon.* When it appears as a half disc it is technically called a *quarter moon,* but most students prefer to call it a *half moon. First quarter* phase occurs about 7 days before full moon and *last quarter* phase occurs about 7 days after full moon. When it is less than a half disc it is called a *crescent* phase—*waning crescent* before new moon and *waxing crescent* after new moon. When it is more than a half disc it is called *gibbous* phase—*waxing gibbous* before full moon and *waning gibbous* after full moon.

Part III: Summarizing the Data

1. After about ten days, the Moon will no longer be visible during the daytime. That is the time to summarize the observations.

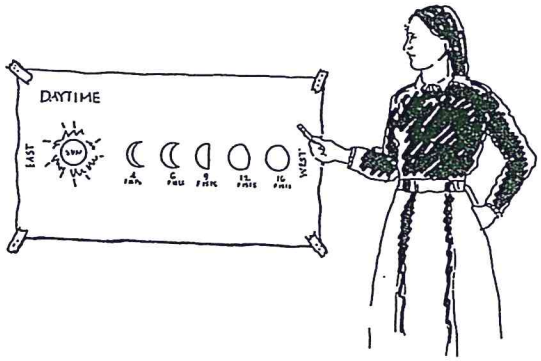
2. Place a large sheet of butcher paper on the wall. Ask your students to take out their folders of moon observations. For the first day's observations, poll the class to find



You may need to clarify the terms waxing and waning.
Waning means declining or fading away.
Waxing means increasing.

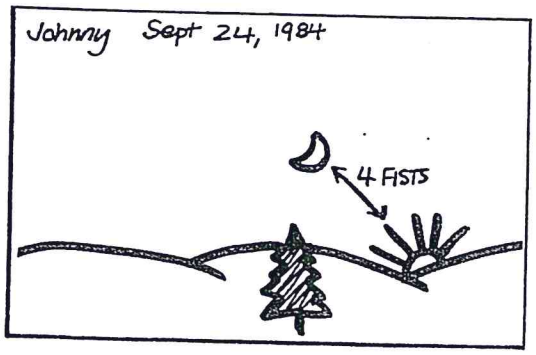
out the approximate number of fists between the Sun and the Moon on that day. List their answers on the chalkboard, then ask them to estimate the average number of fists for that day. Students in upper elementary and higher grades can work out the exact averages using paper and pencil or calculators.

3. Use a marker to draw the Sun and Moon as they appeared on that date. Write the date and the average number of fists next to the Moon. For each day's observation, add one more image of the Moon, the date, and the number of fists.



4. Ask your students to describe the pattern revealed on the large sheet of paper. Their descriptions should include the following conclusions:

- Each morning the Moon moves closer to the Sun.
- As the Moon moves closer to the Sun, its shape appears thinner.
- The lighted portion of the Moon is always on the side facing the Sun.



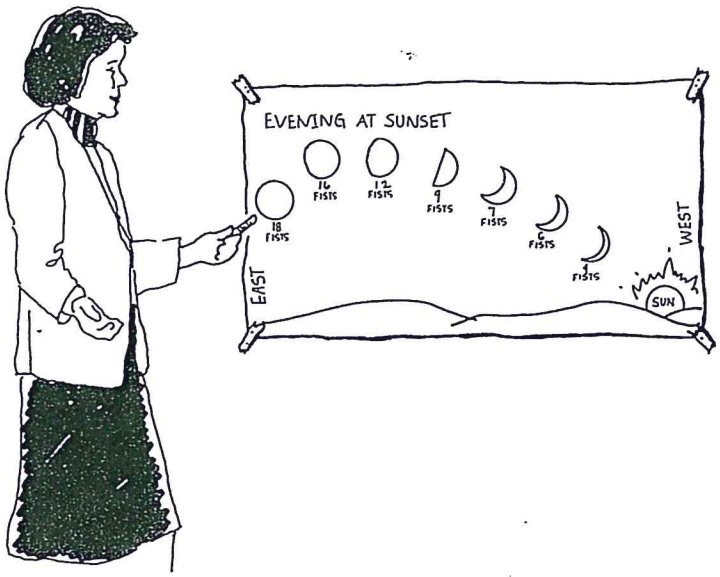
5. After your students summarize their observations, ask them to think further about the Moon's cycle by asking them:

- Where is the Moon now?
- Why can't we see it any more?
- When will we be able to see the Moon again?
- Where will it be?

6. Even if your students have difficulty answering these questions, they have learned enough about the moon's monthly cycle to go on to Activity 4, "Modeling Moon Phases and Eclipses." That activity will help them answer the above questions.

7. (*Optional*): Two or three days after the new moon phase, the Moon will appear as a thin crescent near the setting Sun in the evening. As a homework assignment, have your students watch to see when the Moon first becomes visible. Have them draw the Moon every evening at sunset when possible, marking the date and number of fists between the Sun and Moon. (*Note:* They need only three or four observations on cloudless evenings to draw their conclusions.) Tell your students to add their drawings to their folders. When the Moon is full (about two weeks after the new moon) summarize the observations on a large sheet of butcher paper as you did before. Your students will be able to draw the following conclusions:

- Each evening, the Moon moves away from the Sun.
- As the Moon moves farther from the Sun, its shape appears rounder.
- The lighted portion of the Moon (before it appears full) is always on the side facing the Sun.



Mt. Nose

A Model of Day and Night

Before you do the moon balls activity in this session, but with the lamp already set up, there is a great opportunity to model day and night. This relates to the explanations the students explored in Session I and helps students gain understanding through their own direct perceptions.

1. Gather the class in a circle around the lamp. Explain to the students that each of their heads represents the Earth. The light in the center represents the Sun.

2. Ask the students to imagine that their nose is a mountain and that a person lives on the tip of "Mount Nose." With the students facing the lightbulb, ask, "For the person on your Mount Nose, where in the sky is the sun?" [high in the sky, overhead] Ask, "What time of day do you think it is for the person on Mt. Nose?" [around noon]

3. Ask the students to turn to their left, and stop when their right ears are facing the sun. Ask, "For the person on Mount Nose, where in the sky does the sun seem to be? [near the horizon, low in the sky] Ask, "What time of day is it for the person?" [sunset]

4 Have the students continue to turn, stopping when their backs are to the lightbulb. Ask, "What time is it for the person on Mount Nose?" [around midnight] On what part of your head is it daytime? [the back of your head, because it is now facing the sun]

5. Have the students make another quarter turn, so that their left ears face the sun. Where is the sun? [low in the sky, just "coming up"] What time is it? [sunrise] Have the class turn back to face the light.

6. You may want to have students hold their hands to the sides of their heads to form "horizons" The left hand is the "eastern horizon" and the right hand is the "western horizon." Tell the students to turn slowly and watch for "sunrises" from their "left hand/eastern horizon" and sunsets on their "right hand/western horizon."

7. Remind the class of the term model, as someone's explanation for something that has been observed. Scientists today use a model like the one they have just made to explain the way the Sun seems to move in the sky.