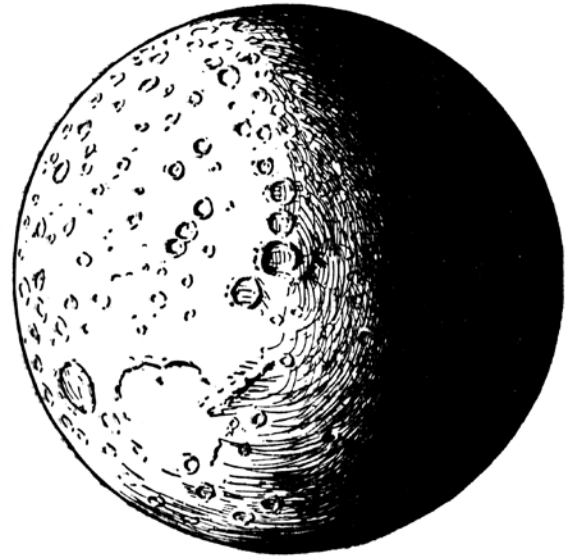


Observe the Moon's Phases



General Information

- ★ Grade level: All cycles
- ★ Students per group: Individual or group activities
- ★ When: After the Planetarium visit
- ★ Duration: One 50-minute period, and a few minutes a day for one month
- ★ Where: In class or at home (outdoors or through the window)
- ★ Subjects covered: Science and technology, Visual Arts
- ★ Essential knowledge:
 - > **Preschool:** Cognitive and metacognitive strategies (observing, exploring, comparing, questioning); learning related to cognitive development (visual arts, mathematics, science and technology, concepts related to space and quantity).
 - > **Elementary: Science and Technology:** The Sun-Earth-Moon system; terminology related to understanding the living and material world, Earth and space — **Visual Arts:** transforming gestures and their extension, the tools; language of visual arts; visual arts production.
- ★ Compulsory Concepts:
 - > **Secondary: Science and Technology:** Concepts related to astronomy; the solar system (phases of the Moon); exploration, instrumentation, analytical and communication strategies — **Visual Arts:** Transforming gestures, materials and tools; visual arts production; visual arts and multimedia language (elements and space); using transforming gestures and elements of visual arts language.

★ Subject-specific competencies:

- > **Preschool:** Perform sensorimotor actions effectively in different contexts; interact harmoniously with others; communicate using the resources of language; construct his/her understanding of the world; complete an activity or project.
- > **Elementary: Science and Technology:** Explore the world of science and technology; propose explanations for, or solutions to, scientific or technological problems; make the most of scientific and technological tools, objects and procedures; communicate in the language of science and technology — **Visual Arts:** Produce individual works in the visual arts.
- > **Secondary: Science and Technology:** Seek answers or solutions to scientific or technological problems; make the most of his/her knowledge of science and technology; communicate in the language of science and technology — **Visual Arts:** Create personal images.

- ★ Cross-curricular competencies (**preschool, elementary and secondary**): Use information; solve problems; exercise critical judgement; use creativity; cooperate with others; communicate appropriately.

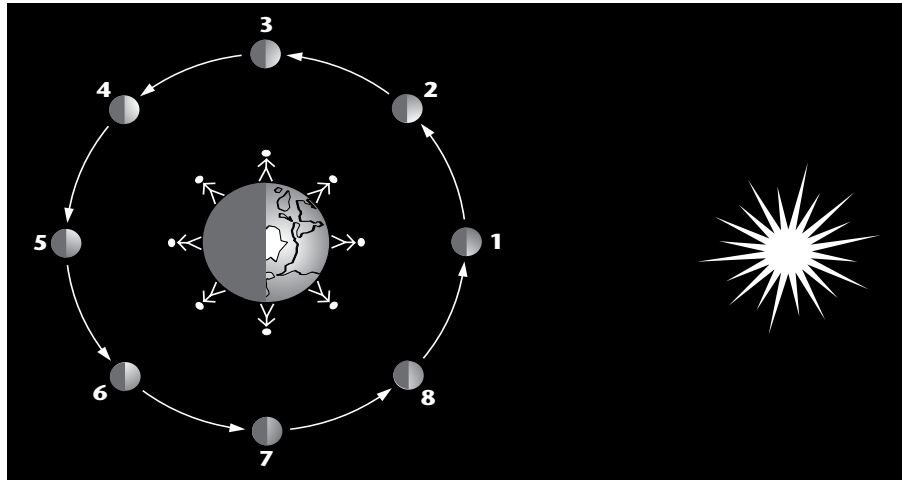
Goals

The activities found in "Observe the Moon's Phases" aim to develop children's interest in observing the sky during the day and night. Students will discover that the Moon changes its appearance from one night to the next; that these different forms of the Moon are called phases; and that they depend on the part of the lunar surface illuminated by the Sun that is visible from Earth.

The activities presented in this document can be used to help your students to better understand the mechanisms of the Moon's phases.

Basic Concepts

As we all know, the Moon's appearance changes from day to day. To understand the mechanisms of the lunar phases, bear in mind that the Moon doesn't produce its own light. Instead, it acts more like a ball, reflecting the light cast by the Sun. Half of the Moon is always lit by the Sun and the other half is in shadow. But the lit side does not always face the Earth! As the Moon circles the Earth, its lit half is seen from different angles, altering how much of the lunar face appears bright and how much is dark. These changes are known as lunar phases.



The Earth-Moon system seen from far above Earth's North Pole



What we see from the Earth: The lunar phases

How do we remember the lunar phases? Observe the Moon for a few weeks and remember the word D-O-C.

For example, when the Moon is in the same direction as the Sun, seen from Earth, the far side of the Moon is lit by the Sun, while the side facing us is dark. This is the new Moon (as in 1 in the illustration above). The Moon is therefore invisible from Earth. As it orbits the Earth, more of the Moon's lit hemisphere becomes exposed to our view, taking the form of a crescent (2). About seven days after the new Moon, the Moon has moved in its orbit to form a right angle with the Earth and Sun. From the Earth, we see half of the lunar face lit by the Sun, and half in darkness. This is the first quarter (3), during which the Moon looks like a capital "D".

During the days following the first quarter, more of the Moon's surface is lit, as seen from Earth, giving us a phase called a gibbous Moon (4), a word which means "rounded." One week after the first quarter, the Moon arrives on the opposite side of the Earth from the Sun. The lit side of the Moon is then facing the Earth: this is the full Moon (5). The Moon then looks like it is hanging from the sky like a big "O".

After the full Moon, we see less and less of the lit side: the Moon, goes through a gibbous phase again (6), like when it was between the first quarter and full Moon. About one week after the full Moon, our satellite reaches its last quarter phase (7). The Moon again forms a right angle with the Earth and Sun, but on the other side of the Earth than it was at first quarter. This time, the Moon looks like a capital "C."

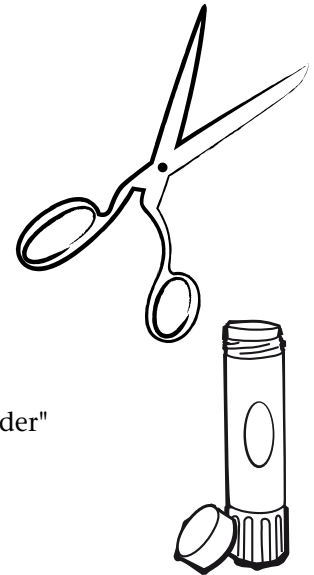
Then the lit portion of the Moon becomes smaller, taking the form of a crescent (8). About seven days after the last quarter, the Moon once again reaches the new Moon position (1), which marks the beginning of a new cycle.

Steps in the Activity

Part 1: The Order of the Phases

Supplies

- copies of WORKSHEET 1: "The Moon in All its Phases"
- copies of WORKSHEET 2: "Place the Phases in the Right Order"
- copies of WORKSHEET 3: "*Corrected* Place the Phases in the Right Order"
- scissors
- glue stick or scotch tape
- pencil (and eraser, if needed)



Advance Preparation

Make enough copies of the two worksheets, titled "The Moon in All its Phases" and "Place the Phases in the Right Order" (one copy per student).

Procedure

1. Ask students if they ever looked at the Moon in the sky, and if they noticed its appearance. Ask a few students to come draw the Moon, as they remember it, on the chalkboard.
2. Divide the class into small groups of two or three students. Ask each group to prepare the supplies they will need: scissors, pencil and glue stick or scotch tape. Distribute copies of the two worksheets: "The Moon in All its Phases" and "Place the Phases in the Right Order." Remind the students to write their name on both worksheets.
3. Have the students cut out the six photographs of the Moon. Their goal is to place them on the worksheet with blank squares (without gluing them right away!) in the order they think they would see them if they observed the Moon over several weeks. Allow 5 to 10 minutes for them to work with the photos and their different combinations.
4. As each group completes its sequence, ask why they chose that specific order. Do not judge the appropriateness of each sequence; rather, use the conversation to encourage the students' deeper thinking and to give you a better idea of their understanding of lunar phases.
5. Once each group is satisfied with the order of the photos, ask the students to tape or glue them to the blank worksheet.

Wrap-up

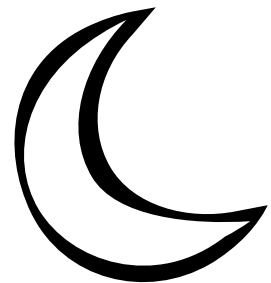
1. When all the work groups have completed their photo sequences, post the groups' sequences (use one worksheet per group) on a bulletin board or on a wall. Ask work groups to explain the reasoning they used for choosing their sequence. Encourage discussion of whether one sequence is more appropriate than another, without telling them which one is correct.

For younger students:

2. Distribute the answer sheet "*Corrected* Place the Phases in the Right Order," which shows the lunar phases in the correct order. Invite the students to fix their sequence, discussing with them the order of the phases. In particular, let them notice that the Moon is first seen as a thin crescent, then grows to become round, then shrinks again to a crescent. This sequence is known as the phases of the Moon.
3. Go to Part 2.

For older students:

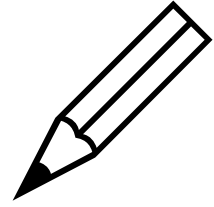
2. Resist the urge to reveal the correct sequence! The discussion should not lead to an immediate conclusion about the most appropriate sequence. It should be used to set the tone for further discovery about lunar phases.
3. Post the predictions on a bulletin board (or wall) for reference during the next activity. Tell them they will be able to review their worksheets later, and even adjust their sequence, if they deem it necessary, by cutting out new photographs of the Moon and gluing them on another worksheet.
4. Go to Part 2.



Part 2: Observe the Phases of the Moon

Supplies

- copies of WORKSHEET 4: "Lunar Observing Record Chart"
- copies of WORKSHEET 5: "Map of the Moon's Visible Face"
- clipboard or a firm writing surface (to bring outside)
- pencil (and eraser, if needed)



Advance Preparation

Make enough copies of the worksheet titled "Lunar Observing Record Chart" (one copy per student). It is best to start this activity two or three days before the first quarter Moon. Look at the following web site to determine when the next first quarter will be visible:

http://www.planetarium.montreal.qc.ca/Information/phases_lune_a.html

Procedure

Begin this activity on a sunny afternoon, when the Moon is visible in the sky. Students may not realize the Moon is often visible in the daytime, as well as at night (see table below). This allows you to help students do some daytime observations during the early part of this activity. With your assistance, students will be able to use their skills to make nighttime observations. (For the younger students, you can start observing the Moon with them at school; then ask their parents to help them at home when the Moon is visible in the evening).

Moon's Visibility and Phases

PHASE	RISES IN THE EAST*	HIGHEST IN THE SKY IN SOUTH*	SETS IN THE WEST*	VISIBILITY
New Moon	6 A.M.	noon	6 P.M.	Invisible
First quarter	noon	6 P.M.	midnight	Afternoon and evening
Full Moon	6 P.M.	midnight	6 A.M.	All night
Last quarter	midnight	6 A.M.	noon	End of night and morning

* Hours are approximate and given as an example only

1. Distribute copies of the activity worksheet "Lunar Observing Record Chart." Tell students they have an opportunity to determine the sequence of the Moon photos from Part 1 by observing the Moon and note their observations on the worksheet. They will be able to determine the real sequence of the Moon's phases.

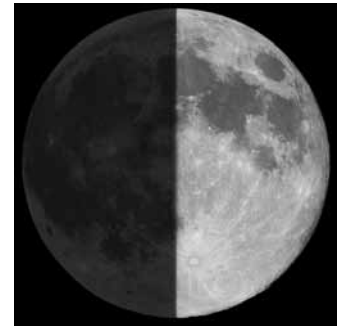
2. Explain how to use the "Lunar Observing Record Chart":
 - Go outside as a group and locate the Moon.
 - Record the day, date and time of the observation.
 - Draw the shape of the Moon as you see it. The pictures at the top of the "Lunar Observing Record Chart" will help students choose the most appropriate phase of the Moon.
 - Leave the lit portion of the Moon in white, and "gray out" the remaining part of the area of the box (see example opposite).

3. Have students go out every clear day and repeat their observations. Mention that the Moon rises about **50 minutes later** from one day to the next, and that a few days after the beginning of this activity, the Moon will be visible in the evening. Henceforth, the younger students will need to ask an adult to go outside with them. Help the students predict what the lunar phase will be, before the next observation, using the table: "Moon's Visibility and Phases."

4. To find the Moon's phase for one given day, especially if the sky is cloudy, look at the following websites:
 - For the dates of the main Moon's phases:
http://www.planetarium.montreal.qc.ca/Information/phases_lune_a.html
 - For the shape of the Moon on a given day:
<http://aa.usno.navy.mil/imagery/moon>

or regularly check the weather section of major newspapers or specialized television stations: most indicate the phase of the Moon, and the time it rises and sets.

5. After the first few observations, challenge the students to predict what the Moon's phase will be before the next observation.



Lunar phase

Date: _____

Time: _____

Draw the lunar phase on the worksheet

6. Post a classroom copy of the "Lunar Observing Record Chart" on one wall of the classroom, where daily observations are summarized.
7. Check in regularly with the students during class. One of the main challenges to the success of their observations will be the weather. Encourage them to be patient and persistent, and take advantage of "holes in the clouds" to look for the Moon.

Wrap-up

1. As the students' observations progress, ask the students to return to their groups from Part 1 and ask them to review their sequences, comparing them to their observations. Students will use their observations to determine the correct sequence of the lunar phases.
2. Compare all results. Several sequences are possible unless students know which part of the Moon is at the top. If they do not realize this multiple possibility, you may need to point it out. Steer their discussion by suggesting that they look at the Moon's surface features (such as craters, maria, and rays), which are recognizable from one image to another. Distribute the sheet: "Map of the Moon's Visible Face." Students can use these details to rotate photos they may have put "upside down" on their "Place the Phases in the Right Order" worksheet.
3. Distribute copies of the "*Corrected* Place the Phases in the Right Order" worksheet, which shows the correct sequence of the Moon's phases in the right order. Invite students to correct their sequence, and discuss with them the order of the Moon's phases. In particular, let them notice that the Moon first appears as a thin crescent, then grows to become quite round, and then decreases again to appear as a thin crescent. It is in this order that we see the lunar phases.

Going further...

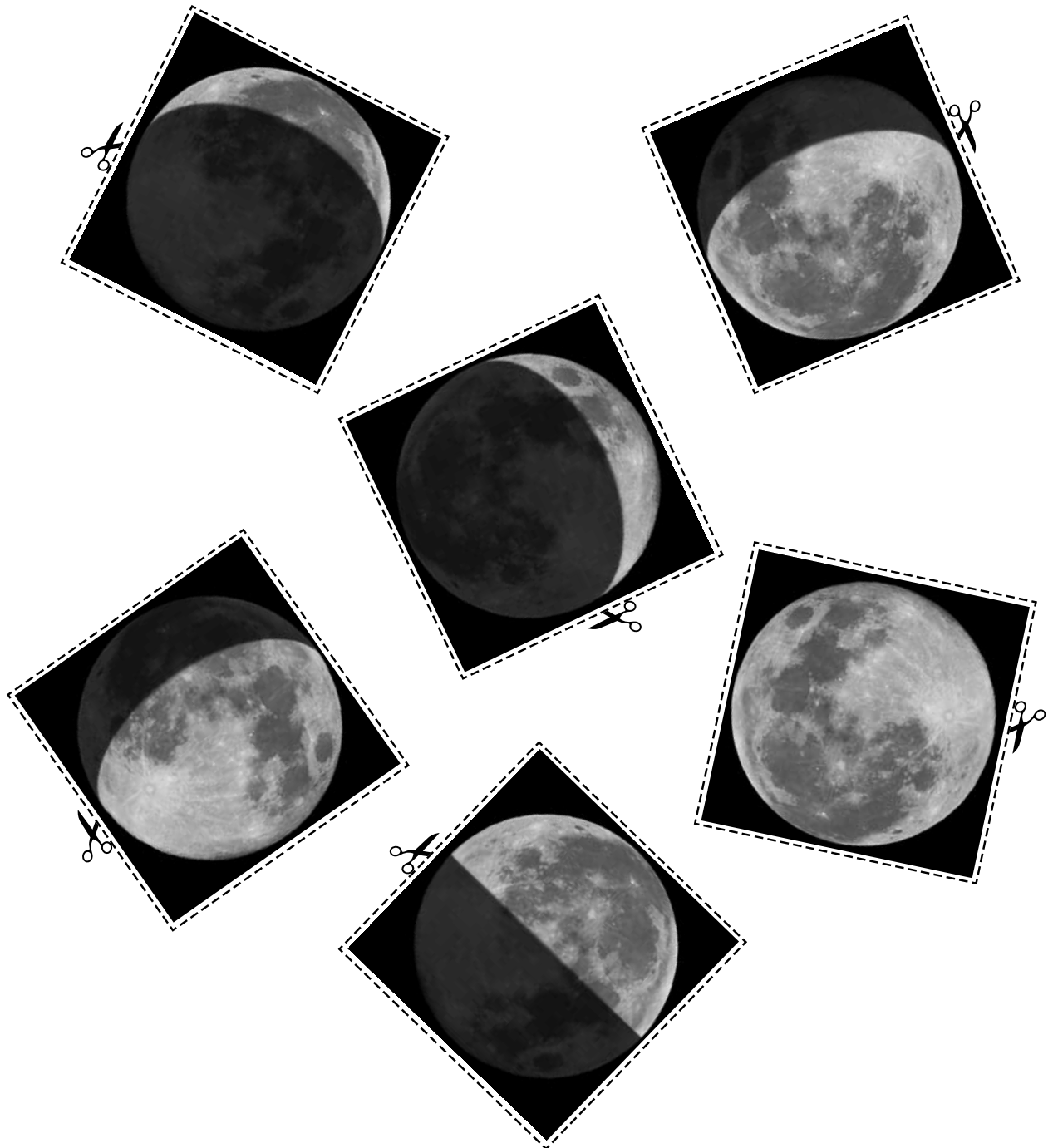
With help from the "Map of the Moon's Visible Face" sheet, students can draw the maria and craters visible on the Moon during the different phases, and even identify them.

*Adapted from: Astro Adventures, par Dennis Schatz et Doug Cooper.
Copyright © 1994 Pacific Science Center*

WORKSHEET 1

THE MOON IN ALL IT'S PHASES

Cut out each photograph. Arrange them on the PLACE THE PHASES IN THE RIGHT ORDER worksheet in the order you would expect to see the Moon during the next several weeks.



WORKSHEET 2

PLACE THE PHASES IN THE RIGHT ORDER

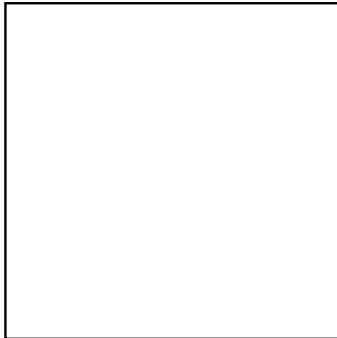
Date: _____

Name: _____

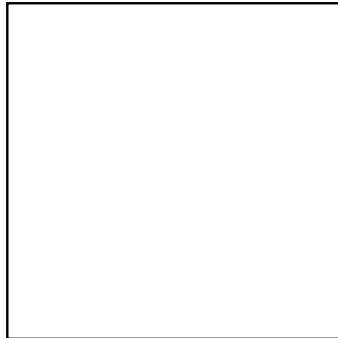
Class: _____

Place the six photographs of the Moon in the order that you think how the Moon will appear to you in the coming weeks. Once you are sure, glue them in place.

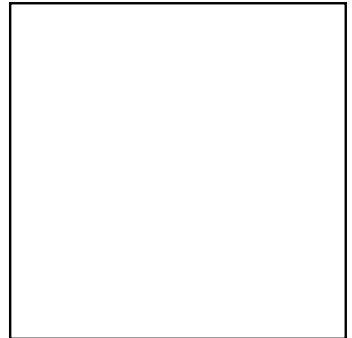
1



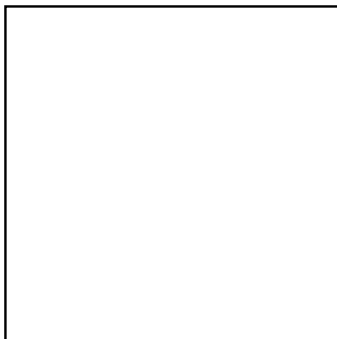
2



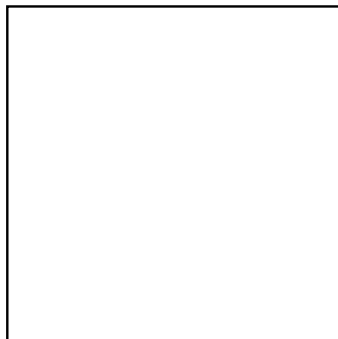
3



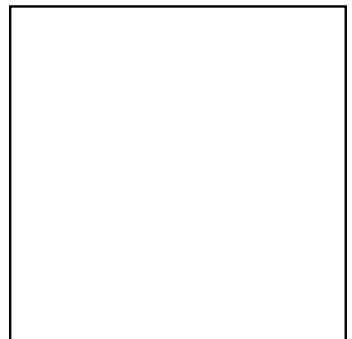
4



5



6



WORKSHEET 3

PLACE THE PHASES IN THE RIGHT ORDER

CORRECTED

Date: _____

Name: _____

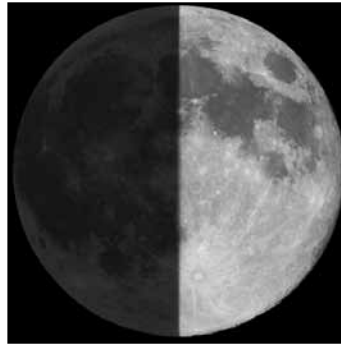
Class: _____

1



waxing crescent Moon

2



first quarter Moon

3



waxing gibbous Moon

4



full Moon

5



waning gibbous Moon

6



waning crescent Moon

WORKSHEET 4

LUNAR OBSERVING RECORD CHART

Date: _____

Name: _____

Class: _____



Directions : Find the Moon in the sky. Record the date and time in the box corresponding to the date. Shade the circle to show the Moon's appearance.

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
Date: _____ Time: _____ 	Date: _____ Time: _____ 	Date: _____ Time: _____ 	Date: _____ Time: _____ 	Date: _____ Time: _____ 	Date: _____ Time: _____ 	Date: _____ Time: _____
Date: _____ Time: _____ 	Date: _____ Time: _____ 	Date: _____ Time: _____ 	Date: _____ Time: _____ 	Date: _____ Time: _____ 	Date: _____ Time: _____ 	Date: _____ Time: _____
Date: _____ Time: _____ 	Date: _____ Time: _____ 	Date: _____ Time: _____ 	Date: _____ Time: _____ 	Date: _____ Time: _____ 	Date: _____ Time: _____ 	Date: _____ Time: _____
Date: _____ Time: _____ 	Date: _____ Time: _____ 	Date: _____ Time: _____ 	Date: _____ Time: _____ 	Date: _____ Time: _____ 	Date: _____ Time: _____ 	Date: _____ Time: _____

WORKSHEET 5

MAP OF THE MOON'S VISIBLE FACE

During your observations, this map of the visible face of the Moon will help you recognize the seas and major lunar craters.

