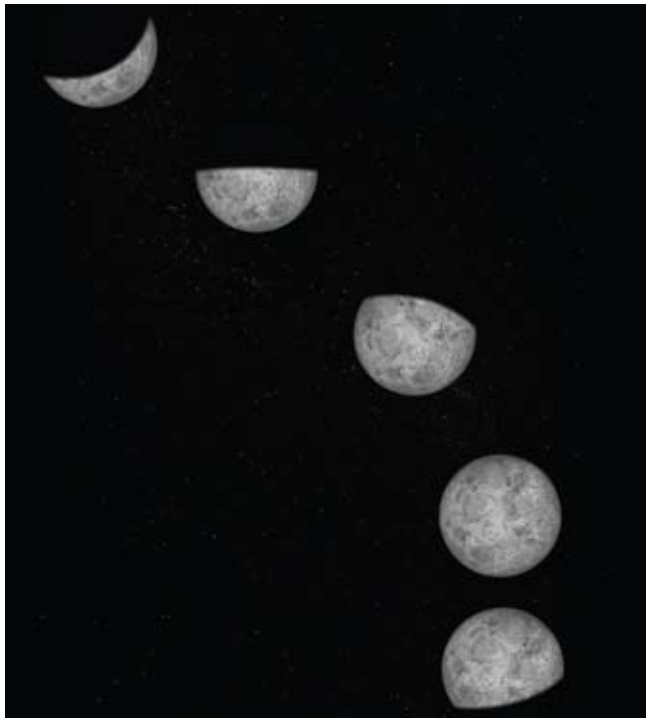
Moon phases

by Bob Riddle



Harvest Moon

"Shine on, Harvest Moon"—these are words from an old vaudeville song that became popular during the early 1900s. While the song is a lover's lament about the dark sky and his desire to propose marriage, it also suggests a name for the full Moon of October—the Harvest Moon. In fact, there are different names for each monthly full Moon coming from various cultures and time periods.

Many names for the full Moon are culturally based and are not arbitrarily given. The full Moon for October is typically referred to as the Harvest or Hunter's Moon. For the Chinese, this is the Kindly Moon or Chrysanthemum Moon, while in medieval England this was the Blood Moon. This becomes an interesting learning opportunity for students as they investigate full Moon names and their origins and meanings.

The name Harvest Moon, or Hunter's Moon, is attributed to the harvesting of crops or hunting by moonlight after the Sun has set. On average, the Moon rises about 50 minutes after the Sun has set. However, at this time of year, the Sun is rising at a less steep angle relative to the horizon than during other seasons. This has the effect of decreasing the amount of time between sunset and moonrise to about 30 minutes. Fields were more or less continuously lit—either by sunlight or moonlight, allowing the farmer or hunter extra hours to work.

Set phasers to stun

When teaching Moon phases, the focus seems to be on the sequence of Moon phases and, in some grade levels, how Moon phases occur. Either focus can sometimes be a challenge, especially without the use of models and observations of the Moon. These are an integral component of my lessons; however, I also want students to do more than just put the Moon phases in correct sequence. For example, if students know the general time of day (sunrise, midday, sunset, midnight) and are shown a Moon phase, they can tell which direction to look in the sky for the Moon. Or, given the time and direction, students can describe the phase of the Moon.

One of the models I have used regularly for many years to teach Moon phases is simply called the Moon phaser, or in this version from the Lowell Observatory, the Moon clock (see Figure 1). This is a paper manipulative that shows phases of the Moon on a disk that can be positioned to show where the Sun and Moon phases are located relative to the horizon. As students manipulate the model, they fill in a data table (see Figure 2). Students enter the day numbers and phase names as we complete each line with the other information.

Having access to a planetarium gives students an additional advantage of being able to see the phases modeled on the dome as they work with the Moon clock. This may be somewhat duplicated outside with the real sky; in either situation, students realize that the Moon clock is most accurate around the months just before, after, and during the two equinox months.

Waxing or waning?

Additionally, when teaching Moon phases, I raise the bar somewhat by expecting my students to be able to recognize incorrectly used Moon phases as shown in many cartoons and illustrations. Do a search for pictures or cartoons (print publications or online) showing a crescent Moon. How would you know or be able to tell whether the Moon was incorrect? What do you look for? You look for the direction that the cusps point toward. This then lets you know where the Sun should be relative to the Moon and the gener-

al time of day, i.e., morning or evening. I ask students to decide if the way the crescent is depicted coincides with the time of day shown in the cartoon. Students could extend their study of Moon phases by researching that idea and examining cartoons or illustrations containing a Moon.

The trick is to understand that the cusps or points of a crescent Moon always point away from the Sun. (Students are taught the shape of the Moon relative to the Sun's position and the position of the cusps.) Alternately, students will sometimes focus on the curved side of the Moon being on the Sun side, and use this as their clue to which phase it is—waxing or waning. If you know the phase, then you also know the direction you must be facing and the approximate time.

An interesting way to model this idea is by having students use their elbows and hands. Hold your right arm straight out in front. Bend the right arm at the elbow and hold the right hand so that all fingers bend to look like a backward letter C. Imagine that your right elbow is the Sun and your right hand is the waxing crescent Moon. If you then place your left hand (western horizon) below the right elbow, you are now modeling the setting Sun and the waxing crescent Moon over the western horizon. Repeat this using your left arm, and you will be modeling the rising waning crescent Moon over the eastern horizon.

FIGURE 1 Unassembled Moon clock

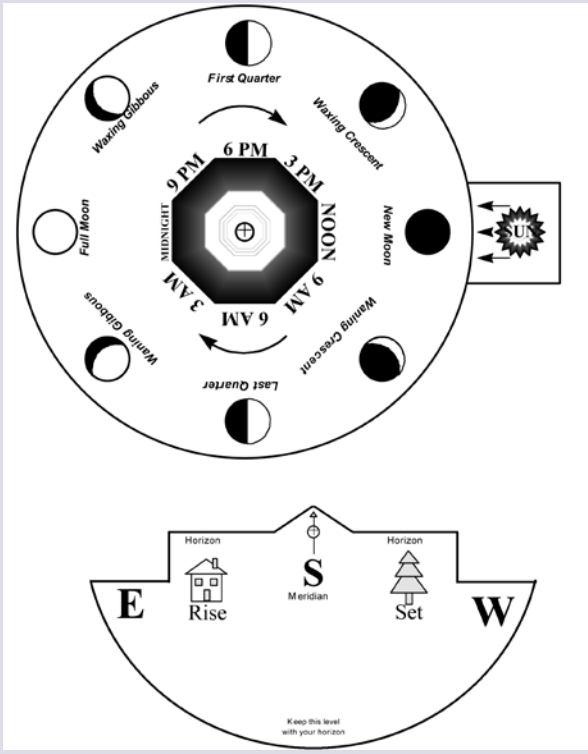


FIGURE 2 Data table for Moon clock

Day number	Name of phase	Rising time	Transit (south)	Setting time
0	New Moon			
3.5	Waxing crescent			
7	First quarter			
10.5	Waxing gibbous			
14	Full Moon			
17.5	Waning gibbous			
21	Last quarter			
24.5	Waning crescent			
28	New Moon			

FIGURE 3 Modeling Moon phases

Moon phases are based on where the Moon is relative to where we (the Earth) and the Sun are positioned. The best way to model or show this is by putting a Styrofoam or similar ball on a stick and taking it outside during the day when the Moon is visible (see Figure 3). At school, the best times to do this are mornings during the waning phases of the Moon. Hold the ball up so that it blocks the Moon from your view. Compare how the ball appears with the phase of the Moon. They both look the same for the same reason—based on where you, the Moon, and the Sun are positioned. For example, if the Moon is quarter phase, it will be half illuminated by the Sun. The ball will also be half illuminated. Both will have the same side illuminated for the same reason. Move the ball toward the Sun and you can see the ball waning as the Moon will in the following days. Student then take turns using the ball.

October

1 Saturn–Sun conjunction
Venus near Mars
Last quarter Moon
2 Moon near Gemini Twins
4 World Space Week (October 4–10)
6 Moon at perigee: 359,455 km
7 New Moon
8 Draconid meteor shower peak
Launch of *Soyuz* to ISS
9 Moon near Venus
10 Moon near Mars
11 Moon near Antares (Scorpius)
End of *Cassini* mission at Saturn
14 First quarter Moon
Cassini Titan flyby
17 Mercury at superior conjunction
New Horizons spacecraft halfway to Pluto
Moon near Neptune
18 Moon at apogee: 405,428 km
19 Moon near Jupiter and Uranus
23 Full Moon
24 Moon near Pleiades (Taurus)
25 Moon near Aldebaran (Taurus)
29 Venus at inferior conjunction
Moon near Gemini Twins
30 Last quarter Moon
31 Moon near Regulus (Leo)

Questions for students

1. Astronomers use the term *transit* in a variety of ways. What does transit mean with regard to the Moon's position in the sky as used on the data table (Figure 2)? (*Astronomically, a* transit *means to pass or cross in front of another object. In this situation, when the Moon is due south, it crosses the meridian [see question #2]*).
2. What is the meant by the term *meridian* as used in the answer to the previous question? (*A* meridian *is an imaginary north-to-south line like the meridians of longitude drawn on the Earth's surface. In astronomy, a meridian means the same. However, it is an imaginary line superimposed on the sky that goes from due south on the horizon to overhead and then due north on the opposite horizon. Any celestial object on the meridian is exactly midway between rising and setting.*)
3. What makes the Moon clock more accurate around the equinox? (*The times on the dial are spaced three hours apart. Using the clock as it is designed, it shows the time of sunrise at 6 a.m., transit at midday [noon], and sunset at 6 p.m. These are the approximate times for these events on the equinox or close to it.*)

Visible planets

Mercury will not be easily seen; by the middle of the month, Mercury will be at superior conjunction and will reappear in the evening skies next month.

Venus will start the month very low over the southwestern horizon at sunset, but will be quickly lost in the Sun's glare as it moves toward inferior conjunction at the end of the month.

Mars will be near Venus, but considerably dimmer and low above the southwestern horizon.

Jupiter will rise around sunset, set around sunrise, and be visible all night.

Saturn will very quickly move into view over the eastern horizon and by month's end will be well above the southeastern horizon at sunrise.

Resources

Cassini Mission—*http://saturn.jpl.nasa.gov*
EarthSky's 2010 meteor shower guide—*http://earthsky.org/astronomy-essentials/earthskys-meteor-shower-guide*
Full Moon names—*www.farmersalmanac.com/full-moon-names*
Keith's Moon facts—*http://home.hiwaay.net/~krcool/Astro/moon*
Lowell Observatory Moon Clock—*www.trschools.com/staff/g/cgirtain/WS/MoonClock.pdf*
Lunar lander simulator—*http://phet.colorado.edu/simulations/sims.php?sim=Lunar_Lander*
Lunar phases lab—*http://astro.unl.edu/naap/lps/lps.html*
New Horizons Mission—*http://pluto.jhuapl.edu*
Soyuz TMA-01M—*http://en.wikipedia.org/wiki/Soyuz_TMA-01M*
World Space Week—*www.worldspaceweek.org*

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