The Lunar Phase Wheel

A lunar phase wheel is a simple device to help you to visualize the positions of the Earth, Moon, and Sun at various times of the day or month, and then predict the phases and the rising and setting times of the Moon accordingly. It is composed of three panels which can be printed from the links labeled "Wheel #1" at the GEAS project lab exercise web page (astronomy.nmsu.edu/geas/labs/labs.html).

Trim each panel along the outer black border, and then align the set (back, middle, and then the front on top) so that the large circular elements have a common center, as shown below. Push a thumb tack or a brad through the center of the common circles, to secure the three panels together. If you use a push pin, place a thick piece of cardboard behind the back panel so that you can place the device on a table without scratching the surface.

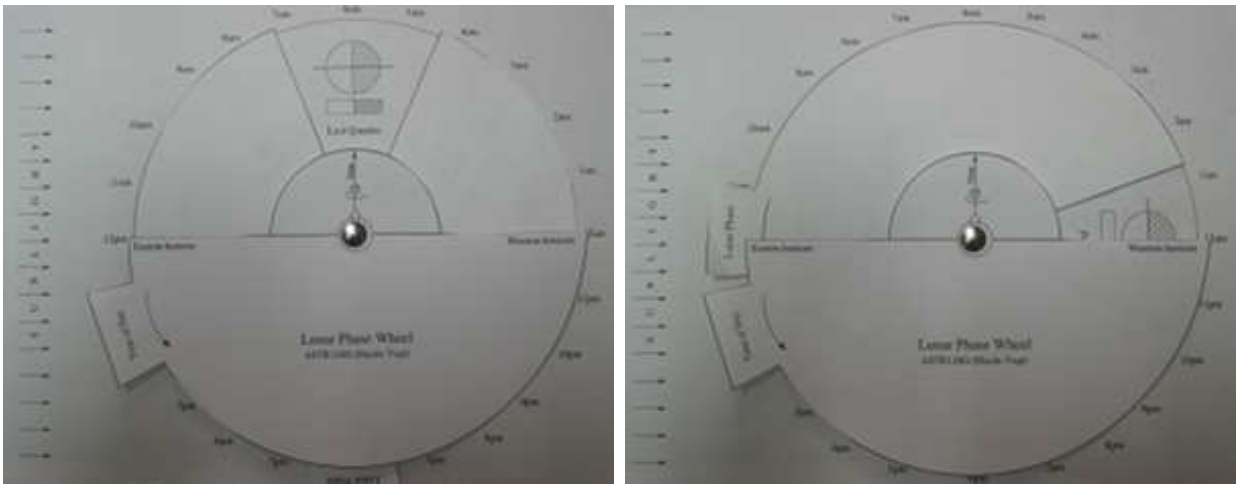


Figure 1.1:

The back panel represents the Sun, and a 24-hour clock that you can place around the Earth to indicate the local time at all locations (based on where the Sun lies in the sky). This panel is fixed to the cardboard back, and should not move.

The middle panel is a mask which hides seven of eight possible lunar phases. Rotate the tab labeled "Lunar Phase" counterclockwise to select the phase of the Moon at different times of the lunar month. Notice how each image of the Moon is illuminated (white) on one side, the half facing the Sun, and is dark (hatched with black lines) on the side facing away from the Sun, cast in shadow. A solid black line bisects each Moon, dividing it into the half seen from Earth (facing the observer below) and the half pointing away from Earth. By estimating the illuminated fraction of the side of the Moon facing the Earth, we can determine its appearance and phase.

The front panel shows an observer on Earth. The small stick figure is a person living near the equator; the arrow labeled "Time" points above their head to the observer's local time (written along the outer ring of the wheel, and determined by the Sun). By rotating the tab

labeled "Time of Day" counterclockwise in a complete circle, our observer will experience a full day on Earth. As you do so, the Sun and Moon will rise in turn (as the eastern horizon sweeps past them), ascend through the sky, achieve a maximum altitude, and then descend (setting when the western horizon sweeps past them roughly twelve hours later).

When you examine the wheel, it is as though you are standing above the North Pole and looking down on the Earth below. The Sun always stays to your left. By rotating the "Lunar Phase" tab you can shift the position of the Moon in its monthly orbit around the Earth, thus changing its apparent phase and the times it rises and sets. By rotating the "Time of Day" tab you can observe objects rise and set in the sky over a full 24-hour period.

Let's run through a few examples of using the wheel, to see how it works.

1. Orient your own lunar phase wheel as shown in the left on the image above, with the Moon in the last quarter phase and the observer examining the sky at dawn.

(a) Where is the Moon in the sky? (overhead)
(b) What object is rising to the east? (the Sun)

Pull the "Time of Day" tab counterclockwise, until the western horizon meets the Moon.

(c) How long till the Moon sets? (6 hours)

Continue rotating the "Time of Day" tab, until the western horizon meets the Sun.

(d) How many more hours till the Sun sets? (6 more hours)
(e) Where is the Moon at this time? (below the horizon)
(f) How long until the Moon rises again? (6 more hours)

2. Orient your lunar phase wheel as shown in the right on the image above, with the Moon in the full phase and the observer again examining the sky at dawn.

(a) Where is the Moon? (setting in the west)
(b) Where is the Sun? (rising in the east)
(c) Is the side of the Moon facing the Earth fully illuminated? (yes)

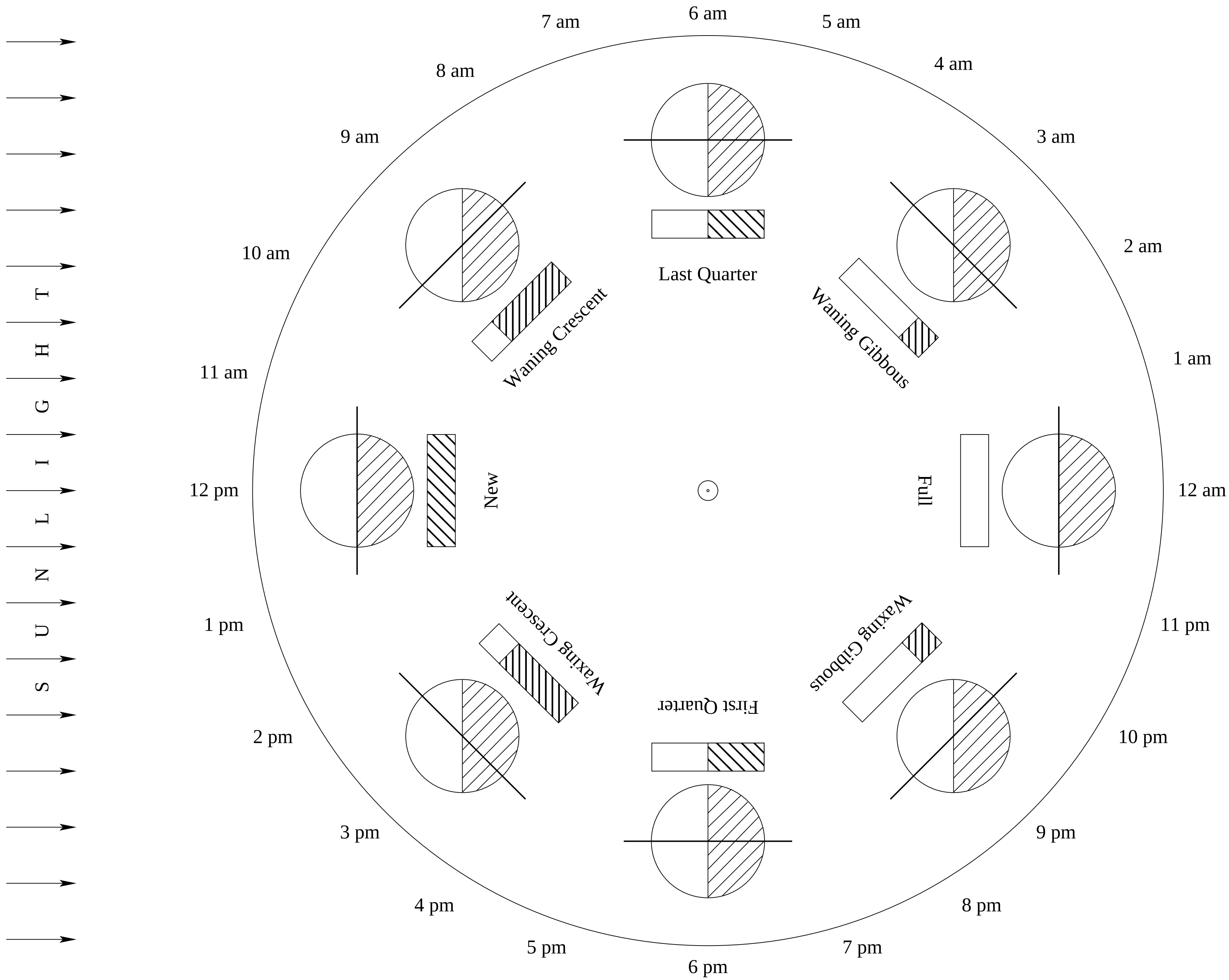
Adjust the "Lunar phase" tab, to show the waning crescent Moon.

(d) How many days have passed since the full Moon? (11 days)
(e) Where is the Moon now? (high above the eastern horizon)
(f) How long until the Moon lies overhead? (3 hours)

3. Orient your lunar phase wheel as needed to answer the following questions.

(a) Is the waning gibbous Moon ever visible at dusk? (no)
(b) Do the horns of the waxing crescent Moon point toward or away from the horizon as it rises / sets? (toward / away)

Keep working with the wheel, until you are confident that you understand how it portrays the positions of the Sun and the Moon in the sky as viewed from the Earth at any time of the day or night. Then try predicting the current phase and location of the Moon, and go outside and test your work!


S U N L I G H T
6 am
5 am
4 am
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12 am
11 pm
10 pm
9 pm
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1 pm
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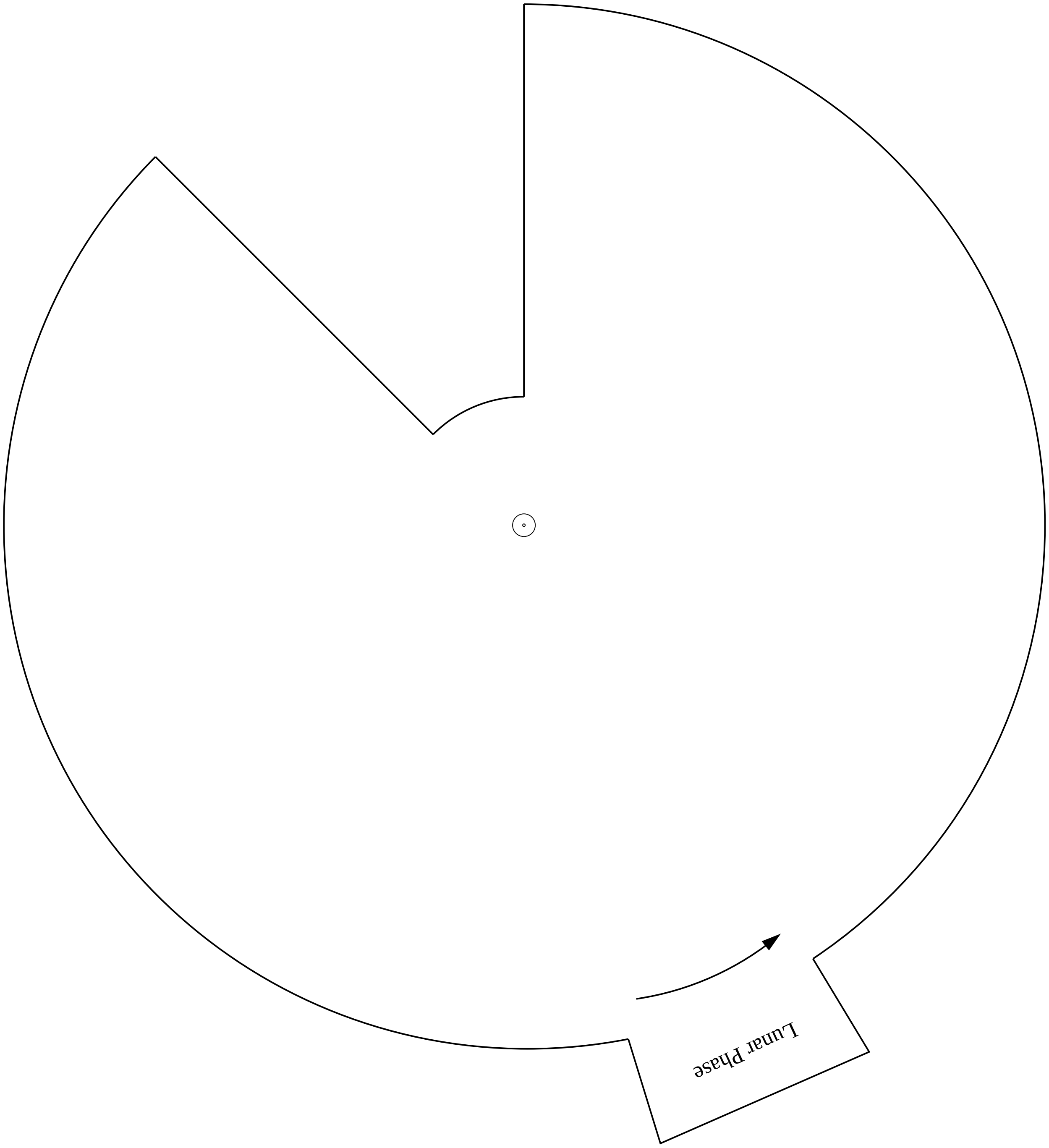
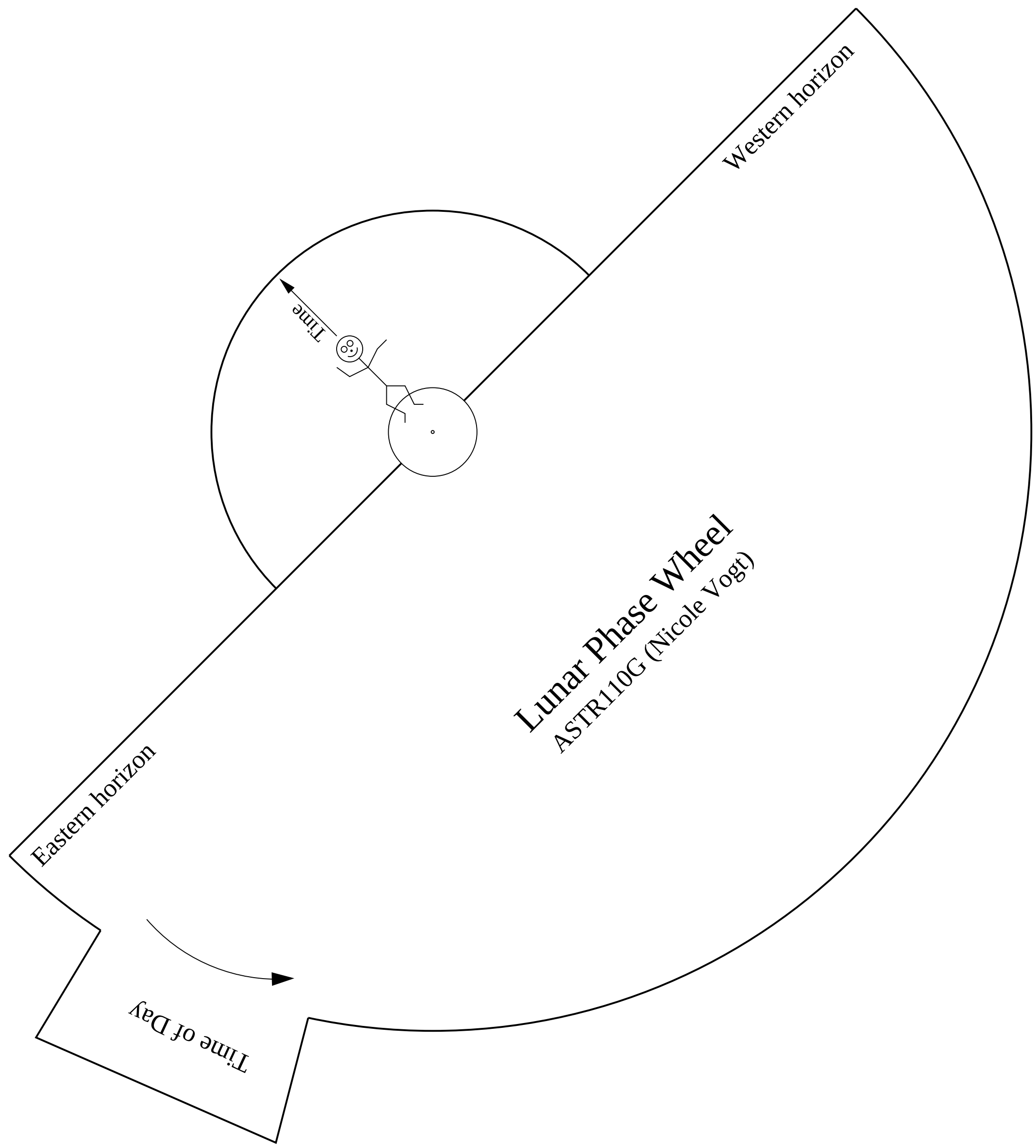
11 am
10 am
9 am
8 am
7 am
Last Quarter
Waning Gibbous
Full
Waxing Gibbous
First Quarter
Waxing Crescent
New
Waning Crescent


Lunar Phase


Western horizon
Time
Lunar Phase Wheel
ASTR110G (Nicole Vogt)
Eastern horizon
Time of Day