

THINKING IN 3D: PHASES OF THE MOON

Draft, October 27, 2018

The following is a draft of a potential activity relating to the phases of the Moon. The phases of the Moon are introduced as part of the Brownie Space Science badge. The phases of the Moon can be a difficult concept for anyone, including adults and can often lead to misconceptions. Part of the issue is simply scale: the relative sizes of the Earth, Moon, and Sun, as well as their distances from one another. These are concepts we will introduce during this workshop.

Put simply, as the Moon orbits the Earth and the Earth and the Moon orbit the Sun, we see different amounts of the illuminated side of the Moon. The important things to remember are that: 1) We always see the same side of the Moon and 2) The only time that the Moon is in the shadow of the Earth is when we have a lunar eclipse which may occur a few times a year (and may not always be visible from where you live).

Figure 1 shows images of the Moon's phases over a month. These are illustrated in Figure 2. As we will learn, the illustration is not to scale. If we were to have the sizes and distance to scale, including the Sun, we would not be able to see the phases.



Fig 1. 25 images of the phases of the Moon from Space.com, photos by Fred Espenak

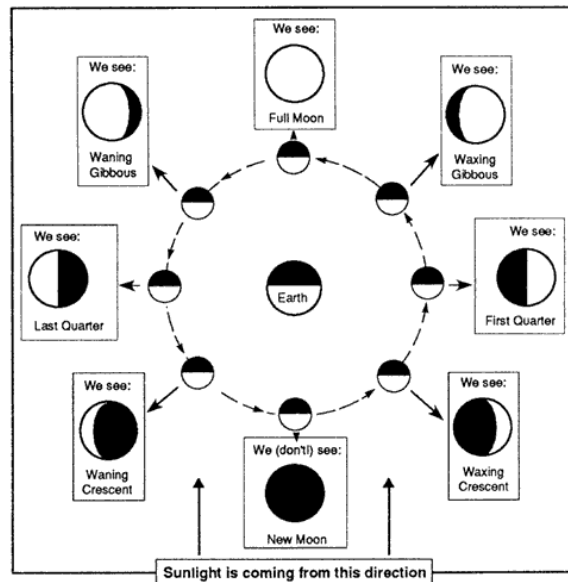


Fig. 2: illustration of the Moon's phases, from Astronomical Society of the Pacific

We can model the phases of the Moon in a room using balls on a stick with a light source (representing the Sun) in the middle of the room or we can do it outside, using the real Sun as the light source. This can be done individually or in pairs. Below are images taken at previous workshops.



Fig. 3: Girl Scout Leaders individually modeling the phases of the Moon



Fig 4: The Moon nearly half-illuminated, first quarter Moon



Fig. 5: Leader on right holding the Moon ball; leader on left “seeing” new Moon (unilluminated portion of Moon) at “sunset”

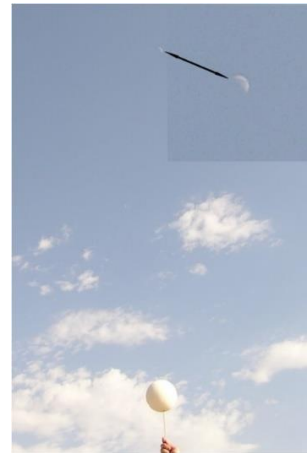


Fig. 6: Two balls being illuminated by the same source, the Sun: a nearby Styrofoam ball and the distant Moon showing the same phase

One can also model lunar and solar eclipses. Figures 7 and 8 demonstrate a partial lunar eclipse using the Girl scout/ASP Eclipse Kit.



Fig. 7: Attempting to align the Earth and the Moon so that the Earth casts a shadow on the Moon



Fig. 8: Shadow of the Earth on the Moon