User's Guide to Viewing the Moon

Photo courtesy of Mike Cook, Kalamazoo Astronomical Society

“Joy in looking and comprehending
is nature’s most beautiful gift.”
- *Albert Einstein*

This Guide was developed as a supplement to the Moon Map that is part of the library telescope kit. It is intended to give you some information about each of the objects labeled on the map. If you're as curious as we are, we know you'll appreciate the added knowledge. We hope you are even more interested and want to view many more objects on the Moon than we have on this list, as this is a very basic list. If you have any questions or concerns when using the telescope, be sure to contact your Portage librarian at (269) 329-4544 ext.600. We hope you have a great experience! Enjoy!!!

WARNING: ***NEVER* look directly at the Sun through your telescope, finder scope, or binoculars - even for an instant - as permanent eye damage could result. Do not point the telescope at the Sun, as parts will melt! Children should use this telescope only with adult supervision.**

Preparing to view the Moon:

The first thing to consider when viewing the Moon is that the Moon can be very bright, often too bright when looking at it with the entire aperture (mirror). This is especially important when trying to keep your eyes “dark adapted”. If you are looking to view faint objects, you might want to do this before viewing the Moon, or at least wait a while after viewing the Moon. Ideally, you should try to view the faint deep sky objects on a night when the Moon is not up. The brightness of the Moon can make it very hard, and many times impossible to find very dim objects.

To make the Moon less bright, we take the small cap off the main telescope dust cap (see picture here) and view it through the 2” hole. This in effect “stops down” the mirror making the Moon much more enjoyable to view.

2” Dust Cap

Remove the main dust cap and push the small cap off from inside. Place the main dust cap back on the telescope, with the 2” hole on top. Move the telescope until the Moon shows through the 2” hole and is centered in the eyepiece. Re-align the EZ finder so that the red dot is centered on the Moon. Once the Moon is centered in the eyepiece and the red dot finder, you’re done!

Note: Once you’re done viewing the Moon, you’ll have to align the red dot finder with the telescope again, in the same manner (without the dust cap on).

Information about objects on Moon Map:

Now the fun part! You get to learn about some of the objects you're viewing. This list will be limited to the objects on the Moon Map, so let's get started! Remember that objects in the eyepiece are *inverted* or upside down compared to naked eye or binocular viewing. Take note of this when using the Moon Map. We've created a Moon Map with some of the major objects and craters labeled on it. This might not match your exact view since the orientation of the Moon varies depending on how you orient your body and the telescope in its mount.

Best times to view objects on the Moon

The best times to view objects on the Moon is when the object is close to the terminator line, the line that separates the light and dark sections on the Moon. The terminator line is present during all phases of the Moon except Full Moon and New Moon. The Full Moon is a beautiful object to view, it can, however, lack a sense of perspective that the partial phases reveal. It is an absolutely amazing view along the terminator line during partial phases! Lunar craters show shadows and depth and mountain ranges show great contrast when the terminator line is nearby. This is due to the low light angle of the Sun close to the terminator line.

For information on observing the Moon:
www.skyandtelescope.com/observing/objects/moon/3381766.html?page=1&c=y

For a free software download visit: Virtual Moon Atlas
sourceforge.net/projects/virtualmoon/

This software is great for those interested in exploring the Moon in great detail. It also lists the best times to observe each of the objects you want to view. It is possible to toggle between current Moon phases and full Moon views.

The Moon

The Moon is believed to be about 4.5 billion years old. Its formation and how it came into being is debatable. Many hypotheses have been presented including breaking off from a rapidly spinning Earth, the Earth's capture of another body, and the Earth and Moon accreting at the same time. Currently, the theory most accepted by the scientific community is that another Mars sized body collided with the Earth, breaking off the Moon.

The Moon is tidally-locked, meaning one side continually faces towards the earth. Our nearest neighbor lacks a significant atmosphere, any bodies of water, has a much lower gravity than Earth, and cools rapidly due to its small size. The Moon possesses a crust, mantle and core (made up mostly of iron). The lunar surface has been formed by different processes, mainly through impact cratering and volcanism. Previously the Moon was believed to be geologically dead. Recent findings show the Moon's crust to be expanding and shrinking. The Moon has an apparent size of slightly bigger than ½ a degree when viewing it higher in the sky.

The Moon goes through a complete set of phases from New Moon through Full Moon and back to New Moon in 29.5 days. The tides are caused by the gravitational pull of the Moon, and the Sun to a much lesser extent. The gravity of the Moon acts as a brake system on the Earth, slowing its rotation and lengthening Earth's days.

Objects on the Moon

Mare: are dark basaltic plains, believed to be formed by ancient volcanic eruptions. Early astronomers called them *Maria* - Latin for “seas,” which is what they believed them to be. They are rich in iron, which is why they appear dark. Most Maria exist on the side of the Moon visible from Earth. Many Maria fill low-lying impact basins and craters.

Craters: The most noticeable geologic process on the Moon is called impact cratering. The craters are formed when objects such as asteroids or comets collide with the Moon’s surface at high velocity. The craters range in size from small pits to immense basins. The largest craters are believed to have formed in the early years of the Moon, while smaller craters are believed to be more recent.

Objects on Moon Map

First we will give you some information on the Mare, Lacus, and Sinus objects on your Moon map. This information is intended to give you a sense of size and perspective of each of the objects you are viewing.

Mare

Mare Imbrium: Latin for “Sea of Shower” or “Sea of Rains.” Mare Imbrium is one of the larger craters in the solar system. It is a lava flooded impact crater 757 miles in diameter, second in size only to Oceanus Procellarum. Apollo 15 landed in Mare Imbrium near the Apennine Mountains. It is believed to be one of the youngest impact basins on the Moon.

<u>Mare Frigoris:</u> Latin for “Sea of Cold.” It is believed to be a lava-filled impact crater 1090 miles wide by 121 miles.

<u>Mare Insularum:</u> Latin for “Sea of Islands.” Its lava-filled crater is 319 miles in diameter. Mare Insularum is bordered by Copernicus Crater on the east, and Kepler Crater on the west. The rays from both craters extend into the mare. It is 545 miles in diameter.

<u>Mare Cognitum:</u> Latin for “Sea that has become Known” or “Known Sea.” It is 233 miles in diameter. Apollo 14 landed near this mare in what is called the Fra Mauro formation.

Mare Humorum: Latin for "Sea of Moisture." The exact age of this mare has not been determined, in part because it was not sampled by the Apollo program. The Humorum basin, or large crater is filled with a thick layer of mare basalt, believed to be more than 2 miles thick at its center. Mare Humorum is 391 miles wide by 391 miles.

Mare Nubium: "Sea of Clouds." This object consists of many different stages of lunar development. The basin, basin material and mare are all from different epochs. The first released images that came from the LRO, or Lunar Reconnaissance Orbiter were of Mare Nubium. It is 454 miles in diameter.

Mare Crisium: "Sea of Crisis." It has a flat floor and wrinkled ridges toward its outer boundary. Craters that have been largely buried are located to the South. A soil sample was brought back to Earth on August 22, 1976 by the Soviet lunar mission Luna 24. It is 345 miles in diameter.

Mare Fecunditatis: “Sea of Fecundity” or “Sea of Fertility.” The mare material is relatively thin compared to Mare Crisium or Mare Tranquillitatis. The interesting thing about this basin is that it overlaps with the Nectaris, Tranquillitatis and Crisium basins. It is 520 miles in diameter.

Mare Tranquillitatis: Latin for “Sea of Tranquility.” This basin has an irregular topography due to its intersection with 4 other basins. Mare Tranquillitatis was the landing site for the Apollo 11 mission. It has a slight bluish tint compared to the other Mare. It is 424 miles in diameter.

Mare Serenitatis: Latin for “Sea of Serenity.” Mare Serenitatis is an example of a mascon, or an anamalous gravitational region of the Moon. Apollo 21 and 17 landed in the area of the Montes Taurus range, which is near the eastern border. It is 524 miles in diameter.

Oceanus Procellarum: Latin for “Ocean of Storms.” Oceanus Procellarum is the largest of the lunar maria, yet is smaller than the surface area of the Mediterranean Sea on Earth. Oceanus Procellarum is the only mare not contained within a single well-defined impact basin. The Apollo 12 mission landed in this mare. It is 1611 miles in diameter.

Sinus Medii: Latin for “Bay of the Center.” This mare is known for its many rille systems, or long, narrow depressions resembling channels. The rilles are believed to form in association with lava flows. Sinus Medii is in the center of our view of the Moon and is the closest mare to Earth. Earth would be located directly overhead as viewed from the Sinus Medii. Sinus Medii is 212 miles in diameter

Mare Vaporum: "Sea of Vapors." South of this mare lies a light colored thin line called Rima Hyginus. Rima Hyginus is a small lunar caldera believed to be volcanic in origin, and is often confused for an impact crater. The Apennine Mountains border Mare Vaporum. This mare is 139 miles in diameter.

Sinus Aestuum: Latin for "Bay of Billows." Sinus Aestuum is nearly featureless, with a few small impacts and some ridges. The surface of this mare is quite flat. Sinus Aestuum is 139 miles in diameter.

Sinus Roris: Latin for “Bay of Dew.” The exact size of this mare has long been in debate. Many lunar maps show a larger region for this area than the official dimensions. The official dimensions show the mare to have a higher *albedo* or higher reflectivity. The higher albedo of this region is due mostly to ejecta from impacts to the north. Sinus Roris is 125 miles in diameter.

Sinus Iridum: Latin for “Bay of Rainbows.” This mare doesn’t contain any notable impact craters, yet is surrounded from the northeast to the southwest by the Montes Jura mountain range. This bay and surrounding mountain range is considered one of the most beautiful features that can be viewed on the Moon. Sinus Iridum is 146 miles in diameter.

Lacus Somniorum: Latin for “Lake of Dreams.” This plain has a very irregular and rough terrain consisting of many craters, rille systems, hills and lava-filled regions. The dimensions of this plain are hard to define.

Sinus Asperitatis: Latin for “Bay of Roughness.” This mare is bordered along its eastern and western sides by irregular terrain. Sinus Asperitatis has two prominent craters on its southern border in the craters Theophilus and Cyrillus. This mare is 128 miles in diameter.

Mare Nectaris: “Sea of Nectar.” The mare material in this lava plain is approximately 1000m thick. Grabens, or depressed blocks of land bordered by parallel faults, have opened up on the mare’s western side. Mare Nectaris is 207 miles in diameter.

Craters and Montes Apenninus (lettered section of Moon Map)

(A) Tycho Crater: Tycho is one of the most prominent craters on the surface of the moon. It is named after the Danish astronomer Tycho Brahe. Tycho’s sharply defined crater is 52 miles in diameter. It is surrounded by one of the most prominent features on the southern hemisphere of the moon: a large ray system. These long white spokes extend in all directions as far as 938 miles away. The central peak in the middle of the crater rises one mile above the floor. The age of Tycho crater is estimated at 108 million years, as determined from soil samples of the ray collected during the Apollo 17 mission.

(B) Pitatus Crater: Pitatus is an ancient impact crater. The wall of Pitatus is heavily worn due to lava flows. The floor of the crater was flooded from the interior by lava flows that caused fractures. Low hills and Rimae Pitatus are also contained within its floor. Pitatus Crater is 59 miles in diameter. This crater is named after Italian astronomer Pietro Pitati.

(C) Copernicus Crater: Named after Nicolaus Copernicus, father of the heliocentric model of the universe (the sun is the center of the universe, not Earth.) This is considered the start of modern astronomy and the defining epiphany that started the scientific revolution. The crater is located in eastern Oceanus Procellarum and is estimated at 800 million years old. The ray system from this crater spreads as far as 500 miles. This crater is 56 miles in diameter.

(D) Kepler Crater: Named after German astronomer Johannes Kepler, who is best known for his laws of planetary motion and was a key figure in the early years of the scientific revolution. Kepler Crater lies between Oceanus Procellarum and Mare Insularum. The crater is best known for its' ray system that extend as far as 188 miles. Surprisingly, one of the rays from Tycho crater intersects this crater. Kepler crater is 19 miles in diameter.

(E) Aristarchus Crater: Named after Greek astronomer Aristarchus of Samos. Aristarchus is considered the brightest of the large objects on the Moon, with an *albedo*, or surface brightness nearly double that of any other object. There have been reports of short-lived changes in appearance or color in this crater. The area has also been known to suddenly brighten or darken. See if you can see them! This crater makes a good test of visual acuity. The crater is 24 miles in diameter.

(F) Montes Apenninus: A mountain range named after the Apennine Mountains in Italy. This mountain range contains several named mountain peaks including Mons Huygens, which is comparable in height to Mount Everest on Earth at 2.9 miles high. The view through the eyepiece of this mountain range is incredible, especially when the terminator line is nearby. The Apollo 15 mission made its landing in the Hadley-Apennine region of these mountains, and was considered the most successful of all Apollo missions. The range is 575 miles long by 61 miles wide.

(G) Plato Crater: This crater was named after the famous Classical Greek philosopher and Mathematician who helped lay the foundations of Western philosophy and science. Plato Crater is believed to be approximately 3.84 billion years old, and has a relatively low albedo or surface brightness. This causes the crater appear dark when comparing it to the surrounding terrain. Plato Crater is 61 miles in diameter.

(H) Aristoteles Crater: Named after the Greek philosopher and polymath Aristotle. He is one of the 3 most important founding figures in Western philosophy, along with Plato and Socrates. Aristotle crater combined with Eudoxus crater to the south form quite a visual pair when viewed with a telescope. Aristotle crater does posses small central peaks off-set to the south. The crater is 53 miles in diameter.

(I) Posidonius Crater: This crater was named after the Greek stoic, politician, and astronomer Posidonius. He was considered the greatest polymath of his era. Around 90 BCE he attempted to make size and distance measurements of the Sun, but was off by half. Posidonius also calculated the size and distance of the Moon. The rim of this crater is shallow, and lava has filled the interior previously. The floor of the crater includes objects such rilles, bulges and hills. Posidonius Crater is 58 miles in diameter.

Please take a moment to phone your Portage librarians @ (269)329-4544 ext. 600 to thank them for the opportunity to view our beautiful universe!!! We hope you had a wonderful experience!

Special thanks to the New Hampshire Astronomical Society and Marc Stowbridge for creating such a wonderful program and making all of this possible! Visit ltp.2012@nhastro.com to let him know you enjoyed the program!

Kalamazoo Astronomical Society

Looking up since 1936

We hope you enjoyed your time viewing and learning about the Moon and had a wonderful experience using the telescope!   Our goal is to give you a better understanding and knowledge of our nearest celestial neighbor, and astronomy in general. Hopefully you've grown to love our companion through space as some of us have (at least on nights when not viewing deep sky objects!)