

29:52 Exploration of the Solar System
Notes for February 25, 2008
The Moon, Part 1

Today we start really “exploring the solar system”. Why should we study the Moon?

1. The Moon is the closest astronomical object to us.
2. Since it is the closest, you can see a lot of detail in a small telescope.
3. It is the only astronomical object that people have set foot on.
4. Most importantly, what we have learned about the Moon (largely because of findings in the Apollo program of the 60s and early 70s, has allowed us to unravel much of what we know about the rest of the solar system.

The Moon’s Orbit

We’ve talked about this before. It is an ellipse with a semimajor axis of 384,400 km, and is noticeably eccentric. Perigee (closest approach to the Earth) is 356,400 km and apogee (furthest point from the Earth) is 406,700 km.

Physical Properties: a comparison with the Earth

How does the Moon stack up relative to the Earth? In terms of diameter, we have 12756 km for the Earth, and 3476 km for the Moon. This means the Moon is about $\frac{1}{4}$ the diameter of the Earth. If the Earth were the size of a 12 inch diameter globe, the Moon would be 3 inches in diameter.

An equally important characteristic is mass. The Earth has a mass of $5.974E+24$ kg, as compared to $7.35E+22$ kg for the Moon. This means that the Moon has only 1.23 % the mass of the Earth. That makes it seem pretty insignificant. Finally, we can consider average density, which for the Earth is 5.52 grams/cc, versus 3.3 grams/cc for the Moon. The average density of the Moon is about typical for rocks, while the average density of the Earth is significantly larger.

While the Moon seems to be tiny compared to the Earth, it is very large comparatively speaking. No other planet has a moon anywhere near as large relative to the host planet (i.e. Venus, which is very similar to the Earth in terms of mass and radius, has no moons at all).

Rotation of the Moon

From the Earth, we always see the same side of the Moon. No one on Earth has every seen the far side of the Moon (it has been extensively photographed with by spacecraft, including ones with people in them). This is an indication that the Moon is rotating according to *synchronous rotation* in which it rotates once on its

axis for every revolution about the Earth. Synchronous rotation arises due to the strong tides raised by the Earth on the Moon. At one time, the Moon was the only astronomical object known to synchronously rotate. It is now known to be extremely important in astronomy, including nearly all of the moons of the other planets.

The Surface of the Moon

The surface of the Moon is fascinating to study with small telescopes or with maps of the lunar surface. It becomes even more fascinating when you learn about the geological history of the Moon, as we will do.

Let's start with the main features that you can see from Earth, even with the naked eye (meaning no use of binoculars or telescopes). The "man in the Moon" light and dark features are the *maria* (Latin for seas, the dark areas) and the *terrae* (Latin for lands, the brighter areas). Careful telescopic observations show that the *terrae* are hundreds of meters or more higher than the *maria*, so they are also sometimes called the *lunar highlands*.

Next time, we'll start talking about what you see when you look at the *maria* and *terrae* close up. Stay tuned on sub-space radio.