

29:52 Exploration of the Solar System
Class Notes for March 7, 2008
Mercury and Venus

Last time, we found out the following. Mercury and Venus are inside the orbit of the Earth. Look again at the planetary orbit data in the tables in the Appendices. Mercury is much smaller than the Earth, and is more like an oversized version of the Earth's Moon. Venus is remarkably similar to the Earth in diameter and mass.

Mercury

As mentioned before, the rotation period of Mercury is 2/3 of the revolution period. This means the length of the day on Mercury (time between successive transits of the Sun) is 2 revolution periods, or 176 days. Look at the excellent Figure 10.3 in your book which illustrates this. Also read the section "A Day on Mercury" on p209 of the book.

Mercury is much closer to the Sun than the Earth, so the amount of solar heating is much larger (technically, the flux of solar radiation is larger by the square of the distances of the planets, which is $\frac{1.00^2}{0.387^2} = 6.7$ times higher. In addition, daytime (when the Sun is above the horizon) lasts 88 days. As a result, the daytime temperature of Mercury is unbelievably hot. Surface temperatures can reach 700 K (700 degrees Kelvin), which is about 770 degrees Fahrenheit. Read the textbook about the Kelvin temperature scale. We will be using it the rest of the course.

At nighttime, the Sun is absent from the sky for a revolution period of 88 degrees, so there is plenty of time for the surface of Mercury to cool off. Furthermore, *Mercury has no atmosphere to help retain the heat*. On the nighttime side, the temperature drops to 100 K, which is similar to temperatures in the outer solar system far from the Sun. The Kelvin temperature scale is described on p134 of your textbook. Read it.

The Geology and Surface of Mercury

Nearly everything we know about the surface and geology of Mercury comes from spacecraft missions. There have been only two such missions. Mariner 10, which flew by Mercury twice in 1975, and the Messenger mission, launched in 2005, which just completed its first flyby, and will return to Mercury for one more flyby before settling into orbit in 2011.

Look at the Messenger webpage at <http://messenger.jhuapl.edu>

Mercury is amazingly similar to the Moon in appearance. The surface is heavily cratered. It also has impact basins and maria, although the Maria here are smaller

in extent. *Since the surface of Mercury still retains impact craters from the Age of Bombardment, we can conclude that there has been very little modification of the surface for the past 4 billion years.* It even appears possible that Mercury's surface has been unmodified for a time longer than that of the Moon.

The high average density of Mercury, and the fact that it has a relatively strong magnetic field suggests that most of the volume of Mercury is occupied by a metallic core. Look at Figure 10.13 for a picture of what we think the structure of Mercury is. This structure of Mercury may be a result of a giant impact early in the history of the solar system.

Venus: Earth's Twin

Look at Figure 10.1 again, as well as the data tables in the appendices, to see how similar Venus is to the Earth in mass and diameter. Given that, we might have expected the surface of Venus to be similar to that of Earth as well. For centuries, we couldn't tell, because with visual light we can't see the surface of Venus. The entire planet is shrouded in a perpetual overcast. When we look at Venus from outer space (that includes us here on Earth), all we see is the topside of a planet-wide cloud layer.

Our knowledge about Venus has all come in the last few decades, and has utilized spacecraft missions and radio astronomy.