

Survey of Solar Systems

After having studied our galaxy, and other galaxies, and then the universe as a whole (cosmology), in this unit we are zooming in on a very minute part of our galaxy, our solar system. So, forget about the billions of galaxies in the part of the universe that we can see, forget about the hundreds of billions of stars in our own galaxy, forget the gigantic clouds of gas and dust that populate our own galaxy, and all the other debris. Zoom in on our own solar system, and you will nevertheless find that about 99.9% of all of the mass in our solar system is in the Sun!

Nevertheless, there are many other objects of interest in our solar system, and many questions of interest. How did our solar system form? How has it evolved, and how will it evolve? How did the planets form, and how will they evolve?

And, of course, there are many mysteries remaining embedded in areas of knowledge that are relatively well-understood. Mysteries abound on Earth, which is only natural since we have more knowledge about Earth than more distant places in our solar system.

The following questions will guide your reading of this unit. The relevant parts of the textbook are Chapter 8 and Section 7.5.

1 Overview of our Solar System

- What are the major and minor constituents of the solar system, and what are some of their basic properties?
- Approximately how far from the Sun are the planets?
- What are dwarf planets, and where are they located?
- Why is Pluto no longer considered a planet? What is a planet?
- What are planetary satellites? Which planets have satellites, and approximately how many satellites does each planet have? Which are the largest satellites in the solar system, and how do their sizes compare with the size of the Moon?
- What are planetary rings? Which planets have rings?
- What is an asteroid? Where are most asteroids found?
- What are comets? Where are they found?
- What are meteors, meteoroids, and meteorites? Where are they found?
- What is the interplanetary medium?

2 Planetary Motions

- What is Kepler's first law of planetary motion?
- What does the eccentricity of an orbit tell you about the orbit? What are some typical values for the planets?
- How closely do the planetary orbits lie in a single plane?

- In which sense do the planets orbit the Sun? How does this compare with the sense of rotation of the planets and Sun about their rotation axes? How does this compare with the sense of orbital motion and rotation of the large satellites in the solar system? What is the significance of these facts?
- What is Kepler's third law of planetary motion? What does Kepler's third law tell you about the solar system?

3 Physical Properties of Planets

- What are the diameters of the planets? How do they compare with each other? How are they determined?
- What are the masses of the planets? How do they compare with each other? How are they determined?
- What are the densities of the planets? How do they compare with each other? How are they determined?
- What do the physical properties of the planets tell you about the solar system?

4 Formation of the Solar System

- What is the collapsing nebula hypothesis for the formation of the solar system? What is some of the evidence that supports this hypothesis?
- What is the frost line? Where in the solar system is it located?
- What is the condensation sequence? What does it tell us about the composition of various bodies in the solar system? Does the evidence support these conclusions?
- Approximately how long did it take for the solar system to form? When did this occur?

5 Evolution of the Solar System

- Approximately how old is the solar system? How do we know this?
- What is radiometric dating? Which chemical elements are commonly used for radiometric dating?
- Approximately how old is the Earth, according to our best estimates using radiometric dating? How old is the Moon? Are these estimates consistent with estimates of the age of the Sun? What can we conclude about the age of the solar system?
- What is the evidence that there was intense "bombardment" of planets by solar-system debris?
- What caused melting of the cores of terrestrial planets? What is the evidence that this occurred?
- What are P waves and S waves? What do they tell us about the internal structure of the Earth?
- What are plates in the Earth's crust? What is plate tectonics?
- What is the theory of continental drift? Who proposed the theory, and what was the evidence for the theory at the time of its proposal? What is the currently available evidence for the theory?

- What commonly occurs at the boundaries where plates meet?
- Which planet has the most volcanoes? Why do you think this might be?

6 Planetary Atmospheres

- What is the source of planetary atmospheres?
- What is a primary atmosphere, and where did it come from? Which planets still have remnants of their primary atmospheres and why? Why have other planets lost their primary atmospheres?
- What is albedo? Which planets have high albedo and which have low albedo?
- Which planets still have significant atmospheres? Why? Why do other planets not have significant atmospheres?
- What is the current composition of Venus's atmosphere?
- Why does Venus have such a high surface temperature?
- What is the greenhouse effect?
- How was oxygen originally produced in Earth's atmosphere? By what process did the oxygen content of Earth's atmosphere later increase rapidly, and when did this occur?
- What is the current composition of Earth's atmosphere? Explain.
- What is the current composition of Mars's atmosphere? Explain.
- What is the current composition of the atmospheres of the Jovian planets? Explain.

7 Tidal Forces, Satellites, and Rings

- What are tidal forces? Upon which factors do tidal forces on Earth due to the Moon depend?
- What causes tidal forces on Earth?
- What are some of the consequences of tidal forces on Earth? Explain in detail the causes of these consequences.
- What is the Roche limit? What is its significance?
- Which planets have rings? What causes the rings? What causes gaps in the rings?