

**29:52 Exploration of the Solar System**  
**Notes for April 7, 2008**  
**Jupiter and Saturn**

Jupiter and Saturn are very large compared to the terrestrial planets. Look at Tables 12.1 and 12.2 at the diameters and masses of these planets. Jupiter is 11.2 times the diameter of the Earth, and 318 times its mass. Saturn is 9.5 times the diameter of Earth and 95 times its mass. These numbers of themselves indicate that Jupiter and Saturn are entirely different types of objects than the terrestrial planets.

**The Appearance of the Jovian Planets from Space**

Pictures of Jupiter and Saturn from space show clearly that we are seeing the top of a layer of cloud rather than the “surface” of a planet. The clouds are in bands of different colors and brightness.

**The Rotation of Jupiter and Saturn**

Given that Jupiter and Saturn are such large objects, one might expect that they would be slow rotators. This is not true. Jupiter rotates on its axis once in 9h50m, and Saturn has a rotation period of 10h14m. The rotation periods of these huge planets are less than half that of Earth.

Jupiter and Saturn also display *differential rotation*, meaning that the equator and poles rotate at different rates. This means that Jupiter and Saturn are not solid objects like the Earth and the terrestrial planets.

**The Chemical Composition of Jupiter and Saturn**

The densities of Jupiter and Saturn are about that of water (Jupiter is 1.33 grams/cc, Saturn is 0.69 grams/cc). Basic physics shows that objects with the mass, size, and density of Jupiter and Saturn must be made of very light elements. Specifically, they must be composed nearly completely of hydrogen and helium.

Although we reach this conclusion on the basis of theoretical physics, this conclusion is borne out by all observations. The spectrum of Jupiter shows absorption lines due to hydrogen-rich molecules such as ammonia (NH<sub>3</sub>), methane (CH<sub>4</sub>), and water, as well as others hydrocarbons such as acetylene, ethane, and propane. This chemical composition was also verified by the Galileo spacecraft probe, which descended into the atmosphere of Jupiter.

Read the quotation in the text about the fact that Jupiter and Saturn are nearly completely composed of hydrogen and helium. *In this, they have the same*

*chemical composition as the Sun and the stars, and a very different composition than the terrestrial planets.*