

7.9: The Giant Planets (Exercises)

For Further Exploration

Articles

Jupiter

Aguirre, Edwin. "Hubble Zooms in on Jupiter's New Red Spot." *Sky & Telescope* (August 2006): 26.

Beatty, J. "Into the Giant." *Sky & Telescope* (April 1996): 20. On the Galileo probe.

Beebe, R. "Queen of the Giant Storms." *Sky & Telescope* (October 1990): 359. Excellent review of the Red Spot.

Johnson, T. "The Galileo Mission to Jupiter and Its Moons." *Scientific American* (February 2000): 40. Results about Jupiter, Io, Ganymede, and Callisto.

Simon, A. "The Not-So-Great Red Spot." *Sky & Telescope* (March 2016): 18. On how the huge storm on Jupiter is evolving with time.

Smith, B. "Voyage of the Century." *National Geographic* (August 1990): 48. Beautiful summary of the Voyager mission to all four outer planets.

Stern, S. "Jupiter Up Close and Personal." *Astronomy* (August 2007): 28. On the New Horizons mission flyby in February 2007.

Saturn

Gore, R. "The Riddle of the Rings." *National Geographic* (July 1981): 3. Colorful report on the Voyager mission.

McEwen, A. "Cassini Unveils Saturn." *Astronomy* (July 2006): 30. A report on the first two years of discoveries in the Saturn system.

Spilker, L. "Saturn Revolution." *Astronomy* (October 2008): 34. On results from the Cassini mission.

Talcott, R. "Saturn's Sweet Surprises." *Astronomy* (June 2007): 52. On Cassini mission results.

Uranus and Neptune

Cowling, T. "Big Blue: The Twin Worlds of Uranus and Neptune." *Astronomy* (October 1990): 42. Nice, long review of the two planets.

Gore, R. "Neptune: Voyager's Last Picture Show." *National Geographic* (August 1990): 35.

Lunine, J. "Neptune at 150." *Sky & Telescope* (September 1996): 38. Nice review.

Websites

Jupiter

NASA Solar System Exploration: <http://Solarsystem.nasa.gov/planets/jupiter>

Nine Planets Site: <http://nineplanets.org/jupiter.html>

Planetary Sciences Site: <http://nssdc.gsfc.nasa.gov/planetary...piterpage.html>

Saturn

NASA Solar System Exploration: <http://Solarsystem.nasa.gov/planets/saturn>

Nine Planets Site: <http://nineplanets.org/saturn.html>

Planetary Sciences Site: <http://nssdc.gsfc.nasa.gov/planetary...aturnpage.html>

Uranus

NASA Solar System Exploration: <http://Solarsystem.nasa.gov/planets/uranus>

Nine Planets Site: <http://nineplanets.org/uranus.html>

Planetary Sciences Site: <http://nssdc.gsfc.nasa.gov/planetary...ranuspage.html>

Neptune

NASA Solar System Exploration: <http://Solarsystem.nasa.gov/planets/neptune>

Nine Planets Site: <http://nineplanets.org/neptune.html>

Planetary Sciences Site: <http://nssdc.gsfc.nasa.gov/planetary...ptunepage.html>

Missions

Cassini Mission Site at the Jet Propulsion Lab: <http://saturn.jpl.nasa.gov/index.cfm>

Cassini-Huygens Mission Site at European Space Agency: <http://sci.esa.int/cassini-huygens/>

NASA Galileo Mission Site: <http://Solarsystem.nasa.gov/galileo/>

NASA's Juno Mission to Jupiter: http://www.nasa.gov/mission_pages/ju...ain/index.html

Voyager Mission Site at the Jet Propulsion Lab: <http://voyager.jpl.nasa.gov/>

Videos

Cassini: 15 Years of Exploration: https://www.youtube.com/watch?v=2z8fzz_MBaw. Quick visual summary of mission highlights (2:29).

In the Land of Enchantment: The Epic Story of the Cassini Mission to Saturn: <https://www.youtube.com/watch?v=Vx135n8VFXy>. An inspiring illustrated lecture by Cassini Mission Imaging Lead Scientist Carolyn Porco (1:37:52).

Review Questions

1. What are the main challenges involved in sending probes to the giant planets?
2. Why is it difficult to drop a probe like Galileo? How did engineers solve this problem?
3. Explain why visual observation of the gas giants is not sufficient to determine their rotation periods, and what evidence was used to deduce the correct periods.
4. What are the seasons like on Jupiter?
5. What is the consequence of Uranus' spin axis being 98° away from perpendicular to its orbital plane?
6. Describe the seasons on the planet Uranus.
7. At the pressures in Jupiter's interior, describe the physical state of the hydrogen found there.
8. Which of the gas giants has the largest icy/rocky core compared to its overall size?
9. In the context of the giant planets and the conditions in their interiors, what is meant by "rock" and "ice"?
10. What is the primary source of Jupiter's internal heat?
11. Describe the interior heat source of Saturn.
12. Which planet has the strongest magnetic field, and hence the largest magnetosphere? What is its source?
13. What are the visible clouds on the four giant planets composed of, and why are they different from each other?
14. Compare the atmospheric circulation (weather) of the four giant planets.
15. What are the main atmospheric heat sources of each of the giant planets?
16. Why do the upper levels of Neptune's atmosphere appear blue?
17. How do storms on Jupiter differ from storm systems on Earth?

Thought Questions

1. Describe the differences in the chemical makeup of the inner and outer parts of the solar system. What is the relationship between what the planets are made of and the temperature where they formed?
2. How did the giant planets grow to be so large?
3. Jupiter is denser than water, yet composed for the most part of two light gases, hydrogen and helium. What makes Jupiter as dense as it is?
4. Why would a tourist brochure (of the future) describing the most dramatic natural sights of the giant planets have to be revised more often than one for the terrestrial planets?
5. The water clouds believed to be present on Jupiter and Saturn exist at temperatures and pressures similar to those in the clouds of the terrestrial atmosphere. What would it be like to visit such a location on Jupiter or Saturn? In what ways would the environment differ from that in the clouds of Earth?
6. Describe the different processes that lead to substantial internal heat sources for Jupiter and Saturn. Since these two objects generate much of their energy internally, should they be called stars instead of planets? Justify your answer.

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