

## Neptune

Neptune is one of the two planets

that cannot be seen without a telescope. The other is Pluto. Neptune is about 30 times as far from the sun as is Earth. Pluto is the only planet farther from the sun than Neptune. But every 248 years Pluto moves inside Neptune's orbit for about a 20-year period, during which it is closer to the sun than Neptune. Pluto last crossed Neptune's orbit on Jan. 23, 1979, and remained within it until Feb. 11, 1999.

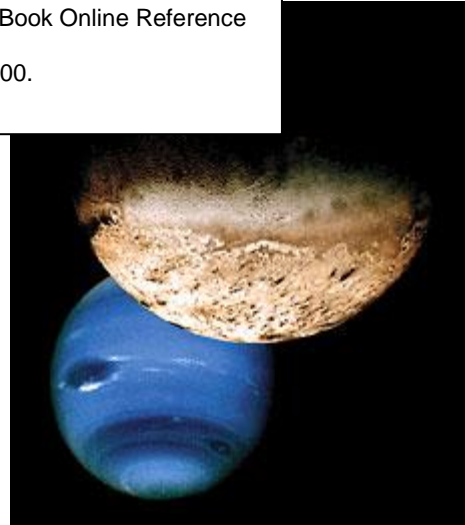
Neptune's diameter at the equator is 30,775 miles (49,528 kilometers), or almost 4 times that of Earth. It is about 17 times as massive (heavy) as Earth, but is not so dense as Earth. Neptune has 11 satellites (moons) and several rings around it.

Neptune travels around the sun in an elliptical (oval-shaped) orbit. Its average distance from the sun is about 2,793,100,000 miles (4,495,060,000 kilometers). Neptune goes around the sun once about every 165 Earth years, compared with once a year for Earth. As Neptune orbits the sun, it spins on its axis, an imaginary line through its center. Neptune's axis is not perpendicular (at an angle of 90 degrees) to the planet's path around the sun. The axis tilts about 28 degrees from the perpendicular position. Neptune spins around once in about 16 hours and 7 minutes.

### Surface and atmosphere

Scientists believe that Neptune is made up chiefly of hydrogen, helium, water, and silicates. Silicates are the minerals that make up most of Earth's rocky crust, though Neptune does not have a solid surface like Earth. Thick clouds cover Neptune's surface. Its interior begins with a region of heavily compressed gases. Deep in the interior, these gases blend into a liquid layer that surrounds the planet's central core of rock and ice. The tilt of its axis causes the sun to heat the Neptune's northern and southern halves alternately, resulting in seasons and temperature changes.

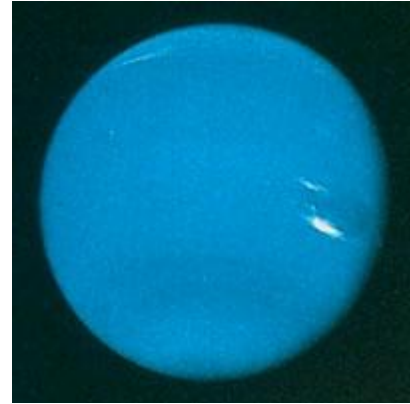
How to cite this article: To cite this article, World Book recommends the following format: Smith, Bradford A. "Neptune." World Book Online Reference Center. 2004. World Book, Inc. <http://www.worldbookonline.com/wb/Article?id=ar386900>.



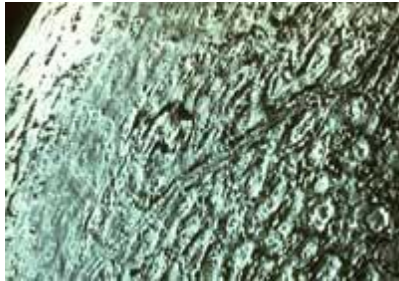
The blue clouds of Neptune are mostly frozen methane, the main chemical in natural gas -- a fuel for heating and cooking on Earth. The other object shown is Neptune's moon Triton. Image credit: NASA/JPL

Neptune is surrounded by thick layers of clouds in rapid motion. Winds blow these clouds at speeds up to 700 miles (1,100 kilometers) per hour. The clouds farthest from Neptune's surface consist mainly of frozen methane. Scientists believe that Neptune's darker clouds, which lie below the clouds of methane, are composed of hydrogen sulfide.

In 1989, the Voyager 2 spacecraft found that Neptune had a dark area made up of violently swirling masses of gas resembling a hurricane. This area, called the Great Dark Spot, was similar to the Great Red Spot on Jupiter. But in 1994, the Hubble Space Telescope found that the Great Dark Spot had vanished.



Bright blue clouds that surround the planet Neptune consist mainly of frozen methane. Winds that carry these clouds may reach speeds up to 700 miles (1,100 kilometers) per hour. Image credit: NASA/JPL



The icy crust of Triton, Neptune's largest satellite, has ridges and valleys that were revealed in photographs taken by the U.S. space probe Voyager 2. Image credit: NASA/JPL

### Satellites and rings

Neptune has 11 known satellites. Triton, Neptune's largest satellite, is about 1,681 miles (2,705 kilometers) in diameter and about 220,440 miles (354,760 kilometers) from Neptune. It is the only major satellite in the solar system that orbits in a direction opposite to that of its planet. Triton has a circular orbit and travels once around Neptune every six days. Triton may once have been a large comet that traveled around the sun. At some point, Neptune's gravity probably captured the comet, and it became a satellite of Neptune. Scientists have discovered evidence that volcanoes on Triton once spewed a slushy mixture of water and ammonia. This mixture is now frozen

on Triton's surface. Triton has a surface temperature of -390 degrees F (-235 degrees C), the coldest known temperature in the solar system. Some volcanoes on Triton remain active, shooting crystals of nitrogen ice as high as 6 miles (10 kilometers) above the moon's surface.

Neptune has three conspicuous rings and one faint ring. All of these rings are much fainter and darker than the rings of Saturn. They appear to consist of particles of dust. Neptune's outer ring is unlike any other planetary ring in the solar system. It has three curved segments that are brighter and denser than the rest of the ring. Scientists do not know why the dust is spread unevenly in the ring.

### Discovery

Neptune was discovered by means of mathematics before being seen through a telescope. Astronomers had noticed that Uranus, which they thought was the most distant planet, was not always in the position they predicted for it. The force of gravity of some unknown planet seemed to be influencing Uranus.

In 1843, John C. Adams, a young English astronomer and mathematician, began working to find the location of the unknown planet. Adams predicted the planet would be about 1 billion miles (1.6 billion kilometers) farther from the sun than Uranus. He completed his remarkably accurate work in September 1845. Adams sent it to Sir George B. Airy, the Astronomer Royal of England. However, Airy did not look for the planet with a telescope. Apparently, he lacked confidence in Adams.

Meanwhile, Urbain J. J. Leverrier, a young French mathematician unknown to Adams, began working on the project. By mid-1846, Leverrier also had predicted Neptune's position. He sent his predictions, which were similar to those of Adams, to the Urania Observatory in Berlin, Germany. Johann G. Galle, the director of the observatory, had just charted the fixed stars in the area where the planet was believed to be. On Sept. 23, 1846, Galle and his assistant, Heinrich L. d'Arrest, found Neptune near the position predicted by Leverrier. Today, both Adams and Leverrier are credited with the discovery. The planet was named for Neptune, the Roman sea god. In August 1989, the Voyager 2 spacecraft provided the first close-up views of Neptune and most of its moons. The spacecraft also discovered the planet's rings and six of its moons -- Despina, Galatea, Larissa, Naiad, Proteus, and Thalassa.

Contributor: Bradford A. Smith, Ph.D., Astronomer, Institute for Astronomy, University of Hawaii.

How to cite this article: To cite this article, World Book recommends the following format: Smith, Bradford A. "Neptune." World Book Online Reference Center. 2004. World Book, Inc. <http://www.worldbookonline.com/wb/Article?id=ar386900>.



In Neptune's outermost ring, 39,000 miles (63,000 kilometers) from the planet, material mysteriously clumps into three bright, dense arcs. Image credit: NASA

## **Voyager 2:**

Voyager 2's exciting flyby of Neptune capped the historic Grand Tour of the outer solar system, taking advantage of a rare planetary alignment to visit the four giant outer planets Jupiter, Saturn, Uranus, and Neptune over the course of 12 years. Voyager 2 skimmed the north pole of Neptune by a mere 4800 kilometers (3000 miles), and determined basic characteristics of Neptune and its largest moon Triton: color, cloud-top features, size, mass, composition, temperature, and rotation rate. Voyager 2 found six new Neptunian moons and three new rings plus a broad sheet of ring material. Unexpectedly, geysers of gaseous nitrogen were found on the largest moon, Triton. Neptune's magnetic field also confounded: tilted 47 degrees with respect to the rotational axis, and offset from the center of the planet by half the planet's radius. Voyager 2's flight path past Neptune sent the spacecraft diving below the ecliptic plane, where it continues its search today for the heliopause (the boundary between the Sun's influence and interstellar space).

### **Neptune: Moons: Triton**

Triton is the largest of Neptune's 13 moons. It is unusual because it is the only large moon in our solar system that orbits in the opposite direction of its planet's rotation - a retrograde orbit.

Scientists think Triton is a Kuiper Belt Object captured by Neptune's gravity millions of years ago. It shares many similarities with Pluto, the best known world of the Kuiper Belt.

Like our own moon, Triton is locked in synchronous rotation with Neptune - one side faces the planet at all times. But because of its unusual orbital inclination both polar regions take turns facing the Sun.

Triton's thin atmosphere is composed mainly of nitrogen with small amounts of methane. This atmosphere most likely originates from Triton's volcanic activity which is driven by seasonal heating by the Sun. Triton, Io and Venus are the only bodies in the solar system besides Earth that are known to be volcanically active at the present time.

Triton is one of the coolest objects in our solar system. It is so cold that most of Triton's nitrogen is condensed as frost, giving its surface an icy sheen that reflects 70 percent of the sunlight that hits it.

NASA's Voyager 2 - the only spacecraft to fly past Neptune and Triton - found surface temperatures of -235°C (-391°F). During its 1989 flyby, Voyager 2 also found Triton has active geysers, making it one of the few geologically active moons in our solar system.

Spacecraft images show the moon has a sparsely cratered surface with smooth volcanic plains, mounds and round pits formed by icy lava flows. Triton consists of a crust of frozen nitrogen over an icy mantle believed to cover a core of rock and metal.

### **Discovery**

Triton was discovered on 10 October 1846 by British astronomer William Lassell, just 17 days after Neptune itself was discovered by German astronomers Johann Gottfried Galle and Heinrich Louis d'Arrest.

### **How Triton Got its Name**

Moons of Neptune are named for characters from Greek or Roman mythology associated with Neptune or Poseidon or the oceans. Irregular satellites are named for the Nereids, daughters of Nereus and Doris and the attendants of Neptune.

Triton is named after the son of Poseidon (the Greek god comparable to the Roman Neptune). Until the discovery of the second moon Nereid in 1949, Triton was commonly known as simply "the satellite of Neptune".