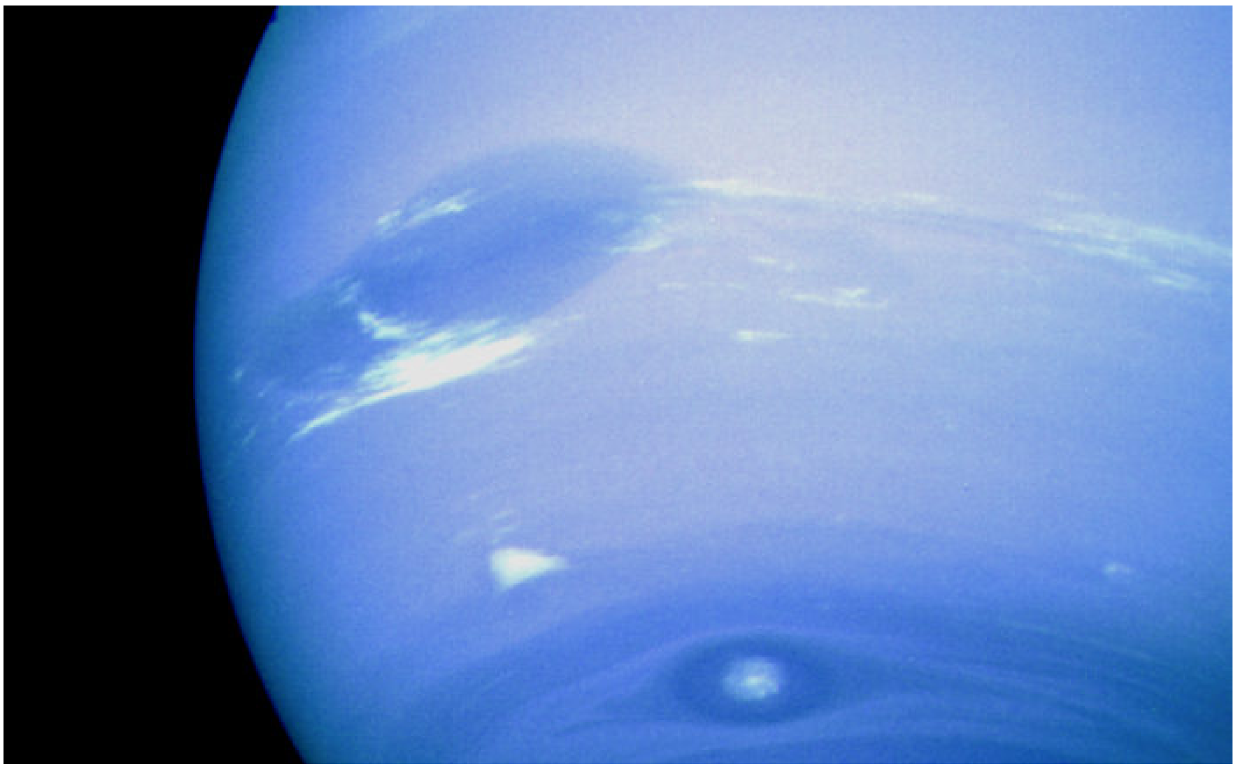
What is the surface of Neptune like?

April 22 2016, by Matt Williams



The "surface" of Neptune, its uppermost layer, is one of the most turbulent and active places in the Solar System. Credit: NASA/JPL

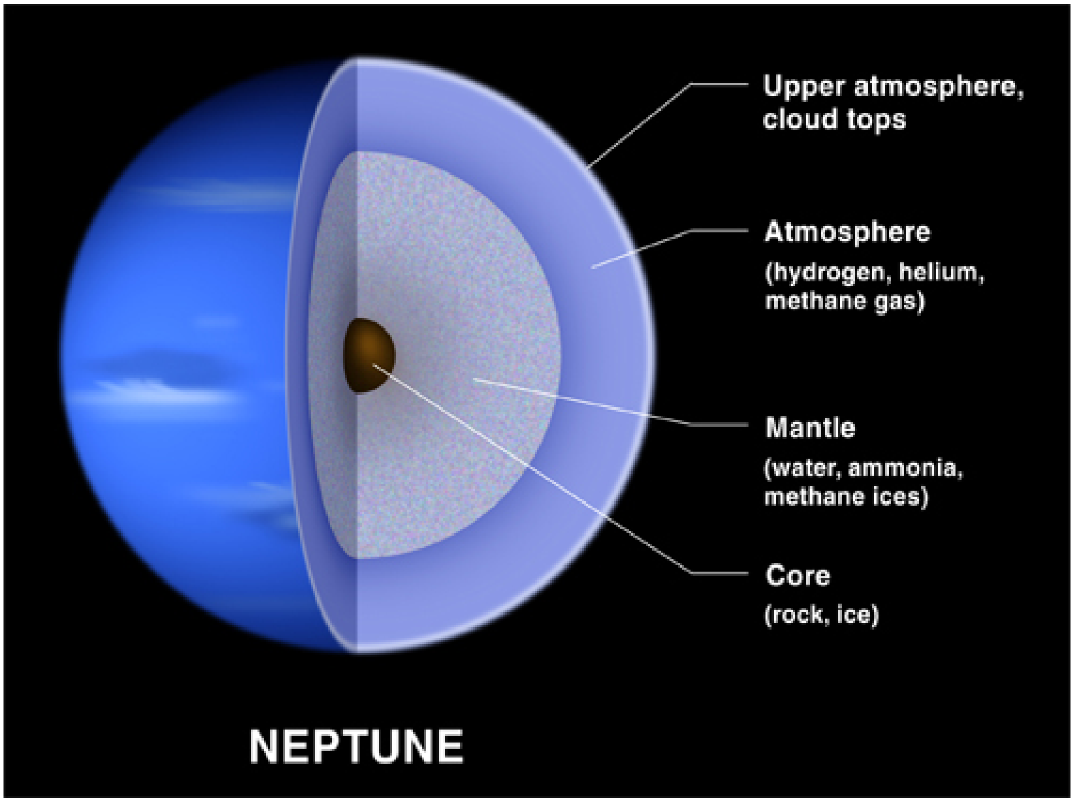
As a gas giant (or ice giant), Neptune has no solid surface. In fact, the blue-green disc we have all seen in photographs over the years is actually a bit of an illusion. What we see is actually the tops of some very deep gas clouds, which in turn give way to water and other melted ices that lie over an approximately Earth-size core made of silicate rock and a nickeliron mix. If a person were to attempt to stand on Neptune, they would sink through the gaseous layers.

As they descended, they would experience increased temperatures and pressures until they finally touched down on the solid core itself. That being said, Neptune does have a surface of sorts, (as with the other gas and ice giants) which is defined by astronomers as being the point in the atmosphere where the pressure reaches one bar. Because of this, Neptune's surface is one of the most active and dynamic places in entire the Solar System.

Composition and Structure:

With a mean radius of 24,622 ± 19 km, Neptune is the fourth largest planet in the Solar System. But with a mass of 1.0243×10^{26} kg – which is roughly 17 times that of Earth – it is the third most massive, outranking Uranus. Due to its smaller size and higher concentrations of volatiles relative to Jupiter and Saturn, Neptune (much like Uranus) is often referred to as an "ice giant" – a subclass of a giant planet.

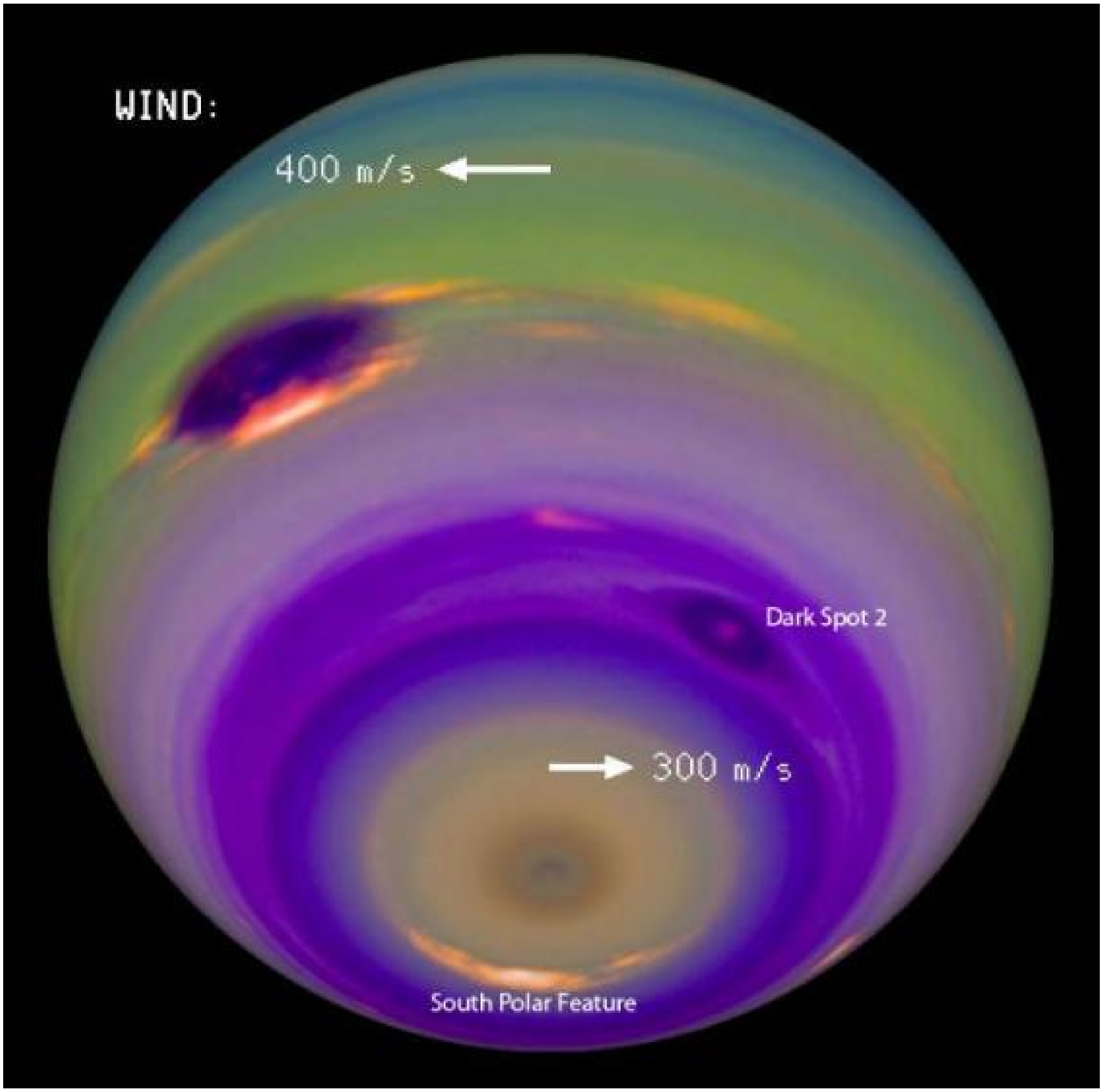
As with Uranus, the absorption of red light by the atmospheric methane is part of what gives Neptune its blue hue, although Neptune's is darker and more vivid. Because Neptune's atmospheric methane content is similar to that of Uranus, some unknown atmospheric constituent is thought to contribute to Neptune's more intense coloring.



The internal structure and composition of Neptune. Credit: NASA

Also like Uranus, Neptune's internal structure is differentiated between a rocky core consisting of silicates and metals; a mantle consisting of water, ammonia and methane ices; and an atmosphere consisting of hydrogen, helium and methane gas. It's atmosphere is also divided into four layers, consisting of (from innermost to outermost) the lower troposphere, the stratosphere, the thermosphere and the exosphere.

The two main regions of Neptune's atmosphere are the two innermost ones: the lower troposhere, where temperatures decrease with altitude; and the stratosphere, where temperature increases with altitude. Within the troposphere, pressure levels range from one to five bars (100 and 500 kPa), hence the surface of Neptune is defined as being within this region.

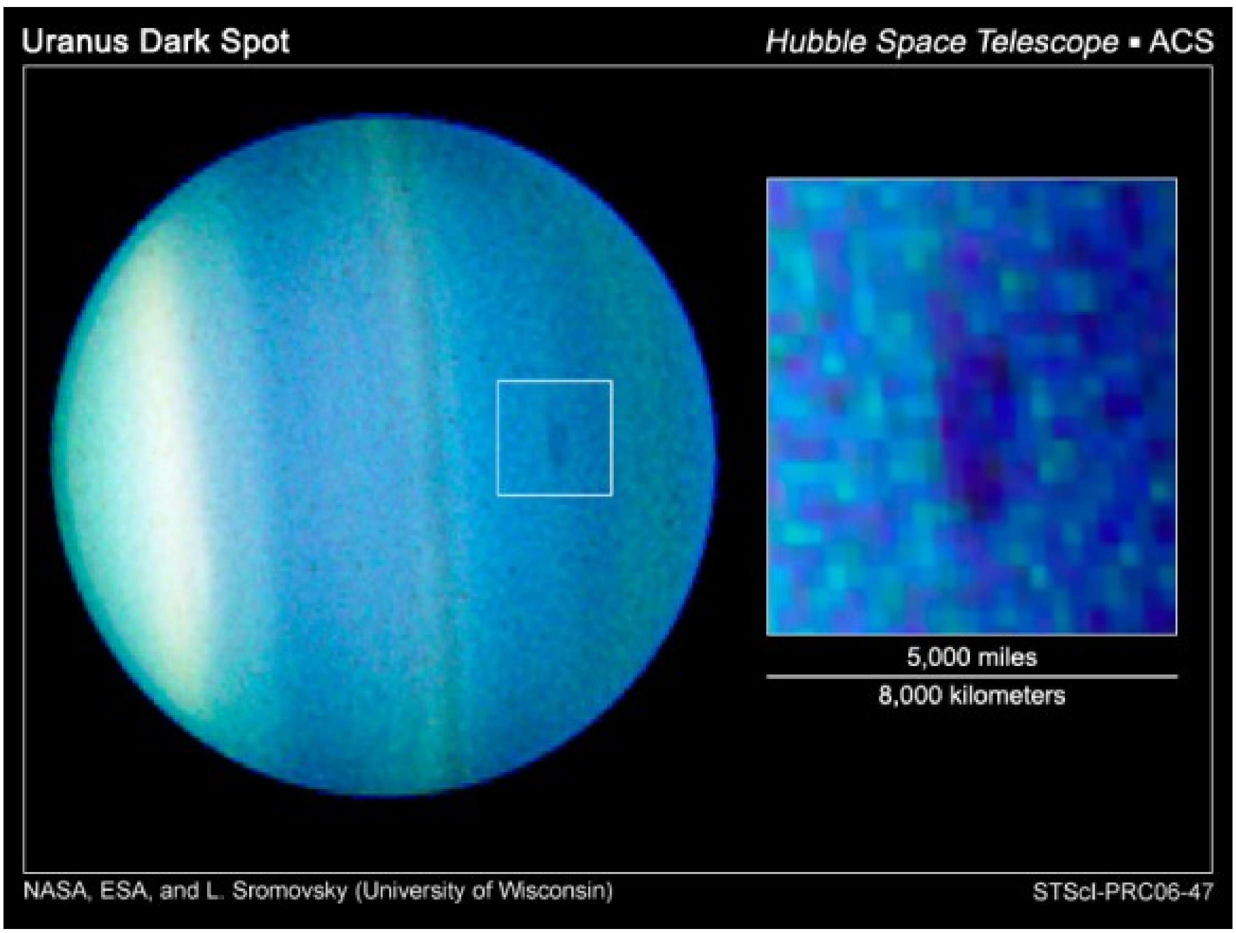


Neptune’s atmosphere, with colors contrasts modified to emphasize the planet’s atmospheric features. Credit: Erich Karkoschka

Atmosphere:

Neptune's "surface" can therefore be said to be composed of about 80% hydrogen and 19% helium, with a trace amount of methane. The surface layer is also permeated by roving bands of clouds with varying compositions, depending on altitude and pressure. At the upper-level, temperatures are suitable for methane to condense, and the pressure conditions are such that clouds consisting of ammonia, ammonium sulfide, hydrogen sulfide and water can exist.

At lower levels, clouds of ammonia and hydrogen sulfide are thought to form. Deeper clouds of water ice should be also found in the lower regions of the troposphere, where pressures of about 50 bars (5.0 MPa) and temperature of 273 K (0 °C) are common.



Neptune’s Great Dark Spot, as observed by the Hubble Space Telescope. Credit: NASA/ESA/HST/L.Sromovsky/UofW

For reasons that remain obscure, the planet's thermosphere experiences unusually high temperatures of about 750 K (476.85 °C/890 °F). The planet is too far from the Sun for this heat to be generated by ultraviolet radiation, which means another heating mechanism is involved – which could be the atmosphere's interaction with ion's in the planet's magnetic field, or gravity waves from the planet's interior that dissipate in the atmosphere.

Because Neptune is not a solid body, its atmosphere undergoes differential rotation. The wide equatorial zone rotates with a period of about 18 hours, which is slower than the 16.1-hour rotation of the planet's magnetic field. By contrast, the reverse is true for the polar regions where the rotation period is 12 hours.

This differential rotation is the most pronounced of any planet in the Solar System, and results in strong latitudinal wind shear and violent storms. The three most impressive were all spotted in 1989 by the Voyager 2 space probe, and then named based on their appearances.

The first to be spotted was a massive anticyclonic storm measuring 13,000 x 6,600 km and resembling the Great Red Spot of Jupiter. Known as the Great Dark Spot, this storm was not spotted five later (Nov. 2nd, 1994) when the Hubble Space Telescope looked for it. Instead, a new storm that was very similar in appearance was found in the planet's northern hemisphere, suggesting that these storms have a shorter life span than Jupiter's.

The Scooter is another storm, a white cloud group located farther south than the Great Dark Spot. This nickname first arose during the months leading up to the Voyager 2 encounter in 1989, when the cloud group was observed moving at speeds faster than the Great Dark Spot. The

Small Dark Spot, a southern cyclonic storm, was the second-most-intense storm observed during the 1989 encounter. It was initially completely dark; but as Voyager 2 approached the planet, a bright core developed and could be seen in most of the highest-resolution images.

Internal Heat:

For reasons that astronomers are still not clear on, the interior of Neptune is unusually hot. Even though Neptune is much further from the Sun than Uranus and receives 40% less sunlight, its surface temperature is about the same. In fact, Neptune gives off 2.6 times more energy than it takes in from the Sun. Even without the Sun, Neptune glows.

This high amount of interior heat matched with the coldness of space creates a huge temperature difference. And this sets the winds blasting around Neptune. Maximum wind speeds on Jupiter can be more than 500 km/hour. That's twice the speed of the strongest hurricanes on Earth. But that's nothing compared to Neptune. Astronomers have calculated winds blasting across the surface of Neptune at 2,100 km/hour.

Deep down inside Neptune, the planet might have an actual solid surface . At the very core of the gas/ice giant is thought to be a region of rock with roughly the mass of the Earth. But temperatures at this region would be thousands of degrees; hot enough to melt rock. And the pressure from the weight of all the atmosphere would be crushing.

In short, there is simply no way one could stand on the "surface of Neptune", let alone walk around on it.

Source: Universe Today