TOP 5 ELEMENTS IN THE ATMOSPHERE OF

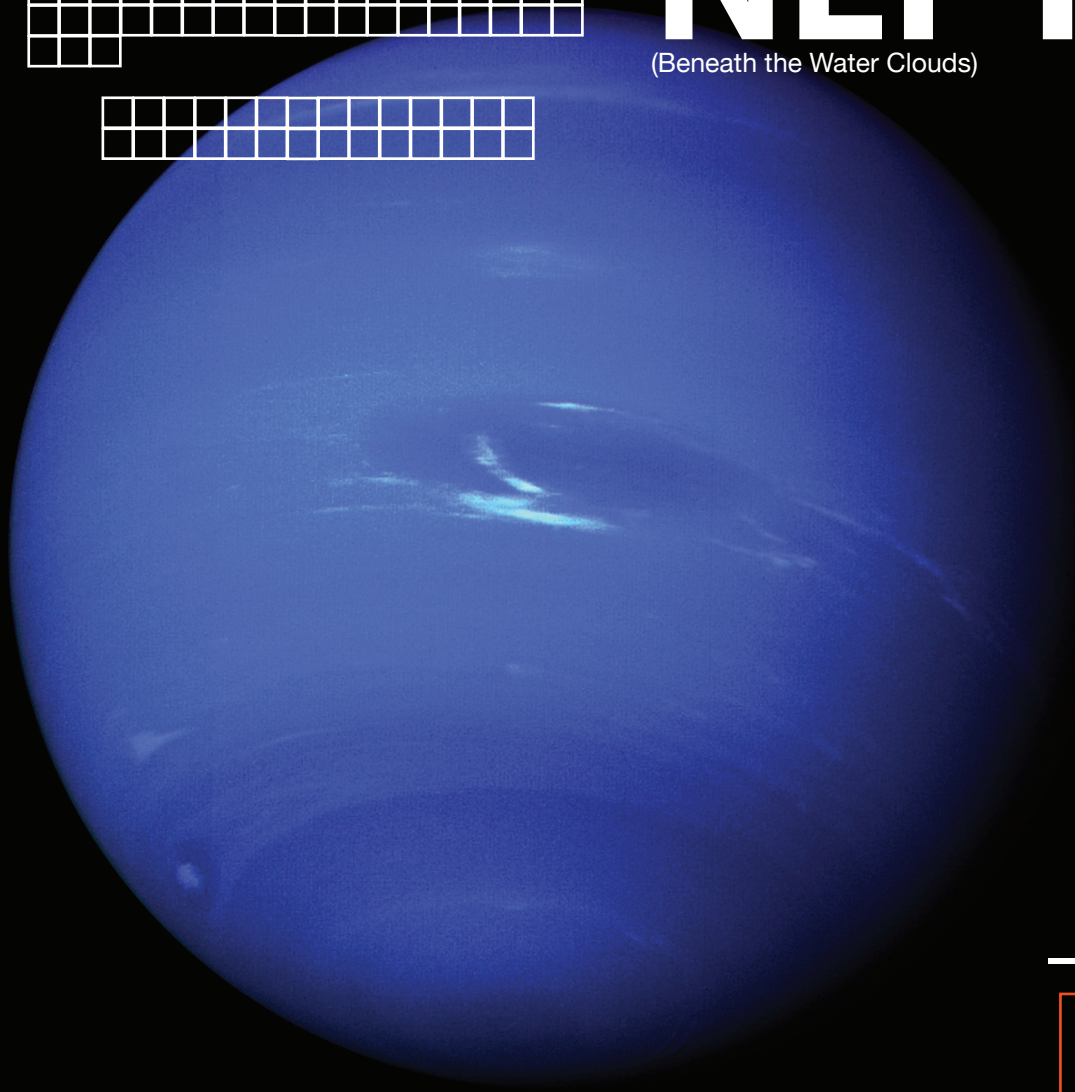
NEPTUNE

(Beneath the Water Clouds)

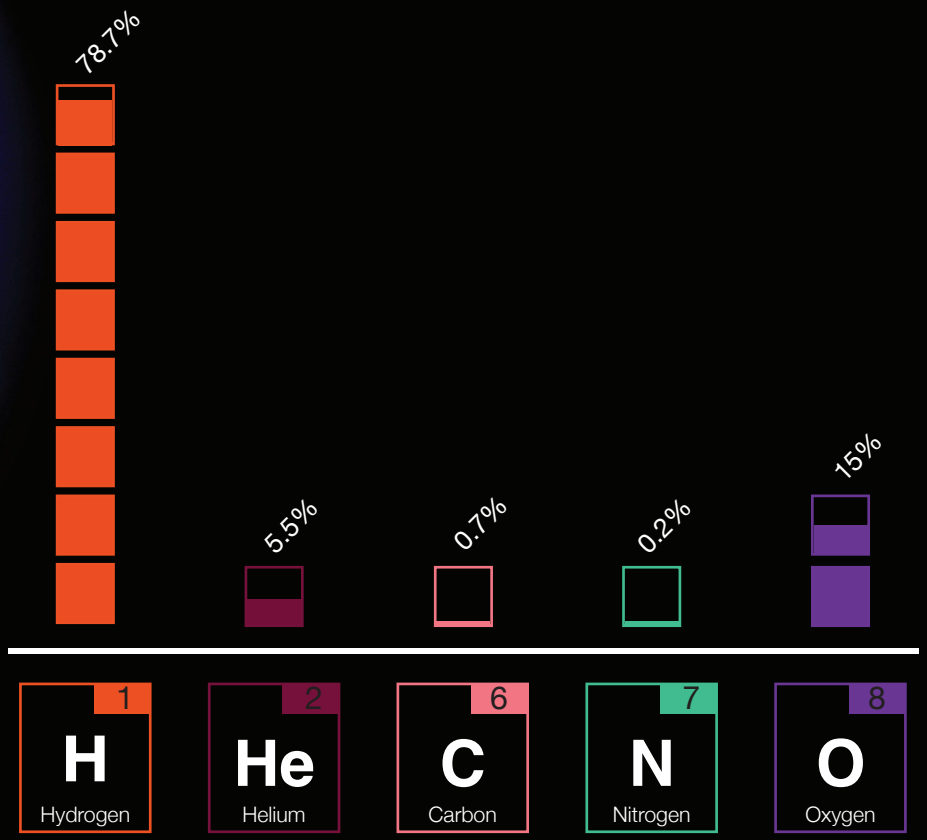
LUNAR AND PLANETARY INSTITUTE

2019 IYPT

International Year of the Periodic Table of Chemical Elements



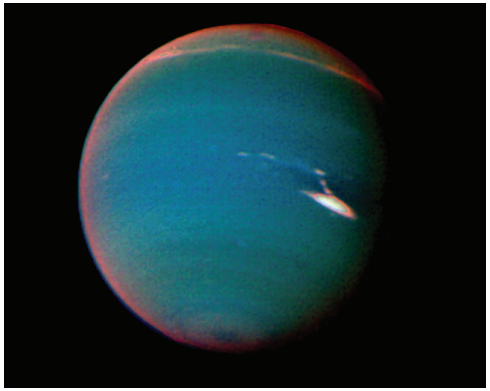
Credit: NASA



Sources:
Lodders & Fegley (2011). Chemistry of the solar system, Cambridge: Royal Society of Chemistry.
Lodders & Fegley (1994). Icarus, Vol. 112.

NEPTUNE

Neptune, the eighth most distant planet from the Sun, was named after the Roman god of the seas, but by fortuitous accident since nothing was known about its composition when it was discovered in 1846. Neptune is often called an ice-giant planet, and it may have up to 640 times more oxygen in the form of water than expected if Neptune had formed from material in the same proportions found in the Sun. Neptune's density, along with spectroscopy from Voyager 2 and Earth-based observations, reveal that its outer, observable atmosphere contains ~80% hydrogen, 19% helium, and 1.5% methane. Consequently, Neptune appears blue because methane absorbs the red wavelengths of visible light it receives from the Sun (the blue light is reflected). The outermost atmosphere is very cold, down to –50°C. Icy cloud layers of methane, ammonia, and water occur with increasing depth in Neptune's atmosphere, which gets hotter and denser inward. Chemical reactions between carbon monoxide and hydrogen provide a window into the composition of Neptune's interior. Deeper in the hot and dense portions of the atmosphere, oxygen is bound in carbon monoxide and water, but in the cooler and less dense upper atmosphere oxygen is mainly bound in water. The observed carbon monoxide gas rising from the deep interior tells us about the high water content of the deep atmosphere of Neptune — which is indeed another water-rich planet and blue dot in the solar system.



This false-color image from Voyager 2 reveals features at different depths in the atmosphere of Neptune: Blue objects are deeper, while white features are at higher altitudes. Credit: NASA/JPL.

United Nations Educational, Scientific and Cultural Organization

International Year of the Periodic Table of Chemical Elements

The year 2019 marks the 150th anniversary of Dmitri Mendeleev's development of the Periodic System and has been proclaimed the "International Year of the Periodic Table of Chemical Elements" (IYPT2019).

www.iypt2019.org

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Dr. Katharina Lodders is a research professor in the Department of Earth and Planetary Sciences and the McDonnell Center for the Space Sciences at Washington University in St. Louis, Missouri. She obtained her degree in nuclear chemistry from the Johannes-Gutenberg University in 1990 and did her Ph.D. work at the Max Planck Institute for Chemistry in Mainz, Germany. From 2010 to 2013 she worked as Program Director in the Division of Astronomical Sciences at the National Science Foundation in Arlington, Virginia. Lodders is the lead author of two books written with Bruce Fegley Jr., The Planetary Scientist's Companion (Oxford University Press, 1998) and Chemistry of the Solar System (Royal Society of Chemistry, 2011), and has contributed to over 90 refereed scientific papers. Her research in astronomy, cosmochemistry, and planetary sciences focuses on experimental and theoretical studies of abundances of the chemical elements, formation of star dust from evolved stars, chemical processes in the solar nebula and accretion disks, formation of meteorite parent bodies, planetary accretion and differentiation, and chemistry in stellar and substellar environments such as giant planets, exoplanets, brown dwarfs, and low-mass stars.

LPI

Founded at the height of the Apollo program in 1968, the Lunar and Planetary Institute (LPI) is an intellectual leader in lunar and planetary science. LPI's mission is to advance understanding of the solar system by providing exceptional science, service, and inspiration to the world. The research carried out at LPI supports NASA's efforts to explore the solar system.

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