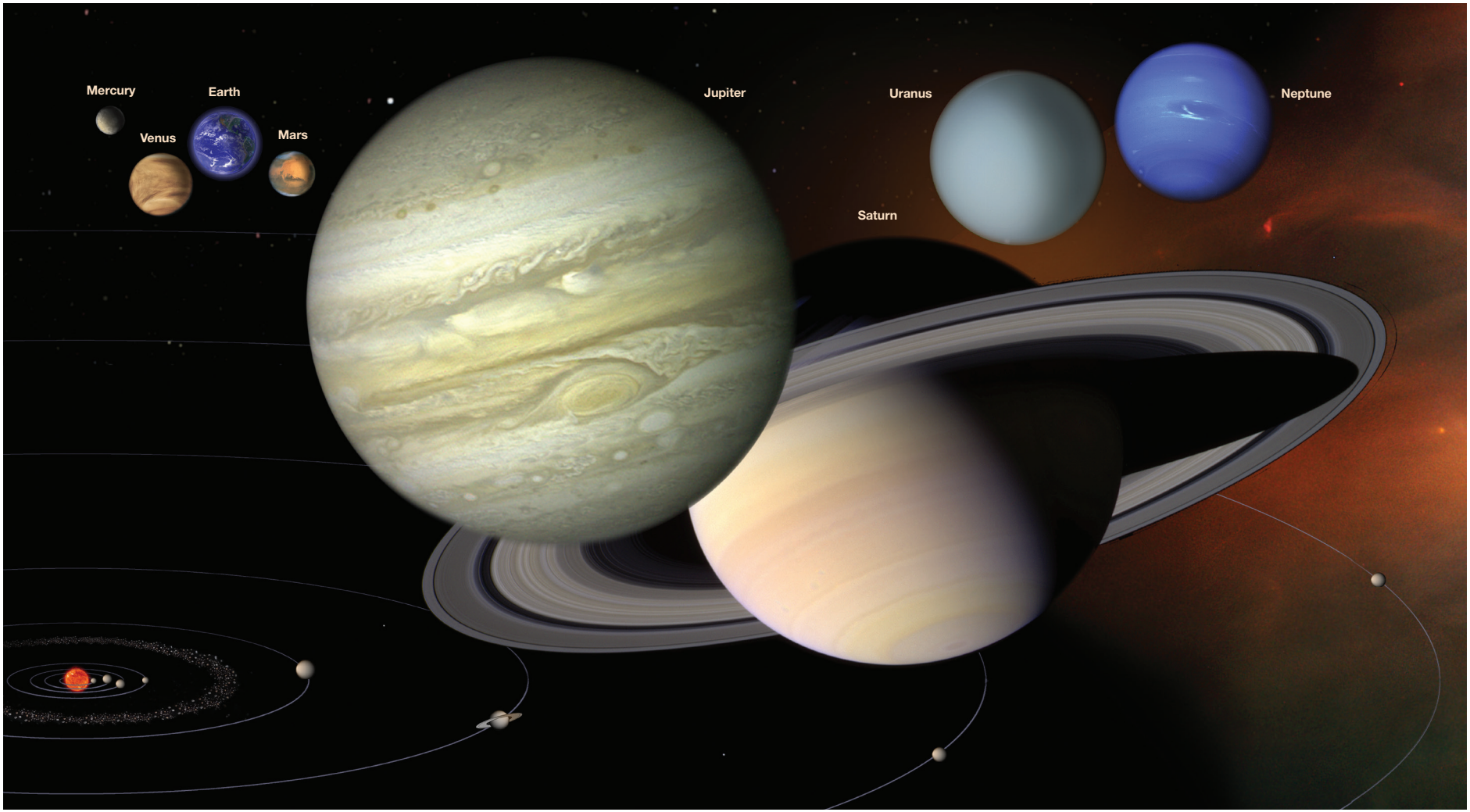

Our Solar System

Humans have gazed at the heavens and tried to understand the cosmos for thousands of years. Ancient civilizations placed great emphasis on careful astronomical observations. Early Greek astronomers were among the first to leave a written record of their attempts to explain the cosmos. For them, the universe was Earth, the Sun, the Moon, the stars, and five glowing points of light that moved among the stars. The Greeks named the five points of light — called *planetes*, or wanderers — after their gods. The Romans later translated the names into Latin — Mercury, Venus, Mars, Jupiter, and Saturn — and these are the names astronomers use today. Planetary features are named by the International Astronomical Union, founded in 1919. For more information about the names of planets, moons, and features, consult the Gazetteer of Planetary Nomenclature website at *planetarynames.wr.usgs.gov*.

Ancient observers believed that the Sun and all the other celestial bodies revolved around Earth. Astronomers gradually realized that the Earth-centered model did not account for the motions of the planets. In the early 17th century, Galileo Galilei's discoveries using the recently invented telescope strongly supported the concept of a "solar system" in which all the planets, including Earth, revolve around a central star — the Sun. Planetary moons, the rings of Saturn, and more planets were eventually discovered: Uranus (in 1781) and Neptune (1846). The largest known asteroid, Ceres, was discovered between Mars and Jupiter in 1801. Originally classified as a planet, Ceres is now designated a dwarf planet (but retains its asteroid label), along with Pluto, which was discovered in 1930; Eris, found in 2003; Haumea, found in 2004; and Makemake, found in 2005. There may be hundreds of dwarf planets in Pluto's realm.

Our solar system formed about 4.6 billion years ago. The four planets closest to the Sun — Mercury, Venus, Earth, and Mars — are called the terrestrial planets because they have solid, rocky surfaces. Two of the outer planets beyond the orbit of Mars — Jupiter and Saturn — are known as gas giants; the more distant Uranus and Neptune are called ice giants.

Earth's atmosphere is primarily nitrogen and oxygen. Mercury has a very tenuous atmosphere, while Venus has a thick atmosphere of mainly carbon dioxide. Mars' carbon dioxide atmosphere is extremely thin. Jupiter and Saturn are composed mostly of hydrogen and helium, while Uranus and Neptune are composed mostly of water, ammonia, and methane, with icy mantles around their cores. The Voyager 1 and 2 spacecraft visited the gas giants, and Voyager 2 flew by and imaged the ice giants. Ceres and the outer dwarf planets — Pluto, Eris, Haumea, and Makemake — have similar compositions and are solid with icy surfaces. NASA spacecraft are en route to two of the dwarf planets — the Dawn mission visits Ceres in 2015 and the New Horizons mission reaches Pluto in that same year. Neither Ceres nor Pluto has been previously visited by any spacecraft.

Moons, rings, and magnetic fields characterize the planets. There are 146 known planetary moons, with at least 27 moons awaiting official recognition. (Three of the dwarf planets have moons: Pluto has five, Eris has one, and Haumea has two.) The planetary moons are not all alike. One (Saturn's Titan) has a thick atmosphere; another has active volcanoes (Jupiter's Io). New moons are frequently discovered, so moon counts can change.

Rings are an intriguing planetary feature. From 1659 to 1979, Saturn was thought to be the only planet with rings. NASA's Voyager missions to the outer planets showed that Jupiter, Uranus, and Neptune also have ring systems.

Most of the planets have magnetic fields that extend into space and form a magnetosphere around each planet. These magnetospheres rotate with the planet, sweeping charged particles with them.

How big is our solar system? To think about the large distances, we use a cosmic ruler based on the astronomical unit (AU). One AU is the distance from Earth to the Sun, which is about 150 million kilometers or 93 million miles. Particles from the Sun can reach far beyond the planets, forming a giant bubble called the heliosphere. The enormous bubble of the heliosphere is created by the solar wind, a stream of charged gas blowing outward from the Sun. As the Sun orbits the center of the Milky Way, the bubble of the heliosphere moves also, creating a bow shock ahead of itself in interstellar space — like the bow of a ship in water — as it crashes into the interstellar gases. The region where the solar wind is abruptly slowed by pressure from gas between the stars is called the termination shock.

Two NASA spacecraft, launched in 1977, have crossed the termination shock — Voyager 1 in 2004 and Voyager 2 in 2007. In late 2011, Voyager 1 data showed that the spacecraft had entered the outermost region of the heliosphere. By 2013, Voyager 1 was about 18 billion kilometers (11 billion miles) from the Sun, and Voyager 2 was about 15 billion kilometers (9 billion miles) from the Sun. Scientists anticipate that Voyager 1 will cross into interstellar space, where gas and dust from other stars are found as well as the enormous Oort Cloud, within a few months to a few years. Both spacecraft should have enough electrical power to send data until at least 2020. It will be thousands of years before the two Voyagers exit the Oort Cloud, a vast spherical shell of icy bodies surrounding the solar system.

As we explore the universe, we wonder: Are there other planets where life might exist? Are we alone? These are the great questions that science is now probing. Only recently have astronomers had the tools — sensitive telescopes on Earth and in space — to detect planets orbiting stars in other solar systems.

FAST FACTS

	Equatorial Radius		Mean Distance from the Sun		
Body	km	mi	km, millions	mi, millions	Moons*
Sun	695,500	432,200	—	—	—
Mercury	2,440	1,516	57.91	35.98	0
Venus	6,052	3,760	108.21	67.24	0
Earth	6,378	3,963	149.60	92.96	1
Moon	1,737	1,080	**	**	—
Mars	3,397	2,111	227.94	141.63	2
Jupiter	71,492	44,423	778.41	483.68	50†
Saturn	60,268	37,449	1,426.73	886.53	53‡
Uranus	25,559	15,882	2,870.97	1,783.94	27
Neptune	24,764	15,388	4,498.25	2,795.08	13Δ

*Known moons as of July 2013. The dwarf planet moons are not included in this list, nor are asteroid moons.
**Mean Earth–Moon distance: 384,400 kilometers or 238,855 miles.
†Jupiter has 17 moons awaiting official confirmation, bringing the total to 67.
‡Saturn has 9 moons awaiting official confirmation, bringing the total to 62.
ΔNeptune has 1 moon awaiting official confirmation, bringing the total to 14.

ABOUT THE ILLUSTRATION

The planets are shown in the upper part of the illustration in their correct order from the Sun and to the same relative size scale. If the distances between the planets were shown at the same scale, the illustration would be miles wide! The correct distance scale between planets is shown in the lower part of the illustration, but the sizes of the planets have been greatly exaggerated (even the Sun would be too small to see at the scale shown). The faint rings of Jupiter, Uranus, and Neptune are not shown. Dwarf planets Pluto, Eris, Haumea, and Makemake do not appear in the illustration. The dwarf planet Ceres is not shown separately; it resides in the asteroid belt between Mars and Jupiter.

FOR MORE INFORMATION

solarsystem.nasa.gov/planets/profile.cfm?Object=SolarSys

solarsystem.nasa.gov/education/

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