



*Mercury Shows Its True Colors –* As the MESSENGER spacecraft receded from Mercury after making its closest approach on January 14, 2008, the Wide Angle Camera recorded a mosaic covering part of the planet not previously seen by spacecraft. Credit: NASA/Johns Hopkins University Applied Physics Laboratory/Carnegie Institution of Washington.

### **Fun facts:**

- Mercury is the smallest planet in our solar system only slightly larger than the Earth's Moon.
- Mercury has a solid, cratered surface, much like the Earth's Moon.
- Mercury has a huge core! The radius of the core is approximately 75% of that of the entire planet (Earth's is about 54%).
- Mercury does not have any moons or rings.

#### **Past missions:**

- Mariner 10 flew by Mercury three times in 1974-1975, giving us our first glimpse of the innermost planet in the solar system. The same side of Mercury was sunlit during the flybys, so Mariner 10 only saw one side of the planet.
- *MESSENGER* launched from Earth in 2004, the MESSENGER spacecraft flew past Mercury three times before going into orbit around Mercury in 2011. It was the first spacecraft to orbit Mercury, providing pictures and data from all over the planet.

# Venus



**Computer Simulated Global View of Venus** – This global view of the surface of Venus is centered at 180 degrees east longitude. Magellan synthetic aperture radar mosaics from the first cycle of Magellan mapping are mapped onto a computer-simulated globe to create this image. Credit: NASA/JPL.

#### Fun facts:

- Venus' thick and toxic atmosphere is made up mostly of carbon dioxide (CO<sub>2</sub>) and nitrogen (N<sub>2</sub>), with clouds of sulfuric acid (H<sub>2</sub>SO<sub>4</sub>) droplets.
- Venus is the hottest planet in the solar system. Its surface experiences extremely high temperatures of almost 480°C (900°F), more than hot enough to melt lead!
- Venus spins backwards (retrograde rotation) when compared to the other planets. This means that the Sun rises in the west and sets in the east on Venus.

#### Past missions:

- *Mariner 2* flew by Venus in 1962, becoming the first spacecraft to send back information from another planet.
- *Magellan* in orbit around Venus from 1990 to 1994, it mapped 98% of the Venusian surface using radar.
- *Venus Express* European Space Agency mission that arrived in orbit around Venus in 2006 and studied the atmosphere and surface of Venus until 2015.

#### Future missions:

• Akatsuki / PLANET-C – Japan Aerospace Exploration Agency mission that will study the atmospheric circulation of Venus.

# Earth



**New Blue Marble** – A 'Blue Marble' image of the Earth taken from the VIIRS instrument aboard NASA's Earth-observing satellite – Suomi NPP. This composite image uses a number of swaths of the Earth's surface. Credit: NASA/NOAA/GSFC/Suomi NPP/VIIRS/Norman Kuring.

#### Fun facts:

- Earth is a rocky planet, also known as a terrestrial planet, with a solid and constantly changing surface of mountains, valleys, canyons, plains, and much more.
- Earth is different from other terrestrial planets in our solar system because it has oceans. 70% of our planet is covered in water.
- Earth is the only place in the universe known to harbor life.

#### **Current missions:**

- Landsat represents the world's longest continuously acquired collection of spacebased land remote sensing data. Four decades of imagery provide a unique resource for those who work in agriculture, geology, forestry, regional planning, education, mapping, and global change research. Landsat images are also invaluable for emergency response and disaster relief.
- Orbiting Carbon Observatory 2 (OCO-2) NASA's first dedicated Earth remote sensing satellite to study atmospheric carbon dioxide from space.
- Soil Moisture Active Passive (SMAP) its soil moisture and freeze/thaw measurements are invaluable across many science and applications disciplines including hydrology, climate, carbon cycle, and the meteorological, environmental and ecology applications communities.

## Mars



*Mars at Ls 107 Degrees: Tharsis*— This picture is a composite of Mars Global Surveyor (MGS) Mars Orbiter Camera (MOC) daily global images acquired at Ls 107 degrees. Credit: NASA/JPL-Caltech/MSSS.

#### Fun facts:

- Mars' solid surface has been altered by volcanoes, impacts, crustal movement and atmospheric effects such as dust storms.
- At this time in the planet's history, Mars' surface cannot support life as we know it. Current missions exploring Mars on the surface and from orbit are determining Mars' past and future potential for life.
- Mars has two moons named Phobos and Deimos.
- Mars is known as the Red Planet because iron minerals in the Martian soil oxidize, or rust, causing the soil – and the dusty atmosphere – to look red.

#### **Current missions:**

- Mars Science Laboratory / Curiosity demonstrated new heavy-load Mars landing technologies, found ancient Mars could have had the right chemistry to be a suitable home for life, and found evidence water once flowed knee-deep in ancient streambed in Gale Crater.
- Mars Reconnaissance Orbiter (MRO) in orbit around Mars since 2005, it has revealed that Mars is a world more dynamic and diverse than was previously realized.
- MAVEN studies Mars' atmosphere to determine the history of Mars' atmosphere and climate, liquid water and planetary habitability by determining how volatiles from the Martian atmosphere have escaped into space over time.

# Asteroids



**Vesta Sizes Up** – This composite image shows the comparative sizes of nine asteroids. Vesta, which is also considered a protoplanet because it's a large body that almost became a planet, dwarfs all other small bodies in this image, with its diameter sizing up at approximately 330 miles (530 kilometers). Credit: NASA.

#### Fun facts:

- Asteroids are solid, rocky, irregular bodies that do not have atmospheres.
- More than 150 asteroids are known to have a small companion moon (some have two moons). The first discovery of an asteroid-moon system was of asteroid Ida and its moon Dactyl in 1993.
- Asteroids that pass close to Earth are called near-Earth asteroids (NEOs).

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#### Current missions:

- Dawn orbited large asteroid 4 Vesta for one year before traveling to dwarf planet Ceres, becoming the first spacecraft to orbit two bodies and the first to visit a dwarf planet.
- *Hayabusa 2* Japan's Hayabusa 2 is designed to study asteroid 1999 JU3 from multiple angles, using remote-sensing instruments, a lander and a rover. It will collect surface and possible subsurface materials and return the samples in a capsule to Earth for analysis.

#### **Future missions:**

• OSIRIS-REx – launching in 2016, it will use a robotic arm to pluck samples from an asteroid to help better explain our solar system's formation and how life began.





**Jupiter Portrait** – This true color mosaic of Jupiter was made with images taken by the narrow angle camera on board NASA's Cassini spacecraft during its closest approach to the giant planet at a distance of approximately 10 million km (6.2 million miles). Credit: NASA/JPL/Space Science Institute.

#### Fun facts:

- Everything visible on the planet is a cloud. The parallel reddish-brown and white bands, the white ovals, and the large Great Red Spot persist over many years despite the intense turbulence visible in the atmosphere.
- Jupiter's diameter is eleven times that of Earth, so even its smallest storms are comparable in size to the largest hurricanes on Earth.

#### Past missions:

 Galileo – the first spacecraft to orbit Jupiter, Galileo discovered an intense radiation belt above Jupiter's cloud tops, revealed extensive and rapid resurfacing of the moon Io because of volcanism, and found the first evidence of liquid water oceans under the moon Europa's icy surface.

#### **Future missions:**

• Juno – arriving in orbit around Jupiter in 2016, it will observe Jupiter's gravity and magnetic fields, atmospheric dynamics and composition, and the coupling between the interior, atmosphere and magnetosphere that determines the planet's properties and drives its evolution.

### Saturn



**True Saturn** – While cruising around Saturn in early October 2004, Cassini captured a series of images that have been composed into this large global natural color view of Saturn and its rings. This grand mosaic consists of 126 images acquired in a tile-like fashion, covering one end of Saturn's rings to the other and the entire planet in between. Credit: NASA/JPL/Space Science Institute.

#### Fun facts:

- Saturn's atmosphere is made up mostly of hydrogen (H<sub>2</sub>) and helium (He).
- Saturn has 53 known moons with an additional nine moons awaiting confirmation of their discovery that is a total of 62 moons!
- Saturn has the most spectacular ring system, which is made up of seven rings with several gaps and divisions between them.
- When Galileo Galilei was observing the planet Saturn in the 1600s, he noticed strange objects on each side of the planet and drew in his notes a triple-bodied planet system and then later a planet with arms or handles. These "handles" were in fact the rings of Saturn.

#### Past missions:

• *Huygens* – an ESA mission, the Huygens lander became the first spacecraft to land

on a moon of another planet when it touched down on the surface of Titan, Saturn's largest moon, in 2005.

#### **Current missions:**

 Cassini – the first spacecraft to orbit Saturn, it completed the first detailed reconnaissance of Saturn and its family of moons and rings, delivered the Huygens probe to Titan for the first landing on another planet's moon, discovered erupting geysers and a global subsurface ocean on Enceladus, found clear evidence of present-day hydrothermal activity on Enceladus – the first detection of hydrothermal activity beyond Earth, revealed Titan as world with rain, rivers, lakes and seas, and revealed Saturn's rings as active and dynamic – a laboratory for how planets form.





**Uranus as Seen by NASA's Voyager 2** – NASA's Voyager 2 spacecraft flew closely past distant Uranus, the seventh planet from the sun, in January 1986. Credit: NASA.

#### Fun facts:

- Like Venus, Uranus has a retrograde rotation (east to west). Unlike any of the other planets, Uranus rotates on its side, which means it spins horizontally.
- Uranus has 13 known rings. The inner rings are narrow and dark and the outer rings are brightly colored.
- Uranus has 27 moons. Uranus' moons are named after characters from the works
  - of William Shakespeare and Alexander Pope.
- Uranus is an ice giant. Most (80% or more) of the planet's mass is made up of a hot dense fluid of "icy" materials – water (H<sub>2</sub>O), methane (CH<sub>4</sub>), and ammonia (NH<sub>3</sub>) – above a small rocky core.
- Uranus has an atmosphere which is mostly made up of hydrogen (H<sub>2</sub>) and helium (He), with a small amount of methane (CH<sub>4</sub>), which gives Uranus its blue tint.

#### Past missions:

• *Voyager 2* – the only spacecraft to have flown by Uranus, it discovered evidence of an ocean of boiling water about 800 km below the cloud tops. The spacecraft discovered ten new moons, two new rings, and a strangely tilted magnetic field stronger than that of Saturn.

# Neptune



**Full-Disk Neptune** – This picture of Neptune taken by the Voyager 2 spacecraft shows the Great Dark Spot and its companion bright smudge; on the west limb the fast moving bright feature called Scooter and the little dark spot are visible. These clouds were seen to persist for as long as Voyager's cameras could resolve them. North of these, a bright cloud band similar to the south polar streak may be seen. Credit: NASA.

#### Fun facts:

- Neptune's atmosphere is made up mostly of hydrogen (H<sub>2</sub>), helium (He) and methane (CH<sub>4</sub>).
- Neptune is a sister ice giant to Uranus. Neptune is mostly made of a very thick, very hot combination of water (H2O), ammonia (NH3), and methane (CH4) over a possible heavier, approximately Earth-sized, solid core.
- Neptune has 13 moons. Neptune's moons are named after various sea gods and nymphs in Greek mythology.
- Neptune has six rings.
- Sometimes, during the course of Neptune's orbit, dwarf planet Pluto is actually closer to the sun, and us, than Neptune. This is due to Pluto's unusual elliptical (egg-shaped) orbit.

#### Past missions:

 Voyager 2 – the only human-made object to have flown by Neptune, it passed less than 5,000 kilometers above the planet's cloud tops in the closest approach of its entire tour. It discovered five moons, four rings, and a "Great Dark Spot" that vanished by the time the Hubble Space Telescope imaged Neptune five years later. Neptune's largest moon, Triton, was found to be the coldest known planetary body in the solar system, with a nitrogen ice "volcano" on its surface.

# Pluto



**The Rich Color Variations of Pluto** – NASA's New Horizons spacecraft captured this highresolution enhanced color view of Pluto on July 14, 2015. Pluto's surface sports a remarkable range of subtle colors, enhanced in this view. Many landforms have their own distinct colors, telling a complex geological and climatological story that scientists have only just begun to decode. Credit: NASA/JHUAPL/SwRI.

#### Fun facts:

- It is thought that Pluto has a rocky core surrounded by a mantle of water ice with other ices coating its surface.
- Pluto has five known moons. Pluto is sometimes called a double-planet system due to the fact that its moon Charon is quite large and orbits close to its parent planet.
- Pluto has a thin, tenuous atmosphere that expands when it comes closer to the sun and collapses as it moves farther away similar to a comet.
- Pluto was considered a planet from 1930, when it was first discovered, until 2006. The discovery of similar-sized worlds deeper in the distant Kuiper Belt sparked a debate which resulted in a new official definition of a planet. The new definition did not include Pluto.

#### Past missions:

 New Horizons – flew through the Pluto system in 2015, becoming the first and only spacecraft to explore Pluto up close. The successful flyby yielded science data that will be beamed back to Earth well into 2017. The mission has potential additional Kuiper Belt targets to possibly explore in the coming years.