

**Distances of Planets, in Feet, from Sun
2000 Feet Radius Solar System**

| | |
|---------|-------|
| Sun | 0 |
| Mercury | 19.6 |
| Venus | 36.6 |
| Earth | 50.6 |
| Mars | 77 |
| Jupiter | 263 |
| Saturn | 483 |
| Uranus | 971 |
| Neptune | 1,520 |
| Pluto | 2,000 |

Diameter of Moon's Orbit: 3.12 inches.

Distance to closest star, Proxima Centauri:
13,716,000 feet or 2,598 miles which is the distance from
San Diego, CA to the top of Maine.

2000-ft Solar System Walk

SUN



Sun

Our Sun is a star just like the other stars in the night sky; however, it is special to us because it is the star

that our planet, Earth, orbits. And because of its majestic brilliance, metaphorically it is the center of our Universe.

A star is a huge ball of mostly hydrogen gas that creates energy by a special process called nuclear fusion. Since stars are very massive, they produce tremendous pressure and heat at their centers, which forces hydrogen atoms together to become helium atoms. During this "fusing" process, a very small amount of excess matter gets converted into an enormous amount of energy. This is the same energy that is produced from nuclear hydrogen bombs. We see some of this energy as the light of stars or the brilliance of our Sun.

Although our Sun is huge, approaching a million miles in diameter, it is only an average-sized star. Its mass, that is, the amount of matter it contains is equivalent to 330,000 Earths. Its surface temperature averages 10,000° F, but its core temperature is estimated to reach 27 million degrees.

Our Sun is composed of 92.1% hydrogen, 7.8% helium, 0.061% oxygen and even smaller amounts of other elements. It is yellowish in color because of its surface temperature. Cooler stars look reddish, and hotter ones look blue or white.

A star like our Sun will shine for 10 to 12 billion years. At the end of its life it will puff up and become a red giant, then shrink down to a white dwarf, a star about the size of Earth.

When you glance at the Sun, the bright part that you see is the photosphere. Photo means light, so you are seeing the part of the Sun that gives off visible light. If you attach a solar filter to a telescope, you can often see sunspots. These dark spots are cooler than their surroundings and indicate areas of intense magnetic fields. Because the Sun rotates, sunspots "move" across its surface, forming, growing and finally dissolving away. Many are larger than Earth.

Immediately above the photosphere is a thin red layer of gas, about 1,000 miles thick, called the chromosphere. This layer separates the lower photosphere from the outer corona. The corona is a magnificent veil of hydrogen gas that reaches temperatures of millions of degrees and extends millions of miles

This would be the actual size of the Sun if the radius of the Solar System were 2,000 feet.



from the surface. The corona is visible as an irregular halo surrounding the Sun during a total solar eclipse.

Our Sun becomes active about every 11 years. During these times, the number of sunspots, prominences and flares increases. Over 100 sunspots per

day can often be counted. Huge prominences jet off from the surface and some loop back. And flares also shoot out charged particles into the solar system creating the wonderful displays of the northern Aurora Borealis and the southern Aurora Australis.

Sun Facts

- **Diameter:** 865,000 miles
- **Surface temperature:** 10,000° F
- **Sunspot temperature:** 6,300° F
- **Temperature at core:** 27,000,000° F
- **Composition:** 92% hydrogen gas, 8% helium gas plus traces of many other elements
- **Source of energy:** Nuclear fusion — the energy released when four hydrogen atoms are forced together to form one helium atom in the core.

2000-ft Solar System Walk

MERCURY



Mercury
The planets were named after ancient Roman and

Greek mythological gods. Mercury, the closest planet to the Sun, was identified with the Roman god who had wings attached to his feet and a helmet on his head. He swiftly delivered messages to the other gods. As the name so well implies, the planet Mercury revolves rapidly around the Sun, more swiftly than any of the others.

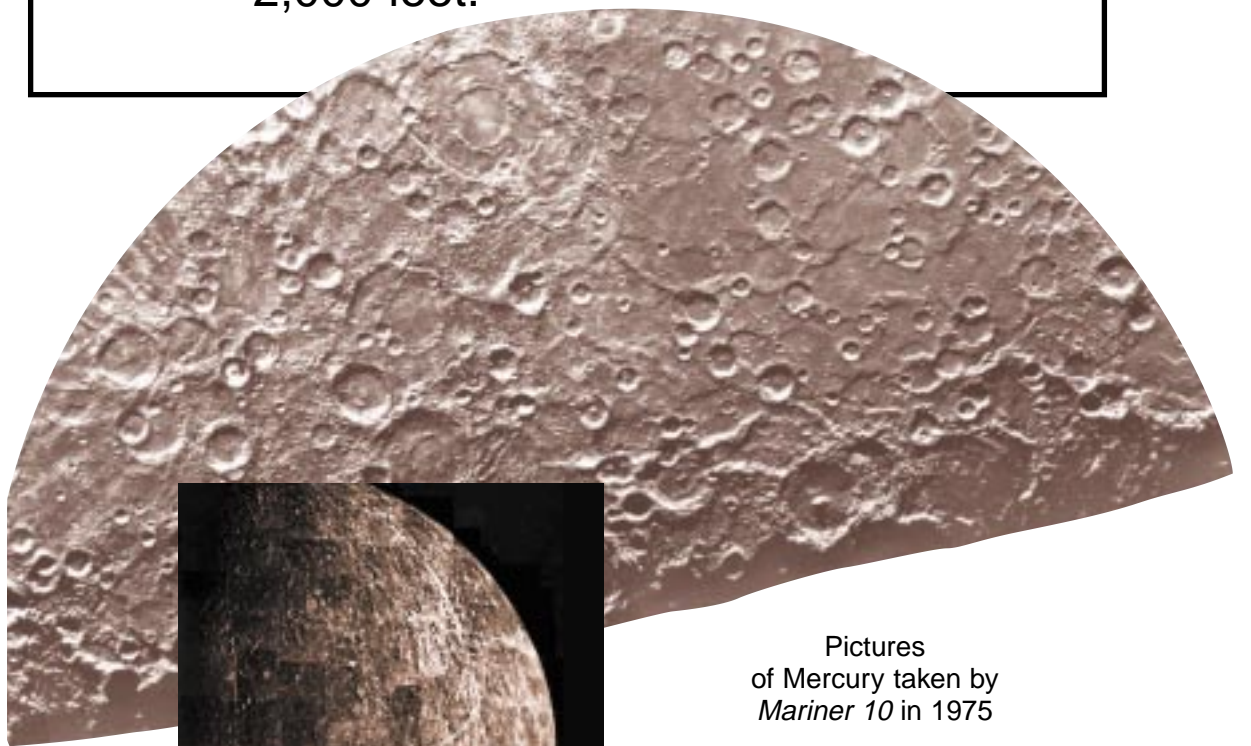
Mercury resembles our Moon. Like our Moon, it is small in size, pitted with craters, and has no atmosphere. Its craters were formed from a heavy bombardment of asteroids and comets during the first billion years of the solar system's existence. The interior of Mercury, once molten, has cooled and is now solid. It is composed mostly of iron ore.

Mercury is difficult to study with a telescope because it is so close to the Sun. All of the close-up pictures of it were obtained by the one spacecraft, *Mariner 10*, that visited it in 1975.

Since Mercury orbits inside Earth's orbit, it cycles through phases like our Moon. When we see phases, we are seeing nothing more than the day and night sides of the planet at the same time.

Mercury in the sky. Mercury is visible as a fairly bright star several times a year; however, most people never see it, because it can only be seen for a short time after sunset or before sunrise.

This would be the actual size of **Mercury** if the radius of the Solar System were 2,000 feet.



Pictures of Mercury taken by *Mariner 10* in 1975



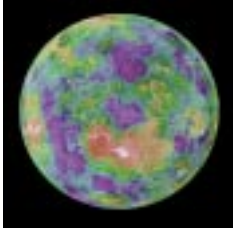
Mercury in the early eastern morning sky. On this day, Mercury was easy to spot because it was simply the brightest object in the area, but it can be missed easily if you are not looking directly at it. Sweeping the area with binoculars helps in locating this planet, but for safety reasons, use binoculars only when the Sun is below the horizon.

Mercury Facts

- **Diameter:** 3,032 miles
- **Distance from the Sun:** 36,000,000 miles
- **Atmosphere:** Mercury has no atmosphere — no air!
- **Temperatures:** 800° F on day side, -300° F on night side
- **Rotation on Axis (Mercury's day):** 59 days
- **Revolution about Sun (Mercury's Year):** 88 days
- **Moons:** Mercury has no moons

2000-ft Solar System Walk

VENUS



Venus

Venus was named after the Roman goddess of love. It is the planet closest and most similar in size to Earth. Like Earth, Venus is a terrestrial planet that is composed of rock-type material, so it has a surface that you can stand and walk on.

If you are at least middle-aged, you may remember Venus referred to as Earth's sister planet. This connotation ended once we learned more about conditions on the planet's surface.

Venus' atmosphere consists mostly of the colorless gas carbon dioxide. However, within this colorless atmosphere are opaque white clouds so thick that it is impossible to see through them to the surface. No one knew what lay beneath these clouds until exploratory spacecraft started visiting the planet in the late 1970s.

The white clouds in Venus' atmosphere are made of sulfuric acid. Venus has numerous volcanos that continually release sulfur dioxide which combines with a small amount of water vapor to form the widespread sulfuric acid clouds.

Venus is also hot! What happens inside a car that is out in the Sun with its windows rolled up? The interior temperature rises because the windows trap the sunlight's heat. The same thing happens to Venus. Its atmosphere of carbon dioxide acts like the windows of a car, trapping the heat energy of sunlight. This type of heating is called the greenhouse effect. On Venus, the greenhouse effects pushed the temperature near the surface to 900°F, the hottest of any planet and hot enough to melt the metal lead.

Overall, Venus' atmosphere contains about 100 times more gas than Earth's. This "heavy" atmosphere creates tremendous pressure at Venus' surface — more than 90 times greater than ours, and equal to the pressure found at an ocean depth of 3,000 feet.

Venus' barren surface is riddled with rocks and volcanos. Scientists

believe that its surface may circulate with its upper level interior and thus renew itself every 100 million years or so.

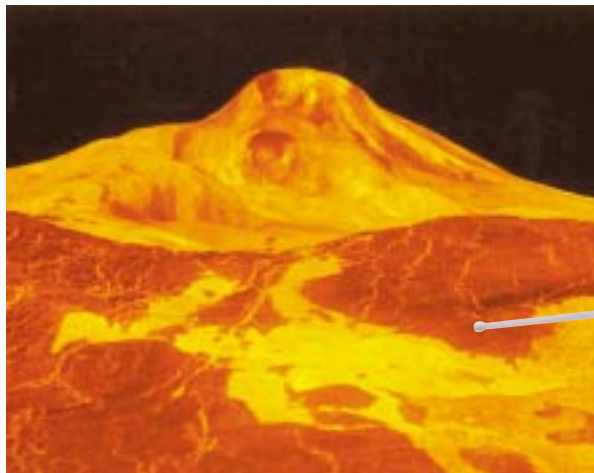
Surprisingly, the former USSR landed the *Venera 13* and *14* probes on Venus in 1982. These landers were able to transmit pictures of the surface and other data for one to two hours before succumbing to the hostile environment.

Venus rotates nearly upside down compared to the other planets. As a result, if you viewed Venus

from the top of the solar system (from the direction of Earth's north pole), it would appear to rotate backward. Also, Venus rotates very slowly on its axis. It takes longer to rotate once on its axis than to revolve around the Sun.

Venus in the sky. Often, Venus is the brightest "star" in the sky. Its white clouds make it highly reflective and its closeness to Earth makes it even brighter. Because Venus orbits inside Earth's orbit, it displays phases.

This would be the actual size of **Venus** if the radius of the Solar System were 2,000 feet.



Above. A colorized image (produced from radar) of the surface of Venus. It is riddled with active volcanos. **Right.** The *Pioneer Venus Orbiter* circled Venus from 1978 to 1992 and gathered general information about the planet. In 1992, it ran out of positioning fuel and burned up in Venus' atmosphere.



Venus Facts

- **Diameter:** 7,520 miles
- **Distance from the Sun:** 67,200,000 miles
- **Atmosphere:** 96% carbon dioxide gas, 4% nitrogen gas plus traces of other gases
- **Temperature:** averages 900° F which is hot enough to melt the metal lead
- **Rotation on Axis (Venus' Day):** 243 days — longer than its year!
- **Revolution about Sun (Venus' Year):** 225 days
- **Moons:** Venus has no moons

2000-ft Solar System Walk

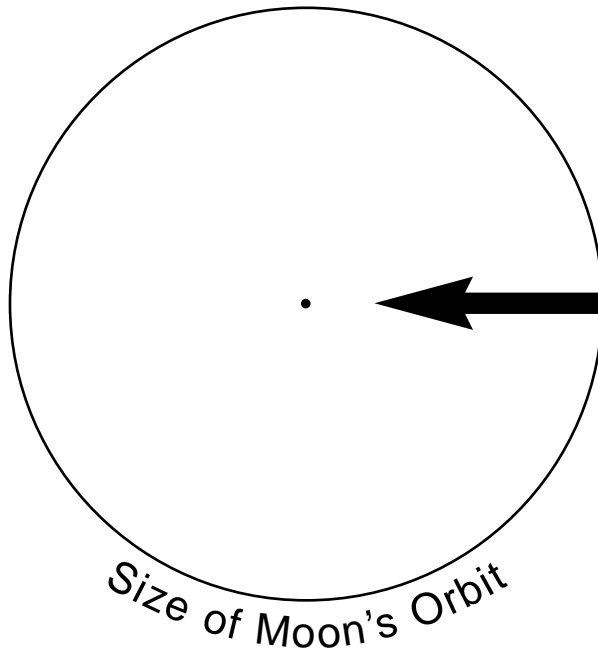
EARTH



Earth

The Earth is our home, and is a planet teeming with life. Scientists

feel certain that two major factors are necessary for life to start and then to flourish. First, a planet must have liquid water. Our Earth's surface is 71% water. Second, the temperature must stay in a narrow range. If the Earth were just a little closer or a little farther away from the Sun than it is now, it would be either too hot or cold for life to flourish. There are many other factors necessary for life to flourish, but if these two conditions were not met, humans, animals and plants would not exist in the abundance that they do now.

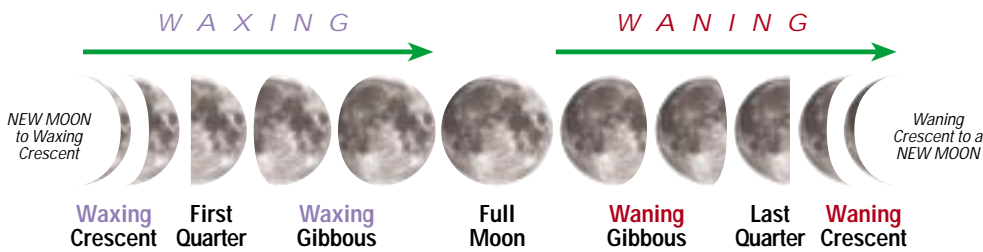


This would be the actual size of **Earth** if the radius of the Solar System were 2,000 feet.



Apollo Moon Landings

- Apollo 11 • July 20, 1969
- Apollo 12 • Nov 19, 1969
- Apollo 14 • Feb 5, 1971
- Apollo 15 • July 30, 1971
- Apollo 16 • Apr 21, 1972
- Apollo 17 • Dec 11, 1972



Moon Phases. The Moon cycles through phases as it orbits Earth every 29 days. When we see a phase, we are viewing nothing more than its day and night sides at the same time. Like Earth, the Moon always has a day and a night side (even when full). And because the Moon revolves around the Earth, we get to see it from angles that allow us to view both sides at once.

Earth Facts

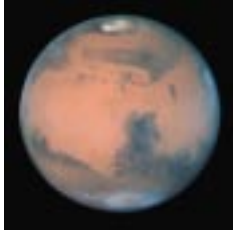
- **Diameter:** 7,910 miles
- **Distance from the Sun:** 93,000,000 miles
- **Atmosphere:** 77% nitrogen, 21% oxygen, 1% water vapor, 1% argon plus traces of many other gases
- **Temperatures:** averages 59° F, highest temperature 136° F, lowest temperature -129° F
- **Rotation on axis (Earth's Day):** 24 hours
- **Revolution about Sun (Earth's Year):** 365 days, 8 hours
- **Thickness of atmosphere:** Our atmosphere extends for hundreds of miles, but most of it lies within 55 miles of the surface.



Top. A picture of Earth taken by the Apollo 17 crew on their way to the Moon in 1972. This was the last manned mission to the Moon. **Below Earth.** The Command and Service Modules circled the Moon with one astronaut aboard while the other two landed in the Lunar Module which Edwin "Buz" Aldrin is climbing down in the **above** picture. Buz became the second person to walk on the Moon. **Left.** A closeup of the crater Tycho, near the terminator and with the Earth hovering above. Tycho is a prominent crater that has magnificent emanating rays. This photograph was taken by the orbiting spacecraft *Clementine* in 1994.

2000-ft Solar System Walk

MARS



Mars

Mars is named after the Roman god of war because of its "red" color. However, when we think of Mars, we often think of Martians. This idea started in the late 1800s

when Giovanni Schiaparelli of Italy and Percival Lowell of America made drawings of what they thought to be channels or canals. Lowell believed that the channels were canals built by Martians to transport water from the poles to the lower latitudes. Mars does not have canals or Martians, but these ideas ignited imaginations throughout the world that have lasted to this day.

Mars shares many similarities with Earth. These include mountains, volcanos (extinct on Mars), hills, plains, grand canyons, sand dunes, craters, polar caps, weather and clouds. As you can see from the pictures on the next page, the surface of Mars resembles a rocky desert.

Since Mars' diameter is a half of Earth's, its total surface area is about the same as the total land area on our planet. The difference in altitude between the highest and lowest points on Mars is 19 miles. Valles Marineris (Val-Les Mar-A-Nair-Us), its deepest canyon, is four times deeper than the Grand Canyon and stretches over 2,500 miles. Olympus Mons is not only the largest inactive volcano in the solar system, but also Mars' highest point. Its cauldron alone is 55 miles across and the area of its lava flow is the size of the state of Arizona. Mars is riddled with craters, but the largest one is Hellas, a whitish oval in the southern hemisphere with a diameter of 1,200 miles. Hellas boasts the lowest point on Mars.

The surface rocks are reddish due to a form of oxidation or rust. There are large areas of coloration caused by regional differences in the hues of the rocks and sand. The boundaries of these regions shift because of wind storms.

Overall, Mars appears to be geologically stable and volcanically inactive. Early in its history, it most likely had active volcanos and a thicker, warmer atmosphere supporting liquid surface water that flowed, and carved some of its terrain. Today's surface appears to have changed little in the past few billion years.

Mars' north polar cap is mostly made of frozen water; its southern cap is made of frozen carbon dioxide, commonly known as "dry ice."

Other than Earth, Mars is the most hospitable planet in our solar system. However, we could only live there in a protected environment. Its atmosphere is thin, unbreathable and cold.

The atmospheric pressure at Mars' surface is 1/100 that of Earth's and would be the same as what we experienced 20 miles above our surface. High performance jets can fly to a height of just over 20 miles. Commercial jetliners top out at 7 miles where the air pressure is 1/6 of sea level pressure. Oxygen is usually required to get to the top of Mount Everest, which is 5.5 miles high with half the air pressure of sea level. Even though Mars' atmosphere is thin, evidence of dust devils have been observed and the winds can "kick up" to produce huge, planet-wide dust storms.

Mars' atmosphere is 95% carbon dioxide, 2.7% nitrogen, 1.6% argon and less than 1% oxygen. Compare this to Earth's 77% nitrogen, 21% oxygen and less than 1/10 of 1% carbon dioxide. Although Mars' atmosphere is not poisonous, you could not breathe it to stay alive.

The average temperature is cold, around -81°F, but varies from -274°F to 72°F. The 72°F would last for just brief periods, close to the surface, around noon. Frost forms on surface rocks but evaporates as the day warms.

This would be the actual size of **Mars** if the radius of the Solar System were 2,000 feet.



Because of Mars' low atmospheric pressure, any liquid water on its surface would boil away into vapor. Likewise, if we stood on the surface without a space suit, the low atmospheric pressure coupled with the heat from our bodies would cause our blood to slowly boil. To walk around on Mars, you would need a light space suit providing adequate air pressure, warmth and oxygen.

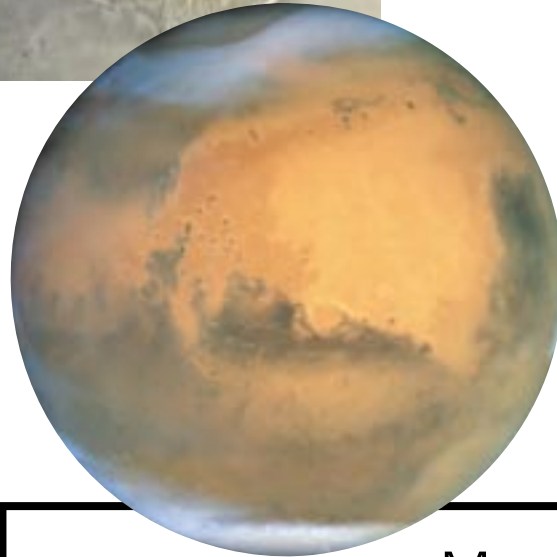
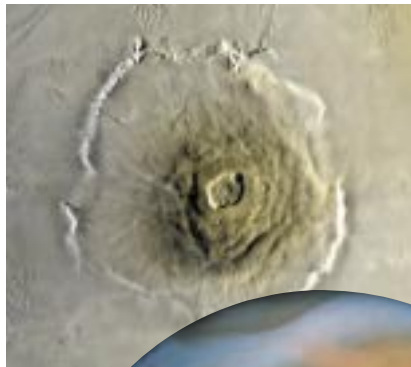
Water is absolutely necessary for humans to survive an extended stay on another planet. Its usefulness extends beyond drinking and watering plants, because it can also be used to make oxygen for breathing as well as hydrogen for fuel.

Mars has frozen water at its north pole and underground, which will make it easier for people to stay and live there.

The two moons of Mars, Phobos and Deimos, are believed to be captured asteroids because their irregular shapes and composition resemble these. Phobos is 17x13 miles in size and orbits Mars in 7.7 hours, at a distance of 5,800 miles. Deimos is 10x8 miles in size, orbiting in 1.3 days, at a distance of 14,600 miles.

Is there life on Mars? Many suspect that there may be microbial life in its soil; however, the answer to this question is years away and will most likely come only after extensive soil samples are taken and analyzed.

Mars in the sky. About every two years, the orbits of Mars and Earth bring them close to one another, allowing the surface colorations of Mars to be observed even with small telescopes. During this same time, Mars is at its brightest and even outshines Jupiter.



Top left. Olympus Mons' area of lava flow covers an area equal to the state of Arizona. The center cauldron spans 55 miles.

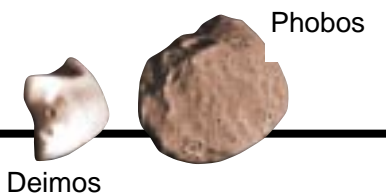
Left. A *Hubble Space Telescope* picture of Mars showing the surface coloration and clouds around the poles.

Lower right. Mars' south pole boasts a permanent cap of frozen carbon dioxide or dry ice.



Mars Facts

- **Diameter:** 4,200 miles
- **Distance from the Sun:** 142,000,000 miles
- **Atmosphere:** 95% carbon dioxide, 3% nitrogen, 1.6% argon, 0.2% oxygen
- **Temperature:** averages -81° F with a high of 72° F and a low of -274° F
- **Rotation on Axis (Mars' Day):** 24 hours, 37 minutes
- **Revolution about Sun (Mars' Year):** 687 days
- **Moons:** Mars has two small moons named Phobos and Deimos



2000-ft Solar System Walk

JUPITER



Jupiter

Jupiter is named after the supreme Roman god, ruler over all the other mythological gods. Jupiter is also the largest planet in our solar system, but was given its name by the ancients because it is consistently the brightest planet in the night sky. It is just a coincidence that the planet Jupiter turned out to be the largest planet in our solar system, because it was named thousands of years before anyone knew its size and what it really was.

The atmosphere of this planet has countless bands of clouds. They are very complex and display a tremendous amount of swirling and variation. There are two very distinct and easily observed bands, one in the northern hemisphere, called the North Equatorial Belt, and the other in the southern hemisphere, called the South Equatorial Belt. The most unique feature on Jupiter is its Great Red Spot. This giant, oval vortex is similar to a hurricane and extends into the South Equatorial Belt. It has been observed for over 150 years. No one knows if it is a permanent feature, but it does display some variation in size and color.

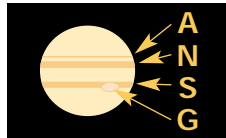
Jupiter has four large moons, called the Galilean moons, in honor of Galileo Galilei, who was one of the first scientists to observe them in 1610. These four moons are similar in size to our Moon. Io, the closest of the four to Jupiter has very active volcanos. Next out is Europa, which may have a vast ocean under its surface of ice. Ganymede, the largest of the four, is also the largest moon in the solar system, even larger than Mercury and Pluto. Finally, there is Callisto, which has craters with multi-rings around them.

Contrary to popular belief, Jupiter is not large enough to have almost become a small star. It would take the mass of 80 Jupiters to start nuclear fusion. There is not even enough mass in all the planets, asteroids and comets in our solar system to make a small star. Jupiter also has a very faint ring system and a strong magnetic field

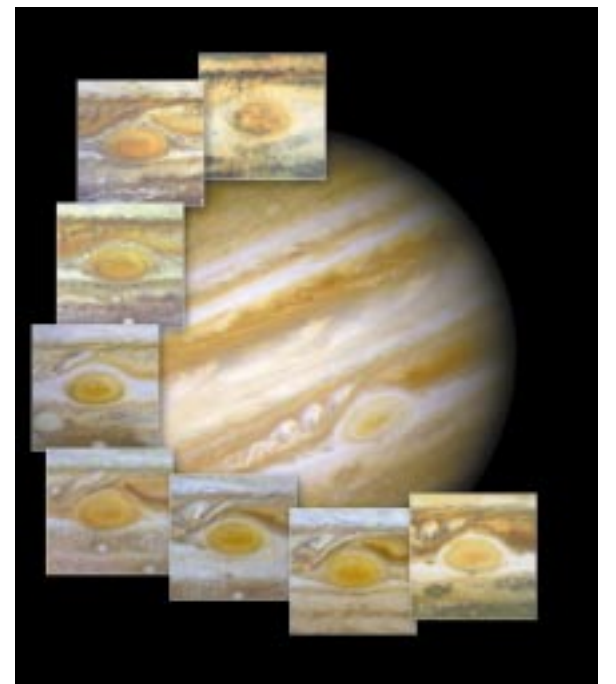
This would be the actual size of **Jupiter** if the radius of the Solar System were 2,000 feet.

which is induced by interior circulations.

Jupiter in the sky. This magnificent object is easy to locate because it is consistently the brightest planet, much brighter than Sirius, the brightest star. If it were not for the glare of this planet, its four Galilean moons could be seen with the naked eye.



Jupiter has numerous cloud belts, but the North and South Equatorial Belts (N and S respectively in the illustration) are the two most distinguished on the planet. They are plainly visible in small telescopes and appear as two "thick" parallel bands on opposite sides of a center line. A narrow band (A) called the North Temperate Belt, just above the North Equatorial Belt can also be seen. Other cloud details can be observed in its many belts with higher magnification, larger aperture telescopes and good seeing conditions.



Eight snapshots of the Great Red Spot from the *Hubble Space Telescope* show variations in size, shape and color. This 14,000-mile-wide hurricane-type storm rotates counter-clockwise once in about seven days with wind speeds topping 270 miles per hour. Some detail within the spot can be seen in telescopes with diameters as small as 8 inches.



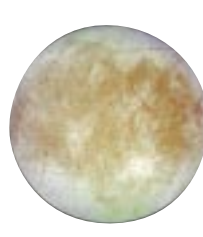
Our Moon

Diameter: 2,160 miles
Orbit Distance: 239,000 miles
Revolution Period: 27 days



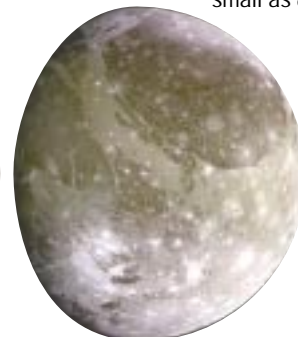
Io

Diameter: 2,255 miles
Orbit Distance: 262,000 miles
Revolution Period: 1.8 days



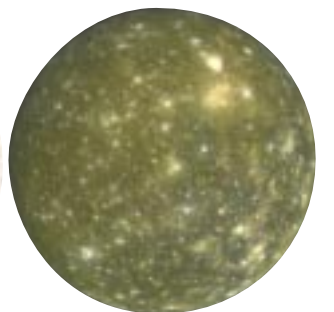
Europa

Diameter: 1,950 miles
Orbit Distance: 417,000 miles
Revolution Period: 3.6 days



Ganymede

Diameter: 3,270 miles
Orbit Distance: 665,000 miles
Revolution Period: 7.2 days



Callisto

Diameter: 2,980 miles
Orbit Distance: 1,171,000 miles
Revolution Period: 16.7 days

Jupiter Facts

- **Diameter:** 88,850 miles
- **Distance from the Sun:** 483,630,000 miles
- **Outer atmosphere:** 90% hydrogen, 10% helium
- **Deep Interior:** Liquid metallic hydrogen
- **Temperature just below cloudtops:** -243° F
- **Rotation on Axis (Jupiter's Day):** 9 hours, 50 minutes
- **Revolution about Sun (Jupiter's Year):** 11 years, 314 days
- **Moons:** Jupiter has dozens of moons, but only the 4 Galilean moons can be seen in small telescopes.

2000-ft Solar System Walk

SATURN



Saturn

When you think of a planet, which planet do you think of first? For most of us, Saturn comes to mind because of its magnificent rings. Saturn was named after the Roman god of agriculture and is the second largest planet in our solar system.

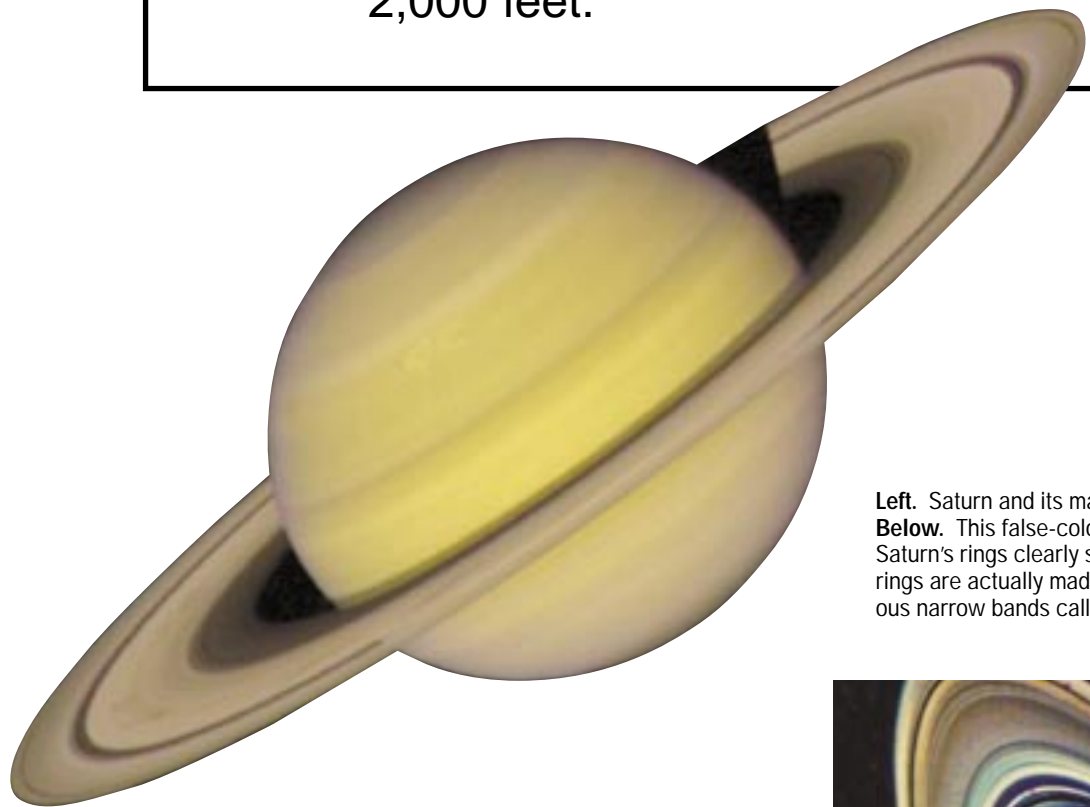
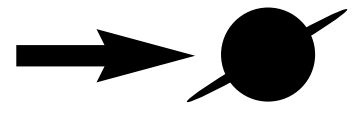
Like Jupiter, Saturn is a gas giant. Its atmosphere is mostly hydrogen with just a small amount of helium. Saturn's cloud belts are simpler and their colors are less distinct than those around Jupiter.

Saturn is the only planet in our solar system that has an overall density of less than 1. Density is a measure that compares the weight of equal volumes of substances. Pure water has a density of exactly 1. Materials with densities of less than 1 float, so Saturn would actually float if there was an ocean big enough to put it in. The densest planet in the solar system is Earth.

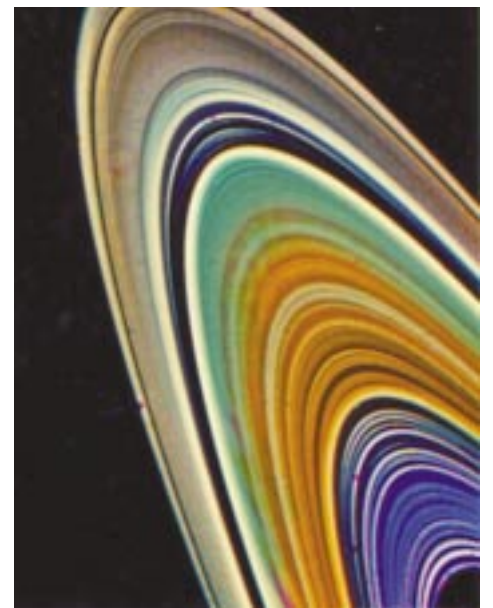
Saturn is distinguished from all the other planets by its magnificent rings. These are actually a series of thousands of narrow rings called ringlets. Each ringlet is composed of billions of small ice chunks (water) about an inch across. There are two bright groups of ringlets, called the A and B rings. These two broad bands are visible in small telescopes and can also be seen in the picture to the right. Between them is a 2,900-mile gap called the Cassini division that is also visible with a small telescope. The outer A ring has a diameter of 170,000 miles and the thickness of the rings varies from 30 to 350 feet.

Until 1977, astronomers thought that Saturn was the only planet with rings, but we know today from Earth-based observations and images taken

This would be the actual size of **Saturn** if the radius of the Solar System were 2,000 feet.



Left. Saturn and its magnificent rings. Below. This false-color picture of Saturn's rings clearly shows that the rings are actually made up of numerous narrow bands called ringlets.



by exploring spacecraft that all four gas giants have them. Still, none are as visible or as developed as Saturn's.

Saturn in the sky. Saturn is almost as large as Jupiter, but twice as far from Earth, so it appears to be about 1/2 the size and 1/4 the brightness of its big brother.

Saturn Facts

- **Diameter:** 75,000 miles
- **Distance from the Sun:** 887,000,000 miles
- **Outer atmosphere:** 97% hydrogen, 3% helium
- **Deep Interior:** Liquid metallic hydrogen
- **Temperature near cloudtops:** -301° F
- **Rotation on Axis (Saturn's Day):** 10 hours, 14 minutes
- **Revolution about Sun (Saturn's Year):** 29 years, 153 days
- **Moons:** Saturn has dozens of moons. Titan, the largest, has a diameter of 3,200 miles.

2000-ft Solar System Walk

URANUS



Uranus

Uranus (pronounced YOOR-uh-nus) was discovered by Sir William

Herschel of England in 1781 while he was exploring the sky, recording nebulae and galaxies. When he first came across Uranus, he thought that he had discovered a comet. However, after several months of observation, Anders Lexell, a mathematician, calculated its orbit and found that it was completely outside of Saturn's orbit. It was a new planet. No one had expected to find any more!

The *Voyager 2* spacecraft, which was launched in 1977, flew by Uranus in 1986 and provided the first closeup images of this outer world: The third largest gas giant has a faint ring system, over 20 moons and a simple cloud system. Uranus also rotates on its side, like a rolling ball, because its axis is tilted 98° from the vertical plane.

Uranus' pale blue color comes from a small amount of methane in its atmosphere. Similarly to the other gas giants, its atmosphere is comprised mainly of hydrogen gas with some helium and traces of other elements. The temperature at its cloudtops is a chilling -323°F. The pictures obtained of Uranus' surface from the flyby of *Voyager 2* showed a plain, featureless atmosphere, but since then, the *Hubble Space Telescope* has observed changing clouds.

Uranus, the father of the Cyclops, was named after one of the earliest supreme gods in Greek mythology. William Herschel had proposed that his new planet be named after King George III of England, but the international consensus was to keep the names of the planets based in mythology.

This would be the actual size of **URANUS** if the radius of the Solar System were 2,000 feet.



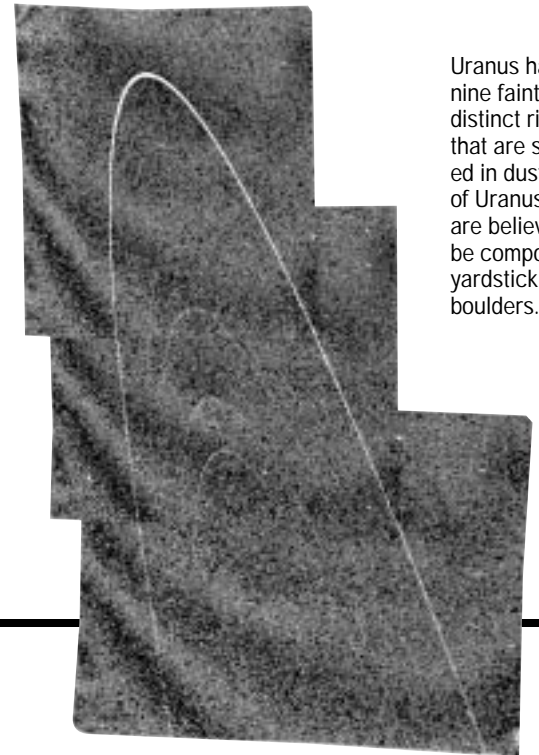
Uranus in the sky. Uranus is *just* visible to the naked eye, but you have to know exactly where to look to find it. Almost every major ancient culture missed this moving star.



Uranus as a crescent. Any of the planets can appear as a crescent to a spacecraft passing by because a crescent represents nothing more than seeing a portion of the dayside.



Although Uranus is closer to the Sun than Neptune its atmosphere is plainer looking than its more distant twin, Neptune.



Uranus has nine faint but distinct ringlets that are shrouded in dust. Most of Uranus' rings are believed to be composed of yardstick-size boulders.

Uranus Facts

- **Diameter:** 31,764 miles
- **Distance from the Sun:** 1,784,000,000 miles
- **Outer atmosphere:** 83% hydrogen, 15% helium, 2% methane
- **Planet's core:** possibly a small rock core surrounded by a soup of various "ices," which is actually a hot mixture of water, methane and ammonia
- **Temperature near cloudtops:** -323° F
- **Rotation on Axis (Uranus' Day):** 17 hours, 54 minutes
- **Revolution about Sun (Uranus' Year):** 83 years, 274 days
- **Moons:** Uranus has a few dozen known moons. Titania, the largest, has a diameter of 1,000 miles and orbits Uranus in 8 days, 17 hours at a distance of 271,000 miles.

2000-ft Solar System Walk

NEPTUNE



Neptune

Uranus was discovered accidentally; however, Neptune was discovered by mathematically calculating its position.

In the years following the discovery of Uranus, astronomers noticed that its path in the sky did not match the path that they had computed. Uranus was straying from its mathematically derived course, but why? Some astronomers thought that this could be attributed to the gravitational pull of an undiscovered planet.

In 1841, John Couch Adams of England calculated where this new planet might be found. But Adams did not engage in observational astronomy, so his results were forwarded to the Royal Observatory in Greenwich, England. Unfortunately, the director there did not use this information to look for a possible new planet.

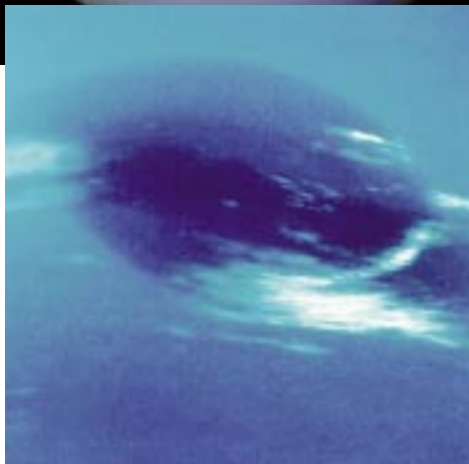
Four years later and independent of Adams, Urbain Le Verrier of France made his own calculations. He then asked Johann Galle, a German astronomer, to search for the planet. Galle found the planet the first night that he looked for it, on September 23, 1846.

Neptune thus became the first of two planets discovered by using scientific methods of investigation. The other one was Pluto. Neptune was named after the Roman god of the sea.

Neptune is the smallest of the four gas giants but could almost be Uranus' twin because their diameters, colors, atmospheres and internal makeup are similar. Uranus and Neptune are the two most similar planets.

In 1989, twelve years after it was launched from Earth, *Voyager 2* flew by Neptune. No one had ever seen this planet close up before. Neptune is colder than Uranus because it is farther away from the Sun. This fact led scientists to believe that its atmosphere would be simpler and even plainer than Uranus'. So they were surprised when they found that Neptune's atmosphere was much more complex and beautiful

This would be the actual size of **Neptune** if the radius of the Solar System were 2,000 feet.



than that of its twin. It has large, oval storms similar to the Great Red Spot on Jupiter. However, in Neptune's case, these storms have been observed forming and dissipating. Neptune was the last planet that *Voyager 2* visited. *Voyager* brought surprise after surprise on its journeys through the solar system and opened our eyes to a more complex and grander system of planets than we had ever imagined.

Neptune in the sky. Neptune cannot be seen with the eyes, yet can be seen with binoculars, but like with Uranus, you have to know exactly where to look because it blends in with the other fainter stars. Neptune is a pretty blue-green color and it takes 200x magnification to discern just the hint of a disk.

Left pictures. A closeup of a "Dark Spot" on Neptune. It is similar to the Great Red Spot on Jupiter in that it is a whirling vortex of clouds, however, these form and dissipate like Earth's hurricanes. The whitish clouds near the top of the dark spot are composed of methane-ice.

Neptune Facts

- **Diameter:** 30,777 miles
- **Distance from the Sun:** 2,794,000,000 miles
- **Outer atmosphere:** 74% hydrogen, 25% helium, 1% methane
- **Planet's core:** possibly a small rock core surrounded by a soup of various "ices"
- **Temperature near cloudtops:** -373° F
- **Rotation on Axis (Neptune's Day):** 19 hours, 12 minutes
- **Revolution about Sun (Neptune's Year):** 164 years
- **Moons:** Neptune has over a dozen moons. Triton, the largest, has a diameter of 1,678 miles and orbits Neptune in 5 days, 22 hours at a distance of 220,000 miles.

2000-ft Solar System Walk

PLUTO



Pluto

On February 18, 1930, Clyde Tombaugh (pronounced

TOM-bah) discovered Pluto from observations he made at the Lowell Observatory in Flagstaff, Arizona. For over 11 months, he searched for the ninth planet by systematically taking and examining photographs of the night sky. Pluto thus became the second planet that was discovered using a scientific method of investigation.

How do you tell a planet from a star? All the stars that we see in the sky are beyond our solar system and are so far away that they do not appear to move, not even in a thousand years.

However, the planets do not stay in place, but move among the fixed stars because they are very close to us and revolve around the Sun just like the Earth. The original meaning of the word planet is "wandering star." The ancients studied the sky and named five stars that did not stay in place. They called them Mercury, Venus, Mars, Jupiter and Saturn. Clyde Tombaugh used the idea of planets moving against the background of stars to find a ninth planet.

Tombaugh took hundreds of photographs using a special 13-inch diameter refractor telescope called an astrograph. Each photograph covered only a small area of the sky. He also took his photographs near a path in the sky called the ecliptic. All of the planets, including the Sun and Moon, can be found near this path because they all orbit the Sun in nearly the same plane. He reasoned that if there was a ninth planet, it would also be near the ecliptic. Tombaugh took two photographs of the same area of the sky, one week apart. He then compared these in a special optical instrument like a microscope, called a blinking comparator. This instrument had the ability to quickly switch back and forth between the two photographs.

This would be the actual size of **Pluto** if the radius of the Solar System were 2,000 feet.



Once they had been aligned properly, the stars would not appear to move as the instrument quickly switched the view between photographs. However, any object that moved during the one-week period would appear to "jump" back and forth. Tombaugh found Pluto as a *very* faint dot jumping back and forth between two photographic plates.

The Lowell Observatory asked the public for help in naming the ninth planet. People from all over the world mailed in their suggestions. Pluto, the Roman god of the underworld, was chosen from a submission sent in by Venetia Burney, an 11-year-old girl from Oxford, England.

Pluto has three moons. Charon, its largest, was discovered in 1978. Its diameter is roughly half that of Pluto and orbits Pluto every 6.4 days. Both planet and moon have the same side locked into facing each other. This is similar to our Moon always showing the same side to us.

Pluto is the only planet that has not been visited by a spacecraft. Because of monetary constraints, a mission to visit Pluto has been in flux. The length of the journey could be a dozen years.

Pluto in the sky. Pluto is the only planet that is very difficult to find and observe in a telescope. It looks like a very faint star.



Pluto and its three moons.

Pluto Facts

- **Diameter:** 1,429 miles
- **Distance from the Sun:** 3,675,000,000 miles
- **Atmosphere:** Maybe 100% methane? Some helium?
- **Composition:** Pluto may be composed of frozen ices and rock-type material. Two of the ices are frozen water and nitrogen.
- **Temperature:** -419° F
- **Rotation on Axis (Pluto's Day):** 6 days, 10 hours
- **Revolution about Sun (Pluto's Year):** 248 years
- **Moon:** Pluto has 3 moons. The largest is named Charon which is 746 miles in diameter and orbits Pluto in 6 days, 10 hours at a distance of 11,900 miles.