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Venus

Venus is known as the Earth's "twin" because the two planets are so similar in size. The diameter of Venus is about 7,520 miles (12,100 kilometers), approximately 400 miles (644 kilometers) smaller than that of the Earth. No other planet comes nearer to the Earth than Venus. At its closest approach, it is about 23.7 million miles (38.2 million kilometers) away.

As seen from the Earth, Venus is brighter than any other planet or even any star. At certain times of the year, Venus is the first planet or star that can be seen in the western sky in the evening. At other times, it is the last planet or star that can be seen in the eastern sky in the morning. When Venus is near its brightest point, it can be seen in daylight.

Ancient astronomers called the object that appeared in the morning Phosphorus, and the object that appeared in the evening Hesperus. Later, they realized these objects were the same planet. They named Venus in honor of the Roman goddess of love and beauty.

Orbit

Venus is closer to the sun than any other planet except Mercury. Its mean (average) distance from the sun is about 67.2 million miles (108.2 million kilometers), compared with about 93 million miles (150 million kilometers) for the Earth and about 36 million miles (57.9 million kilometers) for Mercury.

Venus travels around the sun in a nearly circular orbit. The planet's distance from the sun varies from about 67.7 million miles (108.9 million kilometers) at its farthest point to about 66.8 million miles (107.5 million kilometers) at its closest point. The orbits of all the other planets are more elliptical (oval-shaped). Venus takes about 225 Earth days, or about 7 1/2 months, to go around the sun once, compared with 365 days, or one year, for the Earth.

Phases

When viewed through a telescope, Venus can be seen going through "changes" in shape and size. These apparent changes are called phases, and they resemble those of the moon. They result from different parts of Venus's sunlit areas being visible from the Earth at different times.

As Venus and the Earth travel around the sun, Venus can be seen near the opposite side of the sun about every 584 days. At this point, almost all its sunlit area is visible. As Venus moves around the sun toward the Earth, its sunlit area appears to decrease and its size seems to increase. After about 221 days, only half the planet is visible. After another 71 days, Venus nears the same side of the sun as the Earth, and only a thin sunlit area can be seen.

When Venus is moving toward the Earth, the planet can be seen in the early evening. When moving away from the Earth, Venus is visible in the early morning.

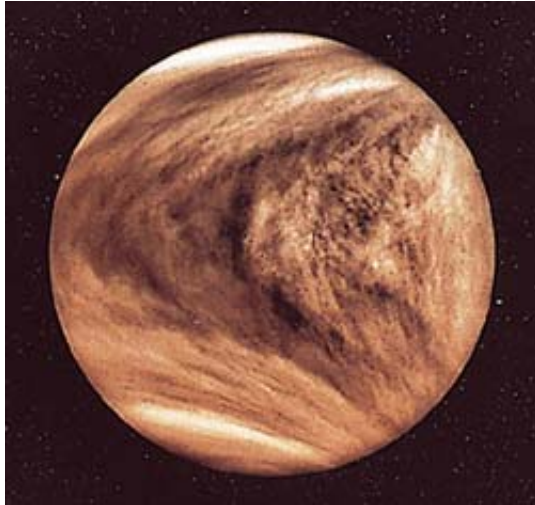
Rotation

As Venus travels around the sun, it rotates very slowly on its axis, an imaginary line drawn through its center. Venus's axis is not perpendicular (at an angle of 90°) to the planet's path around the sun. The axis tilts at an angle of approximately 178



The surface of Venus was scanned with radar waves beamed from orbiting space probes to produce this image. The colors are based on photos taken by probes that landed on Venus. Image credit: NASA

from the perpendicular position. Unlike the Earth, Venus does not rotate in the same direction in which it travels around the sun. Rather, Venus rotates in the retrograde (opposite) direction and spins around once every 243 Earth days.



Thick clouds of sulfuric acid cover Venus. Because visible light cannot penetrate the clouds, astronomers cannot see the planet's surface with even the most powerful optical telescopes. Image credit: NASA

Surface and Atmosphere

Although Venus is called the Earth's "twin," its surface conditions appear to be very different from those of the Earth. Geologists have had difficulty learning about the surface of Venus because the planet is always surrounded by thick clouds of sulfuric acid. They have used radar, radio astronomy equipment, and space probes to "explore" Venus.

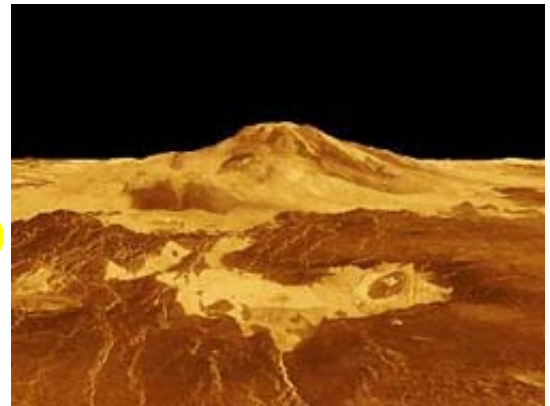
Until recently, much of what geologists knew about the surface of Venus came from ground-based radar observations, the Soviet Union's Venera space probes, and United States Pioneer probes. In 1990, the U.S. space probe Magellan began orbiting Venus, using radar to map the planet's surface.

The surface of Venus is extremely hot and dry. There is no liquid water on the planet's surface because the high temperature would cause any liquid to boil away.

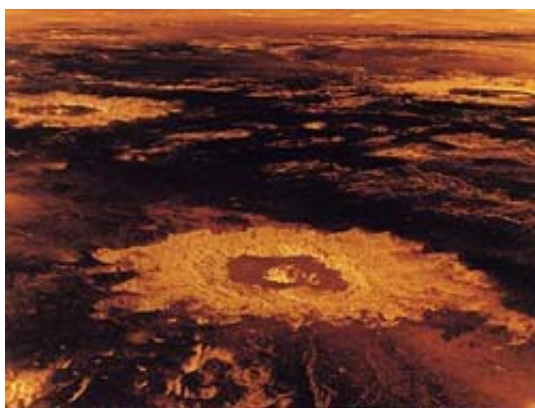
Venus has a variety of surface features, including level ground, mountains, canyons, and valleys. About 65

percent of the surface is covered by flat, smooth plains. On these plains are thousands of volcanoes, ranging from about 0.5 to 150 miles (0.8 to 240 kilometers) in diameter. Six mountainous regions make up about 35 percent of the surface of Venus. One mountain range, called Maxwell, is about 7 miles (11.3 kilometers) high and about 540 miles (870 kilometers) long. It is the highest feature on the planet. In an area called Beta Regio is a canyon that is 0.6 mile (1.0 kilometer) deep.

There are also impact craters on the surface of Venus. Impact craters form when a planet and asteroid collide. The moon, Mars, and Mercury are covered with impact craters, but Venus has substantially fewer craters. The scarcity of impact craters on Venus has led geologists to conclude that the present surface is less than 1 billion years old.



Maat Mons, a mountain on Venus. Image credit: NASA



An impact crater on Venus measures about 23 miles (37 kilometers) across the depression in its center. A computer produced this image in 1991, using information from a radar scan by the U.S. space probe Magellan. Image credit: NASA

A number of surface features on Venus are unlike anything on the Earth. For example, Venus has coronae (crowns), ringlike structures that range from about 95 to 360 miles (155 to 580 kilometers) in diameter. Scientists believe that coronae form when hot material inside the planet rises to the surface. Also on Venus are tesserae (tiles), raised areas in which many ridges and valleys have formed in different directions.

The atmosphere of Venus is heavier than that of any other planet. It consists primarily of carbon dioxide, with small amounts of nitrogen and water vapor. The planet's atmosphere also contains minute traces of argon, carbon monoxide, neon, and sulfur dioxide. The atmospheric pressure (pressure exerted by the weight of the gases) on Venus is estimated at 1,323 pounds per square inch (9,122 kilopascals). This is about 90 times greater than the atmospheric pressure on the Earth, which is about 14.7 pounds per square inch (101 kilopascals).

Temperature

The temperature of the uppermost layer of Venus's clouds averages about 55 degrees F (13 degrees C). However, the temperature of the

planet's surface is about 870 degrees F (465 degrees C), higher than that of any other planet and hotter than most ovens.

The plants and animals that live on the Earth could not live on the surface of Venus, because of the high temperature. Astronomers do not know whether any form of life exists on Venus, but they doubt that it does.

Most astronomers believe that Venus's high surface temperature can be explained by what is known as the greenhouse effect. A greenhouse lets in radiant energy from the sun, but it prevents much of the heat from escaping. The thick clouds and dense atmosphere of Venus work in much the same way. The sun's radiant energy readily filters into the planet's atmosphere. But the large droplets of sulfuric acid present in Venus's clouds -- and the great quantity of carbon dioxide in the atmosphere -- seem to trap much of the solar energy at the planet's surface.

Mass and Density

The mass of Venus is about four-fifths that of the Earth. The force of gravity on Venus is slightly less than on the Earth. For this reason, an object weighing 100 pounds on the Earth would weigh about 88 pounds on Venus. Venus is also slightly less dense than the Earth. A portion of Venus would weigh a little less than an equal-sized portion of the Earth.

Flights to Venus

Venus was the first planet to be observed by a passing spacecraft. The unmanned U.S. spacecraft Mariner 2 passed within 21,600 miles (34,760 kilometers) of Venus on Dec. 14, 1962, after traveling through space for more than 3 1/2 months. It measured various conditions on and near Venus. For example, instruments carried by the spacecraft measured the high temperatures of the planet.

Two unmanned Soviet spacecraft "explored" Venus in 1966. Venera 2 passed within 15,000 miles (24,000 kilometers) of the planet on February 27, and Venera 3 crashed into Venus on March 1.

In October 1967, spacecraft from both the United States and the Soviet Union reached Venus. On October 18, the Soviet spacecraft Venera 4 dropped a capsule of instruments into Venus's atmosphere by parachute. On October 19, the U.S. spacecraft Mariner 5 passed within 2,480 miles (3,990 kilometers) of Venus. It did not detect a magnetic field. Both probes reported large amounts of carbon dioxide in the planet's atmosphere. On Dec. 15, 1970, the Soviet spacecraft Venera 7 landed on Venus. The U.S. planetary probe Mariner 10 flew near Venus on Feb. 5, 1974. The probe transmitted the first close-up photographs of the planet.

On Oct. 22, 1975, the unmanned Soviet spacecraft Venera 9 landed on Venus and provided the first close-up photograph on the planet's surface. Three days later, another Soviet space vehicle, Venera 10, reached Venus. It photographed Venus's surface, measured its atmospheric pressure, and determined the composition of rocks on its surface.

Four unmanned spacecraft reached Venus in December 1978. The United States craft Pioneer Venus 1 began orbiting the planet on December 4. This craft transmitted radar images of Venus, produced a map of its surface, and measured temperatures at the top of the planet's clouds. On December 9, the U.S. Pioneer Venus 2 entered the planet's atmosphere and measured its density and chemical composition. On December 21, the Soviet craft Venera 12 landed on Venus. A second Soviet lander, Venera 11, reached the planet's surface four days later. Both probes sent back data on the lower atmosphere of Venus.

Two more Soviet spacecraft landed on Venus in 1982 -- Venera 13 on March 1 and Venera 14 on March 5. Both probes transmitted photographs of Venus and analyzed soil samples. Beginning in October 1983, two additional Soviet spacecraft mapped the region of Venus north of 30° north latitude using radar. Venera 15 finished its mapping in July 1984; Venera 16, in April 1984. The two probes provided clear images of features as small as 0.9 mile (1.5 kilometers) across.

The U.S. spacecraft Magellan began orbiting Venus on Aug. 10, 1990. Radar images received from the Magellan show



Mariner 10 is the only space probe that has visited the planet Mercury. It flew past Venus in 1974, then made three passes near Mercury in 1974 and 1975. A probe called Messenger, launched in 2004, was scheduled to make its first visit to Mercury in 2008. Image credit: NASA

details of features as small as 330 feet (100 meters) across.

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