

SPACE IS NOT EMPTY. IT IS FILLED with what we call "interstellar matter." This is a mix of gases – mostly hydrogen and helium – and dust, made up of elements such as carbon and silicon. This interstellar matter is the raw material of stars and galaxies. Interstellar matter can clump together to form clouds of gas and dust known as nebulas (from the Latin for cloud). A single nebula may contain enough matter to produce tens of thousands of stars.

We classify nebulas by how they appear to us. The dense and compact clouds of dark nebulas, for example, are not clearly visible in the night sky. But we can make them out when they block the light from stars or glowing gases behind them. Other nebulas are brightly lit. Reflection nebulas reflect the light cast by stars. Emission nebulas are lit from within by the radiation of gas molecules excited by stars inside the nebulas.

Nebulas are key players in the birth of stars. The process begins with the contraction of dark globules within the nebula. Globules contract until they collapse under the force of their own gravity, precipitating the birth of stars.

Although emission nebulas are associated with star birth, other glowing nebulas are on hand when stars die. These are known as planetary nebulas. They are formed by the gas and dust released by some dying stars – stars the size of our Sun. This means we can expect to see a planetary nebula in about five billion years, when the life span of our Sun comes to an end.

NEBULA



ORION NEBULA COMPLEX

ORION IS ONE OF THE BEST-known constellations. It is large in the sky and easy to see. The red supergiant star Betelgeuse sits at the mythical warrior's right shoulder, the brilliant blue supergiant Rigel at his left foot, and three clearly defined stars, almost as bright, form his belt.

Clouds of gas and dust envelop the constellation, which is home to a rich array of nebulas, known as the Orion Nebula Complex. Producing tens of thousands of stars within the past ten million years, the complex is typical of regions throughout the galaxy that are prolific in stellar birth.

Close to Orion's belt is the most famous of all nebulas, the Horsehead Nebula (left, to the right of center). A dark nebula, the Horsehead rears up out of the gloom, silhouetted against the red glow of a large emission nebula. To the left of the Horsehead is Alnitak, the most southerly star in Orion's belt. Below Alnitak is the Flame Nebula, an emission nebula whose hidden stars cast a curious yellow glow.

Set in the hilt of Orion's sword is the Great Nebula of Orion itself (next page). Bright enough to be seen by the naked eye, it is an emission nebula lit by several huge, hot stars at its center. These are the Trapezium stars (the four brightest form a trapezoid). Near the nebula's core are also approximately one thousand young stars.

A COMMUNITY OF NEBULAS
IN ORION'S BELT

VISIBLE-LIGHT COMPOSITE

ANGLO-AUSTRALIAN OBSERVATORY/
ROYAL OBSERVATORY EDINBURGH

OCTOBER 1979

1,400 LIGHT-YEARS FROM EARTH



MOON

"MAGNIFICENT DESOLATENESS" IS how men who have walked on the Moon have described it. And although it is the only extraterrestrial body on which humans have landed, there is still so much we do not understand. It is a barren, cratered sphere, with no water or atmosphere, that orbits the Earth. Sometimes visible and sometimes vanished, it is always mysterious. The Moon is like a place that you cannot completely know, a place that always keeps some secrets.

Myth and mystery have surrounded our understanding of the Moon from ancient times. According to superstition, a full Moon causes madness. The word lunatic comes from "luna," the Latin word for moon, and it literally means moonstruck. Europeans thought they saw the face of the "man in the moon," while Mayans believed they saw the face of a rabbit. Through the ages, the Moon has been a favorite subject for writers. In the 19th century, Jules Verne helped popularize science fiction when he wrote about space travel in stories such as FROM THE EARTH TO THE MOON.

Some of the allure may be due to the Moon's changing faces, or phases. The Moon orbits Earth about once every month, and as it does, its apparent shape changes from a round ball, called a full Moon, to nothing at all, known as a new Moon.

Because the Moon does not produce its own light, we see only the half that is lit by the Sun. And we always see the same side of the Moon, the near side, because it is in synchro-



EARTH'S SATELLITE MOON
(LEFT)
DARK LAVA-FILLED MARIA
IN NORTHERN HEMISPHERE
NORTH POLAR MOSAIC OF
18 VISIBLE-LIGHT IMAGES
GALILEO ORBITER
564,000 MILES (908,000KM)
FROM GALILEO
7 DECEMBER 1992
241,000 MILES
(389,000KM)
FROM EARTH



EARTHRISE OBSERVED
FROM LUNAR ORBIT
(RIGHT)
VISIBLE-LIGHT IMAGE
HANDHELD 70MM
HASSELBLAD THROUGH
MODULE WINDOW
APOLLO 17
DECEMBER 1972
239,000 MILES
(384,000KM)
APOLLO TO EARTH



M

M



VENUS TRANSIT

IN ASTRONOMICAL TERMS, A transit is the passing of a planet across the face of a star. It is a rare occurrence, and of the two transits visible from Earth, Mercury and Venus, that of Venus is rarer. Mercury passes in front of the Sun an average of 13 times every century. Venus's transits occur in widely separated eight-year pairs, at alternating intervals of 105.5 and 121.5 years.

Since the invention of the telescope in 1610, there have been seven transits of Venus: in 1631, 1639, 1761, 1769, 1874 and 1882. The most recent transit occurred in June 2004 and took approximately six hours to complete. The event was visible from start to finish in Europe, Africa and Asia, but not from the Western Hemisphere. The next transit will take place in June 2012.

Astronomers used to be interested in Venus's transits as a means of calculating the distance between Earth and the Sun. Now transits are used to search for other planetary systems. When a planet passes across its central star, there is a momentary reduction in the star's luminosity. By studying such reductions, scientists hope to pinpoint the location and confirm the existence of still unidentified planets in unknown solar systems.



VENUS IN TRANSIT ACROSS THE SUN

VISIBLE-LIGHT IMAGE THROUGH H-ALPHA FILTER

STEFAN SEIP WITH 100MM F/8 APOCHROMATIC REFRACTING TELESCOPE

8 JUNE 2004

26.9 MILLION MILES (43.2 MILLION KM) FROM EARTH TO VENUS AT THE DATE OF TRANSIT

94.4 MILLION MILES (151.9 MILLION KM) FROM EARTH TO SUN AT THE DATE OF TRANSIT