Definition: universe from *Philip's Encyclopedia*

Aggregate of all matter, energy, and space. On a large scale, the universe is uniform: it is identical in every part. It is believed to be expanding at a uniform rate, the galaxies all receding from one another. The origin, evolution, and future characteristics of the universe are considered in several cosmological theories. Recent developments in astronomy imply a finite universe, as postulated in the Big Bang theory. In 1998 scientists discovered evidence that the Universe is expanding at an accelerating rate. See also cosmology; steady-state theory.

Summary Article: universe from *The Columbia Encyclopedia*

The totality of matter and energy in existence. The study of the origin of the universe, or cosmos, is known as cosmogony, and that of its structure and evolution, cosmology. The age of the universe depends on which theory of cosmology one accepts. According to the big bang theory, favored by most scientists, the universe is between 10 and 20 billion years old; most recent calculations place its age at c.13.75 billion years. The steady-state theory holds that the universe has been in existence for all time.

**Matter and Energy in the Universe**

The matter in the universe is subject to various forces, but the greatest force on the cosmological scale is gravitation. This force pulls matter together to form stars, which either exist alone or are part of binary star or multiple star systems, or brown dwarfs, which are also known as "failed stars." Gravitation also acts to group billions of stars into galaxies and to group galaxies into clusters and superclusters, and gravitation also causes most galaxies to cluster along dense strandlike structures formed by dark matter, with enormous voids among the strands. The main source of energy in the universe is the conversion of the matter of the stars into energy through thermonuclear reactions (see nuclear energy). These reactions continue throughout the different stages of stellar evolution (see also stellar populations) until the star has consumed all its available nuclear fuel.

**The Size of the Universe**

The first systematic theory of the size and shape of the universe that attempted to explain observed data was constructed by Ptolemy in the 2d cent. In this theory the solar system was thought to be the entire universe, with the earth at its center and the distant stars located just beyond the farthest planet. This belief was held until the 16th cent., when Copernicus advanced the idea that the sun, rather than the earth, is at the center of the system and that the stars are at very great distances compared to the planets. During the first part of the 20th cent., astronomers discovered that the sun is only one of billions of stars in the Milky Way galaxy and is located far from the galactic center.

Estimates of the size of the universe have been refined as methods of measuring galactic and extragalactic distances have improved. Close stellar distances were at first found by measuring a star's trigonometric parallax. A more powerful contemporary method is to analyze the light reaching the earth from an object by means of a spectroscope; the distance of a very faint object can be estimated by...
comparing its apparent brightness to those of similar objects at known distances. Another method depends on the fact that the universe as a whole appears to be expanding, as indicated by red shifts (see Doppler effect) in the spectral lines of distant galaxies. Hubble’s law makes it possible to estimate their distances from the speed with which they are rushing away from the earth. At present the observable universe is believed to be at least 90 billion light-years in diameter; the entire universe may be 7 trillion light-years in diameter or more. One problem with estimating the size of the universe is that space itself (or more properly, space-time) may be curved, as held by the general theory of relativity. This curvature would affect measurements of distance based on the passage of light through space from objects as far away as 5 billion light-years or more.

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