Earth is the third planet from the Sun and the only place known in the universe where life has originated and found habitability. While Earth may not contain the largest volumes of water in the Solar System, only Earth sustains liquid surface water, extending over 70.8% of the Earth with its ocean, making Earth an ocean world. Earth's polar regions currently retain most of all other water with large sheets of ice covering ocean and land, dwarfing Earth's groundwater, lakes, rivers and atmospheric water. Land, consisting of continents and islands, extends over 29.2% of the Earth and is widely covered by vegetation. Below Earth's surface material lies Earth's crust consisting of several slowly moving tectonic plates, which interact to produce mountain ranges, volcanoes, and earthquakes. Earth's liquid outer core generates a magnetic field that shapes the magnetosphere of Earth, largely deflecting destructive solar winds and cosmic radiation.

Earth has an atmosphere, which sustains Earth's surface conditions and protects it from most meteoroids and UV-light at entry. It has a composition of primarily nitrogen and oxygen. Water vapor is widely present in the atmosphere, forming clouds that cover most of the planet. The water vapor acts as a greenhouse gas and, together with other greenhouse gases in the atmosphere, particularly carbon dioxide (CO_2), creates the conditions for both liquid surface water and water vapour to persist via the capturing of energy from the Sun's light. This process maintains the current average surface temperature of 14.76°C, at which water is liquid under atmospheric pressure. Differences in the amount of captured energy between geographic regions (as with the equatorial region receiving more sunlight than the polar regions) drive atmospheric and ocean currents, producing a global climate system with different climate regions, and a range of weather phenomena such as precipitation, allowing components such as nitrogen to cycle.

Earth is rounded into an ellipsoid with a circumference of about 40,000 km. It is the densest planet in the Solar System. Of the four rocky planets, it is the largest and most massive. Earth is about eight light-minutes away from the Sun and orbits it, taking a year (about 365.25 days) to complete one revolution. The Earth rotates around its own axis in slightly less than a day (in about 23 hours and 56 minutes). The Earth's axis of rotation is tilted with respect to the perpendicular to its orbital plane around the Sun, producing seasons. Earth is orbited by one permanent natural satellite, the Moon, which orbits Earth at 384,400 km (1.28 light seconds) and is roughly a quarter as wide as Earth. Through tidal locking, the Moon always faces the Earth with the same side, which causes tides, stabilizes Earth's axis, and gradually slows its rotation.

Earth, like most other bodies in the Solar System, formed 4.5 billion years ago from gas in the early Solar System. During the first billion years of Earth's history, the ocean formed and then life developed within it. Life spread globally and has been altering Earth's atmosphere and surface, leading to the Great Oxidation Event two billion years ago. Humans emerged 300,000 years ago, and have reached a population of 8 billion today. Humans depend on Earth's biosphere and natural resources for their survival, but have increasingly impacted the planet's environment. Humanity's current impact on Earth's climate and biosphere is unsustainable, threatening the livelihood of humans and many other forms of life, causing widespread extinctions.[27]

Etymology

The Modern English word Earth developed, via Middle English, from an Old English noun most often spelled eorðe.[28] It has cognates in every Germanic language, and their ancestral root has been reconstructed as *erþō. In its earliest attestation, the word eorðe was already being used to translate the many senses of Latin terra and Greek γῆ gē: the ground, its soil, dry land, the human world, the surface of the world (including the sea), and the globe itself. As with Roman Terra/Tellūs and Greek Gaia, Earth may have been a personified goddess in Germanic paganism: late Norse mythology included Jörð ('Earth'), a giantess often given as the mother of Thor.[29]

Historically, earth has been written in lowercase. From early Middle English, its definite sense as "the globe" was expressed as the earth. By the era of Early Modern English, capitalization of nouns began to prevail, and the earth was also written the Earth, particularly when referenced along with other heavenly bodies. More recently, the name is sometimes simply given as Earth, by analogy with the names of the other planets, though earth and forms with the remain common.[28] House styles now vary: Oxford spelling recognizes the lowercase form as the most common, with the capitalized form an acceptable variant. Another convention capitalizes "Earth" when appearing as a name (for example, "Earth's atmosphere") but writes it in lowercase when preceded by the (for example, "the atmosphere of the earth"). It almost always appears in lowercase in colloquial expressions such as "what on earth are you doing?"[30]

Occasionally, the name Terra /ˈtɛrə/ is used in scientific writing and especially in science fiction to distinguish humanity's inhabited planet from others,[31] while in poetry Tellus /ˈtɛləs/ has been used to denote personification of the Earth.[32] Terra is also the name of the planet in some Romance languages (languages that evolved from Latin) like Italian and Portuguese, while in other Romance languages the word gave rise to names with slightly altered spellings (like the Spanish Tierra and the French Terre). The Latinate form Gæa or Gaea (English: /ˈdʒiːə/) of the Greek poetic name Gaia (Γαῖα; Ancient Greek: [gâi̯.a] or [gâj.ja]) is rare, though the alternative spelling Gaia has become common due to the Gaia hypothesis, in which case its pronunciation is /ˈgaɪ.ə/ rather than the more classical English /ˈgeɪ.ə/.

There are a number of adjectives for the planet Earth. From Earth itself comes earthly. From the Latin Terra comes terran /ˈtɛrən/,[34] terrestrial /təˈrɛstriəl/,[35] and (via French) terrene /təˈriːn/,[36] and from the Latin Tellus comes tellurian /tɛˈlʊəriən/[37] and telluric.[38]

Orbit and rotation

Rotation

Main article: Earth's rotation

Earth's rotation imaged by Deep Space Climate Observatory, showing axis tilt

Earth's rotation period relative to the Sun—its mean solar day—is 86,400 seconds of mean solar time (86,400.0025 SI seconds).[158] Because Earth's solar day is now slightly longer than it was during the 19th century due to tidal deceleration, each day varies between 0 and 2 ms longer than the mean solar day.[159][160]

Earth's rotation period relative to the fixed stars, called its stellar day by the International Earth Rotation and Reference Systems Service (IERS), is 86,164.0989 seconds of mean solar time (UT1), or 23h 56m 4.0989s.[4][n 10] Earth's rotation period relative to the precessing or moving mean March equinox (when the Sun is at 90° on the equator), is 86,164.0905 seconds of mean solar time (UT1) (23h 56m 4.0905s).[4] Thus the sidereal day is shorter than the stellar day by about 8.4 ms.[161]

Apart from meteors within the atmosphere and low-orbiting satellites, the main apparent motion of celestial bodies in Earth's sky is to the west at a rate of 15°/h = 15'/min. For bodies near the celestial equator, this is equivalent to an apparent diameter of the Sun or the Moon every two minutes; from Earth's surface, the apparent sizes of the Sun and the Moon are approximately the same.[162][163]

Orbit

Main articles: Earth's orbit and Earth's location

Exaggerated illustration of Earth's elliptical orbit around the Sun, marking that the orbital extreme points (apoapsis and periapsis) are not the same as the four seasonal extreme points (equinox and solstice)

Earth orbits the Sun, making Earth the third-closest planet to the Sun and part of the inner Solar System. Earth's average orbital distance is about 150 million km (93 million mi), which is the basis for the Astronomical Unit and is equal to roughly 8.3 light minutes or 380 times Earth's distance to the Moon.

Earth orbits the Sun every 365.2564 mean solar days, or one sidereal year. With an apparent movement of the Sun in Earth's sky at a rate of about 1°/day eastward, which is one apparent Sun or Moon diameter every 12 hours. Due to this motion, on average it takes 24 hours—a solar day—for Earth to complete a full rotation about its axis so that the Sun returns to the meridian.

The orbital speed of Earth averages about 29.78 km/s (107,200 km/h; 66,600 mph), which is fast enough to travel a distance equal to Earth's diameter, about 12,742 km (7,918 mi), in seven minutes, and the distance to the Moon, 384,000 km (239,000 mi), in about 3.5 hours.[5]

The Moon and Earth orbit a common barycenter every 27.32 days relative to the background stars. When combined with the Earth-Moon system's common orbit around the Sun, the period of the synodic month, from new moon to new moon, is 29.53 days. Viewed from the celestial north pole, the motion of Earth, the Moon, and their axial rotations are all counterclockwise. Viewed from a vantage point above the Sun and Earth's north poles, Earth orbits in a counterclockwise direction about the Sun. The orbital and axial planes are not precisely aligned: Earth's axis is tilted some 23.44 degrees from the perpendicular to the Earth-Sun plane (the ecliptic), and the Earth-Moon plane is tilted up to ±5.1 degrees against the Earth-Sun plane. Without this tilt, there would be an eclipse every two weeks, alternating between lunar eclipses and solar eclipses.[5][164]

The Hill sphere, or the sphere of gravitational influence, of Earth is about 1.5 million km (930,000 mi) in radius.[165][n 11] This is the maximum distance at which Earth's gravitational influence is stronger than the more distant Sun and planets. Objects must orbit Earth within this radius, or they can become unbound by the gravitational perturbation of the Sun.[165] Earth, along with the Solar System, is situated in the Milky Way and orbits about 28,000 light-years from its center. It is about 20 light-years above the galactic plane in the Orion Arm.[166]

Axial tilt and seasons

Main article: Axial tilt § Earth

Earth's axial tilt causing different angles of seasonal illumination at different orbital positions around the Sun

The axial tilt of Earth is approximately 23.439281°[4] with the axis of its orbit plane, always pointing towards the Celestial Poles. Due to Earth's axial tilt, the amount of sunlight reaching any given point on the surface varies over the course of the year. This causes the seasonal change in climate, with summer in the Northern Hemisphere occurring when the Tropic of Cancer is facing the Sun, and in the Southern Hemisphere when the Tropic of Capricorn faces the Sun. In each instance, winter occurs simultaneously in the opposite hemisphere. During the summer, the day lasts longer, and the Sun climbs higher in the sky. In winter, the climate becomes cooler and the days shorter.[167] Above the Arctic Circle and below the Antarctic Circle there is no daylight at all for part of the year, causing a polar night, and this night extends for several months at the poles themselves. These same latitudes also experience a midnight sun, where the sun remains visible all day.[168][169]

By astronomical convention, the four seasons can be determined by the solstices—the points in the orbit of maximum axial tilt toward or away from the Sun—and the equinoxes, when Earth's rotational axis is aligned with its orbital axis. In the Northern Hemisphere, winter solstice currently occurs around 21 December; summer solstice is near 21 June, spring equinox is around 20 March and autumnal equinox is about 22 or 23 September. In the Southern Hemisphere, the situation is reversed, with the summer and winter solstices exchanged and the spring and autumnal equinox dates swapped.[170]

The angle of Earth's axial tilt is relatively stable over long periods of time. Its axial tilt does undergo nutation; a slight, irregular motion with a main period of 18.6 years.[171] The orientation (rather than the angle) of Earth's axis also changes over time, precessing around in a complete circle over each 25,800-year cycle; this precession is the reason for the difference between a sidereal year and a tropical year. Both of these motions are caused by the varying attraction of the Sun and the Moon on Earth's equatorial bulge. The poles also migrate a few meters across Earth's surface. This polar motion has multiple, cyclical components, which collectively are termed quasiperiodic motion. In addition to an annual component to this motion, there is a 14-month cycle called the Chandler wobble. Earth's rotational velocity also varies in a phenomenon known as length-of-day variation.[172]

In modern times, Earth's perihelion occurs around 3 January, and its aphelion around 4 July. These dates change over time due to precession and other orbital factors, which follow cyclical patterns known as Milankovitch cycles. The changing Earth-Sun distance causes an increase of about 6.8% in solar energy reaching Earth at perihelion relative to aphelion.[173][n 12] Because the Southern Hemisphere is tilted toward the Sun at about the same time that Earth reaches the closest approach to the Sun, the Southern Hemisphere receives slightly more energy from the Sun than does the northern over the course of a year. This effect is much less significant than the total energy change due to the axial tilt, and most of the excess energy is absorbed by the higher proportion of water in the Southern Hemisphere.[174]