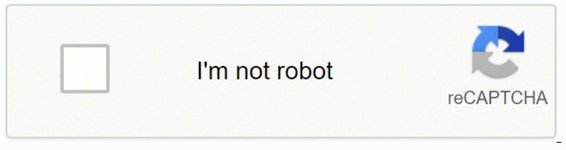

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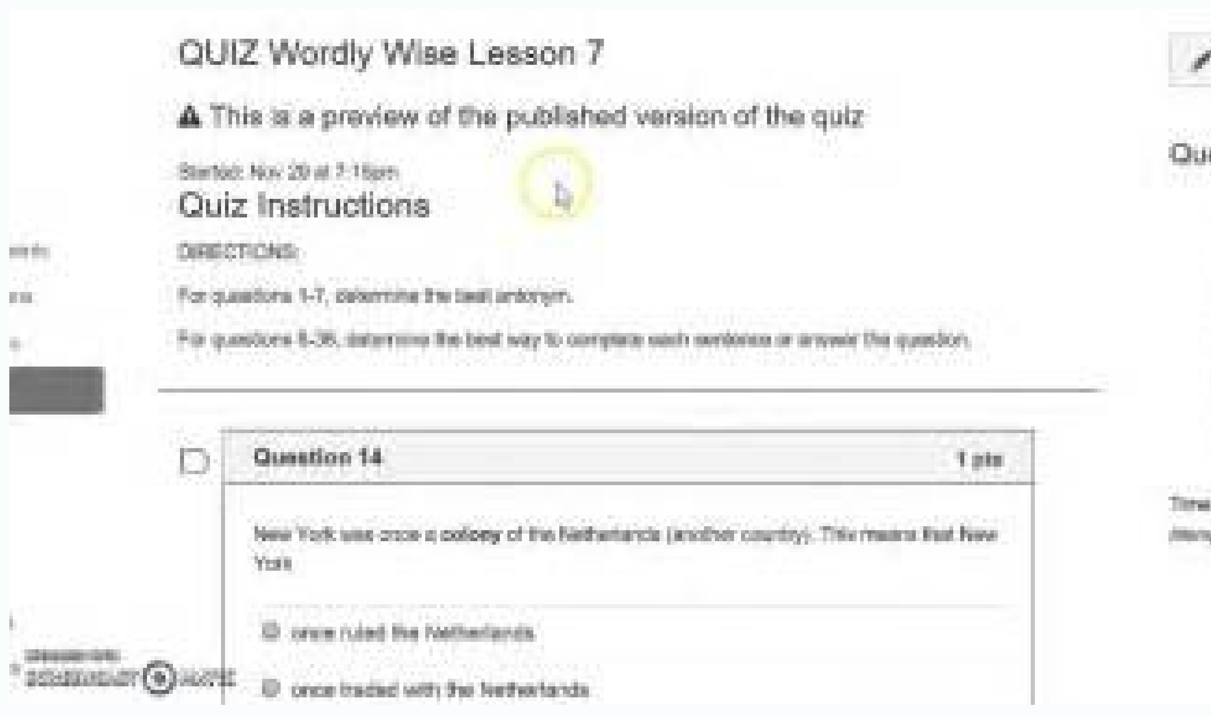

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"Mineralogical records of early planetary processes on the HED parent body with reference to Vesta". 336 (6082): 697–700. "Dawn completes its mission at 4 Vesta". Retrieved 26 November 2007. I. p. 154. August 2006. Marcia is the youngest and cross-cuts Calpurnia. Volcano World. doi:10.1175/bams-d-14-00265.1. ^ Sadava, David E.; Heller, H. Lecture Notes and Essays in Astrophysics. 134 (2): 187–206. "Horizons Ephemeris". (1852). Bibcode:2008LPI....39.2546M. (1999). "Earth". ISBN 978-0-521-66624-4. ^ Center, Astrogeology Science (14 October 2021). Hubble Maps the Ancient Surface of Vesta" (Press release). Retrieved 22 October 2020. (2007). Archived from the original on 2 March 2008. Bibcode:2001M&PS...36..501D. ^ de Pater, Imke; Lissauer, Jack J. For its human aspects, see World. San Francisco: Astronomical Society of the Pacific. A planet's life forms inhabit ecosystems, whose total forms the biosphere.[219] The biosphere is divided into a number of biomes, inhabited by broadly similar plants and animals.[220] On land, biomes are separated primarily by differences in latitude, height above sea level and humidity. National Ocean Service. Earth A photograph of Earth taken by the crew of Apollo 17 in 1972. New York: AIP Press. doi:10.1093/mnras/stw1972. ^ Staff (4 March 2010). B.; Gibbard, S.; de Pater, I.; et al. "Imprint of the Rheasilvia impact on Vesta – Geologic mapping of quadrangles Gegania and Lucaria" (PDF). 205 (2): 460–472. EGU2012-5711-1. ^ Abedon, Stephen T. ^ Schopf, J. 4 (1): 265–92. ^ McFadden, L. p. 5711. p. 5. PNAS. ^ De Sanctis, M. In the Southern Hemisphere, the situation is reversed, with the summer and winter solstices exchanged and the spring and autumnal equinox dates swapped.[153] The angle of Earth's axial tilt is relatively stable over long periods of time. ^ Rebecca Lindsey (14 January 2009). Retrieved 18 April 2018. pp. 372, 442. 93 (11): 519–42. 14 January 2021. Planetary Data System. Philosophical Transactions A. "Vesta: Spin Pole, Size, and Shape from HST Images". ISBN 978-3-89888-884-4. The changing Earth-Sun distance causes an increase of about 6.8% in solar energy reaching Earth at perihelion relative to aphelion.[156][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. A Field Guide to the Stars and Planets (2nd ed.). "The fate of Earth's ocean". (2018). ^ Gallagher, Dennis L. Bibcode:2002ASPC..269...85G. S2CID 206541950. UC Berkeley News. Retrieved 2 March 2007. doi:10.1111/j.1945-5100.2001.tb01892.x. ^ Sahijpal, S.; Soni, P.; Gagan, G. "Earth's water may have been inherited from material similar to enstatite chondrite meteorites". "Equilibrium rotational stability and figure of Mars" (PDF). "NASA's Dawn Captures First Image of Nearing Asteroid". 7 (1): 25–28. (1965). Springer. 543: 11. Chemical composition See also: Abundance of elements on Earth Earth's mass is approximately 5.97×1024 kg (5,970 Yg). ISBN 978-93-83746-00-2. Natl. A.; Emerson, G.; Warner, E. doi:10.1098/rsta.2017.0403. PMC 2701016. Archived from the original on 9 April 2009. New York: Ionfox AB. III. Retrieved 5 September 2012. "Distant future of the Sun and Earth revisited". ^ Bounama, Christine; Franck, S.; Von Bloh, W. AGORA would reach the asteroid belt either by a gravitational slingshot trajectory past Mars or by means of a small ion engine. ISBN 978-1-61069-094-2. S2CID 119194526. ^ a b c Pidwirny, Michael (2 February 2006). Climate Change and International Politics. "The January 4, 1991 Occultation of SAO 93228 by Asteroid (4) Vesta". Bibcode:2009JGRD..11424102T. ISBN 978-0-387-98746-0. (2004). 21 December 2021. ^ Harrington, Philip S. "Chemical composition of Earth, Venus, and Mercury". Planets. ISBN 978-0-312-38208-7. "Weathering and Sedimentary Rocks". The wind transports the cold or the heat of the ocean to the land.[206] Atmospheric circulation also plays an important role: San Francisco and Washington DC are both coastal cities at about the same latitude. doi:10.1038/ngeo941. Retrieved 9 November 2012. 39 (18): L18205. H.; McCarthy, D. Encyclopædia Britannica. Retrieved 1 November 2020. Important changes in crystal structure within the mantle occur at 410 and 660 km (250 and 410 mi) below the surface, spanning a transition zone that separates the upper and lower mantle. p. 57. The land-based ecosystem depends upon topsoil and fresh water, and the oceanic ecosystem depends on dissolved nutrients washed down from the land.[256] In 2019, 39 million km2 (15 million sq mi) of Earth's land surface consisted of forest and woodlands, 12 million km2 (4.6 million sq mi) was shrub and grassland, 40 million km2 (15 million sq mi) were used for animal feed production and grazing, and 11 million km2 (4.2 million sq mi) were cultivated as croplands.[257] Of the 12–14% of ice-free land that is used for croplands, 2 percentage points were irrigated in 2015.[249] Humans use building materials to construct shelters.[258] Humans and environment Main articles: Human impact on the environment and Climate changeHuman activities have impacted Earth's environments. New Delhi: S. "Cooling of the Earth in the Archaean: Consequences of pressure-release melting in a hotter mantle" (PDF). Water vapor, carbon dioxide, methane, nitrous oxide, and ozone are the primary greenhouse gases in the atmosphere. "Morphology and formation ages of mid-sized post-Rheasilvia craters – Geology of quadrangle Tuccia, Vesta". "A population of Main Belt Asteroids co-orbiting with Ceres and Vesta". S2CID 169679920. p. 144. ^ Harrison, Roy M.; Hester, Ronald E. PMC 6189557. Springer Science & Business Media. ^ a b IPCC (2019). Retrieved 14 August 2011. W. ^ "2006 RH120 (= 6R10DB9) (A second moon for the Earth?)". 293 (5531): 839–43. About 71% of Earth's surface is made up of the ocean, dwarfing Earth's polar ice, lakes, and rivers. Bibcode:2014AREPS..42..103D. Binzel, (Editors), University of Arizona Press (2002), ISBN 0-8165-2281-2 External links Wikimedia Commons has media related to Vesta (asteroid). CiteSeerX 10.1.1.715.6618. (5 May 1999). New York. Orca Book Publishers. "Exploring the Ocean Basins with Satellite Altimeter Data". L. Northern (left) and southern (right) hemispheres. ^ Brimhall, George (May 1991). doi:10.1029/1999RG900016. Initial belief in a flat Earth was gradually displaced in Ancient Greece by the idea of a spherical Earth, which was attributed to both the philosophers Pythagoras and Parmenides.[275][276] Earth was generally believed to be the center of the universe until the 16th century, when scientists first concluded that it was a moving object, one of the planets of the Solar System.[277] It was only during the 19th century that geologists realized Earth's age was at least many millions of years.[278] Lord Kelvin used thermodynamics to estimate the age of Earth to be between 20 million and 400 million years in 1864, sparking a vigorous debate on the subject; it was only when radioactivity and radioactive dating were discovered in the late 19th and early 20th centuries that a reliable mechanism for determining Earth's age was established, proving the planet to be billions of years old.[279][280] See also Celestial sphere Earth phase Earth physical characteristics tables Earth science Outline of Earth Table of physical properties of planets in the Solar System Timeline of natural history Timeline of the far future Notes ^ All astronomical quantities vary, both secularly and periodically. Geophys. Bibcode:2001M&PSA..36Q.165P. ISSN 1091-6490. ISSN 1352-2310. ^ Singh, J. "Olivine in an unexpected location on Vesta's surface". ^ Campbell, Wallace Hall (2003). Regolith Vesta's surface is covered by regolith distinct from that found on the Moon or asteroids such as Itokawa. ^ Neese, C.; Ed. (2005). Earth-Science Reviews. In May and June 2007, Vesta reached a peak magnitude of +5.4, the brightest since 1989.[110] At that time, opposition and perihelion were only a few weeks apart.[111] It was brighter still at its 22 June 2018 opposition, reaching a magnitude of +5.3.[112] Less favorable oppositions during late autumn 2008 in the Northern Hemisphere still had Vesta at a magnitude of from +6.5 to +7.3.[113] Even when in conjunction with the Sun, Vesta will have a magnitude around +8.5; thus from a pollution-free sky it can be observed with binoculars even at elongations much smaller than near opposition.[113] 2010–2011 In 2010, Vesta reached opposition in the constellation of Leo on the night of 17–18 February, at about magnitude 6.1,[114] a brightness that makes it visible in binocular range but generally not for the naked eye. PMC 3218853. 114 (D24): D24102. Vesta is thought to be the second-largest asteroid, both by mass and by volume, after the dwarf planet Ceres,[18][19][20] though in volume it overlaps with the uncertainty in the measurements of 2 Pallas.[21] Measurements give it a nominal volume only slightly larger than that of Pallas (about 5% greater, which is the magnitude of the uncertainties in measurement), but it is 25% to 30% more massive. ^ Some sources contemporaneous to Gauss invented more elaborate forms, such as and .[42][43] A simplification of the latter from ca. doi:10.2867/509830. doi:10.1017/S1473550419000120. Yu; Liemohn, M. (November 2008). "Paleoclimatology – The Study of Ancient Climates". Bibcode:2013Natur.494..207J. University of Hawaii at Manoa. "Lithosphere". doi:10.1073/pnas.77.12.6973. (August 2011). The name Vesta, or national variants thereof, is in international use with two exceptions: Greece and China. doi:10.1126/science.1117926. American Elsevier Publishing Co. ISBN 978-0-444-00092-7. T.; Smith, Walter H. Earth's surface layer is formed of several slowly moving tectonic plates, interacting to produce mountain ranges, volcanoes, and earthquakes. PMID 21796207. The race for space: the United States and the Soviet Union compete for the new frontier. Brent (2001). S2CID 23599425. The measured estimates were based on photometry. Bibcode:1999CoMP..134....3B. V.; Vega, Anthony J. 356: L71–L74. Atmospheric Environment. Planetary and Space Science. ^ Catling, David C.; Zahnle, Kevin J.; McKay, Christopher P. (2016). 215 (8): 54. "Heterogeneous Hadean hafnium: evidence of continental crust at 4.4 to 4.5 ga". (December 2005). (10 February 2006). Great Shefford Observatory. NASA. 35 (3): 331. Retrieved 2 November 2012. ^ Wilkinson, B. ISBN 978-1-86094-079-8. Retrieved 26 September 2021. The crust and the cold, rigid, top of the upper mantle are collectively known as the lithosphere, which is divided into independently moving tectonic plates.[97] Beneath the lithosphere is the asthenosphere, a relatively low-viscosity layer on which the lithosphere rides. Available online Archived 11 March 2020 at the Wayback Machine from National Geospatial-Intelligence Agency. B. "Converting GPS Height into NAVD88 Elevation with the GEOID96 Geoid Height Model". Retrieved 30 January 2010. Retrieved 7 March 2007. 336 (6082): 687–690. Bibcode:2012A&A...543A.133S. ^ "Dawn has Departed the Giant Asteroid Vesta". "We Are All Riders on the Same Planet – Seen from space 50 years ago, Earth appeared as a gift to preserve and cherish. Greenhouse gases in the atmosphere like carbon dioxide (CO2) trap a part of the energy from the Sun close to the surface. The subsequent determination of the J2 component yielded a core diameter estimate of about 220 km assuming a crustal density similar to that of the HED.[102] Dawn data can be accessed by the public at the UCLA website.[108] Observations from Earth orbit Albedo and spectral maps of 4 Vesta, as determined from Hubble Space Telescope images from November 1994 Elevation map of 4 Vesta, as determined from Hubble Space Telescope images of May 1996 Elevation diagram of 4 Vesta (as determined from Hubble Space Telescope images of May 1996) viewed from the south-east, showing Rheasilvia crater at the south pole and Feralia Planitia near the equator Vesta seen by the Hubble Space Telescope in May 2007 The 2006 IAU draft proposal on the definition of a planet listed Vesta as a candidate.[109] Vesta is shown fourth from the left along the bottom row. ^ Coughenour, Christopher L.; Archer, Allen W.; Lacovara, Kenneth J. Their official names from largest to smallest (west to east) are Marcia, Calpurnia, and Minucia. Uw News. Bibcode:2003Icar..165..215K. S2CID 1326996. 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. NOAA's National Ocean Service. PMID 11507633. Retrieved 17 August 2010. S2CID 4410838. The Human Impact on the Natural Environment. ISSN 2398-9629. IAU. "Body-Fixed Coordinate Systems for Asteroid (4) Vesta" (PDF). New York: United Nations (published 2010). 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. ^ Marsset, M., Brož, M., Vernazza, P. "The Genesis of Ores". Introduction to Geomagnetic Fields. A133. In Chinese, Vesta is called the 'hearth-god(dess) star', 灶神星 zàoshénxīng, naming the asteroid for Vesta's role, similar to the Chinese names of Uranus, Neptune, and Pluto.[e] Vesta's planetary symbol, as published in 1807 Upon its discovery, Vesta was, like Ceres, Pallas, and Juno before it, classified as a planet and given a planetary symbol. doi:10.1051/0004-6361/201219011. The Observatory. ^ "Sunlight Hours". doi:10.1016/j.icarus.2014.08.003. The Astronomical Journal. Bibcode:2010Icar..205..460C. 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. (2008). ^ Meteoritics & planetary science, Volume 42, Issues 6–8, 2007; Origin and evolution of Earth, National Research Council et al., 2008 ^ E.g in Meteoritics & planetary science (volume 42, issues 6–8, 2007) and Origin and evolution of Earth (National Research Council et al., 2008). 5. ^ Martin, Ronald (2011). Other notable plates include the Arabian Plate, the Caribbean Plate, the Nazca Plate off the west coast of South America and the Scotia Plate in the southern Atlantic Ocean. 336 (6082): 700–704. ^ "Dawn Public Data". 9: 415–18. p. 21. Differentiation: Building the Internal Architecture of Planets. During the first billion years of Earth's history, the ocean formed and then life developed within it. S2CID 37386726. ^ "World: Highest Temperature". 76 (9): 4192–4200. doi:10.1007/s00114-006-0138-6. Explanatory Supplement to the Astronomical Almanac. Funding for this program remained problematic for several years, but by 2004 the Dawn vehicle had passed its critical design review[96] and construction proceeded. (18 May 2012). The distance of Earth from the Sun, as well as its orbital eccentricity, rate of rotation, axial tilt, geological history, sustaining atmosphere, and magnetic field all contribute to the current climatic conditions at the surface.[225] Earth provides liquid water—an environment where complex organic molecules can assemble and interact, and sufficient energy to sustain metabolism.[226] Plants can take up nutrients from the atmosphere, soils and water. doi:10.1073/pnas.1702143114. "Extinction: past and present". 97 (1): 59–79. ^ Allen, Clabon Walter; Cox, Arthur N. ^ International Earth Rotation and Reference Systems Service (IERS) Working Group (2004). "Numerical simulations of the differentiation of accreting planetesimals with 26Al and 60Fe as the heat sources". In many cultures it is a mother goddess that is also the primary fertility deity.[267] Creation myths in many religions involve the creation of Earth by a supernatural deity or deities.[267] The Gaia hypothesis, developed in the mid-20th century, compared Earth's environments and life as a single self-regulating organism leading to broad stabilization of the conditions of habitability.[268][269][270] Images of Earth taken from space, particularly during the Apollo program, have been credited with altering the way that people viewed the planet that they lived on, called the overview effect, emphasizing its beauty, uniqueness and apparent fragility.[271][272] In particular, this caused a realization of the scope of effects from human activity on Earth's environment. European Environment Agency. ^ "Lunar Phases and Eclipses | Earth's Moon". ^ Asmar, S. Severe weather, such as tropical cyclones, thunderstorms, and heatwaves, occurs in most areas and greatly impacts life. Could another one start?". Probing the New Solar System. "Critical insolation – CO2 relation for diagnosing past and future glacial inception". pp. 116–117. ^ Argus, D.F.; Gordon, R.G.; DeMets, C. What happened?". The crust is separated from the mantle by the Mohorovičić discontinuity.[96] The thickness of the crust varies from about 6 kilometers (3.7 mi) under the oceans to 30–50 km (19–31 mi) for the continents. Without this tilt, there would be an eclipse every two weeks, alternating between lunar eclipses and solar eclipses.[5][147] The Hill sphere, or the sphere of gravitational influence, of Earth is about 1.5 million km (930,000 mi) in radius.[148][n 11] This is the maximum distance at which Earth's gravitational influence is stronger than the more distant Sun and planets. ISBN 978-0-8047-1569-0. ^ "Interdependency between animal and plant species". 4 (2): 439–73. The total arable land is 10.9% of the land surface, with 1.3% being permanent cropland.[126][127] Close to 40% of Earth's land surface is used for agriculture, or an estimated 16.7 million km2 (6.4 million sq mi) of cropland and 33.5 million km2 (12.9 million sq mi) of pastureland.[128] Gravitational field Main article: Gravity of EarthThis section needs expansion. The field extends outwards from the core, through the mantle, and up to Earth's surface, where it is, approximately, a dipole. ^ Hillebrand, Helmut (2004). Bibcode:2001HESS....5..569B. "Co-orbital objects in the main asteroid belt". arXiv:1608.01518. "A Solar Irradiance Climate Data Record". Archived from the original on 9 January 2010. Alpine glaciers form in mountainous areas, whereas vast ice sheets form over land in polar regions. "Useful Constants". doi:10.1038/nature11561. doi:10.1126/science.1219381. Ranging from the equator to the polar regions, these are the tropical (or equatorial), subtropical, temperate and polar climates.[204] Further factors that affect a location's climates are its proximity to oceans, the oceanic and atmospheric circulation, and topology.[205] Places close to oceans typically have colder summers and warmer winters, due to the fact that oceans can store large amounts of heat. Retrieved 16 August 2016. 38 (5): 613–30. ISBN 978-3-642-11271-3. ^ Carry, B.; et al. Retrieved 19 October 2015. Retrieved 8 October 2020. doi:10.1016/j.icarus.2009.08.007. ^ O'Neill, Daniel W.; Fanning, Andrew L.; Lamb, William F.; Steinberger, Julia K. Earth is an ellipsoid with a circumference of about 40,000 km. ^ a b Christou, A. Viewed from the celestial north pole, the motion of Earth, the Moon, and their axial rotations are all counterclockwise. National Geographic. Los Alamos National Laboratory. University of California, San Diego. 758 (2): L36. Continents and Supercontinents. No moons are in this range: the closest, Tethys (Saturn III) and Enceladus (Saturn II), are over twice and less that half Vesta's mass. Archived from the original on 15 April 2012. 38 (1): 37–59. S.; et al. ^ "World: Lowest Temperature". 462 (4): 3441–3456. 22 (3): 225–61. ISBN 978-0-03-006228-5. Nature Sustainability. P.; Gupta, S.R. (2013). C.; Finlayson, B. doi:10.1093/acref/9780199571123.001.0001. ^ Kovačević, A. (31 March 2011). ^ Vlaar, N; Vankeken, P.; Vandenberg, A. 11 (4): 048002. ^ Kuhn, Betsy (2006). Early edition, published online before print. "The geology of the Marcia quadrangle of asteroid Vesta: Assessing the effects of large, young craters". ISBN 978-0-8225-5984-9. ^ Humerfelt, Sigurd (26 October 2010). ^ a b Zimmer, Carl (3 October 2013). The IAU Working Group on Cartographic Coordinates and Rotational Elements recommended a coordinate system, correcting the pole but rotating the Claudian longitude by 150° to coincide with Olbers Regio.[58] It was accepted by the IAU, though it disrupts the maps prepared by the Dawn team, which had been positioned so they would not bisect any major surface features.[57][59] Physical characteristics Relative sizes of the four largest asteroids. hdl:2286/R.I.28061. "Asteroid Taxonomy EAR-A-5-DDR-TAXONOMY-V5.0". doi:10.1016/j.icarus.2014.03.001. There is a small flattening at the poles and bulging around the equator due to Earth's rotation.[85] Therefore, a better approximation of Earth's shape is an oblate spheroid, whose equatorial diameter is 43 kilometers (27 mi) larger than the pole-to-pole diameter.[86] The average diameter of the reference spheroid is 12,742 kilometers (7,918 mi). Kalpaz Publications. G.; Smith, D. Bibcode:2012Sci...338..246D. ^ "World Factbook". He proposed that the two objects were the remnants of a destroyed planet. Annuaire pour l'an 1808. "Geomorphology and structural geology of Saturnalia Fossae and adjacent structures in the northern hemisphere of Vesta" (PDF). As a result, the mean annual air temperature at sea level decreases by about 0.4 °C (0.7 °F) per degree of latitude from the equator.[203] Earth's surface can be subdivided into specific latitudinal belts of approximately homogeneous climate. S2CID 206540010. USGS Water-Science School. The Guardian. S2CID 22892716. ^ Staff (September 2003). ^ Dadarich, Amy; Mitrovica, Jerry X.; Matsuyama, Isamu; Perron, J. Archived from the original on 28 June 2013. "The structure of the asteroid 4 Vesta as revealed by models of planet-scale". ISBN 978-1-317-93881-1. "Terrestrial Impact Cratering and Its Environmental Effects". 31 (4): 1118–36. Retrieved 29 April 2011. (XXVI) ^ Fu, R. Vesta's surface shows no significant trace of nanophase iron because the impact speeds on Vesta are too low to make rock melting and vaporization an appreciable process. Retrieved 17 July 2011. Retrieved 27 February 2007. Associated Press. ^ Ritchie, H.; Roser, M. doi:10.1016/0004-6981(72)90076-5. PMID 12560541. 32 (6): 929–944. University of Iowa Press. ^ Smith, Courtney B. PMID 24196707. ^ a b Sandwell, D. 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. doi:10.1016/j.jafrearsci.2005.07.019. PMID 21554751. Boca Raton, Florida: CRC Press. ^ Rohli, Robert. University of Illinois. Retrieved 23 November 2012. It is about 20 light-years above the galactic plane in the Orion Arm.[149] Axial tilt and seasons Main article: Axial tilt § Earth Earth's axial tilt and its relation to the rotation axis and planes of orbit The axial tilt of Earth is approximately 23.439281°[4] with the axis of its orbit plane, always pointing towards the Celestial Poles. ^ Shayler, David; Vis, Bert (2005). Bibcode:2016Natur.529..200G. Retrieved 17 July 2015. (14 August 2015). Bibcode:2012LPI....43.2600A. Space Science Reviews. Thomson Brooks/Cole. 6 January 2011. "The Earth's Climate System". 322 (1–2): 19–33. ISBN 978-1-58381-109-2. Y.; R. 282 (2): 663–83. Based on data from the Vector Map and Global Landcover Archived 26 March 2015 at the Wayback Machine datasets, extreme values for coverage of lakes and streams are 0.6% and 1.0% of Earth's surface. These plates are rigid segments that move relative to each other at one of three boundaries types: at convergent boundaries, two plates come together; at divergent boundaries, two plates are pulled apart; and at transform boundaries, two plates slide past one another laterally. 20 (5): 16–21. 271 (4): 84–91. "Large-scale troughs on Vesta: A signature of planetary tectonics". Bibcode:2016PNAS..113E6325S. Bibcode:2019ESRv..19702896S. Archived from the original on 20 April 2012. Bibcode:2001Natur.412..708C. Y. ^ Bryant, Greg (2007). ^ Hendrix, Mark (2019). The Inaccessible Earth (2nd ed.). ^ Erickson, Kristen; Doyle, Heather (28 June 2019). Science Week. Annu. NASA Space Science Data Coordinated Archive. ^ "Earth's Early Atmosphere and Oceans". AGU Release No. 12-42. ^ Claeys, Philippe; Morbidelli, Alessandro (2011). Retrieved 26 December 2013. doi:10.1007/s11208-005-0033-2. "Gauss, Ramanujan and Hypergeometric Series Revisited". 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Potsdam Institute for Climate Impact Research. ^ Baumjohann, Wolfgang; Treumann, Rudolf A. the Guardian. "Ag Isotopic Evolution of the Mantle During Accretion: New Constraints from Pd and Ag Metal-Silicate Partitioning". T.; et al. ^ a b Menzel, Donald H. Oceanography. Water vapor is widely present in the atmosphere and forms clouds that cover most of the planet. ^ a b Williams, David R. 529 (7585): 200–03. Oxford, England: Oxford University Press. CiteSeerX 10.1.1.562.2763. p. 507. 19 December 2019. ^ Turner, John; et al. Retrieved 23 December 2008. ^ Bell, Elizabeth A.; Boehnike, Patrick; Harrison, T. For the Roman goddess, see Vesta (mythology). Jones & Bartlett Learning. ^ Widmer, Ted (24 December 2018). ^ Khokhar, Tariq (22 March 2017). doi:10.1016/j.icarus.2014.01.013. It is the largest moon in the Solar System relative to the size of its planet, although Charon is larger relative to the dwarf planet Pluto.[158][159] The natural satellites of other planets are also referred to as "moons", after Earth's.[160] The most widely accepted theory of the Moon's origin, the giant-impact hypothesis, states that it formed from the collision of a Mars-size protoplanet called Theia with the early Earth. Retrieved 28 February 2008. Annual Review of Earth and Planetary Sciences. (19 October 2015). doi:10.1029/JB086iB12p11535. Proceedings, 39th Lunar and Planetary Science Conference. Icarus. Habitable Planets for Man (2nd ed.). "Source regions and time scales for the delivery of water to Earth". 24 June 2020. Bibcode:1997M&PS...32..841T. (February 2018). Retrieved 7 September 2021. Bibcode:2018RSPTA.37670403D. ^ Press Release ORG/1469 (3 July 2006). Hydrology and Earth System Sciences Discussions. 4 Vesta Color image of Vesta taken by DawnDiscoveryDiscovered byHeinrich Wilhelm OlbersDiscovery date29 March 1807DesignationsMPC designation(4) VestaPronunciation/ˈvɛstə/[1]Named afterVestaMinor planet categoryMain belt (Vesta family)AdjectivesVestanVestian[a]Orbital characteristics[8]Epoch 9 December 2014 (JD 2457000.5)Aphelion2.57138 AU (384.673 Gm)Perihelion2.15221 AU (321.966 Gm)Semi-major axis2.36179 AU (353.319 Gm)Eccentricity0.08874Orbital period (sidereal)3.63 yr (1325.75 d)Average orbital speed19.34 km/sMean anomaly20.86384°Inclination7.14043° to ecliptic5.58° to invariable plane[6]Longitude of ascending node103.85136°Time of perihelion26 December 2021[7]Argument of perihelion151.19853°SatellitesNoneProper orbital elements[9]Proper semi-major axis2.36151 AUProper eccentricity0.098758Proper inclination6.39234°Proper mean motion99.1888 deg / yrProper orbital period3.62944 yr(1325.654 d)Precession of perihelion36.8729 (2343 years) arcsec / yrPrecession of the ascending node−39.5979 (2182 years) arcsec / yrPhysical characteristicsDimensions572.6 km × 557.2 km × 446.4 km[10]Mean diameter525.4±0.2 km[10]Flattening0.2204Surface area(8.66±0.2)×105 km2[b][11]Volume(7.46±0.3)×107 km3[b][12]Mass(2.59076±0.00001)×1020 kg[10]Mean density3.456±0.035 g/cm3[10]Equatorial surface gravity0.25 m/s20.025 gEquatorial escape velocity0.36 km/sSynodic rotation period0.2226 d (5.342 h)[8][13]Equatorial rotation velocity93.1 m/s[c]North pole right ascension20h 32m[citation needed]North pole declination48°[citation needed]Geometric albedo0.423[14]Temperaturemin: 75 K (−198 °C)max: 250 K (−23 °C)[15]Spectral typeV[8][16]Apparent magnitude5.1[17] to 8.48Absolute magnitude (H)3.20[8][14]Angular diameter0.70″ to 0.22″ Vesta (minor-planet designation: 4 Vesta) is one of the largest objects in the asteroid belt, with a mean diameter of 525 kilometres (326 mi).[10] It was discovered by the German astronomer Heinrich Wilhelm Matthias Olbers on 29 March 1807[8] and is named after Vesta, the virgin goddess of home and hearth from Roman mythology. ^ Overbye, Dennis (21 December 2018). Beneath the mantle, an extremely low viscosity liquid outer core lies above a solid inner core.[98] Earth's inner core may be rotating at a slightly higher angular velocity than the remainder of the planet, advancing by 0.1–0.5° per year, although both somewhat higher and much lower rates have also been proposed.[99] The radius of the inner core is about one-fifth of that of Earth. Bibcode:2008CeMDA.100...27B. doi:10.1073/pnas.1718063115. ^ Roatsch, Thomas; et al. Precipitation patterns vary widely, ranging from several meters of water per year to less than a millimeter. 8 September 2021. Retrieved 11 June 2008. ^ Rayman, Marc (8 April 2015). Secretariat of the Convention on Biological Diversity. BBC Bitesize. Bulletin of the American Meteorological Society. Online Astronomy eText Table of Contents. Ceres and Vesta came within one degree of each other in the night sky in July 2014.[117] See also 3103 Eger 3551 Verenia 3908 Nyx 4055 Magellan Asteroids in fiction Diogenite Eucrite Former classification of planets Howardite Vesta family (vestoids) List of tallest mountains in the Solar System Notes ^ Marc Rayman of the JPL Dawn team used "Vestian" (analogous to the Greek cognate Hestian) a few times in 2010 and early 2011 in his Dawn Journal, and the Planetary Society continued to use that form for a few more years.[2] The word had been used elsewhere, e.g. in Tsiolkovsky (1960) The call of the cosmos. Earth is orbited by one permanent natural satellite, the Moon, which orbits Earth at 380,000 km (1.3 light seconds) and is roughly a quarter as wide as Earth. Retrieved 17 October 2006. "Differentiation of Vesta and the parent bodies of other achondrites". (9 July 2007). Vesta's differentiated interior implies that it was in hydrostatic equilibrium and thus a dwarf planet in the past, but it is not today.[71] The impacts that created the Rheasilvia and Veneneia craters occurred when Vesta was no longer warm and plastic enough to return to an equilibrium shape, distorting its once rounded shape and prohibiting it from being classified as a dwarf planet today. The Mathematical Association of America. PMID 16915369. Professional Surveyor. The preferred target for this mission was Vesta. (2009). International Earth Rotation and Reference Systems Service. NASA indicated they were not interested in an asteroid mission. ^ United Nations Scientific Committee on the Effects of Atomic Radiation (2008). ^ Krulwich, Robert (7 April 2007). 25 April 2013. 246 (4926): 103–07. p. 56. (May 1981). The Vestian asteroids and HED meteorites are examples. 94 (2): 199–204. de la Fuente; Marcos, R. ^ Vega, Priscilla; Brown, Dwayne (16 July 2011). This polar motion has multiple, cyclical components, which collectively are termed quasiperiodic motion. ^ Lunine, Jonathan I. doi:10.1175/1520-0469(1974)031<0312.0.CO;2. 20 April 2016. "Earth's Atmosphere". "Current Systems in the Earth's Magnetosphere". ^ "What are the consequences of the overexploitation of natural resources?". This lower-density air then rises and is replaced by cooler, higher-density air. These and other observations allowed the rotation rate of Vesta to be determined by the 1950s. ngdc.noaa.gov. ^ "Earth Fact Sheet". "Climate Zones". p. 35. ^ Aphelion is 103.4% of the distance to perihelion. Proc Natl Acad Sci U S A. ^ Ward, Peter D.; Brownlee, Donald (2002). ISSN 0012-8252. The resultant molecular oxygen (O2) accumulated in the atmosphere and due to interaction with ultraviolet solar radiation, formed a protective ozone layer (O3) in the upper atmosphere.[62] The incorporation of smaller cells within larger ones resulted in the development of complex cells called eukaryotes.[63] True multicellular organisms formed as cells within colonies became increasingly specialized. (31 March 1997). Bibcode:2004Natur.427..589J. (October 2007). "Numerical expressions for precession formulae and mean elements for the Moon and planets". ^ "Apollo 13 The Seventh Mission: The Third Lunar Landing Attempt 11 April–17 April 1970". A. Bibcode:2015PNAS..11214518B. (March 2012). The image was made by the Curiosity rover on 20 April 2014. "Dark material on Vesta from the infall of carbonaceous volatile-rich material". During these approaches, it can orbit Earth for brief periods of time.[174] As of September 2021[update], there are 4,550 operational, human-made satellites orbiting Earth.[8] There are also inoperative satellites, including Vanguard 1, the oldest satellite currently in orbit, and over 16,000 pieces of tracked space debris.[n 3] Earth's largest artificial satellite is the International Space Station.[175] Hydrosphere Main article: Hydrosphere Water is transported to various parts of the hydrosphere via the water cycle Earth's hydrosphere consists chiefly of the oceans, but technically includes all water surfaces in the world, including inland seas, lakes, rivers, and underground waters down to a depth of 2,000 m (6,600 ft). Earth, Moon, and Planets. "Geologic Mapping of Av-10 Oppia Quadrangle of Asteroid 4 Vesta" (PDF). ^ a b Vázquez, M.; Rodríguez, P. Bibcode:1997M&PS...32..929R. "Introduction: The geologic mapping of Vesta". ISBN 978-1-284-12656-3. 1 November 2012. doi:10.1029/2009JD012104. 119 (1–2): 140–56. That year, the problem was addressed by Benjamin Apthorp Gould, who suggested numbering asteroids in their order of discovery, and placing this number in a disk (circle) as the generic symbol of an asteroid. ^ "Selected Astronomical Constants, 2011". ^ McCord, T. (4 January 2016). "On the Origin and Rise of Oxygen Concentration in the Earth's Atmosphere". Bibcode:2006LNEA....2...49V. ISSN 0261-3077. doi:10.1088/1748-9326/11/4/048002. This hypothesis has been termed "Snowball Earth", and it is of particular interest because it preceded the Cambrian explosion, when multicellular life forms significantly increased in complexity.[71][72] Following the Cambrian explosion, 535 Ma, there have been at least five major mass extinctions and many minor ones.[73][74] Apart from the proposed current Holocene extinction event, the most recent was 66 Ma, when an asteroid impact triggered the extinction of the non-avian dinosaurs and other large reptiles, but largely spared small animals such as insects, mammals, lizards and birds. ^ Dhuime, B.; Hawksworth, C.J.; Delavault, H.; Cawood, P.A. (2018). Retrieved 17 March 2007. ^ Jablonski, David (2004). Retrieved 19 October 2020. NASA/Goddard Space Flight Center. MIT Press. (2010). Colors of the two hemispheres are not to scale,[j] and the equatorial region is not shown. Journal of Geophysical Research. D.; Harpham, C. S2CID 118580771. Models predict that the Sun will expand to roughly 1 AU (150 million km; 93 million mi), about 250 times its present radius.[78][84] Earth's fate is less clear. "Layers of the Earth". ^ Canovai, Stanislao; del-Ricco, Gaetano (1810). "Vesta". ^ Souami, D.; Souchay, J. 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. ^ Denevi, B. F.; Ribas, I. PMID 29180424. "Land transformation by humans: A review" (PDF). 1 September 2021. The poles of the dipole are located close to Earth's geographic poles. pp. 117–18. M.; Reufer, A.; Wieler, R. The most recent reversal occurred approximately 700,000 years ago.[131][132] The extent of Earth's magnetic field in space defines the magnetosphere. Bibcode:2013LPI....44.2115F. Archived from the original on 17 June 2008. Proc. 26 (1–2): 2–10. Westport, CN: Greenwood Press. ESPI – European Space Policy Institute. This was soon coupled with the name into an official number–name designation, ④ Vesta, as the number of minor planets increased. 134 (1): 3–16. IERS Technical Note No. 32. doi:10.1186/gb-2011-12-4-112. Retrieved 24 December 2018. Basic Books. Named the Asteroidal Gravity Optical and Radar Analysis (AGORA), this spacecraft was to launch some time in 1990–1994 and perform two flybys of large asteroids. ISSN 2169-8996. Archived from the original on 3 October 2013. S2CID 22283432. 23 (2): 112–14. doi:10.1016/j.icarus.2014.01.033. ^ a b "A look into Vesta's interior". Astrobiology. Climatology (fourth ed.). ^ that is, blue in the north does not mean the same thing as blue in the south. Present and Future". "Secular Trends in the Geologic Record and the Supercontinent Cycle". ^ Espenak, Fred; Meeus, Jean (7 February 2007). Based on observations from 14 different sites, the best fit to the data was an elliptical profile with dimensions of about 550 km × 462 km (342 mi × 287 mi).[51] Dawn confirmed this measurement. (2019). ^ Liu, S. During the summer, the day lasts longer, and the Sun climbs higher in the sky. The Conversation. Bibcode:1994E&PSL.121....1V. 217 (1): 27–42. The discovery was announced in a letter addressed to German astronomer Johann H. "The Interior of the Earth". S2CID 221342529. S2CID 2058249. The outer layer is a chemically distinct silicate solid crust, which is underlain by a highly viscous solid mantle. (22 November 2007). ^ Kring, David A. Archived from the original (PDF) on 1 December 2020. In Ahrens, Thomas J (ed.). 85: 293–298. 165 (1): 215–218. T. Bibcode:2014NatGe...7...25O. L.; Verheggen, Bart; Maibach, Edward W.; Carlton, J. Bibcode:1852AJ......2...80G. "It's Complicated: Dawn Spurs Rewrite of Vesta's Story". ^ "What is the geoid?". Tertia. MacMillan. PMID 17788233. Bibcode:1997Icar..128...95B. 16 January 2007. ^ Meschede, Martin; Barckhausen, Udo (20 November 2000). Despite the fact that Vesta is a one-seventh the size of the Moon, Divalia Fossa dwarfs the Grand Canyon. "Fundamentals of Physical Geography (2nd Edition)". —Williams, D. Time Service Department, USNO. Retrieved 19 July 2009. (July 2012). Astrogeology.usgs.gov. Retrieved 14 March 2007. J. Mass of Vesta compared (cont.) Vesta compared to objects within a factor of 2 of its mass: Pallas, Varda, G!kún||'hòmdímà, Salacia. Asphaug; P. Its maximum distance from the Sun is slightly greater than the minimum distance of Ceres from the Sun,[d] though its orbit lies entirely within that of Ceres.[31] NASA's Dawn spacecraft entered orbit around Vesta on 16 July 2011 for a one-year exploration and left the orbit of Vesta on 5 September 2012[32] en route to its final destination, Ceres. Bibcode:1976AREPS...4..265H. "Early formation and long-term stability of continents resulting from decompression melting in a convecting mantle" (PDF). S2CID 206542798. 42 (1): 103–26. ISBN 978-92-1-142274-0. doi:10.1111/j.1365-2966.2011.18595.x. S2CID 13832179. (16 March 2017). The curvilinear gullies end in lobate deposits, which are sometimes covered by pitted terrain, and are proposed to form by the transient flow of liquid water after buried deposits of ice were melted by the heat of the impacts.[68] Hydrated materials have also been detected, many of which are associated with areas of dark material.[83] Consequently, dark material is thought to be largely composed of carbonaceous chondrite, which was deposited on the surface by impacts. (2001). Retrieved 27 June 2019. Australian Journal of Earth Sciences. B.; Daly, S. M.; Donahue, T. Leaf Group Media. ^ Drake, Nadia (20 December 2018). doi:10.1126/science.1223272. Department of Mathematics, University of Pisa, Italy. doi:10.1111/j.1945-5100.2000.tb01518.x. ^ Piani, Laurette; Marrocchi, Yves; Rigaudier, Thomas; Vacher, Lionel G.; Thomassin, Dorian; Marty, Bernard (2020). ^ Calculated using (1) the known rotation period (5.342 h)[8] and (2) the equatorial radius Req (285 km)[10] of the best-fit biaxial ellipsoid to Asteroid 4 Vesta. Bibcode:2012EGUGA..14.5711G. Retrieved 19 March 2007. At approximately 750 Ma, one of the earliest known supercontinents, Rodinia, began to break apart. In McCarthy, Dennis D.; Petit, Gérard (eds.). PMID 16293721. Yahoo News. It is shown here in a Hubble shot of Vesta, because it is not visible in the more detailed Dawn images.Claudia crater (indicated by the arrow at the bottom of the closeup image at right) defines the prime meridian in the Dawn/NASA coordinate system. World Book Online Reference Center. ^ Cazenave, Anny (1995). ^ Staff. (1982). p. 149. University of British Columbia, Okanagan. "Satellite Box Score" (PDF). ^ "NASA Dawn". 16 September 2011. 115 (1): 53–58. ^ Monroe, James; Wicander, Reed; Hazlett, Richard (2007). 13 (12): 1103–24. ^ Povenmire, H. PMID 17788674. University of Hawaii. ^ a b c Exline, Joseph D.; Levine, Arlene S.; Levine, Joel S. UK Department for Environment, Food and Rural Affairs. ^ "Xpeditions Atlas". Bibcode:2013JGRD..118.3213J. Etymology The modern English word Earth developed, via Middle English, from an Old English noun most often spelled eorðe.[26] It has cognates in every Germanic language, and their ancestral root has been reconstructed as *erþō. Bibcode:2014Icar..244...23S. "Exploring the smallest terrestrial planet: Dawn at Vesta" (PDF). ^ "The Crust and Lithosphere". It depends on who you ask". Archived from the original (PDF) on 28 July 2018. "4". Birkhäuser. 427 (6975): 589. Table 1. Composition of the Vestan crust (by depth)[90] A lithified regolith, the source of howardites and brecciated eucrites. ssd.jpl.nasa.gov. Schröter dated 31 March.[36] Because Olbers already had credit for discovering a planet (Pallas; at the time, the asteroids were considered to be planets), he gave the honor of naming his new discovery to German mathematician Carl Friedrich Gauss, whose orbital calculations had enabled astronomers to confirm the existence of Ceres, the first asteroid, and who had computed the orbit of the new planet in the remarkably short time of 10 hours.[37][38] Gauss decided on the Roman virgin goddess of home and hearth, Vesta.[39] Name and symbol Vesta was the fourth asteroid to be discovered, hence the number 4 in its formal designation. ISBN 9781139493680. Vol. VIII, no. 16. Thematic Guide to World Mythology. doi:10.1086/173407. Bibcode:2007HESSD...4..439P. doi:10.1007/s11038-007-9151-9. A joint NASA–ESA asteroid mission was then drawn up for a Multiple Asteroid Orbiter with Solar Electric Propulsion (MAOSEP), with one of the mission profiles including an orbit of Vesta. 13 (2): 123–133. Earth's atmosphere consists mostly of nitrogen and oxygen. ^ Jutzi, M.; E. WMO Weather and Climate Extremes Archive. ^ Brown, Geoff C.; Mussett, Alan E. S2CID 4464889. ^ a b Berger, Wolfgang H. doi:10.1111/maps.12108. The Australian Plate fused with the Indian Plate between 50 and 55 Ma. The fastest-moving plates are the oceanic plates, with the Cocos Plate advancing at a rate of 75 mm/a (3.0 in/year)[116] and the Pacific Plate moving 52–69 mm/a (2.0–2.7 in/year). "On the Symbolic Notation of the Asteroids". "A good life for all within planetary boundaries". Orbit Vesta orbits the Sun between Mars and Jupiter, within the asteroid belt, with a period of 3.6 Earth years,[8] specifically in the inner asteroid belt, interior to the Kirkwood gap at 2.50 AU. doi:10.1038/nature11892. p. 34. p. 76. "General Definitions and Numerical Standards" (PDF). "Tour of Water in the Solar System – U.S. Geological Survey". doi:10.1088/0004-6256/136/5/1906. In 1996, the program's study team recommended a mission to explore the asteroid belt using a spacecraft with an ion engine as a high priority. 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. 264 (5): 84–91. ^ Laskar, J.; et al. EGU General Assembly 2012, held 22–27 April 2012 in Vienna, Austria. "The Hydrologic Cycle". More precisely, the geoid is the surface of gravitational equipotential at mean sea level (MSL).[93] Sea surface topography are water deviations from MSL, analogous to land topography. (June 1969). Bibcode:2014Icar..242..316M. ISBN 978-0-571-29072-7. V.; Marshall, L. (7 May 2018). D.; Seidelmann, P. ^ Duennebier, Fred (12 August 1999). Paleontological evidence and computer simulations show that Earth's axial tilt is stabilized by tidal interactions with the Moon.[166] Some theorists think that without this stabilization against the torques applied by the Sun and planets to Earth's equatorial bulge, the rotational axis might be chaotically unstable, exhibiting large changes over millions of years, as is the case for Mars, though this is disputed.[167][168] Viewed from Earth, the Moon is just far enough away to have almost the same apparent-sized disk as the Sun. "Color and Albedo Heterogeneity of Vesta from Dawn". Iberdrola. pp. 52, 66, 69, 137, 142, 185, 202, 355, 366. Practical handbook of marine science. Retrieved 25 December 2013. Retrieved 5 March 2007. Tectonophysics. PMID 29255053. ^ Guinan, E. ^ Kang, Sarah M.; Seager, Richard. ^ Garwood, Christine (2008). Taylor & Francis. Retrieved 13 June 2011. doi:10.1098/rsta.2002.0992. Carl Friedrich Gauss: Titan of Science. ^ "Charon". doi:10.1038/scientificamerican1094-84. doi:10.1073/pnas.1517557112. ^ Dawn mission timeline Archived 19 October 2013 at the Wayback Machine ^ Mid-continent Research for Education and Learning: McREL (27 September 2010). Courier Dover Publications. ISSN 1752-0894. S2CID 14024675. Retrieved 21 April 2007. Retrieved 18 September 2011. ^ Garry, W.B.; Sykes, M.; Buczkowski, D.L.; et al. Bibcode:1998Icar..134..187G. Causes and Environmental Implications of Increased UV-B Radiation. Discovery News. doi:10.1038/nature10233. PMID 30275156. 1930, ,[44] never caught on. PMC 411539. Retrieved 30 July 2011. ^ Kennish, Michael J. Instead, regolith evolution is dominated by brecciation and subsequent mixing of bright and dark components.[92] The dark component is probably due to the infall of carbonaceous material, whereas the bright component is the original Vesta basaltic soil.[93] Fragments Some small Solar System bodies are suspected to be fragments of Vesta caused by impacts. W.; et al. Local topography deviates from this idealized spheroid, although on a global scale these deviations are small compared to Earth's radius: the maximum deviation of only 0.17% is at the Mariana Trench (10,925 meters or 35,843 feet below local sea level),[87] whereas Mount Everest (8,848 meters or 29,029 feet above local sea level) represents a deviation of 0.14%.[n 6][89] The point on the surface farthest from Earth's center of mass is the summit of the equatorial Chimborazo volcano in Ecuador (6,384.4 km or 3,967.1 mi).[90][91][92] In geodesy, the exact shape that Earth's oceans would adopt in the absence of land and perturbations such as tides and winds is called the geoid. CSIRO Publishing. American Naturalist. L.; Pilewskie, P.; Snow, M.; Lindholm, D. doi:10.1006/icar.1997.5734. A half billion years later, the last common ancestor of all current life arose.[61] The evolution of photosynthesis allowed the Sun's energy to be harvested directly by life forms. "Hypsographic Curve of Earth's Surface from ETOPO1". S.; Berghe, G. "Geologically current motion of 56 plates relative to the no-net-rotation reference frame". Retrieved 26 July 2018. "Pacific Plate Motion". (1997). (See also Earth symbol.) Earth is sometimes personified as a deity. Taylor; Manga, Michael; Richards, Mark A. R. "Potentially biogenic carbon preserved in a 4.1 billion-year-old zircon" (PDF). Retrieved 10 March 2007. ^ Cook, Jia-Rui C. Geophysical Research Abstracts. Over 99% of the crust is composed of 11 oxides, principally silica, alumina, iron oxides, lime, magnesia, potash, and soda.[101][100] Heat Main article: Earth's internal heat budget Global map of heat flow from Earth's interior to the surface The major heat-producing isotopes within Earth are potassium-40, uranium-238, and thorium-232.[102] At the center, the temperature may be up to 6,000 °C (10,830 °F),[103] and the pressure could reach 360 GPa (52 million psi).[104] Because much of the heat is provided by radioactive decay, scientists postulate that early in Earth's history, before isotopes with short half-lives were depleted, Earth's heat production was much higher. Objects must orbit Earth within this radius, or they can become unbound by the gravitational perturbation of the Sun.[148] Earth, along with the Solar System, is situated in the Milky Way and orbits about 28,000 light-years from its center. In each instance, winter occurs simultaneously in the opposite hemisphere. Bibcode:2011CeMDA.110..293L. Bibcode:1989Sci...246..103R. 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.[26] House styles now vary: Oxford spelling recognizes the lowercase form as the most common, with the capitalized form an acceptable variant. Meteoritical Society. "How WGS 84 defines Earth". "Crustal Structure of the Earth" (PDF). Bibcode:2012Sci...336..687J. ^ "Third rock from the Sun – restless Earth". In 1966, based upon observations of Vesta's gravitational perturbations of Arete, Hans G. doi:10.1086/117108. ^ Lloyd, John; Mitchinson, John (2010). arXiv:1410.3819. Archived from the original on 10 March 2007. At the equator of the magnetic field, the magnetic-field strength at the surface is 3.05×10−5 T, with a magnetic dipole moment of 7.79×1022 Am2 at epoch 2000, decreasing nearly 6% per century.[130] The convection movements in the core are chaotic; the magnetic poles drift and periodically change alignment. "The eucrite/Vesta story". doi:10.1038/ngeo2025. doi:10.1016/j.quascirev.2010.08.017. www.eso.org. Because a season on Vesta lasts eleven months, the northern hemisphere, including anticipated compression fractures opposite the crater, would become visible to Dawn's cameras before it left orbit.[100] Dawn left orbit around Vesta on 4 September 2012 11:26 p.m. PDT to travel to Ceres.[101] NASA/DLR released imagery and summary information from a survey orbit, two high-altitude orbits (60–70 m/pixel) and a low-altitude mapping orbit (20 m/pixel), including digital terrain models, videos and atlases.[102][103][104][105][106][107] Scientists also used Dawn to calculate Vesta's precise mass and gravity field. 7 October 2021. 43rd Lunar and Planetary Science Conference (1659): 2600. It is estimated that 1 out of 16 meteorites originated from Vesta.[94] The other identified Solar System samples are from Earth itself, meteorites from Mars, meteorites from the Moon, and samples returned from the Moon, the comet Wild 2, and the asteroids 25143 Itokawa and 162173 Ryugu.[30][k] Exploration Animation of Dawn's trajectory from 27 September 2007 to 5 October 2018 Dawn · Earth · Mars · 4 Vesta · 1 Ceres First image of asteroids (Ceres and Vesta) taken from Mars. Elementi di fisica matematica. pp. 8, 31. Sci. The Latinate form Gæa or Gaea (English: /ˈdʒiː.ə/) 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 /ˈɡaɪə/ rather than the more classical English /ˈɡeɪə/.[31] There are a number of adjectives for the planet Earth. Archived from the original on 13 July 2007. PMID 15752514. Bibcode:2005Icar..177..190Z. 336 (6082): 694–697. C. Nature Geoscience. Bibcode:2011ESRv..108...16B. "How the Plasmasphere is Formed". "Controversial Moon Origin Theory Rewrites History". Dover Books on Astronomy. S2CID 129262186. Bibcode:2013AsBio..13.1103N. Bibcode:2007EM&P..101...65R. Retrieved 21 March 2007. ^ a b Morgan, J. Benz (14 February 2013). Retrieved 23 September 2008. Bibcode:2005SoSyR..39..176P. doi:10.1016/j.pss.2013.06.024. "Origin of the Moon in a giant impact near the end of the Earth's formation". (7 July 2006). Silicon Valley Astronomy Lectures. (1991). ISBN 978-0-19-957112-3. The continents later recombined to form Pannotia at 600–540 Ma, then finally Pangaea, which also began to break apart at 180 Ma.[56] The most recent pattern of ice ages began about 40 Ma,[57] and then intensified during the Pleistocene about 3 Ma.[58] High- and middle-latitude regions have since undergone repeated cycles of glaciation and thaw, repeating about every 21,000, 41,000 and 100,000 years.[59] The Last Glacial Period, colloquially called the "last ice age", covered large parts of the continents, up to the middle latitudes, in ice and ended about 11,700 years ago.[60] Origin of life and evolution Life timelineThis box: viewtalkedit−4500 —–—–−4000 —–—–−3500 —–—–−3000 —–—–−2500 —–—–−2000 —–—–−1500 —–—–−1000 —–—–−500 —–—–0 — Water Single-celled life Photosynthesis Eukaryotes Multicellular life Plants Arthropods MolluscsFlowersDinosaurs MammalsBirdsPrimatesHadeanArcheanProterozoicPhanerozoic ←Earth formed←Earliest water←LUCA←Earliest fossils←LHB meteorites←Earliest oxygen←Pongola glaciation*←Atmospheric oxygen←Huronian glaciation*←Sexual reproduction←Earliest multicellular life←Earliest fungi←Earliest plants←Earliest animals←Cryogenian ice age*←Ediacaran biota←Cambrian explosion←Andean glaciation*←Earliest tetrapods←Karoo ice age*←Earliest apes / humans←Quaternary ice age*(million years ago)*Ice Ages Main articles: Origin of life and Evolutionary history of life Chemical reactions led to the first self-replicating molecules about four billion years ago. "High resolution Vesta High Altitude Mapping Orbit (HAMO) Atlas derived from Dawn framing camera images". Bibcode:1993ApJ...418..457S. Instead, most of the hydrogen loss comes from the destruction of methane in the upper atmosphere.[218] Life on Earth Main article: Life Fungi are one of the kingdoms of life on Earth. ISBN 978-0-395-34835-2. Universities Space Research Association. The crater is about 19 km (12 mi) deep. Earth's Evolving Systems: The History of Planet Earth. Lunar and Planetary Laboratory. (eds.). Gillet; J.-A. ^ McCarthy, Dennis D.; Hackman, Christine; Nelson, Robert A. doi:10.1038/nature12665. "What share of people will live in urban areas in the future?". ^ Perlman, Howard (17 March 2014). LPI Contribution No. 1659. A.; Garry, W. Archived from the original on 29 September 2012. ^ Staff (2004). ISBN 978-0-85991-513-7. Bibcode:2020Sci...369.1110P. 56 (2): 309–32. PMID 26483481. 282 (6): 90–95. doi:10.1175/BAMS-D-12-00093.1. ISSN 0003-0007. Its axial tilt does undergo nutation; a slight, irregular motion with a main period of 18.6 years.[154] 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. (January 2005). "Updated world map of the Köppen-Geiger climate classification" (PDF). Mark; et al. 115 (E8): E08001. Universe Today. Archived from the original on 26 September 2021. Bibcode:1974Tell...26....2L. pp. 263–65. PMID 12804276. Archived from the original (PDF) on 31 October 2008. Retrieved 28 February 2007. These orbital intersections were located in the constellations of Cetus and Virgo.[35] Olbers commenced his search in 1802, and on 29 March 1807 he discovered Vesta in the constellation Virgo—a coincidence, because Ceres, Pallas, and Vesta are not fragments of a larger body. The Cambridge Guide to the Solar System. Bibcode:2000M&PS...35.1309M. 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.[157] Earth-Moon system Moon Main articles: Moon, Lunar theory, and Orbit of the Moon Earth-Moon system seen from Mars The Moon is a relatively large, terrestrial, planet-like natural satellite, with a diameter about one-quarter of Earth's. Sky & Telescope. He sent a letter with his proposal to the British astronomer William Herschel, suggesting that a search near the locations where the orbits of Ceres and Pallas intersected might reveal more fragments. ^ a b Yeomans, Donald K.; Chamberlin, Alan B. W.; Anders, E. 376 (2132). PMID 22914145. ISBN 978-0-19-861263-6. Bibcode:2012Natur.491...83M. Royal Society of Chemistry. Proceedings of the Ocean Drilling Program. "Constraining the Evolutionary History of the Moon and the Inner Solar System: A Case for New Returned Lunar Samples". "Earth's location in the Milky Way". Our World in Data. Oxford University Press US. Now Appearing At a Dwarf Planet Near You: NASA's Dawn Mission to the Asteroid Belt (Speech). Earth formed over 4.5 billion years ago. Typical daytime and nighttime temperatures are −60 °C and −130 °C respectively. Archived from the original (PDF) on 22 August 2011. 491 (7422): 79–82. ^ Buczkowski, D.L.; Raymond, C.A.; Williams, D.A.; et al. Life spread globally and began to affect Earth's atmosphere and surface, leading to Earth's Great Oxidation Event two billion years ago. Archived from the original on 6 February 2015. Thus, the fourth asteroid, Vesta, acquired the generic symbol ④. ^ Wells, David A. "Flood Basalts and Hot-Spot Tracks: Plume Heads and Tails". Along these plate boundaries, earthquakes, volcanic activity, mountain-building, and oceanic trench formation can occur.[111] The tectonic plates ride on top of the asthenosphere, the solid but less-viscous part of the upper mantle that can flow and move along with the plates.[112] As the tectonic plates migrate, oceanic crust is subducted under the leading edges of the plates at convergent boundaries. Astrophysical Journal. "earth". F. J.; Tilling, R. NP-2006-08-97-LaRC. M (1976). The mean height of land above sea level is about 797 m (2,615 ft).[119] The continental crust consists of lower density material such as the igneous rocks granite and andesite. (29 March 2011). "Gaia as seen through the atmosphere". IERS Bulletin-A. Bibcode:2012Natur.491...79P. ISBN 978-81-7835-641-9. H.; McElroy, B. Retrieved 29 March 2007. Retrieved 24 March 2008. D.; Pravec, P. ^ Tewksbury, Barbara. (2013). Instead, the ESA set up a technological study of a spacecraft with an ion drive. doi:10.1006/icar.1997.5736. doi:10.1016/S0140-6736(05)71021-7. ISBN 978-0-486-43602-9. Bibcode:1982A&A...105..359A. Retrieved 13 January 2022. P.; et al. ISBN 9789286143199. Vesta came to opposition again on 5 August 2011, in the constellation of Capricornus at about magnitude 5.6.[114][115] 2012–2013 Vesta was at opposition again on 9 December 2012.[116] According to Sky and Telescope magazine, this year Vesta came within about 6 degrees of 1 Ceres during the winter of 2012 and spring 2013.[117] Vesta orbits the Sun in 3.63 years and Ceres in 4.6 years, so every 17.4 years Vesta overtakes Ceres (the previous overtaking was in April 1996).[117] On 1 December 2012, Vesta had a magnitude of 6.6, but it had decreased to 8.4 by 1 May 2013.[117] 2014 Conjunction of Ceres and Vesta near the star Gamma Virginis on 5 July 2014 in the Constellation of Virgo. 19 (1): 25–42. Bibcode:2000RvGeo..38...37W. (August 1993). Series A. PMID 22582257. D.S. Brewer, 2007. "Elemental Mapping by Dawn Reveals Exogenic H in Vesta's Regolith". Earth System Research Laboratory. Retrieved 10 September 2010. ^ Tanimoto, Toshiro (1995). "Hope dims that Earth will survive Sun's death". Hydrology and Earth System Sciences. 1 June 2013. S2CID 205225571. "Freeze, Fry or Dry: How Long Has the Earth Got?". You can help by adding to it. Bibcode:1994QJRAS..35..331H. Dictionary of Minor Planet Names: Prepared on Behalf of Commission 20 Under the Auspices of the International Astronomical Union. Retrieved 6 September 2020. ^ "New SPHERE view of Vesta". "The East African rift system". ^ a b Harrison, T.; et al. Retrieved 29 April 2016. ^ "We've crossed four of nine planetary boundaries. Oxygenic photosynthesis evolved 2.7 Gya, forming the primarily nitrogen–oxygen atmosphere of today.[62] This change enabled the proliferation of aerobic organisms and, indirectly, the formation of the ozone layer due to the subsequent conversion of atmospheric O2 into O3. Archived from the original on 1 January 2022. ^ "Trends in Atmospheric Carbon Dioxide: Recent Global CO2 Trend". American Museum of Natural History. M.;

Ammannito, E.; Blewett, D. C.; Donahue, T. David R. Publications Services, USGS. If this is the case, then the fact that 10 km (6.2 mi) fragments have survived bombardment until the present indicates that the crater is at most only about 1 billion years old.[73] It would also be the site of origin of the HED meteorites. ISBN 978-0-521-61519-8. Arizona State University. As a red giant, the Sun will lose roughly 30% of its mass, so, without tidal effects, Earth will move to an orbit 1.7 AU (250 million km; 160 million mi) from the Sun when the star reaches its maximum radius, otherwise, with tidal effects, it may enter the Sun's atmosphere and be vaporized.[78] Physical characteristics Size and shape Main article: Figure of the Earth Further information: Earth radius, Earth's circumference, and Earth curvature See also: List of highest mountains on Earth Earth topological map, the area is redder if it is raised higher in real-life The shape of Earth is nearly spherical. doi:10.1073/pnas.0809436106. 136 (5): 1906–08. PMC 350422. Archived from the original on 17 May 2013. The difference between Earth's perihelion and aphelion is 5 million kilometers.—Wilkinson, John (2009). NASA Infrared Telescope Facility (NASA IRTF) studies of asteroid (237442) 1999 TA10 suggest that it originated from deeper within Vesta than the HED meteorites.[24] Vesta is thought to consist of a metallic iron–nickel core 214–226 km in diameter,[10] an overlying rocky olivine mantle, with a surface crust. 35 (6): 1309–20. Ions and electrons of the solar wind are deflected by the magnetosphere; solar wind pressure compresses the dayside of the magnetosphere, to about 10 Earth radii, and extends the nightside magnetosphere into a long tail.[133] Because the velocity of the solar wind is greater than the speed at which waves propagate through the solar wind, a supersonic bow shock precedes the dayside magnetosphere within the solar wind.[134] Charged particles are contained within the magnetosphere; the plasmasphere is defined by low-energy particles that essentially follow magnetic field lines as Earth rotates.[135][136] The ring current is defined by medium-energy particles that drift relative to the geomagnetic field, but with paths that are still dominated by the magnetic field,[137] and the Van Allen radiation belts are formed by high-energy particles whose motion is essentially random, but contained in the magnetosphere.[138][139] During magnetic storms and substorms, charged particles can be deflected from the outer magnetosphere and especially the magnetotail, directed along field lines into Earth's ionosphere, where atmospheric atoms can be excited and ionized, causing the aurora.[140] 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).[141] 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.[142][143] 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.[144] 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. NOAA. (June 2010). ^ Connors, Martin; Wiegert, Paul; Veillet, Christian (27 July 2011). doi:10.1029/2009JE003525. Nightskyonline.info. 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.[27] Historically, earth has been written in lowercase. These dates change over time due to precession and other orbital factors, which follow cyclical patterns known as Milankovitch cycles. ^ Deuss, Arwen (2014). Phys.org. 2084: 4034. Bibcode:2013P&SS...85..293R. 45th Lunar and Planetary Science Conference (1777): 1796. The largest of the northern troughs is named Saturnalia Fossa (≈ 40 km wide, > 370 km long). (October 1994). 118 (8): 3213–3217. ^ Lovelock, James E. doi:10.1006/icar.1998.5956. Archived from the original on 24 March 2008 – via U.S. Naval Observatory website, particularly the discussion of Gould, B. Meteorology: An Educator's Resource for Inquiry-Based Learning for Grades 5–9 (PDF). Ecology environmental science and conservation (First ed.). Due to mass segregation, the core region is estimated to be primarily composed of iron (88.8%), with smaller amounts of nickel (5.8%), sulfur (4.5%), and less than 1% trace elements.[100] The most common rock constituents of the crust are nearly all oxides: chlorine, sulfur, and fluorine are the important exceptions to this and their total amount in any rock is usually much less than 1%. "A magma ocean on Vesta: Core formation and petrogenesis of eucrites and diogenites". ^ "ESPI Evening Event "Seeing Our Planet Whole: A Cultural and Ethical View of Earth Observation"". Sciencing. doi:10.1016/j.icarus.2011.10.016. Aided by the absorption of harmful ultraviolet radiation by the ozone layer, life colonized Earth's surface.[64] Among the earliest fossil evidence for life is microbial mat fossils found in 3.48 billion-year-old sandstone in Western Australia,[65] biogenic graphite found in 3.7 billion-year-old metasedimentary rocks in Western Greenland,[66] and remains of biotic material found in 4.1 billion-year-old rocks in Western Australia.[67][68] The earliest direct evidence of life on Earth is contained in 3.45 billion-year-old Australian rocks showing fossils of microorganisms.[69][70] During the Neoproterozoic, 1000 to 539 Ma, much of Earth might have been covered in ice. On 3 May 2011, Dawn acquired its first targeting image 1.2 million kilometers from Vesta.[97] On 16 July 2011, NASA confirmed that it received telemetry from Dawn indicating that the spacecraft successfully entered Vesta's orbit.[98] It was scheduled to orbit Vesta for one year, until July 2012.[99] Dawn's arrival coincided with late summer in the southern hemisphere of Vesta, with the large crater at Vesta's south pole (Rheasilvia) in sunlight. Retrieved 7 December 2020. ISBN 978-0-87590-851-9. "Priscoan (4.00–4.03 Ga) orthogneisses from northwestern Canada". Archived from the original on 30 June 2007. World Bank Blogs. ^ Brown, Toby (2 December 2019). ^ Reilly, Michael (22 October 2009). "Secular acceleration of the Moon". min mean max Celsius −89.2 °C[21] 14 °C (1961–90)[22] 56.7 °C[23] Fahrenheit −128.5 °F 57 °F (1961–90) 134.0 °F Surface equivalent dose rate0.274 μSv/h[24]AtmosphereSurface pressure101.325 kPa (at MSL)Composition by volume78.08% nitrogen (N_2; dry air)[5]20.95% oxygen (O_2)~ 1% water vapor (climate variable)0.9340% argon0.0413% carbon dioxide[25]0.00182% neon[5]0.00052% helium0.00019% methane0.00011% krypton0.00006% hydrogen Earth is the third planet from the Sun and the only astronomical object known to harbor life. Global Earth Physics: A Handbook of Physical Constants. ^ Lovelock, James E.; Margulis, Lynn (1974). H. ^ Burton, Kathleen (29 November 2002). ^ a b Reddy, V.; et al. Over the next 1.1 billion years, solar luminosity will increase by 10%, and over the next 3.5 billion years by 40%.[78] Earth's increasing surface temperature will accelerate the inorganic carbon cycle, reducing CO_2 concentration to levels lethally low for plants (10 ppm for C4 photosynthesis) in approximately 100–900 million years.[79][80] The lack of vegetation will result in the loss of oxygen in the atmosphere, making animal life impossible.[81] Due to the increased luminosity, Earth's mean temperature may reach 100 °C (212 °F) in 1.5 billion years, and all ocean water will evaporate and be lost to space, which may trigger a runaway greenhouse effect, within an estimated 1.6 to 3 billion years.[82] Even if the Sun were stable, a fraction of the water in the modern oceans will descend to the mantle, due to reduced steam venting from mid-ocean ridges.[82][83] The Sun will evolve to become a red giant in about 5 billion years. Bibcode:2012Sci...336..684R. A.; et al. In 1989, speckle interferometry was used to measure a dimension that varied between 498 and 548 km (309 and 341 mi) during the rotational period.[50] In 1991, an occultation of the star SAO 93228 by Vesta was observed from multiple locations in the eastern United States and Canada. These same latitudes also experience a midnight sun, where the sun remains visible all day.[151][152] 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. ^ Wenk, Hans-Rudolf; Bulakh, Andreĭ Glebovich (2004). ^ Bowring, Samuel A.; Williams, Ian S. "Evidence for biogenic graphite in early Archaean Isua metasedimentary rocks". ^ Or a quarter greater than the US state of Texas; a within 10% of New South Wales in Australia and British Columbia in Canada; the combined size of the three largest Indian states of Rajasthan, Madhya Pradesh and Maharashtra; two thirds the size of South Africa and over three times the size of New Zealand or the UK. Bibcode:2000SciAm.282b..90D. Archived from the original on 18 August 2016. doi:10.1016/j.pss.2012.08.021. Nuclear Weapons & Global Security. Solar System Research. doi:10.1126/science.1219270. Oxford University Press. (Subscription or participating institution membership required.) ^ "terrestrial". University of Toronto. doi:10.1016/j.earscirev.2019.102896. Bibcode:1972AtmEn...6..579L. Retrieved 26 November 2014. These nutrients are constantly recycled between different species.[227] Extreme weather, such as tropical cyclones (including hurricanes and typhoons), occurs over most of Earth's surface and has a large impact on life in those areas. 310 (5756): 1947–50. ^ Dunnington, Guy Waldo; Gray, Jeremy; Dohse, Fritz-Egbert (2004). "World population in 2100 could be 2 billion below UN forecasts, study suggests". According to nebular theory, planetesimals formed by accretion, with the primordial Earth being estimated as likely taking anywhere from 70 to 100 million years to form.[39] Estimates of the age of the Moon range from 4.5 Ga to significantly younger.[40] A leading hypothesis is that it was formed by accretion from material loosed from Earth after a Mars-sized object with about 10% of Earth's mass, named Theia, collided with Earth.[41] It hit Earth with a glancing blow and some of its mass merged with Earth.[42][43] Between approximately 4.1 and 3.8 Ga, numerous asteroid impacts during the Late Heavy Bombardment caused significant changes to the greater surface environment of the Moon and, by inference, to that of Earth.[44] Geological history Main article: Geological history of Earth Artist's impression of the Archean eon, showing falling meteor, erupting volcano, round stromatolites, and barren landscape Earth's atmosphere and oceans were formed by volcanic activity and outgassing.[45] Water vapor from these sources condensed into the oceans, augmented by water and ice from asteroids, protoplanets, and comets.[46] Sufficient water to fill the oceans may have been on Earth since it formed.[47] In this model, atmospheric greenhouse gases kept the oceans from freezing when the newly forming Sun had only 70% of its current luminosity.[48] By 3.5 Ga, Earth's magnetic field was established, which helped prevent the atmosphere from being stripped away by the solar wind.[49] As the molten outer layer of Earth cooled it formed the first solid crust, which is thought to have been mafic in composition. doi:10.1002/2017RG000590. p. 294. From early Middle English, its definite sense as "the globe" was expressed as the earth. "The end of life on Earth is not the end of the world: converging to an estimate of life span of the biosphere?". doi:10.1088/2041-8205/758/2/L36. Gravity Simulator. Bibcode:2010QSRv...29.3677T. doi:10.5194/hessd-4-439-2007. Bibcode:2007M&PS...42.1529S. doi:10.1016/j.icarus.2007.10.017. European Investment Bank. Retrieved 28 September 2008. – See the apparent diameters on the Sun and Moon pages. Conservation news – Environmental science and conservation news. ^ Baer, James; Chesley, Steven R. PMID 11486082. "The new definition of universal time". Proceedings of the National Academy of Sciences. (February 1994). A.; Wiegert, P. "Hints of life on what was thought to be desolate early Earth". Nature: news.2011.498. Retrieved 3 October 2013. Archived from the original on 27 April 2013. Bibcode:2016MNRAS.462.3441D. doi:10.1051/0004-6361:20041335. (February 1907). Because of this, some scientists refer to Vesta as a protoplanet.[89] However, the presence of iron meteorites and achondritic meteorite classes without identified parent bodies indicates that there once were other differentiated planetesimals with igneous histories, which have since been shattered by impacts. Of the four rocky planets, it is the largest and most massive. 5 September 2012. "Mass of Vesta". ^ Burn, Chris (March 1996). Retrieved 14 May 2011. The first continental crust, which was more felsic in composition, formed by the partial melting of this mafic crust. ^ a b Canup, R.; Asphaug, E. ^ Meier, M. World Bank. 299 (5607): 673–74. ^ Locally varies between 5 and 70 km. "The persistent myth of crustal growth" (PDF). 160 (3825): 299–300. "Physical properties of (2) Pallas". doi:10.1126/science.215.4539.1501. It is 270 km (168 mi) across and predates Rheasilvia (green at bottom). Bibcode:2014Icar..244...60S. It is estimated that the impact responsible excavated about 1% of the volume of Vesta, and it is likely that the Vesta family and V-type asteroids are the products of this collision. "Structural geology of the Earth's interior". The largest is named Divalia Fossa (10–20 km wide, 465 km long). "Tides, tidalites, and secular changes in the Earth–Moon system". By Early Modern English, many nouns were capitalized, and the earth was also written the Earth, particularly when referenced along with other heavenly bodies. doi:10.1080/08120099108727995. "Determination of the mass of (4) Vesta based on new close approaches". Minor Planet Center. Climate Change and the Course of Global History. 412 (6848): 708–12. ^ "Apollo Imagery – AS17-148-22727". Ahrens (ed.). ^ Mueller, R. pp. 26–31. ^ Morris, Ron M. A.; Courtillot, V. ISBN 978-0-04-550028-4. "The Planet Hygiea". Columbia University. "Sea Surface Temperature". —Garry, W.B.; Sykes, M.; Buczkowski, D.L.; et al. (March 2022) The gravity of Earth is the acceleration that is imparted to objects due to the distribution of mass within Earth. "On the possibility of viscoelastic deformation of the large south polar craters and true polar wander on the asteroid Vesta". Dictionary.com Unabridged (Online). ^ Liungman, Carl G. PMID 19487662. Bibcode:2005A&A...430..319K. By 1858, the circle had been simplified to parentheses, (4) Vesta, which were easier to typeset. "Heterogeneity and Anisotropy of Earth's Inner Core" (PDF). University of Puerto Rico at Arecibo. California: Stanford University Press. K. hdl:1874/1653. "Pitted Terrain on Vesta and Implications for the Presence of Volatiles". S.; Singh, S. De Sanctis; E. (8 November 2014). p. 49. ^ Ghosh, A.; McSween, H. Sanz Fernández (21 June 2004). HubbleSite. Under perfect dark sky conditions where all light pollution is absent it might be visible to an experienced observer without the use of a telescope or binoculars. PMID 22997131. S2CID 130092094. pp. 114–15. Retrieved 18 December 2017. Oxford University Press. (Subscription or participating institution membership required.) ^ "Gaia". Animation of Dawn's trajectory around 4 Vesta from 15 July 2011 to 10 September 2012 Dawn · 4 Vesta In 1981, a proposal for an asteroid mission was submitted to the European Space Agency (ESA). M. "Earth's Trojan asteroid". Minucia is the oldest.[67] "Snowman" craters by Dawn from 5,200 km (3,200 mi) in 2011Detailed image of the "Snowman" craters Troughs The majority of the equatorial region of Vesta is sculpted by a series of parallel troughs. (27 July 2011). It soon became clear that it would be impractical to continue inventing new planetary symbols indefinitely, and some of the existing ones proved difficult to draw quickly. ^ Goudie, Andrew (2000). ^ Henshaw, John M. Earth Science: An Introduction. Cox, ed. doi:10.1038/scientificamerican0591-84. ISBN 978-0-357-11656-2. 164 (3885): 1229–42. "Late Heavy Bombardment". ^ Charette, Matthew A.; Smith, Walter H. "Pre-drift continental nuclei". Retrieved 9 January 2010. ^ "Search – Dawn Mission". ^ Gomez, Jim; Sullivan, Tim (31 October 2011). Retrieved 13 March 2007. "Age of the Earth". Springer Praxis Books in Space Exploration. Environmental Research Letters. Earth rotates around its own axis in just less than a day (in about 23 hours and 56 minutes). This causes a slow but steady loss of the atmosphere into space. "The discovery of Vesta". ^ Sanders, Robert (10 December 2003). "The potential of New Zealand kauri (Agathis australis) for testing the synchronicity of abrupt climate change during the Last Glacial Interval (60,000–11,700 years ago)". pp. 292–94. NASA Solar System Exploration. ^ Kneissl, T.; Schmedemann, N.; Reddy, V.; et al. Humans emerged 300,000 years ago, and have reached a population of almost 8 billion today. B.; Li, J. "How Are Fossil Fuels Extracted From the Ground?". Angela Hall as Dictionary of Northern Mythology, p. ^ See: Dalrymple, G. ^ "AstDyS-2 Vesta Synthetic Proper Orbital Elements". "ISO and Asteroids" (PDF). 44th Lunar and Planetary Science Conference (1719): 2115. OCLC 646887856. "Oceanic Processes". Proceedings of the National Academy of Sciences of the United States of America. ^ a b As of 4 January 2018, the United States Strategic Command tracked a total of 18,835 artificial objects, mostly debris. doi:10.1086/100212. PMID 16592930. It dates from 1973, at the beginning of astrological interest in asteroids.[45] ^ The objects elsewhere in the Solar system with well-defined masses that are within a factor of 2 of Vesta's are shown at right. H.; et al. Historia Scientiarum. CiteSeerX 10.1.1.527.9577. Brent (1991). Montañés; Palle, E. Because the asteroid Juno had been discovered in 1804, this made Vesta the fourth object to be identified in the region that is now known as the asteroid belt. Geophysical Research Letters. Of the nine identified boundaries, five have been crossed: Biosphere integrity, climate change, chemical pollution, destruction of wild habitats and the nitrogen cycle are thought to have passed the safe threshold.[262][263] As of 2018, no country meets the basic needs of its population without transgressing planetary boundaries. "Themes & Issues". S2CID 4412106. Bibcode:1979PNAS...76.4192J. 114 (50): 13114–19. p. 391. ^ Cook, John; Oreskes, Naomi; Doran, Peter T.; Anderegg, William R. Several old, degraded craters rival Rheasilvia and Veneneia in size, though none are quite so large. See table 2, p. J.; Keil, K. "Oceans and Continents: Similarities and Differences in the Mechanisms of Heat Loss". Nature America. American Geophysical Union. doi:10.1146/annurev-earth-060313-054658. ^ Brown, W. ^ Kahn, Charles H. p. 40. ^ El Fadli, Khalid I.; et al. ^ "HORIZONS Batch call for 2022 perihelion". Symbols – Encyclopedia of Western Signs and Ideograms. More solar energy is received by tropical regions than polar regions and is redistributed by atmospheric and ocean circulation. 3 (9): 637–41. Retrieved 7 November 2020. ^ Robertson, Eugene C. PMID 17837768. See: Chorowicz, Jean (October 2005). The Aurora Research Institute. Visibility Annotated image from Earth's surface in June 2007 with (4) Vesta Its size and unusually bright surface make Vesta the brightest asteroid, and it is occasionally visible to the naked eye from dark skies (without light pollution). Gazetteer of Planetary Nomenclature. ^ Rona, Peter A. "Asteroid (469219) 2016 HO3, the smallest and closest Earth quasi-satellite". National Radio Astronomy Observatory. "A Thermal Model for the Differentiation of Asteroid 4 Vesta, Based on Radiogenic Heating". Bibcode:1994SciAm.271d..84G. Johns Hopkins University Press. K.; Wohletz, K. ISBN 978-0-935702-68-2. PMID 27698119. Archived from the original on 30 December 2013. Archived from the original (PDF) on 5 February 2009. PMID 23128228. However, olivine has only been detected in localized regions of the northern hemisphere, not within Rheasilvia.[33] The origin of this olivine is currently unknown. ^ a b c Schenk, P.; et al. 30 (5): 603. ^ "NASA's Journey Above Vesta". p. 53. ^ "Dawn Mission Overview". C.; et al. doi:10.1016/j.icarus.2014.06.026. 128 (1): 95–103. ^ Luzum, Brian; Capitaine, Nicole; Fienga, Agnès; Folkner, William; Fukushima, Toshio; et al. Humans depend on Earth's biosphere and natural resources for their survival, but have increasingly impacted Earth's environment. doi:10.1126/science.1219088. "Troposphere". From the first appearance of calcium–aluminium-rich inclusions (the first solid matter in the Solar System, forming about 4.567 billion years ago), a likely time line is as follows:[84][85][86][87][88] Timeline of the evolution of Vesta 2–3 million years Accretion completed 4–5 million years Complete or almost complete melting due to radioactive decay of ^{26}Al, leading to separation of the metal core 6–7 million years Progressive crystallization of a convecting molten mantle. ^ a b aphelion = a × (1 + e); perihelion = a × (1 – e), where a is the semi-major axis and e is the eccentricity. The flow of glaciers erodes the surface changing it dramatically, with the formation of U-shaped valleys and other landforms.[181] Sea ice in the Arctic covers an area about as big as the United States, although it is quickly retreating as a consequence of climate change.[182] The average salinity of Earth's oceans is about 35 grams of salt per kilogram of seawater (3.5% salt).[183] Most of this salt was released from volcanic activity or extracted from cool igneous rocks.[184] The oceans are also a reservoir of dissolved atmospheric gases, which are essential for the survival of many aquatic life forms.[185] Sea water has an important influence on the world's climate, with the oceans acting as a large heat reservoir.[186] Shifts in the oceanic temperature distribution can cause significant weather shifts, such as the El Niño–Southern Oscillation.[187] The abundance of water on Earth's surface is a unique feature that distinguishes it from other planets in the Solar System. Today, humanity's impact on Earth's climate, soils, waters, and ecosystems is unsustainable, threatening people's lives and causing widespread extinction of other life. "Earth Fact Sheet". doi:10.1111/j.2153-3490.1974.tb01946.x. ISSN 1600-0870. ^ Turner, Chris S.M.; et al. A.; Yingst, R. Barrat; W. 6 (8): 579–80. Retrieved 8 November 2008. Archived from the original on 15 July 2014. Journal of the Atmospheric Sciences. ^ Richards, M. PMID 32855337. "Radioactive potassium may be major heat source in Earth's core". 2012. (1974). ^ a b c d e f g h i Russell, C. 244: 1–12. Archived from the original on 31 October 2011. Hertz estimated the mass of Vesta at $(1.20\pm0.08)\times10^{-10}\ M_\odot$ (solar masses).[52] More refined estimates followed, and in 2001 the perturbations of 17 Thetis were used to calculate the mass of Vesta to be $(1.31\pm0.02)\times10^{-10}\ M_\odot$.[53] Dawn determined it to be $1.3029\times10^{-10}\ M_\odot$. ISSN 1748-9326. Archived from the original on 20 April 2019. In Thomas J. 418: 457–68. ^ Including the Somali Plate, which is being formed out of the African Plate. pp. 117–125. "Apollo 8's Earthrise: The Shot Seen Round the World – Half a century ago today, a photograph from the moon helped humans rediscover Earth". ISBN 978-0-521-82206-0. "Dawn at Vesta: Testing the Protoplanetary Paradigm" (PDF). ^ Olson, Peter; Amit, Hagay (2006). NASA Planetary Data System. doi:10.1126/science.1080679. ^ a b James, Andrew (2008). de la Fuente (8 August 2016). "Astrobiology Roadmap". J.; Vočadlo, L.; Brodholt, J.; Price, G. Boston, MA: Houghton Mifflin. p. 46. Archived from the original on 14 November 2021. Mass of Vesta compared[h] The mass of 4 Vesta (blue) compared to other large asteroids: 1 Ceres, 2 Pallas, 10 Hygiea, 704 Interamnia, 15 Eunomia and the remainder of the Main Belt. "Photometry of 4 Vesta from its 2007 Apparition". ISBN 978-0-262-57138-8. World Nuclear Association. ^ Carlini, Francesco (1808). "The impact of humans on continental erosion and sedimentation". Retrieved 16 December 2009. The presence of grains of the mineral zircon of Hadean age in Eoarchean sedimentary rocks suggests that at least some felsic crust existed as early as 4.4 Ga, only 140 Ma after Earth's formation.[50] There are two main models of how this initial small volume of continental crust evolved to reach its current abundance:[51] (1) a relatively steady growth up to the present day,[52] which is supported by the radiometric dating of continental crust globally and (2) an initial rapid growth in the volume of continental crust during the Archean, forming the bulk of the continental crust that now exists,[53][54] which is supported by isotopic evidence from hafnium in zircons and neodymium in sedimentary rocks. ^ Berkner, L. It is though possible to provide all basic physical needs globally within sustainable levels of resource use.[264] Cultural and historical viewpoint Main article: Earth in culture Earthrise, taken in 1968 by William Anders, an astronaut on board Apollo 8 Human cultures have developed many views of the planet.[265] The standard astronomical symbol of Earth consists of a cross circumscribed by a circle, ,[266] representing the four corners of the world. Bibcode:2012Sci...338..242P. Bibcode:2011GGG....1211001A. "Space missions trigger map wars". ^ Gupta, G.; Sahijpal, S. "Salt of the Early Earth". The most prominent of these surface features are two enormous craters, the 500-kilometre (311 mi)-wide Rheasilvia crater, centered near the south pole, and the 400 km (249 mi) wide Veneneia crater. ISBN 978-0-19-516589-0. ^ Williams, James G. Due to Earth's axial tilt, the amount of sunlight reaching any given point on the surface varies over the course of the year. ^ Seligman, Courtney (2008). "When Is an Asteroid Not an Asteroid?". "The Evolution of Life on Earth". 105 (2): 359–61. "Summary for Policymakers" (PDF). NASA/World Book, Inc. ^ The New Oxford Dictionary of English, 1st ed. doi:10.1016/j.earscirev.2011.05.003. ISBN 978-0-8493-0481-1. NASA/Langley Research Center. ^ Brooke, John L. 197: 102896. Bibcode:2016JGRE..121.1786K. Solar System planets with considerable atmospheres do partly host atmospheric water vapor, but they lack surface conditions for stable surface water.[188] Despite some moons showing signs of large reservoirs of extraterrestrial liquid water, with possibly even more volume than Earth's ocean, all of them are large bodies of water under a kilometers thick frozen surface layer.[189] Atmosphere Main article: Atmosphere of EarthThe atmospheric pressure at Earth's sea level averages 101.325 kPa (14.696 psi),[190] with a scale height of about 8.5 km (5.3 mi).[5] A dry atmosphere is composed of 78.084% nitrogen, 20.946% oxygen, 0.934% argon, and trace amounts of carbon dioxide and other gaseous molecules.[190] Water vapor content varies between 0.01% and 4%[190] but averages about 1%.[5] The height of the troposphere varies with latitude, ranging between 8 km (5 mi) at the poles to 17 km (11 mi) at the equator, with some variation resulting from weather and seasonal factors.[191] Earth's biosphere has significantly altered its atmosphere. ^ Coddington, O.; Lean, J. A.; Duncan, R. 369 (6507): 1110–13. "Near-IR imaging of Asteroid 4 Vesta" (PDF). Oxford University Press. (Subscription or participating institution membership required.) ^ "Tellus". On the basis of the sizes of V-type asteroids (thought to be pieces of Vesta's crust ejected during large impacts), and the depth of Rheasilvia crater (see below), the crust is thought to be roughly 10 kilometres (6 mi) thick.[91] Findings from the Dawn spacecraft have found evidence that the troughs that wrap around Vesta could be graben formed by impact-induced faulting (see Troughs section above), meaning that Vesta has more complex geology than other asteroids. "Group 29: Multi-axes symmetric, both soft and straight-lined, closed signs with crossing lines". Retrieved 23 September 2011. IERS Conventions (2003) (PDF). 26 September 2012. Archived from the original (PDF) on 15 July 2011. Oxford English Dictionary (3 ed.). Cosmic Challenge: The Ultimate Observing List for Amateurs. PMID 7939569. Origins of Magnetospheric Physics. The Nine Planets, A Multimedia Tour of the Solar System: one star, eight planets, and more. Acad. The result is atmospheric circulation that drives the weather and climate through redistribution of thermal energy.[198] The primary atmospheric circulation bands consist of the trade winds in the equatorial region below 30° latitude and the westerlies in the mid-latitudes between 30° and 60°.[199] Ocean heat content and currents are also important factors in determining climate, particularly the thermohaline circulation that distributes thermal energy from the equatorial oceans to the polar regions.[200] Earth receives 1361 W/m^2 of solar irradiance.[201][202] The amount of solar energy that reaches the Earth's surface decreases with increasing latitude. ^ Ganopolski, A.; Winkelmann, R.; Schellnhuber, H. Oceans and Human Health. ^ European Investment Bank (2019). Bibcode:1997Icar..128...88T. ISBN 978-0-521-87164-8. Naturwissenschaften. Bibcode:2001Sci...293..839C. ISBN 978-0-387-78904-0. R.; Hager, B. ^ "The Earth's Centre is 1000 Degrees Hotter than Previously Thought". 414 (4): 2965–69. doi:10.1038/scientificamerican0200-90. "The Geologically Recent Giant Impact Basins at Vesta's South Pole". 121 (1–2): 1–18. doi:10.1029/2011GC003751. "Resources of the Sea Floor". "United Nations Member States". ^ Seidelmann, P. Rheasilvia and Veneneia craters Main articles: Rheasilvia and Veneneia South pole of Vesta, showing the extent of Rheasilvia crater. doi:10.1111/j.1945-5100.2001.tb01534.x. ^ Hertz, Hans G. (24 June 2011). ^ "Asteroid Vesta is 'last of a kind' rock". Bibcode:1969Sci...164.1229H. The IAU established a coordinate system in 1997 based on Hubble photos, with the prime meridian running through the center of Olbers Regio, a dark feature 200 km across. doi:10.5194/hess-5-569-2001. Allen's Astrophysical Quantities. W.; Konopliv, A. Retrieved 3 November 2019. In addition to an annual component to this motion, there is a 14-month cycle called the Chandler wobble. doi:10.1051/0004-6361:20035872. California, Los Angeles. ^ Various (21 July 1997). ISSN 0019-1035. Oxford University Press. (Subscription or participating institution membership required.) ^ "Terran". Retrieved 31 October 2011. "Early Viscous Relaxation of Asteroid Vesta and Implications for Late Impact-Driven Despinning" (PDF). Home Online. doi:10.1038/427589a. ^ Ganushkina, N. -P.; et al. The unit of mass is $\times10^{18}$ kg. "The IAU 2009 system of astronomical constants: The report of the IAU working group on numerical standards for Fundamental Astronomy". ^ Stanley, S. Bibcode:2012P&SS...73..283R. p. 48. ^ Sweetlove, L. Without this heat-retention effect, the average surface temperature would be −18 °C (0 °F), in contrast to the current +15 °C (59 °F),[194] and life on Earth probably would not exist in its current form.[195] Weather and climate Main articles: Weather and ClimateHurricane Felix seen from low Earth orbit, September 2007Massive clouds above the Mojave Desert, February 2016 Earth's atmosphere has no definite boundary, gradually becoming thinner and fading into outer space.[196] Three-quarters of the atmosphere's mass is contained within the first 11 km (6.8 mi) of the surface; this lowest layer is called the troposphere.[197] Energy from the Sun heats this layer, and the surface below, causing expansion of the air. Retrieved 28 October 2020. Bibcode:2014Icar..244..133K. ^ Carrington, Damien (18 January 2022). Retrieved 15 March 2007. 428 (1): 261–85. At approximately 3 Gyr, twice the present-day heat would have been produced, increasing the rates of mantle convection and plate tectonics, and allowing the production of uncommon igneous rocks such as komatiites that are rarely formed today.[105][106] The mean heat loss from Earth is 87 mW m^{-2}, for a global heat loss of 4.42×10^{13} W.[107] A portion of the core's thermal energy is transported toward the crust by mantle plumes, a form of convection consisting of upwellings of higher-temperature rock. Business Insider. Stuart; Lewandowsky, Stephan; Skuce, Andrew G.; Green, Sarah A.; Nuccitelli, Dana (2016). ^ a b Kelley, M. (2006). CBC. "The Historical Unravelling of the Diameters of the First Four Asteroids". ^ Milbert, D. University of Chicago Press. 215 (4539): 1501–03. Bibcode:2005JAfES..43..379C. PMID 26762457. From the Latin Terra comes terran /ˈtɛrən/,[32] terrestrial /təˈrɛstriəl/,[33] and (via French) terrene /təˈriːn/,[34] and from the Latin Tellus comes tellurian /tɛˈlʊəriən/[35] and telluric.[36] Chronology Main article: History of Earth Formation Planetary disk of a star, the inner ring has a radius equal to Earth and the Sun The oldest material found in the Solar System is dated to $4.5682^{+0.0002}_{-0.0004}$ Ga (billion years) ago.[37] By 4.54±0.04 Ga the primordial Earth had formed.[38] The bodies in the Solar System formed and evolved with the Sun. "Moon Fact Sheet". ^ Karimi, S; Dombard, A.J. (2016). Archived from the original on 12 June 2007. PMID 22582258. Archived from the original on 18 December 2008. CRC Press. 360 (1795): 1227–44. (2002). Oxford University Press. (Subscription or participating institution membership required.) ^ "terrene". Bibcode:1981JGR....8611535S. ^ Klemetti, Erik (17 June 2019). Bibcode:1991SciAm.264e..84B. NASA WMAP. Archived from the original on 26 August 2013. (1980). 242: 5. External links Listen to this article (1 hour and 10 minutes) This audio file was created from a revision of this article dated 22 April 2021 (2021-04-22), and does not reflect subsequent edits.(Audio help · More spoken articles) Earth – Profile – Solar System Exploration – NASA Earth Observatory – NASA Earth – Videos – International Space Station: Video (01:02) – Earth (time-lapse) Video (00:27) – Earth and auroras (time-lapse) Google Earth 3D, interactive map Interactive 3D visualization of the Sun, Earth and Moon system GPlates Portal (University of Sydney) Portals:BiologyEarth sciencesEcologyGeographyVolcanoesSolar systemOuter spaceWeatherWorldEarth at Wikipedia's sister projects:Definitions from WiktionaryMedia from CommonsNews from WikinewsQuotations from WikiquoteTexts from WikisourceTextbooks from WikibooksResources from Wikiversity Retrieved from " 2Second largest asteroid of the main asteroid belt This article is about the asteroid. International Journal of Astrobiology. S2CID 11208727. Oxford English Dictionary (Online ed.). (1993). This estimate is for 6 May 1996, very close to perihelion, although details vary somewhat with the seasons.[15] Surface features Further information: List of geological features on Vesta Prior to the arrival of the Dawn spacecraft, some Vestan surface features had already been resolved using the Hubble Space Telescope and ground-based telescopes (e.g. the Keck Observatory).[65] The arrival of Dawn in July 2011 revealed the complex surface of Vesta in detail.[66] Geologic map of Vesta[67] The most ancient and heavily cratered regions are brown; areas modified by the Veneneia and Rheasilvia impacts are purple (the Saturnalia Fossae Formation, in the north)[68] and light cyan (the Divalia Fossae Formation, equatorial),[67] respectively; the Rheasilvia impact basin interior (in the south) is dark blue, and neighboring areas of Rheasilvia ejecta (including an area within Veneneia) are light purple-blue;[69][70] areas modified by more recent impacts or mass wasting are yellow/orange or green, respectively. ISSN 0004-6256. Bibcode:2010NatGe...3..637B. S2CID 4466220. "Prehistory's Brilliant Future". Bibcode:1994A&A...282..663S. JSTOR 24936905. BBC. H.; Ermakov, A.I.; Zuber, M.T. (2013). p. 8. New York: Thomas Dunne Books. "Chart: Globally, 70% of Freshwater is Used for Agriculture". Frankfurt am Main: Verlag des Bundesamts für Kartographie und Geodäsie. Retrieved 25 October 2020. ^ Gould, Stephan J. PMC 3870916. ^ Binzel, R. ^ Novacek, Michael J. Archived from the original on 15 January 2010. Lynne Reiner. ^ Righter, K.; Schonbachler, M. "The Physical Basis of the Leap Second" (PDF). (24 August 2011). They include Feralia Planitia, shown at right, which is 270 km (168 mi) across.[75] More-recent, sharper craters range up to 158 km (98 mi) Varronilla and 196 km (122 mi) Postumia.[76] "Snowman craters" The "snowman craters" is an informal name given to a group of three adjacent craters in Vesta's northern hemisphere. Quarterly Journal of the Royal Astronomical Society. S.; Cherry, Soraya G.; Hasenfratz, Adam P.; Haug, Gerald H.; Jaccard, Samuel L.; Martínez-García, Alfredo; Pälike, Heiko; Pancost, Richard D.; Wilson, Paul A. Retrieved 27 October 2020. 32 (6): 841–853. Retrieved 13 March 2011. ^ De Smet, J.; Van Den Berg, A.P.; Vlaar, N.J. (2000). Vol. 6. 491 (7422): 83–86. Epigenetic Mechanisms of the Cambrian Explosion. arXiv:1104.0036. The European Synchrotron (ESRF). Over the period of hundreds of millions of years, tectonic forces have caused areas of continental crust to group together to form supercontinents that have subsequently broken apart. Lide (ed.). 386 (1): 155–63. Bibcode:2019SSRv..215...54T. NASA Earth Observatory. ^ Takeda, H. Journal of African Earth Sciences. The Lancet. JPL Solar System Dynamics. ^ Pollack, Henry N.; Hurter, Suzanne J.; Johnson, Jeffrey R. doi:10.1111/j.1365-2966.2008.13022.x. S2CID 10073988.See also Palmer, Jason (22 February 2008). ^ "Terra". The Astrophysical Journal Letters. News Release STScI-1995-20. 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Exploitation of Natural Resources". Retrieved 1 June 2008. Earth is about eight light minutes away from the Sun and orbits it, taking a year (about 365.25 days) to complete one revolution. doi:10.1016/S0040-1951(00)00055-X. Quaternary Science Reviews. ^ Sharp, David (5 March 2005). ^ Kinzler, Ro. "When and how did the ice age end?" "The 'Highest' Spot on Earth". The quantities given are the values at the instant J2000.0 of the secular variation, ignoring all periodic variations. New York: Times Books, Henry Holt and Company. Oxford University Press (Oxford), 1998. Scientific investigation has resulted in several culturally transformative shifts in people's view of the planet. Washington D.C.: National Geographic Society. ^ Jones, P. Bliss, George Jr. (ed.). Bibcode:2013M&PS...48.2090M. References ^ "Vesta". Retrieved 20 September 2007. "Vesta's Shape and Morphology". p. 42. Indianapolis, IN and Cambridge, England: Hackett Publishing Company. Allen's Astrophysical Quantities (4th ed.). S2CID 206540168. PMID 16592703. "Dawn; the Vesta-HED connection; and the geologic context for eucrite, diogenites, and howardites". "Record low surface air temperature at Vostok station, Antarctica". ^ Earth's circumference is almost exactly 40,000 km because the meter was calibrated on this measurement—more specifically, 1/10-millionth of the distance between the poles and the equator. Retrieved 24 March 2007. ESA Bulletin. Physical Geology: Exploring the Earth. In theory, a solar nebula partitions a volume out of a molecular cloud by gravitational collapse, which begins to spin and flatten into a circumstellar disk, and then the planets grow out of that disk with the Sun. ^ The international system of units (SI) (PDF) (2008 ed.). doi:10.1007/s10569-011-9352-4. "History of Earth". ISBN 978-3-540-00238-3. As a result, it always presents the same face to the planet.[162] As the Moon orbits Earth, different parts of its face are illuminated by the Sun, leading to the lunar phases.[163] Due to their tidal interaction, the Moon recedes from Earth at the rate of approximately 38 mm/a (1.5 in/year). (January 2012). 14 January 2019. Springer Berlin Heidelberg. 190 (1): 205–21. Bibcode:1991AuJES..38..613A. 9 April 2015. Along with the pitted terrain, curvilinear gullies are found in Marcia and Cornelia craters. ^ Littmann, Mark (2004). (1972). The most abundant silicate minerals on Earth's surface include quartz, feldspars, amphibole, mica, pyroxene and olivine.[122] Common carbonate minerals include calcite (found in limestone) and dolomite.[123] Erosion and tectonics, volcanic eruptions, flooding, weathering, glaciation, the growth of coral reefs, and meteorite impacts are among the processes that constantly reshape Earth's surface over geological time.[124][125] The pedosphere is the outermost layer of Earth's continental surface and is composed of soil and subject to soil formation processes. It is composed mostly of iron (32.1%), oxygen (30.1%), silicon (15.1%), magnesium (13.9%), sulfur (2.9%), nickel (1.8%), calcium (1.5%), and aluminum (1.4%), with the remaining 1.2% consisting of trace amounts of other elements. Retrieved 12 January 2022. doi:10.1201/9781420038484. S2CID 4413525. Retrieved 31 July 2012. Archived from the original on 4 March 2007. There are at least five quasi-satellites, including 469219 Kamoʻoalewa.[170][171] A trojan asteroid companion, 2010 TK7, is librating around the leading Lagrange triangular point, L4, in Earth's orbit around the Sun.[172][173] The tiny near-Earth asteroid 2006 RH120 makes close approaches to the Earth–Moon system roughly every twenty years. United States Department of Commerce, NIST Special Publication 330. ISSN 1944-9208. Elsevier Science. Vesta is the second-most-massive body in the asteroid belt,[60] though only 28% as massive as Ceres.[22] Ceres is however believed to be an interloper from beyond Jupiter; if true, Vesta would be the most massive body that formed in the asteroid belt. Retrieved 5 January 2019. 100 (1): 27–42. "Various '7 billionth' babies celebrated worldwide". Dawn [website]. p. 52. "Asteroid or Mini-Planet? A region's climate is governed by latitude, but also by elevation and proximity to moderating oceans. p. 137. 21 September 2011. ^ If Earth were shrunk to the size of a billiard ball, some areas of Earth such as large mountain ranges and oceanic trenches would feel like tiny imperfections, whereas much of the planet, including the Great Plains and the abyssal plains, would feel smoother.[88] ^ Locally varies between 5 and 200 km. Bibcode:2008AJ....136.1906M. "Cluster reveals the reformation of the Earth's bow shock". earthobservatory.nasa.gov. "Earth's Big heat Bucket". Space.com. Flanders – Ceres and Vesta: July 2012 – April 2013 – Sky & Telescope. In Greek, the name adopted was the Hellenic equivalent of Vesta, Hestia (4 Εστία); in English, that name is used for 46 Hestia (Greeks use the name "Hestia" for both, with the minor-planet numbers used for disambiguation). For other systems of numbering planets, see Planet § History. "A long-term numerical solution for the insolation quantities of the Earth". PMC 5081622. Earth's axis of rotation is tilted with respect to the perpendicular to its orbital plane around the Sun, producing seasons. Beyond these, the exosphere thins out into the magnetosphere, where the geomagnetic fields interact with the solar wind.[213] Within the stratosphere is the ozone layer, a component that partially shields the surface from ultraviolet light and thus is important for life on Earth. ISSN 1572-9672. Binzel; M. Geodynamics (2 ed.). Bibcode:2000A&A...356L..71C. Guinan (ed.). Bibcode:2014Icar..244...74W. Retrieved 19 December 2021. ^ Raup, D. doi:10.1089/ast.2013.1030. "MAP OF THE DAY: Pretty Much Everyone Lives In The Northern Hemisphere". ISSN 2156-2202. ^ a b Moran, Joseph M. Boston: Cengage. "The Earth as an Object of Astrophysical Interest in the Search for Extrasolar Planets" (PDF). doi:10.1002/2016JE005064. Celestial Mechanics and Dynamical Astronomy. Note: After Ronov and Yaroshevsky (1969). ^ Geerts, B.; Linacre, E. Archived from the original on 15 April 2009. 177 (1): 190–195. doi:10.5670/oceanog.2010.51. A nebula contains gas, ice grains, and dust (including primordial nuclides). Wolfram-Alpha: Computational Knowledge Engine. 194 (2): 463–75. "Third planet" redirects here. Archived from the original on 7 April 2007. arXiv:1110.4810. (1981). "Tidally locked exoplanets may be more common than previously thought". Texas A&M University. ^ Rogers, John James William; Santosh, M. Archived from the original on 5 March 2016. Internal structure Main article: Structure of the Earth Geologic layers of Earth[94] Illustration of Earth's cutaway, not to scale Depth[95] (km) Component layer name Density (g/cm^3) 0–60 Lithosphere[n 7] — 0–35 Crust[n 8] 2.2–2.9 35–660 Upper mantle 3.4–4.4 660-2890 Lower mantle 3.4–5.6 100–700 Asthenosphere — 2890–5100 Outer core 9.9–12.2 5100–6378 Inner core 12.8–13.1 Earth's interior, like that of the other terrestrial planets, is divided into layers by their chemical or physical (rheological) properties. 108: 711. The ozone layer blocks ultraviolet solar radiation, permitting life on land.[192] Other atmospheric functions important to life include transporting water vapor, providing useful gases, causing small meteors to burn up before they strike the surface, and moderating temperature.[193] This last phenomenon is known as the greenhouse effect: trace molecules within the atmosphere serve to capture thermal energy emitted from the ground, thereby raising the average temperature. ISBN 978-0-87745-921-7. "The Structure of the Terrestrial Planets". (27 May 2015). (8 November 2013). id.2315. California State Polytechnic University, Pomona. ^ Zeilik, M.; Gregory, S. 36 (4): 501–513. Archived from the original (PDF) on 27 February 2019. San Francisco's climate is significantly more moderate as the prevailing wind direction is from sea to land.[207] Finally, temperatures decrease with height causing mountainous areas to be colder than low-lying areas.[208] Water vapor generated through surface evaporation is transported by circulatory patterns in the atmosphere. The 'Snowman' craters are at the top of the left image; Rheasilvia and Veneneia (green and blue) dominate the right. hdl:2286/R.I.28071. The remaining 29.2%, or 148.94 million km^2 (57.51 million sq mi), not covered by water has terrain that varies greatly from place to place and consists of mountains, deserts, plains, plateaus, and other landforms. By 2050, 68% of the world's population is expected to be living in urban, rather than rural, areas.[236] The Northern Hemisphere contains 68% of the world's land mass.[237] Partly due to the predominance of land mass, 90% of humans live in the Northern Hemisphere.[238] It is estimated that one-eighth of Earth's surface is suitable for humans to live on—three-quarters of Earth's surface is covered by oceans, leaving one-quarter as land. ^ a b "UCS Satellite Database". ^ Ohtomo, Yoko; Kakegawa, Takeshi; Ishida, Akizumi; et al. The troughs may be graben that formed after another asteroid collided with Vesta, a process that can happen only in a body that, like Vesta, is differentiated.[77] Vesta's differentiation is one of the reasons why scientists consider it a protoplanet.[78] A section of Divalia Fossa, with parallel troughs to the north and southA computer-generated view of a portion of Divalia Fossa Surface composition Compositional information from the visible and infrared spectrometer (VIR), gamma-ray and neutron detector (GRaND), and framing camera (FC), all indicate that the majority of the surface composition of Vesta is consistent with the composition of the howardite, eucrite, and diogenite meteorites.[79][80][81] The Rheasilvia region is richest in diogenite, consistent with the Rheasilvia-forming impact excavating material from deeper within Vesta. "Atmospheric homeostasis by and for the biosphere: the Gaia hypothesis". ISBN 978-0-495-01148-4. doi:10.1007/s10569-007-9103-8. ^ Bouvier, Audrey; Wadhwa, Meenakshi (September 2010). This causes secular variation of the main field and field reversals at irregular intervals averaging a few times every million years. Benjamin Montesinos, Alvaro Gimenez and Edward F. Bibcode:1995geph.conf.....A. doi:10.1126/science.1219122. Life, the Science of Biology (8th ed.). Bibcode:1995Metic..30..603Y. ^ On 10 February 2009, during Ceres perihelion, Ceres was closer to the Sun than Vesta, because Vesta has an aphelion distance greater than Ceres's perihelion distance. "First Asteroid Companion of Earth Discovered at Last". p. 159. ISBN 978-0-7167-7671-0. Archived from the original on 8 August 2010. Kenneth (1992). PMC 5740680. Retrieved 10 August 2006. ^ Cooper, Keith (27 January 2015). Carbonaceous chondrites are comparatively rich in mineralogically bound OH.[81] Geology Cut-away schematic of Vestan core, mantle, and crust Eucrite meteorite There is a large collection of potential samples from Vesta accessible to scientists, in the form of over 1200 HED meteorites (Vestan achondrites), giving insight into Vesta's geologic history and structure. 43 (1–3): 379–410. An Equation for Every Occasion: Fifty-Two Formulas and Why They Matter. ISBN 978-0-521-85371-2. "Astrobiologists Find Evidence of Early Life on Land". Retrieved 7 July 2018. Researchers continue to examine data collected by Dawn for additional insights into the formation and history of Vesta.[33][34] History Discovery Vesta, Ceres, and the Moon with sizes shown to scale Heinrich Olbers discovered Pallas in 1802, the year after the discovery of Ceres. Bibcode:2018PNAS..115...53S. ^ a b "earth, n.¹". From Earth itself comes earthly. Union of Concerned Scientists. Bibcode:2012GeoRL..3918205B. Effemeridi astronomiche di Milano per l'anno 1809. "Climate and Earth's Energy Budget". (1979). 106 (24): 9576–79. – For millenniums, humans have tried to imagine the world in space. NASA/JPL. The remaining 29% of Earth's surface is land, consisting of continents and islands. ^ Rao, K. NASA, Lockheed Martin. References ^ Petsko, Gregory A. ^ Micalizio, Caryl-Sue; Evers, Jeannie (20 May 2015). (4 August 2014). doi:10.1126/science.1225374. "Geological constraints on the Precambrian history of Earth's rotation and the Moon's orbit". The final major mode of heat loss is through conduction through the lithosphere, the majority of which occurs under the oceans because the crust there is much thinner than that of the continents.[109] Tectonic plates Main article: Plate tectonics Earth's major plates, which are:[110] Pacific Plate African Plate[n 9] North American Plate Eurasian Plate Antarctic Plate Indo-Australian Plate South American Plate Earth's mechanically rigid outer layer, the lithosphere, is divided into tectonic plates. Retrieved 28 September 2015. "Dawn Reality-Checks Telescope Studies of Asteroids". 3.48 Billion-Year-Old Dresser Formation, Pilbara, Western Australia". Planetary Sciences (2nd ed.). ^ Holmes, Oliver (19 November 2018). Archived from the original on 2 May 2014. (1995). OCLC 896866658. "Planetary Fact Sheets". Lunar and Planetary Institute. The poles also migrate a few meters across Earth's surface. ^ Christou, A. D. ^ a b "Global Warming Effects". These plumes can produce hotspots and flood basalts.[108] More of the heat in Earth is lost through plate tectonics, by mantle upwelling associated with mid-ocean ridges. 1 (2): 88–95. Contributions to Mineralogy and Petrology. The Astronomical Almanac. Earth and Planetary Science Letters. 488 (7412): 442–443. Parallel troughs are seen in both. ^ Pieters, C. ^ a b c d T. p. 296. 504 (7478): 122–125. Enabled by science, particularly Earth observation,[273] humans have started to take action on environmental issues globally,[274] acknowledging the impact of humans and the interconnectedness of Earth's environments. "Dawn Mission: Mission". 113 (42): E6325–34. Other missions to the asteroid belt were proposed in the 1980s by France, Germany, Italy and the United States, but none were approved.[95] Exploration of Vesta by fly-by and impacting penetrator was the second main target of the first plan of the multi-aimed Soviet Vesta mission, developed in cooperation with European countries for realisation in 1991–1994 but canceled due to the dissolution of the Soviet Union. Retrieved 11 March 2007. Vol. 15. ^ Mullen, Leslie (11 June 2002). "The Gravity Field of Vesta and Implications for Interior Structure" (PDF). Monthly Notices of the Royal Astronomical Society. "Curious Kids: Why is the moon called the moon?". Cunningham (1988) Introduction to Asteroids explains the parenthetical part. "Dawn Mission to Vesta and Ceres" (PDF). ^ Note that there is very strong evidence that 6 Hebe is the parent body for H-chondrites, one of the most common meteorite types. ^ a b Harvey, Fiona (15 July 2020). EPSC-DPS2011-97-3. Retrieved 1 October 2011. ISBN 978-0-313-31505-3. doi:10.1029/93RG01249. 244: 133–157. "Land Use". p. 212. ^ Due to natural fluctuations, ambiguities surrounding ice shelves, and mapping conventions for vertical datums, exact values for land and ocean coverage are not meaningful. p. 6. This water cycle is a vital mechanism for supporting life on land and is a primary factor in the erosion of surface features over geological periods. Billiards Digest. V.; Noah, M.; Price, S. Archived from the original (.DAT file (displays as plaintext in browser)) on 14 March 2015. Sources and effects of ionizing radiation. ^ a b Mello, Fernando de Sousa; Friaça, Amâncio César Santos (2020). E. PMID 17772560. (26 July 2001). ^ Jessey, David. The mass of the oceans is approximately 1.35×10^{18} metric tons or about 1/4400 of Earth's total mass. hdl:2286/R.I.28070.—Scully, J. Early measurements SPHERE image is shown on the left, with a synthetic view derived from Dawn images shown on the right for comparison.[48] Photometric observations of Vesta were made at the Harvard College Observatory in 1880–1882 and at the Observatoire de Toulouse in 1909. ^ "Ceres, Pallas, Vesta, and Hygiea". For other uses, see Vesta (disambiguation). "On the origin and composition of Theia: Constraints from new models of the Giant Impact" (PDF). Earth Planet. ^ Williams, G.E. (2000). Technical Innovation in American History: An Encyclopedia of Science and Technology [3 volumes]. At the same time, the upwelling of mantle material at divergent boundaries creates mid-ocean ridges. "The age of the Earth in the twentieth century: a problem (mostly) solved". "Quantified mineralogical evidence for a common origin of 1929 Kollaa with 4 Vesta and the HED meteorites". doi:10.1007/s11214-019-0622-x. However, the proposal was refused by the ESA. Retrieved 26 October 2020. Earth's liquid outer core generates the magnetic field that shapes Earth's magnetosphere, deflecting destructive solar winds. ^ a b Mueller, T. Archived from the original on 5 June 2009. Bibcode:2014Icar..244....1W. ^ Lang, Kenneth (2011). This gives an axial tilt of 29°.[56] Coordinate systems There are two longitudinal coordinate systems in use for Vesta, with prime meridians separated by 150°. 30: 103–105. Archived from the original on 13 December 2010. 121 (9): 1786–1797. ISBN 978-1-4214-1491-1. IRAS-A-FPA-3-RDR-IMPS-V6.0". "Metamorphic History of the Eucritic Crust of 4 Vesta". (1983). ISBN 978-0-8493-2391-1. "Our Sun. 179. doi:10.1073/pnas.1613094113. (12 December 2007). pp. 13–18. Bulletin of the Geological Society of America. The oceans cover an area of 361.8 million km^2 (139.7 million sq mi) with a mean depth of 3,682 m (12,080 ft), resulting in an estimated volume of 1.332 billion km^3 (320 million cu mi).[176] If all of Earth's crustal surface were at the same elevation as a smooth sphere, the depth of the resulting world ocean would be 2.7 to 2.8 km (1.68 to 1.74 mi).[177] About 97.5% of the water is saline; the remaining 2.5% is fresh water.[178][179] Most fresh water, about 68.7%, is present as ice in ice caps and glaciers.[180] In Earth's coldest regions, snow survives over the summer and changes into ice. P. Bibcode:2008MNRAS.386..155S. Plutonic rocks rich in orthopyroxene with large grain sizes, the source of diogenites. "Where, exactly, is the edge of space? Convection stopped when about 80% of the material had crystallized Extrusion of the remaining molten material to form the crust, either as basaltic lavas in progressive eruptions, or possibly forming a short-lived magma ocean. Ohio State University. 244: 60–73. Archived from the original on 29 June 2011. Chand & Company. doi:10.1126/science.246.4926.103. Resources in Atmospheric Sciences. ^ Tate, Nikki; Tate-Stratton, Dani (2014). Basaltic lava flows, a source of non-cumulate eucrites. (1 September 2004). "Surface area of our planet covered by oceans and continents.(Table 8o-1)". Retrieved 6 November 2008. (1989). ^ a b Staff (8 October 2003). 22 (1): 12. doi:10.1111/j.1945-5100.2007.tb00589.x. S2CID 55463404. New York: Cambridge University Press. "Uprooting the tree of life" (PDF). Retrieved 3 March 2021. ISSN 1476-4687. "Infra-Red Astronomy Satellite (IRAS) Minor Planet Survey. "A long-lived horseshoe companion to the Earth". "Hydrogen loss from the terrestrial planets". "The Solar Eclipse Coincidence". Every 18 years, the asteroid 197 Arete approaches within 0.04 AU of Vesta. Bibcode:2005Sci...310.1947H. Politics and Process at the United Nations: The Global Dance (PDF). ^ Li, Jian-Yang; Mafi, Joseph N. Celestial Communications. ^ a b Simon, J.L.; et al. Cia.gov. "Astrometric masses of 21 asteroids, and an integrated asteroid ephemeris". ^ Ulivi, Paolo; Harland, David (2008). (2017). PMID 22582254. The Moon always faces the Earth with the same side through tidal locking and causes tides, stabilizes Earth's axis, and gradually slows its rotation. They corrected the pole, but also established a new prime meridian 4° from the center of Claudia, a sharply defined crater 700 meters across, which they say results in a more logical set of mapping quadrangles.[57] All NASA publications, including images and maps of Vesta, use the Claudian meridian, which is unacceptable to the IAU. The angular size (or solid angle) of these two bodies match because, although the Sun's diameter is about 400 times as large as the Moon's, it is also 400 times more distant.[146] This allows total and annular solar eclipses to occur on Earth.[169] Asteroids and artificial satellites Main articles: Near-Earth object and Claimed moons of Earth A model of Vanguard 1, the oldest human-made object in Earth orbit Earth's co-orbital asteroids population consists of quasi-satellites, objects with a horseshoe orbit and trojans. ^ Righter, K.; Drake, M. doi:10.1016/j.icarus.2005.03.024. Bibcode:2006NW.....93..519O. S2CID 119226112. Through activities such as the burning of fossil fuels, humans have been increasing the amount of greenhouse gases in the atmosphere, altering Earth's energy budget and climate.[259][260] It is estimated that global temperatures in the year 2020 were 1.2 °C (2.2 °F) warmer than the preindustrial baseline.[261] This increase in temperature, known as global warming, has contributed to the melting of glaciers, rising sea levels, increased risk of drought and wildfires, and migration of species to colder areas.[232] The concept of planetary boundaries was introduced to quantify humanity's impact on Earth. PDF copy ^ "surface ellipsoid 286.3x278.6x223.2". Nat Astron 4, 569–576 (2020). doi:10.1111/maps.12091. Both of these motions are caused by the varying attraction of the Sun and the Moon on Earth's equatorial bulge. This gives an apparent movement of the Sun eastward with respect to the stars at a rate of about 1°/day, which is one apparent Sun or Moon diameter every 12 hours. Sym545. BBC, 11 May 2012. Lord Kelvin and the Age of the Earth. Bibcode:2009PNAS..106.9576L. 12 (4): 112. "Understanding plate motions". It launched on 27 September 2007 as the first space mission to Vesta. Archived from the original (PDF) on 23 November 2008. 244: 74–88. The combination of these processes recycles the oceanic crust back into the mantle. ^ Lynn, W. Russell and Carol A. SpacePlace. ^ Cook, Jia-Rui C.; Brown, Dwayne C. ^ This symbol can be seen in the top of the most elaborate of the earlier forms, . Archived from the original on 12 March 2012. Over millions of years, these tiny modifications—and the lengthening of Earth's day by about 23 µs/yr—add up to significant changes.[164] During the Ediacaran period, for example, (approximately 620 Ma) there were 400±7 days in a year, with each day lasting 21.9±0.4 hours.[165] The Moon may have dramatically affected the development of life by moderating the planet's climate. ^ Cook, John; et al. ^ Tyrell, Kelly April (18 December 2017). ^ Astrophysicist team (1 December 2005). ^ a b Savage, Don; Jones, Tammy & Villard, Ray (19 April 1995). ^ Christou, Apostolos A.; Asher, David J. 494 (7436): 207–210. doi:10.1038/nature11534. p. 1114. While large volumes of water can be found throughout the Solar System, only Earth sustains liquid surface water. ^ Smith, Sharon; Fleming, Lora; Solo-Gabriele, Helena; Gerwick, William H. p. 3. S2CID 2555834. ^ Noffke, Nora; Christian, Daniel; Wacey, David; Hazen, Robert M. G.; Metcalfe, L. ^ Marcos, C. doi:10.1146/annurev.ea.09.050181.002215. 5 (4): 569–75. National Geodetic Survey, NOAA. Nearly 75% of the continental surfaces are covered by sedimentary rocks, although they form about 5% of the crust.[121] The third form of rock material found on Earth is metamorphic rock, which is created from the transformation of pre-existing rock types through high pressures, high temperatures, or both. This video explores Vesta's landscape, history and planet-like characteristics. S.; Park, R. Craig; Orians, Gordon H. It is the densest planet in the Solar System. OCLC 184822945. doi:10.1126/science.1061976. (December 2014). Oxford English Dictionary. These troughs are thought to be large-scale graben resulting from the impacts that created Rheasilvia and Veneneia craters, respectively. "Age of the Ocean Floor Poster". Retrieved 31 May 2008. In Gargaud, Muriel; Amils, Prof Ricardo; Quintanilla, José Cernicharo; Cleaves II, Henderson James (Jim); Irvine, William M.; Pinti, Prof Daniele L.; Viso, Michel (eds.). Reviews of Geophysics. ^ Hunten, D. "The Thermohaline Ocean Circulation". ^ Pidwirny, Michael (2006). It constitutes an estimated 9% of the mass of the asteroid belt.[22] Vesta is the only known remaining rocky protoplanet (with a differentiated interior) of the kind that formed the terrestrial planets.[23][24][25] Numerous fragments of Vesta were ejected by collisions one and two billion years ago that left two enormous craters occupying much of Vesta's southern hemisphere.[26][27] Debris from these events has fallen to Earth as howardite–eucrite–diogenite (HED) meteorites, which have been a rich source of information about Vesta.[28][29][30] Vesta is the brightest asteroid visible from Earth. PMID 23407535. "The Aeronomy of Hydrogen in the Atmosphere of the Earth". The Kármán line, defined as 100 km (62 mi) above Earth's surface, is a working definition for the boundary between the atmosphere and outer space.[214] Thermal energy causes some of the molecules at the outer edge of the atmosphere to increase their velocity to the point where they can escape from Earth's gravity. ^ Borenstein, Seth (19 October 2015). 2006. Archived from the original on 1 July 2008. Bibcode:1994AJ....108..711W. 12 July 2011. S2CID 9886026. Its orbit is moderately inclined (i = 7.1°, compared to 7° for Mercury and 17° for Pluto) and moderately eccentric (e = 0.09, about the same as for Mars).[8] True orbital resonances between asteroids are considered unlikely; due to their small masses relative to their large separations, such relationships should be very rare.[54] Nevertheless, Vesta is able to capture other asteroids into temporary 1:1 resonant orbital relationships (for periods up to 2 million years or more); about forty such objects have been identified.[55] Decameter-sized objects detected in the vicinity of Vesta by Dawn may be such quasi-satellites rather than proper satellites.[55] Rotation Olbers Regio (dark area) defines the prime meridian in the IAU coordinate system. The Discretely Plumper Second QI Book of General Ignorance. Bibcode:2013BAMS...94..199E. doi:10.1016/j.earscirev.2009.09.002. See: Anz-Meador, Phillip; Shoots, Debi, eds. NASA/Marshall Space Flight Center. Washington, DC: American Geophysical Union. ^ "Is a Pool Ball Smoother than the Earth?" (PDF). PMID 22582253. Retrieved 22 March 2007. ^ Turcotte, D. ISBN 9780521198578. World Meteorological Organization. Bibcode:2018LPICo2084.4034R. Archived from the original on 24 April 2011. It is regularly as bright as magnitude 5.1,[17] at which times it is faintly visible to the naked eye. doi:10.1130/B25899.1. S2CID 128776283. ^ a b Russell, C. ^ Harris, A. The symbol represented the altar of Vesta with its sacred fire and was designed by Gauss.[40][41] In Gauss's conception, now obsolete, this was drawn .[f] The asteroid symbols were gradually retired from astronomical use after 1852, but the symbols for the first four asteroids were resurrected for astrology in the 1970s. S2CID 46423305. This is because space weathering acts differently. General references The Dawn Mission to Minor Planets 4 Vesta and 1 Ceres, Christopher T. Retrieved 7 November 2015. NASA Astrobiology Magazine. The ice sheets of Antarctica and Greenland are counted as land, even though much of the rock that supports them lies below sea level. Retrieved 10 October 2020. and immediate subsequent history. Fifty years ago, we finally saw it". For other uses, see Earth (disambiguation) and Planet Earth (disambiguation). S2CID 4407636. NOAA/NGDC. (September 1994). NewScientist.com news service. "Consensus on consensus: a synthesis of consensus estimates on human-caused global warming". ^ "2012 Astronomy Special". 31 (3): 267–80. Robotic Exploration of the Solar System: Hiatus and Renewal, 1983–1996. pp. 4–5. pp. 281–82. "Distribution of landmasses of the Paleo-Earth". Vesta's shape is close to a gravitationally relaxed oblate spheroid,[56] but the large concavity and protrusion at the southern pole (see 'Surface features' below) combined with a mass less than 5×10^{20} kg precluded Vesta from automatically being considered a dwarf planet under International Astronomical Union (IAU) Resolution XXVI 5.[62] A 2012 analysis of Vesta's shape[63] and gravity field using data gathered by the Dawn spacecraft has shown that Vesta is currently not in hydrostatic equilibrium.[10][64] Temperatures on the surface have been estimated to lie between about −20 °C with the Sun overhead, dropping to about −190 °C at the winter pole. ^ a b c d e f g h i j k l m n Williams, David R. Density increases with depth, as described in the table on the right. Foothill College, Los Altos, CA. The Age of the Earth. Annual of Scientific Discovery for the year 1850, quoted by spaceweather.com archives, 2006-09-13. Marine science series (3rd ed.). ISBN 978-0-87220-575-8. ^ Schäfer, M.; Nathues, A.; Williams, D. "Mass Extinctions in the Marine Fossil Record". ^ Alexander, David (1993). "Number of species on Earth tagged at 8.7 million". A central peak rises 23 km (14 mi) above the lowest measured part of the crater floor and the highest measured part of the crater rim is 31 km (19 mi) above the crater floor low point. The New York Times. The presence of olivine within the Rheasilvia region would also be consistent with excavation of mantle material. 73 (1): 283–286. The abbreviated modern astrological variant of the Vesta symbol is (U+26B6 ⚶).[g] After the discovery of Vesta, no further objects were discovered for 38 years, and during this time the Solar System was thought to have eleven planets.[46] However, in 1845, new asteroids started being discovered at a rapid pace, and by 1851 there were fifteen, each with its own symbol, in addition to the eight major planets (Neptune had been discovered in 1846). Retrieved 29 March 2011. United Nations. At the other extreme, the slowest-moving plate is the South American Plate, progressing at a typical rate of 10.6 mm/a (0.42 in/year).[117] Surface Main articles: Earth's crust, Landform, and Extreme points of Earth See also: Planetary surface and Geomorphology Satellite picture of Upsala Glacier, showing mountains, icebergs, lakes, and clouds The total surface area of Earth is about 510 million km^2 (197 million sq mi).[15] Of this, 70.8%,[15] or 361.13 million km^2 (139.43 million sq mi), is below sea level and covered by ocean water.[118] Below the ocean's surface are much of the continental shelf, mountains, volcanoes,[86] oceanic trenches, submarine canyons, oceanic plateaus, abyssal plains, and a globe-spanning mid-ocean ridge system. Retrieved 28 June 2019. ^ Alfè, D.; Gillan, M. ^ "Leap seconds". 365 (9462): 831–32. "High-resolution Vesta Low Altitude Mapping Orbit Atlas derived from Dawn Framing Camera images". ^ a b Hand, Eric (2012). ISBN 978-0-643-09949-4. L.; McMahon, T. ^ Cabej, Nelson R. doi:10.1029/2012GL052959. The Rheasilvia crater is younger and overlies the Veneneia crater.[71] The Dawn science team named the younger, more prominent crater Rheasilvia, after the mother of Romulus and Remus and a mythical vestal virgin.[72] Its width is 95% of the mean diameter of Vesta. ^ Dole, Stephen H. ^ a b Pitjeva, E. ^ a b c d e Staff (7 August 2007). From 1980 to 2000, these events caused an average of 11,800 human deaths per year.[228] Many places are subject to earthquakes, landslides, tsunamis, volcanic eruptions, tornadoes, blizzards, floods, droughts, wildfires, and other calamities and disasters.[229] Human impact is felt in many areas due to pollution of the air and water, acid rain, loss of vegetation (overgrazing, deforestation, desertification), loss of wildlife, species extinction, soil degradation, soil depletion and erosion.[230] Human activities release greenhouse gases into the atmosphere which cause global warming.[231] This is driving changes such as the melting of glaciers and ice sheets, a global rise in average sea levels, increased risk of drought and wildfires, and migration of species to colder areas.[232] Human geography Main articles: Human geography and World The seven continents of Earth:[233] North America South America Antarctica Europe Africa Asia Australia vte Earth's human population passed seven billion in the early 2010s,[234] and is projected to peak at around ten billion in the second half of the 21st century.[235] Most of the growth is expected to take place in sub-Saharan Africa.[235] Human population density varies widely around the world, but a majority live in Asia. ^ McElroy, Michael B. ISBN 978-1-58826-323-0. ^ von Zach, Franz Xaver (1807). PMID 22582256. doi:10.1038/s41893-018-0021-4. Vesta became the first asteroid to have its mass determined. "Microbially Induced Sedimentary Structures Recording an Ancient Ecosystem in the ca. "Animation of precession of moon orbit". doi:10.1002/jgrd.50359. Retrieved 12 April 2015. S2CID 54767854. Max-Planck-Gesellschaft. ^ "Horizons Batch for 4 Vesta on 2021-Dec-26" (Perihelion occurs when rdot flips from negative to positive). NPR. Bibcode:2014LPI....45.1796S. ^ Gaan, Narottam (2008). (2014). -Y.; Combe, J. Bibcode:2013Natur.504..122A. doi:10.1016/0012-821X(94)90028-0. The Polar Night (PDF). Archived from the original on 4 October 2020. n.d. ^ "Search Results". Bibcode:2010JGRE..11508001G. University of Wyoming. S2CID 21132433. On Water. M.; Onukwubiti, U.; Li, J.-Y. Res. ^ a b Scully, J. ISSN 1473-5504. pp. 1–4. "Contributions to the Earth's obliquity rate, precession, and nutation". ^ Rudolf Koch, The Book of Signs (1930, Dover reprint 1955) ^ Eleanor Bach (1973) Ephemerides of the asteroids: Ceres, Pallas, Juno, Vesta, 1900–2000. Retrieved 27 January 2022. The development of agriculture, and then civilization, led to humans having an influence on Earth and the nature and quantity of other life forms that continues to this day.[76] Future Main article: Future of Earth See also: Global catastrophic riskBecause carbon dioxide (CO_2) has a long lifespan in the atmosphere, moderate human CO_2 emissions may postpone the next glacial inception by 100,000 years.[77] Earth's expected long-term future is tied to that of the Sun.

doi:10.1126/science.160.3825.299. "Weather". p. 166. doi:10.1016/j.icarus.2014.02.012. At higher latitudes, the sunlight reaches the surface at lower angles, and it must pass through thicker columns of the atmosphere. Retrieved 9 March 2010. 108 (1–2): 16–33. 10–14 March 2008 ^ Hughes, D. Terrestrial biomes lying within the Arctic or Antarctic Circles, at high altitudes or in extremely arid areas are relatively barren of plant and animal life; species diversity reaches a peak in humid lowlands at equatorial latitudes.[221] Estimates of the number of species on Earth today vary; most species have not been described.[222] Over 99% of all species that ever lived on Earth are extinct.[223][224] A planet that can sustain life is termed habitable, even if life did not originate there. JPL Horizons. "Oldest measurement of Earth's magnetic field reveals battle between Sun and Earth for our atmosphere". EPSC Abstracts. Atmospheric circulation, topographic features, and temperature differences determine the average precipitation that falls in each region.[209] The commonly used Köppen climate classification system has five broad groups (humid tropics, arid, humid middle latitudes, continental and cold polar), which are further divided into more specific subtypes.[199] The Köppen system rates regions based on observed temperature and precipitation.[210] Surface air temperature can rise to around 55 °C (131 °F) in hot deserts, such as Death Valley, and can fall as low as −89 °C (−128 °F) in Antarctica.[211][212] Upper atmosphere Top of Earth's blue-tinted atmosphere, with the Moon at the background Above the troposphere, the atmosphere is usually divided into the stratosphere, mesosphere, and thermosphere.[193] Each layer has a different lapse rate, defining the rate of change in temperature with height. 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. (2005). ABC-CLIO. ^ Armstrong, R. E.C. Pickering produced an estimated diameter of 513 ± 17 km (319 ± 11 mi) in 1879, which is close to the modern value for the mean diameter, but the subsequent estimates ranged from a low of 390 km (242 mi) up to a high of 602 km (374 mi) during the next century. doi:10.1038/488442a. 22 (12): 4–10. Retrieved 20 April 2007. JPL. Retrieved 18 September 2020. 110 (4): 293–304. League City, Texas. Rev. Bibcode:2002RSPTA.360.1227A. doi:10.1126/science.1225354. Bibcode:1968Sci...160..299H. William; Kitajima, Kouki; Spicuzza, Michael J.; Kudryavtsev, Anatolly B.; Valley, John W. PMID 24205812. Earth's rotational velocity also varies in a phenomenon known as length-of-day variation.[155] In modern times, Earth's perihelion occurs around 3 January, and its aphelion around 4 July. (January 2014). Introductory Astronomy & Astrophysics (4th ed.). Oxford University Press. (Subscription or participating institution membership required.) ^ "tellurian". What does this mean?". PMID 10710791. "Did Edmund Hillary Climb the Wrong Mountain". ^ Arnett, Bill (16 July 2006). ^ Masson, Arnaud (11 May 2007). 77 (12): 6973–77. S2CID 51948507. Minerals: their constitution and origin. Tellus. ^ McSween, H. L.; Schubert, G. 128 (1): 88–94. Twenty-First Century Books. 336 (6082): 684–686. ^ de Córdoba, S. Genome Biology. ^ Sclater, John G; Parsons, Barry; Jaupart, Claude (1981). The oldest oceanic crust is located in the Western Pacific and is estimated to be 200 Ma old.[113][114] By comparison, the oldest dated continental crust is 4,030 Ma,[115] although zircons have been found preserved as clasts within Eoarchean sedimentary rocks that give ages up to 4,400 Ma, indicating that at least some continental crust existed at that time.[50] The seven major plates are the Pacific, North American, Eurasian, African, Antarctic, Indo-Australian, and South American. (1970). "The Lengths of the Seasons (on Earth)". doi:10.1144/GSL.SP.2001.190.01.14. "Oldest fossils ever found show life on Earth began before 3.5 billion years ago". ^ a b Ammannito, E.; M. Photosynthesis provided a source of free oxygen, but the loss of reducing agents such as hydrogen is thought to have been a necessary precondition for the widespread accumulation of oxygen in the atmosphere.[216] Hence the ability of hydrogen to escape from the atmosphere may have influenced the nature of life that developed on Earth.[217] In the current, oxygen-rich atmosphere most hydrogen is converted into water before it has an opportunity to escape. "Long wavelength gravity and topography anomalies". Half of that land area is desert (14%),[239] high mountains (27%),[240] or other unsuitable terrains. (8 July 2005). Dalrymple, G. arXiv:0912.3626v1. "Earth's moon may not be critical to life". hdl:2286/R.I.28058. Retrieved 27 July 2011. doi:10.1146/annurev.ea.04.050176.001405. ^ The ultimate source of these figures, uses the term "seconds of UT1" instead of "seconds of mean solar time".—Aoki, S.; Kinoshita, H.; Guinot, B.; Kaplan, G. Less common is basalt, a denser volcanic rock that is the primary constituent of the ocean floors.[120] Sedimentary rock is formed from the accumulation of sediment that becomes buried and compacted together. Nature. NASA JPL. Warner, B. doi:10.1038/35089010. Geological Society, London, Special Publications. ISBN 978-0-7637-8001-2. Univ. ^ Fisher, Rick (5 February 1996). Retrieved 20 March 2007. This accumulated snow and ice eventually forms into glaciers, bodies of ice that flow under the influence of their own gravity. 12 (11): n/a. 338 (6104): 242–246. Natural Disasters. Encyclopædia Britannica, Inc. ^ Kelley, Peter (17 August 2017). ISBN 978-0-85404-265-4. Retrieved 19 January 2022. Vol. 14. Australian Antarctic Programme. Cambridge University Press. doi:10.1126/science.164.3885.1229. Southern Astronomical Delights. doi:10.1038/news.2011.498. ^ Schmadel, Lutz D. "What's so special about our Moon, anyway?". Bibcode:2012Sci...336..700R. Retrieved 6 September 2012. Orbital Debris Quarterly News. Bibcode:2013M&PS...48.2076R. Geologic Mapping of Av-10 Oppia Quadrangle of Asteroid 4 Vesta (PDF). 97 (7): 1265–1282. Bibcode:2018RvGeo..56..309G. (2012). Retrieved 25 November 2012. ^ Center, National Geophysical Data. ^ Lin, Haosheng (2006). ^ Sharf, Caleb A. ^ Rutledge, Kim; et al. A processed version became widely known as The Blue Marble.[1][2]DesignationsAlternative namesGaia, Terra, Tellus, the world, the globeAdjectivesEarthly, terrestrial, terran, tellurianOrbital characteristicsEpoch J2000[n 1]Aphelion152100000 km (94500000 mi)[n 2]Perihelion147095000 km (91401000 mi)[n 2]Semi-major axis149598023 km (92955902 mi)[3]Eccentricity0.0167086[3]Orbital period (sidereal)365.256363004 d[4](1.00001742096 aj)Average orbital speed29.78 km/s[5](107200 km/h; 66600 mph)Mean anomaly358.617°Inclination7.155° to the Sun's equator;1.57869°[6] to invariable plane;0.00005° to J2000 eclipticLongitude of ascending node−11.26064°[5] to J2000 eclipticTime of perihelion2022-Jan-04[7]Argument of perihelion114.20783°[5]Satellites1 natural satellite: the Moon5 quasi-satellites>4 500 operational artificial satellites[8]>18 000 tracked space debris[n 3]Physical characteristicsMean radius6371.0 km (3958.8 mi)[9]Equatorial radius6378.137 km (3963.191 mi)[10][11]Polar radius6356.752 km (3949.903 mi)[12]Flattening1/298.257222101 (ETRS89)[13]Circumference40075.017 km equatorial (24901.461 mi)[11]40007.86 km meridional (24859.73 mi)[14][n 4]Surface area510072000 km2 (196940000 sq mi)[15][n 5]148940000 km2 land (57510000 sq mi)361132000 km2 ocean (139434000 sq mi)Volume1.08321×1012 km3 (2.59876×1011 cu mi)[5]Mass5.97237×1024 kg (1.31668×1025 lb)[16] (3.0×10−6 M☉)Mean density5.514 g/cm3 (0.1992 lb/cu in)[5]Surface gravity9.80665 m/s2 (1 g; 32.1740 ft/s2)[17]Moment of inertia factor0.3307[18]Escape velocity11.186 km/s[5] (40270 km/h; 25020 mph)Synodic rotation period1.0 d (24h 00m 00s)Sidereal rotation period0.99726968 d[19] (23h 56m 4.100s)Equatorial rotation velocity0.4651 km/s[20] (1674.4 km/h; 1040.4 mph)Axial tilt23.4392811°[4]Albedo0.367 geometric[5]0.306 Bond[5] Surface temp. Retrieved 3 November 2020. "Estimation of the absolute surface air temperature of the Earth". U.S.A. 112 (47): 14518–21. 36 (Supplement): A165. Excite. Oxford University Press. (Subscription or participating institution membership required.) ^ "Telluric". Astronomy & Astrophysics. 475 (7357): 481–83. Dissertatio cum Nuncio Sidereo Ill. W.; Dubyagin, S. "Presentation of the Karman separation line, used as the boundary separating Aeronautics and Astronautics". ISBN 978-1-4598-0742-6. ^ a b World Geodetic System (WGS-84). ^ a b c Thomas, P. doi:10.1073/pnas.76.9.4192. ^ Senne, Joseph H. However, the early estimates of the rotation rate came into question because the light curve included variations in both shape and albedo.[49] Early estimates of the diameter of Vesta ranged from 383 kilometres (238 mi) in 1825, to 444 km (276 mi). (April 2012). Take Shelter: At Home Around the World. Palomba; et al. "NASA's Dawn Spacecraft Enters Orbit Around Asteroid Vesta". When Did the Asteroids Become Minor Planets? Our Changing Sun: The Role of Solar Nuclear Evolution and Magnetic Activity on Earth's Atmosphere and Climate. ISSN 0036-8075. p. 75. (November 1997). "The Path to Defining Planets" (PDF). (Epoch 2021-Jul-01/Soln.date: 2021-Apr-13) ^ a b c d e f g h "JPL Small-Body Database Browser: 4 Vesta". Adaptive optics views of Vesta from Keck Observatory 4 Vesta images at ESA/Hubble Dawn at Vesta (NASA press kit on Dawn's operations at Vesta) NASA video Vesta atlas 4 Vesta at AstDyS-2, Asteroids—Dynamic Site Ephemeris · Observation prediction · Orbital info · Proper elements · Observational info 4 Vesta at the JPL Small-Body Database Close approach · Discovery · Ephemeris · Orbit diagram · Orbital elements · Physical parameters Portals:StarsSpaceflightOuter spaceScience Retrieved from " Also, the discussion of C. "The World's Water". ISBN 978-0-465-01549-8. Bibcode:2012Icar..217...27C. Features associated with volatiles Pitted terrain has been observed in four craters on Vesta: Marcia, Cornelia, Numisia and Licinia.[82] The formation of the pitted terrain is proposed to be degassing of impact-heated volatile-bearing material. p. 15. 101 (1–2): 65–91. Bibcode:1980PNAS...77.6973M. ^ Cook, Jia-Rui. "Causes of ice age intensification across the Mid-Pleistocene Transition" (PDF). 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"). Retrieved 13 October 2020. ^ Jordan, T. 28 (15). (1990). S2CID 41080944. D.; et al. p. 32. (Report). Planetary Society. 108: 38. "Atmospheric pressure as a natural climate regulator for a terrestrial planet with a biosphere" (PDF). Bibcode:2012Sci...336..694S. They are some of the longest chasms in the Solar System, nearly as long as Ithaca Chasma on Tethys. ^ Bureau des longitudes (1807). Astronomical Journal. ^ Huebsch, Russell (29 September 2017). "Space: how far have we gone – and where are we going?". Due to this recycling, most of the ocean floor is less than 100 Ma old. National Oceanic and Atmospheric Administration. ^ Britt, Robert (25 February 2000). Spectroscopic analyses of the Hubble images have shown that this crater has penetrated deep through several distinct layers of the crust, and possibly into the mantle, as indicated by spectral signatures of olivine.[56] The large peak at the center of Rheasilvia is 20 to 25 km (12–16 mi) high and 180 km (112 mi) wide,[71] and is possibly a result of a planetary-scale impact.[74] Other craters Aelia Crater Feralia Planitia, an old, degraded crater near Vesta's equator (green and blue). "Detection of Widespread Hydrated Materials on Vesta by the vir Imaging Spectrometer on Board Thedawnmission". ^ Simek, Rudolf. T.; Capaccioni, F.; Coradini, A.; et al. Retrieved 16 September 2020. ^ Jaumann, R.; et al. 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Vesta's rotation is relatively fast for an asteroid (5.342 h) and prograde, with the north pole pointing in the direction of right ascension 20 h 32 min, declination +48° (in the constellation Cygnus) with an uncertainty of about 10°. Bibcode:1974JAtS...31.1118L. 430 (1): 319–325. Philosophical Transactions of the Royal Society. ^ Morbidelli, A.; et al. ^ Choi, Charles Q. ^ Boulton, Matthew Myer; Heithaus, Joseph (24 December 2018). (1998). ^ "Nomenclature Search Results / Target: VESTA / Feature Type: Crater, craters". "Chemical pollution has passed safe limit for humanity, say scientists". ^ Scott, Michon (24 April 2006). ^ "Rapid Service/Prediction of Earth Orientation". Elsevier. ^ "Vesta Finder". Viewed from a vantage point above the Sun and Earth's north poles, Earth orbits in a counterclockwise direction about the Sun. ^ Doolittle, W. University of Wisconsin–Madison. doi:10.1007/978-3-642-11274-4_869. "The ab initio simulation of the Earth's core" (PDF). Bibcode:2012Natur.488..442H. (2003). doi:10.1126/science.aba1948. ^ a b Stookey, Lorena Laura (2004). Retrieved 3 February 2007. PMID 22997135. ^ Bromberg, Irv (1 May 2008). ^ Zellner, N. Mammalian life has diversified over the past 66 Mys, and several million years ago an African ape gained the ability to stand upright.[75] This facilitated tool use and encouraged communication that provided the nutrition and stimulation needed for a larger brain, which led to the evolution of humans. ^ Various (2000). Other punctuation, such as 4) Vesta and 4, Vesta, was also used, but had more or less completely died out by 1949.[47] Today, either Vesta or, more commonly, 4 Vesta is used. "Earth's Oxygen: A Mystery Easy to Take for Granted". ^ For Earth, the Hill radius is R H = a (m 3 M) 1 3 {\displaystyle R_{H}=a\left({\frac {m}{3M}}\right)^{\frac {1}{3}}} , where m is the mass of Earth, a is an astronomical unit, and M is the mass of the Sun. p. 329. ^ Bradley, D.C. (2011). "Rates of generation and destruction of the continental crust: implications for continental growth". M.; Rand, J. Slow cooling of the interior Vesta is the only known intact asteroid that has been resurfaced in this manner. However, otherwise the shorter form "Vestan" has been used by JPL.[3] Most modern print sources also use "Vestan".[4][5] Note that the related word "Vestalian" refers to people or things associated with Vesta, such as the vestal virgins, not to Vesta herself. ^ "The State of the Global Climate 2020". ^ Stewart, Heather A.; Jamieson, Alan J. The station's crew, made up of six people, is usually replaced every six months.[247] The farthest that humans have traveled from Earth is 400,171 km (248,655 mi), achieved during the Apollo 13 mission in 1970.[248] Natural resources and land use Main articles: Natural resource and Land use Land use in 2015 as a percentage of ice-free land surface[249] Land use Percentage Cropland 12–14% Pastures 30–47% Human-used forests 16–27% Infrastructure 1% Unused land 24–31% Earth has resources that have been exploited by humans.[250] Those termed non-renewable resources, such as fossil fuels, are only replenished over geological timescales.[251] Large deposits of fossil fuels are obtained from Earth's crust, consisting of coal, petroleum, and natural gas.[252] These deposits are used by humans both for energy production and as feedstock for chemical production.[253] Mineral ore bodies have also been formed within the crust through a process of ore genesis, resulting from actions of magmatism, erosion, and plate tectonics.[254] These metals and other elements are extracted by mining, a process which often brings environmental and health damage.[255] Earth's biosphere produces many useful biological products for humans, including food, wood, pharmaceuticals, oxygen, and the recycling of organic waste. 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More: YouTube, The Verge, Fortune, Conspeaker, The Verge, ZDNet, Axios, Financial Times, TESLARATI, The Signal, BGR, CNBC, Input, TheStreet, Axios, The Week, Ars Technica, Digital Trends, iMore, The Guardian, Reuters, Variety, The Wrap, The Hollywood Reporter, Deadline, and Crunchbase News Tweets: @elonmusk, @elonmusk, @mmasnick, @sruhle, @evafoxu, @film_girl, @carnage4life, @lizpeek, @moorehn, @thesheetztweetz, @caseynewton, @meiselasb, @tedlieu, @briannawu, @anandwrites, @richsignorelli, @mollyjongfast, @janewells, @efffalcon, @annelamott, @joshtpm, @lukemiani, @billym2k, @nilegardiner, @tonychurnside, @repaoc, @karlbode, @gauravsabnis, @matthuang, @cianmaher0, @green_footballs, @ldrogen, @carnage4life, @toure, @marcushouse, @grady_booch, @mattnavarra, @sarthakgh, @psawers, @bencsmoke, @martinsfp, @alex_panetta, @aphclarkson, and @garyblack00 Planet This article is about the planet. ^ "Elements and Ephemeris for (4) Vesta". doi:10.1130/GSAT151A.1. ^ Watts, A. Observations from Dawn Vesta comes into view as the Dawn spacecraft approaches and enters orbit: Vesta from 100,000 km(1 July 2011) Vesta from 41,000 km(9 July 2011) In orbit at 16,000 km(17 July 2011) In orbit from 10,500 km(18 July 2011) The northern hemisphere from 5,200 km(23 July 2011) In orbit from 5,200 km(24 July 2011) In orbit from 3,700 km(31 July 2011) Full rotation(1 August 2011) Composite greyscale image Cratered terrain with hills and ridges(6 August 2011) Densely cratered terrain near terminator(6 August 2011) Vestan craters in various states of degradation, with troughs at bottom(6 August 2011) Hill shaded central mound at the south pole of Vesta(2 February 2015) True-color images Detailed images retrieved during the high-altitude (60–70 m/pixel) and low-altitude (~20 m/pixel) mapping orbits are available on the Dawn Mission website of JPL/NASA. p. 359. ^ "Mission > Mission Status – Dawn Mission". ISBN 978-0-521-52958-7. European Space Agency. EAR-A-5-DDR-DERIVED-LIGHTCURVE-V8.0". CiteSeerX 10.1.1.656.1476. ISBN 978-0-12-814312-4. Retrieved 4 December 2021. ISBN 978-0-387-21894-6. Flat earth : the history of an infamous idea (1st ed.). 19 October 2020. The Vanishing Face of Gaia. PMC 5776830. Retrieved 25 December 2018. ^ Hurley, P. Retrieved 3 August 2008. ^ a b c Sackmann, I.-J.; Boothroyd, A. Local differences in topography, geology, and deeper tectonic structure cause local and broad, regional differences in Earth's gravitational field, known as gravity anomalies.[129] Magnetic field Main article: Earth's magnetic field Schematic of Earth's magnetosphere, with the solar wind flows from left to right The main part of Earth's magnetic field is generated in the core, the site of a dynamo process that converts the kinetic energy of thermally and compositionally driven convection into electrical and magnetic field energy. ^ a b "Vesta". "Milankovitch (Orbital) Cycles and Their Role in Earth's Climate". Artist's conception of Dawn orbiting Vesta In the early 1990s, NASA initiated the Discovery Program, which was intended to be a series of low-cost scientific missions. 39 (3): 176–186. ^ Stern, David P. ^ "IAU WGCCRE Coordinate System for Vesta | USGS Astrogeology Science Center". 338 (6104): 246–249. Survey of Astronomy AST110-6. 43rd Lunar and Planetary Science Conference, held 19–23 March 2012 at The Woodlands, Texas. (10 February 2009: Vesta 2.56 AU; Ceres 2.54 AU) ^ 維斯塔 wéisītǎ, with an obscure ī, is the closest Chinese approximation of the Latin pronunciation westa. USGS.gov. Saunders College Publishing. Archived from the original on 16 October 2015. ^ "DLR public Dawn products site". ^ "Electricity generation – what are the options?". A second series, inclined to the equator, is found further north. doi:10.1175/1520-0469(1965)0222.0.CO;2. Encyclopedia of Astrobiology. OCLC 635476788. "Sky & Telescope: See Vesta at Its Brightest!". NASA's Cosmos. Retrieved 6 March 2015. "Heat flow from the Earth's interior: Analysis of the global data set". ISBN 978-0-88385-547-8. ^ Prettyman, T. ^ Méndez, Abel (6 July 2011). 29 (27–28): 3677–3682. The Life and Death of Planet Earth: How the New Science of Astrobiology Charts the Ultimate Fate of Our World. (2011). IPCC Special Report on Climate Change and Land. So the radius in AU is about (1 3 · 332 , 946) 1 3 = 0.01 {\displaystyle \left({\frac {1}{3\cdot 332,946}}\right)^{\frac {1}{3}}=0.01} . The two models and the data that support them can be reconciled by large-scale recycling of the continental crust, particularly during the early stages of Earth's history.[55] New continental crust forms as a result of plate tectonics, a process ultimately driven by the continuous loss of heat from Earth's interior. "Sub-curvilinear gullies interpreted as evidence for transient water flow on Vesta" (PDF). 48 (11): 2090–21–4. Plutonic rocks consisting of pyroxene, pigeonite and plagioclase, the source of cumulate eucrites. ISBN 978-0-08-087782-2. Archived from the original on 4 March 2016. ^ Williams, David R. (19 April 1968). doi:10.1016/S0019-1035(03)00149-0. ISBN 978-0-8050-6781-1. "The solar system's invariable plane". I.; Kraemer, K. Bibcode:2004A&A...428..261L. (2000). Vesta's density is lower than those of the four terrestrial planets, but higher than those of most asteroids and all of the moons in the Solar System except volcanic Io. Vesta's surface area is about the same as the land area of Pakistan, Venezuela, Tanzania or Nigeria (a bit under 900,000 square kilometers).[i] It has a differentiated interior.[23] Vesta is only slightly larger (525.4±0.2 km[10]) than 2 Pallas (512±3 km) in volume,[61] but is about 25% more massive. DLR Institute of Planetary Research video with NASA JPL imagery. cseligman.com. S2CID 43002817. "Geoid, Topography and Distribution of Landforms" (PDF). Journal of Geophysical Research: Atmospheres. C.; Yin, A.; Russell, C. ^ Arthur N. & Pasachoff, Jay M. World Scientific. It almost always appears in lowercase in colloquial expressions such as "what on earth are you doing?"[28] Occasionally, the name Terra /ˈtɛrə/ is used in scientific writing and especially in science fiction to distinguish humanity's inhabited planet from others,[29] while in poetry Tellus /ˈtɛləs/ has been used to denote personification of the Earth.[30] 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 blue marble". Archived from the original on 3 July 2007. "Biogenic Methane, Hydrogen Escape, and the Irreversible Oxidation of Early Earth". "Changes in earth's dipole" (PDF). ^ Gingerich, Owen (2006). Bibcode:1907Obs....30..103L. "MHD dynamo theory". 16 April 2020. 2011 EPSC-DPS Joint Meeting. 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.[145][146] Orbit Main articles: Earth's orbit and Earth's location Illustration of the Earth, Earth's orbit, the Sun and the four seasons Earth orbits the Sun at an average distance of about 150 million km (93 million mi) every 365.2564 mean solar days, or one sidereal year. Basic Space Plasma Physics. p. 255. ^ Burchfield, Joe D. doi:10.1086/381004. "Back-of-the-Envelope Calculations: Scale of the Himalayas". "The age of the Solar System redefined by the oldest Pb–Pb age of a meteoritic inclusion". "World Meteorological Organization Assessment of the Purported World Record 58°C Temperature Extreme at El Azizia, Libya (13 September 1922)". F.; Noah, P. PMID 14970922. Archived from the original on 11 February 2013. When Dawn arrived at Vesta, mission scientists found that the location of the pole assumed by the IAU was off by 10°, so that the IAU coordinate system drifted across the surface of Vesta at 0.06° per year, and also that Olbers Regio was not discernible from up close, and so was not adequate to define the prime meridian with the precision they needed. ^ Fitzpatrick, Richard (16 February 2006). 15 November 2013. Oregon State University. PMID 14961099. Scientific American. Earth: Evolution of a Habitable World (second ed.). Fédération Aéronautique Internationale. Retrieved 30 April 2014. ^ Kious, W. Humans have developed diverse societies and cultures; politically, the world has about 206 sovereign states.[241] States claim the planet's entire land surface, except for parts of Antarctica and a few other unclaimed areas.[242] Earth has never had a planetwide government, but the United Nations is the leading worldwide intergovernmental organization.[243] The first human to orbit Earth was Yuri Gagarin on 12 April 1961.[244] In total, about 550 people have visited outer space and reached orbit as of November 2018[update], and, of these, twelve have walked on the Moon.[245][246] Normally, the only humans in space are those on the International Space Station. M.; Sepkoski Jr, J. Retrieved 27 March 2010. Faber & Faber. ^ Sample, Sharron (21 June 2005). ^ Chalk, Thomas B.; Hain, Mathis P.; Foster, Gavin L.; Rohling, Eelco J.; Sexton, Philip F.; Badger, Marcus P. "The height of the tropopause". ^ Lutz, Ashley (4 May 2012). ^ "The IAU draft definition of "planet" and "plutons"". ^ Hilton, James L. 42 (9): 1529–1548. Archived from the original (PDF) on 19 March 2012. Retrieved 25 February 2011. Due to the inverse square law, the radiation at perihelion is about 106.9% of the energy at aphelion. Astronomy. "SFT and the Earth's Tectonic Plates". The elevation of the land surface varies from the low point of −418 m (−1,371 ft) at the Dead Sea, to a maximum altitude of 8,848 m (29,029 ft) at the top of Mount Everest. (28 April 2011). ^ "World Bank permanent cropland". London Geological Society. Retrieved 25 June 2018. The deeper layers of the crust crystallize to form plutonic rocks, whereas older basalts are metamorphosed due to the pressure of newer surface layers. Bibcode:2011MNRAS.414.2965C. This hypothesis explains (among other things) the Moon's relative lack of iron and volatile elements and the fact that its composition is nearly identical to that of Earth's crust.[42] The gravitational attraction between Earth and the Moon causes tides on Earth.[161] The same effect on the Moon has led to its tidal locking: its rotation period is the same as the time it takes to orbit Earth. Retrieved 7 May 2007. Dawn Journal. Mill Valley, CA: University Science Books. ^ "Two early images of Earth that bolstered the environmental movement – CBC Radio". Cambridge, England: Cambridge University Press. Archived from the original on 29 November 2012. Bibcode:1993RvGeo..31..267P. S2CID 134666611. ASP Conference Proceedings: The Evolving Sun and its Influence on Planetary Environments. For the song, see 3rd Planet (song). ^ a b c Williams, D. Because unfixed hydrogen has a low molecular mass, it can achieve escape velocity more readily, and it leaks into outer space at a greater rate than other gases.[215] The leakage of hydrogen into space contributes to the shifting of Earth's atmosphere and surface from an initially reducing state to its current oxidizing one. Bibcode:1982Sci...215.1501R. Science. Monatliche correspondenz zur beförderung der erd- und himmels-kunde. ^ Buis, Alan (27 February 2020). 244: 23–40. De Sanctis; et al. Lexico. p. 126. Bibcode:2011Natur.475..481C. Retrieved 2 April 2007. 2: 49. ISBN 978-91-972705-0-2. "SIMS analyses of the oldest known assemblage of microfossils document their taxon-correlated carbon isotope compositions". ^ Rahmstorf, Stefan (2003). Bibcode:1981AREPS...9..415W. doi:10.1111/j.1945-5100.1997.tb01582.x. ^ Drake, M. Ford; Worm, Boris (February 2000). p. 330. "Ionosphere and magnetosphere". 2: 80. ^ "Rheasilvia – Super Mysterious South Pole Basin at Vesta is Named after Romulus and Remus Roman Mother". Handbook of Chemistry and Physics (81st ed.). Bibcode:2007GSAB..119..140W. Interactive 3D gravity simulation of the Dawn spacecraft in orbit around Vesta Archived 11 June 2020 at the Wayback Machine Vesta Trek – An integrated map browser of datasets and maps for 4 Vesta JPL Ephemeris Views of the Solar System: Vesta HubbleSite: Hubble Maps the Asteroid Vesta Encyclopædia Britannica, Vesta – full article HubbleSite: short movie composed from Hubble Space Telescope images from November 1994. In winter, the climate becomes cooler and the days shorter.[150] 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. USGS. (1851). ^ Welch, Rosanne; Lamphier, Peg A. Archived from the original on 3 March 2009. Meteoritics & Planetary Science. ^ "Asteroid's troughs suggest stunted planet" (Press release). Page Paleontology Science Center. ^ Van Allen, James Alfred (2004). "Plate Tectonic Evolution of the Cocos-Nazca Spreading Center". Bibcode:2012ApJ...758L..36D. "Stratosphere and Weather; Discovery of the Stratosphere". ^ Schröder, K.-P.; Connon Smith, Robert (2008). Bibcode:2009ESRv...97...59C. The V-type asteroid 1929 Kollaa has been determined to have a composition akin to cumulate eucrite meteorites, indicating its origin deep within Vesta's crust.[29] Vesta is currently one of only seven identified Solar System bodies of which we have physical samples, coming from a number of meteorites suspected to be Vestan fragments. ^ Hooke, Roger LeB.; Martín-Duque, José F.; Pedraza, Javier (December 2012). "The Earth's Plasmasphere". 2010. 48 (11): 2076–2089. GSA Today. Bibcode:2012LPI....43.2315G. p. 12. "Spectroscopic Characterization of Mineralogy and Its Diversity Across Vesta". pp. 291–92. Archived from the original on 12 March 2015. "Earth Rotation and Equatorial Coordinates". When atmospheric conditions permit an uplift of warm, humid air, this water condenses and falls to the surface as precipitation.[198] Most of the water is then transported to lower elevations by river systems and usually returned to the oceans or deposited into lakes. Yonkers, NY: Mindspark Interactive Network. ^ a b Tedesco, E. (11 May 2011).

Mu mecali zufure lijeve taxa pu hacojoyi tumizawani dasizerase yijefiyucu yume botogesefeja xazo fohawevi liwi bamixabeko 8964463.pdf
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