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The realization that Earth is a planet, and a planet among many others was established “fairly” recently, in the 17th century – this realization came through by the combined forces of ancient philosophers, mathematicians, and astronomers. Plato correctly deduced that the Earth is spherical but this idea would take root and be proven much later. The name “Earth” – is at least 1.000 years old, and it is a Germanic word which simply translates to “the ground.” It is not known who came up with it but it is the only planet that wasn’t named after a Greek or Roman god. However, the Greek equivalent to Earth is Gaia – terra mater – mother Earth, and Roman equivalent was Tellus – the fertile soil. Earth is estimated to have formed around 4.5 billion years ago – almost one-third of the age of the universe – through accretion from the solar nebula. Earth is the third planet from the Sun, at a distance of 1 AU or 147 million km / 91 million mi. It is the fifth-largest planet in the Solar System, being the largest of the terrestrial planets. It has an equatorial radius of 6.371 km / 3.958 mi, and a polar radius of 6.356 km / 3.949 mi, meaning it is not completely spherical but rather bulged at the equator due to rotation. The Earth has a diameter of 12.742 km / 7.917 mi. Earth has a mass of about 6.6 sextillion tons and a volume of about 260 billion cubic miles / 1 trillion cubic kilometers. The surface area of Earth is about 197 million square miles / 510 million square kilometers. Around 71% of the surface is covered by water and 29% by land. The water is 3% fresh and 97% salted. Of that 3% freshwater, over 2% is frozen in ice sheets and glaciers meaning that less than 1% is freshwater found in lakes, rivers, and the underground. In regards to land, the continent of Asia covers about 30% of all the land, having around 60% of the world’s population. The atmosphere of Earth is composed of roughly 78% nitrogen, 21% oxygen, 0.97% argon and carbon dioxide and about 0.04% other gases and water vapor. The mixture of gases is commonly known as air. The thickness of the atmosphere is about 60 miles / 96 kilometers. The atmosphere of Earth is divided into 6 layers: troposphere, stratosphere, mesosphere, thermosphere, exosphere, and ionosphere. The highest temperatures on Earth can reach up to more than 110 degrees Fahrenheit / 48 degrees Celsius, and the lowest around -126 degrees Fahrenheit / -88 degrees Celsius, maybe even lower. Earth has the greatest density out of all the planets in the solar system - 5.51 g/cm^3 - and a gravity of 9.807 m/s^2 or 1 g. This suggests that the Earth’s core is solid, made of iron and nickel about 759 miles / 1.221 kilometers in radius. The temperatures at the core have been estimated to be around 9.800 degrees Fahrenheit / 5.400 degrees Celsius. This is hotter than the surface of the Sun. Together with the inner core, Earth also has an outer core, with the crust being the mantle and the thickest layer. It is a viscous mixture of molten rock about 1.800 mi / 2.900 km thick and has the consistency of caramel. The outermost layer – Earth’s crust – goes about 19 mi / 30 km deep on average on land. But at the bottom of the ocean, the crust is thinner and extends about 3 mi / 5 km from the seafloor to the top of the mantle. Earth has only one satellite – the Moon – and a couple of temporal artificial satellites. Earth’s axis is tilted 23.5 degrees from the plane of its orbit around the Sun. The tilt varies between 22.1 and 24.5 degrees, causing seasons and even chaotic seasons. It changes positions once every 40.000 years. Earth completes a rotation/day – from West to Est - once every 23.9 hours. One orbit/year – a trip around the Sun – is completed within 365 days. The Earth’s orbit is elliptical or oval-shaped. Earth’s magnetosphere acts as a shield against solar and cosmic particle radiation. It has the shape of a tear-drop reaching 36.000 mi / 57.936 km into space, and it is one of the reasons life has managed to develop. Since ancient times the Earth was taught to be at the center of the Universe with the other celestial objects orbiting around it. Some believed that the Earth was flat, while the ancient Greeks such as Plato correctly deduced that the Earth was a sphere. Soon after, the Greek astronomer Ptolemy proposed the idea that planets were in tiny spheres and made circles as they orbited Earth. In the 16th century, the Polish mathematician/astronomer Nicolaus Copernicus created the heliocentric model of the Solar System – where everything orbited the Sun. Later, in the 17th century, Galileo Galilei observed and discovered Jupiter and that it had moons of its own, and that Venus went through phases like the Moon. Observations continued, ideas caught up and finally, it was established that Earth was a planet among many others. The name of our planet came from the Anglo-Saxon word “erda” and the Germanic word “erde” – they both mean soil or ground. The old English version of these words became “eor(th)e” or “ertha”, which later transformed into “Earth.” Many other languages use some form of variation or naming of their own such as: Aarde, Terre, Tera, Jorden, Nchi, Bumi, and many more. We who inhabit Earth can be referred to as: Earthlings, Earthers, Terrans or Gaians. Formation The Earth is believed to have formed around 4.5 billion years ago. The duration for this formation has been estimated to have lasted about 10 to 20 million years. The theory states that a solar nebula partitions a volume out of a molecular cloud by gravitational collapse which begins to spin and flatten into a circumstellar disk. The planets grow out of that disk through gravity pulling swirling dust and gas. Slowly, the Earth’s atmosphere and oceans were formed by volcanic activity and outgassing. It is believed that water vapor condensed into the oceans being augmented by water and ice from asteroids, protoplanets, and comets. The atmospheric greenhouse kept the oceans from freezing when the newly formed Sun had only 70% of its current luminosity. When the Earth’s magnetic field was established it helped to prevent the atmosphere from being stripped away by the solar wind. A crust formed when the molten outer layer of Earth cooled to form a solid. There are two models who propose that the landmass steadily grew to present-day forms, or, more likely that it grew rapidly early in Earth’s history, followed by a long-term steady continental area. The continuous loss of heat from Earth’s interior, helped continents form through - plate tectonics. Through periods of hundreds of millions of years, the supercontinents have assembled and then broke apart. About 750 million years ago, the earliest known supercontinent Rodinia began to break apart. The continents later rejoined and combined again to form Pannotia about 600 to 540 million years ago. This happened again and the supercontinent of Pangaea formed but also broke apart about 180 million years ago. There are patterns that suggest that ice ages began about 40 million years ago and intensified during the Pleistocene around 3 million years ago. Many high-latitude regions have undergone repeated cycles of glaciation and thaw, repeating about every 40.000 to 100.000 years. It is believed that the last continental glaciation ended 10.000 years ago. Distance, Size and Mass Earth is the third planet from the Sun, at a distance of 1 AU or 147 million km / 91 million mi. It is situated in the goldilocks zone where temperatures are just right for liquid water to exist and for life to evolve. Depending upon their current orbital positions, either Venus or Mercury are the closest planets to Earth. It has an equatorial radius of 6.371 km / 3.958 mi, and a polar radius of 6.356 km / 3.949 mi, meaning it is not completely spherical but rather bulged at the equator due to rotation. The diameter of Earth is around 12.742 km / 7.917 mi being the fifth largest planet from the solar system, and the largest of the terrestrial planets (Venus, Mercury, Mars). The Earth is so big that if it were hallowed, almost 50 moons could fit inside it. Earth has a mass of about 6.6 sextillion tons and a volume of about 260 billion cubic miles / 1 trillion cubic kilometers. It has the biggest mass out of all the terrestrial planets and the greatest density out of all the planets - 5.51 g/cm^3. Earth’s mass composition is mostly comprised of iron 32.1%, oxygen 30.1%, silicon 15.1%, magnesium 13.9%, sulphur 2.9%, nickel 1.8 %, nickel 1.8%, calcium 1.5%, and aluminum 1.4%. The remaining 1.2% consists of trace amounts of other elements. Orbit and Rotation The Earth makes a complete rotation on its axis once every 23.9 hours. It takes Earth 265,25 days to complete one trip around the Sun – year. In order for calendars to maintain their consistency with this orbit, every 4 years one day is added – this is called a leap day – as well as a leap year. Earth's orbital speed averages 29.78 km/s (107,208 km/h; 66,616 mph), which is fast enough to cover the planet's diameter in 7 minutes and the distance to the Moon in 4 hours. Structure - Geology Earth has four major main layers: an inner core at the center, an outer core enveloping it, mantle, and crust. Since it has the greatest density out of all the planets in the solar system - 5.51 g/cm^3 - and a gravity of 9.807 m/s^2 or 1 g the Earth’s core is solid. It is made of iron and nickel about 759 miles / 1.221 kilometers in radius. The temperatures at the core have been estimated to be around 9.800 degrees Fahrenheit / 5.400 degrees Celsius. This is hotter than the surface of the Sun. Together with the inner core, Earth also has an outer core, with the crust being the mantle and the thickest layer. It is a viscous mixture of molten rock about 1.800 mi / 2.900 km thick and has the consistency of caramel. The outermost layer – Earth’s crust – goes about 19 mi / 30 km deep on average on land. But at the bottom of the ocean, the crust is thinner and extends about 3 mi / 5 km from the seafloor to the top of the mantle. The crust in a sense floats on the mantle due to lower density. It is not a solid piece but rather broken up into huge tectonic plates. These plates move, driven by the flow of rock in the mantle that is in turn powered by heat. The core heats the bottom of the mantle causing convection leading to the warmer material to rise. It takes about 50.000 to 60.000 years for a blob to move a single kilometer. Though the hot material rises towards the surface, it is blocked by the crust. The magmatic rock pushes on the plates, causing them to slide around slowly. Over millions of years, the surface geology of the Earth changed dramatically because of this. Where the crust is weaker magma can push its way through thus erupting onto the surface, forming volcanoes. Because of volcanoes, material wells out creating new land, and they also pump out gas that greatly contributed to Earth’s atmosphere. The interior of the Earth is very hot – comparable to the surface of the Sun. Most of the heat has remained since the Earth’s formation. As it gained mass it began to contract under its own gravity - the squeezing adding heat to the material. Elements like uranium also contribute to the Earth’s heat as the atoms radioactively decay. Another source for the heat: dense materials such as iron and nickel that sunk to the center, warming up due to friction. As such the core is so hot because of: Leftover heat since the Earth’s formation Gravity’s squeezing effect Radioactive decay from elements such as uranium Friction The surface of the Earth is constantly moving. Molten lava rises from beneath the surface and moves into the gap that is created. The new rock helps push the plates apart and as it cools, it becomes part of the continually regenerating crust. When the ocean plates meet the continental plates they are forced downward. This creates friction beneath and pressure forces molten rock upward to erupt to the crust as ash and lava. Many volcanoes formed this way but there is a second type of collision: when two continental plates converge as one plate slides under the other the lighter mass at the surface thrusts and folds upward forming mountain chains. The third type of plate interaction occurs where plates meet at oblique angles to each other. Pressure and friction between the surfaces prevent slippage and when the tension becomes too great the plates shift, sliding along a fault line. Sometimes, violent tremors result and cause the widespread destruction of an earthquake. Surface The surface area of Earth is about 197 million square miles / 510 million square kilometers. Around 71% of the surface is covered by water and 29% by land. The water is 3% fresh and 97% salted. Of that 3% freshwater, over 2% is frozen in ice sheets and glaciers meaning that less than 1% is freshwater found in lakes, rivers, and the underground. In regards to land, the continent of Asia covers about 30% of all the land, having around 60% of the world’s population. The Earth is divided into 7 continents that constantly “move” several centimeters every year. In about 250 million years about four fundamental scenarios for the formation of the next supercontinent have been hypothesized: Novopangea, Pangea Ultima, Aurica and Amasia. Novopangea seems the most likely scenario based on current evaluations. The Americas would collide with the northward drifting Antarctica, and then into the already collided Africa-Eurasia. The highest altitude – elevation - on Earth is Mount Everest at 8,848 m \ 29,029 ft above sea level. The lowest point on land is in the Dead Sea – 420 m / 1.377 ft below sea level. The average depth of the global ocean is about 2.5 miles / 4 kilometers. Most volcanoes are hidden under these oceans. Hawaii’s Mauna Kea is a volcano much taller than Mount Everest, and even Earth’s longest mountain range – four times longer than the Andes, Rockies, and Himalayas combined – is underwater at the bottom of the Arctic and Atlantic oceans. The shape of the Earth is nearly spherical. There is a small flattening at the poles and bulging around the equator due to Earth's rotation speed. This makes the shape of Earth approximately an oblate spheroid. The point on the surface farthest from Earth's center of mass is the summit of the equatorial Chimborazo volcano in Ecuador. Atmosphere The atmosphere of Earth is a layer of gas above the crust. It is not solid and thus it fades away with height. The line between Earth’s atmosphere and space is set at 100 km / 62 miles up. It is called the Kármán line. Technically, anyone, who goes above it is an “astronaut.” The atmosphere by volume is about 78% nitrogen, 21% oxygen, 1% argon, and the rest an assortment of trace gases. Water vapor is also present, almost all of it below a height of about 8-15 km/ 4.9 – 9 mi. This part of the atmosphere is the warmest at the bottom, creating convection in the air that in turn creates currents of rising air. They carry water, forming clouds, which in turn is why we have weather. The ozone layer is situated at a height of 25 km / 15.5 mi on average. This is a molecule of oxygen that absorbs very well solar ultraviolet light. This type of light is dangerous to biological molecules thus the ozone layer is critical for our protection and survival. The atmosphere of Earth can be divided into 6 major layers: (1). Troposphere – The lowest starting at ground level and extending upward to about 10 km / 6.2 miles. Most of the weather occurs here and most clouds are present. (2). Stratosphere – It extends from the top of the troposphere to about 50 km / 31 mi above the ground. This is where the ozone layer is present. Unlike the troposphere, it gets warmer upwards this means a lack of turbulence favorable to commercial jet plane rides. (3). Mesosphere – It extends upward to a height of about 85 km / 53 miles above the planet. Most of the meteors burn up in the mesosphere and unlike the stratosphere, the temperature drops again with the top temperature reaching about -90 degrees Celsius / -130 degrees Fahrenheit. The air here is far too thin to breathe and the pressure is well below 1% of the pressure at sea level. (4). Thermosphere – A layer with very rare air and high-energy X-rays and radiation from the Sun being present but absorbed by the thermosphere. This raises the temperatures considerably and most satellites orbit the Earth in this layer. The auroras, Northern and Southern Lights, occur in the thermosphere. The top of the thermosphere varies between 500-1.000 km / 311-621 mi above the ground. (5). Exosphere – Considered the final frontier of Earth’s gaseous envelope. The air here is extremely thin and leaks into space. The top once again varies: 100.000-190.000 km / 62.000-120.000 mi above the surface of Earth. The latter value is about halfway to the Moon. (6). Ionosphere – It is not a distinct layer as the previous ones. It is rather a series of regions in parts of the mesosphere and thermosphere where high-energy radiation from the Sun has knocked electrons loose from their parent atoms and molecules. The electrically charged atoms & molecules are called ions endowing this region with some special properties. Magnetosphere Earth’s outer core is made from liquid metal which conducts electricity. The liquid convects, and this motion generates magnetic fields. Earth’s rotation helps organize this motion into huge cylindrical roles that align with the Earth’s axis. This generates a magnetic field similar to a bar magnet, with a magnetic north pole and south pole. This field surrounds the Earth and deflects most of the charged particles from the solar wind. Without this geomagnetic field, the solar wind would directly hit Earth’s atmosphere eroding the air away. Mars doesn’t have a strong magnetic field, and it is believed that because of this its atmosphere is mostly vanquished. Some solar wind particles are trapped by Earth’s magnetic field and are channeled down into the atmosphere. There, they are slammed into air molecules about 150 km / 93.2 mi up. This energizes the molecules, which respond by emitting light in different colors. This glow is called aurora. The auroras happen near the geomagnetic poles, far north and south. They form ribbons and sheets, depending on the shape of the magnetic field. Analysis revealed that a magnetic reversal takes place once every 40.000 years on average. When it will happen, compass needles would likely point in many different directions for a few centuries while the switch is being made. After this, the south will become north and vice versa. Axial Tilt The Earth orbits around the Sun with one pole constantly tilted towards it. This tilt results in how much light reaches a given point on the surface of Earth. Earth’s axis is tilted towards the ecliptic of the Sun at approximately 23.4 degrees. This is responsible for Earth’s seasonal changes and the diurnal cycle. Hydrosphere Earth is currently the only known planet with water on the surface. Referred to as the “Blue Planet”, Earth’s hydrosphere consists chiefly of oceans, inland seas, lakes, rivers, and underground waters down to a depth of 2.000 m / 6.600 ft. The deepest underwater location is the Challenger Deep of the Mariana Trench in the Pacific Ocean with a depth of 10.911 m / 35.799 ft. The mass of the oceans represents about 1/4400 of Earth’s total mass. Habitability - Biosphere Life forms inhabit ecosystems, whose total is sometimes said to form a biosphere. The evolution of the biosphere is speculated to have begun about 3.5 Gya. The biosphere is divided into biomes, inhabited by broadly similar plants and animals. In 2016, scientists reported identifying a set of 335 genes from the last universal common ancestor (LUCA), of all organisms living on Earth. The origin of life on Earth is still disputed. There are 2 major standing theories that suggest that life developed here from chemical reactions or that life was brought here by a process named panspermia. Chemical reactions led to the first self-replicating molecules about 4 billion years ago. Half a billion years later, the last common ancestor of all current life arose. Photosynthesis allowed the Sun’s energy to be directly harvested by life forms. The resultant molecular oxygen accumulated in the atmosphere and due to interaction with ultraviolet solar radiation formed a protective ozone layer in the upper atmosphere. Smaller cells incorporated into larger ones and resulted in the development of complex cells called eukaryotes. Among the earliest fossil evidence for life is microbial mat fossils found in 3.48 billion years old sandstone in Western Australia. The panspermia theory suggests that life exists throughout the Universe, distributed by space dust, meteoroids, asteroids, comets, and also spacecraft carrying unintended contamination by microorganisms. Basically, organisms such as extremophiles can become trapped in debris ejected into space after collisions between planets and other small objects. These organisms may travel dormant until arriving at suitable planets that host suitable conditions for life to thrive and evolve. Cartography About 80% of Earth’s oceans haven’t been mapped, and about 65% of the Earth remains unexplored. There are no maps that can actually accurately portray the Earth. The most well-known model – the Mercator – is flawed because the linear scale increases with latitude. This distorts the size of geographical objects far from the equator and conveys a distorted perception of the overall geometry of the planet. Probably the most accurate map is the AuthaGraph World Map because it folds the Earth into a three-dimensional globe. Satellites Earth has one natural satellite the Moon, and several other artificial satellites such as asteroids or large rocks trapped by Earth’s gravity. They are trapped only temporarily for months or even years before returning to an orbit around the Sun. It is believed that the Moon was formed after a collision billions of years ago. A large chunk of rock smashed into Earth and displaced a portion of Earth’s interior. The resulting chunks clumped together and formed our Moon. This is at least the most widespread theory, researching continues. The Moon Since ancient time’s humanity has used the moon to measure the passing of months due to its moving phases from full moon to new moon and back again. It is called the moon because it was used to measure the months. The word moon can be traced to the Old English word “mōna.” It shares its origin with the Latin words “metri”, which means to measure, and “mensis”, which means month. Earth’s moon is the fifth largest of all the moons in the solar system. The Moon is pretty big when comparing it to Earth, being a full quarter of the diameter of the planet. This is the biggest ratio, much bigger than for any other moon orbiting a planet. The Moon has a diameter of about 3.470 km / 2. 156 mi, and on average it is about 380.000 km / 236.121 mi away from Earth. This means that 30 Earth’s could fit in between to cover the distance. The Moon has a radius of 1.079 mi / 1.737 km. It’s not even wider than the United States. The Moon has a similar structure to that of the Earth: a solid iron inner core, a liquid outer core, a thick mantle, and a crust of lighter materials on the top. The core is believed to be around 350 km / 217 in radius with hot temperatures being present but not as high as in Earth’s core. The lower mantle may be a thick fluid, but unlike Earth’s mantle, the upper part is solid. The Moon is tidally locked to Earth, meaning it always shows only one side of its surface to us. The side that we see called the near side is divided into two distinct types of regions: - Highlands, which are heavily cratered - Maria (Latin for seas), which are darker and smoother. The Moon may as well act as a shield against space objects. The highlands were cratered by impacts over the eons from asteroid and comet collisions. Rocks from these regions have been dated to be about 4 billion years old, nearly as old as the Moon itself. The maria region doesn’t have nearly as many craters. They are younger, appearing to be about 3.5 billion years old. The maria are made of darker, basaltic material, which means they probably formed from lava flooding older areas. The dark side of the moon referred to as the “far side” remained a mystery for us for most of our existence. In 1959 the Soviet Union flew the Luna 3 space probe around the Moon, photographing the far side. Expectations were that the far side would look like the near side. However, the far side was vastly different presenting almost no maria. The crust on the far side is thicker than on the near side. The only explanation for this has to do with how the moon was formed. The most well-known theory is the Giant Impact hypothesis. A Mars-sized planet slammed into the young Earth, not head-on impact but rather a grazing collision. The material from both planets was blasted into space and later formed the Moon. Though is it similar to Earth in composition, some rocks show a peculiar ratio of different kinds of oxygen atoms called isotopes, possibly being a piece of strong evidence for this theory. Further, the Moon was probably closer to Earth and suffered from Earth’s high temperatures at the time while the far side later suffered during the Late Heavy Bombardment. There is a possibility that the Moon has water on it. Deep craters near the Moon’s poles have floors that never see sunlight. Comet impacts can distribute water all over the Moon, most of it being destroyed by the sunlight however, it can collect in these dark craters. In fact, water was already discovered on the Moon but the water at the poles remains a bit hypothetical but very probable. The Moon helps our planet be more livable by moderating Earth’s wobble on its axis, leading to a relatively steady climate. It also causes tides, creating a rhythm that has guided humanity for thousands of years. The Moon used to have active volcanoes but now they are dormant. It also has a thin and weak atmosphere, called an exosphere. Location Earth, along with the Solar System, is situated in the Milky Way and orbits about 28,000 light-years from its center. It is about 20 light-years above the galactic plane in the Orion Arm. The Future The Earth is constantly gaining and losing mass with the Moon distancing itself from us one inch every year. Humanity must continue to strive and colonize other planets for survival as nothing lasts forever, especially finite materials. In one billion years the solar luminosity will increase by about 10% causing the atmosphere to become a “moist greenhouse”, resulting in a runaway evaporation of the oceans. In about 2-3 billion years Earth’s magnetic dynamo may cease. Future missions for the colonization of the Moon are being prepared by several nations as well as other important missions to other worlds. This hopefully will finally put an end to the flat Earth conspiracy and to the Moon flight conspiracy, and maybe humanity will realize its true capability and raison d’etre, with the hopeful success of future space missions. Did you know? If all of Earth’s crustal surface were at the same elevation, the depth of the resulting ocean would be 2.7 km / 1.68 mi. The average salinity of Earth’s oceans is about 35 grams of salt per kilogram of seawater – 3.5% salt. The continents of Earth move at the same rate as human fingernails grow. The Moon and Earth orbit a common barycenter every 27.32 days relative to the background stars. The sphere of gravitational influence, of the Earth, is about 1.5 million km (930,000 mi) in radius. This is the maximum distance at which the Earth's gravitational influence is stronger than the more distant Sun and planets. Objects must orbit the Earth within this radius, or they can become unbound by the gravitational perturbation of the Sun. If space were a vacuum, Earth’s magnetic field would extend to infinity. The Moon orbits the Earth roughly as fast as a rifle bullet. The Earth is gradually rotating slower at about 17 milliseconds per 1.000 years. The Moon contributes to this and as Earth slows down, the Moon creeps away. The Earth’s magnetic field and its interaction with the solar wind also produce the Van Allen radiation belts, a pair of doughnut shaped rings of ionized gas (or plasma) trapped in orbit around the Earth. The Earth is travelling through space at roughly 67.000 miles 107,826 kilometers per hour. Earth has a lot fewer craters than the surface of most other planets. This is because the planet has lots of volcanoes and earthquakes which cause the highs and lows of the surface to sink or be worn down over time. Around 1.300.000 Earth’s could fit into the Sun. The Sun will eventually turn into a red giant and engulf Earth. The first picture taken of Earth from outer space was conducted by the Apollo 17 team. The original picture portrayed Earth upside-down. The image was later edited. If 7 billion people were to jump at the same time, a magnitude 4 to 8 earthquake would ensue. Light pollution prevents one third of Earth’s population from seeing the Milky Way galaxy in the night sky. The Moon has been visited by over 100 space probes. The rocks brought back by the Apollo 11 team from the moon are still studied to this day. Sources: Image sources: The Nine Planets is an encyclopedic overview with facts and information about mythology and current scientific knowledge of the planets, moons, and other objects in our solar system and beyond. The 9 Planets in Our Solar System The smallest and fastest planet, Mercury is the closest planet to the Sun and whips around it every 88 Earth days. Spinning in the opposite direction to most planets, Venus is the hottest planet, and one of the brightest objects in the sky. The place we call home, Earth is the third rock from the sun and the only planet with known life on it - and lots of it too! The red planet is dusty, cold world with a thin atmosphere and is home to four NASA robots. Jupiter is a massive planet, twice the size of all other planets combined, and has a centuries-old storm that is bigger than Earth. The most recognizable planet with a system of icy rings, Saturn is a very unique and interesting planet. Uranus has a very unique rotation--it spins on its side at an almost 90-degree angle, unlike other planets. Neptune is now the most distant planet and is a cold and dark world nearly 3 billion miles from the Sun. The Five Dwarf Planets Ceres is the largest object in the asteroid belt but was reclassified a dwarf planet in 2006 - even though it's 14 times smaller than Pluto. Pluto will always be the ninth planet to us! Smaller than Earth's moon, Pluto was a planet up until 2006 and has five of its own moons! Haumea lives in the Kuiper belt and is about the same size as Pluto. It spins very fast, which distorts its shape, making it look like a football. Also in the Kuiper belt, Makemake is the second brightest object in the belt, behind Pluto. Makemake (and Eris) are the reason Pluto is no longer a planet. Eris is the same size as Pluto, but three times further from the Sun! It's so far away, we don't know much about this extremely cold and remote dwarf planet. Other Objects in The Solar System The Sun is the heart of our solar system and its gravity is what keeps every planet and particle in orbit. This yellow dwarf star is just one of billions like it across the Milky Way galaxy. The only place beyond Earth that humans have explored, the Moon is the largest and brightest object in our sky - responsible for the tides and keeping Earth stable on its axis. Comets are snowballs made up of frozen gas, rock, and dust that orbit the Sun. As they get closer to the Sun, they heat up and leave a trail of glowing dust and gases. Asteroids are small, rocky, debris leftover from the formation of our solar system around 4.6 billion years ago. There are currently over 822,000 known asteroids. Between the orbits of Mars and Jupiter, the asteroid belt contains an estimated 1.9 asteroids. The total mass of all objects in the asteroid belt is still less than that of Earth's Moon. Northgate Academy offers Earth science and astronomy as online homeschooling courses. Washington Technical Institute is an accredited college that offers online paralegal program and more. In our Solar System, there are eight planets. The planets in order from the Sun based on their distance are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune. The planets of our Solar System are listed based on their distance from the Sun. There are, of course, the dwarf planets Ceres, Pluto, Haumea, Makemake, and Eris; however, they are in a different class. Among the dwarf planets, Pluto was listed as a planet the longest. This all changed in 2006 when the Astronomical Union – IAU – finally decided on the definition of a planet. According to the definition, a planet is a celestial body that is in orbit around the Sun, has enough mass to assume hydrostatic equilibrium – resulting in a round shape, and has cleared the neighborhood around its orbit. Many still consider Pluto as a planet to this day. Though we must sadly disconsider Pluto, here are some quick facts about each planet of the Solar System. Mercury is the closest planet to the Sun. It is only 58 million km / 36 million mi or 0.39 AU away. Though it is the closest, it isn’t the hottest planet in the Solar System; Venus holds that titled. Mercury is, however, the smallest planet out of the eight. It is slightly larger than our Moon but smaller than Ganymede – one of Jupiter’s moons. Mercury itself doesn’t have any moons. Being a terrestrial planet, Mercury has a high density, and it is primarily composed out of rock and iron ore. Its surface is heavily cratered, very similar to Earth’s Moon. Mercury orbits the Sun once every 87.97 Earth days, while one Mercurian day is equivalent to 59 Earth days. Surface temperatures range from – 173 to 427 degrees Celsius. The small planet has a diameter of 4.879 km / 3.032 mi. The second closest planet to the Sun. Venus is on average at a distance of 108 million km / 67 million mi or 0.72 AU away from the Sun. It is the hottest planet of the Solar system since its atmosphere keeps the temperatures almost consistently the same. The temperatures are around 462 degrees Celsius – about four and a half times the amount of heat needed to evaporate water. Its diameter has been measured to be at 12.104 km / 7.521 mi. Venus has 90% the Earth’s surface area, and it orbits the Sun once every 225 days. One day on Venus is equivalent to 243 Earth days; thus, a day on Venus is longer than a year. Its atmosphere is very thick, composed mainly out of carbon dioxide, nitrogen, and clouds of sulfuric acid. It doesn’t have any moons, and the planet, like Uranus, spins backward – retrograde rotation. It is a terrestrial planet, often considered Earth’s sister. The third closest planet to the Sun. Earth is at an average distance of 150 million km / 93 million mi or 1 AU away from the Sun. It only has one moon and several other smaller satellites. Earth is the biggest terrestrial planet having a diameter of 12.760 km / 7.926 mi. Surface temperatures on Earth are around 14 degrees Celsius. Around 70% of Earth’s surface is covered in water, while the atmosphere is made out of 78% nitrogen, 21% oxygen, and 1% other gases. The fourth terrestrial planet and closest celestial body to the Sun. Mars is 228 million km / 142 million mi or 1.52 AU distance away from the Sun. Also known as the Red Planet due to its reddish hue primarily because of its iron oxide on its surface, Mars is very similar to Earth. It has two moons, Phobos and Deimos. Like Earth, it has volcanoes, valleys, deserts, and polar ice caps. The rotational period and tilt are also very similar to Earth with one day lasting 24 hours and 37 minutes, while a year is equivalent to 687 Earth days. The atmosphere is thin, while the surface temperatures are, on average, around -63 degrees Celsius. Mars has a diameter of 6.787 km / 4.217 mi. More than 40 spacecraft have been launched to Mars. The fifth and most massive planet of the Solar System. Jupiter is 778 million km / 484 million mi or 5.2 AU away from the Sun. It is 317 times more massive than Earth and 2.5 times larger than all the other planets combined. Jupiter is a gas giant; it is primarily composed of hydrogen, helium, and other gases. Its atmosphere is the most intense in the Solar System. Probably second only to Uranus in terms of wind speeds which can reach up to 100 m/s or even more. Jupiter has a diameter of 142.984 km / 88.846 mi. One year on Jupiter is the equivalent of 12 Earth years, while a day lasts only 9.8 hours. Temperatures are around -148 degrees Celsius. Jupiter has 79 moons while possibly more awaiting confirmation; it is only second to Saturn in terms of satellites. The sixth planet from the Sun, and also a gas giant. Saturn is 1.4 billion km / 886 million mi or 9.5 AU distance away from the Sun. Seven ring systems surround it. The gas giant has been recently crowned as the king of the moons since it has 82 confirmed satellites. Its atmosphere is made up of hydrogen, helium, and other gases. Saturn’s diameter has been estimated to be at around 120.500 km / 74.900 mi. A year on Saturn is the equivalent of 30 Earth years, while a day lasts 10.7 hours. The average temperatures on Saturn are around -178 degrees Celsius. Saturn is probably the most recognizable planet of the Solar System. The seventh planet from the Sun, the ice giant Uranus. Uranus is 2.9 billion km / 1.8 billion mi or 19.19 AU away from the Sun. It is classified as an ice giant due to the presence of ammonia, methane, water, and hydrocarbons in ice form. The presence of methane causes its bluish hue. It also has a ring system though it is very faint. It is the coldest planet of the Solar System with temperatures at around -224 degrees Celsius. Uranus is the only planet that rotates on its side. Like Venus, it also rotates in the opposite direction. This planet has a long orbital duration, 84 years. A day on Uranus, on the other hand, is the shortest, lasting only 17 hours. Currently, 27 moons have been confirmed to orbit around Uranus. The diameter has been estimated at 51.118 km / 31.763 mi. It is the third-largest planet in the Solar System. The farthest planet, Neptune. It lies at around 4.5 billion km / 2.8 billion mi or 30.07 AU away from the Sun. Like Uranus, it is also an ice giant. It has a series of faint planetary rings, around 14 confirmed moons, and it has the fastest wind speeds of any planet, reaching speeds of 2.160 km / 1.314 mi per hour. One day on Neptune lasts 16 hours, while a year is equivalent to 165 Earth years, the longest of any planet. Neptune is the fourth-largest planet having a diameter of around 49.244 km / 30.598 mi. It is primarily composed out of layers of gases, around 29% helium and 80% hydrogen, with traces of other elements. Its bluish color is believed to be caused by the presence of methane. It is the first planet discovered through mathematical calculations and predictions. Since Pluto has a very elliptical orbit, it can sometimes get closer to the Sun and Earth than Neptune.The most cratered planet of the solar system is Mercury.Some believe that Saturn and Jupiter came close once and thus provoked the Great Flood on Earth.Every 15 years, the rings of Saturn briefly disappear from view due to their angle.Saturn produces the eeriest radio emissions in the solar system.Mars is the second most populated planet when it comes to robots. UniversetodaySpaceWikipedia The distance among each of the eight planets in our Solar System will alter depending on where each planet is in its orbit revolution around the Sun. Depending on the time of year the distance can also differ significantly. The main reason for the planets to vary their distance is due to elliptical orbits. No planet in our Solar System orbits the sun in a perfect circle which means that the distance between planets is never the same. For this reason, to calculate the distance, we use the average to measure how far planets are from one another. The Astronomical units (AU) column is the average distance between Earth and the Sun and is the most common way for scientists to measure distance in our Solar System. Below is a table of the distances between each of the planets in our solar system. Ever went from one side of the Earth to the other? Our planet is truly big among the celestial objects in our Solar System, so you could be forgiven if you think that a train ride, plane ride, or anything else takes too long. But just how big is the Earth? The Earth has a radius of 2.439 kilometers / 1.516 miles and a diameter of only 12.742 km / 7.917 mi. When it comes to weight, the mass of Earth is equivalent to 5.9 quadrillion kg. In the Solar System, our Earth is the fifth largest planet and the largest of the terrestrial planets. You might have heard many talks about colonizing Mars; well, Mars is almost two times smaller than Earth. Its diameter is slightly more than half that of Earth’s. So how do the other planets compare to our Earth? Let’s find out! Earth and Solar System Size Comparison Earth vs Mercury Mercury is the smallest terrestrial planet, and overall the smallest planet in our Solar System. It has a diameter of only 4.879 km / 3.032 mi and a radius of 2.439 km / 1.516 mi and only 0.055 Earth masses. Our Earth is three times bigger than Mercury. Mercury doesn’t have any moon, while Earth has only one, and several other very small temporary satellites trapped in its orbit. Earth vs Venus Venus is the sixth-largest planet from the Sun. It has a diameter of 12.104 km / 7.521 mi and a radius of around 6.051 km / 3.760 mi. The mass of Venus is equivalent to 0.9 Earth masses, or 90% of our Earth’s mass. Venus is also three times bigger than Mercury, and it is the second-largest terrestrial planet after our Earth. It is just slightly smaller than our Earth, and it doesn’t have a moon. Venus is considerably hotter than our Earth, though, and it is actually the hottest planet in the Solar System, with surface average temperatures recorded at 900o F / 465o C. Since the average temperatures on Earth are around 14oC, this means that Venus is 33.2 times hotter than Earth. But if we were to compare the hottest temperatures ever recorded on Earth, which was 70.7oC, which was taken in the Lut Desert of Iran, then the surface temperatures on Venus would still be around 6.5 times greater. Earth vs Mars The most populated planet when it comes to robots, Mars, is Earth’s red twin in many aspects; however, in terms of size, things start to change. Mars is the second-smallest planet in the Solar System, having a diameter of only 6.779 km / 4.212 mi (30% bigger than Mercury), and a radius of 3.389 km / 2.105 mi. The Red Planet has two moons, Phobos and Deimos, though they are extremely small. Mars has only 11% of our Earth’s mass or 0.11 Earth masses. Earth is basically almost two times bigger than the Red Planet, and it still has more robots, duh! Earth vs Saturn Saturn, which is the second-largest planet in our Solar System, is a monster in comparison to Earth. Saturn has a diameter of approximately 120.536 km / 74.897 mi and a radius of around 58.232 km / 36.183 mi. It is quite massive as well, having the equivalent of 95.16 Earth masses. Saturn’s diameter is 9.5 times bigger than our Earth’s, and if the gas giant were hollow, you could fill it with more than 764 Earth-sized planets. When it comes to moons, Saturn is the King of the Moons, having 82 confirmed orbiting around it, and more await to be discovered. Earth vs Jupiter The true giant in our Solar System, namely the planet Jupiter, has a diameter of around 142.984 km / 88.846 mi at the equator, and a diameter of about 133.708 km / 83.082 mi at the poles. It has a mean radius of 69.911 km / 43.440 mi, and its mass is equivalent to 318 Earth masses. You could fit 1.300 Earths inside Jupiter. Jupiter has more than 11 times the diameter of Earth. It is the biggest planet in the Solar System. Earth vs Uranus The icy giants, Uranus and Neptune, are a bit similar in size and mass; however, they are both several times bigger than our Earth. Uranus is the third-largest planet in the Solar System, and it has a diameter of around 51.118 km / 31.763 mi and a radius of 25.362 km / 15.759 mi. Uranus is reasonably massive, with its mass being equivalent to 14.54 Earth masses. It would take around 63 Earth-sized planets to fill Uranus, and yes, that sounds dirty. Uranus is four times wider than Earth, wait, that sounds even dirtier, well… moving on to Neptune. Earth vs Neptune Neptune is the fourth-largest planet in the Solar System. Neptune has a diameter of 49.244 km / 30.598 mi, and a radius of 24.764 km / 15.387 mi. The mass of Neptun is equivalent to 17.15 Earth masses, and it would take around four Earth-sized planets to fill Neptune. The diameter of Neptune is four times wider than the diameter of the Earth. Now that we’re done with the planets, let’s check how the Earth fares against other celestial objects. Earth vs Pluto Pluto is the ninth-largest planet in the Solar System, and though many don’t regard it as a planet anymore, it is large enough to deserve a size-comparison. Pluto has a diameter of around 2.376 km / 1.476 mi and a radius of around 1,188 km / 738 mi. It’s not quite a massive planet, since it has only 0.01 Earth masses or just 1% of our Earth’s mass. Pluto has only 18.5% of our Earth’s diameter, and, like Earth, it also has a moon, which is large relative to itself, namely, Charon. Charon has 9.5% of our Earth’s diameter, and since we’ve compared Pluto’s moon to our Earth, let’s see how our Moon fares in comparison to Earth. Earth vs Moon Earth’s Moon has a diameter of around 3.474 km / 2.158 mi and a radius of 1.737 km / 1.079 mi. In comparison to Earth, the Moon has only 1.2% of Earth’s mass, or in another way of looking at it, the Earth is 81 times heavier than the Moon. The Moon is about one quarter the size of Earth, and it would take around 50 moons to fill the Earth. Our Moon is, though, the largest moon in the Solar System relative to its parent planet. Did you know? Our Earth is both gaining and losing mass due to the accretion of infalling material. This includes celestial objects such as micrometeorites and cosmic dust, while the loss of hydrogen and helium gas is also influencing our Earth’s size. If all of Earth’s crustal surface were at the same elevation, the depth of the resulting ocean would only be at around 2.7 km / 1.68 mi. Now that wouldn’t be fun for fish. The average salinity of Earth’s oceans is about 35 grams of salt per kilogram of seawater – 3.5% salt. The continents of Earth move at the same rate as human fingernails grow, and over the course of thousands of years, the continents sometimes mold together. The Sun has a diameter, which is 109 times greater than that of Earth. It weighs 330,000 times more than our Earth, and it would take around 1.3 million Earth’s to fill the Sun. Sources: Wikipedia NASA Space Universetoday Image Sources: The solar system consists of the Sun; the eight official planets, at least three “dwarf planets”, more than 130 satellites of the planets, a large number of small bodies (the comets and asteroids), and the interplanetary medium. (There are probably also many more planetary satellites that have not yet been discovered.) Orbits The solar system consists of the Sun; the eight official planets, at least three “dwarf planets”, more than 130 satellites of the planets, a large number of small bodies (the comets and asteroids), and the interplanetary medium. (There are probably also many more planetary satellites that have not yet been discovered.) The inner solar system contains the Sun, Mercury, Venus, Earth and Mars: The main asteroid belt (not shown) lies between the orbits of Mars and Jupiter. The planets of the outer solar system are Jupiter, Saturn, Uranus, and Neptune (Pluto is now classified as a dwarf planet): The first thing to notice is that the solar system is mostly empty space. The planets are very small compared to the space between them. Even the dots on the diagrams above are too big to be in proper scale with respect to the sizes of the orbits. The orbits of the planets are ellipses with the Sun at one focus, though all except Mercury are very nearly circular. The orbits of the planets are all more or less in the same plane (called the ecliptic and defined by the plane of the Earth’s orbit). The ecliptic is inclined only 7 degrees from the plane of the Sun’s equator. The above diagrams show the relative sizes of the orbits of the eight planets (plus Pluto) from a perspective somewhat above the ecliptic (hence their non-circular appearance). They all orbit in the same direction (counter-clockwise looking down from above the Sun’s north pole); all but Venus, Uranus and Pluto also rotate in that same sense. (The above diagrams show correct positions for October 1996 as generated by the excellent planetarium program Starry Night; there are also many other similar programs available, some free. You can also use Emerald Chronometer on your iPhone or Emerald Observatory on your iPad to find the current positions. This information is also useful for designing a solar panel system.) Sizes The above composite shows the eight planets and Pluto with approximately correct relative sizes (see another similar composite and a comparison of the terrestrial planets or Appendix 2 for more). One way to help visualize the relative sizes in the solar system is to imagine a model in which everything is reduced in size by a factor of a billion. Then the model Earth would be about 1.3 cm in diameter (the size of a grape). The Moon would be about 30 cm (about a foot) from the Earth. The Sun would be 1.5 meters in diameter (about the height of a man) and 150 meters (about a city block) from the Earth. Jupiter would be 15 cm in diameter (the size of a large grapefruit) and 5 blocks away from the Sun. Saturn (the size of an orange) would be 10 blocks away; Uranus and Neptune (lemons) 20 and 30 blocks away. A human on this scale would be the size of an atom but the nearest star would be over 40000 km away. Not shown in the above illustrations are the numerous smaller bodies that inhabit the solar system: the satellites of the planets; the large number of asteroids (small rocky bodies) orbiting the Sun, mostly between Mars and Jupiter but also elsewhere; the comets (small icy bodies) which come and go from the inner parts of the solar system in highly elongated orbits and at random orientations to the ecliptic; and the many small icy bodies beyond Neptune in the Kuiper Belt. With a few exceptions, the planetary satellites orbit in the same sense as the planets and approximately in the plane of the ecliptic but this is not generally true for comets and asteroids. The classification of these objects is a matter of minor controversy. Traditionally, the solar system has been divided into planets (the big bodies orbiting the Sun), their satellites (a.k.a. moons, variously sized objects orbiting the planets), asteroids (small dense objects orbiting the Sun) and comets (small icy objects with highly eccentric orbits). Unfortunately, the solar system has been found to be more complicated than this would suggest: there are several moons larger than Pluto and two larger than Mercury; there are many small moons that are probably started out as asteroids and were only later captured by a planet; comets sometimes fizzle out and become indistinguishable from asteroids; the Kuiper Belt objects (including Pluto) and others like Chiron don’t fit this scheme well The Earth/Moon and Pluto/Charon systems are sometimes considered “double planets”. Other classifications based on chemical composition and/or point of origin can be proposed which attempt to be more physically valid. But they usually end up with either too many classes or too many exceptions. The bottom line is that many of the bodies are unique; the actual situation is too complicated for simple categorization. In the pages that follow, I will use the conventional categorizations. The eight bodies officially categorized as planets are often further classified in several ways: by composition: terrestrial or rocky planets: Mercury, Venus, Earth, and Mars: The terrestrial planets are composed primarily of rock and metal and have relatively high densities, slow rotation, solid surfaces, no rings and few satellites. jovian or gas planets: Jupiter, Saturn, Uranus, and Neptune: The gas planets are composed primarily of hydrogen and helium and generally have low densities, rapid rotation, deep atmospheres, rings and lots of satellites. by size: small planets: Mercury, Venus, Earth, Mars. The small planets have diameters less than 13000 km. giant planets: Jupiter, Saturn, Uranus and Neptune. The giant planets have diameters greater than 48000 km. The giant planets are sometimes also referred to as gas giants. by position relative to the Sun: inner planets: Mercury, Venus, Earth and Mars. outer planets: Jupiter, Saturn, Uranus, Neptune. The asteroid belt between Mars and Jupiter forms the boundary between the inner solar system and the outer solar system. by position relative to Earth: inferior planets: Mercury and Venus. closer to the Sun than Earth. The inferior planets show phases like the Moon’s when viewed from Earth. Earth. superior planets: Mars thru Neptune. farther from the Sun than Earth. The superior planets always appear full or nearly so. by history: classical planets: Mercury, Venus, Mars, Jupiter, and Saturn. known since prehistorical times visible to the unaided eye in ancient times this term also refered to the Sun and the Moon; the order was usually specificied as: Saturn, Jupiter, Mars, Sun, Venus, Mercury and Moon, based on the time for them to go “all the way round” the sphere of the “fixed” stars). modern planets: Uranus, Neptune. discovered in modern times visible only with optical aid Earth. The IAU decided that “classical” should refer to all eight planets (Mercury thru Neptune, including Earth but not Pluto). This is contrary to historical usage but makes some sense from a 21st century perspective. PicturesNote: most of the images in The Nine Planets are not true color. Most of them were created by combining several black and white images taken thru various color filters. Though the colors may look “right” chances are they aren’t exactly what your eye would see. The Nine Planets montage (larger version of the above) 36k jpg Another relative size comparison (from LANL) 93k gif Sun and large planet comparison (from Extrema) 15k jpg Earth and small body comparison (from Extrema) 13k jpg Voyager 1 mosaic of the solar system from 4 billion miles out 36k jpg; html (caption) Voyager 1 images of 6 planets from 4 billion miles out 123k jpg; html Pale Blue Dot, reflections on the above image by Carl Sagan. More General Overview The largest, smallest, brightest, etc bodies The history of solar system discovery Solar System Introduction from LANL Solar System Family Portrait from NSSDC Solar System Live, the interactive Orrery of the Web. notes about the most distant object in the solar system and the surface temperatures of the planets from RGO scale models of the solar system Walk the Solar System, a nice size comparison calculator from the Exploratorium Meta Calc, a simple online calculator Your Weight on Other Worlds, another neat calculator from the Exploratorium ConverTable Planets, a nice little Macintosh app to calculate your weight on other planets Galileo SSI Education Module on Planetary Surfaces a good bibliography of print material about the solar system The Big Questions What is the origin of the solar system? It is generally agreed that it condensed from a nebula of dust and gas. But the details are far from clear. How common are planetary systems around other stars? (Updated June 2014) The number of planets around other stars has increased dramatically since the first discoveries of HD 1144762 b in 1989 and gamma Cephei b in 1988 (confirmed in 2003). exoplanet.eu lists 1,811 planets up to 25 July 2014, including over 400 multiple planet systems. Plus there are over 3,000 additional potential planets indicated by the Kepler spacecraft according to the NASA Exoplanet Archive. The reader will note there may be differences in the reported numbers between the two sites referenced. What conditions allow the formation of terrestrial planets? It seems unlikely that the Earth is totally unique but we still have no direct evidence one way or the other. Is there life elsewhere in the solar system? If not, why is Earth special? (Updated June 2014) We do not yet know of life elsewhere. One of the things that makes Earth special of particular interest to the exoplanet search is our location with respect to our Sun — the habitable or so-called “goldilocks zone”. The “goldilocks zone” the area around a star where water would be a liquid on the surface of a planet. The location and extent of which would depend on a number of criteria such as the parent star size and temperature. Once planets in these habitable zones are found the size of the planet is taken into account. The size is what may enable a suitable atmosphere for our familiar life forms. The Planetary Habitability Laboratory at the University of Puerto Rico at Arecibo maintains the Habitable Exoplanet Catalog Is there life beyond the solar system? Intelligent life? Is life a rare and unusual or even unique event in the evolution of the universe or is it adaptable, widespread and common? Answers to these questions, even partial ones, would be of enormous value. Answers to the lesser questions on the pages that follow may help answer some of these big ones. Since ancient times Saturn was known to humanity because of its brightness and closeness to Earth. It’s not possible to give someone credit for the discovery of Saturn, however, the first telescopic observation was conducted by Galileo Galilei in 1610. Because of the crude telescope available at the time, Galileo failed to observe the rings of Saturn. The discovery of the rings was made by Christiaan Huygens in 1659. Saturn is named after the Roman god of harvest and time, the equivalent of the Greek god of time, Cronos. Out of the five visible planets (Mercury, Venus, Mars, Jupiter), Saturn is the most distant from Earth, at a distance of 10.6 AU and an average of 9.6 AU away from the Sun. Light takes approximately 1 hour and 29 minutes to travel from Saturn and then arrive at us. For an actual and accurate position of Saturn, you can check it up online, as the planet is constantly tracked. Saturn is the second-largest planet of the Solar System, second only to Jupiter, having a radius of 58.232 km or 36.183 mi, about nine times that of Earth. It has a diameter of 120.536 km or 74.897 mi, almost 9.5 times bigger than the diameter of Earth and a surface area about 83 times greater. The rings of Saturn are the most extensive of any other planet. They cannot be seen without an unaided eye. Generally, only 3 rings can be seen by regular telescopes, powerful telescopes can view 8 rings and when the spacecraft Cassini orbited Saturn, it counted well above 30 rings. It is important to understand that these rings are actually countless since they are comprised of millions of generally small rocks creating illusions of ring systems. The ring system of Saturn can extend up to 282.000 km / 175.000 mi from the planet. The rings of Saturn together with the planet itself can fit in the distance between the Earth and the Moon. It is the most oblate planet in the Solar System, with its equatorial diameter of 120.536 km / 74.897 mi, being greater than the planet's polar diameter of 108,728 km / 67.560 mi. If viewed from a small telescope it appears flattened. Saturn has the lowest density of all the planets - 687 kg/m^3 - or in other words, it is lighter than water thus if placed on water, it would float. The low density is attributed to its composition. The planet is largely made up of gases such as hydrogen and helium. This together with its atmosphere that is composed of ammonia – yellow, ammonia hydrosulfide – orange, and water – white – influence the planet's colorful appearance of a brownish-yellow. Saturn rotates quite quickly on its axis, completing a rotation or day in about 10.6 hours. However, its orbit around the Sun is slow, completing one trip around the Sun or a year, in about 29.5 Earth years. The temperature of Saturn’s upper atmosphere is on average about -175C (-285F), quite cold for a gas giant, while below the clouds it gets considerably hotter. Due to Saturn’s axial tilt of 26.73 degrees, similar to that of Earth, the southern and northern hemispheres are heated differently, causing seasonal temperature variations. Much of these variations in temperature are horizontal. Though it doesn’t have a solid surface, being enveloped in swirling gases and liquids deeper down, it is believed that Saturn has a core much smaller than Jupiter, almost twice the size of Earth – comprised mostly of metals like iron and nickel surrounded by rocky material, and other compounds, solidified by the intense pressure and heat. Periodic storms are present on Saturn. They are large enough to be seen from Earth and are named White Spots. Recently, many other moons were discovered orbiting around Saturn, thus making the second-largest gas giant the planet with the most numerous satellites. Saturn now has 82 confirmed moons. The largest moon of Saturn is named Titan. It’s the second biggest moon in the Solar System after Jupiter’s moon Ganymede. Titan is even bigger than the planet Mercury. Though the potential for life is zero for Saturn, many of its moons such as Titan or Enceladus, have internal oceans that could possibly hold life. Saturn - also nicknamed the “Ringed Planet” – has been observed since ancient times by different cultures around the world. Because of this, no one can be credited with first discovering the planet. Though it is the most distant of the visible planets, it still can be seen with the naked eye. The first telescopic observation was conducted by Galileo Galilei in 1610. Because of the crude telescope available at the time, Galileo failed to observe the rings of Saturn. He thought that the planet was surrounded very closely by two moons but when he looked again, the objects disappeared. After a couple of years, observations made by Christiaan Huygens in 1659, elucidated the mystery, concluding that in fact, the objects were a ring system surrounding Saturn. Because of the planet’s slow orbit around the sun, it was associated with time, and due to its golden-like glow, it was also associated with wealth. It was thus named after the Roman god of wealth and agriculture Saturn, which is the equivalent of the Greek god of time, Cronos. Formation Saturn formed together with the rest of the solar system about 4.5 billion years ago. Gravity pulled swirling gas and dust together and thus the gas giant was created. About 4 billion years ago, Saturn settled into its current position in the outer solar system. Like Jupiter, Saturn is mostly made of hydrogen and helium, the same two main components that make up the Sun. Distance, Size, and Mass Saturn is about 9.5 times farther away from the Sun than Earth. At a distance of 9.6 AU away from the Sun and 10.6 AU away from Earth, it is the sixth most distant planet. Light takes approximately 1 hour and 29 minutes to travel from Saturn and then arrive at Earth. It is the second-largest planet in the Solar System, having a radius of 58.232 km or 36.183 mi, about nine times that of Earth and a diameter of 120.536 km or 74.897 mi, almost 9.5 times bigger than the diameter of Earth. The surface area is about 83 times bigger than our planet, and the mass of Saturn is about 95 times greater. Though the volume of Saturn is about 764 times that of Earth, it is the least dense planet in the solar system. Earth is 8 times denser than Saturn, and if it would have a surface, the gravity would be similar. The density of Saturn has been estimated to be about 0.687 g/cm3, less dense than water due to its gaseous composition. Orbit and Rotation Saturn has the second-shortest day in the solar system, completing a rotation quite quickly, in about 10.6 hours. However, its orbit around the Sun is slow, completing one trip around the Sun or a year, in about 29.5 Earth years. Its average orbital speed is about 9.68 km/s - 6.01 mi/s. The elliptical orbit of Saturn is inclined 2.48° relative to the orbital plane of the Earth. The perihelion and aphelion distances are, respectively, 9.195 and 9.957 AU, on average. Axial tilt Due to Saturn’s axial tilt of 26.73 degrees, similar to that of Earth, the southern and northern hemispheres are heated differently, causing seasonal temperature variations. Much of these variations in temperature are horizontal. Structure Predominately composed out of hydrogen and helium, Saturn’s density is the lowest out of all the planets in the Solar System, having no true surface just like Jupiter, Uranus, and Neptune. It does have a dense core in the center, composed out of water, ice, and rocky materials, but no actual landmass. The core is believed to be similar to that of Jupiter – rocky, enveloped by a liquid metallic hydrogen layer and a molecular hydrogen layer with traces of various ices. The interior is very hot at the core – 12.000 K / 11,700 °C – and it radiates 2.5 times the amount of energy it produces into space than it receives from the Sun. It is estimated that the core’s mass is about 9-22 times bigger than that of Earth. This would result in a diameter of 25.000 km/15.534 mi or almost two times the size of Earth. The thick liquid metallic hydrogen layer followed by a liquid layer of helium-saturated molecular hydrogen gradually transitions to a gas with increasing altitude. The outermost layer spans 1,000 km / 621 mi and consists of gas. Atmosphere Covered with clouds that appear as faint stripes, jet streams and storms, Saturn’s upper atmosphere is characterized by winds that can reach up to 1,600 feet / 500 meters per second. The atmosphere’s pressure is strong enough that it squeezes gas into liquid. The temperature of Saturn’s upper atmosphere is on average about -175C (-285F), quite cold for a gas giant, while below the clouds it gets considerably hotter. The atmosphere is composed of ammonia, ammonia hydrosulfide, and water that influence the planet's colorful appearance of a brownish-yellow. The outer atmosphere of Saturn contains 96.3% molecular hydrogen and 3.25% helium by volume. The Great White Spot of Saturn is comprised of many periodic storms large enough to be seen from Earth through a telescope. They are several kilometers wide and encircle the planet, occurring once roughly every Saturnian year - every 30 Earth years. It is predicted that the Great White Spot will occur again in 2020 during the northern hemisphere summer solstice. Thermography has shown that Saturn's South Pole has a warm polar vortex, the only known example of such a phenomenon in the Solar System. Whereas temperatures on Saturn are normally −185 °C, temperatures on the vortex often reach as high as −122 °C, suspected to be the warmest spot on Saturn. North Pole Vortex A persisting hexagonal wave pattern around the north polar vortex in the atmosphere at about 78°N was first noted in the Voyager images. The sides of the hexagon are each about 13,800 km / 8,600 mi long, which is longer than the diameter of Earth. The entire structure rotates with a period of 10 hours-39 minutes - which is the same period as that of the planets eerie radio emissions. This is also assumed to be equal to the period of rotation of Saturn's interior. South Pole Vortex The Hubble space telescope imaging of the South Polar Region indicates the presence of a jet stream, however no strong polar vortex nor any hexagonal standing wave. Later the Cassini spacecraft observed a hurricane-like storm locked to the South Pole that had a clearly defined eyewall. Eyewall clouds had not been seen on any other planet except for Earth. It is believed that the South Pole storm may have been present for billions of years. This south vortex is comparable to the size of Earth with winds blowing at speeds of 500/km – 310/mi – per hour. Magnetosphere Saturn has an intrinsic magnetic field that has a simple, symmetric shape – a magnetic dipole. Its strength at the equator is about 0.2 gauss / 20 µT – approximately one-twentieth of that of the field around Jupiter. It is slightly weaker than Earth’s magnetic field. It is believed that Saturn’s magnetic field is generated similarly to that of Jupiter: by currents in the liquid metallic-hydrogen layer called a metallic-hydrogen dynamo. Saturn’s moon Titan orbits within the outer part of the magnetosphere and contributes plasma from the ionized particles in Titan’s outer atmosphere. The magnetosphere also produces aurorae. Moons Saturn is now the “king of the moons” in the Solar System, having a total of 82 confirmed and diverse satellites that range from a couple of meters to several hundred kilometers. The orbits of these 82 moons have been confirmed as not being embedded in its rings. Only 13 of these satellites have diameters greater than 50 km/31 mi - as well as dense rings that contain millions of embedded moonlets and innumerable smaller ring particles. Only 7 of these moons are large enough to have collapsed into a relaxed, ellipsoidal shape, though only one or two, Titan and possibly Rhea, are currently in hydrostatic equilibrium. Momentarily, not all the moons have been named. Regular Satellites Out of the 82 moons, only 24 are regular satellites. This means they have prograde orbits not greatly inclined to Saturn’s equatorial plane. They include the 7 major satellites, 4 small moons that exist in a Trojan orbit with larger moons, 2 mutually co-orbital moons and 2 that act as Sheppard moons of Saturn’s F Ring. Two other known regular satellites orbit within the gaps of Saturn’s rings, while Hyperion is locked in resonance with Titan, the largest moon of Saturn. The remaining regular moons orbit near the outer edge of the A Ring, within G Ring, and between the major moons Mimas and Enceladus. These regular satellites are usually named after Titans or other figures associated with the mythological Saturn. Irregular Satellites Out of the 82 moons, the remaining 58 are irregular moons with diameters ranging from 4 to 213 km – 2.4 to 132 mi. They have orbits much farther from Saturn, high inclinations, and are mixed between prograde and retrograde motions. It is believed that these moons are actually captured minor planets, or debris from the breakup of such bodies after they were captured, creating collisional families. These irregular satellites have been classified by their orbital characteristics into the Inuit, Norse, and Gallic groups, and their names are chosen from the corresponding mythologies. The largest known irregular moon is Phoebe, the ninth moon of Saturn, discovered at the end of the 19th century. Major Moons Saturn has seven major satellites with one of them being even bigger than the planet Mercury. Titan Titan is the first discovered moon of Saturn. It was discovered in 1655 by astronomer Christiaan Huygens. It is the largest

moon of Saturn and the second-biggest moon in the Solar System. It has a radius of about 1.600 mi / 2.575 km and a diameter of 3.199 mi / 5.149 km. It is bigger in size than the planet Mercury but only 40% as massive. Titan is 50% larger than Earth’s moon and 80% more massive. It is almost as wide as the state of Canada. Though it is second in size only to Jupiter’s moon Ganymede, Titan is the only moon in the Solar System with clouds and a dense atmosphere with clear evidence of stable bodies of surface liquid. The moon is primarily composed of ice and rocky material, with a rocky core in the center surrounded by various layers of ice, and a subsurface layer of ammonia-rich liquid water. The atmosphere is largely made up of nitrogen, methane, and ethane clouds with nitrogen-rich organic smog. Climate features include wind and rain that create features similar to those of Earth, such as dunes, rivers, lakes, seas, and deltas. It orbits Saturn once every 15 days and 22 hours and it is tidally locked with its parent planet, only one side of its face is director towards Saturn, permanently. The small, irregularly shaped satellite Hyperion is locked in a 3:4 orbital resonance with Titan. Analysis of Titan's atmospheric nitrogen suggested that it has possibly been sourced from a material similar to that found in the Oort cloud and not from sources present during co-accretion of materials around Saturn. The surface temperature is about 94 K (−179.2 °C). At this temperature, water ice has an extremely low vapor pressure, so the little water vapor present appears limited to the stratosphere. Titan receives about 1% as much sunlight as Earth. Atmospheric methane creates a greenhouse effect on Titan's surface, without which Titan would be far colder. Titan is the most distant body from Earth to have a space probe land on its surface. The spacecraft Huygens landed on Titan in 2005. Analysis since then points out that Titan may be a prebiotic environment rich in complex organic compounds. It contains a global ocean beneath its icy shell, and within this ocean, conditions are potentially suitable for microbial life. These discoveries make Titan a very closely studied object, with future missions already being planned. Hyperion It is the first non-round moon to be discovered in the Solar System. It was discovered in 1848 by William Bond, George Bond, and William Lassell. Its irregular shape, chaotic rotation, and sponge-like appearance make it a very unique object. It is named after the Titan god of watchfulness and observation, the elder brother of Cronus. Hyperion has a diameter of about 121.57 km/ 75.54 mi, making it one of the largest known bodies of highly irregular shape in the Solar System. It is believed that this moon was once part of a larger body that suffered a large impact in the past. Like most of the other moons, it has a low density suggesting that it is composed largely out of water ice and rock. The surface is covered with deep, sharp-edged craters that give it an appearance similar to that of a sponge. Dark material fills the bottom of each crater. Its rotation is chaotic, wobbling so much that its orientation in space is quite unpredictable. Together with Pluto’s moons Nix and Hydra, they are among the few moons in the Solar System that rotate chaotically. Enceladus Enceladus is the sixth-largest moon of Saturn with a diameter of around 500 km / 310 mi. It was discovered in 1789 by William Herschel and named after the giant Enceladus of Greek mythology. This moon is mostly covered by fresh, clean ice, making it one of the most reflective bodies of the Solar System. The surface temperature at noon reaches 198 °C (−324 °F), far colder than a light-absorbing body would be. Over 100 geysers have been identified, together with water-rich plumes, cryovolcanoes that shoot geyser-like jets of water vapor, molecular hydrogen, other volatiles, and solid material into space. Some of the water vapor falls back unto its surface creating fresh snow, while the rest supplies most of the material that makes up Saturn’s E Ring system. It is the only moon of Saturn that is currently endogenously active while at the same time, it is the smallest known body in the Solar System that is geologically active today. Enceladus releases gas and dust at a rate of more than 100 kg/s. It may also have liquid water underneath its south-polar surface. The energy source for Enceladus’s cryovolcanism is thought to be its 2:1 mean-motion resonance with Dione, the second-largest inner moon of Saturn. Recently, data revealed the presence of organic compounds in the plumes of liquid water that shoot into space. These compounds carry nitrogen and oxygen – elements that play a key role in producing amino acids, the building blocks of proteins. Tethys Tethys is the third-largest inner moon of Saturn. It has the lowest density out of all the moons suggesting it is primarily made out of water, and a small fraction of rock. It was discovered in 1684 by G.D. Cassini and named after a titan of Greek mythology. It has a diameter of about 1.060 km / 660 mi and a low density of 0.98 g/cm3. A small amount of unidentified dark material is present on the moon. It is the second-brightest moon of Saturn and it is heavily cratered and cut by large faults/graben. A famous crater is named Odysseus, having a diameter of 400 km / 248 mi. It is believed that the moon formed alongside the other regular moons from the Saturnian sub-nebula – a disk of gas and dust that surrounded Saturn soon after its formation. It orbits Saturn at a distance of almost 295.000 km / 183.304 mi. Dione Dione is the second-largest inner moon of Saturn. It has a higher density than the geologically dead Rhea, the largest inner moon, but lower than that of active Enceladus. It was discovered in 1684 by G.D. Cassini and named after a titan of Greek mythology. It orbits Saturn with a semimajor axis and it is currently in a 1:2 mean-motion orbital resonance with moon Enceladus, completing one orbit of Saturn for every two orbits completed by Enceladus. This resonance maintains Enceladus's orbital eccentricity (0.0047), providing a source of heat for Enceladus's extensive geological activity, which shows up most dramatically in its cryovolcanic geyser-like jets. Dione has a diameter of about 1.122 km / 697 mi, being the 15th largest moon in the Solar System while its mass is greater than all the other small moons combined. About two-thirds of Dione's mass is water ice, and the remaining is a dense core, probably silicate rock. Further information suggests that it also has an internal liquid saltwater ocean similar to Enceladus. While the majority of Dione's surface is heavily cratered old terrain, the moon is also covered with an extensive network of troughs and lineaments, indicating that in the past it had global tectonic activity. Dione may be geologically active even now, although on a scale much smaller than the cryovolcanism of Enceladus. Rhea Named after the “mother of the gods” in Greek mythology, Rhea was discovered in 1672 by G.D Cassini. It is the second-largest moon of Saturn and the ninth-largest in the Solar System. It has a density of about 1.236 g/cm3. This low density indicates that it is made of ~25% rock (density ~3.25 g/cm3) and ~75% water ice (density ~0.93 g/cm3). Although Rhea is the ninth-largest moon, it is only the tenth-most-massive moon. Rhea's features resemble those of Dione, with dissimilar leading and trailing hemispheres, suggesting similar composition and histories. The temperature on Rhea is 99 K (−174 °C) in direct sunlight and between 73 K (−200 °C) and 53 K (−220 °C) in the shade. Rhea has a diameter of about 1.528 km / 949 mi and a tenuous atmosphere – exosphere - that consists of oxygen and carbon dioxide. It is possible that Rhea may have a tenuous ring system as well, meaning it would be the first moon with rings ever discovered but observations continue. Iapetus The third-largest moon of Saturn, Iapetus orbits its planet parent at a distance of 3.5 million km / 2.1 million mi, by far the most distant of Saturn’s large moons, and also it has the largest orbital inclination, 15.47°. Known for its unusual two-toned surface, it was discovered in 1671 by G.D. Cassini and named after a titan of Greek mythology. It is tidally locked, always keeping the same face towards Saturn and has a diameter of about 1.436 km / 892 mi. Due to its appearance, it is nicknamed the yin-yang of the solar system. It also has a low density, indicating that it is mostly comprised of ice and rocky materials. It’s neither spherical nor ellipsoid but has a bulging waistline and squashed poles. This unique equatorial ridge is so high that it can be viewed from a distance.
The equatorial ridge runs along the center of Cassini Regio, about 1,300 km (810 mi) long, 20 km (12 mi) wide, and 13 km (8.1 mi) high. It is not well understood neither how this ridge was created nor why Iapetus has such a chaotic orbit, but generally, it is believed that collisions are at fault. The two-tone coloration is often attributed to Phoebe, a smaller moon that orbits Saturn. Phoebe is very dark and emits streams of particles due to the Sun’s radiation and minor collisions. These particles accumulate on one side of Iapetus while the other remains white due to differences in temperature. Planetary Rings The moons of Saturn also play a role in the planet's ring system. The ring system of Saturn is the largest and most complex in the entire Solar System. They are made out of ice and rock remnants from comets, asteroids, and moons. These particles range in size from being as small as dust to as big as houses, or even mountains. The ring system is divided into 7 groups of rings: D Ring, C Ring, B Ring, A Ring, F Ring, G Ring, and E Ring. Together, they are as wide as 4.5 Earths but only about two-thirds of a mile thick. The rings can extend up to 282.000 km / 175.000 mi from the planet. They stay intact and on track because of Saturn’s smallest moons. These shepherding moons orbit between the rings and use their gravity to shape the ring material into circular paths. Life Habitability Since it doesn’t have a true surface, but rather swirling fluids, it is not conducive to life as we know it. The moons of Saturn however, respectively Titan and Enceladus, have internal oceans that could possibly hold life. Future plans for Saturn Much of Saturn has been discovered, and much still remains to be discovered. Right now, since its moons, Titan and Enceladus, have higher chances of either containing life or being somewhat more hospitable than Saturn and the rest of its moons, most our attention is directed towards them. The conditions on Titan could become far more habitable in the far future, as such a mission named Dragonfly will launch in 2026, consisting of a large drone powered by an RTG, to fly in the atmosphere of Titan. The purpose of this mission is to study how far prebiotic chemistry may have progressed. It is possible that Enceladus may also be subject to further observations. Did you know? Saturn has the eeriest radio emissions in the Solar System. The planet’s sounds can be found and listened to, on the internet. It is estimated that Saturn will lose its rings in about 100 million years. The rings are being pulled into Saturn by gravity as a dusty rain of ice particles under the influence of Saturn’s magnetic field. This event is often called Ring Rain. The closest distance of Saturn to Earth will happen in 2091, at a distance of 8.03 AU. You could fit 764 Earths inside Saturn, and almost 1.600 Saturn’s could fit into the Sun. A theory suggests that Saturn and Jupiter came close to one another and thus provoked the “Great Flood” on Earth. Controversially, recent studies of ancient cultures show that the ancients might have mistakenly considered Saturn as the Sun or at least, a Sun-like object. Some cultures considered that Saturn was a star. The day Saturday was named after Saturn. The winds on Saturn are the second fastest among the Solar System's planets, after Neptune's. The mean apparent magnitude of Saturn is 0.46 with a standard deviation of 0.34. Most of the magnitude variation is due to the inclination of the ring system relative to the Sun and Earth. The brightest magnitude, −0.55, occurs near in time to when the plane of the rings is inclined most highly, and the faintest magnitude, 1.17, occurs around the time when they are least inclined. Twice every Saturnian year - roughly every 15 Earth years - the rings of Saturn briefly disappear from view, due to the way in which they are angled and because they are thin. Such an event will next occur in 2025, but Saturn will be too close to the Sun for any ring-crossing observation to be possible. As Saturn is now the new king of the moons, with 20 new moons being discovered, a contest is held online for the naming of these moons. The contest ends on December 6, 2019 – so we recommend you to search for this on the internet if you are interested in providing a name. Saturn’s largest moon Titan comprises more than 96% of the mass in orbit around the planet. Scientists surmise that the atmosphere of early Earth was similar in composition to the current atmosphere on Titan, with the important exception of a lack of water vapor on Titan. In ancient Greek, Saturn was known as Phainon while in Hindu astrology, it was known as Shani, a deity that judges everyone based on the good and bad deeds performed in life. Ancient Chinese and Japanese cultures designated Saturn as the “earth star”. Almost two tons of Saturn’s mass came from Earth – The Cassini spacecraft was intentionally vaporized in Saturn’s atmosphere in 2017. Only four spacecraft’s have visited Saturn: NASA’S Pioneer 11 in 1979, NASA’S twin Voyager 1 & 2 in 1980 and 1981, and the international Cassini spacecraft mission in 2004. The spacecraft Cassini studied Saturn for about 13 years. Sources: Image source: The short answer is that Neptune has the coldest overall average temperature and Uranus has the coldest temperature recorded. The long answer is that once upon a time the answer to this question was simple. Pluto was the planet furthest away from the Sun and also the coldest. However, Pluto was declassified as a planet in 2006 and is now known as a dwarf planet. So, what is the coldest planet in our Solar System now? It sounds like a simple question, but actually, there are two planets in the running for this title. It all depends on whether we are talking about the average temperature of the planet or the lowest temperature the planet reaches. Neptune Most would say the coldest planet in our solar system is the frosty Neptune. This is because it is the eighth planet in our solar system and therefore the furthest away from the Sun. The Sun is our primary heat source so it would make sense that the planet with the greatest distance from it would be the coldest. Neptune is known as an Ice Giant and for a good reason. It has an average temperature of around -214 degrees Celsius. That is much chillier than Earth’s average of 15 degrees Celsius. Neptune lacks a solid surface as such and instead has an icy water layer that serves as the planet’s mantle. This makes finding a surface temperature difficult, but research conducted from Earth and fly by missions have managed to take this average temperature from the upper atmosphere. Uranus Curiously though, Neptune only holds the title for the coldest average temperature, and it is the seventh planet from the Sun, Uranus, that has the record for the lowest temperature. This has been recorded at a very low -224 degrees Celsius. This is unexpected as Uranus is more than a billion miles closer to the Sun than Neptune. That’s a long way! So how can it be colder? Well despite the large distance between these two ice giants, they are both so far out into the solar system that the Sun has little effect on the temperature of the planets. Any heat is mostly caused by the motion of the planets and their interiors which is where the differences between them lie. One theory is related to the curious position of Uranus. Uranus sits on an axis of 98 degrees meaning the planet is rolling around the Sun on its side. This is unique, although some are slightly tilted, none of the other seven planets in our Solar System do this. Astronomers are not entirely sure of the cause of this, but it is believed that long ago, when the Solar System was first forming, Uranus was struck by a large object. This object would have had to be very big, maybe even as large as planet Earth, to be able to knock an entire planet off its axis. This would have caused huge disturbances to the planet’s core, and a lot of heat would have been lost in the process with heat continuing to spill from the planet’s atmosphere due to its strange orientation. Both Neptune and Uranus have very similar atmospheres that contain high levels of methane. Methane is a gas that traps heat very well. It will try and retain any heat that reaches the planet. Neptune has a slightly higher level of methane in its atmosphere, and so it is more efficient at keeping in the heat generated at its core. So Neptune has more heat to begin with and an atmosphere that is better at keeping it. Related Questions A star that hosts planets orbiting around it is called a planetary system, or a stellar system, if more than two stars are present. Our planetary system is called the Solar System, referencing the name of our Sun, and it hosts eight planets. The eight planets in our Solar System, in order from the Sun, are the four terrestrial planets Mercury, Venus, Earth, and Mars, followed by the two gas giants Jupiter and Saturn, and the ice giants Uranus and Neptune. These are the eight planets of our Solar System; however, there is a ninth, or at least, there used to be a ninth planet, namely Pluto. Pluto was considered the ninth planet of our Solar System until 2006, when it was declassified to a dwarf planet. Conclusion For Pluto This happened after astronomers settled upon what would define a planet, and Pluto seemed to lack criteria. Many, even from high positions at NASA, still consider Pluto, the ninth planet of our Solar System. As such, it is quite a matter of preference for how many planets are in our Solar System. Even if Pluto is now classified as a dwarf planet, it still is remarkable, in the sense that small planets are quite a rarity when it comes to stellar systems. A New Planet? Many believe a mysterious tenth (if considering Pluto) or ninth planet is orbiting in our Solar System, commonly referred to as Planet X. This hypothetical planet might be the size of Neptune, and it would have a highly elongated orbit, even more so than Pluto. Planet X would complete one orbit around the Sun once every 10.000 or 20.000 years. Some mathematical evidence leads many to believe that this elusive planet indeed exists. In 2015, Caltech astronomers showed that something massive out there disrupts the orbits of at least several other objects located in the Kuiper Belt. This may indeed be a planet, but further evidence is needed to support this. The Solar System But let us get back to the known planets of our Solar System. The closest planet to the Sun is Mercury, followed by Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, and the dwarf planet Pluto. This is the order of the planets. The smallest planet in our Solar System is Mercury, which is only one third the size of Earth, while the biggest planet in the Solar System is Jupiter, which is 11 times bigger than our Earth, and more than 1,300 could fit inside it if it were hollow. Mercury is only 0.4 AU or 58 million km / 36 million mi away from our Sun, while our Earth is at 1.00 AU or 150 million km / 93 million mi away. The farthest planet, Neptune, is 30 AU or 4.5 billion km / 2.8 billion mi away from the Sun, and if you want to know how far Pluto is, its 39.5 AU or 5.9 billion km / 3.7 billion mi away from the Sun. Here is a table about the planets in our Solar System, their mass, size, and distance from the Sun. The Solar System Object Type of Celestial Object Mass Radius Average Distance From the Sun Sun Star 330.000 Earth Masses 696.340 km / 432.685 mi – Mercury TerrestrialPlanet 0.055 Earth Masses 2.439 km / 1.516 mi 0.4 AU or 58 million km / 36 million mi Venus Terrestrial Planet 0.9 Earth Masses 6.051 km / 3.760 mi 0.7 AU or 108 million km / 67 million mi Earth Terrestrial Planet 1 Earth Mass = 5.9 Quadrillion Kg 6.371 km / 3.958 mi 1.00 AU or 150 million km / 93 million mi Mars TerrestrialPlanet 0.11 Earth Masses 3.389 km / 2.105 mi 1.5 AU or 228 million km / 142 million mi Jupiter GasGiant 318 Earth Masses 69.911 km / 43.440 mi 5.2 AU or 778 million km / 484 million mi Saturn Gas Giant 95.16 Earth Masses 58.232 km / 36.183 mi 9.5 AU or 1.5 billion km / 886 million mi Uranus IceGiant 14.54 Earth Masses 25.362 km / 15.759 mi 19.8 AU or 2.9 billion km /1.8 billion mi Neptune Ice Giant 17.15 Earth Masses 24.764 km / 15.387 mi 30 AU or 4.5 billion km / 2.8 billion mi Pluto Dwarf Planet 0.01 Earth Masses 1,188 km / 738 mi 39.5 AU or 5.9 billion km / 3.7 billion mi Scientists have analized many other planetary systems throughout the Universe, and it seems that our Solar System isn’t so unique. Many other planetary systems have either less, equal, or even more planets than our Solar System. One interesting fact about our Solar System is that it lacks a specific type of planet called a Super-Earth. Super-Earth planets are terrestrial planets that are more massive and much bigger than our Earth, by several times. These giant planets are usually smaller than the gas giants; however, they should harbor life, and it would be interesting to think about how life would evolve on such a planet. Just imagine our Earth being four times bigger, at least, how many species could there have been in such a world. Are There More Planets in Our Solar System? You could say that there are 13 planets in our Solar System, maybe even more. Pluto isn’t the only dwarf planet orbiting the Sun; there are others as well. The dwarf planets Ceres, Haumea, Makemake, and Eris, are also orbiting our Sun, so there are actually 13 planets in our Solar System. The biggest dwarf planet is Pluto, followed by Eris, Haumea, Makemake, and Ceres. Some consider that the biggets moon of Pluto, named Charon, might also be a dwarf planet. Regardless of its classification, Charon is even bigger than Ceres. Ceres is an attractive dwarf planet since it is also classified as an asteroid, the biggest yet discovered. Some believe that life may have come from Ceres through the process of panspermia. Regardless, some other big-sized objects were discovered in our Solar System, such as Sedna, Quaoar, Orcus, Gonggong, Chiron, or Interamnia. Some of them have been classified as asteroids, comets, but many are possible dwarf plantes. If this is true, then our Solar System really seems like a crowded place. Who knows what we will discover in the future and if the hypothetical Planet X will also be debunked one day. Did you know? The planet which has the most natural satellites/moons in our Solar System is the gas giant Saturn – hosting 82 moons, some of which are among the biggest we know of, like Titan, who is larger than the planet Mercury, or Iapetus, Rhea, Tethys, and Dione, which are dwarf-planet sized. When it comes to the biggest moon in our Solar System, that would be Ganymede, Jupiter’s largest moon. It is also the ninth-largest object in our Solar System, having a radius of 2.634 km / 1.636 mi. Everything in the Universe moves, and this also applies to our Solar System, which has an average velocity of 720,000 km / 450,000 mi per hour. If you want to look in the direction of where our Solar System is moving, you would have to find the star Sirius and Vega. Sirius is the brightest star in the night sky, and it will be easier to find. Simply stand with your back to Sirius facing northwest, and you’ll be facing the direction of where our Solar System is headed through the Milky Way galaxy. The Earth might not be flat, but our Solar System sure is. All the planets in the Solar System are orbiting in a very thin plane surrounding the Sun. Sources: Wikipedia NASA Space Skyandtelescope Image Sources: de Admin » 15 Juil 2025, 10:39 A1) Calculatrices graphiques et calcul exactGo to topCes deux familles étaient adaptées à l'ancien programme de Première Scientifique jusqu'à l'année scolaire 2018-2019.Il est à noter que ce n'est hélas plus le cas de nos jours. Depuis l'année scolaire 2019-2020, les exponentielles sont abordées en spécialité Mathématiques dès la classe de Première Générale.Heureusement nous avons la NumWorks qui fait mieux. En effet le fonctionnement de son moteur de calcul exact Poincaré est différent ; il travaille non pas en faisant tourner des algorithmes numériques sur les résultats approchés, mais directement sur des arbres de calculs permettant de représenter les différentes saisies.Là où la concurrence se contente d'écritures décimales approchées dès que l'on sort des deux familles précédentes, la NumWorks à la différence a l'immense avantage d'être capable de retourner une valeur exacte pour n'importe quelle saisie algébrique ! CasioTINumWorksA2) Calculatrices NumWorks et calcul littéralGo to topToutefois le fonctionnement interne de Poincaré n'a pas changé. Les arbres continuent à pouvoir mélanger noeuds numériques et littéraux, et le moteur continue à procéder aux simplifications par développements et réductions. C'est juste à la fin si l'expression correspondant à l'arbre obtenu après traitement fait encore appel à des termes littéraux, que le résultat affiché est au dernier moment remplacé par la valeur undef.Pour ceux qui disposent d'une calculatrice NumWorks N0100 (arrêtée pour la rentrée 2019) ou N0110 (arrêtée pour la rentrée 2023), il est ainsi possible de réactiver le calcul littéral en installant un firmware Omega ou Upsilon. Ces firmwares tiers sont des forks améliorés du firmware officiel Epsilon, et entre autres retirant justement la limitation précédente.Et précisons de plus qu'avec la mise à jour Epsilon 15.3 de janvier 2021, NumWorks avait changé son algorithme de détermination de nombres dérivés. L'algorithme numérique pouvant retourner des résultats faux dans bien des cas particuliers avait été remplacé par une véritable dérivation de l'expression de la fonction au niveau de l'arbre de calcul, autrement plus fiable.Les firmwares tiers Omega et Upsilon exploitent fort avantageusement ce nouvel algorithme, en te permettant d'obtenir l'expression littérale de la fonction dérivée ! Pour cela, dans ta saisie demandant le nombre dérivé en une valeur, il suffit de remplacer la valeur en question par la variable de la fonction.A3) Changements Epsilon 24Go to topÀ l'époque de la version bêta 24.0.1 de décembre 2024, ce nouveau moteur de calcul était manifestement défectueux.Diverses formes de résultats n'étaient plus simplifiées correctement :Epsilon ≤23Epsilon 24.0C'était encore pire dans le cas de résultats complexes avec des formes d'écritures non respectées ou même des résultats totalement inutiles :Epsilon ≤23Epsilon 24.0Le moteur de calcul Poincaré étant sollicité de façon transversale par les diverses applications, les conséquences étaient loin de se limiter à la seule application Calculs :Epsilon ≤23Epsilon 24.0Face à l'ampleur sans précédent de ces régressions, dans l'intérêt des élèves, nous formions des vœux pour qu'Epsilon 24 ne sorte pas avant les examens 2025.Mais ce n'était pas tout. Il y avait également de quoi profondément attrister les plus grands fans de NumWorks, avec Epsilon 24.0 le pseudo-calcul littéral ne fonctionnait plus du tout :Epsilon ≤23Epsilon 24.0NumWorks a donc fait le choix de la prudence en nous sortant cette nouvelle version bêta d'Epsilon 24 après la session d'examens 2025.Et bien la version bêta Epsilon 24.2 semble corriger l'ensemble des dysfonctionnements précédents.Par rapport à l'édition précédente Epsilon 23, nous remarquons au passage la notation désormais naturelle des écritures décimales utilisant des puissances de 10, en lieu et place de l'opérateur infixé E hérité des premières calculatrices scientifiques utilisant des afficheurs à 7 segments.Epsilon ≤23Epsilon 24.2Quelques anomalies persistent toutefois, comme ici l'absence surprenante de la forme exacte du résultat pour les factorielles de 16, 17 et 18... comportement difficilement compréhensible alors que le résultat exact plus grand est à nouveau communiqué à partir de la factorielle de 19.Toutefois autre excellente nouvelle qui devrait en ravir plus d'un, le peuso-calcul littéral est cette fois-ci de retour ! B) Onglets Graphique (Grapheur, Suites, Régression)Go to topC) Application Grapheur et fonctionsGo to topD) Application SuitesGo to topE) Onglets Données (Statistiques, Régression)Go to topLa calculatrice NumWorks disposait d'un gros défaut - l'intégralité des données mémoire était définitivement perdue lors de l'utilisation du mode examen.Tu perdais donc entre autres tout ce que tu avais pu mettre dans ta calculatrice (scripts Python, applications, ...), et ici de façon définitive. Il te fallait tout réinstaller manuellement après chaque utilisation du mode examen, à condition bien sûr d'avoir accès à une copie (attention donc aux scripts Python saisis directement sur la calculatrice).C'était d'autant plus incompréhensible qu'il n'y avait pas ce problème chez la concurrence. Depuis une décennie, les données préexistantes y étaient juste verrouillées lors de l'activation du mode examen (c'est-à-dire rendues inaccessibles) puis.Avec Epsilon 24, NumWorks s'attaque enfin à ce problème et annonce enfin, la récupération des données préchargées lors de la désactivation du mode examen !Epsilon ≤23Epsilon 24.2Les données ainsi récupérables sont les scripts Python, expressions, fonctions, listes, équations.Attention toutefois aux NumWorks bien pleines, la priorité était donnée au bon fonctionnement de la calcualtrice en mode examen. Dans les cas où le volume de données saisies en mode examen excède la capacité de stockage de ta mémoire RAM, la sauvegarde de tes données préchargées sera automatiquement supprimée dans son intégralité pour faire de la place. Et dans ce cas, tu ne retrouveras pas tes données lors de la désactivation du mode examen.NumWorks semble toutefois s'être montré très timide sur cette fonctionnalité, qui est hélas loin d'atteindre le niveau de la concurrence.Précisons en effet que la sauvegarde lors de l'activation du mode examen ne concerne que les données que tu as préchargées en mémoire RAM.Elle ne concerne malheureusement pas ce que tu as pu mettre en mémoire Flash, notamment les applications que tu as installées.C'est même pire que cela, si tu as installé la moindre application additionnelle en mémoire Flash, cette fonctionnalité de sauvegarde et restauration des données de la mémoire RAM sera complètement court-circuitée, car dans ce cas la calculatrice démarre le mode examen en effectuant un redémarrage. À l'activation du mode examen, tu perdras ainsi non seulement l'ensemble des applications installées en mémoire Flash, mais également l'intégralité des données de ta mémoire RAM.Avoir enfin accédé aux souhaits de la minorité vocale des utilisateurs mettant des scripts Python sur leur calculatrice et ayant envie d'en conserver certains sans avoir à la réinstaller à chaque utilisation du mode examen est une bonne chose.Mais fort malheureusement, cela a été codé au détriment de la majorité silencieuse des utilisateurs scolaires.Rappelons en effet qu'une des choses ayant toujours été présentée comme la plus urgente à faire en fin d'épreuve, c'est de désactiver le mode examen. Parce qu'il entraîne une surconsommation de piles/batterie avec le clignotement de la diode empêchant l'extinction complète de la calculatrice, et parce qu'il faut arriver à l'éventuelle prochaine épreuve avec un mode examen désactivé. Comme cette désactivation ne peut se faire de manière autonome et nécessite du matériel externe, il est essentiel de l'effectuer dès que l'on a le bon matériel sous la main.Or désormais, à la désactivation du mode examen, tu perds l'intégralité des données saisies pendant le mode examen. Cela implique que tu perds certes les éventuels petits scripts Python créés pendant ton épreuve, mais aussi les fonctions définies, les séries statistiques saisies, ou encore l'historique des calculs effectués. Tu perds donc toute trace de ton travail pendant l'examen, ce qui t'empêchera donc de le confronter correctement aux corrigés qui sortent dès la fin de l'épreuve.Rappelons que jusqu'à la version précédente Epsilon 23, la calculatrice NumWorks conservait bien les données saisies en mode examen. C'est également le cas d'autres modèles populaires comme la bien moins chère TI-82 Advanced Edition Python ou encore la populaire TI-83 Premium CE. C'était un gros avantage notamment par rapport aux calculatrices Casio.Si on fait le bilan, cette nouveauté n'est donc pas une amélioration mais une régression. Espérons donc que NumWorks acceptera de corriger cela d'ici la version stable, dans l'intérêt supérieur de la masse des utilisateurs scolaires.G) Application Paramètres et écranGo to topH) Gestion de l'alimentationGo to topLorsque tu branchais ta NumWorks sur un hôte USB actif (ordinateur, tablette, smartphone, ...) tu bénéficiais d'un écran explicatif dédié au transfert de données.Toutefois, rien de tel lorsque tu branchais ta calculatrice à un hôte USB passif (adaptateur secteur, batterie USB, ...). La recharge n'était que très discrètement indiquée par l'icône de batterie en haut à droite de l'écran.Liens : Lien vers le sujet sur le forum: Bêta-test public mise à jour Epsilon 24.2 pour NumWorks (Commentaires: 6) de critor » 30 Juin 2025, 17:19 Nous avons le plaisir de t'annoncer le lancement pour cette rentrée 2025 du tout nouveau site du distributeur de calculatrices R. Jarrety.Ce nouveau site unifie les deux sous-domaines entre lesquels il fallait choisir auparavant selon que l'on souhaitait passer une commande individuelle ou groupée.Chaque page de modèle de calculatrice affiche dorénavant à la fois de le prix pour un achat individuel et le prix réduit pour une commande groupée ! Des options sont de plus proposée désormais :gravure laser d'un message de ton choix (tes nom et prénoms par exemple), une formidable protection contre le vol si tu n'as pas pris la précaution de conserver une trace du numéro de série de ta calculatrice quelque part, au tarif unique de 5,94€ peu importe le modèleune extension de garantie de 2 ans, tarif variant selon le modèleLien : Lien vers le sujet sur le forum: Nouveau site Jarrety rénové pour la rentrée 2025 (Commentaires: 0) de critor » 30 Juin 2025, 15:57 Dans le cadre des précommandes de Zero ZGC4, la calculatrice s'inspirant de la TI-83 Premium CE (ou TI-84 Plus CE hors de France), nous avons le plaisir de t'annoncer aujourd'hui la sortie de son logiciel de connectivité ZeroConnect enfin en version stable 2.5.1.Par rapport à la version bêta de 2020 qui était déjà en ligne chez nous, la dernière version 2.5.1 a l'avantage :d'être installable aussi bien sur les ordinateurs Windows que Macde gérer parfaitement les derniers modèles ZGC3/ZGC4d'inclure un éditeur de programmes en langage ZeroBasicTéléchargements : ZeroConnect 2.5.1 pour Windows MacSource : Lien vers le sujet sur le forum: Sortie logiciel connectivité ZeroConnect 2.5.1 Windows/Mac (Commentaires: 0) de critor » 29 Juin 2025, 17:00 Voici aujourd'hui un pénultième test de participation à notre concours de programmation Python 2024-2025, par Ayabusa.Dans le cadre de ce concours il s'agissait de produire un jeu sur le thème la "la carte", à tous les sens du terme. Et nous citions entre autres, certes en plaisantant, la carte du restaurant…Téléchargement :Dépôt : Lien vers le sujet sur le forum: À la carte NumWorks concours Python 2024-2025 (Commentaires: 8)