PLANETS AND GRAVITY pdf

1: BBC Bitesize - KS2 Science - Gravity on Earth, Jupiter and Pluto

The surface gravity, g, of an astronomical or other object is the gravitational acceleration experienced at its surface. The surface gravity may be thought of as the acceleration due to gravity experienced by a hypothetical test particle which is very close to the object's surface and which, in order not to disturb the system, has negligible mass.

Gravity is a fundamental force of physics, one which we Earthlings tend to take for granted. However, for those who have gone into space or set foot on the Moon, gravity is a very tenuous and precious thing. Basically, gravity is dependent on mass, where all things â€" from stars, planets, and galaxies to light and sub-atomic particles â€" are attracted to one another. Depending on the size, mass and density of the object, the gravitational force it exerts varies. And when it comes to the planets of our Solar System , which vary in size and mass, the strength of gravity on their surfaces varies considerably. This means that an object, if held above the ground and let go, will accelerate towards the surface at a speed of about 9. This is the standard for measuring gravity on other planets, which is also expressed as a single g. Based on their sizes and masses, the gravity on another planet is often expressed in terms of g units as well as in terms of the rate of free-fall acceleration. So how exactly do the planets of our Solar System stack up in terms of their gravity compared to Earth? With a mean radius of about 2, km and a mass of 3. This makes Mercury the smallest and least massive planet in the Solar System. However, thanks to its high density â€" a robust 5. Gravity anomalies on Mercuryâ€"mass concentrations red suggest subsurface structure and evolution. With a mean radius of 4. Gravity on the Moon: This is one astronomical body where human beings have been able to test out the affects of diminished gravity in person. Calculations based on its mean radius km , mass 7. Mars is also similar to Earth in many key respects. However, when it comes to size, mass and density, Mars is comparatively small. In fact, its mean radius of 3. Its density, meanwhile, is about o. Because of this, Mars has 0. Jupiter is the largest and most massive planet in the Solar System. But being a gas giant, Jupiter is naturally less dense than Earth and other terrestrial planets, with a mean density of 1. If one were to stand on it, they would simply sink until they eventually arrived at its theorized solid core. Like Jupiter, Saturn is a huge gas giant that is significantly larger and more massive than Earth, but far less dense. With a mean radius of 25, km and a mass of 8. However, as a gas giant, its density 1. All told, it is 3. But, being a gas giant, it has a low density of 1. All of this works out to a surface gravity of All in all, gravity runs the gamut here in the Solar System, ranging from 0. And on the Moon, were astronauts have ventured, it is a very mild 0. Understanding the effect of zero-gravity on the human body has been essential to space travel, especially where long-duration missions in orbit and to the International Space Station have been concerned. In the coming decades, knowing how to simulate it will come in handy when we start sending astronauts on deep space missions. And of course, knowing just how strong it is on other planets will be essential to manned missions and perhaps even settlement there. Given that humanity evolved in a 1 g environment, knowing how we will fare on planets that have only a fraction of the gravity could mean the difference between life and death.

2: Surface Gravity of the Planets and the Sun

Gravity is a fundamental force in our universe. And on the planets in our Solar System, it is dependent on the size, mass, and density of the body.

How strong is gravity on other planets? January 1, by Matt Williams, Universe Today Gravity is a fundamental force of physics, one which we Earthlings tend to take for granted. However, for those who have gone into space or set foot on the Moon, gravity is a very tenuous and precious thing. Basically, gravity is dependent on mass, where all things â€" from stars, planets , and galaxies to light and sub-atomic particles â€" are attracted to one another. Depending on the size, mass and density of the object, the gravitational force it exerts varies. And when it comes to the planets of our solar system , which vary in size and mass, the strength of gravity on their surfaces varies considerably. This means that an object, if held above the ground and let go, will accelerate towards the surface at a speed of about 9. This is the standard for measuring gravity on other planets, which is also expressed as a single g. Based on their sizes and masses, the gravity on another planet is often expressed in terms of g units as well as in terms of the rate of free-fall acceleration. So how exactly do the planets of our solar system stack up in terms of their gravity compared to Earth? With a mean radius of about 2, km and a mass of 3. This makes Mercury the smallest and least massive planet in the solar system. However, thanks to its high density â€" a robust 5. With a mean radius of 4. Gravity on the Moon: This is one astronomical body where human beings have been able to test out the affects of diminished gravity in person. Calculations based on its mean radius km , mass 7. Mars is also similar to Earth in many key respects. However, when it comes to size, mass and density, Mars is comparatively small. In fact, its mean radius of 3. Its density, meanwhile, is about 0. Because of this, Mars has 0. Jupiter is the largest and most massive planet in the solar system. But being a gas giant, Jupiter is naturally less dense than Earth and other terrestrial planets, with a mean density of 1. Gravity anomalies on Mercuryâ€"mass concentrations red suggest subsurface structure and evolution. If one were to stand on it, they would simply sink until they eventually arrived at its theorized solid core. Like Jupiter, Saturn is a huge gas giant that is significantly larger and more massive than Earth, but far less dense. With a mean radius of 25, km and a mass of 8. However, as a gas giant, its density 1. All told, it is 3. But, being a gas giant , it has a low density of 1. All of this works out to a surface gravity of All in all, gravity runs the gamut here in the solar system, ranging from 0. And on the Moon, were astronauts have ventured, it is a very mild 0. Understanding the effect of zero-gravity on the human body has been essential to space travel, especially where long-duration missions in orbit and to the International Space Station have been concerned. In the coming decades, knowing how to simulate it will come in handy when we start sending astronauts on deep space missions. And of course, knowing just how strong it is on other planets will be essential to manned missions and perhaps even settlement there. Given that humanity evolved in a 1 g environment, knowing how we will fare on planets that have only a fraction of the gravity could mean the difference between life and death.

3: Gravity - Acceleration around Earth, the Moon, and other planets | www.enganchecubano.com

Students learn about gravity, mass, and weight by calculating their weights on various planets in this hands-on science activity. This lesson includes instructions, materials list, and a weight chart for recording data.

It is a well known fact that the planets of the Solar System vary considerably in terms of size. And in some cases, planets can actually be smaller than the largest moons. In the end, how massive a planet is has more to do with its composition and density. And while Jupiter is times as massive as Earth, its composition and density mean that it is only It is also one of its densest at 5. As a terrestrial planet , it is composed of silicate rock and minerals and is differentiated between an iron core and a silicate mantle and crust. But unlike its peers Venus, Earth and Mars , it has an abnormally large metallic core relative to its crust and mantle. Combined with its density and size, Mercury has a surface gravity of 3. Internal structure of Mercury: Like Earth, Mercury and Mars, it is a terrestrial planet, and hence quite dense. In fact, with a density of 5. Its average radius is roughly 6, km And when it comes to mass, the planet weighs in at a hefty 4. Not surprisingly, this is the equivalent of 0. Combined with its density and size, this means that Venus also has comparable gravity to Earth â€" roughly 8. Like the other planets of the inner Solar System, Earth is also a terrestrial planet, composed of metals and silicate rocks differentiated between an iron core and a silicate mantle and crust. Combined with its size and density, Earth experiences the surface gravity that we are all familiar with â€" 9. Mars is the third largest terrestrial planet, and the second smallest planet in our Solar System. Like the others, it is composed of metals and silicate rocks that are differentiated between a iron core and a silicate mantle and crust. But while it is roughly half the size of Earth with a mean diameter of km, or In short, Mars has a mass of 0. Combined with its size and density â€" 3. Jupiter is the largest planet in the Solar System. With a mean diameter of , km, it is big enough to fit all the other planets except Saturn inside itself, and big enough to fit Earth But with a mass of x kg or 1,,,, trillion metric tons , Jupiter is more massive than all the other planets in the Solar System combined â€" 2. Kelvinsong CC by S. However, it is significantly less massive than its Jovian cousin, with a mass of x kg or ,,, trillion metric tons. Still, this makes Saturn the second most-massive planet in the Solar System, with 95 times the mass of Earth. Much like Jupiter, Saturn has a low mean density due to its composition. In fact, with an average density of 0. But of course, like all gas giants, its density increases considerably the further one ventures towards the core. With a mean diameter of 51, km, Uranus is the third largest planet in the Solar System. But with a mass of This is due to its mean density of 1. And with a mass of x kg or ,,, trillion metric tons it is also more massive â€" about 17 times more to be exact. This makes Neptune the third most massive planet in the Solar System; while its density is the greatest of any gas giant 1. As you can see, the planets of the Solar System range considerably in terms of mass. But when you factor in their variations in density, you can see how a planets mass is not always proportionate to its size. In short, while some planets may be a few times larger than others, they are can have many, many times more mass. Astronomy Cast has episodes on all of the planets.

4: Which Planet In Our Solar System Has The Most Gravity? - www.enganchecubano.com

Basically, gravity is dependent on mass, where all things - from stars, planets, and galaxies to light and sub-atomic particles - are attracted to one www.enganchecubano.coming on the size, mass and.

Home Universe Gravity Gravity Do you know what gravity is? Firstly gravity is so very important to the universe and how the universe works. So gravity is a force of nature that is there, and is key to our planet and the universe. Well first of all, we can thank the well-known historical physicist Sir Isaac Newton for discovering gravity. It was this great mind who one day discovered that objects of Matter are not just on the earth, that they are actually pulled down to the earth by a force discovered as gravity. Gravity is a strong force of nature, but not so strong that it actually pulls absolutely everything down all of the time so strongly. However it is a force that keeps everything in check and in balance, and keeps us grounded. Like when Newton and that famous story as to how he discovered gravity â€” the Apple fell from the tree, however the Apple grew and was connected to the tree, and came off naturally, hitting the ground. So what that means is that objects of matter are pulled to the ground with mid force once they have become free. So you can climb the tree and gravity will not pull you and the tree down to earth, but if you come away from the tree and fall, you are gown down!! So while gravity keeps us grounded on earth, it does something different with the planets, stars, galaxies and the whole universe. Gravity brings and binds everything together, all the way through the cosmos. Think of gravity as like the glue that sticks to the earth and the universe, and helps everything work. Gravity is so special, we cannot do without it. Kids Fun Facts Corner 1. Gravity as a force compared to other forces in the universe is quite weak. The tides in the oceans are governed by the gravitational forces of the earth and its moon. What does Gravity do in the whole universe? Gravity brings and binds everything together. Humans would fall off the Earth. Who is credited with discovering Gravity?

5: Gravitational Pull of the Planets - Planet Facts

Start studying planets and gravity. Learn vocabulary, terms, and more with flashcards, games, and other study tools.

Bring fact-checked results to the top of your browser search. Acceleration around Earth, the Moon, and other planets The value of the attraction of gravity or of the potential is determined by the distribution of matter within Earth or some other celestial body. In turn, as seen above, the distribution of matter determines the shape of the surface on which the potential is constant. Measurements of gravity and the potential are thus essential both to geodesy , which is the study of the shape of Earth, and to geophysics , the study of its internal structure. For geodesy and global geophysics, it is best to measure the potential from the orbits of artificial satellites. Surface measurements of gravity are best for local geophysics, which deals with the structure of mountains and oceans and the search for minerals. Changes with time The gravitational potential at the surface of Earth is due mainly to the mass and rotation of Earth, but there are also small contributions from the distant Sun and Moon. As Earth rotates, those small contributions at any one place vary with time, and so the local value of g varies slightly. Those are the diurnal and semidiurnal tidal variations. For most purposes it is necessary to know only the variation of gravity with time at a fixed place or the changes of gravity from place to place; then the tidal variation can be removed. Accordingly, almost all gravity measurements are relative measurements of the differences from place to place or from time to time. Measurements of g Unit of gravity Because gravity changes are far less than 1 metre per second per second, it is convenient to have a smaller unit for relative measurements. The gal named after Galileo has been adopted for this purpose; a gal is one-hundredth metre per second per second. Absolute measurements Two basic ways of making absolute measurements of gravity have been devised: In the English physicist Henry Kater, building on the work of the German astronomer Friedrich Wilhelm Bessel , was the first to use a reversible pendulum to make absolute measurements of g. If the periods of swing of a rigid pendulum about two alternative points of support are the same, then the separation of those two points is equal to the length of the equivalent simple pendulum of the same period. By careful construction, Kater was able to measure the separation very accurately. Since that time, electronic instruments have enabled investigators to measure with high precision the half-second time of free fall of a body from rest through one metre. It is also possible to make extremely accurate measurements of position by using interference of light. Consequently, direct measurements of free fall have replaced the pendulum for absolute measurements of gravity. Nowadays, lasers are the sources of light for interferometers, while the falling object is a retroreflector that returns a beam of light back upon itself. The falling object can be timed in simple downward motion, or it can be projected upward and timed over the upward and downward path. Transportable versions of such apparatuses have been used in different locations to establish a basis for measuring differences of gravity over the entire Earth. The accuracy attainable is about one part in More recently, interferometers using beams of atoms instead of light have given absolute determinations of gravity. Interference takes place between atoms that have been subject to different gravitational potentials and so have different energies and wavelengths. The results are comparable to those from bodies in free fall. Relative measurements From the time of Newton, measurements of differences of gravity strictly, the ratios of values of gravity were made by timing the same pendulum at different places. During the s, however, static gravimeters replaced pendulums for local measurements over small ranges of gravity. Today, free-fall measurements have rendered the pendulum obsolete for all purposes. Spring gravimeters balance the force of gravity on a mass in the gravity field to be measured against the elastic force of the spring. Either the extension of the spring is measured, or a servo system restores it to a constant amount. High sensitivity is achieved through electronic or mechanical means. If a thin wire is stretched by a mass hung from it, the tension in the wire, and therefore the frequency of transverse oscillations, will vary with the force of gravity upon the mass. Such vibrating string gravimeters were originally developed for use in submarines and were later employed by the Apollo 17 astronauts on the Moon to conduct a gravity survey of their landing site. Another relatively recent development is the superconducting gravimeter, an instrument in which the position of a magnetically levitated superconducting sphere is sensed to provide a measure of g. Modern gravimeters may have sensitivities better than 0. Differences in gravity measured with gravimeters are obtained in quite arbitrary unitsâ€"divisions on a graduated dial, for example. The relation between these units and milligals can be determined only by reading the instrument at a number of points where g is known as a result of absolute or relative pendulum measurements. Further, because an instrument will not have a completely linear response, known points must cover the entire range of gravity over which the gravimeter is to be used. Since g is an acceleration, the problem of its measurement from a vehicle that is moving, and therefore accelerating relative to Earth, raises a number of fundamental problems. Pendulum, vibrating-string, and spring-gravimeter observations have been made from submarines; using gyrostabilized platforms, relative gravity measurements with accuracies approaching a few milligals have been and are being made from surface ships. Experimental measurements with various gravity sensors on fixed-wing aircraft as well as on helicopters have been carried out. Gravimetric surveys and geophysics As a result of combining all available absolute and relative measurements, it is now possible to obtain the most probable gravity values at a large number of sites to high accuracy. The culmination of gravimetric work begun in the s has been a worldwide gravity reference system having an accuracy of at least one part in 0. The value of gravity measured at the terrestrial surface is the result of a combination of factors: It is therefore necessary to make proper allowance for the other factors. The first two factors imply a variation of gravity with latitude that can be calculated for an assumed shape for Earth. This value, however, assumes that material of zero density occupies the whole space between the point of observation and sea level, and it is therefore termed the free-air correction factor. In practice the mass of rock material that occupies part or all of this space must be considered. This is commonly called the Bouguer correction factor. Terrain or topographical corrections also can be applied to allow for the attractions due to surface relief if the densities of surface rocks are known. Tidal effects the amplitudes are less than 0. Cook The Moon and the planets Although the Apollo astronauts used a gravimeter at their lunar landing site, most scientific knowledge about the gravitational attractions of the Moon and the planets has been derived from observations of their effects upon the accelerations of spacecraft in orbit around or passing close to them. Radio tracking makes it possible to determine the accelerations of spacecraft very accurately, and the results can be expressed either as terms in a series of spherical harmonics or as the variation of gravity over the surface. As in the case of Earth, spherical harmonics are more effective for studying gross structure, while the variation of gravity is more useful for local features. Spacecraft must descend close to the surface or remain in orbit for extended periods in order to detect local gravity variations; such data had been obtained for the Moon, Venus, Mars , and Jupiter by the end of the 20th century. There are also large, more-local irregularities from visible and concealed structures. Mars also exhibits some large local variations, while the equatorial bulges of Mercury and Venus are very slight. By contrast, the major planets, all of which rotate quite fast, have large equatorial bulges, and their gravity is dominated by a large increase from equator to pole. The polar flattening of Jupiter is about 10 percent and was first estimated from telescopic observation by Gian Domenico Cassini about As mentioned above, Edmond Halley subsequently realized that the corresponding effect on gravity would perturb the orbits of the satellites of Jupiter those discovered by Galileo. The results of gravity measurements are crucial to understanding the internal properties of the planets.

6: Relationship Between Gravity & the Mass of the Planets or Stars | Sciencing

Gravity is the force by which a planet or other body draws objects toward its center. The force of gravity keeps all of the planets in orbit around the sun. The force of gravity keeps all of the planets in orbit around the sun.

We often use the terms "mass" and "weight" interchangeably in our daily speech, but to an astronomer or a physicist they are completely different things. The mass of a body is a measure of how much matter it contains. An object with mass has a quality called inertia. If you shake an object like a stone in your hand, you would notice that it takes a push to get it moving, and another push to stop it again. If the stone is at rest, it wants to remain at rest. This quality or "sluggishness" of matter is its inertia. Mass is a measure of how much inertia an object displays. Weight is an entirely different thing. Every object in the universe with mass attracts every other object with mass. The amount of attraction depends on the size of the masses and how far apart they are. For everyday-sized objects, this gravitational pull is vanishingly small, but the pull between a very large object, like the Earth, and another object, like you, can be easily measured. All you have to do is stand on a scale! Scales measure the force of attraction between you and the Earth. This force of attraction between you and the Earth or any other planet is called your weight. If you are in a spaceship far between the stars and you put a scale underneath you, the scale would read zero. Your weight is zero. There is an anvil floating next to you. Are you or the anvil mass-less? If you grabbed the anvil and tried to shake it, you would have to push it to get it going and pull it to get it to stop. It still has inertia, and hence mass, yet it has no weight. The Relationship Between Gravity and Mass and Distance As stated above, your weight is a measure of the pull of gravity between you and the body you are standing on. This force of gravity depends on a few things. First, it depends on your mass and the mass of the planet you are standing on. If you double your mass, gravity pulls on you twice as hard. If the planet you are standing on is twice as massive, gravity also pulls on you twice as hard. On the other hand, the farther you are from the center of the planet, the weaker the pull between the planet and your body. The force gets weaker quite rapidly. If you double your distance from the planet, the force is one-fourth. If you triple your separation, the force drops to one-ninth. Ten times the distance, one-hundredth the force. The force drops off with the square of the distance. If we put this into an equation it would look like this: The "r" below is the distance from the center of the planet. The masses are in the numerator because the force gets bigger if they get bigger. The distance is in the denominator because the force gets smaller when the distance gets bigger. Note that the force never becomes zero no matter how far you travel. Perhaps this was the inspiration for the poem by Francis Thompson:

7: Gravity Fun Facts for Kids

Gravity is what keeps planets in orbit around the sun. The sun is extremely massive, thus it holds very distant objects, like the outer planets and comets, in its orbit. This can also be seen on a smaller scale, with planets keeping satellites in their orbits; the more massive a planet is, the more distant its satellites.

The starting point for general relativity is the equivalence principle , which equates free fall with inertial motion and describes free-falling inertial objects as being accelerated relative to non-inertial observers on the ground. Einstein proposed that spacetime is curved by matter, and that free-falling objects are moving along locally straight paths in curved spacetime. These straight paths are called geodesics. For instance, we are no longer following geodesics while standing because the mechanical resistance of the Earth exerts an upward force on us, and we are non-inertial on the ground as a result. This explains why moving along the geodesics in spacetime is considered inertial. Einstein discovered the field equations of general relativity, which relate the presence of matter and the curvature of spacetime and are named after him. The Einstein field equations are a set of 10 simultaneous , non-linear , differential equations. The solutions of the field equations are the components of the metric tensor of spacetime. A metric tensor describes a geometry of spacetime. The geodesic paths for a spacetime are calculated from the metric tensor. Solutions Notable solutions of the Einstein field equations include: The Schwarzschild solution , which describes spacetime surrounding a spherically symmetric non- rotating uncharged massive object. For compact enough objects, this solution generated a black hole with a central singularity. For charges with a geometrized length which are less than the geometrized length of the mass of the object, this solution produces black holes with double event horizons. The Kerr solution for rotating massive objects. This solution also produces black holes with multiple event horizons. The Kerr-Newman solution for charged, rotating massive objects. Tests General relativity accounts for the anomalous perihelion precession of Mercury. The prediction of the deflection of light was first confirmed by Arthur Stanley Eddington from his observations during the Solar eclipse of 29 May However, his interpretation of the results was later disputed. The time delay of light passing close to a massive object was first identified by Irwin I. Shapiro in in interplanetary spacecraft signals. Gravitational radiation has been indirectly confirmed through studies of binary pulsars. Alexander Friedmann in found that Einstein equations have non-stationary solutions even in the presence of the cosmological constant. Thus general relativity predicted that the Universe had to be non-staticâ€"it had to either expand or contract. The expansion of the Universe discovered by Edwin Hubble in confirmed this prediction. This was verified on earth and in the solar system around Gravity and quantum mechanics Main articles: Graviton and Quantum gravity In the decades after the publication of the theory of general relativity, it was realized that general relativity is incompatible with quantum mechanics. However, this approach fails at short distances of the order of the Planck length , [27] where a more complete theory of quantum gravity or a new approach to quantum mechanics is required. This image spans half a second and was captured at 20 flashes per second. If an object with comparable mass to that of the Earth were to fall towards it, then the corresponding acceleration of the Earth would be observable. The strength of the gravitational field is numerically equal to the acceleration of objects under its influence. Thus, an object starting from rest will attain a velocity of 9. Also, again ignoring air resistance, any and all objects, when dropped from the same height, will hit the ground at the same time. This means that the Earth also accelerates towards the object until they collide. The force of gravity on Earth is the resultant vector sum of two forces: The force of gravity varies with latitude and increases from about 9. Equations for a falling body near the surface of the Earth Main article: The acceleration due to gravity is equal to this g. An initially stationary object which is allowed to fall freely under gravity drops a distance which is proportional to the square of the elapsed time. The image on the right, spanning half a second, was captured with a stroboscopic flash at 20 flashes per second. This expression is valid only over small distances h from the surface of the Earth. Similarly, the expression h.

8: My Solar System - Motion | Acceleration | Velocity - PhET Interactive Simulations

PLANETS AND GRAVITY pdf

The Sky Tonight Which planets are visible in the night sky from your location. How to Use the Planet Size Comparison Chart Click on a planet or the Sun for details on composition, mass, gravity, and number of moons.

9: Game: Planet X Gravity | The Royal Institution: Science Lives Here

Planetary Fact Sheet in Metric Units. Planetary Fact Sheet in U.S. Units. Index of Planetary Fact Sheets - More detailed fact sheets for each planet. Notes on the Fact Sheet - Explanations of the values and headings in the fact sheet.

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