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Chapter 1 : Near-Earth object - Wikipedia

Abstract 'The Threat from Space' considers the threat of asteroids and comets colliding with Earth. Potential impacts of Near Earth Asteroids, with almost circular orbits, have been identified, but the threat from comets, which follow strongly elliptical paths, is uncertain.

Even though it was later discovered that the asteroid XF11 actually posed little threat, it made many people become aware that the Earth is just a sitting duck in the shooting gallery of space. What are Asteroids and Comets? About four and half billion years ago, our solar system was one big huge cloud of gas and rocks, which was slowly moving together under the influence of gravity. As the material compressed together in the centre, the surrounding gas and rocks started to form into other separate lumps. It was from these that our solar system was formed, with the central mass forming the sun and the separate lumps forming the planets that would encircle the sun. However, there was some material left over, which formed the comets and asteroids that threaten and amaze us today. Meteorites are very common and cause little worry among scientist, about 50 collide with the earth every year, most burning up in the atmosphere. However, it is the big asteroids that cause the most devastation and which worry most scientists. There is band of asteroids named the asteroid belt which contains many huge asteroids, some being miles in diameter. This belt is about million miles from the sun and acts as the boundary between the inner solar system and the outer solar system. Comets however are very different to asteroids in both appearance and makeup. Asteroids are usually made of solid rock which reflects a very small amount of light, but comets tend to contain a lot of water ice which refracts the suns rays making the comet appear to glow. Comets are very famous for their tails, which some times hang hundreds of miles behind to comet glowing in the suns rays. One strange effect of the solar wind is that the tail always points away from the sun following the direction of the solar wind , which often means a comet that is moving away from the sun will have its tail in front, the comet will be moving backwards. This much energy would create a crater 20 miles in diameter, and would throw so much dust and material into the air that the sun would be blocked out for weeks. What About The Big Asteroids? At the present day our solar system contains millions of asteroids, most of which have not been discovered yet. Some of these asteroids are no more than a few feet in diameter and are almost impossible to spot, however, some asteroids measure up to miles wide. In , an astronomer named J. Palisa discovered an asteroid that measured an incredible 37 miles long and 14 miles wide. This amazing asteroid named Ida was the rd to be discovered and is also one of the largest in our solar system. Using a telescopic spectrometer, scientists were able to determine that the asteroid was that of a class S asteroid, which means that the asteroid contains large amounts of iron. However, this asteroid posses little threat to us as it still remains within the asteroid belt, it is far from being on any potential cataclysmic orbit. It is believed that Ida was part of a larger asteroid that was destroyed in a collision with another asteroid. This included almost all the dinosaurs and many forms of plant life, all of which can only be found in fossilised rocks. If an asteroid the size of Ida did hit our planet, virtually all life would be destroyed. If the impact was in the sea which is the most likely place it would create a 2 mile high tidal wave that would hit almost every coast line in the world, a crater the size of Scotland on the sea bed and would throw up enough dust to block out the sun for years. The initial explosion would create a sub-sonic shock wave that would be felt all over the world, an atmospheric shock wave that would travel around the world twice and enough heat to vaporise over a hundred cubic miles of sea water instantly. The Biggest Asteroids Although Ida may be incredibly big, our solar system contains an even bigger monster. This amazing asteroid is miles wide, and is called Ceres. It was discovered by an astronomer named G. Piazza and was the first to be ever discovered. However, it still remains within the asteroid belt and orbits the sun at a distance of million miles. Unfortunately it is not alone, there are two other giants that also exist in the asteroid belt, their names being Pallas and Vesta. Pallas measures at miles in diameter and was the 2nd asteroid to be found. The astronomer who found this was also responsible for discovering the 4th asteroid, Vesta, which is miles in diameter.

Chapter 2 : The Threat of Asteroids

The Threat of Asteroids and Comets. The Unispace III Conference held in Vienna, Austria from 19 to 30 July, addressed a wide range of space issues, and one of the topics that received a good deal of attention was the threat to human civilization posed by potentially hazardous asteroids and comets.

Asteroid Toutatis is a potentially hazardous object that has passed within 2. The risk that any near-Earth object poses is viewed having regard to both the culture and the technology of human society. It has a diameter of about a kilometer 0. It was also observed by radar during its close approach in , allowing much more precise orbit calculations. Although this asteroid will not strike for at least years and thus has no Torino scale rating, it was added to the Sentry list in April because it was the first object with a Palermo scale value greater than zero. By December 28, , additional observations had produced a smaller uncertainty zone which no longer included the Earth during the approach. The risk of impact consequently dropped to zero, but later potential impact solutions were still rated 1 on the Torino scale. The risk was lowered to a Torino rating of 0 in August The original Spaceguard goal has thus been met, only three years late. If we had spacecraft plans on the books already, that would take a year I mean a typical small mission Asteroids can also be members of an asteroid family , and comets create meteoroid streams that can generate meteor showers. The accepted origin of these asteroids is that main-belt asteroids are moved into the inner Solar System through orbital resonances with Jupiter. The asteroid belt has gaps, known as Kirkwood gaps , where these resonances occur as the asteroids in these resonances have been moved onto other orbits. New asteroids migrate into these resonances, due to the Yarkovsky effect that provides a continuing supply of near-Earth asteroids. The rest of the near-Earth asteroids are driven out of the asteroid belt by gravitational interactions with Jupiter. Using this method, an absolute magnitude of Some Amor asteroid orbits cross the orbit of Mars. Some authors define Atens differently: All co-orbital asteroids have special orbits that are relatively stable and, paradoxically, can prevent them from getting close to Earth: Near the orbit of a planet, there are five gravitational equilibrium points, the Lagrangian points , in which an asteroid would orbit the Sun in fixed formation with the planet. Two of these, 60 degrees ahead and behind the planet along its orbit designated L4 and L5 respectively are stable; that is, an asteroid near these points would stay there for millions of years even if perturbed by other planets and non-gravitational forces. The region of stability around L4 and L5 also includes orbits for co-orbital asteroids that run around both L4 and L5. Seen from Earth, the orbit can resemble the circumference of a horseshoe, or may consist of annual loops that wander back and forth librate in a horseshoe-shaped area. By , 12 horseshoe librators of Earth have been discovered. Since the asteroid orbits the Sun slower than Earth when further away and faster than Earth when closer to the Sun, when observed from Earth, the quasi-satellite appears to orbit Earth in a retrograde direction in one year, even though it is not bound gravitationally. By , five asteroids were known to be a quasi-satellite of Earth. NEAs can also transfer between solar orbits and distant Earth orbits, becoming gravitationally bound temporary satellites. Meteoroids[edit] In , the IAU defined meteoroids as a class of solid interplanetary objects distinct from asteroids by their considerably smaller size. Comet nuclei are typically less dense than asteroids but they pass Earth at higher relative speeds, thus the impact energy of comet nucleus is slightly larger than that of a similar-sized asteroid. Short-period comets, with an orbital period of less than years, originated in the Kuiper belt , beyond the orbit of Neptune ; while long-period comets originate in the Oort Cloud , in the outer reaches of the Solar System.

Chapter 3 : Asteroid or NEO impact Earth everyday causing a Threat

While major asteroid strikes are rare in terms of Earth's billion-year geological history, even another Tunguska-sized impact would have a devastating effect on a populated area.

On the low end of the local scale is the fall of meteorites that seem to have a propensity for conking cars for example, the October 9, fall in Peekskill, New York, that demolished an old Chevrolet. These impacts are not known to have caused any serious human injuries in modern times. Progenitors for such meteorite falls are probably bodies only a few meters across. Bodies 50 meters across having modest strengths are likely to strike the ground intact, creating a crater and a local explosion. The airburst over the Tunguska River in Siberia was probably due to the atmospheric entry of a comet or weak asteroid about 50 meters across. Had the Tunguska blast, which leveled 1, square kilometers square miles of forest, occurred over a populated area, the result would have been a devastating disaster with a death toll equivalent to or exceeding such other natural disasters as floods, hurricanes, and tsunamis. Looking at it another way, the risk for a Tunguska-sized impact on a lightly or densely populated area is about 1 percent per century. While the occurrence of a Tunguska-like or larger event over a major city would be an unprecedented human disaster, the consequences to the worldwide ecosystem and climate would be minimal. Assuming that the cosmic impact is not misinterpreted as a hostile nuclear attack set in motion by a real or imagined enemy, the remaining civilizations of the world would presumably remain stable and would be able to supply aid and comfort to the afflicted area. A global event is one where impact fallout dust lofted into the stratosphere, smoke from wildfires, and so on causes global climate change sufficient to disrupt worldwide agriculture and threaten mass starvation. For a global event, all citizens of the world are endangered, regardless of where on Earth the impact takes place -- inhabited or uninhabited areas, northern or southern hemisphere, land or ocean. Sizing Up The Threat Most estimates suggest that an impacting stony asteroid about 1. However, there is much uncertainty associated with making this size estimate, and realistic guesses fall between 0. Another area of uncertainty arises from variations in the nature of potential impactors. For example, asteroids in near-Earth space typically encounter our planet with velocities of about 20 kilometers 12 miles per second. Comets, however, encounter Earth with much higher velocities, typically 30 to 60 kilometers 19 to 37 miles per second. Because the damaging effects are dependent on the kinetic energy of the impact equal to half of the mass of the impactor times the square of its velocity , a comet smaller than 1 kilometer 0. Given their greater numbers in near-Earth space, asteroids probably account for 75 percent of the total hazard. Comets comprise the other 25 percent. From the recent lunar cratering record, from the record of more than now identified terrestrial craters and from our preliminary reconnaissance of near-Earth space, we can estimate that the impact of a 1. Perception of Risk -- Low-Probability, High-Consequence From a sociological standpoint, it is important to consider whether the hazard due to cosmic impacts is worth worrying about at all. Cosmic impacts fall into the category of events that are extremely rare but are of high consequence when they do occur. An airliner crash is an example of an infrequent but high-consequence event that seems to grab international attention. Motor vehicle accidents, on the other hand, kill times more people in an average year, yet these frequent events, with lesser consequences per event, garner comparatively less public attention. Thus it would seem that we, as a society, are attuned to low-probability but high-consequence events. However, extremely low-probability events such as cosmic impacts are beyond our personal and even historical experience, requiring that we take a long-term view in evaluating the hazard and relating it to everyday life. One way to examine the cosmic impact hazard is to compare the long-term threat to you as an individual posed by the two categories of collisions: Tunguska-like events occur on average once every 1, years and are likely to directly result in your death only if you happen to be within the approximately 1,square-kilometer square-mile region of devastation. Given the surface area of Earth, it is fortunate that there is only a 1 in , chance that you would be at the wrong patch of the planet at the wrong time. Thus, in any given year, there is only a 1 in million chance that you will die from a Tunguska-like impact. Over a human lifetime, which we round up to an even years for simplicity, it would seem there is only a 1 in 5 million chance that a Tunguska-like impact will result in your untimely death. A 1 in 5 million chance may be small enough that most people would give it little practical concern. What about the comparative hazard from much less frequent global-scale impacts? Integrated over a century, our simple metric for a human lifetime, the chance becomes 1 in 40, that a large cosmic impact will be the cause of your death. Such a probability is in the realm that most people consider a practical concern.

Chapter 4 : Asteroid AG5 May Pose Threat to Earth in | HuffPost

Five steps to prevent asteroid impacts Editor's note: This post was updated June 28, June 30, the anniversary of the Tunguska airburst that leveled 2, square kilometers of Siberian forest in , has been declared Asteroid Day to raise awareness of the threat asteroids and comets pose to Earth.

This post was updated June 28, June 30, the anniversary of the Tunguska airburst that leveled 2, square kilometers of Siberian forest in , has been declared Asteroid Day to raise awareness of the threat asteroids and comets pose to Earth. This seems like a good opportunity for me to review how we can prevent asteroid impacts â€" a 5 point plan for preventing the only large scale natural disaster we can prevent The good news is the rate of discovery is going up. We are doing quite well at finding asteroids big enough to cause global disaster. But much remains to be done to find a majority of the smaller asteroids still capable of causing regional disasters. Track Even if we find an asteroid, how do we know if is going to hit the Earth? We need to track itâ€" get lots of telescopic observations over days, months, and years, each of which helps us refine the predicted orbit of the asteroid. Without sufficient observations, sometimes needed quickly after discovery, asteroids can even be lost: Characterize To both understand specific asteroids in case we need to deflect them, and to more broadly understand the asteroid population, we need to characterize the asteroids: Asteroids are highly variable, including in ways that could affect missions to deflect or disrupt an Earth threatening asteroid. Deflect If, or really when, an asteroid is found to be on a collision course with Earth, what do we do? This is not a topic you want to first consider when an asteroid is bearing down on Earth with the capability of wiping out a city, or creating a gigantic tsunami. There are a variety of possible asteroid deflection techniques in various states of readiness, but all need more development and testing. Techniques include the slow gravity tractor spacecraft gravity pulls the asteroid , to the mid-range kinetic impactor slam one or more spacecraft into the asteroid , to developing techniques such as laser ablation vaporizing rock to create jets that push the asteroid , to last resort shorter warning nuclear options nuclear disruption, or stand-off nuclear ablation: Coordinate and Educate No matter how you look at it, asteroid impact is an international issue that requires international coordination. Any impact will require international disaster response. Threats will require international coordination on what spacefaring countries will do what to prevent an impact. And, sticky situations will arise. For example, when you deflect an asteroid, as you move the target point off the Earth, you move it across the Earth first, so an asteroid targeting London might need to have its target point cross, say, Moscow on its way to getting it off the Earth. For all these reasons, international coordination ahead of time is critical. And, international education about the asteroid threat is required at all levels, from policy makers, to disaster management agencies, to the general public. It is important for all to be aware of the level of threat and its potential to be prevented. Dangerous asteroid impacts occur rarely, but they will happen with disastrous consequences, unless we stop them. Image from Kulick expedition of The Tunguska blast leveled square kilometers of trees. Grant winners make some discoveries step 1. We supported early lab research into a promising deflection technique step 4 called Laser Bees at the University of Strathclyde in Scotland. We were part of Action Team 14 of the Near Earth Object working group of the United Nations that recommended international coordination groups that have now being implemented step 5. And, we are producing content in a variety of forms from video , to radio , to print to help educate about the asteroid threat step 5. More generally, we are a primary sponsor of the Planetary Defense Conference that brings together experts in all aspects of asteroid threat and impact. With the support of Planetary Society members and supporters, we continue to expand our involvement with Planetary Defense: In a nutshell, here is how I suggest we view asteroid impact: For updates on Planetary Defense and other Planetary Society news and activities, be sure to sign up for our monthly newsletter, The Planetary Post.

Chapter 5 : NASA asteroid-watchers team up on emergency plan with White House, FEMA - CBS News

impact (E) is a function of the diameter of the asteroid/comet (d), the velocity of the impactor relative to Earth (v), and the density of the impactor (D). Equation (1) defines the kinetic energy release expressed in megatons of.

See Article History Earth impact hazard, the danger of collision posed by astronomical small bodies whose orbits around the Sun carry them near Earth. These objects include the rocky asteroid s and their larger fragments and the icy nuclei of comet s. Space in the vicinity of Earth contains a great number of solid objects in a range of sizes. They are also the least dangerous; they either burn up in the atmosphere or settle to the surface as dust. Of the somewhat larger objectsâ€"i. However, there are occasional reports of roughly softball-sized meteorite fragments damaging houses or cars, and in more than 1, people in the Chelyabinsk region of Russia were injured, mostly by flying glass, when a meteorite 17 metres 56 feet wide broke up in the atmosphere. The apparently only verified case of a meteorite hitting and injuring a human being occurred in Reports of falls of meteorites with masses in the one-ton range are less frequent; when these objects strike the ground, they can excavate craters a few metres across. It is only the biggest projectiles, those that collide with Earth very infrequently on average, that are acknowledged to pose a great potential danger to human beings and possibly to all life on the planet. Recognition that such a danger might exist dates back at least to the English astronomers Edmond Halley and Isaac Newton and their work on the Great Comet of , whose orbit they showed crossed that of Earth. Modern interest was rekindled in when the experimental physicist Luis Alvarez of the University of California , Berkeley, and colleagues presented evidence that the impact of an asteroid or comet having a diameter of about 10 km 6 miles was responsible for the mass extinction at the end of the Cretaceous Period The consequences would include a decrease in the amount of sunlight reaching the surface and a prolonged depression of surface temperaturesâ€"a so-called impact winterâ€"leading to loss of photosynthesizing plant life and worldwide starvation and disease. The cloud of dust and carbon gases that resulted is thought by some scientists to have been the cause of the extinction of the dinosaurs. The buried structure, which measures at least km miles across, is thought to be the scar remaining from the impact 65 million years ago of an asteroid or comet measuring perhaps 10 km 6 miles in diameter. Sharpton, University of Alaska, Fairbanks; NASA In the early s astronomers in the United States, followed by those in several other countries, began studies aimed at better defining the risk posed by cosmic impacts, developing programs to detect threatening objects, and determining if anything could be done to protect Earth from the most devastating impacts. One outgrowth of these efforts was the development of a scale for categorizing the potential impact hazard of objects newly discovered to be orbiting near Earth. Short-period comets complete their orbits in less than years and so likely have been observed before; they generally approach along the plane of the solar system , near which lie the orbits of most of the planets, including Earth. Long-period comets have orbital periods greater than years and usually much greater; they can approach from any direction. These determine the total kinetic energy released. A typical NEO would strike Earth with a velocity of about 20 km 12 miles per second and a typical long-period comet with a greater velocity, 50 km 30 miles per second or higher. For objects with diameters less than a few hundred metres, their physical properties are important in calculating how much destruction would result, but for larger bodies only the total energy of the impact is important. Hence, most damage assessments are based on the kinetic energy of an impact rather than the diameter or mass of the projectile. This energy is expressed in millions of tons megatons of TNT , the same units used to quantify the energy released by thermonuclear bomb s. Estimates of the energy released by the impact range between 15 and 40 megatons. A ring-shaped hydroelectric reservoir lake 70 km 40 miles in diameter occupies the centre of the crater. The original outer rim, which measured km across, has been worn down by erosional processes. The impact that formed the crater is estimated to have happened some million years ago, near the end of the Triassic Period, and may have played a role in the mass extinction of species that occurred about the same time. This very wide range corresponds to NEOs with diameters from about 50 metres feet to 20 km 12 miles or to long-period comets with diameters about half as large. Objects smaller than about 50 metres would break up high in the atmosphere; the damage would be limited to less than a few hundred square kilometres around the impact point. For an object at the lower end of this size range, an ocean impact could cause more damage than one on land because it would result in large tsunamis that would devastate coastal areas for many kilometres inland. The last destructive impact known, called the Tunguska event , occurred at the low end of this range over land. On June 30, , an object thought to be as much as 50 metres feet in diameter exploded over central Siberia, leveling about 2, square km , acres of pine forest. Frequency of impacts Because there are far fewer large NEOs and long-period comets in space than smaller ones, the chances of a collision decrease rapidly with increasing size. An impact by a 1-km- 0. On the other hand, an impact by a metre foot NEO, the smallest believed capable of causing regional devastation, is estimated to occur about once every 1, years on average. An impact from a body the size of the Chelyabinsk meteorite of [17 metres 56 feet] is expected to occur once per century. The hazard posed by long-period comets is less certain because fairly few such objects are known, but it is thought to be perhaps as high as 25 percent of that for NEOs. Estimated average times between impacts on Earth for near-Earth objects NEOs over a range of sizes and equivalent amounts of released kinetic energy. Because there are far fewer large NEOs than smaller ones, the chance of an impact drops off rapidly with increasing size. The major difference between the threat posed by the impact of an asteroid or comet and that posed by other natural disasters is the extent of the damage that could be done. In some parts of the world at high risk for floods or earthquakes , the chances of dying in such an event are â€" times greater than the risk of dying from a cosmic impact. NEO search programs The outlook for detecting long-period comets that are specifically on a collision course with Earth is poor. Long-period comets, by definition, would likely be discovered on their way into the inner solar system only a few monthsâ€"or, at best, a few yearsâ€"before impact. Although it might be feasible to detect long-period comets as early as about six months before impact, this knowledge would be useful only if a practical technology were already in place for preventing the collision. And if the comet is not on a collision course, then it is of little immediate concern, because it will not return for at least years and perhaps not for millennia. In principle, the outlook for identifying the larger NEOs is more promising. Using current technology, it is possible to find virtually all NEOs with diameters greater than 1 km 0. A number of loosely coordinated programs to search for NEOs have been instituted. Their objective is to find objects capable of causing global catastrophe were they to hit Earth. The images are then compared with one another to find objects that have moved rapidly. The distance that the object has moved between images and its brightness provide clues to its distance and size. For example, fast-traveling, bright objects are almost certainly very close to Earth. For every NEO a kilometre or larger in size, there are thousands more as small as about metres feet. An impact by a metre object has the explosive power of about megatons of TNT , roughly equivalent to the largest man-made nuclear explosions. If the blast of the Tunguska event had an energy of 15 megatons, as some damage-based estimates have placed it, then the colliding object likely had a diameter of about 30â€"50 metres [â€" feet]. Search programs in the s discovered several NEOs in this smaller size range passing close enough to Earth to attract attention in the popular press. In fact, for each one detected, hundreds of unobserved objects passed just as close or closer. Dozens in this range were larger than metres and thus large enough to cause a devastating tsunami or, if one were to hit land, to destroy an area the size of a small country. The chance of an impact by a metre NEO is about 1 in 10 per century. For each actual impact, however, there will be numerous near misses. Many of these NEOs are certain to be detected as a by-product of searches for the larger objects capable of causing global catastrophes. If sufficient observations are made during its discovery apparition, a fairly good orbit can be computed. In practice, however, few orbits are reliably determined during the first apparition, and later observations of the object are required to learn how its position has changed in the interim. Observations to determine its size are rarely made perhaps several in are so observed , because they require specialized techniques such as radar or thermal infrared radiometry; rather, the size of an NEO is estimated from its brightness. Sizes estimated this way are uncertain by about a factor of 2â€"that is, an object reported as being 1 km 0. In most cases, sufficient observation of an object will establish that the chances of its colliding with Earth are negligible. In some cases, however, there is no opportunity for additional observation. This happens, for example, when the object is small and discovered while passing very close to Earth; it quickly becomes too faint to observe further. Even a larger and more distant object can be lost because of poor weather a factor taken into account in choosing observing sites for search programs. When computations indicate that a NEO estimated to be larger than about metres feet could strike Earth during the next century or two, the object is called a potentially hazardous asteroid PHA. As of there were more than 1, identified PHAs. Observations of PHAs are continued until their orbits are refined to the point where their future positions can be reliably predicted. Torino , Italy, where it was presented at an international NEO conference in The purpose of the scale is to quantify the level of public concern warranted. The value for a given object can change as probability and energy estimates are refined by additional observations. The Torino Impact Hazard Scale is a means of assessing the level of public concern warranted by predictions of close encounters of asteroids and short-period comets with Earth. The value can change as probability and energy estimates are refined by additional observations and more-accurate orbital calculations. Binzel, Massachusetts Institute of Technology. On the Torino scale, a value of 0 indicates that the likelihood of a collision is zero or well below the chance that a random object of the same size will strike Earth within the next few decades. A value of 10 indicates that a collision is certain to occur and is capable of causing a global climatic catastrophe; such events occur on timescales of , years or longer the mass extinction event at the end of the Cretaceous Period falls here. Intermediate values categorize impacts according to various levels of probability and destructiveness. A Torino scale value is always reported together with the predicted date of the close encounter to convey further the level of urgency that is warranted. Since the implementation of the Torino scale, there has been only one NEO with a final value greater than 0. For asteroid VK, there is a 1 in 3, chance that it will strike Earth on June 3, ; this asteroid ranks as a 1 on the Torino scale. Other objects often have received higher initial values, but these values have proved fictitious once the needed additional observations have been made and more accurate orbits have been calculated. Defending Earth from a colliding object Even with the best of search programs, whether anything can be done about an object found to be on a collision course with Earth depends on many factors. The most important are the amount of lead time and the physical properties of the objectâ€"its size, shape, spin rate, density, strength, and other characteristics. Scientists believe that kinetic energy interception is adequate for the majority of objects, including those of intermediate size and most likely to cause destructive tsunamis. Such a strategy would involve the use of a nonexplosive projectile sent to strike the object in a particular location at high speed to change its orbit and possibly to fragment it. For the remainder, more aggressive measures, likely involving the use of powerful thermonuclear devices, are thought to be necessary to achieve the same results. Because the physical properties of NEOs are so poorly known, however, it is possible that such measures could do more harm than goodâ€"e. Validating these options requires additional theory, laboratory experiments, and safe experiments involving actual NEOs in space. In the early years of the 21st century, few, if any, such efforts were being made.

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Yes, everyday an Asteroid or NEO approaches the Earth and could cause a threat to the Earth. Every now and then a NEO makes it to the surface!

Email The White House Office of Science and Technology Policy is spearheading a year plan to improve detection of near-Earth asteroids and comets that could crash into Earth and to expand research into possible countermeasures to deflect an incoming body if detected in time, officials said Wednesday. The National Near-Earth Object Preparedness Strategy and Action Plan also calls for increased international cooperation to prepare for potential global impact threats and work to strengthen U. But if we show impact possibilities for an asteroid, most emergency managers will have no idea what that means or how NASA even came up with this information. Nevertheless, asteroid impacts do occur. The devastation from a similar event today would stretch across the entire metropolitan New York area. An asteroid or comet between and feet across exploded over Tunguska, Russia, in , leveling trees in a square-mile area. A similar blast today would wreak havoc across the entire metropolitan New York area. National Near-Earth Object Preparedness Strategy and Action Plan In February , a foot-wide meteor exploded above Chelyabinsk, Russia , releasing the energy of 30 atomic bombs , damaging buildings below and injuring more than 1, people. Current estimates indicate a population of nearly 10 million NEOs larger than 60 feet across. Chelyabinsk-class events happen every 30 to 40 years, researchers calculate, while impacts by objects with diameters greater than one mile occur once every several hundred thousand years. Those predicted to pass within about 4. There were 18, known NEOs as of June 18 and more than 1, known PHAs, 57 of which are more than 3, feet -- one kilometer -- in diameter. Such objects are informally known as "planet busters" because an impact would trigger a global catastrophe. The impact of an asteroid about six miles in diameter some 65 million years ago led to the extinction of the dinosaurs and many other species. In , Congress ordered NASA to identify and characterize, within 10 years, 90 percent of all comets and asteroids with diameters greater than one kilometer In , the search was expanded to include the identification of 90 percent of near-Earth objects with diameters greater than feet. This image shows the explosion caused when a small pound impactor launched by NASA slammed into comet Tempel 1 in at a relative velocity of 23, mph. NASA The action plans calls for expanding the search for NEOs, streamlining inter-agency communications to deal with possible threats, educating state and local emergency management personnel and developing more detailed plans to deflect an asteroid on a collision course with Earth. Lindley Johnson, a senior planner with the Planetary Defense Coordination Office at NASA Headquarters in Washington, said engineers envision three basic techniques for deflecting an incoming asteroid, all of which require months or years of advance warning. One method would use a so-called "gravity tug," a spacecraft that would fly in tandem with the approaching body to gently nudge it off course with its own minuscule gravity. Another technique calls for crashing a robotic spacecraft into an asteroid at extremely high speed to knock it off course. A demonstration flight is planned in the early s. A third, more drastic, option would be to detonate a nuclear device near the approaching body, not to break it up but to heat its surface to the point that the plume would effectively blow it off its trajectory. But any such flight would require advance warning, enough to launch spacecraft on missions laster longer than a year to reach the target far enough out to deflect it from Earth.

Chapter 7 : Earth impact hazard | astronomy | blog.quintoapp.com

"These effects have been observed by heating by the sun alone," lead author Qicheng Zhang, a physics undergraduate at the University of California, Santa Barbara, told blog.quintoapp.com

Eicher It commenced with a press conference, streamed onto the Internet, featuring a rock star, a filmmaker, and a cosmologist. Asteroid Day is thus intended to raise awareness over the threat from Earth-crossing asteroids. They read a declaration about the danger our planet faces from impacts by small solar system bodies, a document signed by important scientists, astronaut-explorers, entrepreneurs, and celebrities. They described activities that will take place next June to further raise awareness. There, Richters, German-born and a resident of London, screened his film, which portrays events leading up to an asteroid impact in London, a film that was enthusiastically received and featured musical contributions by May. Richters also had the idea, along with his friend, photographer Max Alexander, to assemble a movement that would lead to Asteroid Day. I was even present at a dinner on the summit of La Palma, during the festival, when Richters and Alexander raised the issue of an Asteroid Day and began talking about it as a hypothetical event. And that made what was to come even more absorbing. Although it should be said that whenever Brian May does something, it certainly attracts attention, and the same could also be said of Martin Rees, who is one of the most brilliant people on the planet. The announcement found itself plastered throughout numerous newspapers and online media the world over. The attention was explosive, and certainly was also helped from the inclusion of two ex-astronauts, Ed Lu and Rusty Schweickart, under whose guidance the B Foundation has tackled the asteroid threat. They were also joined by the ubiquitous Bill Nye, president of the Planetary Society, who did an excellent job of explaining the realities of asteroid impact dangers. The Asteroid Day crew, a loose assemblage of folks helping the hard-working Richters, established a website, www. In marking the anniversary, scientists, astronauts, and celebrities will come together to help raise awareness about the dangers our planet faces from Earth-crossing asteroids. To learn more about the events planned for Asteroid Day, visit http: As the mission of Asteroid Day moved toward producing educational content and fleshing out plans for the summer of , reactions to the announcement and the subsequent publicity began trickling in from the community of astronomy enthusiasts. Strangely, I found the topic to be more polarizing than logic would have dictated. But another contingency struck out in social media posts, on blogs, and elsewhere, sometimes even angrily accusing the movement of exaggerating the possibilities of death from the skies. In a world increasingly dominated by character tweets, I found lots of hearsay and accusations washing back and forth with little substance or real understanding. The question arises, then: What exactly is our current best knowledge about the real danger of future impacts? To help answer this, I consulted a number of planetary scientists and read voluminous papers from others. Gradually, a clear picture of reality began to crystallize. Chodas is a leading authority on the dynamics of asteroid orbits and the impact probabilities from small solar system bodies. He is the primary creator of the orbital calculation and impact probability software used by NASA, and specifically the near-Earth object office at JPL. Chodas is, along with his colleague Don Yeomans who has just retired , also a co-developer of the Sentry impact monitoring system, automated software that continuously scans databases of the orbits of known asteroids, checking for potential future collisions. Chodas reminds us that just two years ago, we had two unrelated encounters with small bodies passing close to or striking Earth during the same day. With a mass greater than that of the Eiffel Tower, the asteroid exploded in an airburst, unleashing energy equal to about kilotons of TNT, some 20 or 30 times the energy released in the Hiroshima atomic explosion. Eerily, within 24 hours, DA14, a space rock about 30 meters across, whizzed past Earth at a distance of some 27, kilometers, some 2. Your browser does not support the video tag. The two events, Chelyabinsk and DA14, which seemed intuitively connected due to timing, were not. They were separate objects on completely different orbital paths. But these were just the latest events. In the early solar system, Earth was struck frequently and by large objects. Most planetary scientists believe the Moon formed as the result of a very early collision between Earth and a planetesimal some 4. During the so-called Late-Heavy Bombardment, about 4. The Moon, which does not hide its scars so effectively, shows this impressive battering yet today. Most travelers to northern Arizona are familiar with Meteor Crater near Winslow, and walking the perimeter of the 1-kilometer rim makes for an interesting hike. Some 50, years ago, a to meter iron meteorite, part of the core of an asteroid, hurtled into the desert plain, striking with the force of 15 megatons. In the late s, two geophysicists working for the Mexican oil giant Pemex discovered a huge underwater arc in a ring some 40 kilometers across. They soon found another arc and then discovered the feature formed a circle, suggestive of an ancient impact crater. Near-Earth asteroid Eros spans some 33 kilometers in its longest dimension. They found evidence of a massive impact on Earth coinciding with the boundary between the Cretaceous and Paleogene geological eras, some 66 million years ago. The Alvarez team discovered high levels of iridium and osmium, and four years later scientists found shocked quartz and microdiamonds associated with an extraterrestrial impact. This coincided with the disappearance of the dinosaurs, and the K-Pg Impact first called K-T before the redoing of geological nomenclature was held responsible. Moreover, geological evidence ties the Chicxulub Crater with the impact, giving geologists a place on Earth where the impactor struck. This was no small rock, either, but a roughly kilometer asteroid. Two other recent events gave planetary scientists pause. In , for the first time, astronomers discovered a small asteroid that was heading toward Earth, before it impacted. Designated TC3, the tiny space rock was a 4-meter-wide object weighing some 80 tons that Richard Kowalski of the Catalina Sky Survey near Tucson found on October 6 of that year. Enthusiasts and scientists recovered more than meteorites collectively weighing some The latest by a large asteroid, that of BL86, took place January 26, , when this meter space rock, a binary system, passed 1. A Tunguska-sized meter object passes within the lunar distance from Earth several times a year. This illustration shows the orbits of all of the so-called Potentially Hazardous Asteroids â€" those bigger than meters across that come close to Earth â€" known in early Harris, in fact, is the one who has produced population studies, most recently in and , that have been quoted and used by Chodas and others. According to Harris, objects 6 meters or larger across strike Earth about once every two years. Roughly 10 million Chelyabinsk-sized objects are in Earth-crossing orbits and the impact interval is closer to 50 years. The system of discovery used by Kowalski and his colleagues, the Catalina Sky Survey, is one of the primary tools employed by NASA to search for near-Earth objects and to create a list of so-called Potentially Hazardous Asteroids that could impact Earth. In the U. Congress issued a directive to NASA to discover and track at least 90 percent of near-Earth objects of 1 kilometer or larger in diameter. A further directive in ordered NASA to identify potential impactors of meters or larger. The survey telescope is a 0. Bigelow in the Catalina Mountains just north of Tucson. Lemmon, also in the Catalina Mountains north of Tucson, is used as both a discovery and a follow-up instrument. The Japanese spacecraft Hayabusa landed on the near-Earth asteroid Itokawa in and returned samples to Earth in Itokawa measures just 0. Additionally, the Lincoln near-Earth asteroid Research project has been a collaboration between the U. Like the Catalina Survey, the Spacewatch program is hosted at the University of Arizona and uses two telescopes on Kitt Peak, Arizona, to help survey near-Earth objects. Mainzer also leads a team that has proposed NEOCam, a space-based infrared telescope designed to discover and characterize perhaps the majority of potentially hazardous asteroids near Earth. With these surveys and others underway, astronomers have discovered a large number of near-Earth objects, with more than 12, currently known. Nearly all such objects are known to be asteroids, but about 1 percent are comets. How many of these objects are relatively large? Some are near-Earth asteroids larger than 1 kilometer across, and they would produce a global catastrophe if they struck Earth. Planetary scientists currently estimate that some such objects ought to exist, and therefore that they know of just under 90 percent of them. Chodas and other planetary scientists stress that new telescopes with larger apertures and greater sensitivities, both on the ground and in space, will be needed to find the majority of the smaller asteroids, objects between and meters across. From all that astronomers have learned about asteroids over the past generation, they know that the danger from near-Earth objects is very real. On average, they estimate a

Tunguska-sized asteroid will strike Earth every years. It should be said that the object that created Meteor Crater was an iron asteroid, and that composition enabled it to survive until it struck the ground. It was only a little larger than Tunguska in total mass. But the fraction of iron objects relative to rocky objects is small. A civilization killer like the kilometer asteroid of the K-Pg impact, the extinction event that did away with the dinosaurs, will strike on average every million years. But these are averages; the next big impact could happen next year, or years from now. Or million years from now. The Galileo spacecraft captured this view of asteroid Gaspra in Its dimensions about 19 by 12 by 11 kilometers make it only slightly larger than the kind of asteroid that could wipe out civilization. A small asteroid impact from an object a few meters to a few tens of meters across would cause a localized problem; a meter object might cause a local or regional crisis. An asteroid like the one that scooped out Meteor Crater or flattened the Siberian forest would cause a disaster of epic proportion if it struck a city. No one knows, and current research is investigating, whether a space rock of this size that struck the ocean would cause a far-ranging tsunami. But an asteroid of 1 to 2 kilometers in diameter â€" though it is smaller than the dinosaur killer â€" packs a sinister and devastating punch. A 1- to 2-kilometer asteroid not only causes local and regional devastation, but it also strikes with such force and delivers so much energy that it casts a large amount of material far up into the atmosphere such that it comes down globally. It is this problem that wiped out the dinosaurs, who otherwise by rights should exist still today, and enabled small mammalian survivors to carry on, in need of only modest amounts of food, to evolve 66 million years later into human beings. The 12, near-Earth objects now known by scientists are not the end of the story. Using work from a variety of sources and projects, Chodas estimates that something like 20, such objects in the range of meters or larger must exist in the space surrounding Earth. The range of sizes of these objects is believed to be from about 1 meter to 20 meters. These 20 radar images reveal the meter-wide asteroid HQ, which passed within 1. An incoming meter asteroid will produce an airburst event, unleashing 1 megaton of energy, and this will happen on average every years. A meter asteroid will strike Earth on average once every 2, years and will cause local scale devastation as it hits with 10 megatons of energy. When asteroids are larger yet, the potential for widespread damage and deaths on Earth rises significantly. A meter asteroid will impact Earth on average every 20, years, according to Harris, and will unleash megatons of energy, causing regional scale devastation.

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Chapter 8 : Tracking the threat of asteroids and comets - News - University of Saskatchewan

Scientists are keeping a close eye on a big asteroid that may pose an impact threat to Earth in a few decades. The space rock, which is called AG5, is about feet (meters) wide.

The space rock, which is called AG5, is about feet meters wide. It may come close enough to Earth in that some researchers are calling for a discussion about how to deflect it. Simulation created with JPL Horizons data. So far, researchers have been able to watch the asteroid for just a short time â€" the first nine months of â€" and the numbers may change after further observation, Yeomans told SPACE. Asteroids in Deep Space] "Fortunately, this object will be observable from the ground in the interval," Yeomans said. In the very unlikely scenario that its impact probability does not significantly decrease after processing these additional observations, "there would be time to mount a deflection mission to alter its course before the keyhole," he added. Prudent course of action AG5 may zip through such a keyhole on its close approach to Earth in February , which will bring the asteroid within 0. One astronomical unit is the average distance between Earth and sun, which is approximately 93 million miles million km. According to a JPL estimate, the keyhole â€" through which AG5 must pass in order for there to be a real chance of an Earth impact in â€" is roughly 62 miles km wide. Processing additional observations in the time period, he added, "will almost certainly see the impact probability for AG5 significantly decrease. Johnson said NEO watchers have flagged the asteroid "as one we should keep an eye on. Observing opportunities are even better, he added, starting in November and for several months thereafter. The space rock presents a "decision challenge" to the international community, Schweickart suggested, "in the unlikely chance that its current low, but significant probability of impacting Earth in continues to increase after additional tracking becomes available. He also provided to the Action Team several new appraisals of options for deflection of asteroid AG5 to avoid a potentially dangerous Earth encounter in Delayed deflection campaign A decision date for a keyhole deflection is very soon, if not now, Schweickart suggested. Based on the latest analysis, Schweickart reported, a deflection campaign delayed until after the close approach appears marginally possible, as long as a decision to commit is made immediately thereafter. In the low-probability case in which the impact threat of the asteroid persists beyond its apparition, "should a keyhole deflection campaign be foregone â€" for whatever reason â€" the international community may be faced with the difficult decision of choosing between an expensive multikinetic impactor or a nuclear explosive to prevent an impact should the NEO indeed pass through the keyhole," Schweickart said. The next tracking opportunities of AG5 will occur in September , and then again in November Bolden also remarked that the asteroid makes an apparition in , more than seven years before the close keyhole passage in that could set in motion an Earth impact in the time frame. Leonard David has been reporting on the space industry for more than five decades.

Chapter 9 : Sizing Up the Threat from Near-Earth Objects (NEOs) | The Planetary Society

June 30, , is the th anniversary of the Tunguska event, when a small asteroid or comet flattened more than 2, square kilometers of forest in central Siberia.

Tunguska and similar events Spacewatch and other near-Earth object search programs demonstrate that the Earth is surrounded by a swarm of asteroids and comets that threaten us with collision and world-wide destruction. The danger from near-Earth objects has sparked research into the probability of occurrence of damaging impacts as well as the possibility of deflecting potential impactors before they strike the Earth. The extent of the damage even a small impactor can cause is exemplified by the asteroid or comet fragment which exploded in the air over Tunguska in Siberia in June of with a force equivalent to between ten and twenty megatons of TNT. Such an explosion in the air in which the impactor does not reach the ground intact is called an airburst or airblast. The resulting blast wave leveled hundreds of square kilometers of forest. The area was sparsely inhabited so only two people are reported to have been killed: Vasiliy son of Okhchen died from wounds sustained after being hurled against a tree by the blast, and the aged hunter Lyuburman of Shanyagir died from shock. The Tunguska object was probably a stony body about meters around feet in diameter. An object of this size could easily destroy a large metropolitan center. This nearly happened with Tunguska; a difference in arrival time of a few hours might have seen populous St. Peterburg or another European city destroyed. In fact, at about the same time as the Tunguska object exploded, a small object struck near the city of Kiev. The coincidence in time leads some scientists to speculate that the Kiev object may be a fragment of the Tunguska impactor, or at least, a fragment of the same parent object as the Tunguska impactor. Smaller scale airbursts over populated areas have caused minor damage. For example, an airburst over Madrid, Spain in smashed windows and leveled a wall. There are many reports of airbursts causing tremors and minor damage in inhabited areas. Another which occurred July 7, over New Zealand was captured on videotape. Fortunately, most airbursts occur over the oceans, so no damage to human habitations results. What size impactor makes it through the atmosphere to the lower atmosphere or the ground with enough remaining velocity to produce a damaging airburst or crater-forming impact? Stony bodies greater than 60 meters and less than meters can cause significant airburst damage as at Tunguska. The greatest danger from an ocean impact occurs when the incoming body does not disintegrate in the atmosphere but instead strikes the water relatively intact. The impact raises a tsunami which, if the object is large enough, can devastate coastal areas hundreds of miles away. Tsunamis of unknown origin are usually attributed to earthquakes and volcanos, but it is likely that some -- including the largest and most damaging -- result from cosmic impacts. An asteroid of sufficient size to raise a tsunami with an average height of meters along the entire coast of the ocean strikes once every few thousand years on average. Stony bodies less than meters in diameter do not produce tsunamis, while those larger than meters can produce catastrophic tsunamis. Water waves generated by such an impactor are two-dimensional disturbances that fall off in height only inversely with distance from the point of impact. The average runup in height of a tsunami as it reaches the continental shelf is more than an order of magnitude. An impact anywhere in the Atlantic of a stony asteroid more than m 1, feet in diameter would devastate coasts on both sides of the ocean. Tsunami runups would exceed 60m feet. Frequently it is asserted than there have been no recorded deaths caused by meteorite strikes. In fact, as John Lewis points out in his book Rain of Iron and Ice, there have been a number of injuries and deaths attributed to meteorite impacts throughout history. Walter Branch offers another list of meteorites that have struck man-made objects, humans, and animals. The well-known Richter scale is often used to gauge the severity of an earthquake. The recently developed Torino Scale measures the potential damage from a cosmic impact on a scale on 0 no damage to 10 an impact event capable of causing a global climatic catastrophe. The Torino scale was developed by Richard P. The idea of deflecting impactors before they strike the Earth goes back at least to Lord Byron, who in wrote: Who knows whether, when a comet shall approach this globe to destroy it, as it often has been and will be destroyed, men will not tear rocks from their foundations by means of steam, and hurl mountains, as the giants are said to have done, against the flaming mass? A few ideas for deflecting a threatening near-Earth comet or asteroid include: Fire the rocket engines for a sufficiently long time to nudge the NEO into a new non-threatening orbit. A mass drive accelerates fragments of the NEO into space. The reaction would nudge the NEO into a different non-threatening orbit. Attach a thin solar sail several square kilometers in size to the NEO with strong cables. Solar wind pressure would eventually nudge the NEO into a new non-threatening orbit. Detonate sizable nuclear weapons near the NEO. The vaporized material blown away from the surface would propel the NEO in the opposite direction, again moving the the NEO into a non-threatening orbit. All of these methods -- and many more which have been proposed -- rely on sufficiently early detection of the threat from a particular near-Earth object. That is why the NEO search programs are so important. A sufficiently large impactor we extinguish us and most life on Earth. We could go the way of the dinosaurs without even knowing what hit us. Asteroid And Comet Impact Hazard Bibliography offers a short list of important papers and books on this subject from collected by David Morrison. Rideout calculates the approximate kinetic energy of an impacting asteroid and comet along with the consequences of the impact. Asteroids, Comets, Death, and Extinction by J. Ponder discusses the danger posed by earth-crossing objects. Predictability and Policy Issues by Clark Chapman discusses the history of work on the impact threat and deflection strategies. Probability of Collisions with Earth by Ray Newburn discusses the likelihood of impact events of different sizes. A bit tongue-in-cheek but interesting anyway. Binzel discusses the origin of near-Earth objects and the dangers those pose. Alpha Space Foundation is a not-for-profit organization seeking to build a space-based network of telescopes for detecting threatening objects; a space shield to divert or destroy such objects; and several self-sufficient space settlements to ensure the continued existence of the human race should a large object penetrate the shields and collide with the Earth. These observations are designed to update the orbital elements, and to determine the rotation rates, shapes, and spin axis orientation of the observed asteroids. Asteroid Avoidance by Arthur Krispin surveys several methods of averting catasclysmic impacts of asteroids with the Earth. Toon, Kevin Zahnle, and David Morrison to study the environmental repercussions of asteroid and comet impacts on the Earth. Asteroid and Comet Tracking by John Walker allows you to plot the orbit and current position of an asteroid minor planet or comet by pasting its orbital elements into the text box provided for that purpose on his page. You enter the orbital elements, which permit calculation of the position of the object for a period of time surrounding the Epoch for which they are computed, in the form currently published in the International Astronomical Union IAU and Minor Planet Electronic Circulars. Asteroid Collisions offers background information on collisional outcomes as well as a laboratory impact experiment database. Rideout calculates the approximate kinetic energy of an asteroid and a comet released on impact with the Earth. This team searches for near-Earth objects using technology originally designed by the United States Air Force to track satellites. Asteroid Impact reports on a class project to decide whether or not it would be a good idea to build a research center to study Near Earth Objects. Asteroid Insurance offers a policy against an asteroid impact. Ostro discusses ongoing projects to determine asteroid physical properties and orbits using radar. This includes Earth-crossing asteroids. Asteroids and Comets Threat by Victor D. Noto offers constantly updated news about impact-related research and events. Includes annotated links to a variety of catastrophism, astronomy, and space resources. Asteroids and us discusses the origin and evolution of asteroids, their relationship to comets, and the danger asteroids pose to Earth. Asteroids, Comets, and Meterorites: Broker discusses impacts of comets and asteroids, among other things. Asteroids -- Effects of an Impact on Earth by Mark Prado discusses Tunguska, reports and detection methods of small asteroid hits, effects of impacts on Earth, defense methods, and more. Nuttall discusses proposed methods for deflecting potentially destructive incoming objects. A total of square degrees have been scanned to date, resulting in the discoveries of 62 new asteroids and 1 new comet. Our mission therefore is to serve as a buffer between the scientists and the rest of the global community to help convey the importance of this matter. Comet and Asteroid Risks to Earth offers extracts from several articles and books which discuss the impact threat and means to divert potential impactors. Comet and Asteroid Search by Gil Esquerdo discusses this program, currently in a "wait and see" position, at the Planetary Science Institute. Comet Busters by Peter Tyson is an article from Technology Review which discusses the dangers posed by earth-crossing objects. Tyson discusses some of the proposals for diverting such objects. Comet or asteroid impact with the earth: How real is the threat? Comets and Asteroids and Catastrophes by Glen W. Describes sources of potential dangerous impactors and includes some ancient texts which may describe impact events. Cosmic Collisions by Sally Stephens offers a primer on asteroid collisions with Earth. Nuttall interviews Victor Clube, who discusses the danger of impacts, especially from the Taurid stream. Hale discusses the search for near earth objects and ways to deflect them. A longer version of this article is also available from Florida Today Space Online. Raffrey discusses the threat from NEOs and methods for deflecting them. Asteroids by Brian Friel reports on comments from U. Doomsday Asteroid offers the transcript of a television program about the impact danger. Earth can servive suggests we need to start building a system to protect our planet from destruction. Includes links to various catastrophism resources including some religiously oriented sites. Earth-crossing asteroids by Scott Hudson discusses how and why people study asteroids, the nature of the impact hazard, spacecraft missions to asteroids, what research has told us about asteroids, and more. Also offers links to related web sites and a short bibliography.