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Mission statement: Use Earth-based observations of the dark portion of the Moon to establish the rates and sizes of large meteoroids (greater than 10s of grams or a few ounces in mass) striking the lunar surface. Why it is important: The Meteoroid Environment Office is charged with developing an understanding of the meteoroid environment. Lunar impact monitoring enables measurement of meteoroids in the 10s of grams to kilograms size range which are difficult to measure with other techniques. When we observe: Observations are taken between New and 1st Quarter Moon and between Last Quarter and New Moon, when the solar illumination is between 10 and 55 percent. These conditions yield 10-12 observing nights per month. Who is involved: This project is a joint effort involving NASA's Meteoroid Environment Office and the Marshall Space Flight Center's Space Environments Team. The participating individuals are/have been: Richard Altstatt, Jacobs Technology (2006) Rhiannon Blaauw, JSEG (2010-2017) Emily Bowsher, NASA Academy Intern (Summer 2008) Tiffany Clements, JSEG Victoria Coffey, Space Environments Team (2006-2008) Bill Cooke, Meteoroid Environment Office Lead Anne Diekmann, Jacobs Technology (2008-2010) Leanna Dugger, NASA USRP Intern (Summer 2007) Steven Ehlert, JSEG (2014-2019) Nick Hollon, Jacobs Technology Intern (Summer 2006) Matthew Hosek, NASA USRP Intern (Summer 2010) Aaron Kingery, JSEG Heather Koehler, Meteoroid Environment Office (2006-2014) Leah McCarrick, NASA Academy Intern (Summer 2007) Danielle Moser, JSEG Eric Ramesh, NASA Academy Intern (Summer 2010) Leigh Smith, Space Environments Team (2006-2008) Rob Suggs, Space Environments Team Lead, Lunar Impact Monitoring Lead Ron J. Suggs, Space Environments Team (2006-2018) Wesley Swift, Raytheon (2006-2010) Observing facility: Observations are conducted at NASA Marshall Space Flight Center in Huntsville, Alabama at the Automated Lunar and Meteor Observatory (ALaMO). The facility consists of two observatory domes, a 15 meter (50 ft) tower with a roll-off roof, and an operations center with laboratory space. A second observatory in Chickamauga, Georgia (Walker County) was operational from September 15, 2007 to June 2011. The facility consists of a ground level building with a roll-off roof. This observatory was run remotely from Marshall Space Flight Center. A fourth 14 inch telescope was operated at New Mexico Skies Observatory from October 2011 to September 2012. Lunar impact rate: On average, 33 metric tons (73,000 lbs) of meteoroids hit Earth every day, the vast majority of which harmlessly ablates ("burns up") high in the atmosphere, never making it to the ground. The Moon, however, has little or no atmosphere, so meteoroids have nothing to stop them from striking the surface. The slowest of these rocks travels at 20 km/sec (45,000 mph); the fastest travels at over 72 km/sec (160,000 mph). At such speeds even a small meteoroid has incredible energy — one with a mass of only 5 kg (10 lbs) can excavate a crater over 9 meters (30 ft) across, hurling 75 metric tons (165,000 lbs) of lunar soil and rock on ballistic trajectories above the lunar surface. The lunar impact rate is very uncertain because observations for objects in this mass range are embarrassingly few — a single fireball survey conducted by Canadian researchers from 1971 to 1985. Clearly more observations are needed if we are to establish the rate of large meteoroids impacting the Moon. But why look at the Moon? We need to understand the numbers of meteoroids across a range of sizes so we can evaluate the threat to spacecraft. Small meteoroids are measured with radar as they ablate in Earth's atmosphere. Larger meteoroids are less abundant so a large collecting area is needed to measure a statistically significant sample. The surface of the Moon provides millions of square kilometers of collecting area we can see from Earth. Meteor showers: It is well known that the Earth experiences meteor showers when it encounters the debris left behind by comets; so too does the Moon, though perhaps at not exactly the same time. On Earth these showers are capable of producing spectacular celestial fireworks displays, delighting the public. On the airless Moon, however, these showers are swarms of high energy projectiles, producing fireworks only when they strike the surface with tremendous force. During such times, the rate of shower meteoroids can greatly exceed that of the sporadic background rate and may pose a hazard to spacecraft. Looking for meteor shower impacts on the Moon at about the same time as they occur here on Earth will yield important data that can be fed into meteor shower forecasting models, which can then be used to predict times of greater meteoroid hazard in near-Earth space. Observing lunar impacts: Looking for impacts on the Moon is as simple as pointing a telescope at its dark portion. When a meteoroid strikes the Moon, a large portion of the impact energy goes into heat and producing a crater; however, a small fraction goes into generating visible light, which results in a brilliant flash at the point of impact. This can be seen from Earth if the incoming meteoroid has enough kinetic energy. Just how much is "enough" depends on the equipment used in the observations. In designing a system to look for these impact flashes, we need to take into account two important considerations. First, we want to see as faint as possible, and secondly we want to see as much of the lunar dark side as we can. The first is important because faint flashes are generally produced by smaller meteoroids, and the smaller the meteoroid, the more there are of them. More meteoroids mean more flashes and hence better statistics on which to base improved models. We can also get more flashes by monitoring as much of the lunar surface as possible, as the number of observed hits is going to be directly proportional to the amount of area seen by our instrument. That's why the second point is important. It turns out that a modestly-wide field optical system (one with a fast focal ratio) meets both of these criteria nicely. So we perform simultaneous observations of the Moon using two 14" telescopes. While you can look for impact flashes with just the telescope and your eyes, it is much better to have a record of the event that can be subjected to detailed analysis. A still camera is not a good choice, as you don't know when the impact will occur. Impact flashes are short, usually less than a half-second, and you would be very lucky to press the shutter button in time to get a picture. Even if you did, you would miss the brightest part of the event, which occurs near the very beginning of the flash. A better choice is a low light level video camera, which records continuously at rates of 1/30th of a second. Hours of this data can be stored on a video tape or computer hard disk for later analysis. And that is exactly what we do — we attach a Watec Ultimate H2 camera to each of our telescopes, and route the camera output into a Sony tape deck or Canopus video digitizer, which converts the video signal into a digital format that is stored on a hard disk. After an observing session, we look for flashes in the data. Our first impact was found by someone simply looking through a couple of hours of video. This can be quite tedious, however, and tired humans can easily miss a short impact flash, so custom computer software was developed to look for the flashes. If one is found, additional software is then used to extract detailed information on the flash — its brightness as a function of time (light curve), where it was seen on the Moon, if it was due to a meteor shower, and so forth. Using this information, we can estimate the mass or size of the meteoroid. If it is a sporadic meteoroid, all we can do is put limits on the size, as its speed can range from 20 km/sec (2 miles/sec) all the way up to 70 km/sec (44 miles/sec). If it is a shower meteoroid, then things are better because every member of a meteor shower moves with the same, known speed. This allows us to calculate a single, less uncertain size estimate. The above paragraph gives a greatly simplified summary of the analysis. In practice, it is much more detailed, as a flash on the video may be caused by something other than a meteoroid striking the Moon. Most of the flashes we see last for only a single video frame (1/30th of a second) and are due to cosmic rays striking the camera's CCD chip. If we had only one telescope we would discount any flash that is only one frame in duration, blaming a cosmic ray as the culprit. However, in doing so, we would probably miss some of the smaller impact events. A better way of eliminating cosmic rays is to use two telescopes of similar characteristics, observing at the same time — this is what we do at the ALaMO. A given cosmic ray can only strike one camera; therefore any flash observed simultaneously with both instruments cannot be a cosmic ray. There are other possible causes of flashes, such as reflections or glints from satellites and orbital debris that happen to move between our observatory and the Moon, or point meteors, which are meteors in Earth's atmosphere that are coming straight at the observer. Of course point meteors don't hit, but they produce a flash when they ablate. These flashes can be eliminated by looking at the light curve — an impact flash has a sharp onset, followed by a slower decrease in the amount of light, whereas a point meteor will have a light curve that appears more symmetrical. Flashes produced by satellites can be removed by determining whether or not the flash moves in the video; if it does, then it is caused by a satellite. If the satellite is moving quickly, or the flash consists of a single frame, then this "moving in the video" discriminator is less reliable. The addition of a third telescope at a distance (North Georgia in our case) helps us discriminate against sun glints from orbiting debris via parallax. If the flash shifts position against the background Moon field when comparing images taken from the AlaMO and our second observatory site in Georgia, then it is probably caused by glint from a satellite or orbital debris. If there is no shift of position between flashes viewed from the two different sites, then it is likely a true impact flash. Noise can also masquerade as flashes in the video recording; recording directly to hard drive (instead of recording to videotape and then transferring to hard drive) reduces noise. And using two telescopes to observe simultaneously helps to eliminate this problem. Part of a comprehensive strategy: Monitoring the Moon for impacts is only part of the equation for determining the rate of large meteoroids hitting the Moon and the risk they pose to future space exploration. In order to get at the size of the impactor, we must figure out how much of its energy is converted into light. This amount, expressed as a fraction of the total energy, is called the luminous efficiency, and it depends on the speed of the meteoroid and the nature of the lunar surface where it hits. Current estimates of impact luminous efficiency are little more than guesses, so the Meteoroid Environment Office and the Space Environments Team performed a small series of experiments in which lunar surface simulants were struck by small projectiles fired from hypervelocity guns at speeds up to 6 km/sec (13,000 mph). The flashes from these impacts are recorded by a camera like that attached to our telescopes. A comparison of the amount of light energy produced by the flashes to the known kinetic energies of the projectiles will give us direct calculations of the luminous efficiencies. The values can then be applied to our observations and improved meteoroid size or mass values obtained. View More Impact Candidates The Moon's mass is 7.34 × 10^{22} kg. For an asteroid to have a noticeable effect, its mass must be in that ballpark. the asteroid mass needed also depends on its speed (kinetic energy). what time frame do you want to consider? On a timescale of a billion years, a tiny asteroid will have measurable effects: the change in orbit will be tiny, but over millions of orbits that change will add up. A very big asteroid would be needed to produce effects that would be noticeable in the short term. An asteroid big enough to affect the Moon's orbit would break off large chunks of Moon, which would result in a meteor bombardment on Earth (see Neal Stephenson's novel Seveneves for an example of that), so we'd have more immediate concerns than its influence on tides. A bomb can displace ~100 tons of soil per ton of TNT. So detonating a 1 MT nuclear bomb would displace (optimistically, rock will be harder to move than soil) 100 MT or 10^{11} kg of rock, or a fraction of 10^{-11} of the moon's mass. Also, most of that mass would stay on the Moon, so the total gravitational pull of the Moon would remain the same. The blast would exert some thrust on the Moon, so its orbit could be altered. But again that effect would be tiny, just going by the orders of magnitude we're considering here. What would happen to the Moon really depends on the details: a retrograde impact slows the moon down and widens its orbit, a prograde impact speeds it up and tightens its orbit. To get the Moon to collide with Earth, I'd expect an asteroid the size of the Moon would be needed, or lots of patience. As it is, the Moon recedes slowly: the tides rob orbital energy from the Moon. Small effects like detonating a bomb would be swamped by this effect. A wider orbit means smaller tides. At first, asteroid 2024 YR4 seemed like a potential threat to Earth, but that risk has since been greatly reduced.The asteroid is estimated to be between 30 and 65 metres wide.Meanwhile, the chances of it hitting the Moon have increased. It was recently revealed that it had more than doubled, from 1.7 to 3.8 per cent, according to NASA. Most viewed There is still a much greater chance that it will whiz past the Moon.But what does this mean for the Moon and Earth? Several readers have asked us whether a potential impact on the Moon would have any significant consequences for us on Earth, and whether such an impact could affect the Moon's orbit. Much, much larger asteroidsThis asteroid is about the size of a large building, and it's hurtling along at tens of thousands of kilometres per hour. If the small chance materialises and it actually hits the Moon, it would happen on December 22, 2032, according to current estimates. But even though the asteroid has enough force to create a formidable crater on the surface, it is far too small to have any effect on the Moon's orbit, Stephanie Werner writes in an email to sciencenorway.no.She is a professor at the University of Oslo's Centre for planetary habitability."I don't think any of the known asteroids would alter the Moon's orbit, because the masses of the asteroids compared to the Moon are too small," she writes.We're talking about asteroids that can be many kilometres wide – much, much larger than 2024 YR4. The Moon is massive. It is among the largest moons in the entire solar system. In fact, it is even bigger than Pluto, the dwarf planet located on the outer edge of the solar system. The Moon and Pluto to scale side by side. (Image: NASA) Werner points out that the Earth-Moon system is very stable. Although some models show that the Moon's rotation may have been altered in the past by very large asteroid impacts, says Werner. But this asteroid is not nearly that large.A powerful flash of light? The impact will have no effect on Earth, astronomer Jan-Erik Ovaldsen writes in an email to sciencenorway.no. He runs the astronomy website himmelkalenderen.com.However, there is a chance that we might be able to see the impact itself – if it happens on the side of the Moon that faces us. We never see the far side of the Moon from Earth. "I can't estimate the visibility myself, but some astronomers believe it wouldn't be visible to the naked eye due to bright light. Others think there's a good chance we would see a flash of light, even in broad daylight," he writes.This depends on where exactly the impact occurs. It could happen on the shadowed part of the surface, or in the sunlit area. When there's a full moon, the entire surface facing us is illuminated by the Sun. "On the estimated date of impact, about 70 per cent of the lunar disc will be illuminated. Preliminary calculations show there's a much higher chance the impact would occur on the illuminated side," according to Jan-Erik Ovaldsen. He points out that impacts have previously been observed on the shadowed side of the Moon as visible flashes of light. One example of a flash can be seen in an amateur video from 2023, in the bottom right corner. "If the chances of a Moon collision remain or increase, we can expect professional observatories, space probes, and thousands of amateur astronomers will be watching closely," he writes.Stephanie Werner believes the asteroid would create an impact large enough to be seen with a good amateur telescope – if the collision happens, and if it's on the side facing Earth. Unfortunately, she thinks there is a greater chance the collision would occur on the far side, hidden from view on Earth. So now it's just a matter of waiting: Will the odds increase as we approach 2032? Or will 2024 YR4 quietly disappear back into the solar system? ———Translated by Alette Bjordal GjellesvikRead the Norwegian version of this article on forskning.no The Moon's mass is 7.34 × 10^{22} kg. For an asteroid to have a noticeable effect, its mass must be in that ballpark. the asteroid mass needed also depends on its speed (kinetic energy). what time frame do you want to consider? On a timescale of a billion years, a tiny asteroid will have measurable effects: the change in orbit will be tiny, but over millions of orbits that change will add up. A very big asteroid would be needed to produce effects that would be noticeable in the short term. An asteroid big enough to affect the Moon's orbit would break off large chunks of Moon, which would result in a meteor bombardment on Earth (see Neal Stephenson's novel Seveneves for an example of that), so we'd have more immediate concerns than its influence on tides. A bomb can displace ~100 tons of soil per ton of TNT. So detonating a 1 MT nuclear bomb would displace (optimistically, rock will be harder to move than soil) 100 MT or 10^{11} kg of rock, or a fraction of 10^{-11} of the moon's mass. Also, most of that mass would stay on the Moon, so the total gravitational pull of the Moon would remain the same. The blast would exert some thrust on the Moon, so its orbit could be altered. But again that effect would be tiny, just going by the orders of magnitude we're considering here. What would happen to the Moon really depends on the details: a retrograde impact slows the moon down and widens its orbit, a prograde impact speeds it up and tightens its orbit. To get the Moon to collide with Earth, I'd expect an asteroid the size of the Moon would be needed, or lots of patience. As it is, the Moon recedes slowly: the tides rob orbital energy from the Moon. Small effects like detonating a bomb would be swamped by this effect. A wider orbit means smaller tides. A Japanese astronomer captured the telltale flash of a meteorite impacting the moon, causing a brief flash on our celestial neighbor's nightside. Daichi Fujii, curator of the Hiratsuka City Museum, recorded the event using cameras set to monitor the moon.The time of the flash was 20:14:30.8 Japan Standard Time (7:14 a.m. EST, or 1114 GMT) on Feb. 23. The meteorite appears to have struck near Ideler L crater, slightly northwest of Pitiscus crater, Fujii said. You may like Related: What are asteroids?Japanese astronomer Daichi Fujii captured this shot of a meteorite impacting the moon (bright flash at bottom left) on Feb. 23, 2023. (Image credit: Daichi Fujii (Hiratsuka City Museum))Meteors travel on average at around 30,000 mph (48,280 kph), or 8.3 miles per second (13.4 km/s). Their high-velocity impacts generate intense heat and create craters, while also giving out a brilliant flash of visible light. Moon impacts can be seen from Earth, as captured above, if they are large enough and occur in an area during lunar nighttime facing Earth.The newly created crater could be around a dozen meters (39 feet) in diameter and may eventually be imaged by NASA's Lunar Reconnaissance Orbiter or India's Chandrayaan 2 lunar probe, Fujii said. 私の観測史上最大の月面衝突閃光を捉えることができました！2023年2月23日20時14分30.8秒に出現した月面衝突閃光を、平塚の自宅から撮影した様子です（実際の速度で再生）。なんと1秒以上も光り続ける巨大閃光でした。月は大気がないため流星や火球は見られず、クレーターができる瞬間に光ります。 pic.twitter.com/Bi2JhQa9Q0February 24, 2023While meteors collide with Earth every day, the vast majority of these burn up completely on contact with the atmosphere. The moon, however, has only a very tenuous exosphere, meaning meteors that would not reach Earth's surface commonly impact the moon, creating its crater-covered appearance. These rocks constantly pound the lunar surface, sometimes breaking it right down to fine particles, or lunar soil.Breaking space news, the latest updates on rocket launches, skywatching events and more!Capturing these events also has science value, helping scientists learn the rate of impacts on the lunar surface, which is all the more relevant with the U.S. and other countries preparing to send astronauts to the moon. Follow us on Twitter @Spacedotcom or Facebook. There is a slim 0.3% chance that the space rock could end up hitting the Moon. Christian Garavaglia Meteored Argentina 02/20/2025 7:00 AM 4 min An asteroid of worrying dimensions could hit Earth in less than a decade. The object, identified as 2024 YR4, is about 55 meters wide and traveling at a speed of 48,000 km/h . While the probability of impact remains low, scientists are constantly adjusting their estimates.According to the European Space Agency (ESA) on Wednesday 19, "The probability of asteroid 2024 YR4 impacting Earth in 2032 has increased to 2.8%.""This means that it has surpassed the probability of impact briefly experienced by the much larger asteroid Apophis in 2004. "The asteroid is large enough to destroy an entire city. If it hits, it would release about 8 megatons of energy, equivalent to 500 times the force of the atomic bomb that leveled Hiroshima in 1945. However, astronomers have determined that there is also a smaller chance, 0.3%, that the space rock could end up hitting the Moon .An impact on the Moon: visible consequences, but not catastrophicIn a post on Bluesky, Catalina Sky Survey operations engineer at the University of Arizona, David Rankin, revealed that if a collision with the Moon were to occur, the consequences could be visible from Earth, although without posing any real danger to us . "There is a possibility that this could eject some material that could impact Earth, but I highly doubt it would pose a significant threat," Rankin told New Scientist.The probability of asteroid 2024 YR4 hitting Earth in 2032 has increased to 2.8%.The impact could create a crater of about 2 kilometers in diameter on the lunar surface . However, this would be just a small mark compared to other scars that the Moon has received throughout its history, such as the gigantic South Pole-Aitken basin, which measures 2,400 km in diameter.Professor Gareth Collins, from Imperial College London, said any material ejected from the lunar surface after the impact would likely burn up as it entered Earth's atmosphere . "We would be pretty safe on Earth," he told New Scientist .A key investigation to pinpoint the threatDespite the uncertainty, NASA and an international team of scientists have requested emergency use of the James Webb Space Telescope (JWST) to obtain more precise data on the size and trajectory of 2024 YR4 . Until now, astronomers have only been able to analyze it through ground-based telescopes, by measuring the amount of light reflected by its surface.The JWST will allow for more detailed analysis by measuring the heat emitted by the asteroid. This will provide a more accurate picture of its true size and composition, helping to determine whether it poses a significant threat to Earth or the Moon ."As of now, there's still a 97.9 percent chance of not hitting Earth," Rankin told Live Science . "When the odds doubled from 1 percent to 2 percent, it created a lot of buzz. But it's not the same as going from 40 percent to 80 percent. This asteroid is not something we're losing sleep over . "For now, the risk remains low, but scientists will continue to monitor the trajectory of 2024 YR4 to determine whether it could become a real threat in the future. Until then, humanity can continue to observe the cosmos with fascination and caution. From the September 2023 issue It can take millions of years for debris from a lunar impact to fall to Earth, and most modern-day strikes are small. By Astronomy Staff | Published: September 11, 2023 | Last updated on January 30, 2024 What would happen on or to Earth if a large asteroid hit the Moon? Gary WatsonPittsburgh, Pennsylvania Asteroids pummeling the lunar surface is an ongoing process. Geologists listened to the thumping of impacts with seismometers placed on the Moon during the Apollo missions, and astronomers continue to record collisional impact flashes with Earth-based telescopes. Most impacts are small, but as recently as 2013, an intense flash of light led geologists to a freshly excavated 62-foot-diameter (19 meters) crater in Mare Imbrium. When larger asteroids produce craters with diameters of a few hundred meters, rock is catapulted into space at escape velocity. Some of that debris collides with Earth, usually within a million years, blazing trails of ionized gas through the atmosphere before falling to the ground relatively harmlessly, like other meteorites. Researchers have recovered several hundred of these lunar meteorites and traced them to over a hundred different asteroid impacts that threw out rock from the Moon in the recent past. Deeper in geologic time, an intense epoch of asteroid bombardment produced impact basins on the Moon with diameters larger than 185 miles (300 kilometers). During that 4-billion-year-old epoch, the Moon was about three times closer to Earth and three times larger in the sky. Each basin-size impact engulfed the Moon with rocky debris and a fiery plume of melt and vapor. A substantial fraction of that debris escaped the Moon and struck Earth within 100,000 years of impact, filling the sky with countless meteors. The largest of these fragments survived atmospheric deceleration and cratered Earth's surface, potentially perturbing nascent microbial communities. But these impact events were dwarfed in number and size by the asteroids that took aim at Earth directly. Asteroid bombardment and how it shaped the Earth-Moon system is a key scientific target of Artemis exploration. Astronauts will soon be walking across an impact-cratered landscape, collecting clues about those collisional processes. So stay tuned for new revelations. David A. KringPrincipal Scientist, Lunar and Planetary Institute, Houston, Texas Dave - Okay. There are two questions there. If a meteor hit the moon and blew it in to thousands and thousands of pieces, what would happen to the Earth? The short answer is that we would have a nuclear winter. You would put huge amounts of rock into the atmosphere. It would block out the sun.Chris - It will actually reach us, would it?Dave - If it hit hard enough to blast the moon into millions of pieces, then there would be enough energy that a significant portion of the moon would land on our atmosphere. You'll get huge amounts of dusts in the atmosphere. All the plants would die.Chris - Because some people suggested that one way to mitigate against global warming is in fact to create a cloud of dust by mining the moon and ejecting material into orbit in the same orbit as the moon, therefore, creating a sort of buffer against solar influx, and this would cool down the Earth a bit.Dave - Yes. If you completely destroy the moon, it would be like that...Chris - In fact it would cool down a lot!Dave - A billion times over! And the Earth would be a pretty nasty place. The other question is if you just got the moon and took it away, and disappeared it somehow, what would happen? You'd immediately lose the tides because those are due to the moon's gravity. And also, on a longer term, there would be some subtle effects; the axis of the Earth is actually stabilised by the moon orbiting it. The moon's got huge amounts of angular momentum, so perturbations don't tend to have a very large effect on it and it tends to stabilise the direction of the Earth's axis over millions of years.So, if you then waited millions of years, the Earth's axis would rotate and that could have all sorts of complex effects on the weather and life in general and also not having tides could have all sorts of strange effects on weather because you're not mixing the oceans and the oceans move far more energy around the Earth than the atmosphere does. Although asteroid impacts are now much more rare, smaller impacts from meteoroids (smaller than one meter or three feet in diameter) still happen on the Moon every day, just like they do on Earth. Whereas our planet's atmosphere burns up most meteoroids that intersect our orbit, the Moon has nothing to burn up or even slow down an incoming rock. Traveling at speeds as great as 72 kilometers per second (160,000 miles per hour), even a small rock can create a sizable crater.What would a large impact do?If a large asteroid were to impact the Moon, it would create a large crater that would eject a lot of material from the surface, but that would be the extent of the damage. There aren't any asteroids large enough to split the Moon apart or knock it off its orbit around the Earth. In fact, the total mass of all the Solar System's asteroids combined is less than the mass of the Moon.Impactors that would cause widespread damage on Earth would not cause nearly the same problems if they impacted the Moon, even though there's no lunar atmosphere to slow them down. The reason is simple: there's nothing to destroy on the Moon. Damage on Earth is not about the rock underneath us being disturbed, but about the structures, ecosystems, and individual lives that are affected. On the Moon, the only thing that would be affected by an impact is the rock of the lunar surface.Although it's possible that an impact in just the wrong place could disturb the historically significant Apollo landing sites, the chances of that happening are very slim. The Moon's surface area is about 38 million square kilometers (14.6 million square miles), and even with smaller meteoroids that impact more frequently, any given square kilometer patch of ground only gets hit every thousand years or so by an object the size of a ping pong ball or larger.How likely is a large asteroid impact?Potentially hazardous asteroids are those larger than about 140 meters (460 feet) with orbits that bring them within 7.5 million kilometers (4.5 million miles) of Earth's orbit — which would also bring them close to the Moon. As of March 2023, NASA has identified around 2,300 asteroids that are considered potentially hazardous. All of their trajectories have been calculated, and none threaten Earth (or, therefore, the Moon) for at least the next 100 years. Smaller asteroids are more likely to sneak up on us, and are therefore more likely to impact the Moon as well as Earth. An expert has revealed the impact it would have on us if the 'city destroying' asteroid '2024 YR4' hit the Moon instead of our planet.Earlier this month, scientists over at NASA increased the likelihood of Asteroid 2024 YR4 colliding from 1.2 percent to 2.3 percent.Experts say the asteroid could come plummeting into the Earth on December 22, 2032.Reports suggest it could be as big as the Statue of Liberty, so it's important scientists tread carefully when it comes to how's best to approach things.The 'city destroyer' may hit in just under eight years (Getty Stock Photo)But scientists have now also warned there's a chance 2024 YR4 could collide with the Moon.David Rankin, who works as an operations engineer for the University of Arizona's Catalina Sky Survey, has said there's a 0.3 percent chance the asteroid could hit the Moon.And if that unlikely collision was to occur, the impact it would have on us is actually minimal."There is the possibility this would eject some material back out that could hit the Earth, but I highly doubt it would cause any major threat," Rankin told New Scientist.While Gareth Collins, of Imperial College London, added: "We would be quite safe on Earth. Some small ejecta fragments might reach Earth, but [would be] totally harmless."These would ultimately burn up in the atmosphere, according to the expert - meaning no harm done for us on Earth.Meanwhile, Dr Robin George Andrews previously warned that even protecting ourselves from the asteroid's impact could go wrong.There's a chance the asteroid could collide with Earth (Getty Stock Photo)On Twitter, the expert referred to the Double Asteroid Redirection Test (DART), a mission dedicated to investigating and demonstrating one method of asteroid deflection by changing an asteroid's motion in space through kinetic impact."Nobody wants to accidentally 'disrupt' an asteroid, because those components can still head for Earth. As I often say, it's like turning a cannonball into a shotgun spray," Andrews said."But we aren't going to see it again until another Earth flyby in 2028. So much could go wrong if we try and hit it with something like DART."It may be smaller, or larger. If it's too big, we may not be able to deflect it with one spacecraft. We'd need several to hit it perfectly, all without catastrophically breaking it."As for where it'll hit the Earth, Rankin mapped out a 'risk corridor', predicting it to collide anywhere around northern South America, across the Pacific Ocean, southern Asia, the Arabian Sea, and Africa.That would mean that India, Pakistan, Bangladesh, Ethiopia, Sudan, Nigeria, Venezuela, Colombia, and Ecuador would be at risk of taking the brunt of the impact. Is asteroid 2024 YR4 on a collision course with the moon? By Lauren WellbankPublished April 4 2025, 2:07 p.m. ETSource: NASA/UnsplashWhat would happen if an asteroid hit the Earth's moon? No, it's not the plot of an upcoming blockbuster movie starring everyone's favorite action heroes. Instead, it's the very real prediction NASA is making after the discovery of asteroid 2024 YR4.The experts at the space agency have said that there is a small probability that the asteroid could make contact with the Earth's satellite, raising questions about what that could mean for life here on our planet. Article continues below advertisementWhile it doesn't sound like it would look anything like the special effects we would expect to see in a Hollywood film, there are some things that NASA says we can, and cannot, expect to see if an asteroid makes direct contact with our moon.Keep reading to learn more, including when 2024 YR4 is expected to make impact. Source: Dennys Hess/UnsplashArticle continues below advertisementBefore you start to worry about how apocalyptic an asteroid hitting the moon could be, it's important to realize that asteroids hit the Earth's moon all the time. In fact, The Planetary Society says that these space rocks are actually what gives the moon its cratered texture. And, while the number of craters on the moon likely number in the millions, The Planetary Society says that not every divot was caused by an asteroid. So, other than a lot of dents, what does happen when asteroids hit the moon? It depends on the size. For example, a large asteroid would make a large hole and send a lot of debris up into the atmosphere. Smaller asteroids would make smaller dents, and likely send up less of a cloud. The good news is that, despite what Hollywood would have us believe, it's unlikely that any asteroid could do much damage to the moon. Article continues below advertisementSource: Syed AhmadThe Planetary Society says that even if you combined all of the asteroids our solar system, it still wouldn't be big enough to do significant damage to the moon, making it next to impossible for a "city killer" asteroid to even do so much as put a crack in the moon's surface. Article continues below advertisementLike we mentioned, NASA has discovered an asteroid that has a small chance — as of April 4, 2025, NASA put the probability of impact at 3.8 percent, according to the BBC — of hitting the moon in 2032.The space agency has been tracking 2024 YR4 using the James Webb Space Telescope, and periodically updates the probability of an impact as new information is observed. The Moon is at risk of colliding with an asteroidAstronomers are monitoring the asteroid 2024 YR4, which may collide with the Moon. Its size is estimated at 53-67 meters, and its rotation speed is 19.5 minutes. Calculations show that the probability of a collision is 0.3%, and… pic.twitter.com/0sLavg8ZUa— Black Hole (@konstructivizm) April 4, 2025 Article continues below advertisementThe 2024 YR4 is estimated to be the size of a 10-story building. Of course, NASA officials haven't really dialed in on the asteroid's size yet, thanks to the distance and rate of speed it's traveling at. But, to put it into perspective, NASA says that the largest asteroids — which are known as Vesta and clock in at about 329 miles in diameter — are far more formattable than 2024 YR4, which is just an estimated 130-300 feet in diameter. That should bring a sign of relief to anyone who was worried about the possible consequences an asteroid could have when it makes impact on the moon, since it doesn't sound like 2024 YR4, or any asteroids really, will have too much of a negative impact on the satellite. Latest Weather & Global Warming News and Updates