**HERA**

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| Soundbites |  |
|  | Text  **Chapter 1: What is Hera?** |
|  | This is the moment a spacecraft crashed into an asteroid...  2 years ago, NASA made history by intentionally slamming into an asteroid with its DART mission.  The asteroid was not a threat to us here on Earth, but scientists wanted to see if they could change the path of an asteroid to test a technique that could one day protect us from a real threat.  The experiment was a success: humans can move an asteroid.  But the bad news is that scientists aren’t sure yet they understand why it worked. There is still a lot we do not know. Like, what exactly happened on the asteroids surface after impact, what the asteroid is made of and how well the deflection worked. .  Ultimately The DART impact remains a mystery in space.  But our Hera spacecraft will soon fly to that same asteroid to answer all our questions.  Hera will perform a close-up ‘crash scene investigation’, gathering data on the asteroid’s mass, structure and make-up to turn this kinetic impact method of planetary defence into a well understood and repeatable technique. |
|  | **Chapter 2: Why do we need to protect our planet?** |
|  | In 1908, people reported a bright flash and a noise that sounded like a bomb ten minutes later. This was from the largest observed asteroid strike ever recorded which occurred over the Tunguska region in Siberia.  People up to 500 miles away reported seeing the flash, some claimed it was even brighter than the Sun. The explosion was massive, causing 80 million trees to flatten, windows up to 250 miles away to smash and the effects of the shockwave could even be felt in London!  This represented a lucky escape for Europe: it happened just a short distance from affecting heavily populated regions. As a result, ESA, NASA, and other space agencies started closely monitoring space to track potentially dangerous asteroids.  So far, we have found more than 20,000 asteroids whose orbits bring them dangerously close to Earth.  But if one was on a collision course with us, what could we do?  To answer this question, an international team came up with the first planetary defence mission: DART, to hit the asteroid, and Hera, to gather data after the impact. |
|  | **Chapter 3: Knowing there are so many asteroids that could be a danger to us, how did we pick one to explore?** |
|  | The asteroid that DART hit and that our Hera spacecraft will now visit is called Dimorphos. It’s a small asteroid, about half the size of the Eiffel Tower, but if it impacted Earth, it could devastate a small country or city.  Dimorphos orbits a larger asteroid called Didymos which Hera will also visit.  Together, the two asteroids form the Didymos system.  Here are some of the reasons why scientists decided to explore the Didymos system among all the asteroids out there:   1. The two asteroids are not a real threat to Earth so nudging one of them wouldn't accidentally set it on a crash course to Earth. 2. The system passes relatively close to Earth, so they are not impossible to get to. 3. The 150-m diameter of Dimorphos is important. We know about 95% of all near-Earth objects larger than 1 km in size, but the majority of smaller asteroids are yet to be discovered, despite their ‘city-killing’ potential. 4. Since Dimorphos orbits Didymos, we can easily see any changes in its orbit from Earth. |
|  | **Chapter 4:** *So, what are we expecting to see on Dimorphos? We asked one of our experts Patrick Michel, the principal investigator of the Hera mission to find out more* |
|  | **Inteview with Patrick Michel**  **00:17:00 -00:38:00**    *"What do we expect to find on Dimorphos? That is a big question because we don't really know. The DART mission by NASA made an impact on Dimorphos and based on the current data that we have there are different solutions. Dimorphos may host a crater whose size is unknown, or it could be completely reshaped."*   Prior to DART’s impact, it took Dimorphos 11 hours and 55 minutes to orbit its larger parent asteroid. Since the collision, astronomers have found that the spacecraft’s impact altered Dimorphos’ orbit around Didymos by 33 minutes, shortening the orbit to 11 hours and 22 minutes.  The mission was deemed a large success but to learn more about these asteroids’ physical properties and DART impact outcome, we need to visit them.  Initially, we thought that when DART crashed into Dimorphos it would create a big impact crater – potentially the first one ever made by humans. But now, scientists think there might not be a crater on Dimorphos after all.  More recent simulations suggest the impact might have completely changed the asteroid's shape. Scientists estimate that around 8% of the asteroid’s mass was shifted around its body and 1% of the entire mass of Dimorphos was thrown into space, some of which may reach us here at Earth as small meteroids.  **Inteview with Patrick Michel**    **03:30:00 -03:51:00**  *"So, the DART impact created a lot of ejecta, a lot of material, that is still escaping from the system, tens of thousands of km from Dimorphos. And it may be that some particles eventually reach Mars or Earth in the form of shooting stars. What you see in the night sky, with no risk."*  **00:47:00 -00:54:00**  *"We do not know what it looks like now, so there are going to be a lot of surprises. I am so excited because in 2 years we will have the answer."*  Crater or no crater, we need to go back to Dimorphos to study the aftermath of the impact. This will help us turn the DART deflection experiment into a well-understood, repeatable technique that might one day be needed for real. |
|  | **Chapter 5: How do we get there?** |
|  | *So, we know it will take us 2 years to reach the asteroids after launch. But how do we get there?*On its way, Hera will make a swingby of Mars in March 2025, borrowing speed to help reach its destination. In the process, Hera will get as close as 6 000 km from the surface of the Red Planet, closer than the orbits of the two martian moons!  Hera's trajectory will be tweaked so that it can train its science instruments onto Mars’s smaller moon Deimos from less than 1 000 km away, a practice run for when it reaches the asteroid system, while also observing Mars itself.  A second deep space manoeuvre in February 2026 will line Hera up for arrival at the Didymos system. Hera will have an ‘impulsive rendezvous' with the system in October 2026, meaning it will be captured by their gravity and begin to orbit.  Didymos’s gravity is estimated to be about 40,000 times weaker than Earth’s while Dimorphos’s is approximately 200,000 times weaker. This is so low that Hera must orbit around their common centre of gravity at very low velocity to remain captured. To maintain the optimal distance for studying the asteroids, Hera's orbit will need regular adjustments, otherwise the spacecraft could gradually drift away from them.  The possibility of Hera touching down on one of the poles of Didymos at the end of its mission is being considered. Although, it has not been specifically designed for landing it could descend towards the surface. However, once on the surface, Hera will no longer be able to communicate with us on Earth, effectively bringing the mission to an end.  . |
|  | **Chapter 6: What type of technology do we need to inspect an asteroid?** |
|  | Although Hera itself may not land on the asteroid, it is packed with new technologies which will allow us to study the asteroids in extraordinary detail. Hera carries a total of 12 instruments to explore the Didymos system.  It has a state-of-the-art camera which will take detailed pictures of the asteroids, a laser altimeter which will create a map of the asteroid’s surface, a camera which can look at the asteroids in different colours of light to find out exactly what they’re made of, a radio science experiment which can use radio waves to figure out the mass and gravity of the asteroids.  To explore Dimorphos and Didymos, Hera doesn’t go by itself. Instead, the spacecraft carries two shoebox-sized ‘CubeSats’ that resemble terrestrial drones, able to fly closer and take more risks, and eventually even land – a world first!  *Let's learn more about them from Patrick Michel:*  **Inteview with Patrick Michel**  **01:20:00 -01:58:00**  *"This is the first time that we send a spacecraft with two CubeSats that will do deep space exploration of an asteroid. And the reason why we bring these CubeSats is because we want to go to a very close proximity to the asteroid and we don't want to cause any risk to the main spacecraft. These two will have their own instruments. For example, for the first time will be able to probe the internal property of an asteroid which has never been done before, on the Juventas CubeSat. On the second CubeSat, Milani, we will measure the mineralogical composition of the asteroid and detect whether there is still dust around the body (??)"*  The two cubesats, called Juventas and Milani, will get up close and personal with the asteroids.  Juventas will use radar, sending out radio waves that will bounce off the asteroids and come back. By measuring how long it takes for the waves to return, we will be able to tell how far away the asteroid is at any given point and even what shape it is. More importantly, it will allow us To explore what an asteroid is like on the inside for the first time. Is Dimorphos a rubble pile or a monolith covered with pebbles and gravels?  Once it has inspected both asteroids it will then descend to Dimorphos’ surface, to take detailed pictures of the surface features, including hopefully the exact spot of the DART impact. Once on the ground, it will use a gravimeter to increase our knowledge of the gravity field of the asteroid.  The other CubeSat, Milani, will measure the mineralogical composition of the asteroid and will analyse any surrounding dust. Later on, it will also attempt a landing on Dimorphos. Its onboard instruments will gather valuable data on the landing and any subsequent bounces, to give insight into the surface properties of the asteroid. If Milani lands safely, its VISTA instrument will analyse the dust on Dimorphos’ surface. |
|  | **Chapter 6: Conclusion** |
|  | By the end of the six-month exploration by these three spacecraft, scientists will have a better understanding of the delicate art of asteroid deflection, and asteroid impacts will become the first avoidable natural disaster.  At first glance, an asteroid is just a tiny dot of light in the sky. We require more observations to see if it is a real threat.  Planetary defence is a global problem and therefore we need to be able to work together with other space agencies to protect our planet and Hera is the perfect demonstration of that. |
|  | **ESA OUTRO** |
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| 10:04:38:18 | **END** |