

## THE CONVERSATION

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# Metal asteroid Psyche is all set for an early visit from NASA

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NASA/JPL

Three times further away from the sun than the Earth lies an enormous lump of metal. Around 252km in diameter, the metallic “M-class” asteroid 16 Psyche is the target of NASA’s next mission to the belt of giant rocks that encircles the inner solar system. And the space agency now plans to visit it **much sooner** than originally planned.

Not only has the launch has been brought forward one year to the summer of 2022, but NASA’s scientists have also found a way to get to Psyche (pronounced SYKe-ee) much faster by taking a more efficient trajectory. The new route means the Psyche spacecraft won’t have to swing around the Earth to build up speed and won’t pass as close to the sun, so it needs less heat protection. It is now due to arrive in 2026, four years earlier than the original timeline.

The main aim of the journey to Psyche is to gather more information about our own solar system. Psyche is one of many wandering members of the asteroid belt. Unlike the rest of its rocky neighbours, Psyche appears to be entirely made of nickel and iron, just like the Earth’s core. This, together with its size, has led to the theory that it might be the remains of the inside of a planet.

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Asteroids are made up of primitive materials, leftovers from the dust cloud from which our solar system originated. Different types of asteroids resemble the various steps it took to form planets from this dust cloud. This means they reveal a lot about the origin and evolution of our solar system. Scientists think Psyche could be what's left of an exposed metal core of a planet very similar to Earth.



Psyche shares its home on the asteroid belt with more than 7,000 other planetoids. Shutterstock

We actually derive much of our knowledge about asteroids and the evolution of planets from the study of meteorites. Many asteroids and comets are primitive protoplanetary bodies accumulated from the same dust cloud our solar system originates from. As these protoplanetary bodies collide, gravity pulls them together into ever-larger bodies. Eventually these bodies become big and hot enough to partially melt, allowing heavy materials such as iron to sink to the core – and lighter material such as silicon to rise to the surface.

This process, known as **differentiation**, explains why Earth and other planets such as Mercury, Venus or Mars have an iron core and silicon-rich mantle and crust. The 16 Psyche asteroid is thought to be the leftover iron core of a planet stripped of its mantle in a giant collision.

But many questions regarding the formation of Psyche remain. How do you strip a planet of its mantle only leaving the core? Perhaps there is an alternative formation mechanism of an iron-rich body that does not involve differentiation? Psyche may once have been molten and, if so, did it cool from the inside out or from its surface to the core?

Also, Earth's magnetic field comes from a liquid outer core circling around a solid inner core. Did these processes occur on Psyche and create a magnetic field? What elements other than iron accumulate in a core? And how does the surface geology of an iron body look compared to a rocky or icy body?

## Avoiding collisions

There are other reasons for visiting asteroids. For one thing, possible collisions with Earth can have devastating effects. The impact of an 15km-wide asteroid approximately 65m years ago is linked to the extinction of the dinosaurs. And the explosion of the 30m-diameter Chelyabinsk asteroid over Russia in 2013 led to injuries and damage on the ground. We need to know as much as possible about the composition and physical make-up of asteroids to devise the best ways to defend our planet.

Asteroids also provide resources. Those containing water or other valuable materials may act as stepping stones for human exploration of the solar system. And asteroids crossing Earth's orbit may become convenient targets for mining operations, providing materials that are running out on Earth and potentially taking environmentally detrimental extraction methods off Earth. Companies including Planetary Resources and countries like Luxembourg have already started to pursue these ideas in earnest.

The Psyche spacecraft will carry four instruments to gather as much information about the asteroid as it can: a camera, a gamma-ray spectrometer to record what chemical elements are there, a magnetometer, and a radio gravity experiment. The data these devices collect should help us work out if Psyche is the frozen core of a former planet or simply a lump of unmelted metal. If it is a core, then it might help us determine exactly what's at the centre of our own planet.

Lindy Elkins-Tanton, the lead scientist of the mission, probably summarised it best: "We learn about inner space by visiting outer space".

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