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MISSION TO A METAL WORLD

INFOGRAPHIC BY JAMES ROUND

Scattered throughout space are asteroids with secrets to reveal. They can give us glimpses into the origins of our Solar System and tell us how planets are formed. But more than that, asteroids might even have transported the building blocks of life to Earth. A great deal of space exploration has involved missions to better understand these rocky relics. But this October, the next one – Psyche – is due to launch. As it embarks on its journey to the large metallic asteroid that inspired the mission's name, it's hoped Psyche will give scientists the opportunity to gain fresh insights into these ancient astronomical bodies.

3 PROPELLING TO PSYCHE

The spacecraft is the first to use Hall thrusters beyond lunar orbit. Electricity from the solar arrays is used to generate electromagnetic fields to ionise Xenon fuel, which is expelled to propel Psyche through space.

WHAT MAKES PSYCHE SPECIAL?

Psyche was spotted by Annibale di Gasparis in 1852 and was the 16th asteroid to be discovered. It's the largest known M-type asteroid, meaning that it has a metal-rich composition. At 226km (140 miles) in diameter, it's roughly 1/16th the diameter of the Moon. Scientists believe that Psyche may be a partial core from a planetesimal, one of the building blocks of our Solar System's terrestrial planets, which could offer new insights into how planets like Earth form.

6 GOODBYE PSYCHE?

After completing its scientific investigations, Psyche's mission will come to an end. However, with the asteroid's resources valued at \$10 quintillion, there are plenty of reasons for a return trip!

2 ASSISTANCE FROM MARS

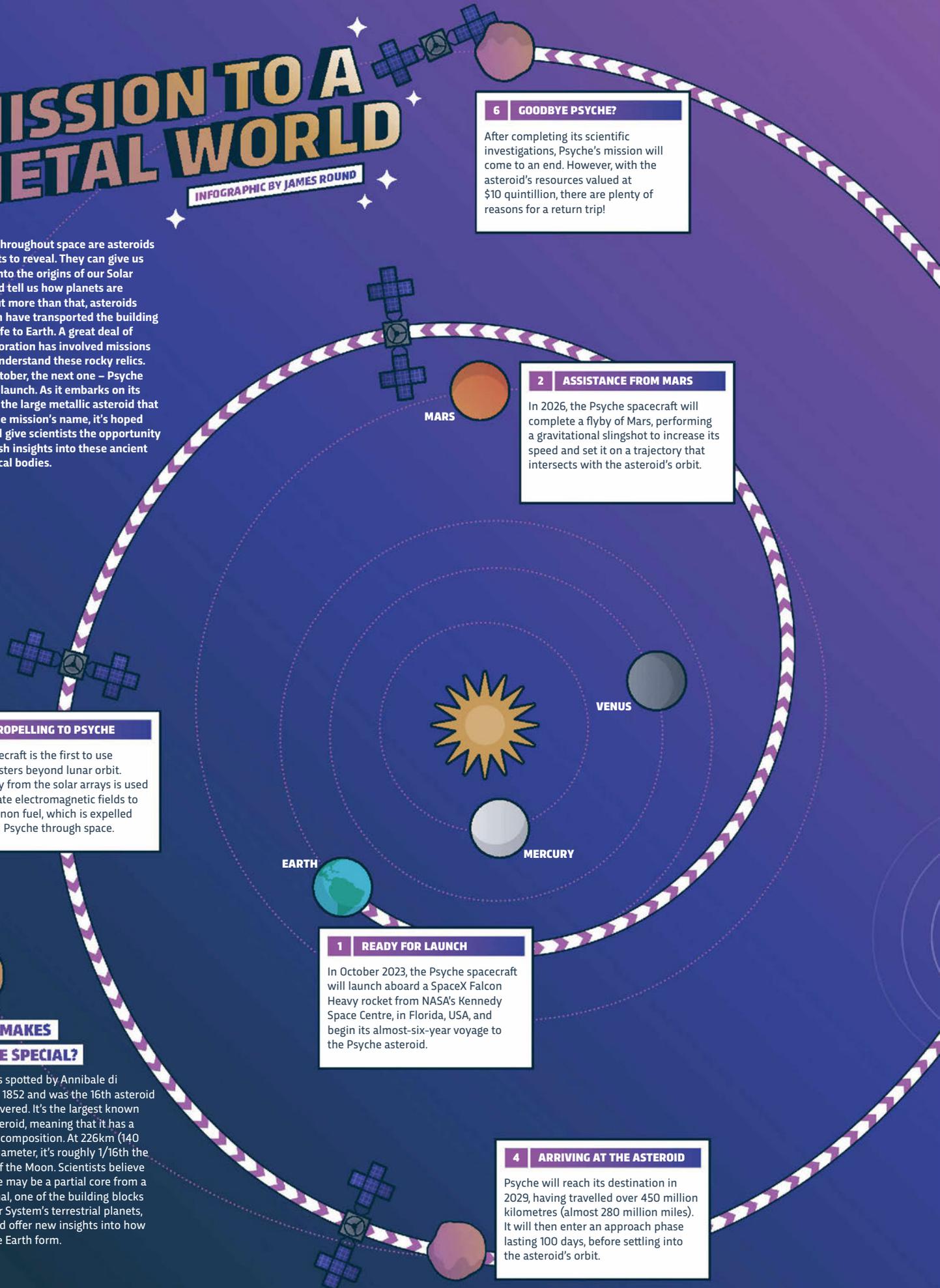
In 2026, the Psyche spacecraft will complete a flyby of Mars, performing a gravitational slingshot to increase its speed and set it on a trajectory that intersects with the asteroid's orbit.

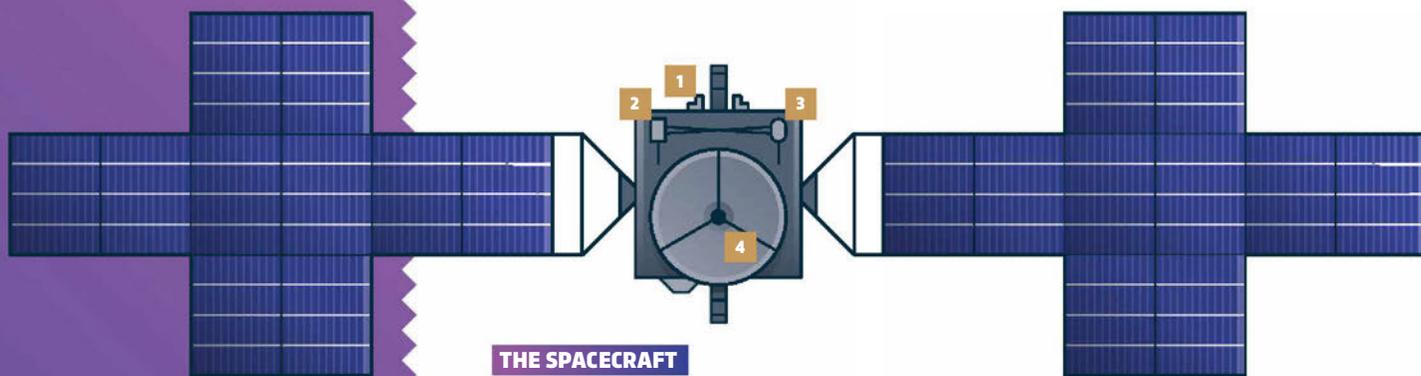
1 READY FOR LAUNCH

In October 2023, the Psyche spacecraft will launch aboard a SpaceX Falcon Heavy rocket from NASA's Kennedy Space Centre, in Florida, USA, and begin its almost-six-year voyage to the Psyche asteroid.

4 ARRIVING AT THE ASTEROID

Psyche will reach its destination in 2029, having travelled over 450 million kilometres (almost 280 million miles). It will then enter an approach phase lasting 100 days, before settling into the asteroid's orbit.





THE SPACECRAFT

First approved for flight by NASA in 2017, with construction completed in 2021, Psyche consists of a body attached to two solar arrays and is about the size of a tennis court. The spacecraft contains a number of innovative tools to help scientists better understand its namesake asteroid...

LENGTH AND WIDTH
24m (81ft) x 7m (24ft)

SPACECRAFT COST
~\$670 million (~£537m)



1
Multispectral Imager

Two cameras with a variety of filters and lenses will document the asteroid in order to understand its composition, and provide a topographical map of its surface.



2
Spectrometer
This gamma-ray and neutron spectrometer will measure the asteroid's elemental composition, to help explain its formation and how it has changed over time.



3
Magnetometer
These two high-sensitivity sensors will be trying to detect and measure the remains of an ancient magnetic field, which could reveal insights into the asteroid's origins.



4
Telecommunications
As well as being used to send commands to the spacecraft, this system will measure changes in radio waves to determine the asteroid's rotation, wobble, mass and gravity field.

5 ORBITING THE ASTEROID

Once in orbit, the spacecraft will begin its scientific operations. These will take place over a series of four progressively lower orbits, with each one focusing on a different objective.

THE MISSION

The asteroid's physical characteristics and orbital parameters are not fully known. To ensure the mission's safety and success, the spacecraft will move through a series of progressively lower orbits during its scientific operations, building a better understanding of the asteroid in the process.

SCIENTIFIC MISSION
21 months

TOTAL ORBITS
1,256



ORBIT A
Characterisation

- 700km (430 miles)
- 41 orbits
- 56 days

The first phase of orbits will be used to detect the asteroid's magnetic field and model its gravity field, in order to plan the spacecraft's lower orbits.



ORBIT B
Topography

- 290km (180 miles)
- 169 orbits
- 80 days

Psyche's second phase of orbits will have the best lighting conditions in order to create a topographical map of the metal-rich asteroid.



ORBIT C
Gravity science

- 170km (105 miles)
- 362 orbits
- 100 days

The third phase of orbits offers the best opportunity to conduct gravity science. The Psyche spacecraft will also continue magnetic field observations.



ORBIT D
Elemental mapping

- 85km (52 miles)
- 684 orbits
- 100 days

As the spacecraft reaches the closest phase of orbits, it will begin investigations into the chemical composition of the asteroid.

THE FUTURE OF SPACE COMMUNICATIONS

In addition to the mission's primary objectives, the Psyche spacecraft will also be testing a new communications technology. NASA's Deep Space Optical Communication experiment uses a laser to send messages by encoding the data into photons. Using light rather than radio waves allows for significantly more bandwidth, which will enable future missions to Mars and beyond to transmit large amounts of data, images and video.

SOURCES NASA, JPL, Space.com, The Planetary Society, Wikipedia, Arizona State University, Smithsonian Magazine.