

Lucy spacecraft begins 12-year mission to study asteroids and the origins of the Solar System

Bryan Dyne
17 October 2021

The NASA space probe Lucy began its 12-year mission after being successfully launched from Cape Canaveral aboard an Atlas V 401 rocket. The spacecraft is slated to study eight asteroids in the main asteroid belt and among Jupiter's trojans, two groups of asteroids that share that planet's orbit around the Sun, as part of a campaign to more closely study the origins of Earth and the other planets in the Solar System.

Lucy was selected in 2017 for development and launch, alongside the Psyche mission, after more than two years of review, and winning out over 26 other proposals. Astronomers will use three instruments—L'Ralph, L'LORRI, and L'TES—to image target asteroids in visible and infrared light, measure ice, silicate and organic material on each celestial body's surface, and study asteroid interiors and bulk properties. These instruments will be operated by teams operating out of the Southwest Research Institute in Boulder, Colorado, the Southwest Research Institute and the Goddard Space Flight Center.

The spacecraft also has a golden plaque adorned with a sampling of current culture, including quotes from Albert Einstein and Carl Sagan, as a time capsule for future generations.

Asteroids have long been a target of astronomical study because they, like comets, are a snapshot of different parts of the Solar System's history. The eight planets as they are now have been shaped by billions of years of geophysical process, such as weather, climate and tectonic activity (as well as human processes on Earth). In contrast, asteroids (meaning "star-like") are suspected to be the shattered remains of objects that never became large enough to form actual planets. They thus exist mostly as they have since they were

formed and stand as moments of planetary formation preserved over the eons that provide insight into the physical conditions and dynamics of the early Solar System.

Millions of these small bodies exist in the solar system and hundreds of thousands have been cataloged for more careful study. They range in size from just a few meters across to the largest, Ceres, which is 1,000 kilometers in diameter and large enough to qualify as a dwarf planet. They are made up of a combination of different metals and minerals and have even been envisioned as the subject of future space-based mining operations.

Several missions have been launched in the past few decades to study asteroids, including the sample return mission to Bennu by the OSIRIS-REx spacecraft, the successful landing of two rovers on 162173 Ryugu by the Japanese mission Hayabusa2, and the Dawn mission, which orbited two different asteroids, Vesta and Ceres, during a mission lasting 11 years. The New Horizons spacecraft was also directed to fly past an asteroid, now named 486958 Arrokoth, four years after the historic first close encounter with Pluto.

Lucy builds on the ambition of and knowledge gained from these previous projects and was one of the primary goals outlined for astronomical research by the most recent Planetary Science Decadal Survey. While targets of most previous missions are either near-Earth asteroids or are part of the main asteroid belt between Mars and Jupiter, Lucy will be studying asteroids farther out, focusing on Jupiter's trojan asteroids.

These two groups of asteroids that share Jupiter's orbit around the Sun were first predicted by Italian-born mathematician Joseph-Louis Lagrange in 1772. He

showed that a small body like an asteroid might be trapped in an orbit of a planet, but at a point leading or trailing the planet by 60 degrees. These leading and trailing points are now denoted Lagrange points 4 and 5 (L4 and L5), and are among the five gravitationally stable points between any two astronomical bodies where one orbits the other. Jupiter's first trojans were actually observed by German astronomer Max Wold in 1906 and more than 9,800 have been discovered since then.

By convention, all asteroids trapped in such orbits are referred to generically as trojans, including those in co-orbits with Mars, Neptune and Earth. They do not actually orbit the planet, but are held in place in specific orbits around the Sun by the planet's far greater mass. Those trapped by Jupiter are called the "Trojans" if they are trailing behind the Solar System's largest planet and the "Greeks" if they are in front of it, and asteroids in each group are named after figures from the Trojan War.

Lucy will be studying seven of these asteroids, 3548 Eurybates and its satellite Queta in August 2027, 15094 Polymele in September 2027, 11351 Leucus in April 2028, 21900 Orus in November 2028 and the binary pair 617 Patroclus-Menoetius in March 2033. In order to travel to so many targets, five of which are in the "Greek camp" and two of which are in the "Trojan camp," which are separated by about 1.3 billion kilometers, Lucy will use three gravitational assists from Earth to travel between different parts of the Solar System.

The spacecraft will also make a test run of its operational capabilities at the main belt asteroid 55246 Donaldjohanson in April 2025. The asteroid is named after Donald Johanson, the discoverer of the fossilized remains of the female hominin australopithecine known as "Lucy" in Ethiopia, a 3.2 million-year-old ancestor of modern humans. The Lucy mission is named after this skeleton as a tribute and in the hopes the Lucy spacecraft will provide insight into the origins of the planets similar to what the Lucy fossil provided in relation to the development of the *Homo* genus.

Lucy is the American space agency's 13th Discovery-class mission, a program which is nominally designed to produce missions that have very focused objectives. In practice, the Discovery missions are bound by the philosophy championed by Clinton-appointed NASA

administrator Daniel Goldin that space missions should be "faster, better, cheaper" and have very limited budgets.

The political limitations have not, however, stopped the missions that have been launched from producing some fantastic scientific results. Discovery class missions include Mars Pathfinder and its Sojourner rover, the MESSENGER mission to Mercury, and the exoplanet observatory Kepler. All of these missions have brought critical new insights about the physical world and humanity's place in it.



To contact the WSWWS and the Socialist Equality Party visit:

wsws.org/contact