Video: Big questions about small worlds

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Scientists who study the solar system tend to ask big questions: How was our solar system formed? Where did the building blocks of life come from? What hazards from above threaten life on our planet? To find answers, they're looking more and more at small worlds.

What are small worlds? Asteroids for sure. Comets too. Also the many small satellites or moons that orbit large planets as well as the icy worlds at the distance of Pluto and beyond. Some have combined, only to be broken apart later by collisions and tidal forces. Others have gone largely untouched since the dawn of the solar system. Some carry water and organic compounds, others are almost entirely composed of metal. And all hold keys to questions about our solar system and the origin of life on Earth.

Dr. Adriana Ocampo, Program Executive for NASA's New Horizons mission, says "Water is key to life as we know it. Learning where water is found in our solar system provides pieces to the puzzle of understanding the origins of life. New Horizons recently surprised us by discovering a large abundance of water ice at Pluto." More surprises are in store, as New Horizons transmits the data from its January 1, 2019 flyby of the Kuiper Belt object 2014 MU69 back to Earth!

Small worlds can be found in a wide range of locations across the solar system, from the inner solar system all the way out to the Kuiper Belt. When they are studied together, these remnants of the early solar system can help tell the story of solar system formation.

Dawn recently completed a mission to the Main Asteroid Belt, visiting the dwarf planet Ceres and the Belt's largest asteroid, Vesta. OSIRIS-REx has arrived at Bennu, a near-Earth asteroid about 1650 feet (500 m) across, and will return to Earth in 2023 with a sample so scientists can begin to understand Bennu's origin and history. The Lucy mission will be traveling to six trojan asteroids, trapped in the orbit of Jupiter. These objects are the only remaining unexplored population of small worlds in the solar system. The Psyche mission will be visiting a metal object in the Main Asteroid Belt that could be the remnant core of a proto-planet similar in size to Vesta!

While those missions travel to their individual targets, NEOWISE, a repurposed space telescope in low-Earth orbit, has made infrared measurements of hundreds of near-Earth objects and tens of thousands of other small worlds in the solar system. These diverse worlds offer insights into how our solar system formed and evolved.

Dr. Tom Statler, Planetary Science Program Scientist at NASA Headquarters notes, "This is not your grandparent's solar system, and things are not as orderly as we once believed."

"The data we've gleaned from these objects so far have changed the way we think about the origin of the planets. For example, the small worlds in the Kuiper Belt are leading us to think that Uranus and Neptune formed much closer to the Sun than where they reside now, then gradually moved to their current orbits."

The biggest misperception about small worlds? Their distance to each other. Statler explains, "In the movies, they always show an asteroid belt with millions of rocks almost touching each other, whereas in reality there is much more empty space. You have to travel hundreds of thousands of miles to get from one asteroid to another."

Yet scientists are also looking closer to home. Determining the orbits and physical characteristics of objects that might impact Earth is critical to understanding the consequences of any such impact; and responding to an actual impact threat, if one is ever discovered. NASA knows of no asteroid or comet currently on a collision course with Earth. But, to prepare for that scenario NASA is developing the Double Asteroid Redirection Test or DART mission as the first demonstration of the kinetic impact technique that could be used to change the motion of a hazardous asteroid away from Earth.

Provided by NASA