NASA InSight mission successfully lands on Mars

By Bryan Dyne
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NASA's InSight mission touched down on the surface of Mars on Monday at approximately 3 p.m. Eastern Time, successfully completing a six-and-a-half month journey of more than 480 million kilometers. InSight, the Interior Exploration using Seismic Investigations, Geodesy and Heat Transport lander, is the first mission to successfully land on Mars since the Curiosity rover in 2011, and the eighth successful landing of an unmanned spacecraft on the planet. It is the beginning of the most extensive geological survey of a celestial body beyond Earth.

As of this writing, all of the probe's systems are operating as expected. Two initial photos have been sent from the surface of Mars confirming that it is on the ground, its solar panels have been deployed and it is in contact with the fleet of spacecraft orbiting Mars. Its meteorological suite and magnetometer have been deployed while its robotic arm with an attached camera will be deployed in the coming days.

The mission's primary instrument suite will come online over the next three months. This includes a seismometer to study Marsquakes (tectonic activity on Mars) and a radio science experiment that will calculate the size and rotation of Mars' core and mantle. InSight is also slated to drill five meters into the surface, deeper than any previous study, and place heat sensors every ten centimeters to learn about the evolution of heat flow in the planet's interior.

These instruments are designed to collect data for at least the next two years in order to better understand the internal structure and geology of the Red Planet. This in turn will be incorporated into humanity's more general knowledge of how rocky worlds form, from Earth and the Moon to exoplanets such as those in the Trappist-1 system. All this for a mere $830 million, less than the cost of one of the US military's nearly two dozen B-2 stealth bombers.

InSight's design is heavily based on the successful Mars Phoenix Lander, which completed its mission in 2008. They have a similar solar panel and general spacecraft design, though InSight is designed to last more than four times as long as its predecessor. InSight also has cameras similar to Spirit, Opportunity and Curiosity, reusing technologies that have both proven robust and provided a large volume of scientific information.

Like every mission to Mars, InSight would not have been possible without a high level of meticulously planned international coordination involving hundreds of researchers and engineers. InSight's primary instrument for studying the Martian interior, the Seismic Experiment for Interior Structure, was developed through the coordinated efforts of engineers in France, Germany, Switzerland, the United Kingdom and the United States. Its probe to measure heat flow five meters below Mars' surface was made in Germany and Poland, its weather station in Spain and its laser reflector, which will be used for precision longitude, latitude and altitude measurements, in Italy. The experiment which will map the interior structure of Mars and measure its rotation was developed in the United States. Even launching the mission and operating the spacecraft while it was traveling to Mars required the cooperation of scientists in Australia, Spain and the United States.

InSight arrived at the Elysium Planitia, a low-lying and massive expanse of ancient Martian lava near the planet's equator. While the geology and chemistry of the region are interesting, the site was chosen more for the ease of landing and large amounts of sunlight than its surface features. The solar panels that provide the lander energy for all of its communications equipment

and scientific instruments produce 600 to 700 watts on a clear day, less than what a microwave oven uses.

Coincidentally, InSight is relatively close to Curiosity, about 600 kilometers north from the rover's position in Gale Crater. Traveling at its maximum speed, it would take Curiosity 3,000 days or just under eight and a half years to reach InSight. They are currently the two closest man-made objects on the surface of Mars.

As with all craft that enter orbit and/or land on Mars, InSight's final approach to the planet was done automatically. It takes less than seven minutes for the craft to touch down on the surface, but fourteen minutes for signals to be relayed from Mars to Earth and back. As a result of the distance, there could be no human supervision as the lander entered the atmosphere, deployed its parachutes, chose the exact spot to land, fired its landing thrusters and softly touched down. Dozens of operations and thousands of lines of code were pre-programmed into the machinery and memory of the spacecraft and by all accounts they executed perfectly.

The landing of InSight was also a test for Mars Cube One (MarCO), a flyby of two miniaturized and inexpensive satellites called CubeSats that were used to relay InSight's telemetry to Earth during the spacecraft's entry, descent and landing, as radio signals directly from InSight to Earth were blocked by Mars itself. Normally, this relaying is done using the already existing spacecraft such as NASA's Mars Odyssey and Mars Reconnaissance Orbiter or the European Space Agency's Mars Express. Instead, InSight's team used MarCO A and B to test the much smaller and cheaper communications technologies provided by CubeSats, which successfully relayed mission-critical data during the entire process and for eight minutes thereafter.

Future deep space missions are now expected to increasingly adopt this technology. CubeSats have been shown to provide an effective and cost-efficient way for spacecraft to relay information to Earth without needing to have previous craft already in orbit around a celestial body or to use the primary mission's energy to send information all the way back to Earth while it is entering orbit or landing. They have the potential to both cut mission costs as well as provide a new platform for scientific observations.

This latest successful mission to Mars is a welcome demonstration of the power of human foresight and scientific planning, in the face of the promotion of irrationalism and anti-science prejudice by both the political right and the pseudo-left.