Perseverance rover begins three-year mission on Mars

Bryan Dyne
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NASA's latest and most complex robotic explorer yet safely touched down on the surface of Mars in Jezero Crater on Thursday, 20:55 UTC (3:55 p.m. Eastern). Perseverance landed after a seven-month journey of 472 million kilometers from Earth to Mars. As its many instruments become active, it will undertake the most advanced astrobiological study ever conducted of the red planet.

Perseverance is a direct upgrade of its immediate predecessor, Curiosity. Much of the overall framework was built with excess hardware incorporated into a similar but more advanced and robust design. Alongside the seven primary instruments to study Mars, the rover brought along a small helicopter, which will attempt the first powered flight on another world, and will leave behind sealed samples of Martian rocks and soil as the first step for future attempts to return samples of Mars to Earth.

The successful landing evoked widespread public enthusiasm. Hundreds of thousands watched the live feed of the NASA control center as the spacecraft approached Mars at more than 19,200 kilometers per hour and, seven minutes later, safely touched down on the surface. In those critical moments, the vessel slammed into Mars' atmosphere, successfully deployed a supersonic parachute to slow down, mapped and calculated its exact landing point, activated its rocket pack, and safely lowered the rover from a hovering skycrane onto the rocky landscape of the fourth planet from the Sun.

Landing on Mars is made all the more difficult because the entire sequence must be automated, and, despite many recent successes, nothing can be taken for granted. At its current distance from Earth, radio signals take 22 minutes to go to Mars and back, meaning that the entire entry, descent and landing sequence, starting about an hour before touchdown, must be automated. To do this, Perseverance required about 500,000 lines of code to direct hundreds of precise maneuvers that had to be planned in advance, an effort by hundreds of scientists and engineers working on the project over several years.

Invaluable roles were also played by the Mars Reconnaissance Orbiter (MRO) and MAVEN spacecraft, which acted as relays between the rover and Earth during the descent, as direct communication to Earth was blocked by Mars itself during the final parts of the landing. Telemetry was received by the Deep Space Network, which has powerful radar dishes in the United States, Spain and Australia.

All indications are that the entire sequence was executed flawlessly. Moments after it landed, the rover transmitted two images of the surface of Mars, the first of thousands to come. The scenes of jubilation at Mission Control echoed the celebrations around the globe at the start of a new stage of discovery on an alien world. At a cost of a mere $2.7 billion over seven years, less than what the Pentagon spends in ten days, the safe landing of the Perseverance rover is a rare and welcome moment of triumph for modern science and humanity as a whole amidst the ongoing coronavirus pandemic.

Perseverance was launched on July 30, 2020, and is the third mission to reach Mars in the past nine days. It follows the Hope and Tianwen-1 orbiters, operated by the United Arab Emirates and China, respectively, which both successfully entered Martian orbit last week. All three missions took advantage of the "launch window" between Earth and Mars that occurs about every two years, which minimizes the time and rocket fuel needed to cross between the planets.

Like its predecessors—including Sojourner, Spirit,

Opportunity and the still operational Curiosity —Perseverance was developed, built and landed on Mars to increase scientific knowledge about the planet itself, as well as the general evolution of all the bodies in the Solar System, including Earth. It is in particular designed to deepen the search for signs of any past life on or slightly below the Martian surface.

In many ways, Perseverance's mission can be summed up in a single question: Did life evolve on Mars?

Jezero Crater was selected as the rover's landing site because satellite observations suggest that answers to that question are quite likely to be contained within the crater's many interesting features. Imagery of the region from MRO reveals that the crater has both an inflow and an outflow channel, meaning that it was likely a lake in the distant past. It has a delta, which on Earth are places where microbial life thrives, and a very diverse mineral content.

The crater was actually one of the possible landing sites for Curiosity in 2012. It was rejected then because it was deemed too dangerous for a landing. Perseverance, however, was developed using the many lessons learned from the previous rover's landing eight-and-a-half years ago, and came equipped with a powerful new mapping tool that was able to determine the rover's location far more precisely even as it was attempting to land. In doing so, it was able to avoid hazards such as cliff faces, boulders and sand dunes to land in a very treacherous but scientifically interesting location on Mars.

There are additionally and, for the first time on a Mars probe, two microphones to record sounds. These were turned on before the spacecraft entered the atmosphere, and are expected to return audio of the entire landing sequence. It is expected that, combined with the images taken during landing, we will soon be able to watch a video of and listen to a Mars landing from the perspective of the rover itself.

In the coming days and weeks, the full instrument suite of Perseverance will come online, which was built and will be operated by thousands of people in the United States and around the world, including researchers in Norway, Spain and France. The many cameras and sensors will be used to study Martian geology, as well as the temperature, wind speed, pressure, humidity and aerosol content of Mars' atmosphere. Others instruments will measure radiation at the planet's surface and use ground-penetrating radar to potentially detect any underground sources of water.

Perseverance also has a two-meter long Mastcam-Z, similar to but larger than the Mastcam on Curiosity, which will be the main camera used to image the landscape of Mars, both to help guide the rover as it drives around and to share the vistas of Mars with humanity back on Earth.

The rover will also debut the Ingenuity helicopter in the coming weeks and months. The solar-powered drone is slated to undertake five short flights over the course of thirty days and act as a testbed to learn how hard it is to achieve flight in the Martian atmosphere. If all goes well, Ingenuity during that time will also act as a scout for Perseverance, taking aerial pictures to spot hazards hidden from the rover's vantage point on the surface.

One of the more forward-thinking aspects of the mission is that Perseverance is equipped with ultra-clean sample containers, which it will use to store material from the surface and certain rocks it drills into to preserve for a future sample-return mission. The samples will be left at various places along its journey, and will hopefully be collected when sample-return missions begin their slated operations in the early 2030s. If successful, these will allow for a much more detailed analysis of the Martian surface using the much more powerful tools available on Earth.

Of course, especially when science is ultimately subservient to the profit motive, no such guarantees can truly be made. The successful landing of Perseverance is a testament to the power of science and international cooperation at a time when national borders are being ever more closed off, bigger and more destructive wars are being prepared, and during a deadly pandemic which has so far claimed more than 2.4 million lives worldwide. The same rational planning used to touch down a robot on the surface of Mars must be applied to society as a whole, and the ruthless domination by capitalism ended.