Trouble viewing? Open in web browser.

Stanford | News Service

JULY 20, 2020

Stanford scientists anticipate the Mars 2020 rover launch

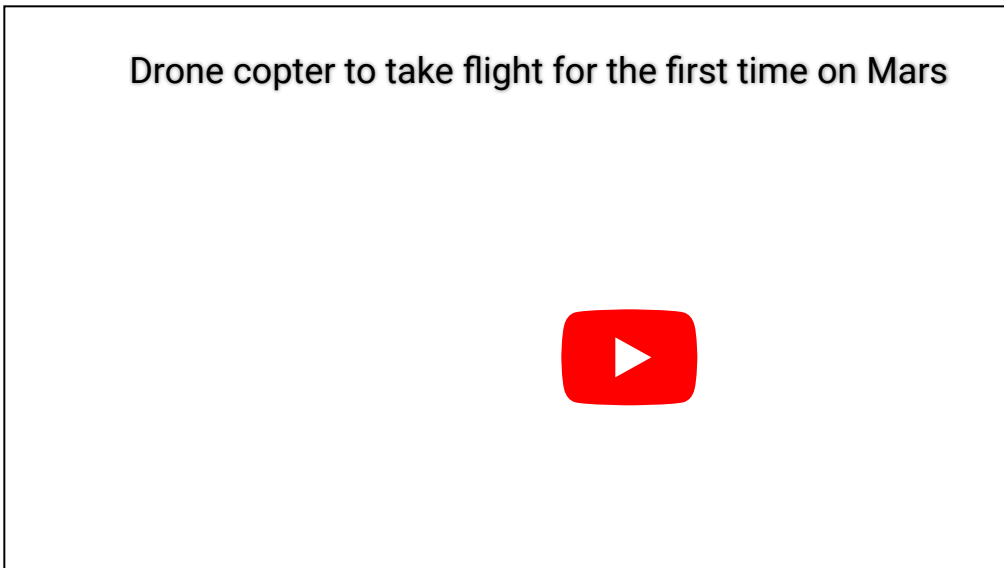
According to Stanford University Mars experts, NASA's latest Martian rover will drive a wave of exciting discoveries when it lands on the Red Planet – and possibly alter scientists' understanding of the blue one it launches from.

BY LARA STREIFF

Despite a global pandemic and some technical delays, NASA's 2020 Mars Rover – the aptly named Perseverance – is scheduled to launch this summer (currently slated for July 30) on a groundbreaking endeavor. Traveling from Earth to Mars is best done when the planets orbit nearest one another, providing only a narrow window of opportunity (rover pun intended) between mid-July and mid-August to start the journey. Its success will be the opening salvo in an ambitious series of missions designed to bring samples of Martian crust to Earth for the first time for study.

Go to the web site to view the video.

Kurt Hickman



NASA's 2020 Mars Rover – the aptly named Perseverance – is scheduled to launch this summer on a groundbreaking endeavor.

"Rovers are the closest we can get to having a geologist on Mars at the moment, so any new rover data is really valuable," said Mathieu Lapôtre, an assistant professor of geological science at Stanford's School of Earth, Energy & Environmental Sciences (Stanford Earth) who researches the geological processes that shape planetary surfaces. "Every time we have a rover like this, a wave of discoveries follows. It's a very exciting time."

Stanford scholars have a long history of contributing to NASA's space missions – including the design of technologies sent into space, guidance and control of spacecraft. That tradition continues with this latest Mars mission. For example, Marco Pavone, a former research technologist at the NASA Jet Propulsion Laboratory (JPL), helped develop algorithms to optimize the selection of landing spots on Mars – in the case of Perseverance, an ancient meteorite impact site known as the Jezero Crater, or the Jezero Delta.

Even though NASA has an impressive track record of landing rovers on Mars, Pavone cautions against underestimating the adventure ahead. "Landing on Mars is a tremendous challenge," said Pavone, an associate professor of aeronautics and astronautics and director of Stanford's Autonomous Systems Laboratory. "Even if we did it successfully in the past, it is certainly not a done deal."

Building upon a history of Mars missions

Perseverance is the fifth Mars rover from NASA, following Curiosity, Opportunity, Spirit, and the original Mars rover, Sojourner, named for civil rights activist Sojourner Truth. That first trailblazing rover arrived on Mars in 1997 equipped with few instruments and only able to venture roughly 40 feet from its lander, Pathfinder. "But the key requirement to demonstrate mobility on another planet was met," said Scott Hubbard, an adjunct professor of aeronautics and astronautics at Stanford; Hubbard was the first Mars program director at NASA Headquarters, where he earned the nickname of "Mars Czar."

Each rover since Sojourner has been sent to Mars with more sophisticated instruments, expanded capabilities and more ambitious goals. Curiosity directly preceded Perseverance and has the most in common with it, including size – which is roughly that of a small SUV. "To save money, the Perseverance rover was required to be a near duplicate of Curiosity wherever possible, even using leftover parts," said Hubbard, who also authored Exploring Mars: Chronicles from a Decade of Discovery.

Perseverance will pick up where Curiosity left off. After landing in February 2021, the rover will roam the planet for at least one Mars year, which is roughly equal to two Earth years. Its tool suite includes a novel drilling and storage mechanism to extract and cache roughly 30 rock samples. This is the rover's most critical function, according to Hubbard, because the plan is to retrieve those samples with a future "fetch rover," shoot them into Martian orbit and eventually return them to Earth,

where they will be analyzed for "fingerprints of life." "Getting those samples back to Earth has been the 'holy grail' of Mars science for almost 50 years," Hubbard said.

Once the Martian rocks are on Earth, they will be quarantined for safety, and then subjected to a battery of tests and measurements that cannot be performed on Mars itself. "With Curiosity, we are looking for habitable environments and organic molecules," said Lapôtre. "But without bringing the samples back to Earth, it is really difficult to tell for sure if what we found was biogenic – formed by something that was alive – or abiogenic, meaning the organic molecules are not related in any way to life."

It's been a long road to reach this point. When the Mars Exploration Program was being revived by Hubbard's team in the early 2000s after two mission failures, he believed the scientific, engineering and technology requirements of a sample return mission were too daunting to tackle. "Twenty years later, the suite of missions, orbiters and rovers that came out of our re-planning effort have yielded a wealth of knowledge about the Red Planet," said Hubbard, "including the ability to now select the all-important site for a sample return."

Location, location, location: Picking the right landing site

Real estate agents will tell you that the value of a property has more to do with location than anything else; a landing site is not much different. Pavone describes the process of selecting the site as finding the "sweet spot" on the planet's surface that strikes a balance between scientific potential and risk to the rover.

"This specific landing site was chosen because of its promise in terms of astrobiological potential," said Lapôtre. "In my opinion, it was very well chosen. Whether we find evidence for ancient life or not, I am convinced that we will learn a lot about the ancient environment on Mars."

Jezero Crater was once a lake formed by an ancient river filling a meteor impact crater. "It makes for a great place to look for evidence of life," said Lapôtre, "because, like the Nile or the Mississippi, this river likely picked up sediments and any forms of life that may have existed along its course and concentrated them in one place."

The Jezero location is also older than previous rover landing sites – somewhere around 3.7 billion years, which is when scientists believe Mars may have been habitable. Any life on Mars at the time would consist of simple unicellular organisms like microbes. So scientists must look for biomarkers – pieces of organic molecules or chemical indicators – that these living things could have left behind in the rocky surface, rather than bones or fossils.

Another advantage of this site is that it could allow scientists to test the hypothesis that ancient organisms on Mars lived in the subsurface. "This crater punctured through the Martian surface to expose ancient rocks," said Janice Bishop, a senior research scientist for the SETI Institute and a Stanford alumnus. Bishop utilizes remote sensing to study rocks on the surface of the Red Planet to gain insights about

Mars' watery past, so this mission is of particular interest as the selected landing site features an ancient river delta. "Perseverance is expected to reveal secrets about the early history of water on Mars," Bishop added.

Like Mars, Earth was devoid of large organisms for most of its history, such that its geological processes were largely unaffected by macroscopic life. However, Earth's surface is constantly recycled through the continual shifting of continent-sized plates; this process is known as plate tectonics and does not occur on Mars. "A lot of us are super excited about how this information could improve our understanding of Earth before there was life," said Lapôtre. "I will definitely use the mission data in my research program, and have PhD students combine rover and orbiter data to answer questions about the geologic history of Mars."

Information gleaned from the ancient river that once emptied into Jezero crater could change how scientists think about how rivers form, and tie into global carbon cycles and climate – not only on Mars but also Earth and other planets.

Testing new technologies on Mars

Perseverance will be breaking new technological ground as well on this mission. "Continuing in the tradition of using each Mars mission as a technology test-bed for new future capabilities, the rover will bring along a very small, four-pound helicopter," said Hubbard. Dubbed Ingenuity, the copter will be the first flying vehicle on another planet and will have to navigate the frigid nights and dust-filled skies of Mars while operating in an atmosphere that is 100 times thinner than Earth's.

"Sojourner was itself a technology demonstration to prove wheeled mobility on Mars," said Pavone. "Who knows what we'll be able to do another 20 years down the road once we prove we can fly helicopters on Mars?"

Nineteen high-resolution cameras on the 2020 rover should provide unprecedented images of the Martian surface, as well as the landing process. Perseverance is also equipped with an instrument called Moxie, which will test the potential of converting Mars' thin atmosphere into oxygen for future human explorers.

"If this were a perfect world, humans will be arriving on Mars in 2033," said Hubbard. "This seems to be far in the future, but it is literally around the corner in space mission terms."

-30-

Contact

Ker Than, Stanford News Service:
(650) 723-9820;
kerthan@stanford.edu

Contact Stanford News

More Stanford coverage

©2020 Stanford University. Stanford, California 94305. (650) 723-2300.