Mars 2020 Science Definition Team Report
Frequently Asked Questions

Q: What is the purpose of the Mars 2020 mission?

A: NASA appointed a Mars 2020 Science Definition Team in January 2013 to propose objectives and capabilities for this mission. The team envisions a mission that would explore the geology of a once habitable site, seek signs of past life, fill a returnable cache with the most compelling samples, and demonstrate technology for future human exploration of Mars. These goals include deciphering the geological history of the landing site and determining whether past environmental conditions were favorable for microbial life and for preserving signs of life, had it existed. The search for signs of past life would combine two independent yet complementary strategies. The rover would use its own instruments on Mars for visual, mineralogical and chemical analysis down to a microscopic scale to identify candidate features that may have been formed by past life. It would also collect and package a carefully selected set of samples for possible return to Earth by a future mission, which would enable a broad range of investigations and more definitive analysis by laboratories on Earth. As proposed by the team, the mission would also demonstrate technologies for advancing toward human missions to Mars.

Setting science goals is a crucial step in developing a mission to Mars. Based on input from the Science Definition Team, NASA will select final objectives for the 2020 rover. Those will become the basis for soliciting proposals to provide instruments for the rover's science payload in the fall of 2013.

Q: How is this mission an advance beyond what Curiosity is doing?

A: Like other missions in NASA's Mars Exploration Program, the 2020 mission would take the next logical step in pursuit of the science strategy for “Seeking the Signs of Life”. This mission would build upon what Curiosity and earlier missions have accomplished, while taking the science and technology to the next levels. NASA’s Spirit and Opportunity rovers were sent a decade ago to seek evidence about past watery environments on Mars, and they succeeded. Curiosity landed last year to seek evidence about past conditions that were favorable for life, and it has already succeeded. The next logical step in investigating whether Mars has ever supported life is to go to a promising landing site, study the rocks there, and seek possible signs of past life. To do this, the 2020 rover as proposed by the Science Definition Team would carry a different and more advanced set of science instruments than Curiosity carries, its drill would extract cores rather than blended powder from rocks, and it would collect and package samples for possible future return to Earth. The instrument payload will be selected through a competitive process, ensuring the best possible measurements to meet the mission objectives. In addition, many sites of particularly high scientific interest could become accessible for the first time because of advances in landing technology.

NASA does plan to re-use much of the design and engineering of the Curiosity rover and the Mars Science Laboratory flight system that put Curiosity on Mars with a sky crane landing. This should ensure mission costs and risks are as low as possible while delivering an inherently capable system well-matched to the mission objectives. Technological advances under consideration for the 2020 mission could include ways to target the landing even more precisely and a step toward making use of natural resources at Mars in support of future human explorers.

Q: Are we ready to carry out a search for past life on Mars?

A: The Mars 2020 mission concept does not presume that life ever existed on Mars. The search for potential signs of past life is one step in testing whether it did or not, albeit a very challenging one. Answering the question either way would be important. Given recent findings that past conditions on some parts of Mars were favorable for microbial life, we should begin the difficult endeavor of seeking the signs of life. Even if no signs of life are discovered, we would make significant progress in understanding the circumstances of early life existing on Earth and the possibilities of extraterrestrial life. If the Mars 2020 Science Definition Team's objectives are adopted, the 2020 rover would examine whether past environmental conditions were favorable to have supported microbial life and also whether they were favorable for preserving clues about life, if any existed. Beyond that, it would check at a microscopic level for potential visual, mineralogical and chemical signs of past life.

Q: What would the 2020 rover actually measure to achieve its objective?

The Science Definition Team proposes that the 2020 rover have capabilities for context imaging and mineralogy, as well as microscopic-scale imaging, mineralogy, elemental chemistry and organic chemistry. The capability for examining the mineralogic composition of samples at microscopic scale would be unprecedented for a mission to Mars. The search for potential signs of past life could use assessments of textures, shapes, mineralogy, organic-matter content, and possibly elemental chemistry at the scale of individual grains within a sample. Such measurements are needed to detect features regarded as potential signs of past microbial life. Examples of potential signs of past life that these capabilities might detect, if present, include preserved cellular structures, mineral structures created biologically, and organic-chemical structures that characterize life forms. Such detections on Mars could be suggestive of past life, but would almost certainly require additional investigations (including return of samples from Mars).

The scientific significance of any potential sign of past life comes not only from the probability of life having produced it, but also from the improbability of non-biological processes producing it.

Q: Why is caching samples for possible return to Earth so important?

A: Caching scientifically selected Martian samples for future return to Earth was identified as the top-priority large mission for the coming decade in a survey of planetary scientists completed for the National Research Council in 2011. This conclusion is consistent with previous decadal surveys and separate NRC reports.

When returned to Earth, cached samples could be examined using state-of-the-art analytical instrumentation, unconstrained by spacecraft restrictions on mass, size, power, preconceived concepts of the needed flight instruments, sample handling/processing constraints, or other factors. Various kinds of scientific investigation would be enabled only by the return of samples. In research related to the possibility of extraterrestrial life, if there are definitive signs of life in the rocks from Mars, the most likely way to confirm them would be investigation in laboratories on Earth. A series of such investigations in Earth laboratories on these carefully selected Martian samples could be conducted at ultimately much lower cost, in much less time, and with much greater fidelity than on Mars. No robotic mission can match the depth and sensitivity of analysis that can be done on samples in Earth laboratories.

Returned samples could also remain available for future generations of science instrumentation using capabilities non-existent today. One example of this is the Apollo samples from Earth's moon. Researchers are still making wonderful discoveries on those samples decades after the huge initial science return and the leap in our understanding of the moon after return of these samples.

Q: When would the samples be returned to Earth?

A: When and how Mars samples might be returned to Earth is a decision to be made in the future. Caching by the Mars 2020 mission would not compel the subsequent steps needed for returning the samples to Earth, but it would accomplish a required first step and would demonstrate how samples at other sites on Mars could be selected and cached in the future, if needed. Information that the 2020 rover's instruments would provide about the mission's cached samples would help inform future missions, including the value of returning the cached sample, or even caching a different set of samples. The Mars Program Planning Group in 2012 studied different architectures for obtaining samples from Mars—one of which involved sampling at different sites before commencing a retrieval mission. A retrieval mission could occur as early as the mid-2020s or wait until the 2030s. Such timing would be determined by future budget availability and the technology capabilities that are developed in the coming years. The results from Curiosity’s continuing mission, not to mention the 2020 mission, along with those from the MAVEN and ExoMars missions, may influence planning for when or whether to return the first samples cached on Mars.

Q: How would the Mars 2020 mission get NASA closer to sending humans to Mars?

A: NASA intends to send humans to the Mars system by the 2030s, and the proposed objectives for the Mars 2020 mission would help make that possible in at least three ways. The 2020 mission would be a step toward return of Martian samples for analysis on Earth, which could be important in planning best ways to protect the health and safety of astronauts on Mars (for example, the properties of Martian dust and how it could affect astronauts and mechanical systems). Technologies under consideration for use during the final minutes before landing could improve the precision of targeting the landing location, an important capability for landing humans on Mars. A specific objective proposed for the 2020 mission would demonstrate technology to prepare for making use of natural resources on Mars in support of accomplishing a human mission. Such a technology demonstration would be conducted by NASA's Human Exploration and Operations Mission Directorate as a participant in the Mars 2020 mission.

Q: How would the Mars 2020 mission improve the precision of targeting its landing location?

A: Two technologies under consideration for Mars 2020 would improve on the precision of the dramatic sky crane landing of the Mars Science Laboratory. One, called "range triggering," would enable the incoming spacecraft to deploy its parachute based on calculated distance to its target, rather than basing this timing purely on the spacecraft's velocity. This technology would not require any new hardware. The other, "terrain-relative navigation," would autonomously use real-time imaging of the ground, correlated with a reference map, to recognize the target landing zone and any potential mission-ending hazards, and use maneuvers to avoid them and land at a safe target. These innovations would allow selection of a landing area with scientifically appealing features that might otherwise be considered too hazardous.

Q: Where will the Mars 2020 rover land?

A: The landing site has not yet been selected. Candidate landing sites do include sites considered for Curiosity and also new candidates. As with Curiosity, all sites would be analyzed intensively by the broader scientific community to determine the best landing site to meet the mission objectives. In addition, with the improved targeting capabilities expected with the 2020 mission, many new sites will now be accessible.

Q: Will the Mars 2020 rover use the same type of nuclear power source that Curiosity uses?

A: No final decision on a power source for the 2020 rover would be made until the mission completes a review through the National Environmental Policy Act process, which considers the environmental impacts of launching and conducting the mission. This process is currently scheduled to conclude in late 2014. The baseline-design power source for 2020 mission planning is the same as Curiosity's: a multi-mission radioisotope thermoelectric generator. Other possible power sources are also under consideration, including solar power.