



NASA's rover Curiosity on a test drive

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NASA's Mars Science Lab

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NASA's next planetary mission is set to launch on the 26th of November at 10:02 am from Cape Canaveral. It's called the Mars Science Lab, and its objective is to discover if Mars has ever had the potential for life. Sushil Atreya, who is a professor of Atmospheric and Space Sciences at the University of Michigan, has been involved in the project from the beginning. Even before the official acknowledgement and green light for the mission given eight years ago, he was active in conceptual developments that eventually led to the current mission.

The [Mars Science Lab](#) (MSL) will help answer some of the biggest and largest outstanding questions about the red planet: is it, or was it in the past, capable of having life, what happened to the water and carbon dioxide that should have been abundant in Mars' past, and how has the planet's climate evolved over time.

Curiosity, the rover built for the mission, is designed to help solve these questions. Current knowledge gained from observation on Earth and an orbital around Mars have provided a hint of trace amounts of methane in the air, which on Earth is strongly associated with life as we know it. The instruments for [Sample Analysis at Mars](#) (SAM) on Curiosity were built to detect even the tiniest amount of methane. SAM instruments will also search for organics in the soil and rock, and if found help determine if they are connected to biological activity. Atreya is a co-investigator on the SAM science team. The University of Michigan's Space Physics Research Lab helped construct SAM; they were responsible for much of the electronics.

Curiosity is set to land in Gale Crater; a location Atreya says was selected because of its enormous diversity and evidence for possible past water. It is rich in clay and sulfate minerals that form with long exposure to water. The rover's exact landing point is at the base of a three mile high mountain in the crater, which will give Curiosity the opportunity to climb and gather data from different layers that presumably contain record of different epochs in Mars's geologic history.

MSL's mission is not to find life. "If we were looking for life, we'd be looking for fossils," says Atreya. Instead, the focus is on the potential for sustained life.

Life needs certain things to form, one of them being large bodies of standing, liquid water. Rivers and streams won't do, they move too fast. Nor is ice, like on Mars's polar caps, an indication of life. It takes more than just evidence of water to prove that life could have existed. SAM is looking for other evidence as well, because it's possible that a large body of liquid water didn't produce life at all. All the little pieces of data have to add up, not just one.

One of the things Atreya is looking at is the ratio of the heavy carbon isotope, carbon-13, to the lighter carbon isotope carbon-12 in the methane from the air or solid materials. The heavier isotope is roughly 1% as common of its lighter version in samples. In biochemical reactions, lighter versions of carbon have an easier time bonding to create complex organic molecules associated with life. Thus, the ratio of carbon-12 to carbon-13 isotopes increases up to roughly 10% compared to its presence in non-biologic carbon-bearing molecules. Similar deficiency of the heavier carbon isotope on Mars could indicate the formation of life.

In another experiment, SAM will compare the shape of complex organic compounds known as chirality. As long as an organic compound has the same elements and parts, it can take a variety of shapes. These shape varieties appear equally; the number of right branching compounds will equal the number of left branching compounds. Except of course where life and evolution is involved. The biological organic molecules on Earth have a left-handed structure, and SAM instrument are capable of determining the shape of certain organic molecules such as amino acids.

"The presence of methane, deficiency in heavy carbon, and a particular chirality of organic molecules are necessary but not sufficient evidence of life as we know it however," cautions Atreya. "Supporting data from many MSL instruments will be needed."

There have been a number of rovers to visit the red planet and orbiting stations around it that have been gathering information on Mars. But are we really any closer to answering the question of life on Mars?

"I don't know," Atreya answers. "Every mission to Mars has brought us closer to answering this question. Curiosity is the most advanced laboratory ever built to address the question of habitability of Mars, so it has the best chance of them all. Each day the tasks of the rover will depend on the data collected before. The nature of future missions will also depend on information we find."

Curiosity is set to ride to Mars on an Atlas-V rocket on the 26th, the day after it's original launch date to allow time for the team to replace a flight termination system battery, and come August 2012 the rover will set down in Gale Crater.

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That doesn't mean Atreya and the rest of the MSL team can have a break. There are practice scenarios for them to run, preparing everyone for when Curiosity lands. Curiosity's nominal mission duration is two Earth-years, but it has the potential to run much longer thanks in part to its power generator; it's based on plutonium which has a half life of over 88 years. There's a lot learn about Mars, they will need all that time.

"It's exciting," Atreya says, his face breaking into a grin.

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