Lasers, Cameras and Particle Detectors: Mars Rover's Super High-Tech Science Gear

- By Adam MannEmail Author August 3, 2012 | 11:55

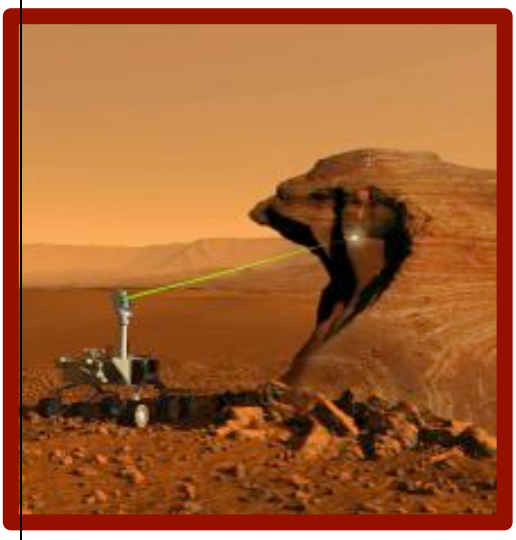
Assuming it safely passes through its terrifying and complex descent sequence, NASA's newest rover, **Curiosity,** should get its wheels on the Martian surface in just two short days, at 10:32 p.m. Pacific on Aug. 5. The size of a small SUV, Curiosity is packed with 10 state-of-the-art instruments that will allow it to answer questions about Mars' wet history, current atmosphere and climate, and the possibility of ancient or contemporary life.

Curiosity represents a scientific and engineering leap over the previous rovers, Spirit and Opportunity, and its nuclear-powered battery will allow it to rove day and night. Over the course of its two-year initial mission, the probe will climb up a 3-mile-high mountain in the middle of Gale Crater, poking, prodding, and drilling into the soil and rocks.

Here we take a closer look at the individual instruments that will help Curiosity make the next breakthrough discoveries about the Red Planet.

From the moment the rover hits the Martian atmosphere it will start taking data. Studded in 14 locations around the probe's heat shield are devices known as the **Mars Science Laboratory Entry Descent and Landing Instrument** (MEDLI). This equipment will provide information about Mars' atmosphere and the dynamics of the rover's descent, analyzing Curiosity's trip to the surface and providing information helpful in designing future Mars missions.

Additionally, a special camera, the **Mars Descent Imager** (MARDI) will be watching the view as the ground rushes up at Curiosity. By taking high-resolution color video during the probe's landing sequence, MARDI will provide an overview of the landscape during descent and allow geologists back on Earth to determine exactly where Curiosity lands.



Possibly the coolest Curiosity instrument is the **ChemCam**, which uses a laser beam to shoot rocks (and maybe a Martian or two) in order to vaporize a small sample. A spectrograph will then analyze the vapor, determining the composition and chemistry of the rocks. Situated on Curiosity's head, ChemCam can shoot up to 23 feet and should provide unprecedented detail about minerals on the Martian surface.

The **Chemistry and Mineralogy** (CheMin) instrument will look at various minerals on the Martian surface. Specific minerals form in the presence or in the absence of water, revealing the history of an area and helping scientists to understand whether or not liquid existed there. Curiosity will drill into rocks to obtain samples for CheMin, pulverizing the material and transporting it into the instrument's chamber. CheMin will then bombard the sample with X-rays to determine its composition.

The **Rover Environmental Monitoring Station** (REMS) will be Curiosity's weatherman, providing data about daily atmospheric pressure, wind speed, humidity, ultraviolet radiation, and air temperature. REMS will sit on Curiosity's neck and also help assess long-term seasonal variation in Mars' climate.

The **Alpha Particle X-Ray Spectrometer** (APXS) sits the end of Curiosity's arm, allowing the rover to place it right up against rocks and soil. It will then shoot X-rays and alpha particles (essentially Helium nuclei) at the materials to identify how they formed.

The **Sample Analysis at Mars** (SAM) is one of the most important instruments and the reason that Curiosity can be called a mobile laboratory. Taking up more than half of the rover's body, SAM contains equipment found in top-notch labs on Earth: a mass spectrometer to separate materials and identify elements, a gas chromatograph to vaporize soil and rocks and analyze them, and a laser spectrometer to measure the abundances of certain light elements such as carbon, oxygen, and nitrogen – chemicals typically associated with life. SAM will also look for organic compounds and methane, which may indicate life past or present on Mars.

The other experiment important in Curiosity's search for Martian habitability is the **Dynamic Albedo of Neutrons** (DAN) instrument, which will look for water in or under the Martian surface. Water, both liquid and frozen, absorbs neutrons differently than other materials. DAN will be able to detect layers of water up to six feet below the surface and be sensitive to water content as low as one-tenth of a percent in Martian minerals.

Curiosity has plenty of eyes to take in the view on the ground. Perched atop its head is the **MastCam**, two cameras capable of taking color images and video, as well as stitching pictures together into larger panoramas. One of these two cameras has a high-resolution lens, allowing Curiosity to study the distant landscape in detail.

The **Mars Hand Lens Images** (MAHLI) instrument will provide close-up views of rocks and soil samples near the rover. MAHLI sits at the end of Curiosity's long, flexible arm, and can image details down to about 12.5 micrometers, roughly half the diameter of a human hair. The instrument will also be able to see in ultraviolet light, which will come in handy during night exploration and funky psychedelic parties.

Rounding out Curiosity's cameras are the hazard-avoidance **Hazcams** and navigation **Navcams**. The Hazcams will watch underneath the rover to prevent it from crashing into any large objects while the Navcams will be mounted on the rover's mast to help it steer. Both camera sets will be capable of taking stereoscopic 3D images.

Future Mars missions may rely on data from the **Radiation Assessment Detector** (RAD). The first instrument that Curiosity fires up when it lands on Mars, RAD will measure radiation at the Martian surface, determining how plausible it is that microbes exist there. One of RAD's main selling points is its ability to assess how safe or dangerous the Martian surface would be to future human explorers, calculating the radiation dose future astronauts may receive.