Curiosity on Mars

MARS HAS BEEN A FASCINATION FOR THOUSANDS OF YEARS. FIRST SIGHTED AND DOCUMENTED OVER 4,000 YEARS AGO, THE RED PLANET CAN BE SEEN AT NIGHT WITHOUT THE USE OF BINOCULARS OR TELESCOPES. SLIGHTLY MORE THAN HALF THE SIZE OF EARTH, IT IS THE PLANET THAT IS MOST SIMILAR TO OUR HOME PLANET. WHAT HAS BEEN DISCOVERED THUS FAR HAS BEEN REMARKABLE. WHAT WILL BE DISCOVERED IN THE NEAR FUTURE CAN BE LIFE CHANGING.

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Armen Toorian inspecting the arm of a replica of Curiosity.

The Mars rover explorations began in 1997 with the Pathfinder, 32 years after the U.S. Spacecraft Mariner 4 took the first close-up images of Mars. In 1976, Viking 1 and 2 were the first successful launches to reach the surface of Mars and send back data, following the earlier Mariner space probes. In 2004, Opportunity, one of the next rover missions, discovered salt-water traces beneath rocks. Opportunity's co-rover Spirit found there may have been a possibility that there was water between the cracks of Mars' surface. The third generation of rovers, Curiosity, was deployed on November 26, 2011, and is expected to land on Mars in August 2012. Armen Toorian, a Systems Engineer at Jet Propulsion Laboratory has been working on Curiosity and will continue to track its progress as it travels throughout Mars. Curiosity is greatly improved from its first version but is still being tested through trial and error at JPL's Mars field. As the rover approaches Mars, scientists at NASA's Mars Science Laboratory will monitor it to ensure it lands in the correct position. If needed, course corrections will take place to help nudge it in the right direction. As it hits the atmosphere of Mars, the scientists will begin corrections with the heat shield, slowing down the rover and then opening the parachute. Curiosity should have a smoother landing compared to previous rovers because it will be tethered down. As a Systems Engineer, Armen worked a great deal on various functions of the Curiosity Rover. "I first worked on the actuators. These are the motors that spin the wheels and rotate the joints of the robotic arm, mast and antenna," explained Armen. The rover is about the size of a small SUV – 10 feet long (not including the arm), 9 feet wide and 7 feet tall – or about the height of a basketball player. Weighing in at approximately 2,000 pounds, Curiosity has many functions that previous rovers did not. Though the functions are similar to the second set of rovers, Curiosity will not be solar-powered. Instead, it will function through a radioisotope power system that generates electricity from the heat of plutonium's radioactive decay. Armen explained, "In our previous missions, when the solar panels on the rovers were covered in dust, they did not allow for recharge. We would have to wait until winds picked up to clean off the panels. Curiosity will be able to continue its work at times when sunlight is

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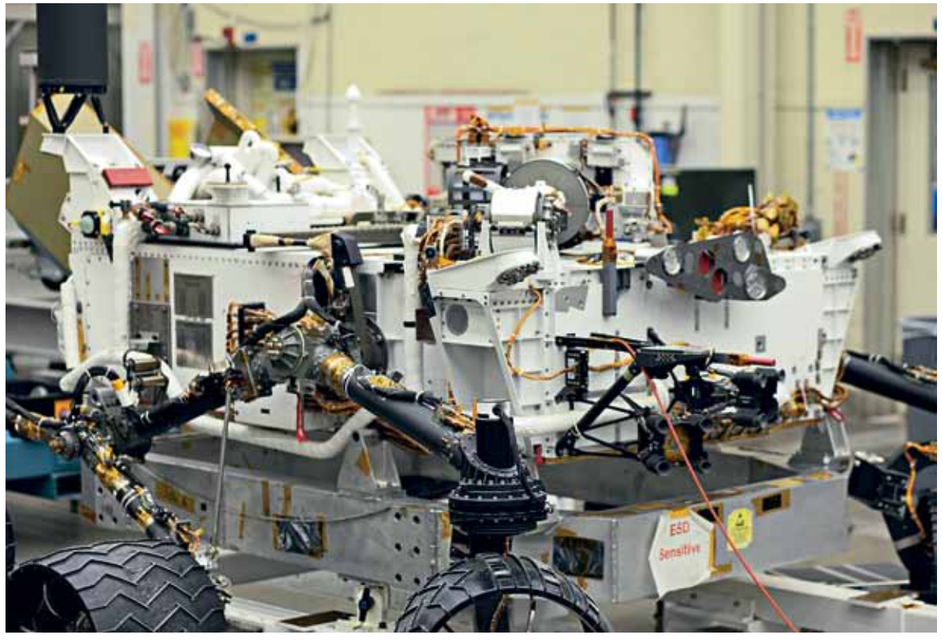
The 4th Planet from the Sun
Mars is named after the Roman God of War. The planet is considered to have similar characteristics as Earth, although it would be impossible to survive there. By visiting Death Valley in California, you may get a sense of what life would be like on Mars (which ironically was also the name of the Roman guardian of agriculture as well as the God of War). The planet, about half the size of Earth, has two moons, Phobos and Deimos, and has an orbit of 687 earth days or two earth years.

limited." The power from decay will give the rover an energy life of one Martian year which is 687 Earth days. "I currently specialize in the Entry/Descent/Landing phase of the mission. It is very different from what I started out doing, but it is a natural progression as we transitioned from designing and building the spacecraft to testing and operating it. We are currently running countless simulations and tests to prove to ourselves that we have done everything in our power to survive the 'seven minutes of terror' that comprise entering the Martian atmosphere, decelerating to a safe speed, then maneuvering and touching down gently on the surface." said Armen.
Curiosity will inventory the area's chemical building-blocks of life, assess clues about wet environments in the area's history and examine rocks, soil and atmosphere with a diverse payload of tools. The rover has mast-mounted cameras to study targets from a distance, arm-mounted instruments to study targets they touch, deck-mounted analytical instruments to determine the composition of rock and soil samples acquired with a powdering drill and a scoop, and other instruments to analyze the environment. Its arm will reach out and inspect the dirt and rocks around the rover. The rotating mast will take pictures and aim the laser which will vaporize the surface of rocks and determine their composition. An antenna will track Mars' orbiters flying overhead, allowing the command center to relay information back and forth between Earth and Mars. The rover is designed to travel a distance from 5 to 20 kilometers a day. The wheels of Curiosity have patterned holes to make the rover lighter and leave JPL signature tracks in Morse code as it drives around on Mars. "It is an incredible feeling knowing that I have physically touched every single actuator in the Curiosity rover, and that they will be there, sitting on another planet millions of miles away from Earth for a long, long time," said Armen excitedly.
A highly advanced internal computer will control Curiosity's exploration autonomously. Because it takes 15 minutes to send a signal and another 15 minutes to receive confirmation that the signal went through, the rover has a pre-planned and programmed route.
Toorian is one of more than five thousand people from 39 states who worked on this project. Components for Curiosity have come from many countries around the world, including Russia. Once the rover lands, scientists from a variety of fields will examine the collected samplings. Armen and the team of scientists who follow the Curiosity mission will need to adjust to the Martian calendar for at least two of Earth's years. "By learning about the history and geology of Mars, we can better understand how the Earth's systems function and the elements that were necessary for the development of life on our planet," concluded Armen.



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Testing for the Rover still continues.

Origin of the Name
Twelve year-old student Clara Ma was the one who named the rover Curiosity. In her essay contest, she writes, "Curiosity is an everlasting flame that burns in everyone's mind. It makes me get out of bed in the morning and wonder what surprises life will throw at me that day. Curiosity is such a powerful force. Without it we wouldn't be who we are today. When I was younger, I wondered, 'Why is the sky blue? Why do the stars twinkle? Why am I me?' And I still do. I had so many questions, and America is the place where I want to find my answers. Curiosity is the passion that drives us through our everyday lives. We have become explorers and scientists with our need to ask questions and to wonder. Sure, there are many risks and dangers, but despite that, we still continue to wonder and dream and create and hope. We have discovered so much about the world, but still so little. We will never know everything there is to know, but with our burning curiosity, we have learned so much."

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When asked about the path that led him to this space project, Toorian revealed that he has always had an interest in engineering and space exploration and what it offers us humans. As an undergraduate at California Polytechnic State University, San Luis Obispo, Armen learned about a project called the CubeSat Program where students built tiny satellites (10cm cubes) and launched them into Earth's orbit. The program – a collaborative effort between Stanford University and Cal Poly – provided a way to give universities, small companies and nations without space programs access to space and affordable launch opportunities.

The experience honed Armen Toorian's interest in space and engineering, especially robotic exploration of other planets, introduced him to many people in the industry and gave him an amazing experience in terms of technical growth and insight into the aerospace industry. The highlight of the program was a trip to Russia, Ukraine and Kazakhstan. Cal Poly was the launch broker. It was their job to organize and plan launches for CubeSats as well as provide the technical interfaces between the launch provider (in this case, a Russian company – Kosmotras) and CubeSats. It was very fulfilling for Armen to be part of the development of the CubeSat Program which has expanded to over 100 universities participating worldwide as well as missions to launch American, European, Russian and Indian mini-satellites into orbit.
Later, while still in school, Toorian had a unique opportunity to help develop the Masters in Space System Engineering program at Cal Poly, San Luis Obispo, and was among the first group of students to graduate with that specific degree. "I started as a Mechanical Engineering student at Cal Poly. I wasn't sure exactly what my calling was, so I decided to pick the hardest of the options I had available, thinking that if I succeeded, I could achieve any of my other goals as well." Thus, upon graduation, Armen joined JPL. ■