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RANGER

Stewards for parks, visitors & each other

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TECHNOLOGY IN THE NATIONAL PARKS

THE QUEST TO EXPLORE OTHER PLANETS

Image A shows examples of self-guided robotics entered in the Great Sand Dunes robotics challenge. Image B shows the Curiosity rover exploring Mars. The wheels on Curiosity are 16 inches (40cm) wide.

NASA, Smithsonian conduct research at Mars-like national park

By Andrew Valdez, Great Sand Dunes, and James Zimbelman, Smithsonian Institute

THE NATIONAL PARK SERVICE HAS THE HAPPY TASK OF PRESERVING AND PROTECTING SOME OF THE MOST INTERESTING LANDSCAPES IN THE UNITED STATES. SOME OF THESE LANDSCAPES ARE UNUSUAL ENOUGH TO HAVE SIMILARITIES TO WHAT IS SEEN ON OTHER PLANETS. IN THESE PLACES, SCIENTISTS HAVE NATURAL LABORATORIES WHERE THEY CAN STUDY CONDITIONS ON PLANETS WE CAN'T YET VISIT.

Great Sand Dunes National Park and Preserve (GRSA) in Colorado is such a place. It's the site of the tallest dunes in North America and is an arid environment dominated by wind-shaped landforms similar to what's been studied in photographs of Mars.

In the late 1960s and early 1970s, scientists from NASA's Mariner program began exploring Mars. The images Mariner captured revealed that Mars has sand dunes and sand seas. Some of the dunes developed within craters. The crater walls surrounded closely spaced sand dunes in a manner similar to the way in which the Sangre de Cristo Mountains confine the closely spaced dunes at GRSA.

Because we know that southwesterly winds at GRSA have blown sand to the mountain front, scientists can use this information to determine wind directions on Mars where the dunes are found on a specific side of a crater. Scientists found that the side of the crater containing the dunes was the downwind side, and so an understanding of the processes shaping the physical environment on Mars began to develop.

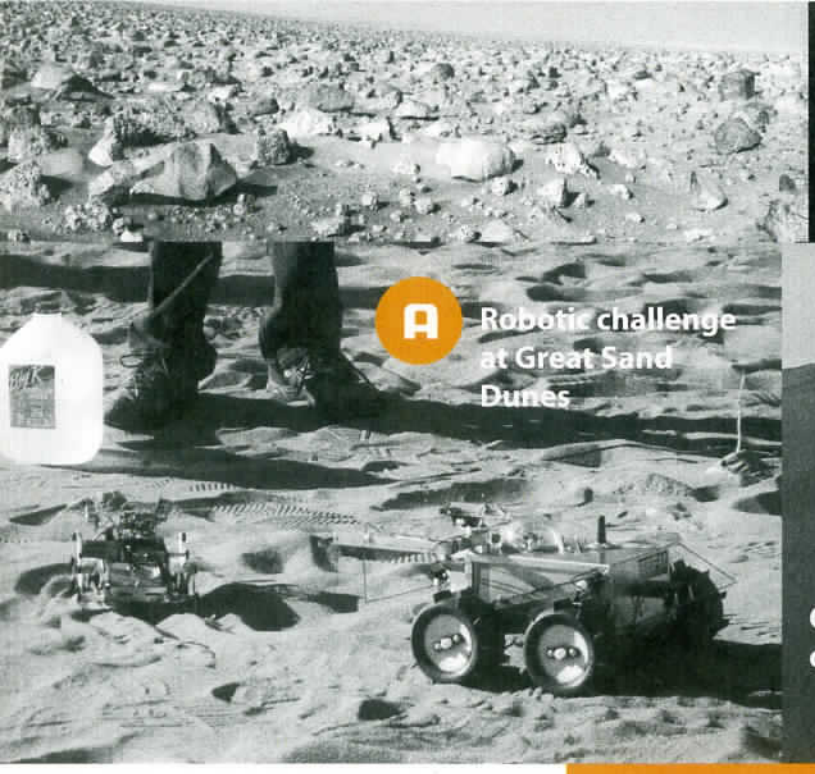
NASA COMES TO GRSA

NASA's Viking missions in the mid-1970s included a landing vehicle that provided ground-level photos of Mars. Designing the lander's camera was challenging: It had to be launched from Earth, travel through space, land on another planet and work in a sandy environment. Engineers tested the camera at GRSA to ensure that it could withstand Mars' sand, cold and thin atmosphere (GRSA is 8,000 feet above sea level). Although Mars is much colder that GRSA, with temperatures rarely above freezing, and its atmosphere has less than 1 percent of the pressure of Earth, GRSA is considered to be "Mars-like."

The mission was a success; Viking images showed even more similarities to GRSA, revealing a rocky surface where wind had removed the sand and silt, leaving a boulder-laden field above a sandy substrate.

The same environment can be found at GRSA, where streams deposit sand and boulders. When a stream shifts its course or dries, sand in the former channel blows off, leaving a Mars-like boulder field behind. These findings led to even greater use of GRSA by NASA.

SEE THE FULL CURIOSITY FIGURE:
HTTP://PHOTOJOURNAL.JPL.NASA.GOV/CATALOG/PIA20316



Viking lander imagery shows boulders overlying a sandy substrate. Similar surfaces can be found at GRSA near Medano Creek.

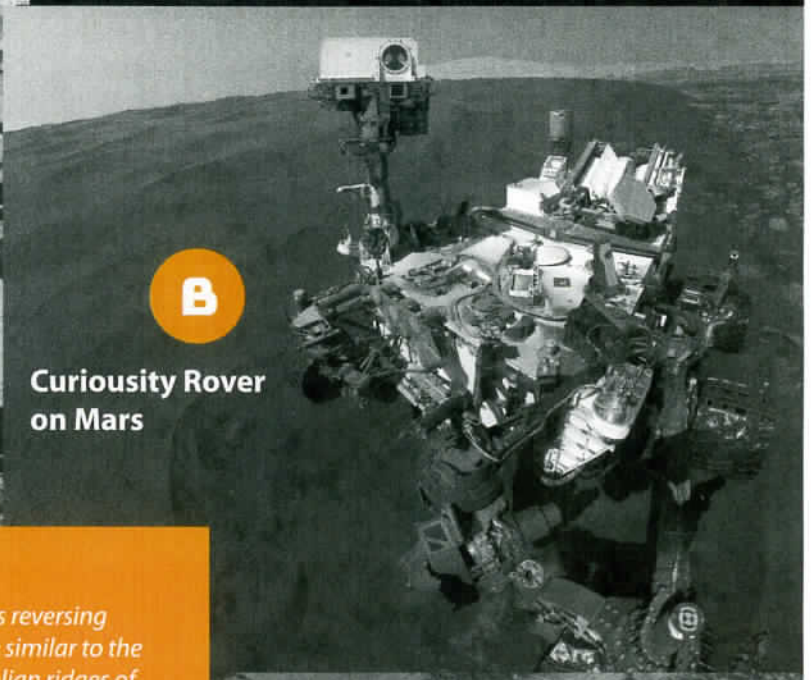
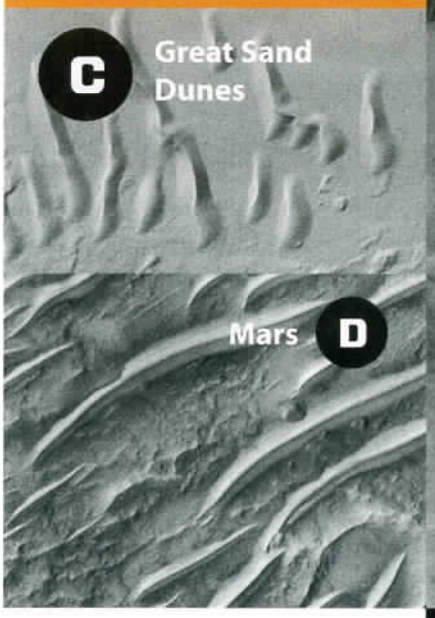
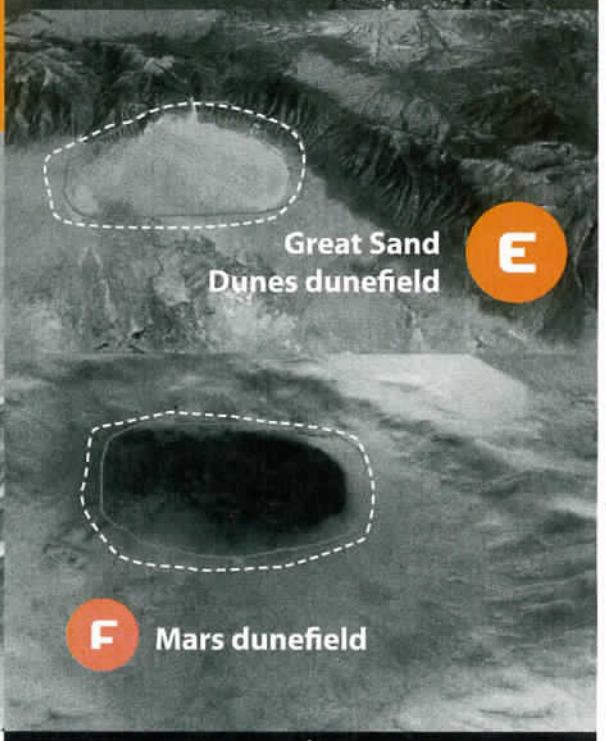


Image C shows reversing dunes that are similar to the transverse aeolian ridges of Mars shown in image D.





Dunefields formed in similar topographic traps (dunefields are circled by a red line). Image E shows GRSA nestled in a bend of the Sangre de Cristo Mountains. Image F shows a Martian dunefield in the downwind corner of a crater. Each image is at a similar scale.

Robotic spacecraft like the Viking lander have become popular again in the 2000s as the NASA missions have placed Sojourner, Spirit, Opportunity, Curiosity and Phoenix landers on Mars, and university engineering departments are filled with students eager to design such robotics. Since 2011, NASA and Adams State University have sponsored an annual robotics challenge at GRSA to test robotic, self-guided designs by their engineering students. The boulder and sand surfaces offer Mars-like challenges to the roving vehicles.

NEW DUNE FORM FOUND

In January 2016, the Curiosity rover made the first up-close measurements of an active sand dune on Mars, which has provided important new insights into how sand moves on Mars and how to operate robotic vehicles on sand. NASA is now receiving vast quantities of high-resolution imagery that have led to more discoveries about the planet.

One such discovery is a unique dune form called Transvers Aeolian Ridges

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Students with robots they built as part of the Space Grant.

TECHNOLOGY FOR THE 22ND CENTURY

TECHNOLOGY HAS COME A LONG WAY SINCE 1916, WHEN THE NATIONAL PARK SERVICE WAS ESTABLISHED. IT HAS ENABLED SIGNIFICANT SOCIETAL IMPROVEMENTS, AND IT HAS ALSO PROVIDED NEW CHALLENGES. I BELIEVE TECHNOLOGY WILL PROVIDE AN AUGMENTATION TO THE MISSION OF PARK RANGERS IN THE NEXT 100 YEARS; WE MAY EVEN SEE RANGERS ON HOVER BOARDS ONE DAY.

By Brian Sanders

My great-grandparents lived just outside Rocky Mountain National Park close to 100 years ago, and they helped many visitors experience the area daily. I was fortunate that my parents took me to Great Sand Dunes National Park & Preserve (GRSA) when I was 5, and I have fond memories of making dams in the seasonal runoff at the base of the dunes. As an adult, I have enjoyed sharing the beauty of Rocky Mountain with my children on quiet fall days. These experiences have given me a great appreciation for nature.

Working with technology on a daily basis, I help develop future leaders and engineers as a part of NASA's higher education program called Space Grant. I see amazing technology that is enabling exploration of distant planets and a greater appreciation of our Earth and our changing environment.

The Colorado Space Grant Consortium hosts an annual robotics event for students inspired by the U.S. space program and the exploration of Mars. With support from GRSA we hold the event just outside the park near Alamosa, Colorado. We are able to leverage geographical features similar to what some of the participating students might someday encounter while driving a Mars rover — or perhaps when visiting the red planet themselves.

Photos by Brian Sanders

FUTURE ROLES FOR TECHNOLOGY

How can technology of the future help the mission of the park ranger as a steward of the land, history and resources? Looking at current technology to make projections for the future is a good method for understanding the possibilities.

Take the Roomba as an example of how current technology could be extended to the parks. This small, commercially available robot roves a home and vacuums up dirt and debris. A larger version of the Roomba could rove parks to help clean up visitor areas, such as parking lots overnight.

Environmental data collection within parks could be revolutionized through the capabilities developed for cell phones. As an example, NASA launched a few satellites about the size of a liter water bottle, each with a smartphone at its core. Image if this technology could be leveraged for terrestrial sensors. This could create low-cost, highly capable low-power sensor networks powered by thumbnail-sized solar cells, enabling data networks that could telemeter environmental data.

Consider a fleet of small hexapod robots, each about the size of a tennis ball, scouring the forest floor for ecological features. This distributed network of sensors, fixed or mobile, could be deployed in smaller packages with greater spatial density while providing smaller temporal resolutions to monitor environmental or geographic changes, enabling the monitoring of microclimates, for example.

Robotic platforms such as the Mule from Boston Dynamics could transform how equipment could be transported over challenging terrain. The Mule is a mule-sized quadruped robot with legs similar to a mule. With the right technology it could be as quiet as a horse and carry more weight without the rest and food requirements of a horse.

Artificial intelligence will transform society in the next century. Artificial intelligence conjures ideas of HAL 9000 from "2001: A Space Odyssey" or androids running amuck. Society and technologists will need to assure that AI growth is responsible and complementary.

Adaptive learning and the ability to harness endless stores of information could provide park visitors ready access to information. Some of the most exciting advances based on current technology could be in the areas of safety and communications. Amazon has announced its plans for drone deliveries to customers' doorsteps. Although it is currently illegal to fly drones in U.S. national parks, the idea of using drones to scour the wilderness in search of a lost hiker and then deliver water, food and a method to communicate is amazing. A drone could use sound, infrared and other superhuman senses to find and deliver immediate aid.

Augmented reality might be a way to provide detailed information to the user about the surrounding flora and fauna. For example, Google Glass could provide a real-time image of a park visitor's surroundings and overlay augmenting information such as plant and animal species identification.

CONSIDER THE IMPLICATIONS

All this technology would provide more information, but at a cost. A concerted look at the use of technology and balancing the visitor experience also will be necessary as technology enables new capabilities.

▲ *A student-built rover about the size of a house cat. Students build robots as part of the Space Grant program.*

It would be a shame to have park visitors not looking up or not interacting with nature or other people. Visitors would miss the serenity and the opportunity of learning from the experts in the park, park rangers. Rangers set the tone for visits to national parks and provide the human connection to the land and its history. They can never be replaced.

The ranger's mission may be augmented by technology, but hopefully only with careful consideration. I hope my great-grandkids can enjoy a quiet fall day in 2116 in the Rocky Mountains, experiencing the land just as my great-grandparents did in 1916.

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Exploring other planets continued from pg. 7

(TARs), which at first appeared to be unique to Mars. GRSA has played a key role in improving our understanding of TARs. TARs are unusual because of their symmetry. Both sides of the dunes have the same slope, which is uncommon on Earth. GRSA has mega-ripples, which have larger than normal-scale sand ripples, and reversing dunes, where opposing winds cause the sand to pile up. Since 2002, the Smithsonian Institute has been measuring GRSA mega-ripples and reversing dunes for comparison to TARs.

Should there be a time when humans settle on Mars, perhaps the National Park Service's experience in managing sand dunes will help shape decisions about the dunes there. Maybe we will even celebrate the creation of Martian Dunes International Park.

WE WONDER – WILL THERE BE AN ENTRANCE FEE?

Andrew Valdez is a geologist at Great Sand Dunes National Park & Preserve (GRSA).
James Zimbelman, Ph.D, is a geologist at the Smithsonian Institute. Zimbelman was the first person to note the uniqueness of Transvers Aeolian Ridges (TARs) on Mars and is a member of the scientific team that named them. He is the lead Smithsonian scientist studying the environment at GRSA for comparison with TARs on Mars.