Science

Roaming rovers

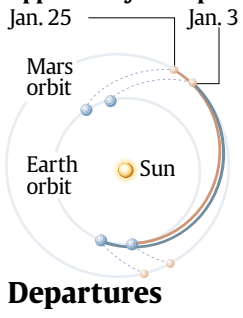
The two NASA rovers — Spirit and Opportunity — will take panoramic images of Mars. The cameras will provide 360-degree views of the terrain. These will allow scientists to select promising geological targets. Then the rovers will drive to those locations to perform scientific investigations during their 90-day mission. Each 380-pound rover could travel as far as 100 yards in one day.

The long journey

After six months and 25 days, the first Mars exploration rover has arrived on Mars.

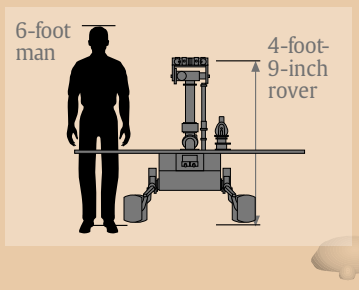
Arrivals

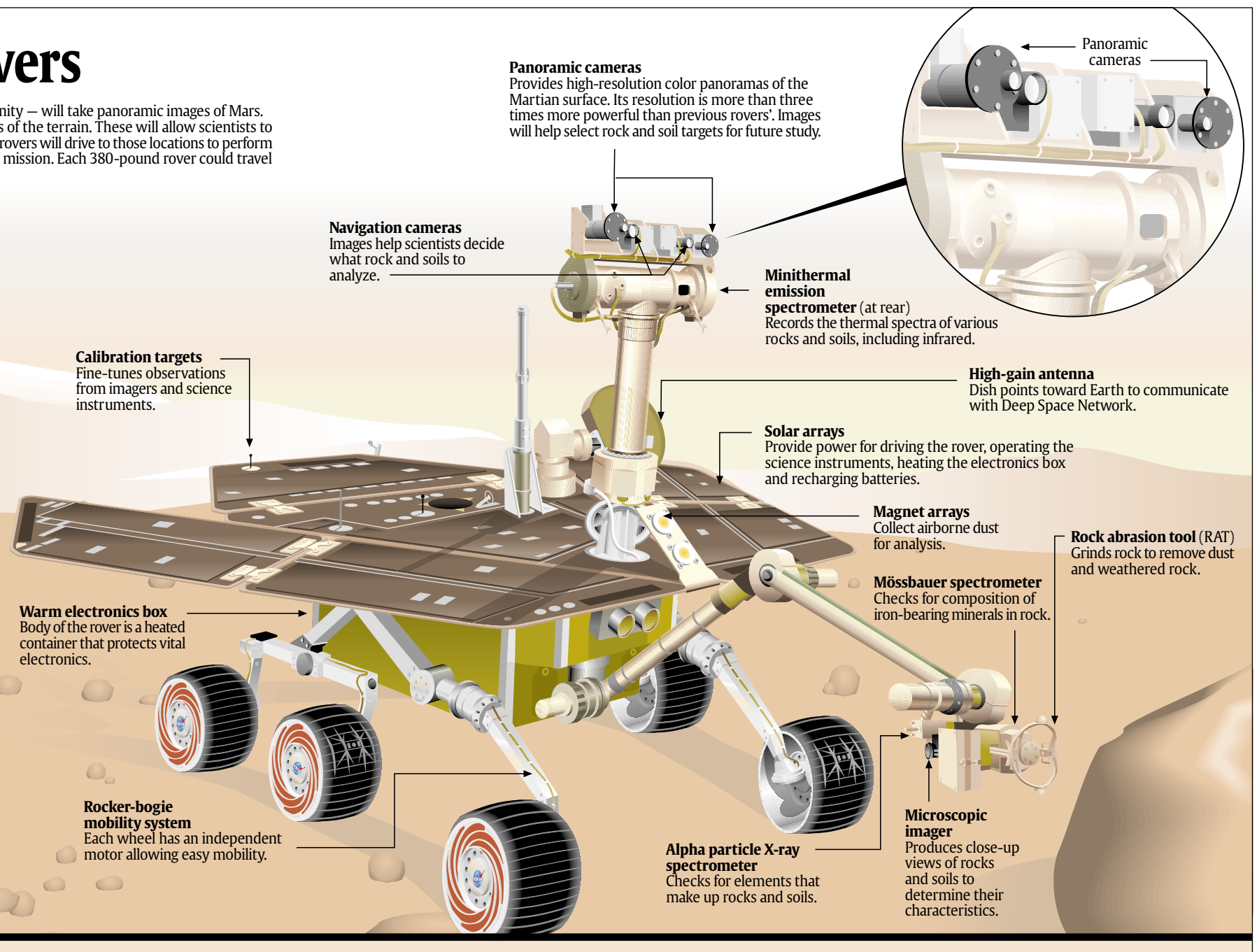
Opportunity Jan. 25
Spirit Jan. 3



Departures

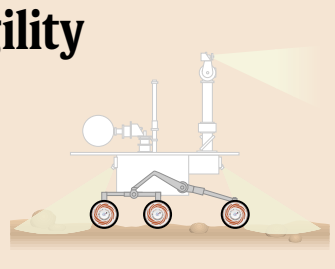
Spirit July 10
Opportunity June 10



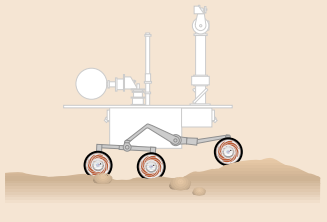


Movements and agility

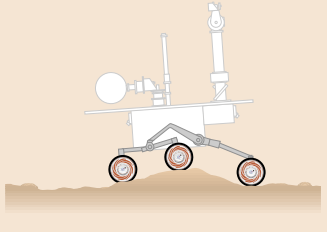
Scientists based in NASA's Jet Propulsion Laboratory in Pasadena, Calif., control the rover's movements. The team will analyze its data transmissions, and while the rover sleeps through the night, refine plans for the next sol's (a Martian day) activities.



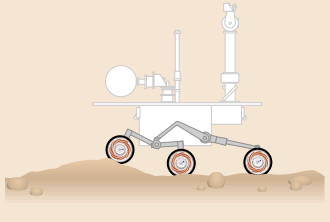
Rover scans for surface hazards and gathers data to transmit to Earth. It moves for 10 seconds, stops and studies for 20 seconds.



Top speed for the rover is a cautious 2 inches per second, allowing scientists to select the safest route.

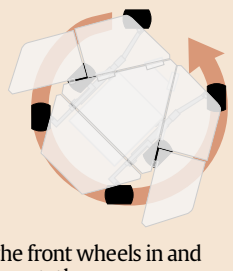


The suspension allows the rover to minimize rocking as it travels, and safeguards its instruments from shock.



Though it can withstand a 45-degree tilt without overturning, the rover has 30-degree limitations in its programming.

TOP VIEW



Rover's rotational six-wheel drive

By moving the front wheels in and back wheels out, the rover can rotate on a dime. The center wheels are drive only.

Sources: NASA, JPL, *Florida Today*, GNS research

By Jerald Council, Jef Dauber and Janet Loehrke, Gannett News Service

For Mars lander scientists, nothing to say but it's OK

Beatles tune sets Spirit grooving across Red Planet

By Dan Vergano and Robert Davis
USA TODAY

Everybody knows there's nothing doing
Everything is closed it's like a ruin
Everyone you see is half asleep
And you're on your own you're in the street
Good morning, good morning . . .

— The Beatles
(*Good Morning, Good Morning*)

■ ■ ■

Tired but ecstatic, scientists began exploring their new playground on Mars Sunday by blasting The Beatles in their California control room and celebrating new pictures from the Red Planet.

Their probe, Spirit, was awakened as the scientists played *Good Morning, Good Morning* and studied pictures the craft took as it descended onto the planet Saturday night. The images provided the scientists with their first glimpse of their home away from home — an area they will study for months.

Scientists are thrilled with what they have seen. "Home sweet home," says Steve Squyres, lead investigator. "This is our new neighborhood."

Michael Watkins, one of the navigators, called Spirit's landing a "bull's-eye" because the craft entered the atmosphere just 660 feet away from its target in the Connecticut-sized Gusev Crater.

But exactly where the probe ended up on the surface was still part of the scientific debate Sunday. Scientists must pinpoint the location before sending signals.

They zeroed in by comparing pictures Spirit took just before it landed with images that have been taken over the years by other craft orbiting Mars.

"We know with great certainty that we are in the place where we absolutely wanted to be," Squyres said.

That spot has more to do with accessibility to rocks than breathtaking views.

"What we wanted was someplace where Mother Nature has cleaned off the rocks for us," Squyres said, showing a picture of the planet's surface. "Those marvelous snakelike features are dust-devil tracks. Dust devils (whirlwinds of dust) are good at swirling dust up off the surface and cleaning up rocks."

Rocks hold clues to the planet's past. And Spirit will study those rocks — at times using an arm to reach out and touch them for analysis — to try to answer questions about water and life on Mars.

Squyres chuckled at the thought of being able to reach out and touch a Martian rock within just a few days: "That would be cool."

He said Spirit's neighborhood appears "a lot easier to drive on" than that faced by the Viking and Pathfinder probes. "It's remarkably devoid of big boulders. That is just glorious, because big boulders are something we have trouble driving over."

Which way to drive is one of the big questions facing the scientific team.

Better pictures will lead the way. Today the team expects to begin getting images that are 14 times sharper than Spirit's early pictures.

"We will have to be a little bit cautious. This is someplace that we've never been before, so we are going to tread carefully," Squyres said.

Asked whether the dust devils pose a threat to Spirit, Squyres chortled. "As far as a dust devil coming in and flipping our rover over, nuh-uh. Ain't going to happen," he said. In fact, the team hopes to spot one with its sophisticated cameras to make "a dust-devil movie."

"We hit the sweet spot," he said. "There is some great stuff on the horizon."

NASA/JPL via AP

"Home sweet home": The Mars probe Spirit has begun transmitting pictures from the Red Planet and is expected to begin sending higher-quality shots sometime today.

The hows, whys and wheres of the latest Mars exploration

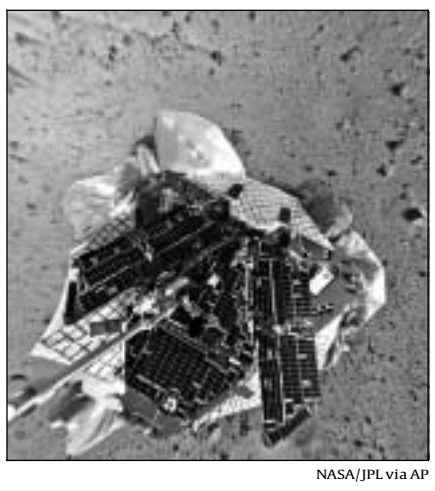
NASA has cleared a giant hurdle in landing a rover on Mars. USA TODAY's **Dan Vergano** and **Robert Davis** look at this new chapter in space exploration.

Q: Where is Spirit right now?
A: As intended, Spirit appears close to the middle of Gusev Crater, a huge bowl that may have once held a lake. Scientists do know it rests upright — a very good thing — atop its landing craft and the deflated airbags that cushioned its landing.

Q: What is it doing?
A: The priority now is pinpointing the rover's position and its exact heading so that its high-power antenna — a lollipop-shaped object on its top — can be pointed toward Earth. That antenna will allow scientists to communicate directly with Spirit instead of using an orbiting craft as a go-between, as they were on Sunday. Scientists also say solar power is about 20% less than expected for Spirit because of the dust on Mars. They may change plans to deal with the shortfall.

Q: How soon will it start driving around?
A: It will start moving nine days after landing at best, NASA scientists say, so Jan. 13 would be the soonest for "egress," in NASA-speak, from the landing craft. When Spirit landed, it was folded up with its instruments turned off, so engineers and scientists are busy testing systems and limbering up the rover while plotting what path it should take on its three-month exploration. By Tuesday the rover should be up on its wheels. A 29-inch-high rock is on the right side of the landing craft, blocking one avenue to roll off, but overall the platform is tilted only about 2 degrees, convenient for egress.

Q: Why did the rover land in a bouncing airbag instead of setting down with rockets as in the moon landings?
A: Airbags remove the need for stabilizing rockets and electronics that make "soft" rocket landings possible; they were envisioned as a way to save weight and money for the 1997 Pathfinder mission. But the method has limits — it's imprecise, and at 400 pounds, Spirit is about the largest probe likely to try airbag landings on Mars, says landing expert Paul Withers of Boston University. NASA's next lander missions, scheduled for 2007 and 2009, are larger and will land with rockets.



NASA/JPL via AP

Safe landing: Rover as seen on Saturday by its navigation camera.

Q: Why did last month's Beagle 2 landing apparently go badly when this one went well?
A: Most likely bad luck and fewer resources, Withers says. Any number of accidents might have occurred, but Beagle 2 lacked the stabilizing rockets Spirit had to combat winds, and its airbags were not the heavy-duty ones used by NASA, which might have left it vulnerable to damage.

Q: What are scientists looking for with Spirit?
A: Finding sedimentary rocks in what is believed to be a dried lake in Gusev Crater would be a first step. The rover might have to enter smaller craters to look for these layers of rock. A grinder would show cameras and other instruments whether Mars' water came from hot springs, a salty sea or some other source. Volcanic dust might have covered any sedimentary rock in the crater, and scientists hope examination of this rock tells them something about the geologic history of the Red Planet.

Q: Can Spirit find the lost Beagle 2?
A: No; if it indeed landed, it would be too far away, and scientists don't know where to look. Spirit mission manager Mark Adler says it would take "1,000 years" for the rover to reach Isidis Planitia, the flat basin where Beagle 2 was supposed to have landed.

Q: Does Spirit's landing mean that the Opportunity rover scheduled to land Jan. 24 also will land safely?
A: Not surprisingly, NASA officials are cautious and say Spirit's landing went far better than expected. But new stabilizing rockets and landing camera systems performed better than expected, "which gives everybody very high confidence," says Louis Friedman, head of the Planetary Society, a space exploration advocacy group whose companion event to the Spirit landing in Pasadena drew a standing-room-only crowd of 2,000.

Q: What are the "Sol" days that scientists mention when they say what time it is on Mars?
A: A Sol is a Martian day: 24 hours, 39 minutes, 35 seconds. About 40 members of the rover science team will be living on a "Sol" schedule, instead of Earth time, during the mission.

Q: Where is Opportunity headed?
A: Meridani Planum, a smooth equatorial plain marked by deposits of gray hematite, an iron oxide mineral usually associated with water on Earth. Once again, NASA is trying to "follow the water" in its exploration of Mars.