Imagine sitting at a computer on Earth and commanding a small vehicle to roll across the rocky red surface of Mars. Wearing three-dimensional goggles, you would feel as if you were driving, exploring places no one had ever seen before.

That’s what Brian Cooper did during the famous Pathfinder mission to Mars in 1997. Cooper is a computer-software programmer at NASA’s Jet Propulsion Laboratory in California. He designed the program that controlled the vehicle, which is called a rover, and he was one of two drivers during the four-month mission.

Cooper’s opportunity to drive the rover came in July 1997. As Americans celebrated Independence Day, a three-foot-tall spacecraft called Pathfinder Lander reached the surface of Mars after a seven-month journey from Earth. The next day, Sojourner, a rover about the size of a small toy wagon, rolled out of the lander. Creeping about one inch every two seconds, Sojourner explored Ares Vallis, a valley once flooded with water.

This marked the first visit to Mars since 1976, when NASA’s two Viking landers sampled Martian soil.

The 1997 mission was a technological milestone in planetary research. Unlike the Viking landers, Sojourner could move around. It could explore.

**Really Remote Control**

Sojourner demonstrated that it was possible to explore a distant planet without astronauts ever leaving Earth.
With Cooper driving by remote control, Sojourner analyzed rocks and soil in the search for clues about the origins of Mars. Scientists chose the rocks to explore, and Cooper safely steered Sojourner to them. Each evening Cooper used a computer to plot all of Sojourner’s movements for the next day. The data were relayed first to *Pathfinder Lander*, and then from the lander to Sojourner the next morning.

Driving the rover was similar to playing a video game. “I’ve been playing video games since I was a kid, and the program I wrote looks like a video game,” said Cooper. “One big difference is that in a video game you’re getting immediate feedback, whereas I’m packaging it up in a whole day’s worth of commands and sending it later.”

Unlike a remote-controlled vehicle on Earth, Sojourner could not respond instantly to Cooper’s commands. It took about eleven minutes for signals to reach Mars. For example, if Sojourner were near the edge of a cliff, it would take eleven minutes to receive a stop command. In the meantime the rover might fall.

The rover designers solved this problem by giving Sojourner sensors that could make it stop whenever it met unexpected dangers.

### Seeing in 3-D

Cooper’s “eyes” on Mars were cameras that worked in stereo. On the lander, one camera snapped photographs from the left-eye view. At the same time, another camera took photos from the right-eye view. The rover also had two cameras that worked in stereo. The images were sent to Cooper’s computer, and his goggles blended the views into three-dimensional images.

“With my three-dimensional goggles on, it’s as if I’m standing on Mars,” Cooper said. “I can look at the panorama and move back and forth as if I’m right on the lander or down on the ground at Sojourner’s perspective.”

Cooper used a special computer mouse called a spaceball, with a cursor that was a lifelike model of Sojourner. The model moved in three dimensions, creating a sense of depth.

“The key to all this is that the computer calculates where the rover model will be on
the real surface of Mars,” Cooper said. “I can measure how many meters right and how many forward Sojourner should go. I can decide how to squeeze over this rock or get around a bigger one.”

Using information sent back by the lander and Sojourner, Cooper’s program also created a three-dimensional model of the land that could be viewed and explored on the computer screen. These computerized pictures created a “virtual reality” effect that allowed Cooper to “fly” over the ground as if he had a camera in a helicopter. Then he could see rocks from above and sideways.

**Real Science**

Cooper also helped analyze rocks with the Alpha Proton X-Ray Spectrometer, an instrument mounted on Sojourner. He pointed it at rocks chosen by the NASA team. The team also gave these rocks funny names, like Yogi and Scooby Doo. The instrument sent back information about the composition of the rocks, which will help scientists understand the history of Mars.

Did life ever exist on Mars? Can Mars provide clues to predict how Earth will change? NASA hopes to answer these questions by bringing samples of Martian rocks and soil back to Earth. The *Pathfinder* lander and rover will stay on Mars, but several more Mars missions (none carrying astronauts) will be launched by the year 2005. Finally, one spacecraft will bring samples back to Earth in 2008.

These missions mean more work for Cooper, who likes to explore new places. Cooper said, “The most fun was driving into areas that you couldn’t see from the lander. We could drive behind hills and see areas that were brand-new exploration. That could only happen with the rover.”