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Mars 500: Training Astronauts for a Manned Mission to Mars

[Future Transportation](#) > [Cliff Kuang](#) on March 8, 2010 at 5:00 am PST



What happens

when you put five astronauts in a small ship for 500 days and fly them to Mars?

This is the fourth part in [an eight-part series](#) on the future of transportation. New articles published every Monday.

Ever since the dawn of the space age, we've been preparing for a red-planet mission. In the 1960s, 1970s, and 1990s, Europeans and Russians locked themselves into tiny capsules for hundreds of days at a time to simulate a Martian mission. Locations were selected for remoteness and desolation, whether that meant the Atacama desert in Chile or the iciest reaches of Canada.

Yet those extremes pale against Mars 500, a test that will begin in the middle of this year in Moscow, inside a warehouse on the campus of the Russian Institute for Biomedical Problems. There, a crew of seven men will lock themselves inside a series of rooms no bigger than a tiny house for 520 days—the approximate amount of time a return trip to Mars would take, with a 30-day layover on the planet. If they last, each crew member will get a bounty, possibly upwards of \$100,000. What are we hoping to learn from this exercise? And, really, why would anyone want to do that?



Think of Mars 500 as something like the original *Real World*, minus the sexual tension and booze, with a few details changed:

“This is the true story of seven strangers (three Europeans, three Russian cosmonauts in training, and one Chinese)...

...picked to live in a house (that looks like the lovechild of a Quonset hut and the International Space Station)...

...work together and have their lives taped (constantly, from fixed cameras. With doctors, engineers, and psychologists watching at all times)...

...to find out what happens when people stop being polite and start getting real ...”

From a technology standpoint, a manned Martian landing is not out of reach. It's just a matter of committing the resources and solving the inherent problems. Yet all that work would be useless if the crew can't accomplish the task, either mentally or physically. Proving they can is the main thrust of Mars 500.

We can point to examples that prove human beings can function in tight quarters for long periods—on submarines, in Antarctica at McMurdo Station, and for up to 438 days on the Mir space station. But the challenges of Mars 500 are unique.



To simulate the real-world experience of traveling to Mars, the crew won't see any natural light for the duration. They won't be able to shower. To communicate with loved ones or with mission control (in the next room) they'll have to wait 20 minutes for a reply, because that's how long, on average, a real-life telecom signal would take to travel to Earth and back.

"The risk of a serious incident is probably quite small," says Dr. David Dinges, a renowned experimental psychologist and the designer of two experiments that the crew will participate in.

The simulator itself has three main cabins: a medical bay with a dining room; living quarters with a common room, kitchen and six tiny bedrooms; and a utility module with a gym, greenhouse, and restroom. On the outside they all look like large, shiny metal storage tanks; on the inside, they look like Soviet-era mobile homes, covered in wood veneer and equipped with cheap folding furniture. Each module is connected to the next by a narrow crawl tunnel. The Mars landing will be simulated by moving half the crew into a tiny "lander module." They'll emerge on the Martian surface—a sealed-in section of the warehouse facility—and step across concrete floors to perform mock scientific experiments.

The scientists running Mars 500 have already run through a 105-day isolation experiment, which ended in April, 2009, to test the viability of the facility and the scores of experiments that will be performed in the final, full-length run. But perhaps the most important test was the selection process—finding the right people for the job. The Mars 500 crew members were selected after weeks of psychological testing, which included the crew being dropped into the Russian wilderness for a three-day survival course. The goal was not to teach survival skills, but to dissect crew interactions.



"I've always been curious about space," says Oliver Knickel, one of the six volunteers who participated in the 105-day test mission. "But I wanted to see if I could complete this challenge. I wanted to see if I could cope. When I went in, I knew I wasn't going to stop." He and Cyrille Fournier beat out more than 5,600 applicants for the mission's two European slots. They both fit the astronaut criteria—Knickel is a former paratrooper and engineer in the German Army; Fournier is an Air France captain.

According to Knickel, the experience was also surreal by the end, causing a feeling of dislocation—a blessing in disguise, as it would be hard to endure the experience if one actually felt the days passing with any normal rhythm. As he wrote in his mission log:

I have absolutely lost the feeling for ... the total length of time we have spent inside the module now. It seems like three to four weeks, but the calendar proves that it has been 105 days and we will leave the facility later today.

Most important was motivation. The crew shared a selflessness that can be hard to grasp. As Fournier wrote in his log:

You need to realize that the isolation you are in is more valuable (in all senses) than the life you could have had outside, with your family and friends, with all of the possible good moments or potential important achievements you could have accomplished.

And afterward, Knickel says, the strangest facet of the experience was how the experience shaped his everyday life. It felt, for the first time, infinitely rich. He gave up 105 days, and that made each one that followed much sweeter.



The Mars 500 test run was a flying success—the men aboard became a remarkably cohesive, jovial group, and remain friends to this day. And yet the secret, perhaps, wasn't in anything special to them—the sheer amount of work involved turned out to be a balm. “To be honest, the depression and isolation weren't a problem,” says Knickel. “Being so busy made it impossible.”

From 8 a.m. to 7 p.m., the crew was consumed with over 70 experiments, devised by scientists around the world. The final Mars 500 run, meanwhile, will feature 100. A few are technical—testing a chemical “nose” that looks like a minivac and sniffs out dangerous bacterial growths—but they are the exception.

Most of the trials will study the crew members themselves, through questionnaires, fitness tests, detailed biometrics, and daily blood and urine tests. The scientists want to understand not just whether someone might go insane—but exactly how, why and when, so that mission control might plan for it and prevent it with exercises in meditation, conflict resolution, or stress management.

The science straddles sci-fi and shrink's chair. Many of the tests will plumb the mind-body connection,

trying to determine, if, for example, detailed data about the crew's mood correlates with any decreased cardiovascular fitness; or whether specially formulated nutrient diets—including things like tryptophan and Omega 3s—might be used to bolster moods. Another set of experiments is trying to determine whether such extreme isolation affects the immune system and hormone levels.

Other teams are mining the fuzzier realms of the mind. There will be reams of questionnaires, probing how the crew members perceive each other and how they interact; and how varying personal values—ranging from benevolence to power to tradition to hedonism—affect how well each crew member adapts to the situation.

The most pernicious threat is simply that the first thing to ebb in long periods of isolation is self-awareness. To that end, Dinges is using video cameras and facial-recognition algorithms to gauge and catalogue crew member's emotions. His ultimate aim is to create robotic aides that will help people monitor and modulate their moods. In other words, a sensitive version of HAL from *2001: A Space Odyssey*—without the murderous impulses. (Dinges actually rigged his own computer with HAL's voice, to get a taste of what that might be like.)

In a high-tech, 21st-century way, such exhaustive analysis of the crew members' minds happens to parallel the motives of any other explorer. And, in a crucial way, Mars 500 is actually harder than a real expedition—precisely because once the destination is reached, the crew won't have had the satisfaction of touching Mars. When it's over, they'll simply have endured something no one else ever has, just to see if they could do it while everyone else watched. Call it science, or performance art. Call it exploration.

Large photographs by [TrujilloPaumier](#). Smaller images courtesy of [ESA](#) and [ESA - S. Corvaja](#).