

# Staying Put on Earth, Taking a Step to Mars

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MOSCOW — On Tuesday, six people will be voluntarily locked into a cloister of cramped, hermetically sealed tubes woven inside a Moscow research facility the size of a high school gymnasium. They will eat dehydrated food, breathe recycled air and be denied conversation with practically everyone else but one another.



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**ON THE INSIDE** One of the common areas in the Mars-500 experiment. Each crew member has a bedroom compartment.

And they must stay inside for 105 days.

In a small step in the direction of Mars, the international crew is embarking on a simulated flight to the planet to test the limits of human tolerance for the isolation and monotony of interplanetary travel.

“It is really like a real space flight without the weightlessness and the danger to our lives,” said Sergei N. Ryazansky, a cosmonaut-in-training who will lead the mission. “On the inside, we will have a lack of incoming information, so it’s the science of sensory deprivation.”

Called Mars-500, the Russian-led project based at the Institute for Biomedical Problems here will culminate in a 520-day simulation beginning early next year of a complete manned mission to the planet — a time frame that incorporates launching to Mars touchdown and back — that scientists hope will edge humanity a little closer to that next giant leap.

An actual manned mission to Mars may be more than 20 years away, but Russian scientists, backed by the nation’s leaders, are keen to take a lead role in laying the foundation. The Mars-500 project is moving forward despite the dire economic situation in Russia; the prime minister, Vladimir V. Putin, has pledged not to cut financing to the space industry.

Russia’s research into manned space flights has taken on added importance as the National Aeronautics and Space Administration in the United States prepares to shut down the space shuttle program, leaving Russia with a monopoly on manned launchings until NASA’s new Ares rockets take flight.

But for scientists and cosmonauts involved in the project, the cosmic competition that defined the cold war and the race to the Moon has given way to a new spirit of international cooperation. In addition to Russian space agencies, the Mars-500 project involves scientists from organizations like the European Space Agency and the National Space Biomedical Research Institute based in Houston.

“We are proud that we have an experiment that has received wide international coverage and that has attracted the top scientists of other countries,” said Mark S. Belakovsky, the project’s deputy director. “We are working not only for ourselves but for the future of humanity.”

Mr. Belakovsky and others working on the project say only an international effort will be able to overcome the daunting obstacles to any future manned mission to Mars. Crews must be protected from hazardous radiation and muscle and bone atrophy caused by long-term weightlessness, not to mention the myriad potential pitfalls that will follow that first step onto Mars.

Protecting crews from themselves, however, poses special challenges.

Interplanetary travel will markedly differ from long-term missions in orbit around Earth, where crews remain in contact with mission control, receiving assistance from specialists on the ground and well wishes from family and friends. On a mission to Mars, astronauts will have to contend with communication gaps of as long as 20 minutes.

“Working in such conditions requires that a person be able to check himself, evaluate his condition in relation to the crew and in relation to mission control and be able to correct himself,” said Boris V. Marukov, the experiment’s director and a former crew member on the International Space Station. “He will be a psychotherapist for himself.”

Despite the risks and expense, many scientists think the potential scientific gains from a manned Mars voyage will outweigh the advantages of interplanetary exploration by robots.

“Unless there is a huge breakthrough in artificial intelligence, having the human being on site, being able to make scientific decisions on the fly, in real time — there is really little substitute for that,” said Jim Logan, a former chief of medical operations at Johnson Space Center in Houston.

The longest a human has spent in space is 438 days, a record set by Valery V. Polyakov when he returned from the Russian space station, Mir, in 1995. His safe and healthy return, he said in an interview, showed that “it is possible to preserve your physical and psychological health throughout a mission similar in length to a flight to Mars and back.”

Volunteers for the first leg of Mars-500 — four Russians, a German and a Frenchman — will oversee and participate in more than 70 experiments testing fluctuations in metabolism, sleep-wake cycles and the cardiovascular and immune systems under conditions of prolonged isolation. Another experiment will study cross-cultural compatibility in the expectation that any real Mars mission will involve an international crew.

The mock spacecraft consists of four hermetically sealed modules built in the 1970s for isolation experiments ahead of missions aboard Soviet space stations and later the International Space Station. A section was recently added in which participants in the 520-day experiment will simulate a Mars landing.

The facility’s wood-paneled interior maintains a particularly Soviet aesthetic, but it has been equipped with new life-support systems to be tested during the Mars-500 project. Volunteers will tend experimental greenhouses that scientists hope will provide fresh vegetables and sights and smells of home.

Scientists in a control center at the Institute of Biomedical Problems will monitor the activities of the crew via video cameras mounted in most sections of the facility, watching for stress and tension among crewmembers. They will largely keep out of the crew’s affairs and will impose the 20-minute communication delay anticipated on a real Mars mission during the final 35 days of the experiment.

Amid a stream of mock emergency situations and inevitable disagreements between crewmates, the volunteers will endeavor to keep emotional control.

Past experiments in long-term isolation have shown how intergroup conflicts can endanger a mission. During a nine-month simulated Earth-orbit mission starting in 1999 and conducted at the same Moscow institute, a male Russian's attempt to kiss a female Canadian colleague ended in accusations of sexual harassment and the Russians' being barred from the woman's module.

Mr. Ryazansky, who took part in that experiment, is optimistic that advancements in space psychology have made these kinds of conflicts less likely. And while he does not think he will actually ever fly to Mars, he believes his work on Mars-500 will allow him at least to see a manned mission in his lifetime.

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