So You Want to Go to Mars?

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Written by David L. Dreier

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Front cover: After driving a short distance from their landing site, two explorers stop to inspect a robotic lander and its small rover in this artist's concept of a future Mars mission.

Title page: NASA's new SLS rocket and Orion capsule could be key elements in any mission to Mars.

Page 3: Mars One plans call for using part of a Mars rocket to grow a hydroponic garden.

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Correlation

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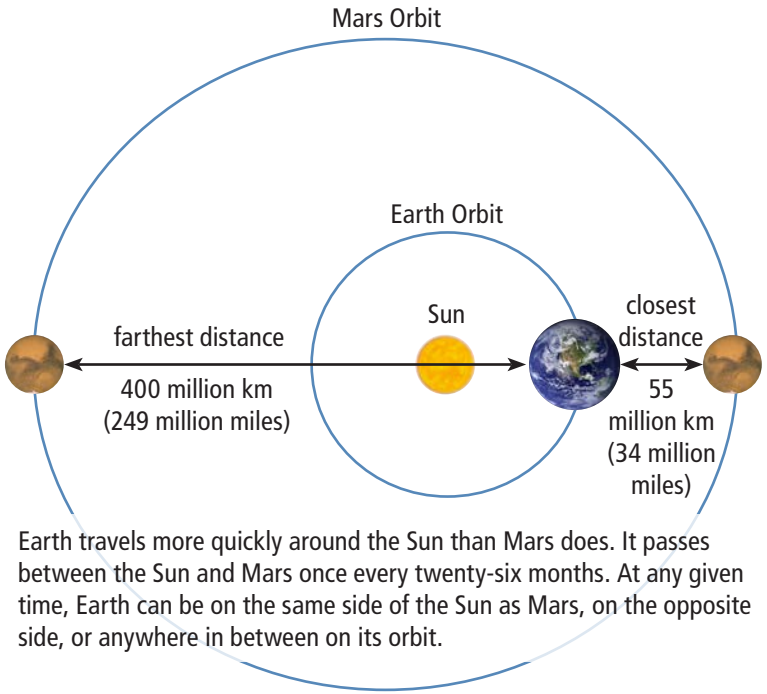
Are We There Yet?

Scientists have been talking about sending astronauts to Mars for what seems like . . . forever! However, the closest the United States has gotten is to send a series of rovers to Mars. Between 1969 and 1972, the United States sent astronauts on six round trips to Earth's nearest neighbor, the Moon. With that accomplished, Mars was the obvious next stop in our solar system. But when are we going to actually go there? What's the holdup?

This design concept for a Mars-capable ship comes from the Inspiration Mars project, a private nonprofit foundation.

How Far Away Is Mars? It Depends When You Ask . . .



Earth travels more quickly around the Sun than Mars does. It passes between the Sun and Mars once every twenty-six months. At any given time, Earth can be on the same side of the Sun as Mars, on the opposite side, or anywhere in between on its orbit.

It turns out that traveling to Mars presents challenges that astronauts have never had to face. For starters, Mars is much, much farther away than the Moon—more than five hundred times farther away on average. Getting to Mars in one piece and staying alive there won't be easy. In fact, it will be the greatest technological **feat** humans have ever accomplished. But here's the good news: The talk about a Mars mission is finally getting serious.

Many people would love to make that trip. Maybe you're one of them. Let's find out what you're up against.

You're Going to Need a Bigger Rocket . . .

So just how long is this trip to Mars that you want to take? Well, the Red Planet—so called because of reddish iron-rich minerals in its soil—is never closer than about 55 million kilometers (34 million mi.) from Earth. The average distance is about 240 million kilometers (140 million mi.). A Mars mission would take seven to nine months each way. Add to that whatever amount of time you plan to spend on the planet's surface.

A trip of that distance and duration will require spaceships bigger than anything that exists today. The National Aeronautics and Space Administration (NASA)—the U.S. space agency—is hard at work building an enormous rocket called the Space Launch System (SLS). In the meantime, a private company, SpaceX, is developing its own rocket, a whopper called Falcon Heavy.

NASA's new SLS rocket will be more powerful than the Saturn V rocket used to carry astronauts to the Moon.

It's taken more than thirty flights to deliver and assemble the pieces that make up the International Space Station (ISS).

Great! So you can just hop on one of those puppies and go to Mars!

If only. No, neither of those rockets would work as a stand-alone vehicle for a Mars mission. A Mars ship would have to be even bigger, with a larger crew area. Experts say a Mars mission would be such a huge undertaking that several ships would be required to transport the crew, supplies, and **habitat**.

What the SLS and Falcon Heavy rockets could be used for is lifting separate parts of Mars ships to Earth **orbit**. The spacecraft would be assembled there for the trip to the Red Planet, saving lots of fuel. That's how the International Space Station (ISS) was built, so we know how to do it. We're just not ready yet.

Don't Forget to Take Some Gravity!

Gravity will also be a problem—or rather the absence of it.

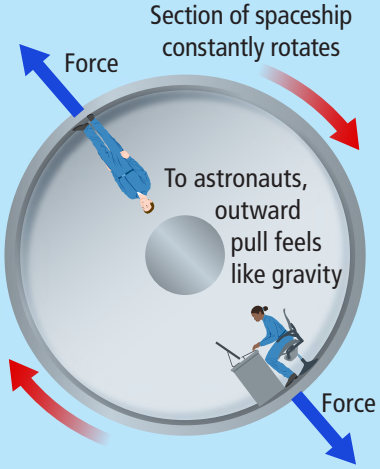
Gravity is a good thing. It enables us to walk, pour a glass of milk, shoot baskets—all the stuff we take for granted. Gravity also keeps us healthy and fit by making our bodies work against it.

A spaceship would be a zero-gravity environment. Without gravity, bad things start to happen to your body. Muscles shrink and bones weaken. After nine months in space, you'd be a physical wreck.

The answer to this problem is artificial gravity. A circular, rotating section of the spaceship would **simulate** gravity through centrifugal force.

Centrifugal Force

In a spaceship, centrifugal force could be used within a large, rotating section of the ship to create artificial gravity. Astronauts on the inside surface of this circular area would be constantly moving around the center of rotation. They could walk around on the surface as though they were being pulled downward by gravity.

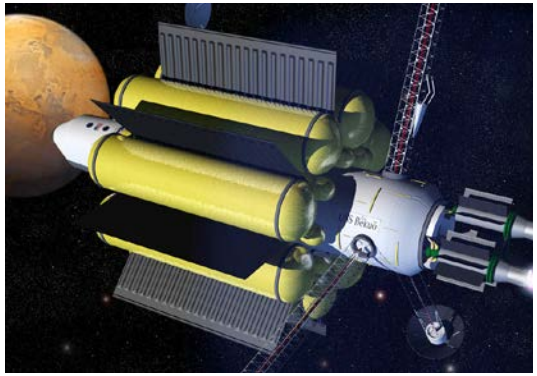


Cosmic Radiation Is Bad

In space, electrically charged particles whiz around by the gazillion, coming from both the Sun and interstellar space. Down here, we're safe from all that dangerous **radiation** because Earth is surrounded by a magnetic field that pushes the particles away. A Mars ship, however, would be continuously bombarded.

Engineers are studying ways of protecting astronauts from radiation on long space journeys. One idea is to surround the crew areas with a tank of water to absorb incoming particles. However, water is heavy, and it would greatly increase the **mass** of the ship. Increased mass means higher fuel usage.

A better solution might be to design a spaceship with its own magnetic shield, making it a sort of mini-Earth. Researchers around the world are busy trying to design such a system. So, engineers—to your workstations!



This NASA rocket design would use fuel tanks and shields arranged in a ring outside the vessel to protect the crew from radiation.

But We Just Dusted Yesterday!

When you finally arrive at Mars, what awaits you on the surface? Let's just say, life on the Red Planet will be no picnic.

First of all, because Mars has no protective magnetic field, the radiation problem for astronauts will continue. You simply won't be able to get away from that pesky radiation unless you go underground. Any habitat constructed on the planet's surface will have to be as heavily shielded as the spaceship.

That's not all. Mars is a **barren** planet covered with dust, dirt, and rocks. Violent, towering dust storms often roar across its surface. That dust will pose a threat to both you and your equipment.

Mars has the largest dust storms in our solar system.

What's There to Eat on Mars? Nothing. (But, Hey, There's Water)

To put it bluntly, Mars is not good farmland. So what are voyagers to the Red Planet going to eat? Well, if you're going to stay a short while and then return to Earth, you can take your food with you. That's what NASA plans for its first Mars missions.

On the other hand, let's say you plan to settle down and call Mars home—what then? Your best bet would be to grow crop plants in a **hydroponic** solution. That would require lots of water. Here's where Mars can lend a helping hand. The planet seems to have plenty of water, both at the poles (frozen as ice) and deep underground. There's enough water for drinking, indoor farming, and other uses. Maybe some of it could be used to wet down that dust!

Hydroponic Farming

During grocery shopping, your parents may have bought produce labeled "hydroponically grown." In hydroponic farming, crop plants are grown in large tanks of water to which various nutrients have been added. The most common crop plants grown hydroponically here on Earth are lettuce, tomatoes, peppers, and cucumbers. A Mars colony would undoubtedly grow many other kinds of crops in this way.

Biosphere 2 explored how living things interact in an enclosed space.

Are You Still Here?

A big problem can arise when people are confined together for a long time. Being that close to other people for such a long time can result in, shall we say, tension. People often end up arguing or fighting with one another. Annoying attitudes and personality traits—usually shrugged off in normal circumstances—become magnified in an enclosed environment over a long period. The result can be severe conflicts.

To avoid personality clashes, would-be Mars voyagers would have to be carefully screened for **compatibility**. There would be no guarantee of friendly relations, of course. In the 1990s, eight carefully selected people—four men and four women—were locked for two years in an artificial environment in Arizona. That experiment, called Biosphere 2, was actually designed to mimic life on Mars. By the end of the two years, the volunteers were barely on speaking terms.

What's All This Going to Cost?

The short answer to this question is: plenty. The long answer is that it depends on what kind of Mars mission you're planning. The estimated costs for a round trip to Mars with a stay on the surface—weeks or months—have ranged up to $500 billion. That's billion, with a *b.*

The high price tag is one of the reasons a Mars mission has not yet been undertaken. When a mission to the Red Planet finally becomes a reality, it will probably be a team effort of the United States and several other nations.

A private company—Mars One, based in the Netherlands—has its own ideas. It proposes using SpaceX's Falcon Heavy to lift parts for each of its spacecraft into low Earth orbit for assembly. Mars One claims it can carry out a mission to the Red Planet for $6 billion. That's not exactly small change, but compared to $500 billion, it's a bargain.

This artist's drawing shows what a Mars One settlement might look like.

Mars or Bust! (Could Be Both, Actually)

Okay, so things are shaping up for a trip to Mars. What's the expected schedule?

NASA is talking about a possible round trip to Mars in about 2033. Three ships would be assembled in Earth orbit. Two of the ships would take a habitat and supplies to Mars ahead of the third ship, which would carry the crew. The astronauts would spend weeks or months exploring the planet and gathering soil samples.

An American billionaire, Dennis Tito, hopes to beat NASA to Mars. His proposed mission, Inspiration Mars, would send two people to Mars on a flyby—around the Red Planet and back—in 2018.

If a trip to the Red Planet is still your vision of paradise, Mars One could be the answer. It hopes to send several dozen people to Mars beginning in 2024 to establish a permanent **colony**. A crew of four would make the first trip and would be followed by four more settlers every two years.

This is your chance! Once you turn the required age of eighteen, YOU could possibly go to Mars. There's just one catch: These trips will all be *(gulp)* one-way. None of the Mars One colonists can expect to return home.

How many people would want to sign up for a deal like that? Well, lots, actually. As of 2014, more than two hundred thousand hopefuls had applied for the program.

Those selected will undergo an eight-year training program. Then, if all goes well, they will **embark** for Mars.

The colonists will live in a base of connected domes containing living and work areas. The base will also have areas for hydroponic farming. The settlers will carry out a variety of tasks. They will study the health effects of living on Mars, research the planet's geology, and look for evidence of both present and ancient life.

But Biosphere 2 holds some cautionary lessons for Martian colonists. That Arizona experiment went wrong in several ways aside from interpersonal conflict. Other problems included crop failures and a rising shortage of oxygen. Those people could shrug and walk out into the fresh air of Arizona. There would be no escape on Mars.

The would-be Martians beating on Mars One's doors are undaunted by the dangers. Their attitude is, "I want to go to Mars! Choose me!"

Glossary

barren *(adj.)* lacking vegetation (p. 10)

colony *(n.)* a group of people living in a new territory who maintain relations with their place of origin (p. 14)

compatibility *(n.)* the state of coexisting or working together without conflict or problems (p. 12)

embark *(v.)* to get on a ship, airplane, or other vehicle; to start something new (p. 15)

feat *(n.)* an amazing action or accomplishment (p. 5)

gravity *(n.)* the natural force that tends to pull objects toward each other, such as objects being pulled toward the center of Earth (p. 8)

habitat *(n.)* a structure built to allow people to live in an area where they normally could not, such as beneath the sea (p. 7)

hydroponic *(adj.)* of or relating to the growing of plants without soil in a water-based solution (p. 11)

mass *(n.)* the amount of matter in something, measured on Earth by its weight (p. 9)

orbit *(n.)* the path taken by one object in space circling around another larger object (p. 7)

radiation *(n.)* a powerful and dangerous type of energy released by nuclear reactions (p. 9)

simulate *(v.)* to model or imitate the appearance or condition of something (p. 8)