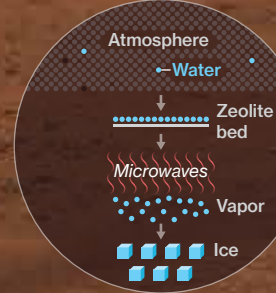


The Challenge of an Unforgiving World

A key step in the journey to Mars is to orbit it, which NASA hopes will happen in the 2030s. But landing, surviving, and ultimately thriving on the red planet – with its low gravity level, seesawing temperatures, and nearly oxygen-free atmosphere – present myriad issues for human colonists.

Solutions for Survival

The more resources we can find – or create – to make Mars habitable, the fewer we'd have to bring from Earth. Scientists are now studying ways to use what already exists on Mars. To establish a colony, humans would need to be able to supply five things: oxygen, water, shelter, food, and energy.



**WATER**  
**EXTRACTING WATER FROM AIR**  
Although Martian air is more than 95 percent carbon dioxide, it does contain traces of water to harvest. Beds of a mineral called zeolite would extract moisture from the air. Once saturated, the beds could be microwaved to vaporize the water, which would then condense, freeze, and be stored as ice.

**WATER**  
**GETTING GROUNDWATER**  
In addition to the ice on Mars's surface at high latitudes, there might be a great deal of frozen water within the soil closer to the planet's equator. Microwaving the soil could melt and extract the water.

MARS

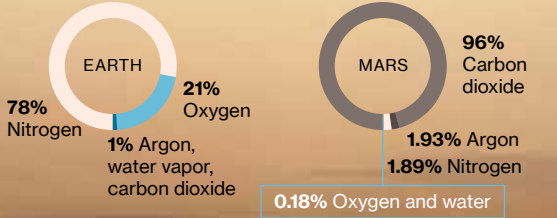
To learn more about colonizing the red planet, tune in to the Channel's global event series, *MARS*, on November 14 at 9/8c.

For related educational resources go to [natgeoed.org/mars](http://natgeoed.org/mars).

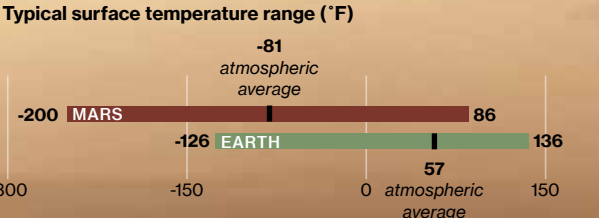
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The diameter of the sun appears 34 percent smaller on Mars.

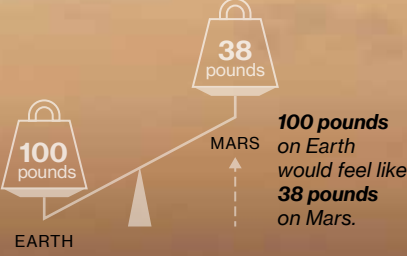
**ATMOSPHERE**  
Today Mars has an atmospheric pressure that is just 0.6 percent of Earth's, which isn't enough to hold a body of water in place. A more robust atmosphere may once have supported large bodies of water, yet something – perhaps solar radiation, the impact of an asteroid, a change in the magnetic field – made oceans impossible.



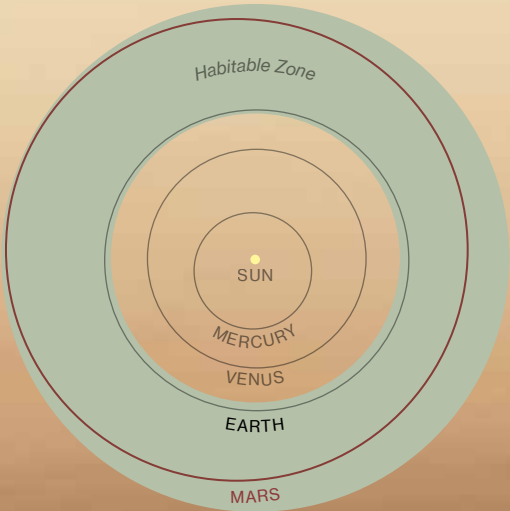
**TEMPERATURE**  
Like Earth, Mars has days and nights, weather patterns, distinct seasons, and polar ice caps. But while its midlatitudes can be temperate at times, its thin air and vast distance from the sun – one Martian orbit takes nearly two Earth years to complete – make it susceptible to wild temperature swings.



**VOLUME AND MASS**  
Mars's planetary volume is 15 percent of Earth's; its mass is 11 percent. According to the laws of Newtonian physics, gravity on Mars is about a third of that on Earth. This means astronauts there could lose a lot of the skeletal and muscle mass they developed fighting Earth's gravity. It also means that launching a spaceship from Mars would take less energy.



**DISTANCE**  
Earth lies near the inner edge of the solar system's habitable zone, defined as the range of distances from a star, in this case the sun, where a planet can sustain liquid water (with enough atmospheric pressure to keep it in place). Mars sits within the habitable zone too, but closer to the outer edge.



COLONIZING MARS

Could humans live on Mars? One day, perhaps. But establishing settlements there would be a forbidding task. The vision shown here is drawn from the National Geographic Channel's global event series on Mars. It reflects what some scientists are thinking right now, based on the most recent research. Time will tell if it's a blueprint for living on the red planet.

**ENERGY**  
**PORTABLE POWER**  
Spacecraft and the precise scientific instruments they carry require safe, reliable, long-lasting power systems. One source that could generate the necessary juice is a nuclear battery – a radioisotope thermoelectric generator – that converts heat into electricity.

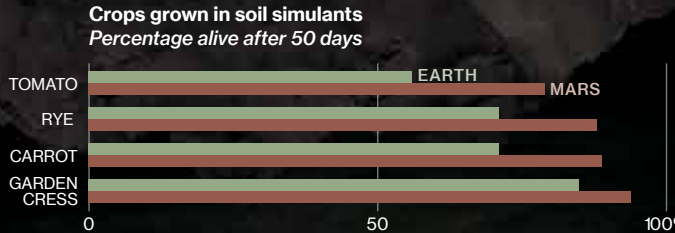
**ENERGY**  
**NUCLEAR POWER**  
NASA developed a power-producing system that could be used on many planets and asteroids. A fission reaction in a nuclear reactor would produce electricity. Surrounded by a radiation shield, the reactor would be connected to the base by a cable, delivering power at any time of day, under any atmospheric conditions.

**Nuclear fission reactor**  
The reactor would be buried under the surface; extended panels would shed excess heat.

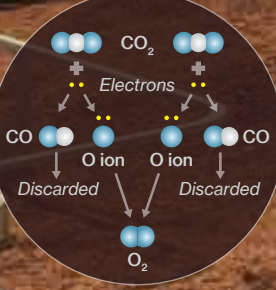
**ENERGY**  
**POWER FROM THE SUN**  
Solar energy would be a logical resource for creating electricity on Mars. But harvesting sunlight would be more difficult than it is on Earth, not only because of the planet's distance from the sun but also because of Mars's massive dust storms. So other power sources would need to be developed.

Solar panels

**FOOD**  
**MARTIAN GREENHOUSES**  
Ecologists have tested 14 plants in soil produced to match the chemical composition of Martian soil, which contains all essential nutrients for plants to grow, including phosphorus, nitrogen, potassium, and iron. But for plants on Mars to maintain the kind of growth shown at right, agronomists would need to engineer soil that is more water efficient and nitrogen rich.



**OXYGEN**  
**BETTER BREATHING THROUGH CHEMISTRY**  
Scientists could collect the abundant carbon dioxide gas in Mars's atmosphere, compress it, and use electricity to split its molecules into oxygen and carbon monoxide molecules. The oxygen would be tested for purity and stored, and the carbon monoxide vented back into the atmosphere.



**COMMUNICATION**  
Point-to-point communication on Mars would be via radio waves. To avoid obstructions, signals would have to be beamed to orbital satellites and then relayed back to the ground.

**SHELTER**  
**LIVING IN LAVA TUBES**  
Lava tubes are cave-like conduits formed underground by cooled, hardened lava after molten rock has flowed through. Scientists say the ones on Mars may be significantly larger than those on Earth. The interiors of the Martian tubes, hidden under dozens of feet of solid rock, are protected from cosmic and solar radiation and fluctuating temperatures on the harsh, dusty surface.

Lab

Corridor

Greenhouse

Common area

Dorm

**WATER**  
**HIDDEN GLACIERS**  
Ground-penetrating radar from NASA's Mars Reconnaissance Orbiter has revealed massive glaciers of frozen water preserved beneath rocky debris at much lower latitudes than where ice had been previously identified. These glaciers extend for dozens of miles.