
EXPLORE MARS, INC. PRESENTS:
MARS
INNOVATION
CHALLENGE
Slide Presentation By Chaya Shinensky

MARS INNOVATION CHALLENGE

You and your team ***don't have to actually build your innovation/design***, but you are asked to imagine a Mars Innovation that answers these questions:

- Please give your innovation a name and title
  - How does your physical design operate on the Red Planet?
  - How does your Mars Innovation rely on existing resources, aka what we find on Mars or re-use what we've already sent to Mars? (In-Situ Resource Utilization (ISRU))
  - How does your Mars Innovation also benefit humans on Earth?
  - How does the design and operation of your Mars Innovation Solution meet the big challenges of living on Mars?

Please record a 2-5 minute video of yourself/crew explaining how your Mars Innovation works, how it will be implemented, and how it has positive repercussions for humans on Earth.

For extra Martian points, create a slogan for your product and a 30-second commercial for your product!

MARS INNOVATION CHALLENGE

If we're going to go out into the solar system, we're going to have to use the resources we find at the destination.

The most practical strategy for long stays on Mars involves living off resources that already exist on the Red Planet instead of relying on resupply ships from Earth. The five major consumable resources that researchers identified Martian settlements would need include ***energy, water, oxygen, construction material and food,*** and the first four are able to be found on Mars.

Energy/ Power - solar power, together with nuclear-fission reactors, can help provide energy for would-be Martians.

Water - Ice and hydrated minerals on Mars can be sources of water.

Air - Carbon dioxide can get converted into oxygen.

Shelter/ Structures - Finally, Martian soil can be readily made into bricks for building supplies.

***Food - Our biggest challenge will be creating sustainable food sources from resources we bring with us.**

https://www.space.com/how-feed-one-million-mars-colonists.html

MARS INNOVATION CHALLENGE

Challenge 1:

Surviving on Mars

Environmental Control/Life Support Systems (ECLSS) - How do we live in such challenging conditions?

Water - drinking and recycling it

Food - growit with farming and with science

Air - How can we breath on Mars?

Challenge 2:

Living on Mars

Building Martian Cities - what will we need? The surface of Mars is very different from Earth, and we could live in caves or lava tubes.

Power - what kinds of energy can we create and use?
wind/electric/solar

Shelter Structures - homes, schools, recreation centers, stores, offices

Challenge 3:

Thriving on Mars

Brains and Bodies - how do we support mental and physical health?

- Mood & Mental Health
- Exercise
- Maintaining Relationships
- Leisure & Relaxation
- Entertainment and Sports on Mars

Challenge 1: Surviving on Mars
Water

The bone-dry desert of Mars may seem like the last place you would look for water, but the Red Planet actually has a lot of water locked up in ice. Evidence that Mars once supported liquid water has been growing for years, and exploratory missions have found that water ice still exists on the planet's poles and just beneath its dusty surface. Accessing that water could require digging it up and baking it in an oven, or beaming microwaves at the soil and extracting the water vapor. Mined water could be used for drinking, growing plants or creating fuel.

Numerous studies have suggested that water exists on Mars, based on evidence from Mars orbiters and rovers such as outflow channels, ancient lake beds, and surface rocks and minerals that could only have formed in the presence of liquid water. Today, Mars is too frigid, and its atmospheric pressure is too low, to support liquid water on its surface but frozen water can be found in the planet's ice caps and beneath the soil surface.

NASA's Phoenix lander detected water ice at its landing site in 2008. The spacecraft dug up chunks of soil, and its onboard mass spectrometer found traces of water vapor when the sample was heated above freezing. More recently, NASA's Curiosity rover detected water molecules in soil samples analyzed by its SAM (Sample Analysis at Mars) instruments, suggesting Martian soil contains about two pints of water per cubic foot of soil.

Click the links below to learn more about water on Mars:

https://www.space.com/24052-incredible-tech-mining-mars-water.html

https://www.space.com/17048-water-on-mars.html

Challenge 1: Surviving on Mars
Air

The air on Mars

The Martian atmosphere is thin — its volume is only 1% of the Earth's atmosphere. To put it another way, there's 99% less air on Mars than on Earth.

That's partly because Mars is about half the size of Earth. Its gravity isn't strong enough to keep atmospheric gases from escaping into space. And the most abundant gas in that thin air is carbon dioxide. For people on Earth, that's a poisonous gas at high concentrations. Fortunately, it makes up far less than 1% of our atmosphere. But on Mars, carbon dioxide is 96% of the air! Meanwhile, Mars has almost no oxygen; it's only one-tenth of 1% of the air, not nearly enough for humans to survive.

If you tried to breathe on the surface of Mars without a spacesuit supplying your oxygen — bad idea — you would die in an instant, and because of the low atmospheric pressure your blood would boil, both at about the same time.

https://www.space.com/could-people-breathe-air-on-mars

Challenge 1: Surviving on Mars
Air

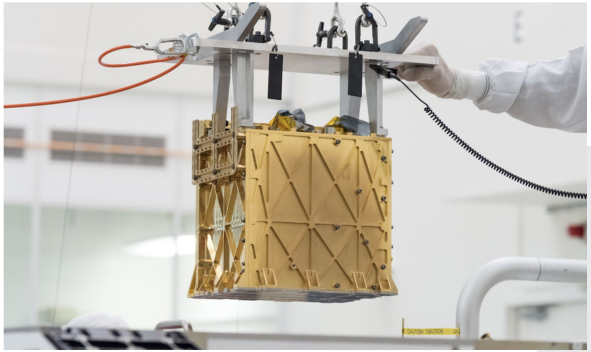
Do-it-yourself oxygen

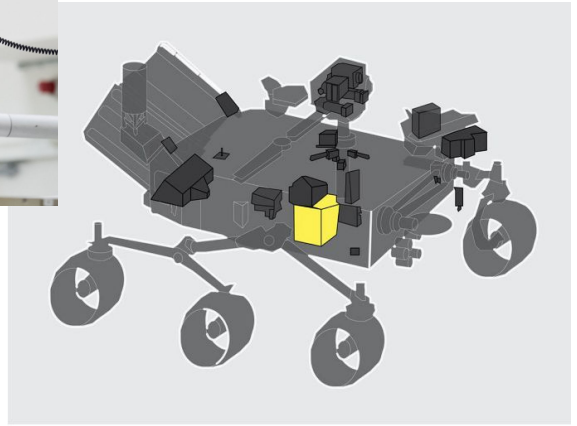
Among the seven instruments on board the Perseverance rover is MOXIE, an incredible device that takes carbon dioxide out of the Martian atmosphere and turns it into oxygen. If MOXIE works the way that scientists hope it will, future astronauts will not only make their own oxygen; they could use it as a component in the rocket fuel they'll need to fly back to Earth. The more oxygen people are able to make on Mars, the less they'll need to bring from Earth — and the easier it becomes for visitors to go there. But even with "homegrown" oxygen, astronauts will still need a spacesuit.

https://www.space.com/could-people-breathe-air-on-mars

"To support a human mission to Mars, we have to bring a lot of stuff from Earth, like computers, spacesuits, and habitats. But oxygen? If you can make it there, go for it — you're way ahead of the game."

- Jeff Hoffman, MOXIE Deputy Principal Investigator





Click the link below to learn more about MOXI

https://mars.nasa.gov/mars2020/spacecraft/instruments/moxie/

Challenge 1: Surviving on Mars
Food

What might it take to feed a million people on Mars? Lab-grown meat, tunnel-grown crops and cricket farms. Insect farms are well-suited for Martian cuisine, as they provide a lot of calories per unit land while using relatively minor amounts of water and feed, the researchers said. Crickets in particular are one of the more promising examples of edible insects, with cricket flour potentially incorporated and hidden in many different recipes, they noted. "Bugs are the way to go, if people can get over the gross factor," Cannon said.

For those who do not fancy insects, "cellular agriculture" — that is, food derived from cells grown in lab dishes — could help people on Mars eat a somewhat more familiar diet, the researchers said. Everything from algae to meat and fish to cow-less milk and chicken-less eggs are now possible,

tunnels lit with high-strength LEDs are likely needed to grow plants on Mars, supplemented with sunlight collected and piped down through fiber-optic cables, the researchers said. Soilless farming involving hydroponic or aeroponic systems is possible, but those strategies would require more mass shipped to Mars in the form of trays, pumps and reservoirs, they said. In addition, soil-based farming may be more robust against plant disease, but inorganic Martian dirt would require significant research and treatment to convert it to a living soil that could support plant growth,

Previous research suggested a number of crops may prove especially practical when it comes to feeding Martian colonists, such as wheat, corn, soybeans, peanuts and sweet potatoes.

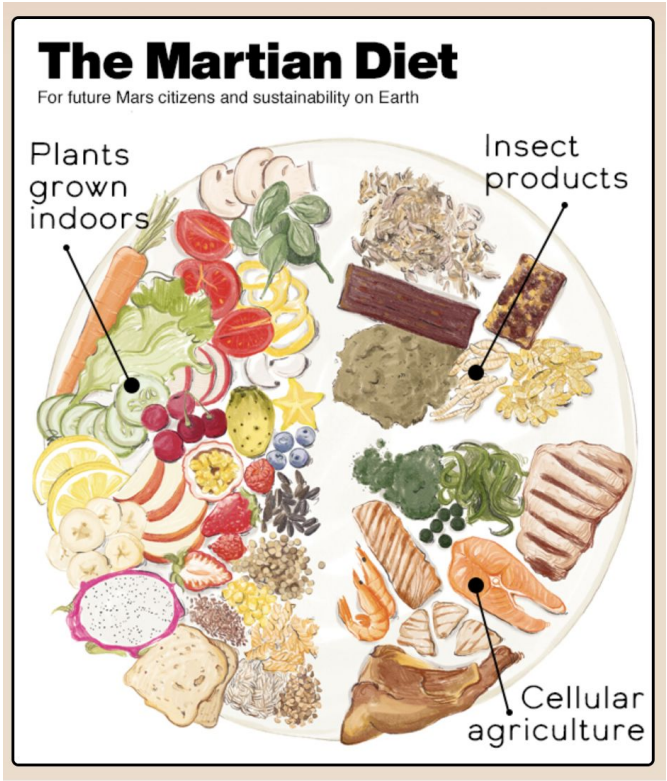
Challenge 1: Surviving on Mars
Food

What will People Eat on Mars?

Think about your current diet: how much cheese, milk, eggs, and factory-farmed meat do you eat? If you're vegetarian or vegan, imagine the water and energy needed to irrigate and harvest all those crops. Can these eating habits be transplanted to Mars? Can they be sustained on Earth?

On Mars, **plants cannot be grown outdoors**, and **there won't be any animals roaming around**, at least for now. Water will be scarce. Will martian citizens be forced to import all their food from Earth? How long could you put up with instant coffee and reconstituted spaghetti?

Faced with these questions, we wrote a paper on how to achieve food self-sufficiency for one million people on Mars by producing plants, insects and cell-based (or cultured) meat, drawing heavily on local resources.



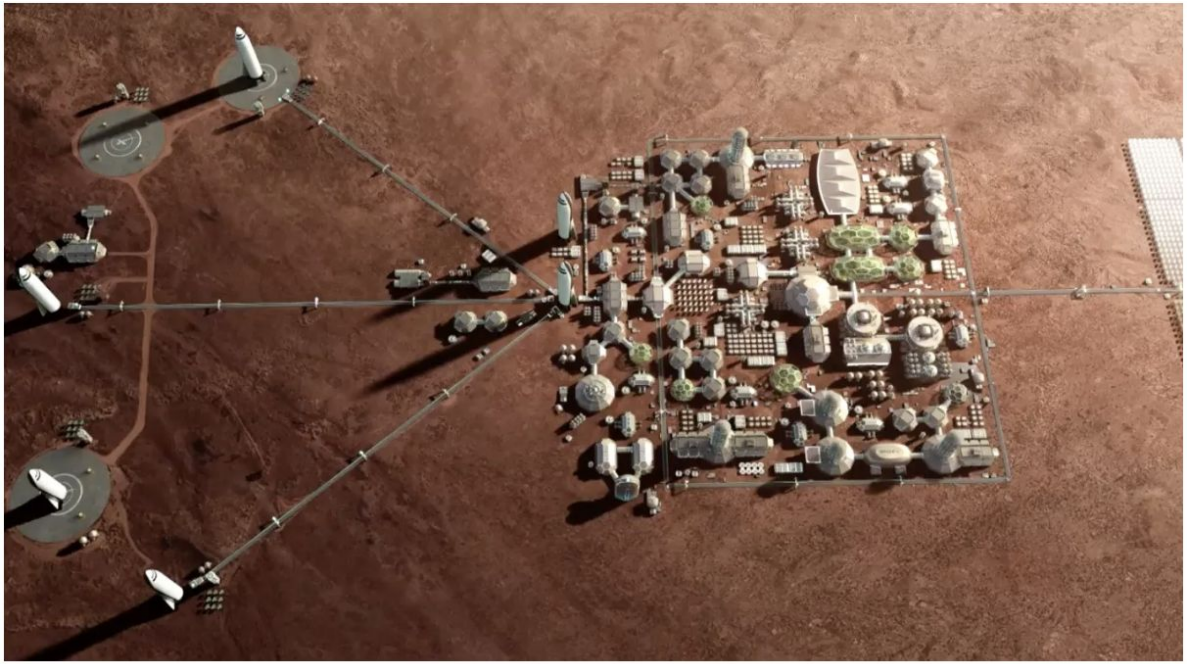
The Martian Diet

You can start eating like a Martian today! Well, sort of. Cell-based meat products are not on grocery store shelves yet, but a host of companies are working on making it happen within 1-2 years, while others are introducing dozens of insect-based products to North America and Europe.

The "Martian Diet" offers environmental and ethical benefits over traditional Western habits: no mass suffering of caged animals, and sharp cuts in land, water, energy use, and carbon emissions.

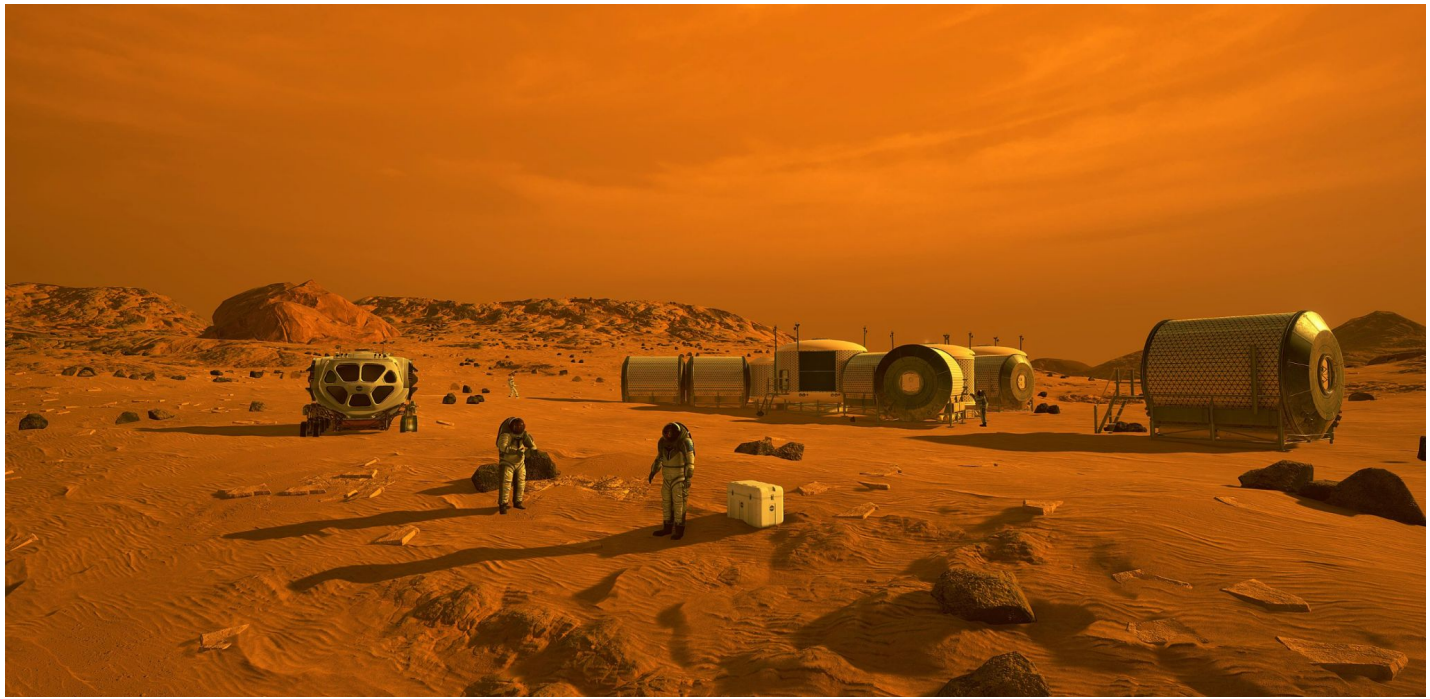
https://eatlikeamartian.org/

Challenge 2: Living on Mars
Shelter Structures



SpaceX aims to help establish a million-person city on Mars. What would all of those people eat? (Image credit: SpaceX)

Challenge 2: Living on Mars
Shelter Structures



https://en.wikipedia.org/wiki/Mars_habitat#/media/File:PIA23302-FirstHumansOnMars-ArtistConcept.jpg

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Shelter Structures

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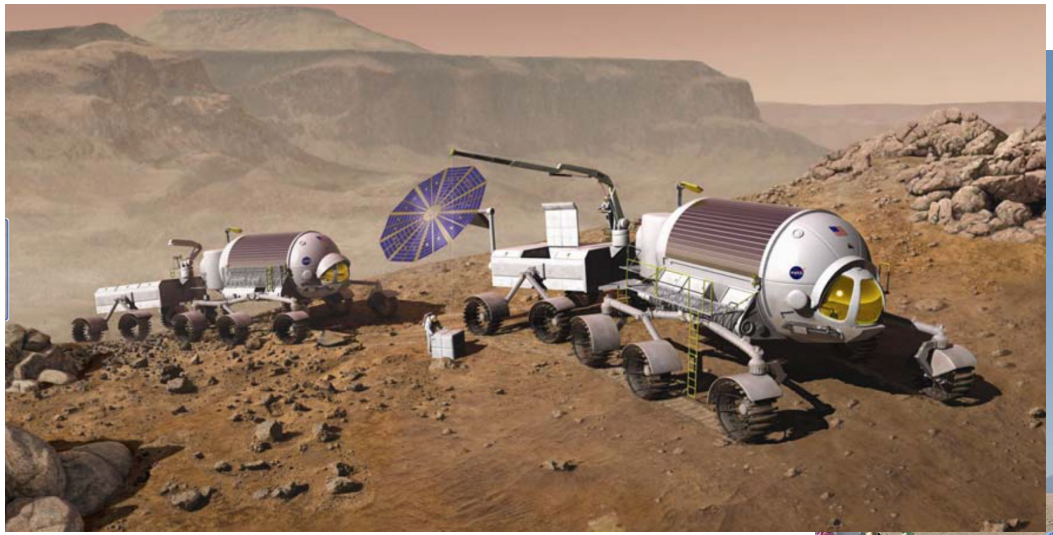

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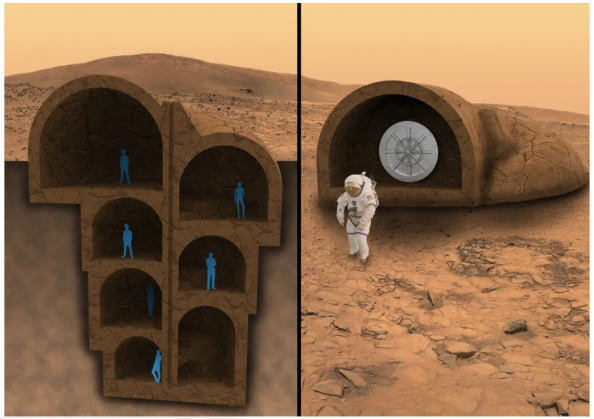
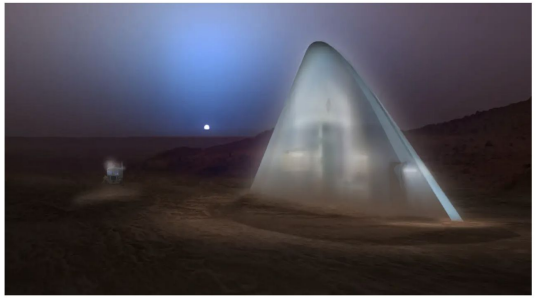
Challenge 2: Living on Mars
Shelter Structures

Team Foster + Partners — A fleet of three robots will dig out craters for the habitat and self-assemble the inflatable structure. Ceilings are tall to accommodate Mars' bouncy one-third gravity.

Redworks Habitat — The multi-level underground dwelling was inspired by ancient cultures' use of modular rooms, as in pit houses, to create a system that can adapt to Martian geology.



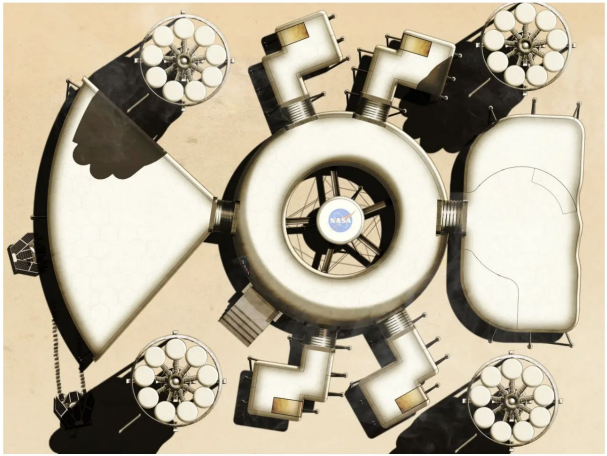
ICE HOUSE — A multi-layered shell of ice encases a living zone and hydroponic greenhouse. The average temperature on Mars is 67 degrees below zero. The structure will not melt.



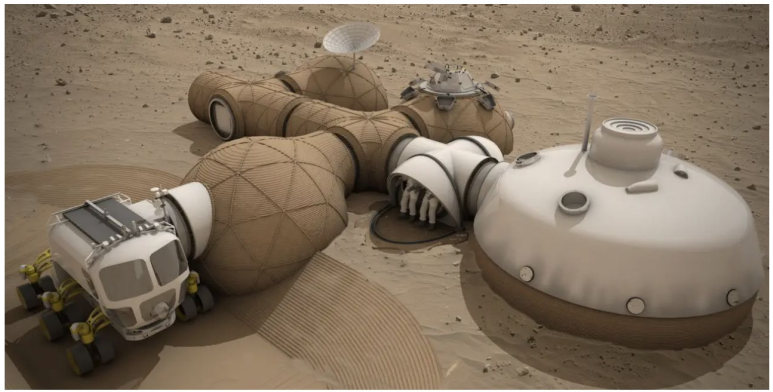
https://www.businessinsider.com/10-designs-from-nasas-mars-habitat-challenge-2015-9#team-foster--partners--a-fleet-of-three-robots-will-dig-out-craters-for-the-habitat-and-self-assemble-the-inflatable-structure-ceilings-are-tall-to-accommodate-mars-bouncy-one-third-gravity-5

Challenge 2: Living on Mars
Shelter Structures

Team INMODE — The modular system has four sleeping pods, a lab, and a recreation area. Astronauts have ample privacy without feeling cramped.



Team LavaHive — A technique known as lava-casting turns Martian lava into a protective shell, which can encase the inflatable habitat and preserve atmospheric conditions.



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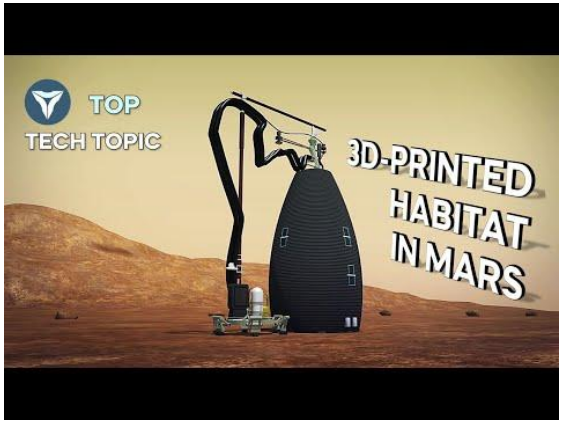
Challenge 2: Living on Mars
Shelter Structures



How could we use robots and 3D printers to build shelters on Mars?

Challenge 2: Living on Mars
Shelter Structures

The NASA “Mars Ice Home” is a large inflatable torus, a shape similar to an inner tube, that is surrounded by a shell of water ice. The Mars Ice Home design has several advantages that make it an appealing concept. It is lightweight and can be transported and deployed with simple robotics, then filled with water before the crew arrives. It incorporates materials extracted from Mars, and because water in the Ice Home could potentially be converted to rocket fuel for the Mars Ascent Vehicle, the structure itself doubles as a storage tank that can be refilled for the next crew.

The Ice Home concept balances the need to provide protection from radiation, without the drawbacks of an underground habitat. The design maximizes the thickness of ice above the crew quarters to reduce radiation exposure while also still allowing light to pass through ice and surrounding materials.

https://www.nasa.gov/feature/langley/a-new-home-on-mars-nasa-langley-s-icy-concept-for-living-on-the-red-planet

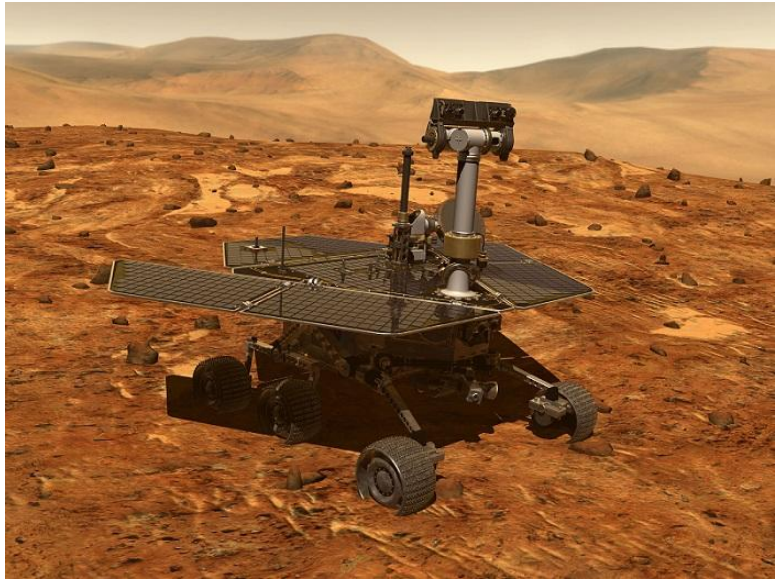
Challenge 2: Living on Mars
Power Sources

What power source would be best on Mars?

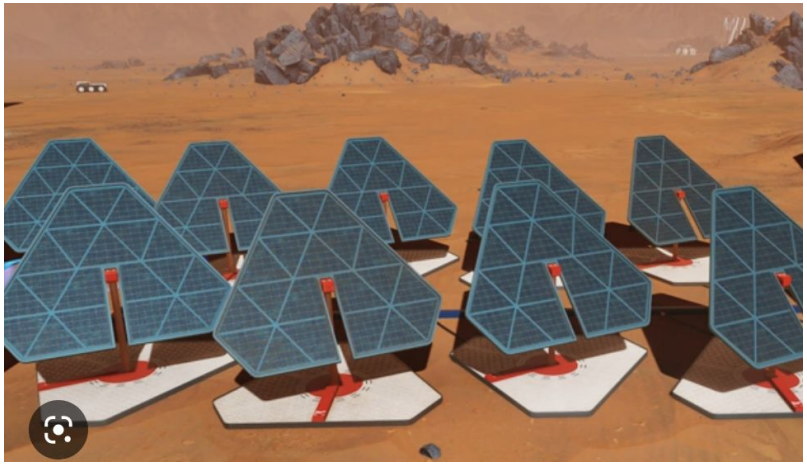
Solar power would be the superior option over nuclear power for crewed Martian missions near the planet's equator. Researchers found that a six-person Red Planet Mars mission could be powered by solar power as used by robotic NASA Mars explorers such as the Spirit and Opportunity rovers and the InSight lander.

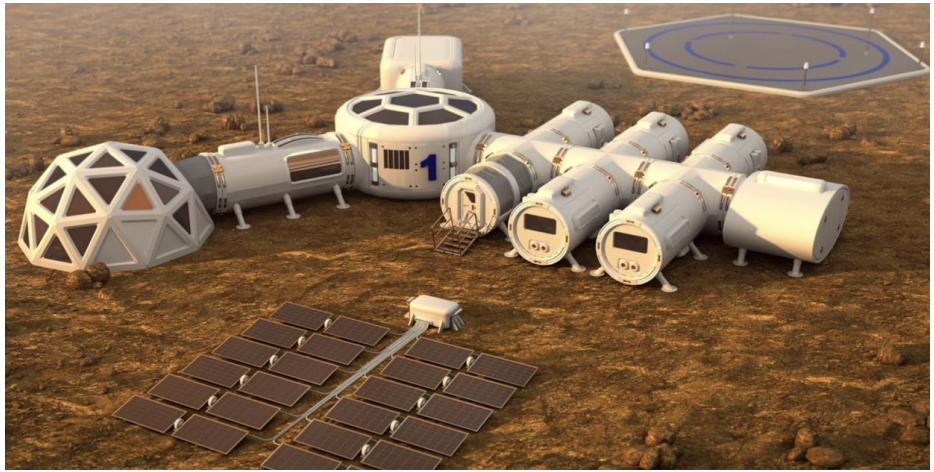
And humans could clean the solar panels on site, the study authors noted, preventing the problem of dust buildup that have plagued Mars spacecraft over the years. (A big dust storm killed Opportunity back in 2018.)

https://www.space.com/solar-power-better-nuclear-astronauts-mars



Challenge 2: Living on Mars
Power Sources





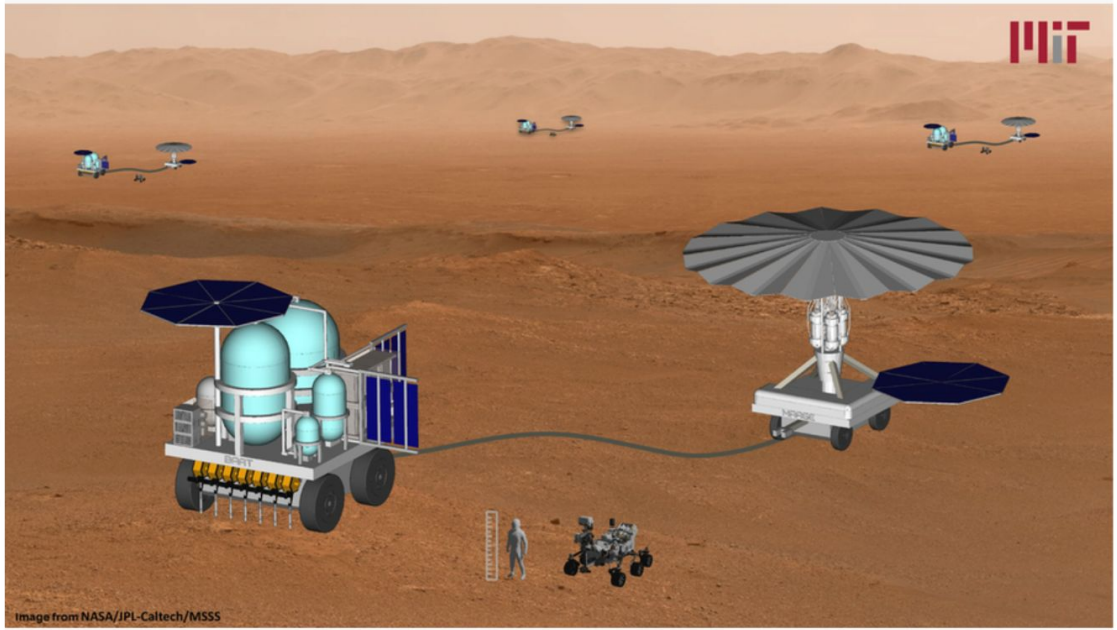
https://www.space.com/solar-power-better-nuclear-astronauts-mars

MIT design for Mars propellant production trucks wins NASA competition

BART and MARGE will reliably produce, store, and distribute 50 tons of rocket fuel per year on the surface of Mars.

Sara Cody | Department of Aeronautics and Astronautics
July 11, 2022

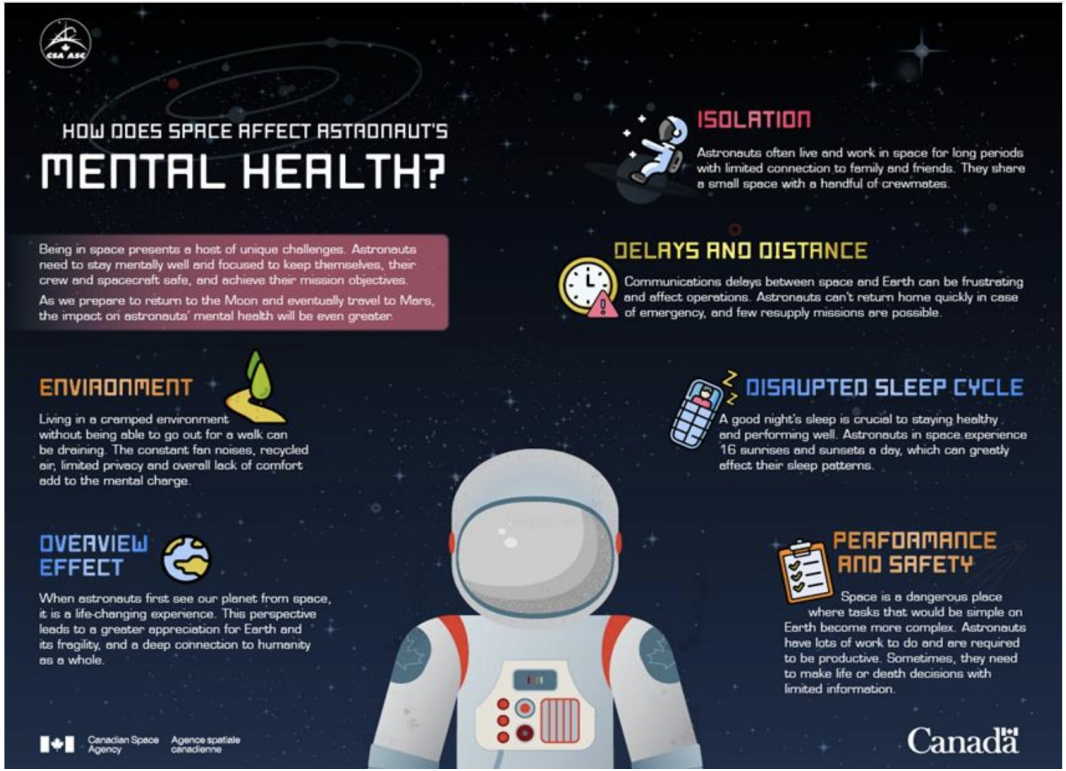
PRESS INQUIRIES



An MIT team's winning design for NASA's annual Revolutionary Aerospace Systems Concepts – Academic Linkage (RASC-AL) features the Bipropellant All-in-one In-situ Resource Utilization Truck (BART, left) and Mobile Autonomous Reactor Generating Electricity (MARGE, right). BART and MARGE are intended to travel around Mars in tandem; BART handles all aspects of production, storage, and distribution of fuel produced while MARGE provides power for the operation.

Background image courtesy of NASA/JPL-CalTech/MSSS

Challenge 3: Thriving on Mars
Mental Health



Challenge 3: Thriving on Mars
Mental Health

How does space affect astronauts' mental health?

Being in space presents a host of unique challenges. Astronauts need to stay mentally well and focused to keep themselves, their crew and spacecraft safe, and achieve their mission objectives. As we prepare to return to the Moon and eventually travel to Mars, the impact on astronauts' mental health will be even greater.

Environment Living in a cramped environment without being able to go out for a walk can be draining. The constant fan noises, recycled air, limited privacy and overall lack of comfort add to the mental charge.

Overview effect When astronauts first see our planet from space, it is a life-changing experience. This perspective leads to a greater appreciation for Earth and its fragility, and a deep connection to humanity as a whole.

Isolation Astronauts often live and work in space for long periods with limited connection to family and friends. They share a small space with a handful of crewmates.

Delays and distance Communications delays between space and Earth can be frustrating and affect operations. Astronauts can't return home quickly in case of emergency, and few resupply missions are possible.

Disrupted sleep cycle A good night's sleep is crucial to staying healthy and performing well. Astronauts in space experience 16 sunrises and sunsets a day aboard the International Space Station, which can greatly affect their sleep patterns.

Performance and safety Space is a dangerous place where tasks that would be simple on Earth become more complex. Astronauts have lots of work to do and are required to be productive. Sometimes, they need to make life or death decisions with limited information.

https://www.asc-csa.gc.ca/eng/multimedia/search/image/watch/17399

Challenge 3: Thriving on Mars
Physical Health

Any communication between Mars and Earth will have a 20 minute delay each way, according to NASA's Human Research Program. In the case of equipment failures or medical emergencies, the crew will need to be capable of handling everything on their own. Food will have to be preplanned for the entire trip, and medicine will need to be provided for many potential problems.

The Human Research Program is currently studying what kinds of medical problems may come up in space over the six months it would take to travel to Mars. That way, NASA can plan what types of procedures, equipment and medications will be needed, as well as what medical skills the crew will need.

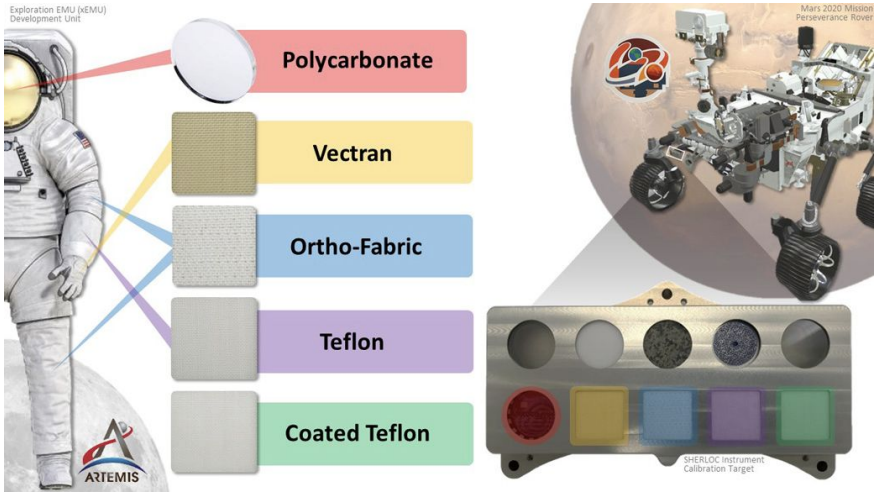
Astronauts who travel to space now perform ultrasounds to monitor how their bodies change in response to the off-Earth environment. And the Human Research Program is also testing ways to improve food formulation, processing, packaging and preservation so that nutrients remain stable for a long time, as well as ways to package medications and preserve their integrity on long-duration space missions.

https://www.space.com/42918-big-space-risks-mars-astronauts-videos.html

Challenge 3: Thriving on Mars
Physical Health

Astronauts aboard the International Space Station (such as Luca Parmitano, shown here in 2013) usually exercise about two hours per day to maintain physical health. Despite such efforts, long-duration spaceflight can cause fitness levels to drop by up to 50 percent, a recent study suggests. (Image credit: NASA)

https://www.space.com/36779-spaceflight-astronaut-fitness-blood-vessels-function.html



https://www.nasa.gov/feature/jpl/nasas-perseverance-rover-will-carry-first-spacesuit-materials-to-mars

Challenge 3: Thriving on Mars
Physical Health

Most people know that being exposed to too much radiation can make you sick, but the levels of radiation we experience on Earth are nothing compared to those that astronauts would be exposed to on the journey to Mars. Space radiation is much more harsh and damaging than the radiation experienced by people living on Earth.

Even astronauts who live on the International Space Station, which sits inside Earth's protective magnetic field, are exposed to 10 times the radiation they would if they were back on Earth, according to NASA officials.

Anyone who traveled through deep space would be at much greater risk from radiation exposure. Outside of Earth's protective shield, radiation can increase cancer risk and damage a person's central nervous system (which would cause altered cognitive function, reduced motor function and behavioral changes), NASA's Human Research Program said. Other dangers of being exposed to such high radiation include nausea, vomiting, anorexia, fatigue, cataracts, cardiac disease and circulatory disease.

That's why NASA is studying how radiation affects the human body and mind, so the agency can figure out ways to counteract the effects and keep astronauts safe as they travel through deep space.

Radiation Protection: https://www.space.com/42918-big-space-risks-mars-astronauts-videos.html

Challenge 3: Thriving on Mars
Physical Health

A human mission to Mars means sending astronauts into interplanetary space for a minimum of a year, even with a very short stay on the Red Planet. Nearly all of that time, they will be outside the magnetosphere, exposed to the harsh radiation environment of space. Mars has no global magnetic field to deflect energetic particles, and its atmosphere is much thinner than Earth's, so they'll get only minimal protection even on the surface of Mars.

Throughout the entire trip, astronauts must be protected from two sources of radiation. The first comes from the sun, which regularly releases a steady stream of solar particles, as well as occasional larger bursts in the wake of giant explosions, such as solar flares and coronal mass ejections, on the sun. These energetic particles are almost all protons, and, though the sun releases a large number of them, the proton energy is low enough that they can almost all be physically shielded by the structure of the spacecraft.

In addition to spacecrafts, shelters, and spacesuits, radiation risk mitigation can also be approached from the human body level. Though far off, a medication that would counteract some or all of the health effects of radiation exposure would make it much easier to plan for a safe journey to Mars and back.

https://www.nasa.gov/feature/goddard/real-martians-how-to-protect-astronauts-from-space-radiation-on-mars

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For extra Martian points, create a slogan for your product and a 30-second commercial for your product!

Mars Mission Innovation Project

Name: _____ Partner:_____

Group Team (6 students): Circle one: A B C

Team Name: _____

Choose your Challenge: Check one

- ❑ Challenge 1: Surviving on Mars
- ❑ Challenge 2: Living on Mars
- ❑ Challenge 3: Thriving on Mars

Challenge Focus: _____

_____