Hands-on

STAR★net

Tested & Approved STEM Activities

Trip To Mars

Activity Guide

STAR★net

Science-Technology Activities & Resources For Libraries

A product of the Science-Technology Activities and Resources for Libraries (STAR_Net) program.
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Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

Trip to Mars

Activity Time

10-30 minutes (participants may opt to repeat the game multiple times)

Intended Audience

Families or other mixed-age groups, including children as young as 4 years old *with assistance from an older child, teen, or adult*
School-aged children ages 5 and up
Tweens

Type of Program

- ☑ **Facilitated hands-on experience**
- ☑ **Station, presented in combination with related activities**
- ☑ Passive program (if instructions are provided at the start of the game)
- ☐ Demonstration by facilitator

Overview

Participants play a game that steps through a human mission to Mars, to learn about the variety of people on the ground supporting missions, and the factors that can affect a mission outcome.

What's The Point?

- **Each space mission is supported by a large team with different responsibilities.**
- **Missions are influenced by many factors, including weather, solar storms, human health, and technological challenges.**

Materials

For each facilitator:

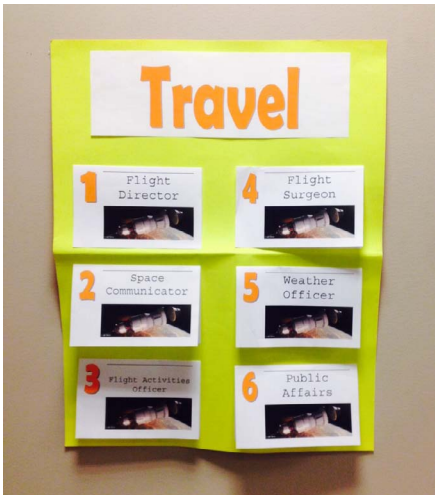
- ☐ 2 to 4 large dice constructed using:
  - ☐ 2-4 (6-12-inch-wide) cube-shaped boxes
  - ☐ 12-24 pieces of colorful paper
  - ☐ 1 thick, dark marker
  - ☐ Tape
- ☐ 6 (28" x 22") poster boards for the different mission stages
- ☐ 1 set of "Poster Scenarios," printed double-sided (select Print > Properties > Finishing > Document Options: Print on both sides) and folded in half to make lift-up flaps (below)
- ☐ 1 set of Poster Titles (below)
- ☐ An uploaded copy of the video "How Do You Get to Mars?" from http://mars.nasa.gov/msl/multimedia/videos/ind€ex.cfm?v=32#

For each participant:

- ☐ A copy of the Mission Instructions

Preparation

Before the event:



- Prepare the posters:
  - – Tape the name of the step to the top of each poster board: Step One: Launch, Step Two: Travel, Step Three: Habitat, Step Three: Crops, Step Three: Ice, Step Four: Return
  - – Print and fold the poster scenarios, then tape each of the six pages (Flight Director; Com Officer; Flight Activities Officer; Flight Surgeon; Earth, Space, and Mars Weather Officers; and Public Affairs Officer) to the appropriate poster, so that lifting the flap will reveal the information.
  - – Tape the posters in order on walls or prop them up on stands.

- Wrap or cover the faces of the boxes with the colorful paper, and write numbers 1 through 6 on the faces, to be used as dice.

Activity

1. Share ideas and knowledge.

- Introduce yourself. Help the participants learn each other's names (if they don't already know each other).
- Show the participants the video "How Do You Get To Mars?" and frame the activity with the main message: each space mission has a large team with different responsibilities helping it to be successful.
- Ask the participants what they think it would be like to explore on Mars.

As much as possible, encourage the participants to offer information and to respond to others' questions. This model can be used to answer questions such as:

- What would they do on Mars?
- What are some of the reasons that a trip to Mars is difficult?
- Why do they want to go to Mars?
- What are some of the jobs people could do on Mars?
- What help do astronauts need from people on Earth?

2. Guide participants through the game.

Let the participants know that they will be using a mission sheet to follow the steps of a human mission to Mars and go to different posters.

- Each poster has different mission staff on it, with a number for written next to each one.
- At each poster, they will each roll a box with numbers on it (a die).
- Depending on what number they get, they will choose the flap with that same number on it. They will lift the flap and follow the directions written underneath.

The game has been designed so that the participants are likely to fail only half of the time. In reality, missions to Mars are much more difficult. Of the 43 spacecraft sent to Mars by China, the European Space Agency, Japan, India, Russia/USSR, and the United States between 1960 and 2015, less than half succeeded – and only a small portion of those were attempting to land on Mars. (Missions to the Moon and Venus have also been challenging.)

Activity (continued)

- When they successfully complete a mission, they can start a new one, until everyone has finished at least one mission.

These are just a handful of the people that support NASA missions:

- **Flight Director** (FD) leads the flight control team and is responsible for the overall mission. The Flight Director makes all decisions regarding a safe flight.
- **Communications Officer** (Com Officer) serves as primary communicator between the flight control team on Earth and the astronauts.
- **Flight Activities Officer** (FAO) plans and supports the astronauts' activities, procedures and schedules.
- **Flight Surgeon** (Surgeon) monitors the astronauts' activities to keep track of their health, and leads the medical operations flight control team to advise the astronauts on health concerns and issues.
- **Earth, Space, and Mars Weather Officers** provide up-to-date information on the potential weather or space weather hazards near the spacecraft.
- **Public Affairs Officer** (PAO) provides information to the news media and the public.

3. Conclude.

Draw on the participants' observations and reflections:

- What are the different types of jobs for people helping with space missions?
- What are some of the problems that might come up during a mission?
- Do all missions always finish successfully?
- Aside from being an astronaut, what roles would they like to perform in a mission?

Correlations to the Next Generation Science Standards

The Nature of Science

Scientific Investigations Use a Variety of Methods

- Science investigations use a variety of methods and tools to make measurements and observations.

Science is a Human Endeavor

- Men and women from all cultures and backgrounds choose careers as scientists and engineers.
- Most scientists and engineers work in teams.
- Creativity and imagination are important to science.

Science Addresses Questions About the Natural and Material World

- Scientific knowledge is constrained by human capacity, technology, and materials.

References

Canright, Shelley, ed. "The People Behind the Astronauts." *NASA*. NASA Education. April 10, 2009. www.nasa.gov/audience/foreducators/k-/features/F_People_Behind_the_Astronauts.html

Frazier, Sarah. "Real Martians: How to Protect Astronauts from Space Radiation on Mars." *NASA*. NASA's Goddard Space Flight Center. September 30, 2015. www.nasa.gov/feature/goddard/real-martians-how-to-protect-astronauts-from-space-radiation-on-mars

"Historical Log of Mars Missions." *NASA*. Mars Exploration. n.d. http://mars.nasa.gov/programmissions/missions/log/

Wenz, John. "All the Times We Tried To Get To Mars And Failed Magnificently: The times the 'Great Galactic Ghoul' plagued NASA, the Russians, and other agencies." *Popular Mechanics*. October 1, 2015

Trip to Mars

Mission Instructions

A large team of people on Earth make decisions to keep you and the other astronauts in your crew safe and help you explore Mars:

- **Flight Director** (FD) leads the flight control team and is responsible for the overall mission. The Flight Director makes all decisions regarding a safe flight.
- **Communications Officer** (Com Officer) serves as primary communicator between the flight control team on Earth and the astronauts.
- **Flight Activities Officer** (FAO) plans and supports the astronauts' activities, procedures and schedules.
- **Flight Surgeon** (Surgeon) monitors the astronauts' activities to keep track of their health, and leads the medical operations flight control team to advise the astronauts on health concerns and issues.
- **Earth, Space, and Mars Weather Officers** provide up-to-date information on the potential weather or space weather hazards near the spacecraft.
- **Public Affairs Officer** (PAO) provides information to the news media and the public.

Go to each poster and roll one of the dice. Lift the flap of the flight control team member with the number you rolled, then follow the directions. The directions may say to go back to an earlier poster or to move to the next poster.

If the directions say "roll again," then stay at that poster and roll one of the dice again, and follow the new directions.

Step One: Launch

Many factors are important in a launch—the equipment, the astronauts' health, and even the weather! Once your launch is successful, go to the "Travel to Mars" poster.

Go to the "Launch" poster and roll one of the dice to determine whether or not you and the rest of the crew are on your way to Mars!

Step Two: Travel to Mars

You travel for eight months to reach Mars. Like on a long road trip, it is sometimes hard for you and your crew to get along in such a small space with little privacy. Thanks to years of practice working as a team, you are all keeping a positive attitude during the long journey, traveling far from your friends and family, and exercising daily to keep your bones and muscles in shape without Earth's gravity.

Go to the "Travel" poster and roll one of the dice to learn what types of issues your crew can face during your trip.

Mission Instructions (continued)

Step Three: Start a Colony

Once you have arrived at Mars, you need to choose between three activities on Mars. Go to one of the three posters:

Three A: Build a Mars Crew Habitat
Your habitat was delivered to the surface of Mars by robotic spacecraft, but it is still tightly packaged from the journey and not yet assembled. Are you successful at assembling it?

Go to the "Habitat" poster and roll one of the dice to determine whether or not you are successful at assembling the habitat.

OR

Three B: Grow Crops
After surviving so long on freeze-dried packages of food that you brought with you from Earth, you and your crew are hungry for fresh fruits and vegetables! You must plant crops in a greenhouse and tend them for several weeks and months. Are you successful at growing and harvesting the first crops on Mars?

Go to the "Crops" poster and roll one of the dice to determine whether or not you are successful at growing crops.

OR

Three C: Search for Ice Deposits
You and your crew — and your crops — need water to survive. Water can also be used to manufacture oxygen to breathe or to make rocket fuel. Take a trip to some nearby ice deposits and bring ice back to the colony to melt for water.

Go to the "Ice" poster and roll one of the dice to determine whether or not you are successful at collecting water.

Step Four: Return to Earth

You and the rest of your crew have explored Mars and it's time to return to Earth. It's been a long trip, but you're looking forward to being back home again!

Go to the "Return" poster and see how the team on Earth helps your capsule to splash down safely in the ocean.

You and your crew are home after a triumphant mission to Mars! Welcome home!

Begin again at "Launch" to participate in another mission to Mars.

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Step One Launch

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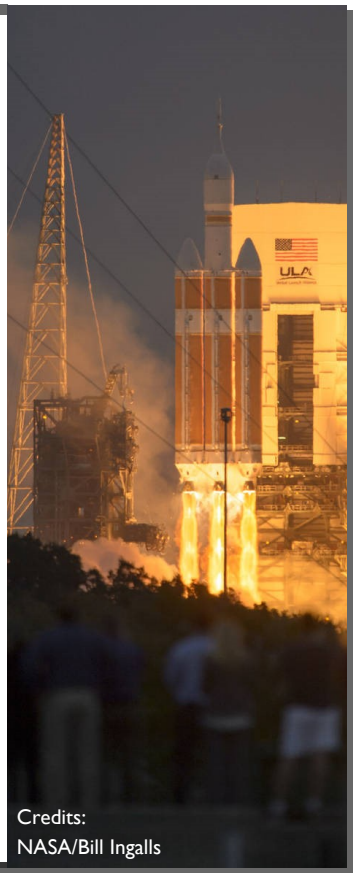
1

Launch

Flight Director



Credits:
NASA/Bill Ingalls

The weather is too stormy! Try again on another day.

Roll again.

2

Launch

Com

Officer

Credits:
NASA/Bill Ingalls

Ground Control reports that the communication system is not working.

Roll again.

3 Launch

Flight Activities Officer

Credits:
NASA/Bill Ingalls

All systems check out and you're ready to go.

Your launch is successful!

Go to Step Two: Travel.

4 Launch

Flight Surgeon

Credits:
NASA/Bill Ingalls

Your years of training have paid off! You and your team are healthy and ready for launch.

Go to Step Two: Travel.

5 Launch

Earth Weather Officer

Credits:
NASA/Bill Ingalls

The launch weather officer reports that the weather is calm and clear.

Your launch is successful!

Go to *Step* Two: Travel.

6 Launch

Public Affairs

Credits:
NASA/Bill Ingalls

The President of the United States is watching your launch! Say something to the reporters about your mission.

Your launch is successful!
Go to Step Two: Travel.

Step Two
Travel

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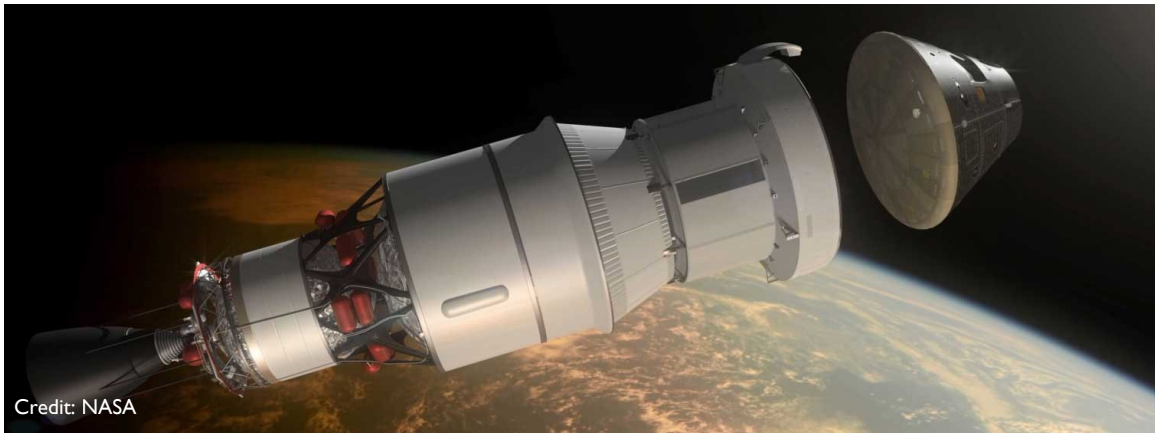
1

Travel

Flight Director



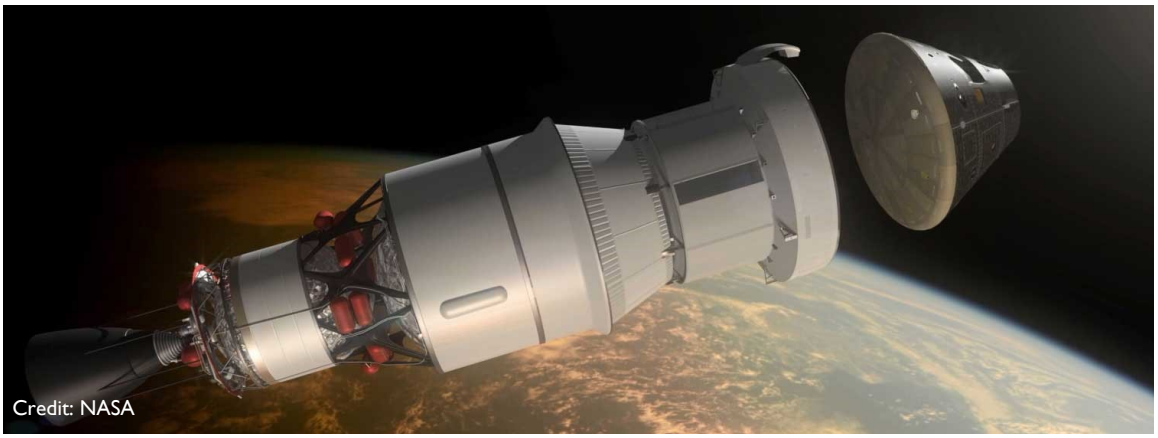
Credit: NASA

The rocket engines that send astronauts to the International Space Station and the Moon are too slow. Your spacecraft uses a new type of engine to get you safely and quickly to Mars.

Continue to one of the Step Three posters.

Travel2

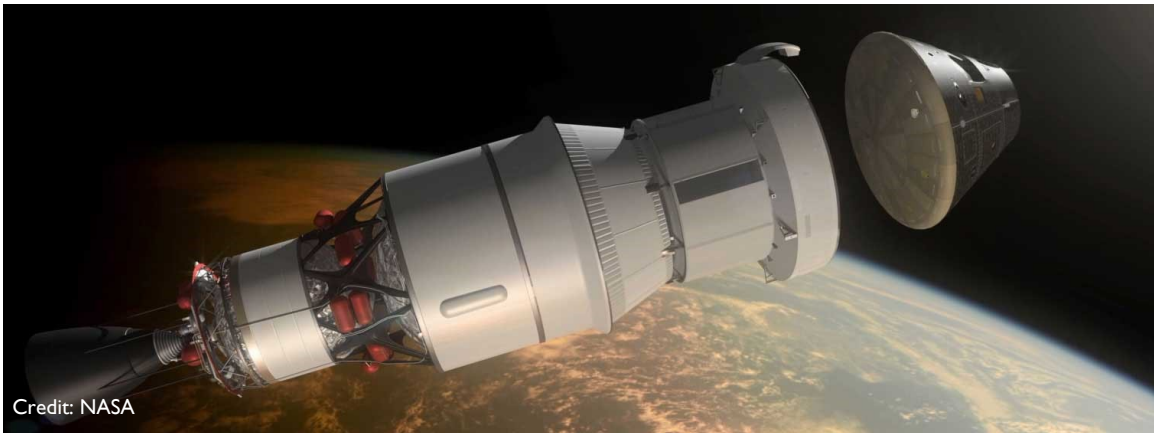
Com Officer



Your spacecraft passed through a clump of debris from a comet and small space rocks (meteoroids). Your communications array was damaged. You will need to repair it.

Roll again.

Flight Activities Officer

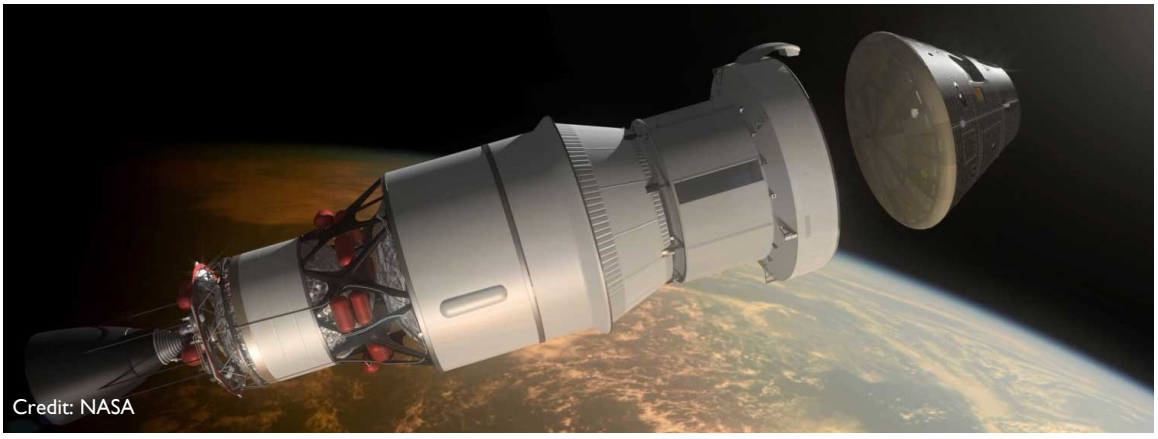


Your heating and cooling system is not working properly. You will need to repair it.

Roll again.

Travel 4

Flight Surgeon



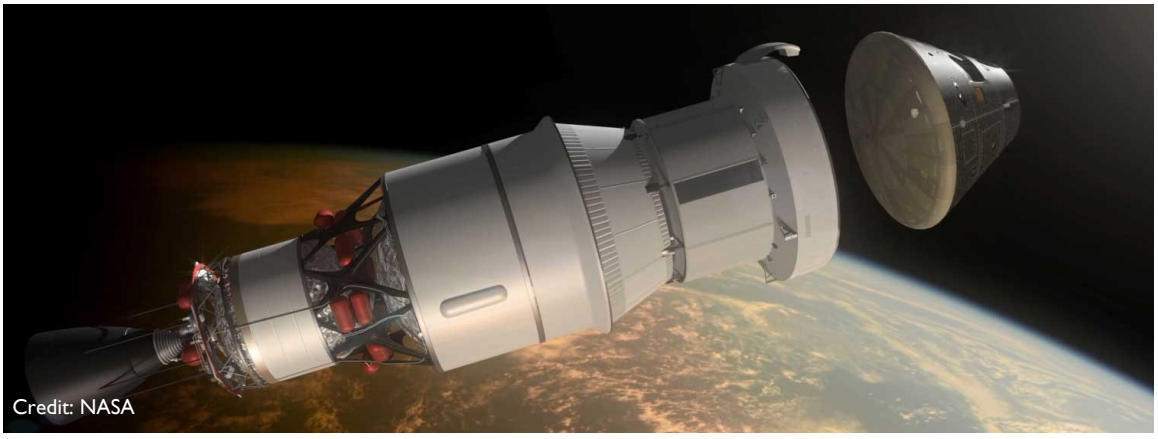
A crew member has become very sick and you don't have the special medicine that your crew member needs. You must return to Earth.

Start all over

at Step One: Launch.

Travel 5

Space Weather Officer

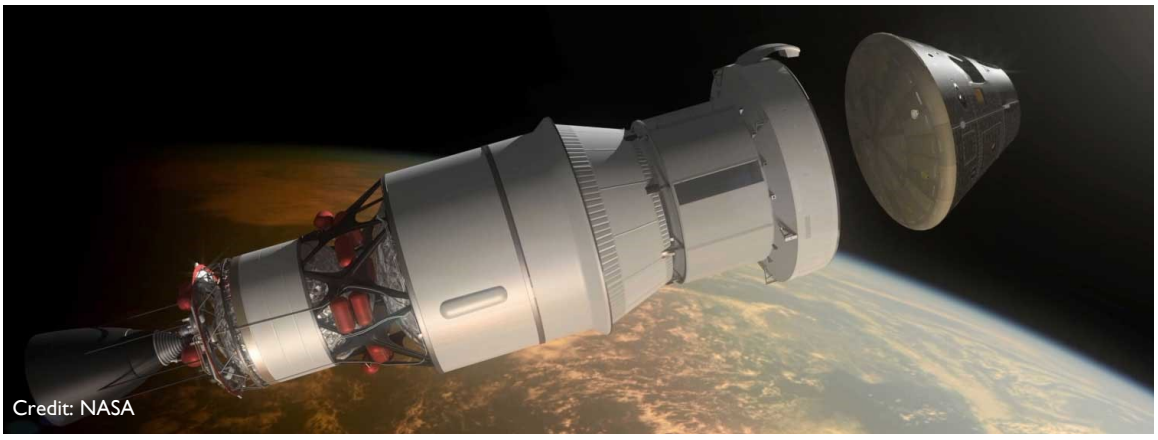

Credit: NASA

New spacecraft shields protected you and your crew from radiation from distant exploding stars and our Sun. You arrive safely at Mars!

Continue to one of the Step Three posters.

Travel 6

Public Affairs



You receive messages from fans back on Earth. It takes 20 minutes for messages to get from Earth to your spacecraft.

You have finally arrived at Mars! **Continue to one of the Step Three posters.**

Step Three
A. Habitat

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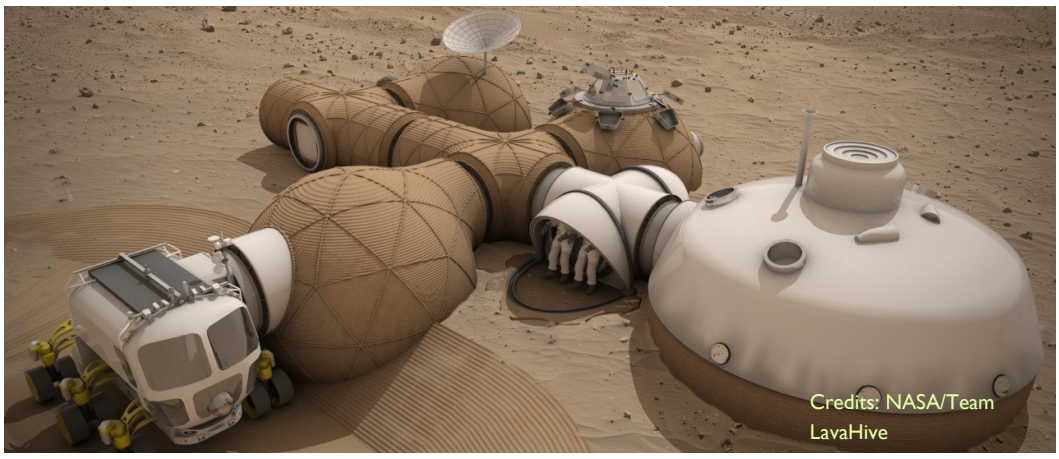
Habitat 1

Flight Director

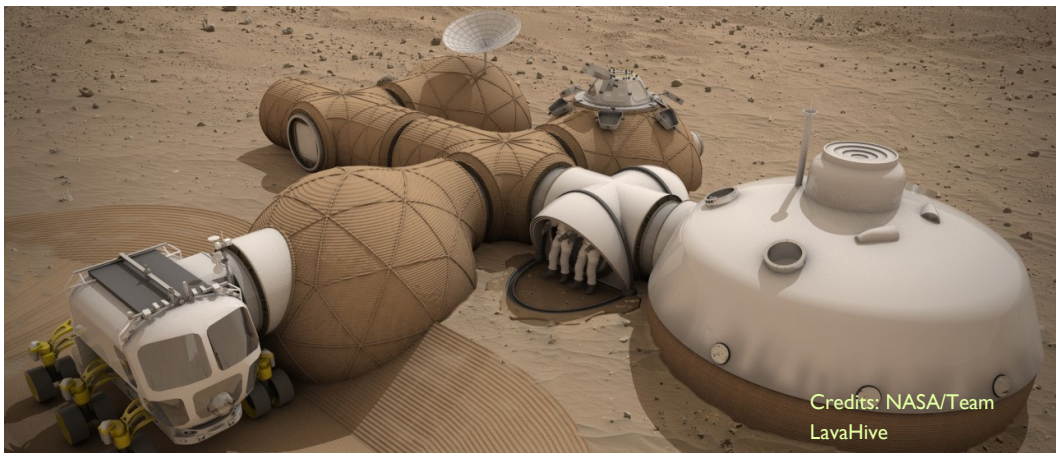


The habitat you have made leaks air. You will need to repair it.

Roll again.

Habitat 2

Com Officer

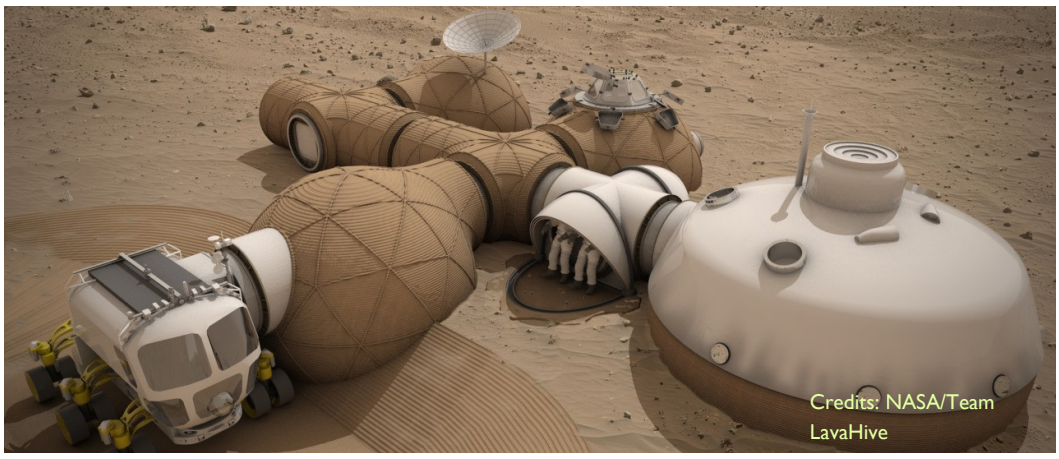


A part has broken and you must use a 3D printer to make a new one. Engineers on Earth email the printing file to you. You create the part and make the repair.

Continue to
Step Four: Return.

Habitat

3 Flight Activities Officer

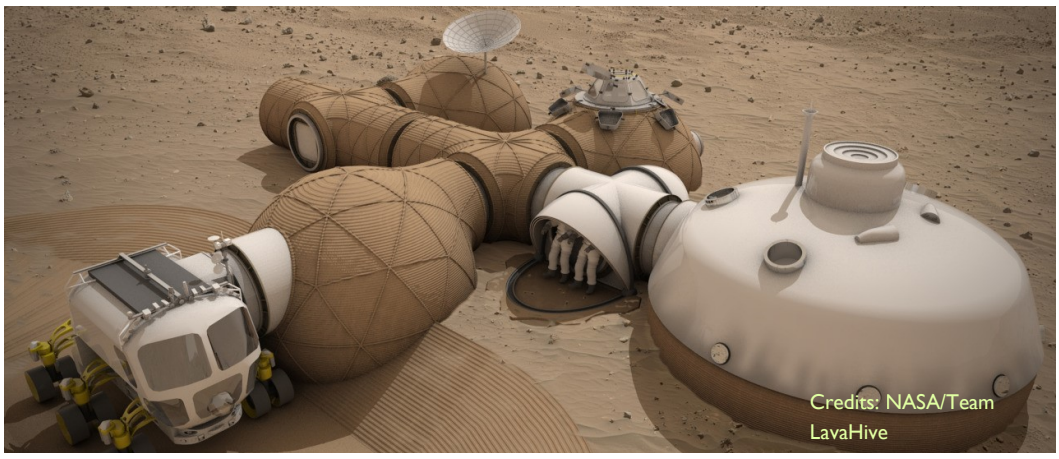


The atmosphere on Mars is too thin for humans, but you are successful at building the habitat to protect your crew.

Continue to Step Four: Return.

Habitat

4 Flight Surgeon

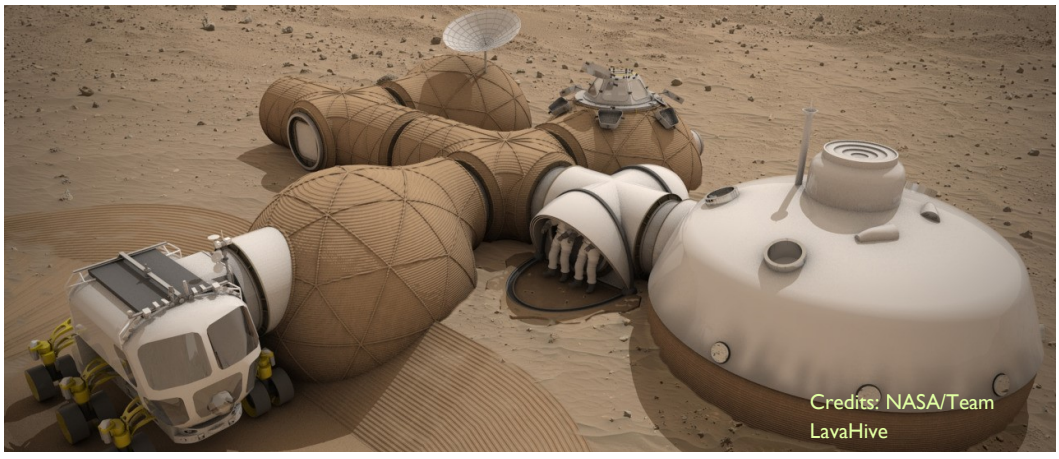


Gravity on Mars is weaker than on Earth. You exercise for two hours each day to keep your bones and muscles healthy.

Continue to Step Four: Return.

Habitat

5 Mars Weather Officer

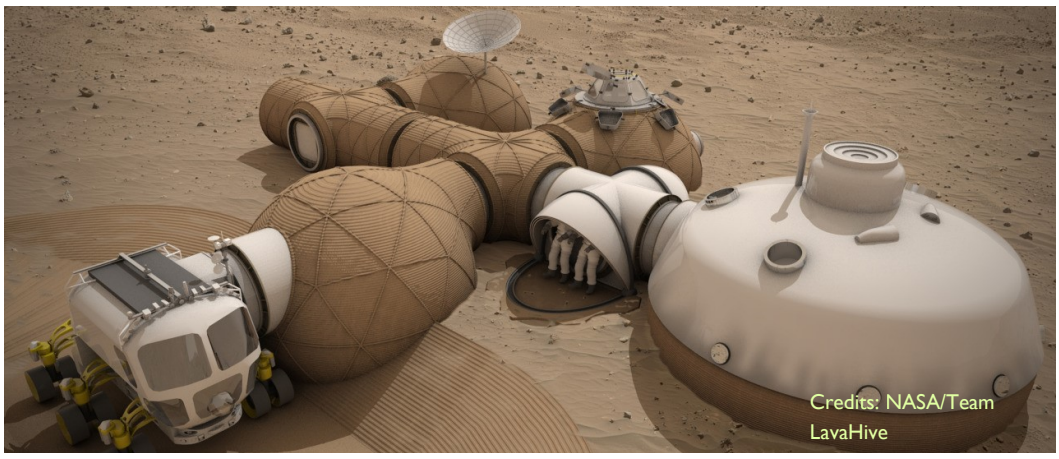


Mars winds have covered the habitat’s solar panels with dust. You will need to clean off the panels.

Roll again.

Habitat

6 Public Affairs



Your team creates a video while building the habitat, which is seen by students all over Earth.

Continue to Step Four: Return.

Step Three
B. Crops

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Crops

1 Flight Director

Credits: NASA/Pat Rawlings

Congratulations! Your fruits and vegetables are growing!

Continue to Step Four: Return.

Crops

2

Com Officer

Credits: NASA/Pat Rawlings

Your team spoke with experts on Earth to decide the best location for the greenhouse.

Congratulations—it worked! Go to Step Four: Return.

Crops

3

Flight Activities Officer

Credits: NASA/Pat Rawlings

The plants are not getting the nutrients that they need on Mars. Your team cannot survive long on Mars without them. You must return to Earth.

Start all over at Step One: Launch.

Crops

4 Flight Surgeon

Credits: NASA/Pat Rawlings

Not only are the plants growing, but your team's health is improving with fresh vegetables!

Continue to
Step Four: Return.

Crops

5 Mars Weather Officer

Credits: NASA/Pat Rawlings

Dust storms are blocking the sunlight that the plants need to grow.

Roll again.

Crops

6 Public Affairs

Credits: NASA/Pat Rawlings

You and the team send messages back to Earth with recipes using the delicious food you grow!

Continue to
Step Four: Return.

Step Three

C. Ice

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Ice Flight Director

You did not find water ice yet and supplies are running low. Time to abort the mission.

Start over again at Step One: Launch.

Ice 2

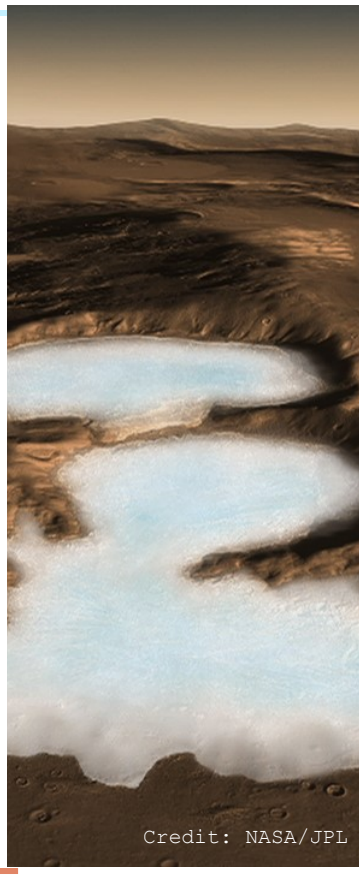
Com Officer

One of your crewmates reports that she has found ice nearby!

Continue to Step Four: Return.

Ice 3

Flight Activities Officer



Your rover’s wheel has gotten stuck on a rock and you must clear a path to smoother ground.

Roll again.

4 Ice

Flight Surgeon

Your spacesuit kept you safe from the thin, cold Martian atmosphere and radiation from the Sun.

Go to Step Four: Return.

Ice 5

Mars Weather Officer

Credit: NASA/JPL

A solar storm has sent a burst of radiation toward Mars. Mars doesn't have the magnetic field and thick atmosphere that protect us on Earth. You must stay indoors and look for ice another day.

Roll again.

6

Ice

Public Affairs

Credit: NASA/JPL

You've discovered lots of ice for future missions! On Earth, everyone is excited about your discovery!

Go to the Step Four: Return.

Step Four
Return

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1

Return

Flight Director

Credit: U.S. Navy

You have made a successful splashdown! Your family is watching from Mission Control as U.S. Navy sailors help you climb out of your space capsule. Congratulations!

Roll at the "Launch" step to go on another mission.

Return 2

Com Officer

As you prepare to leave your capsule, you hear congratulations on your radio from all of NASA after a successful mission.

Roll at the “Launch” step to go on another mission.

Return 3

Flight Activities Officer

The heat shield on your space capsule was damaged during the journey to Mars and back. You will have to do a space walk to repair it before you land.

Roll for a new number at this step.

4

Return

Flight Surgeon

Your spine was stretched in space and the stress of splashing down on Earth has damaged it. While you are in the hospital healing, fans from around the world send you flowers and cards to thank you for your bravery.

5

Return

Earth Weather Officer

Credit: U.S. Navy

There is stormy weather at your splashdown site. You will need to splash down at a different location.

Roll again for a new number at this step.

Return 6

Public Affairs


Credit: U.S. Navy

There is a parade to honor you and your crewmates!

Wave to your fans and then roll at the "Launch" step to go on another mission.