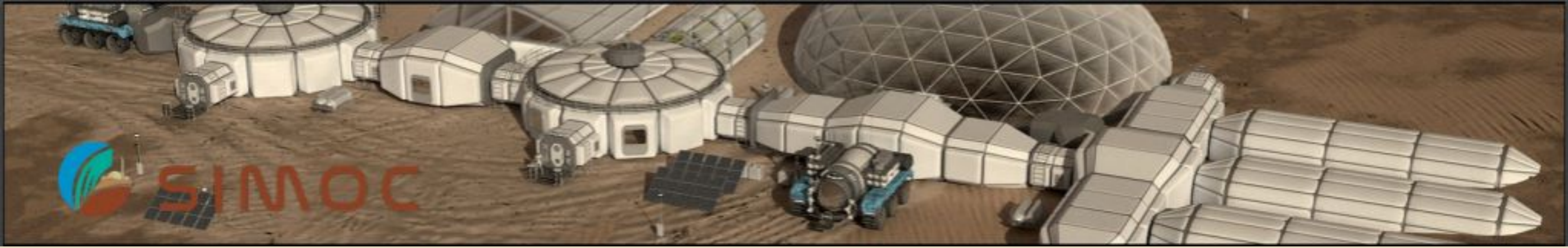
WATCH

What problems would we face if we wanted to inhabit Mars?

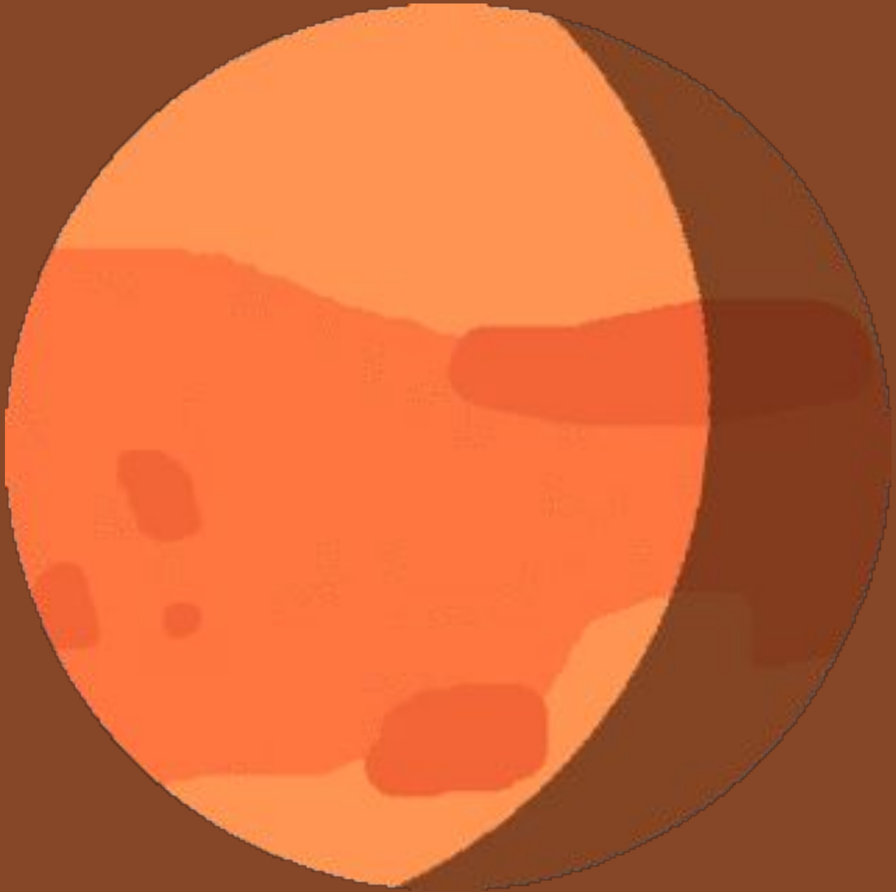
Jot down your thoughts here:



"We will in the coming decades establish ourselves in orbit around the Moon, on the surface of Mars, and in a more distant future on moons of Jupiter and Saturn. To get there we must learn how to sustain human life in hostile environments, with limited resupply. What balance of mechanical and biological systems will be required to sustain human life in a growing, off-world habitat?"

EQ: How can I use the SIMOC model to develop a habitat to support life off-world?

The SIMOC model uses authentic data gathered from decades of NASA and other science research on life support systems to develop a habitat to support at least 4 researchers on Mars or other off-world environments. This is your chance to be a citizen scientist! The results from your simulations will become a part of the data used to help research and solve this problem!

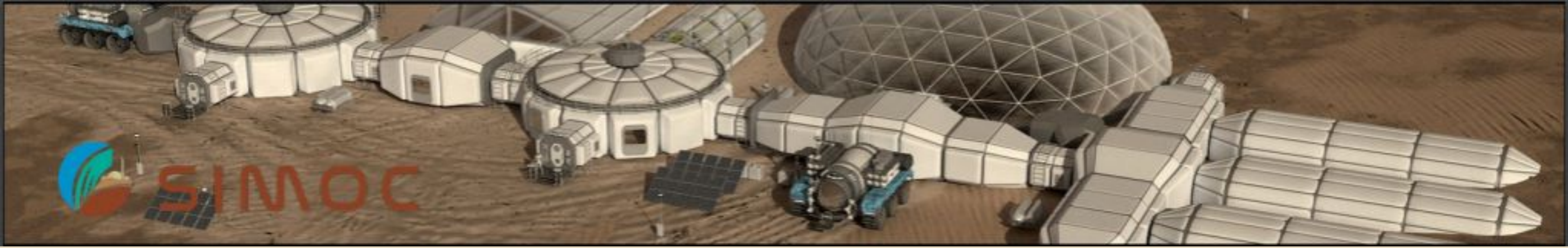


You will design a Mars habitat complete with astronauts, crew quarters, greenhouse, plants, solar panels and batteries. You will set their model in motion, simulating weeks, months, even a year living on Mars in total isolation to learn if the balance of food, power, machines and plants enables a successful, sustainable mission.

SIMOC is a scalable, interactive model of an off-world community built upon life support and closed ecosystem research at NASA, Paragon, and universities world-wide. The goal is to design the minimum complexity required to sustain human life on another world with a combination of mechanical life support (as on the International Space Station) and bioregeneration (living plants). You will gain an appreciation for the challenges of living on another planet, and a deeper understanding of the impact of our choices here on Earth.

Perhaps you will find the solutions ...

SIMOC is an Arizona State University, School of Earth and Space Exploration, Interplanetary Initiative Pilot Project.



Sound simple? Science fiction has made it look far too easy with airlocks that never require decompression, food materializing out of thin air, and terraforming in a matter of hours rather than thousands of years. In the real cosmos, living off-world is far more challenging. Finding a balance of machines, plants, algae, and humans is a complex endeavor. The slightest incongruity in waste management, power production, or CO2 scrubbing can result in catastrophic failure, forcing abandonment of the habitat, or worse.

WATCH

What happens on Mars stays on Mars!

(A) Designing the Habitat

Earth supplies humans with everything we need to live. But what about when we leave Earth? We currently have research on the International Space Station (ISS) and NASA is preparing to send people to the Moon and Mars in the future. NASA scientists and engineers have found ways to support humans away from Earth. A space suit, a space capsule, and the International Space Station are sealed containers protecting humans in space. These specialized "containers" are designed to provide a habitat that humans need to live in space. But what do humans need to live away from Earth, especially with a three-year round-trip to Mars?

To help you think about this problem, you have been asked to design a habitat that is on Mars. You can bring some initial supplies. After that nothing comes into the habitat and nothing leaves the habitat. You can choose how many people you want in your habitat, but there must be at least four. You must design your habitat so that it supplies everything that is needed to keep your team healthy and happy for several years.

There are two additional constraints on the design process.

1. You are designing a habitat to be used on Mars within 25 to 50 years. That means you must research what is know currently known about living in sealed habitats (like the International Space Station).
2. Cost is always a constraint. Although we are not identifying a budget, it is best to keep costs as low as possible. One big cost is the launch of materials from Earth. The current range of costs is $10,000 to $20,000 **per kilogram** and the Curiosity rover cost as much as $2.78 million per kilogram. So, a huge habitat on Mars might be attractive, but it would be too costly. Scientists will probably work for the smallest mass (in kilograms) habitat that will accomplish the mission.

What constraints do you need to consider when designing your habitat?

Jot down your thoughts here:

Based on your brainstorming, you've identified these basic human needs on Mars:

- Breathable air
- Drinkable water
- Food
- Waste disposal
- Energy
- Protection

Some questions you still need to think about are:

- How will we provide breathable air?
- How will we provide clean water?
- How will we get food?
- How will we dispose of waste?
- How will we get energy and power our systems?
- How will we protect ourselves from the harsh environment?

Designing a research station on Mars breaks down into 2 major components

How do you design a habitat that will provide life support for the researchers?

and

How do you design an environment that promotes health and emotional support in an alien environment?

Research-Type your answers in the text boxes.

What are the temperatures like on Mars?

What is the terrain like?

What kind of atmosphere is there on Mars?

Is there water and food on Mars?

Earth's atmosphere includes nitrogen (78%), Oxygen (21%), Argon (0.93%), Carbon Dioxide (0.04%), and trace amounts of neon, helium, methan, krypton, hydrogen, and water vapor. How do we maintain this composition of air on Earth?

Could we use some of the same techniques in a closed habitat on Mars?

What designs has NASA worked on that could guide us?

How much water does a person need every day?

How does Earth produce clean water and recycle impure water?

Can this be done in a closed habitat on Mars?

What systems has NASA designed to provide clean water in a closed habitat?

Design A Prototype- Create a design for your Mars habitat. You will be testing it out in the SIMOC simulator. The data from your tests will help scientists design sustainable habitats!

Describe how you would design a habitat on Mars to sustain life for 4 humans. Provide a sketch with labels to help us visualize. Remember, you need a plan to provide drinkable water, breathable air, food, power, etc. All the while, you are keeping cost in mind.

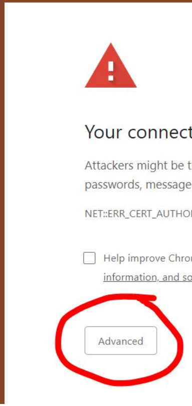
Sketch (or insert pic of 3D design you've created):

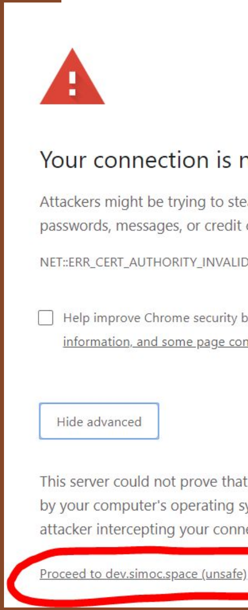
Test Your Design - Go to https://dev.simoc.space/ and follow the directions to run a simulation to test your design (instructions on how to login are on the next slide). You will get quantitative results of testing your habitat design. Record the results below. You can adjust factors as you go to help you be more successful. Remember: Your design/simulations provide scientists with useful information! You are a CITIZEN SCIENTIST! YOU MATTER!

SIMOC Simulation #	What were the starting conditions?	What worked well?	What did not work?	What would you change?

How to Access the Simulator:

1. Go to https://dev.simoc.space/
2. You will likely hit a security error screen. This is OK. You will need to click "Advanced", and then "Proceed to dem/simoc/space (unsafe)". It is safe, don't worry.
3. Username: jimmykimmel   Password: tomatoe
4. Once you are in, click Proceed.
5. Click "Sign Up" and create a username and password for yourself. Write it down just in case you forget it!
6. Click "New Configuration". The other option requires you to have completed the simulation already and have downloaded data. You are welcome to do that, but you aren't required to.
7. For this particular assignment, under "Presets" choose 4 humans for 10 days. Everything else can be based on your design. You can change it as needed each time you test your revised design!
8. Play around with the simulator! Have fun with it!





Reflect-Type your answers below and then go to Flipgrid and record a summary of your responses/reflection on this experience.

What did you learn based on your design and your test simulations?

How does this type of activity help society?

What ideas or questions did this activity help you generate?

Based on what you learned, what are some adaptations that would help organisms (plants and animals) survive on Mars?

Did you enjoy this activity? Why or why not?

This presentation was created by
Gretchen Hollingsworth using curriculum materials developed by the SIMOC team.

Images and GIFS were searched and inserted within the Google Slides Image Search feature.

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