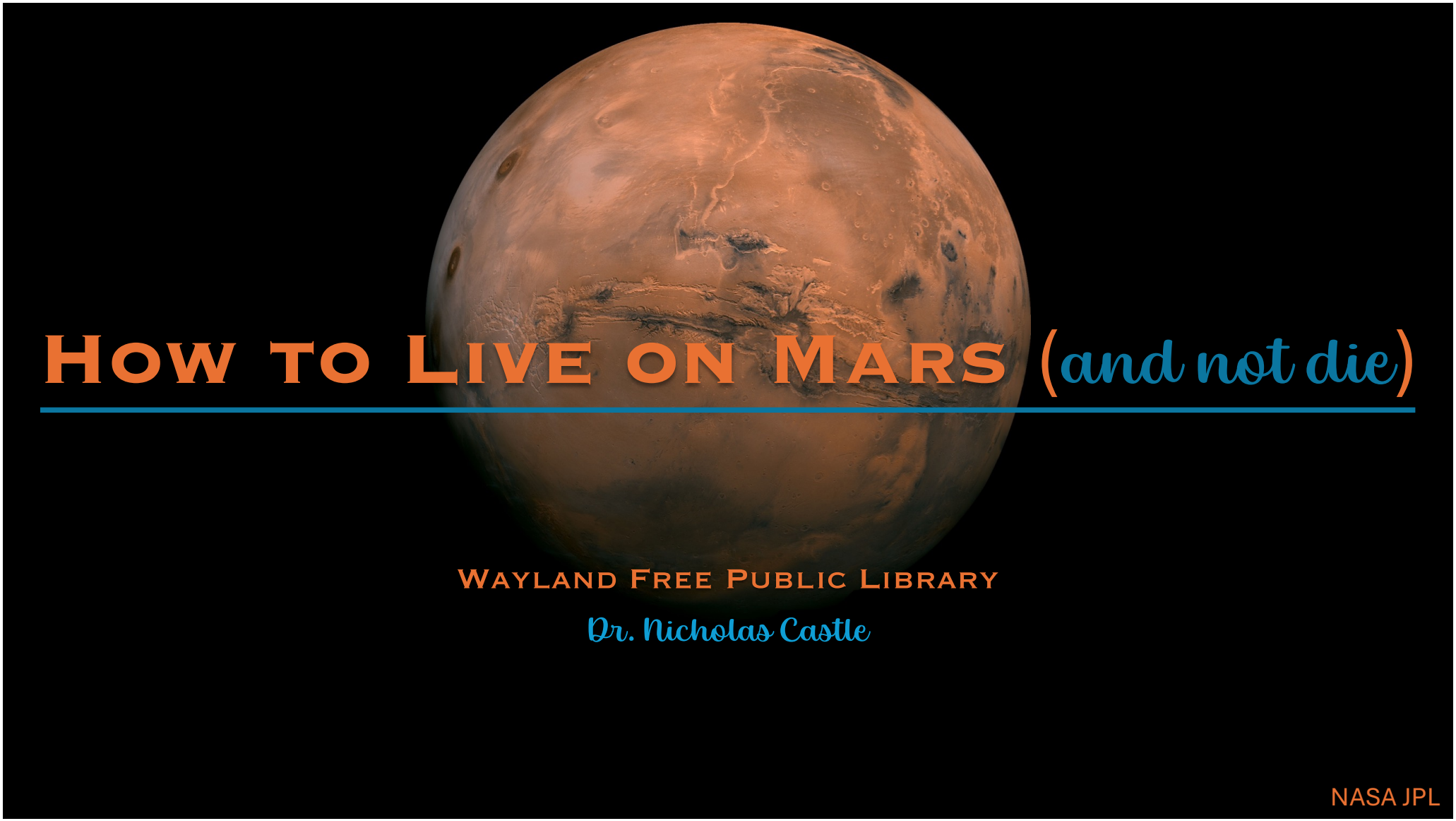
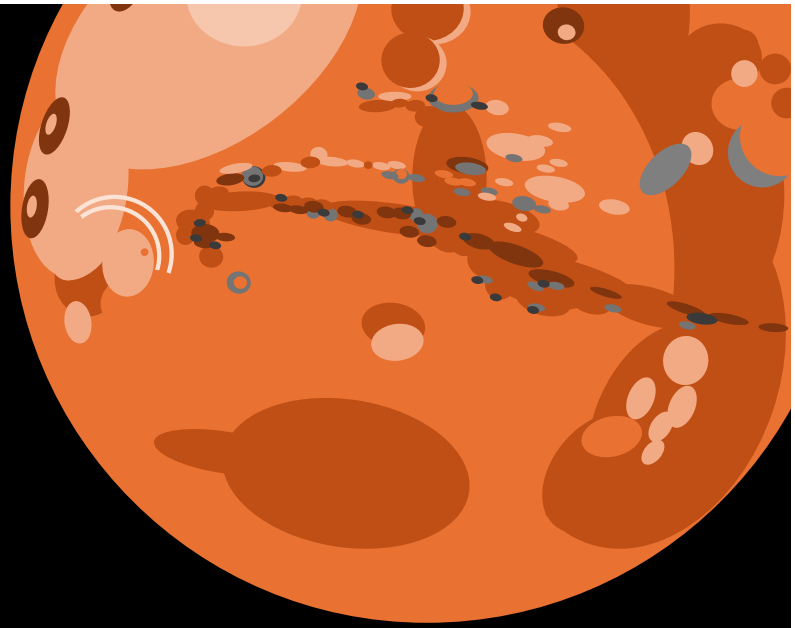


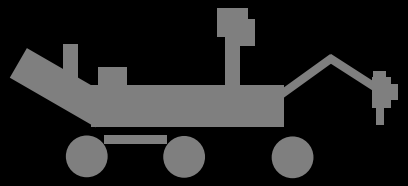
How to Live on Mars (and not die)

Wayland Free Public Library

Dr. Nicholas Castle

NASA JPL



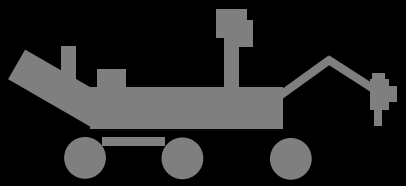


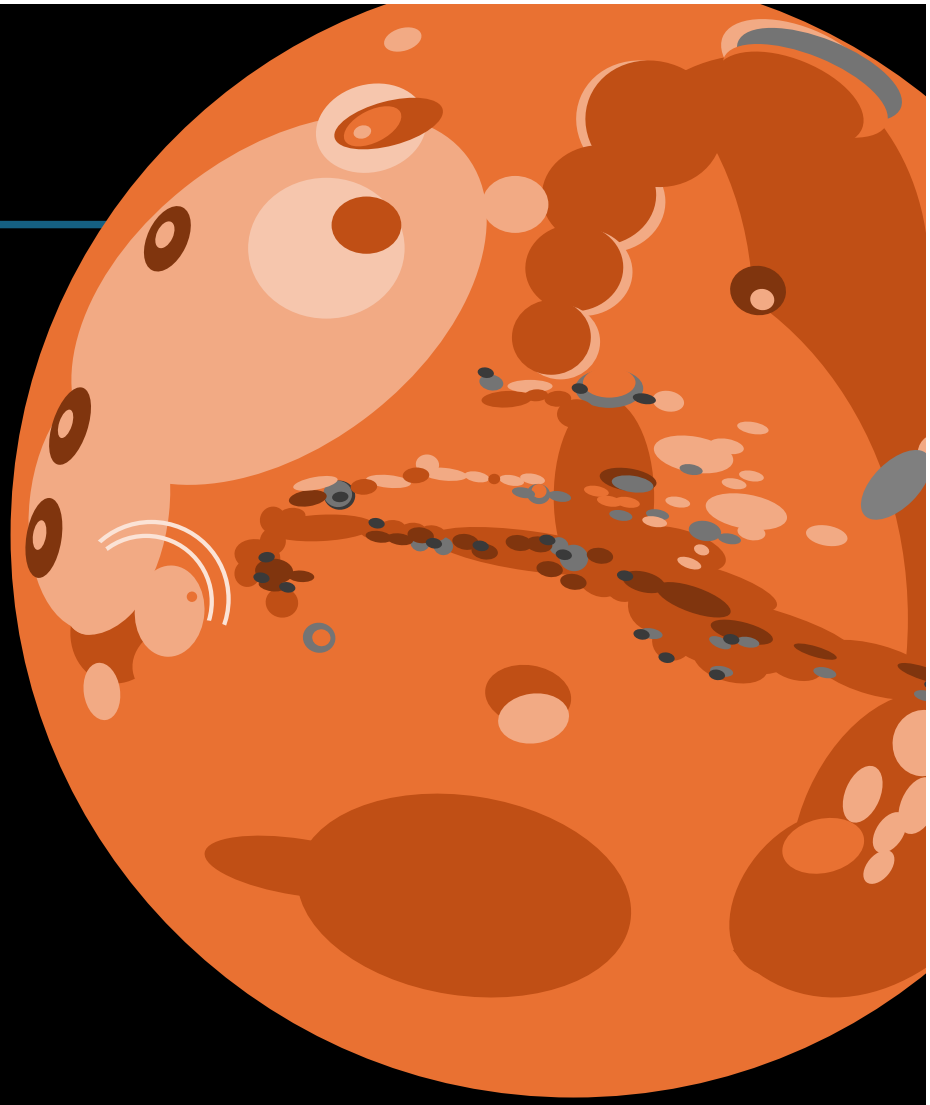
Should We Live On Mars?

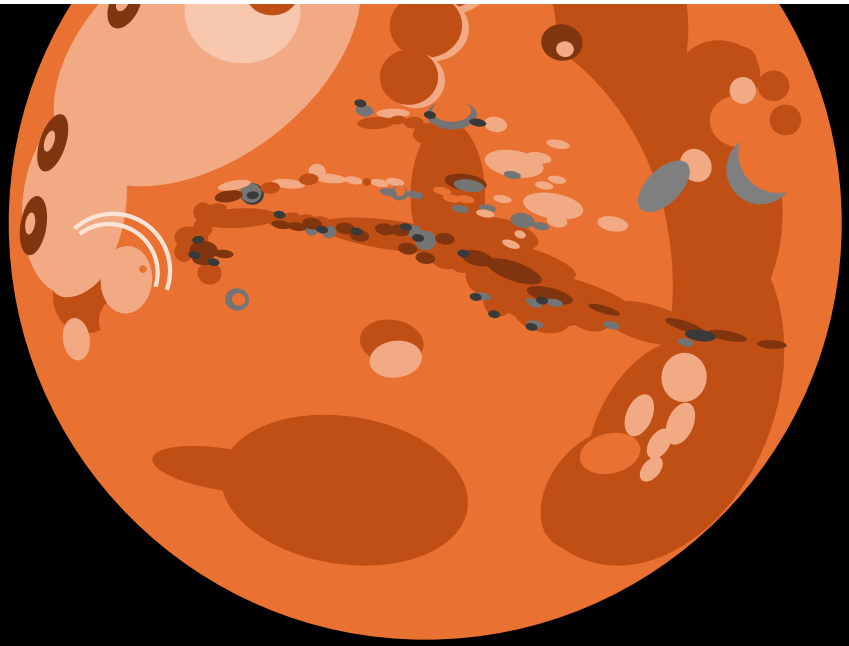
Space exploration has fueled innovation in the past. Will it again in the future?

Overview

- What is hard about Mars?
- How would we approach the challenge of living on Mars?
- How could industry work on the Red Planet?
- What might we learn if we decided to live there?







What do we know about Mars?

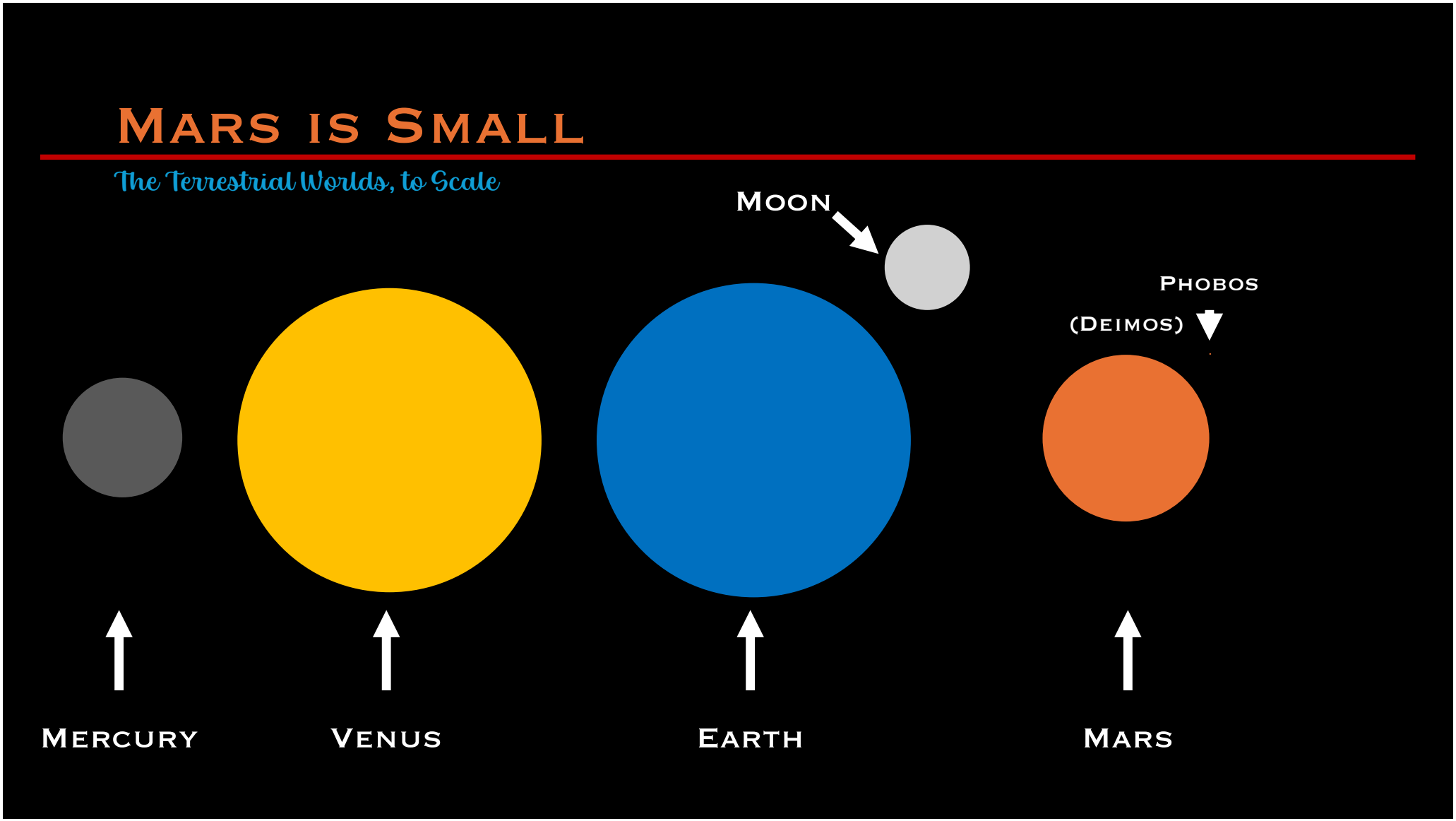
The Atlantic called Mars a hellhole. They're not wrong. What challenges might we face there?

Mars is a Hellhole

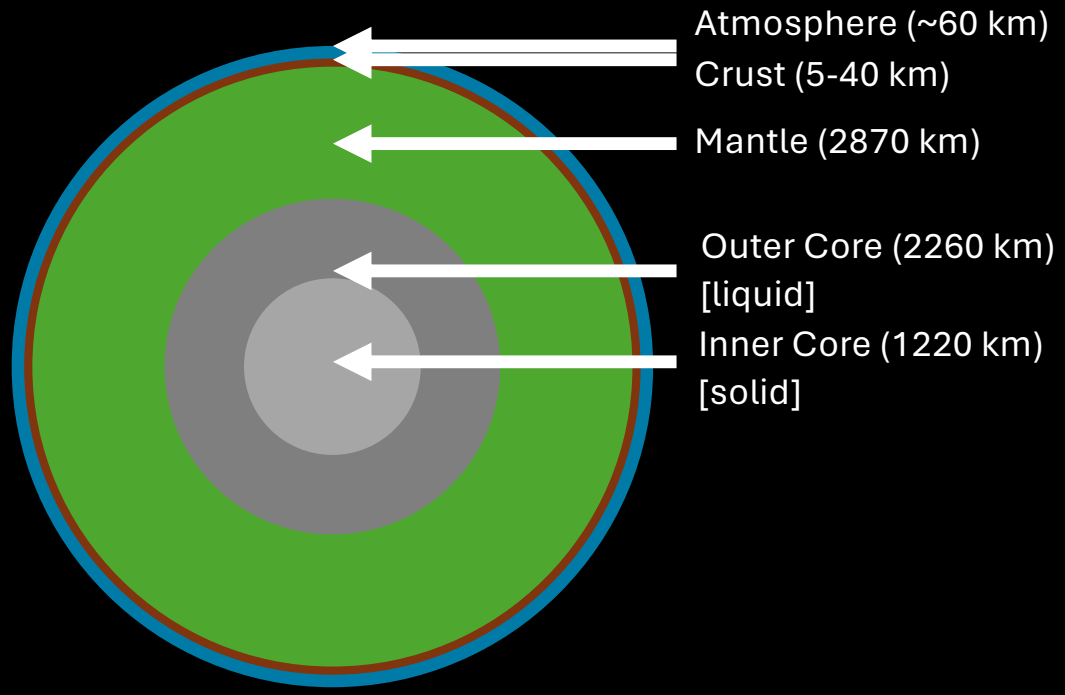
Colonizing the red planet is a ridiculous way to help humanity.
Shannon Stirone, February 26, 2021, The Atlantic

Mars is Small

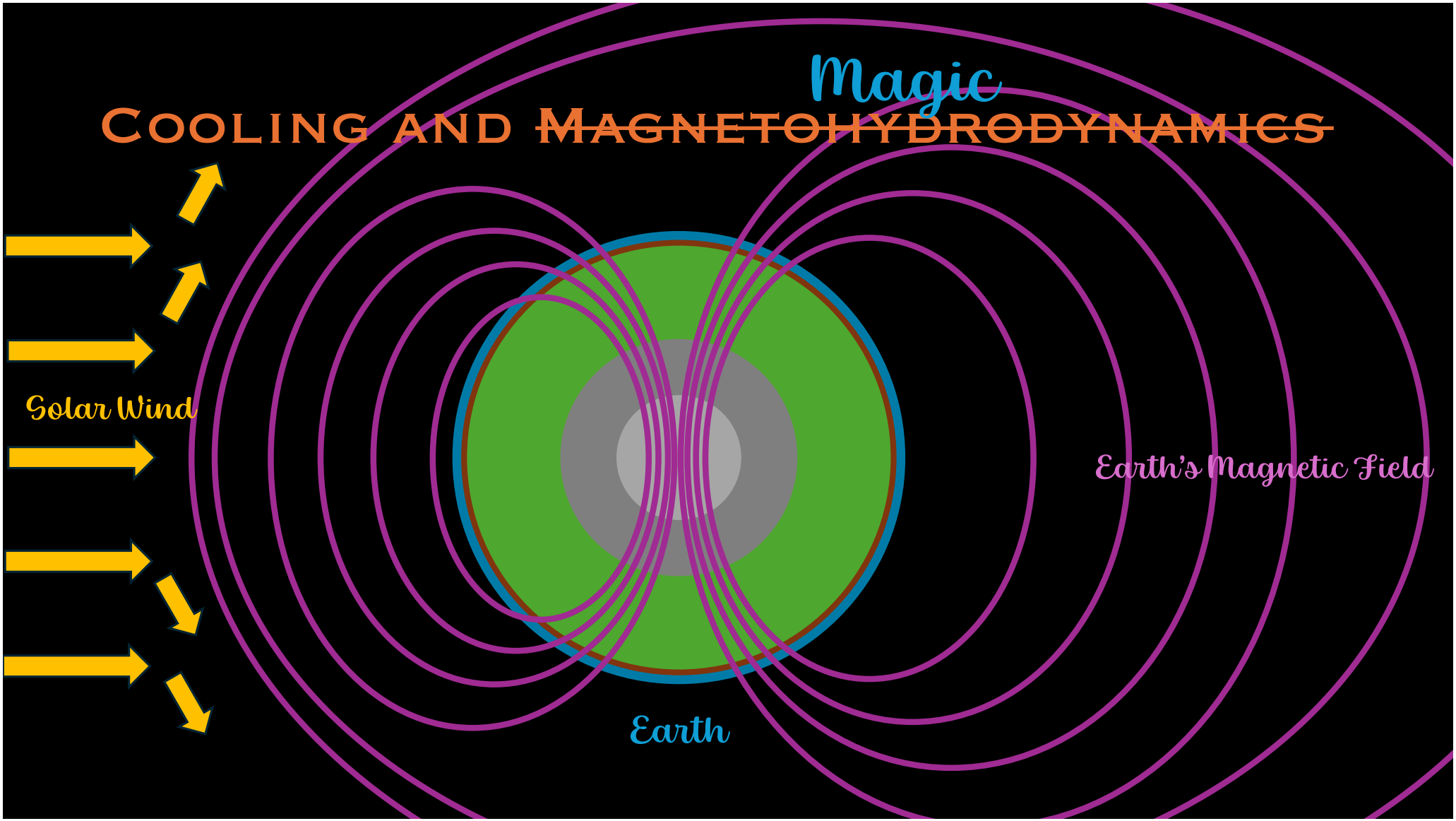
The Terrestrial Worlds, to Scale



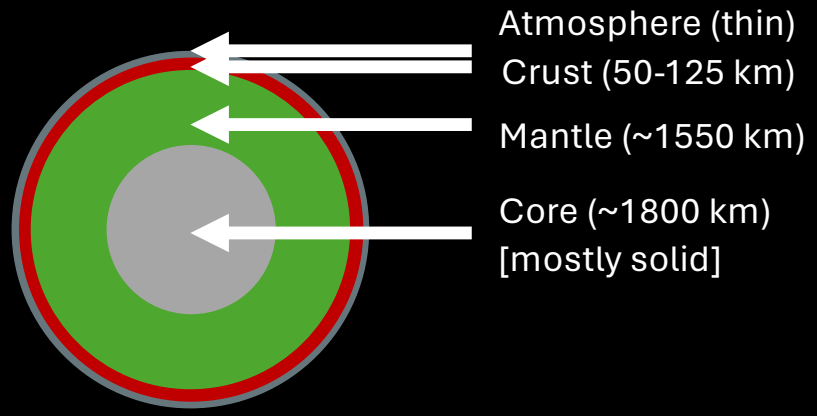
Cooling and Magnetohydrodynamics



Earth


Cooling and ~~Magnetohydrodynamics~~
Magic
Solar Wind
Earth's Magnetic Field
Earth

Cooling and ~~Magnetohydrodynamics~~ Magic



Cooling and ~~Magnetohydrodynamics~~ Magic

Atmospheric Spallation

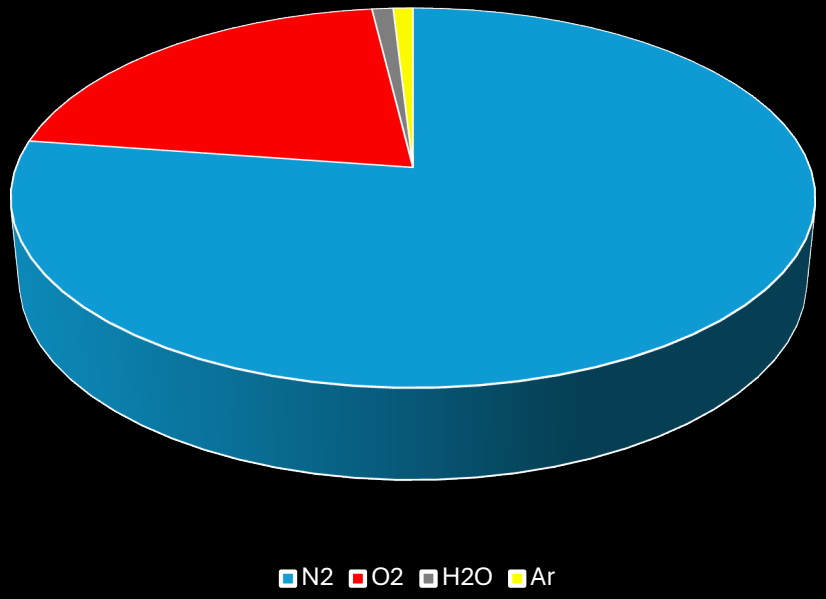
Loss of water, nitrogen, carbon dioxide, etc.

The Martian Surface: *dry, dusty, barren*

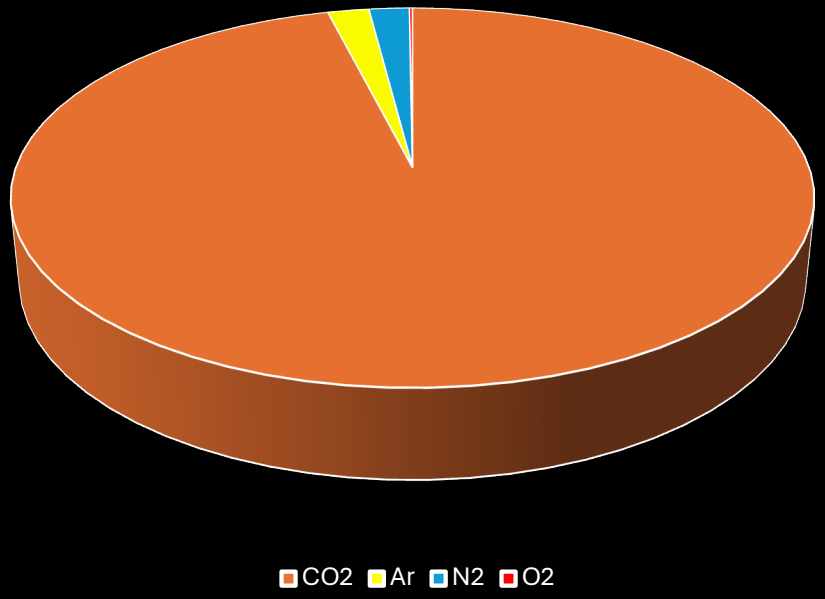
NASA/JPL-Caltech/MSSS

Martian Atmosphere: toxic composition

Earth Atmosphere

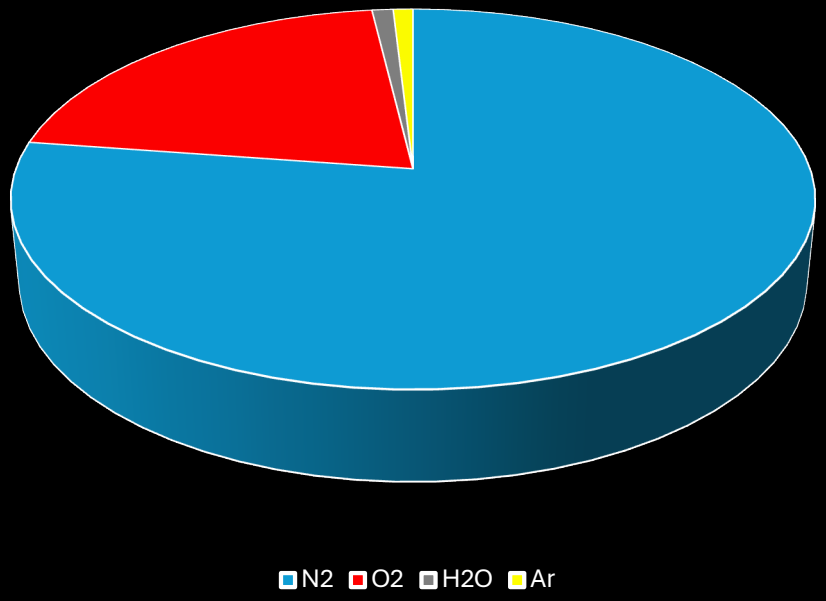


Mars Atmosphere

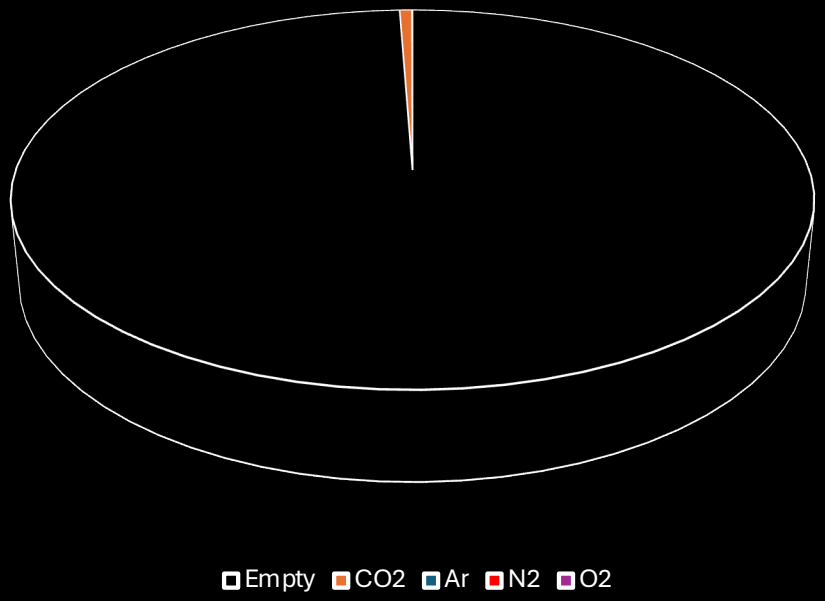


Martian Atmosphere: a last gasp

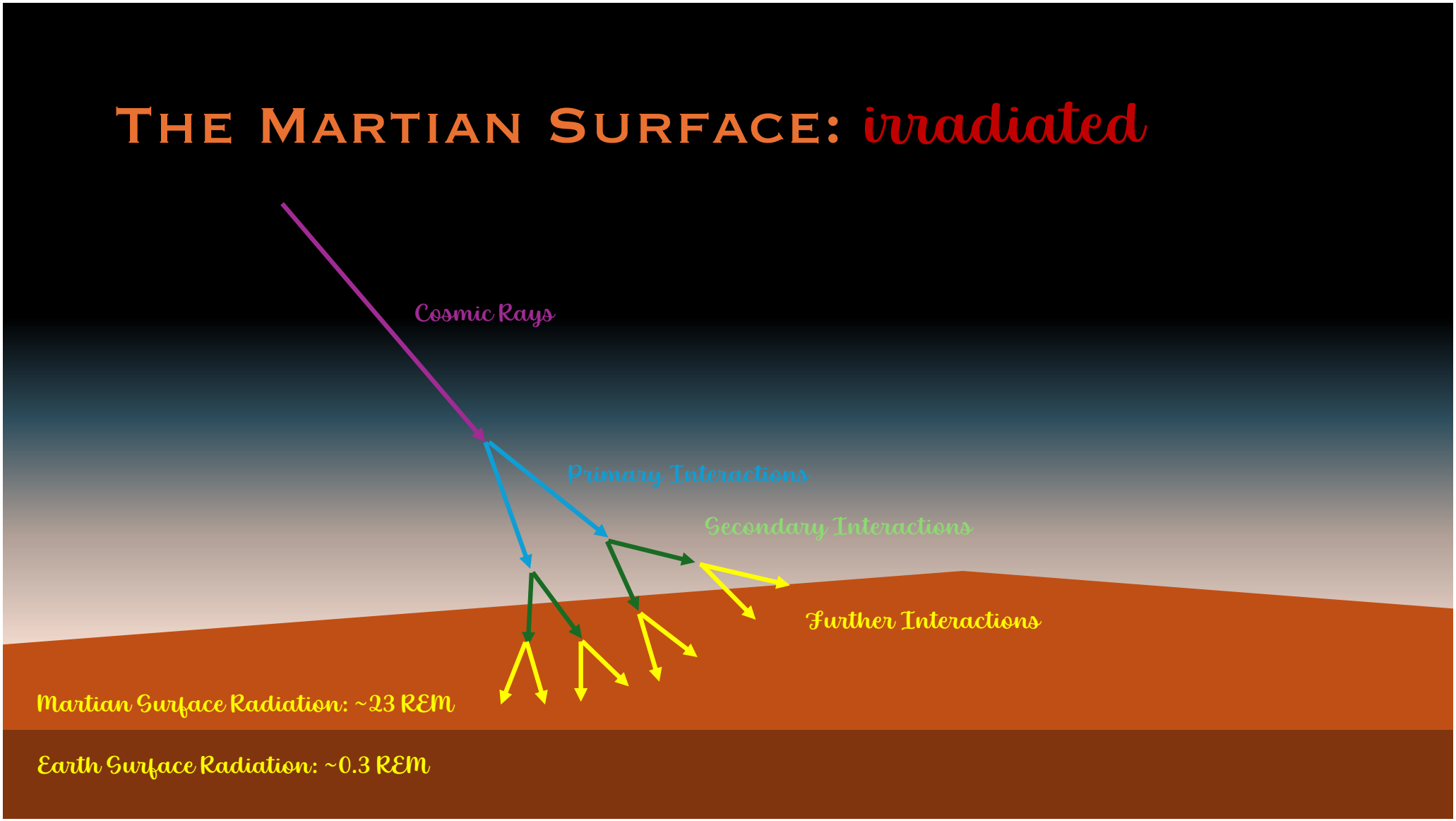
p=1 bar
Earth Atmosphere



p=0.006 bar
Mars Atmosphere

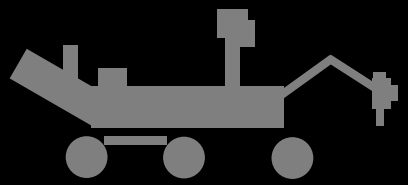


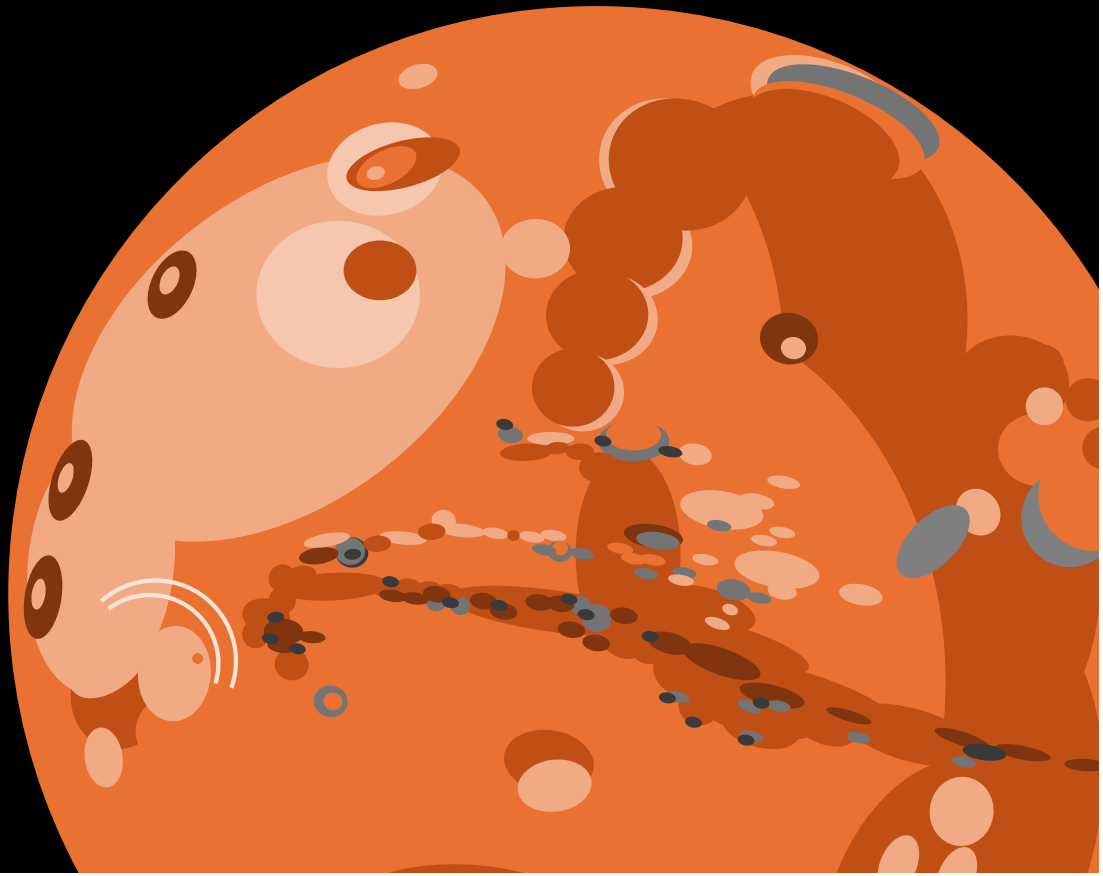
The Martian Surface: irradiated

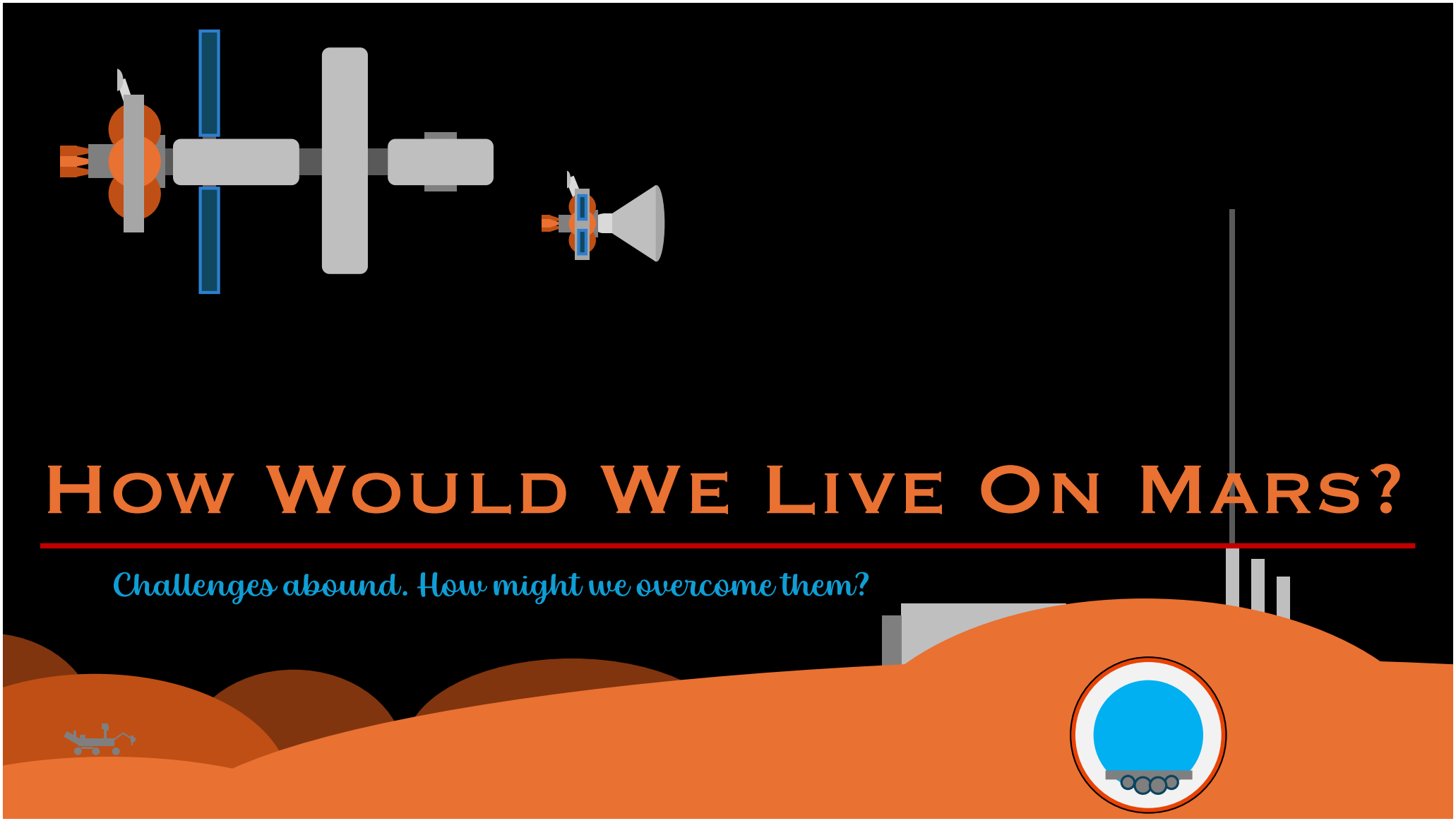


Mars Hazards

- Small
- Dry
- Dusty
- Toxic Atmosphere
- Thin Atmosphere
- Irradiated Surface

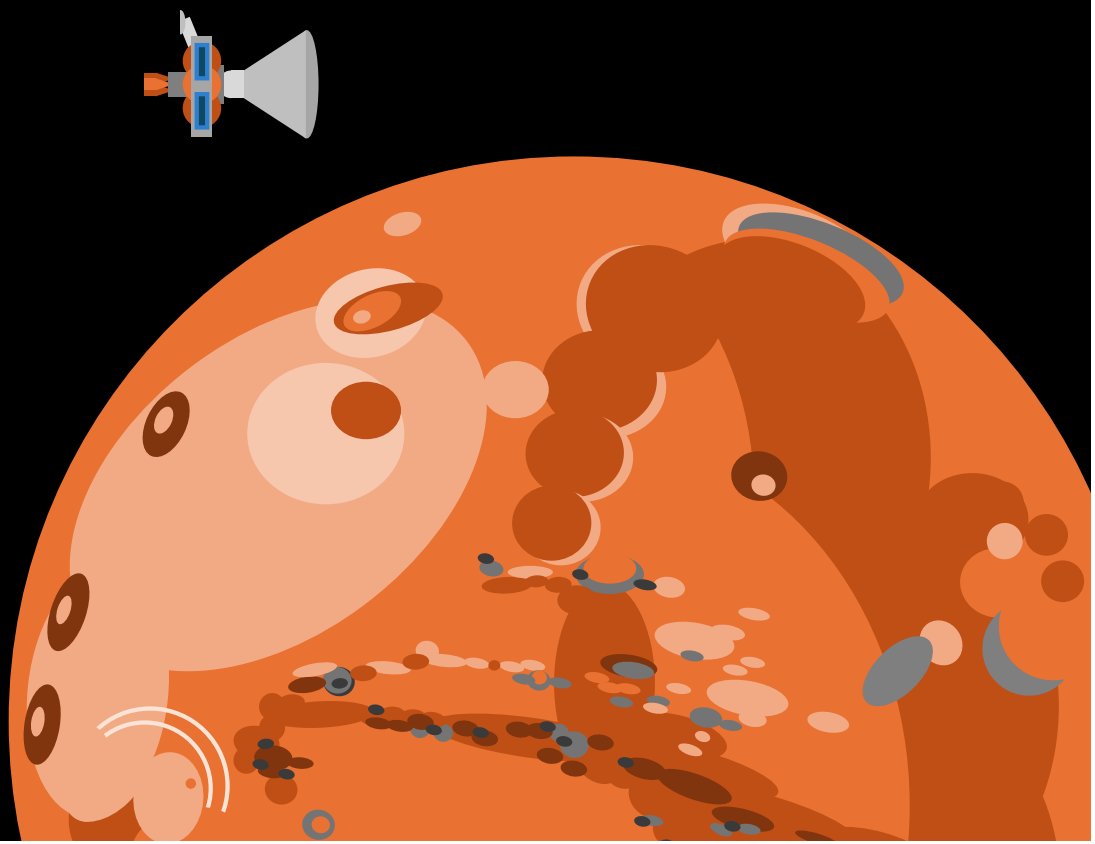


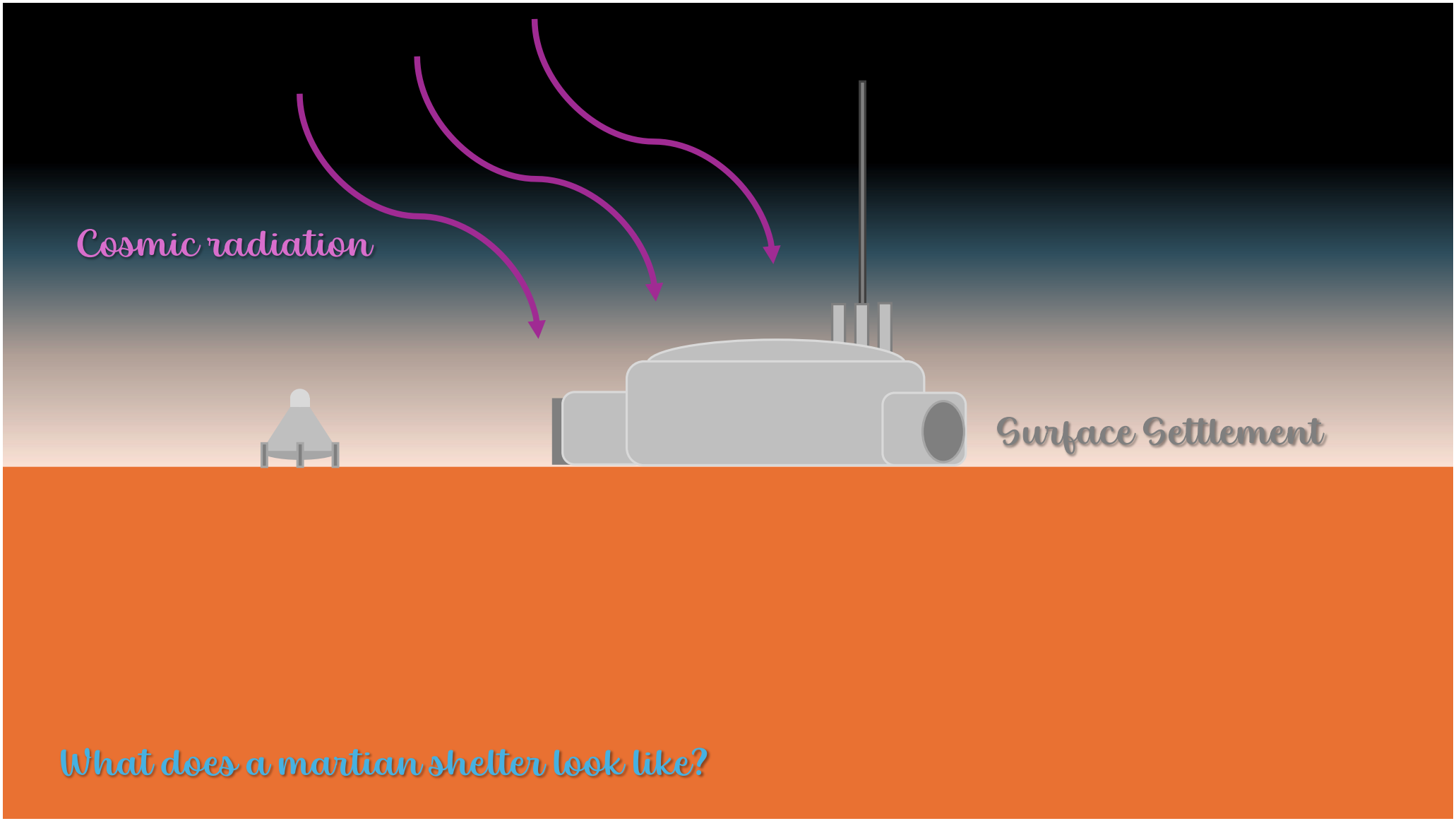


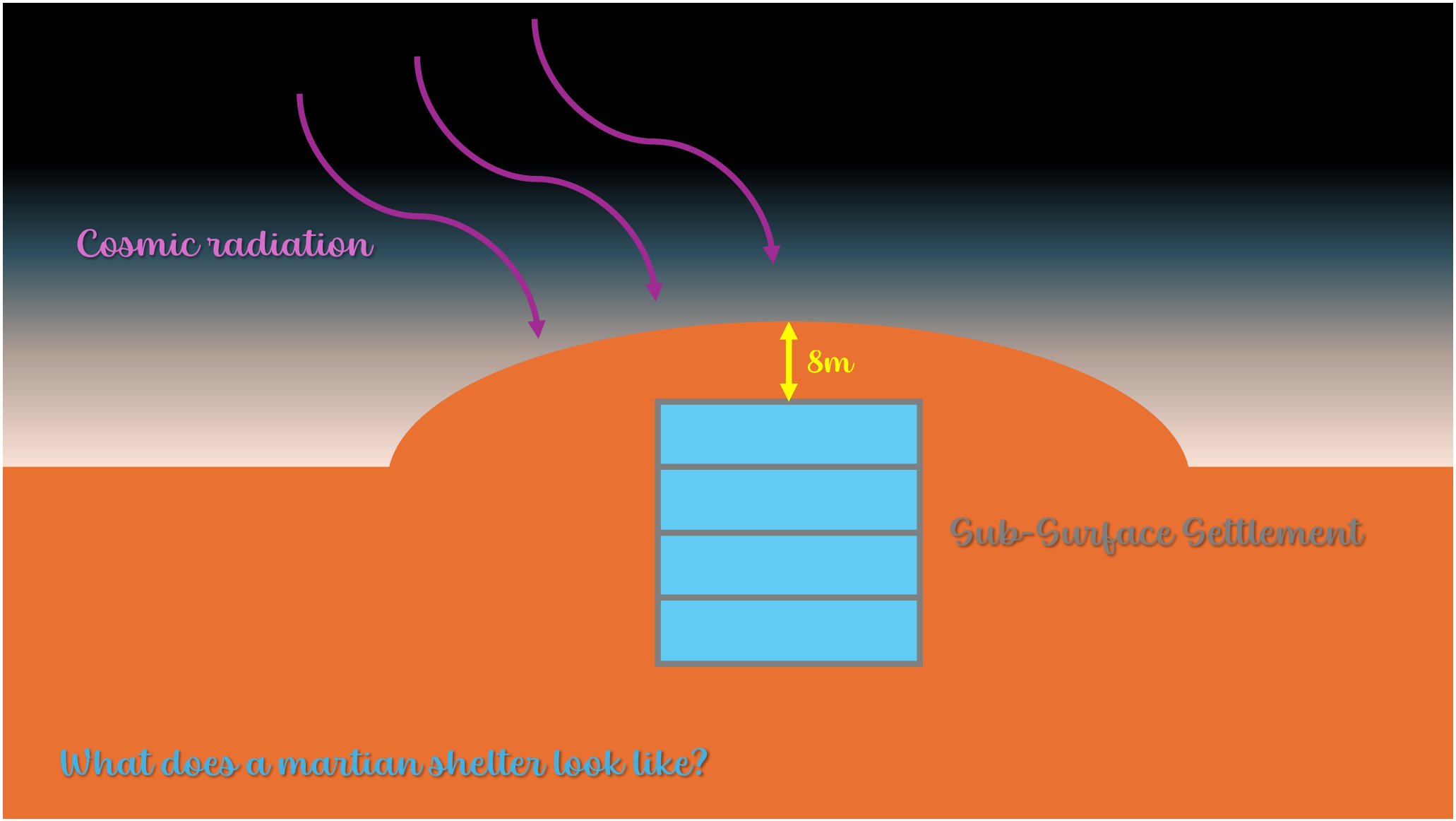

How Would We Live On Mars?
Challenges abound. How might we overcome them?

What Do Humans Need to Survive?

- Food and Water
- Shelter
- Clothing



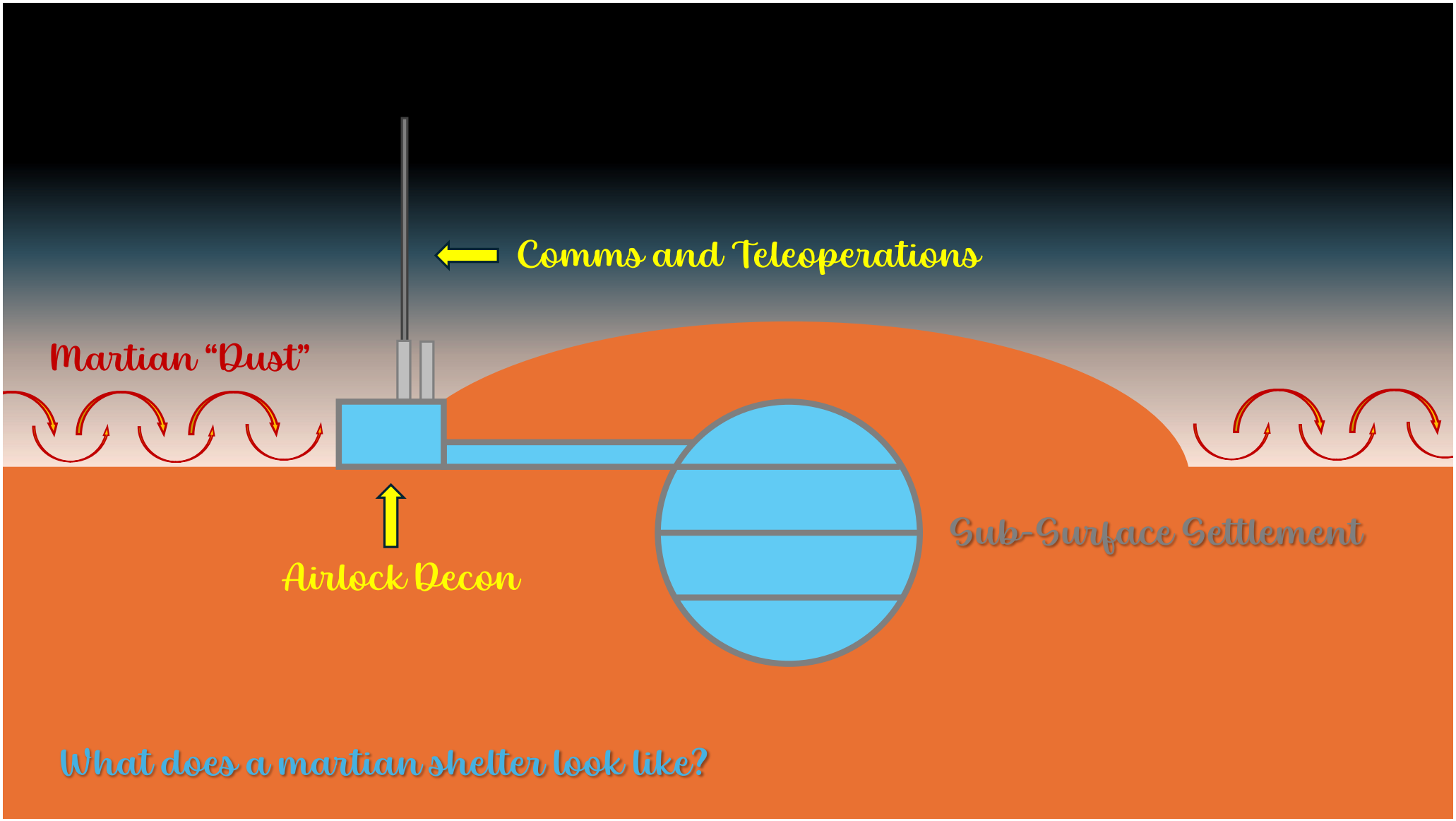

Cosmic radiation
Surface Settlement
What does a martian shelter look like?

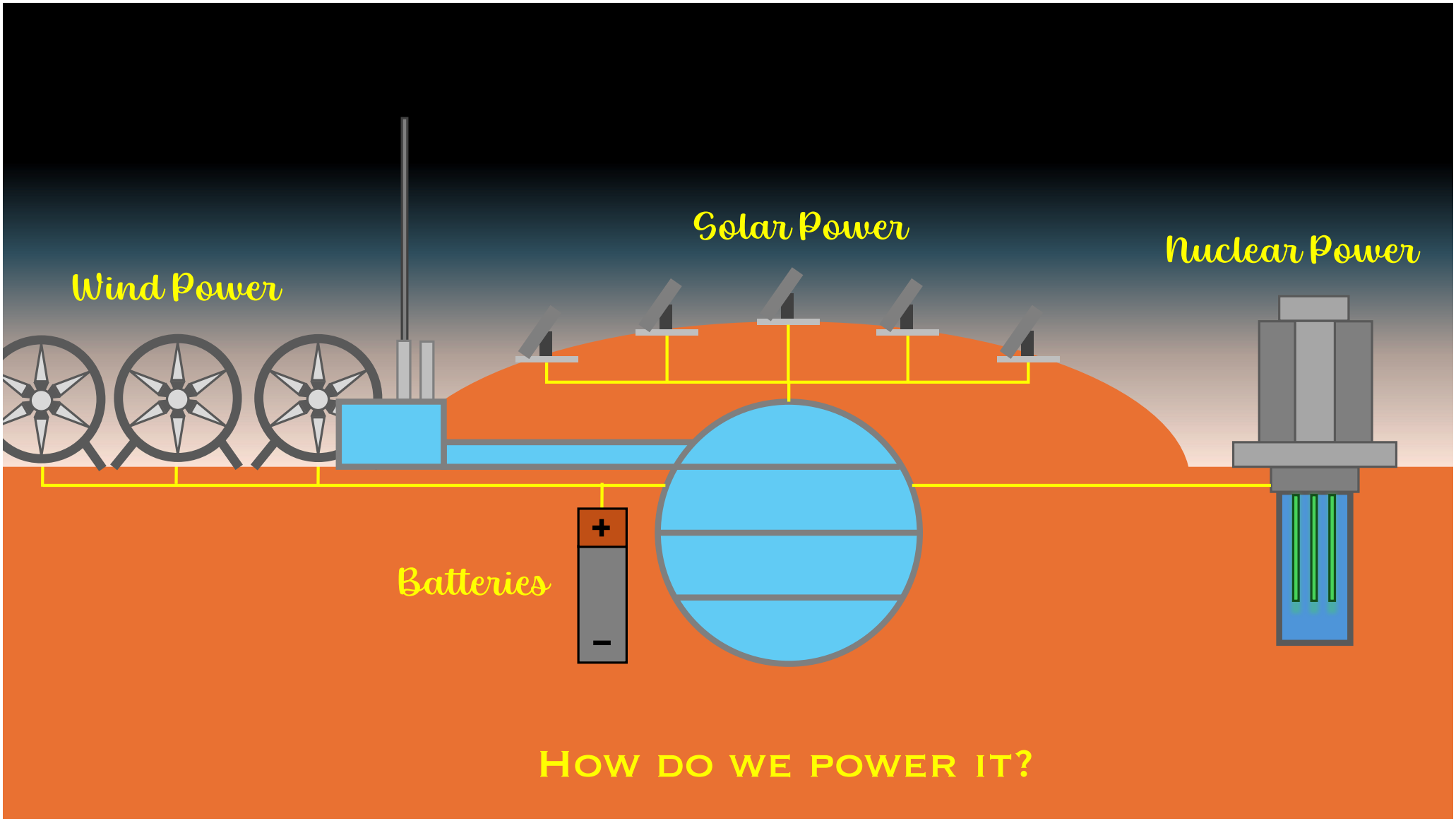

Cosmic radiation
8m
Sub-Surface Settlement
What does a martian shelter look like?

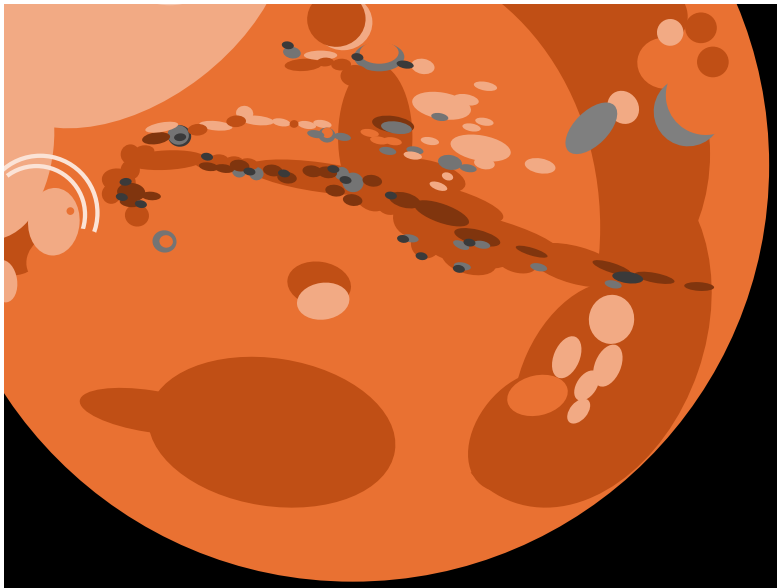
Low Pressure Environment

Sub-Surface Settlement

What does a martian shelter look like?

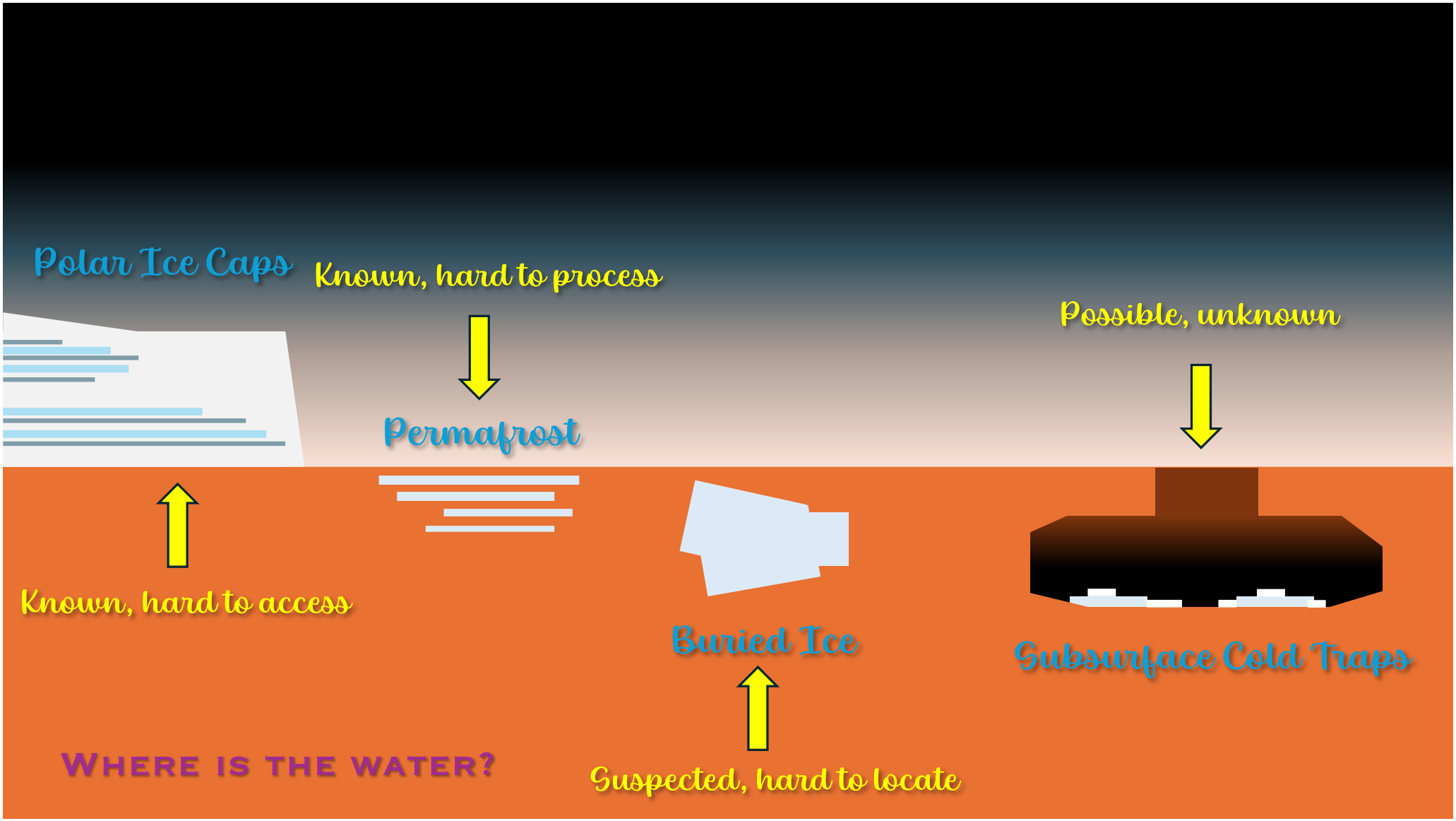

Comms and Teleoperations
Martian "Dust"
Airlock Decon
Sub-Surface Settlement
What does a martian shelter look like?

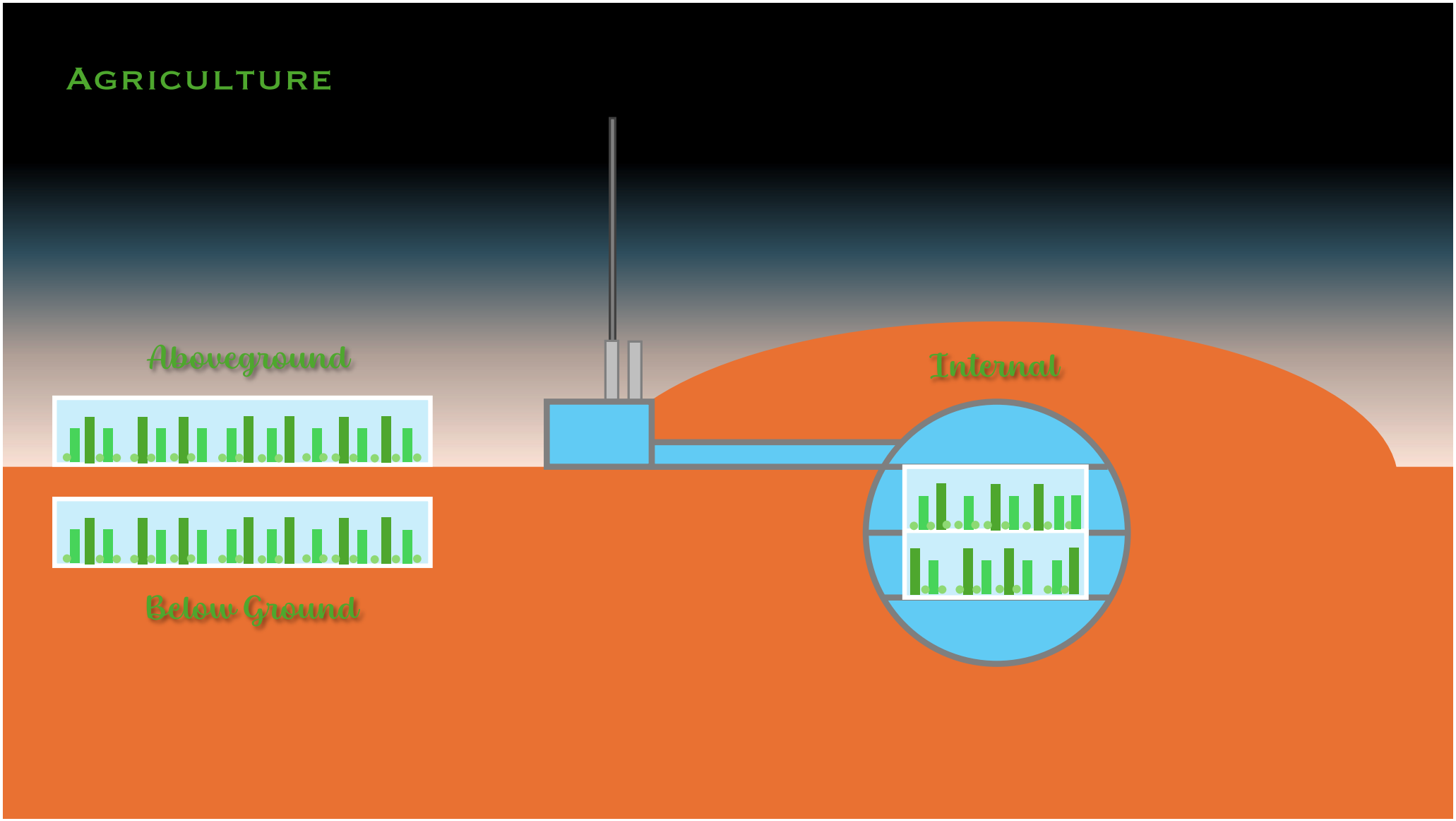

Wind Power
Solar Power
Nuclear Power
Batteries
+
–
How do we power it?



Martian Food and Water

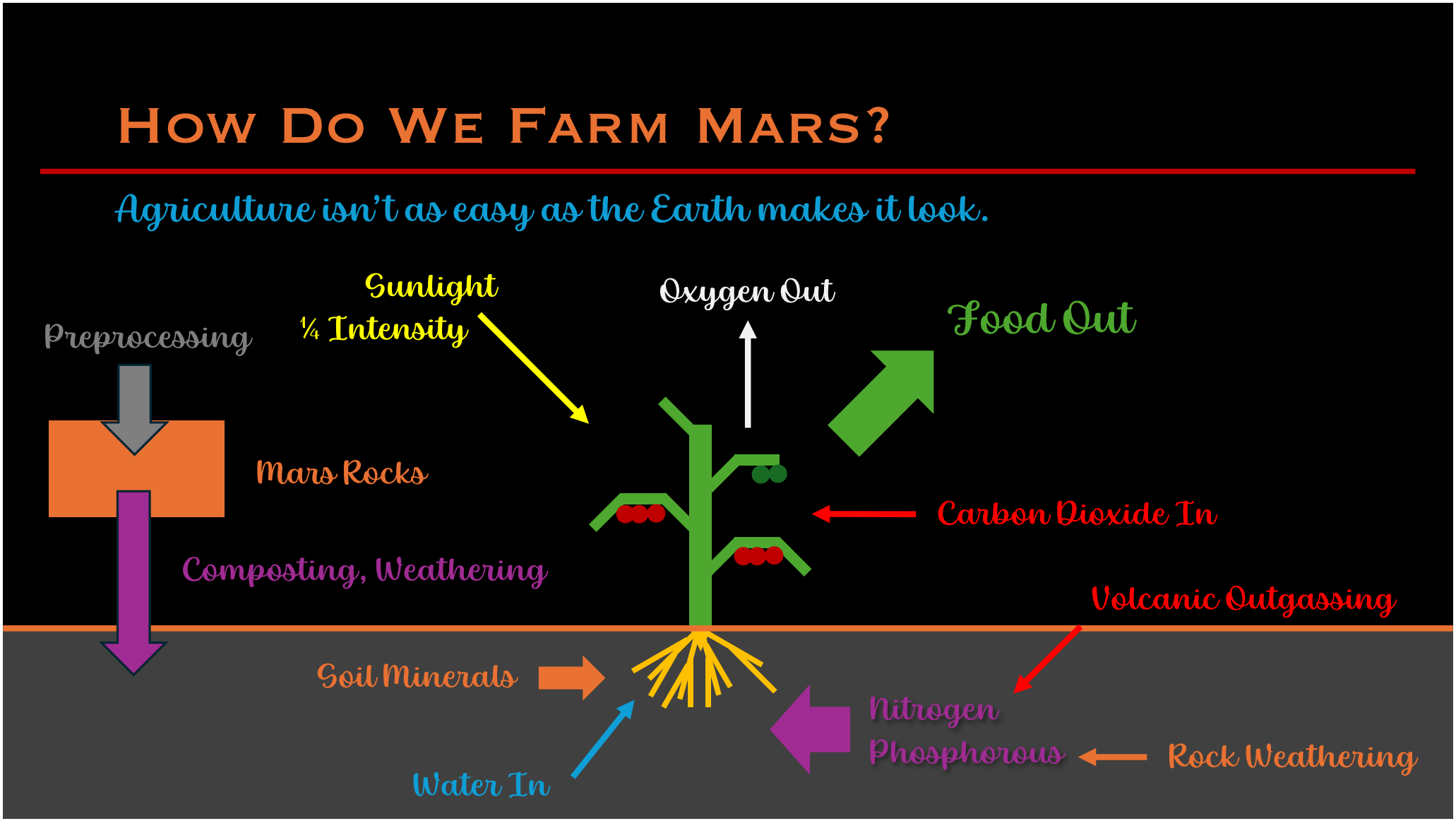
One does not simply grow potatoes on Mars, especially without water.


Polar Ice Caps
Known, hard to process
Possible, unknown
Permafrost
Known, hard to access
Buried Ice
Subsurface Cold Traps
WHERE IS THE WATER?
Suspected, hard to locate


Agriculture
Aboveground
Below Ground
Internal

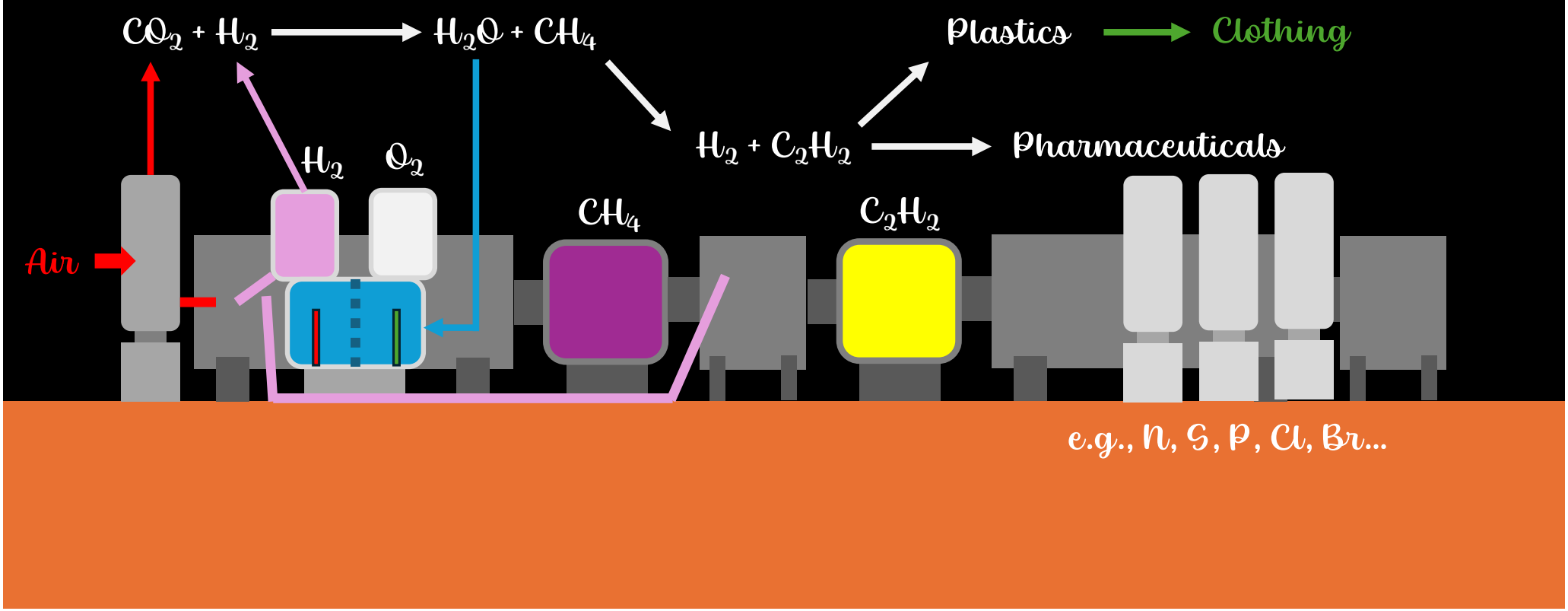
How Do We Farm Mars?

Agriculture isn't as easy as the Earth makes it look.



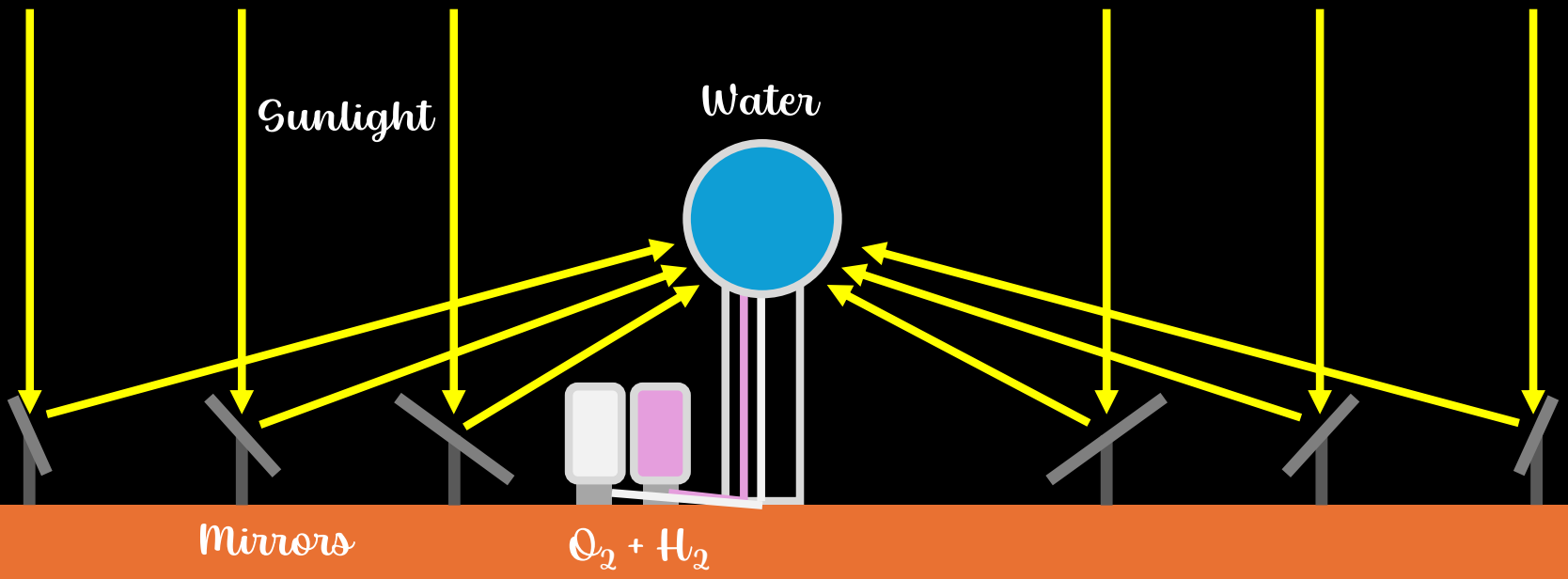
How Do We Make Plastics on Mars?

Atmosphere + Water turns into Rocket Fuel, Plastics, Medicine, etc.



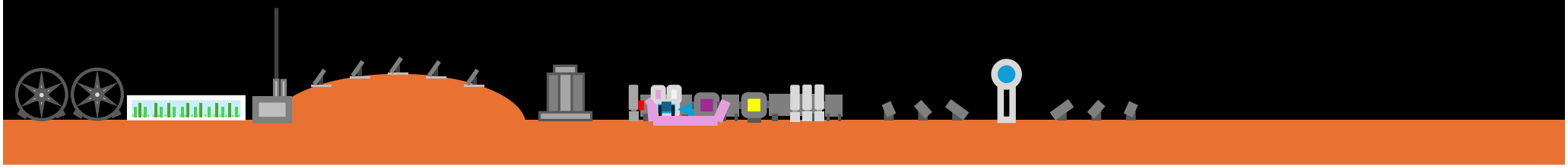
Hydrogen Solar Furnace

Harnessing the Sun for industry.



How Do We Build On Mars?

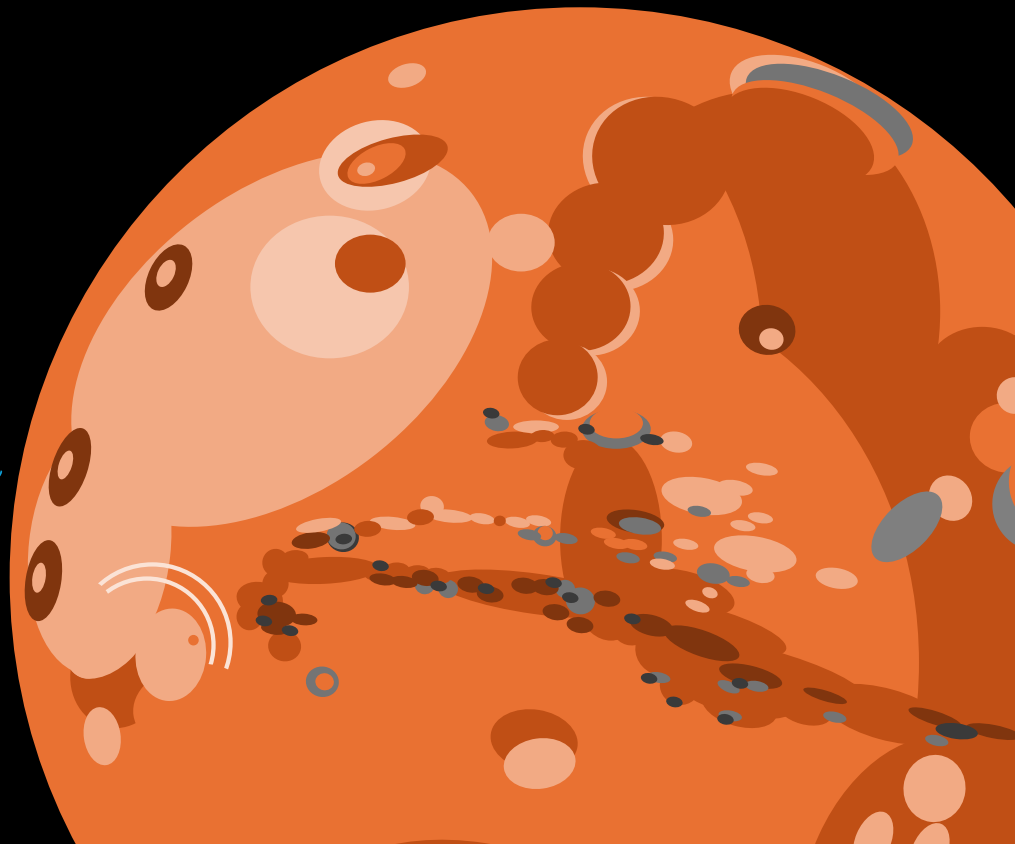
What are buildings made from anyway?



Building Materials

- Wood
- Plastic
- Glass
- Metal
- Bricks
- Concrete ~95% of Modern Structures

Cement + Rocks + Water
10% 80% 10%

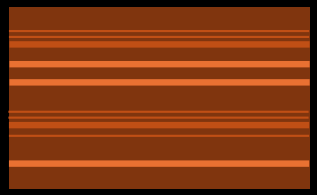


Concrete Manufacture

Limestone

$CaCO_3$

Clay



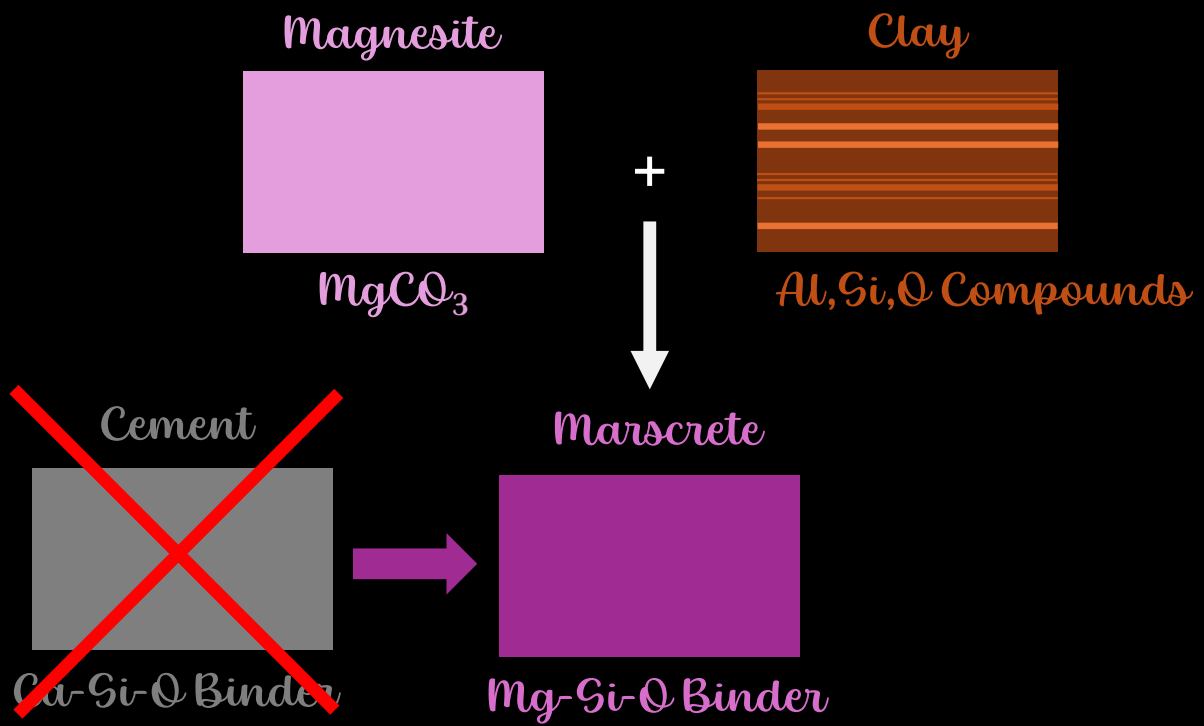
Al,Si,O Compounds

Heat

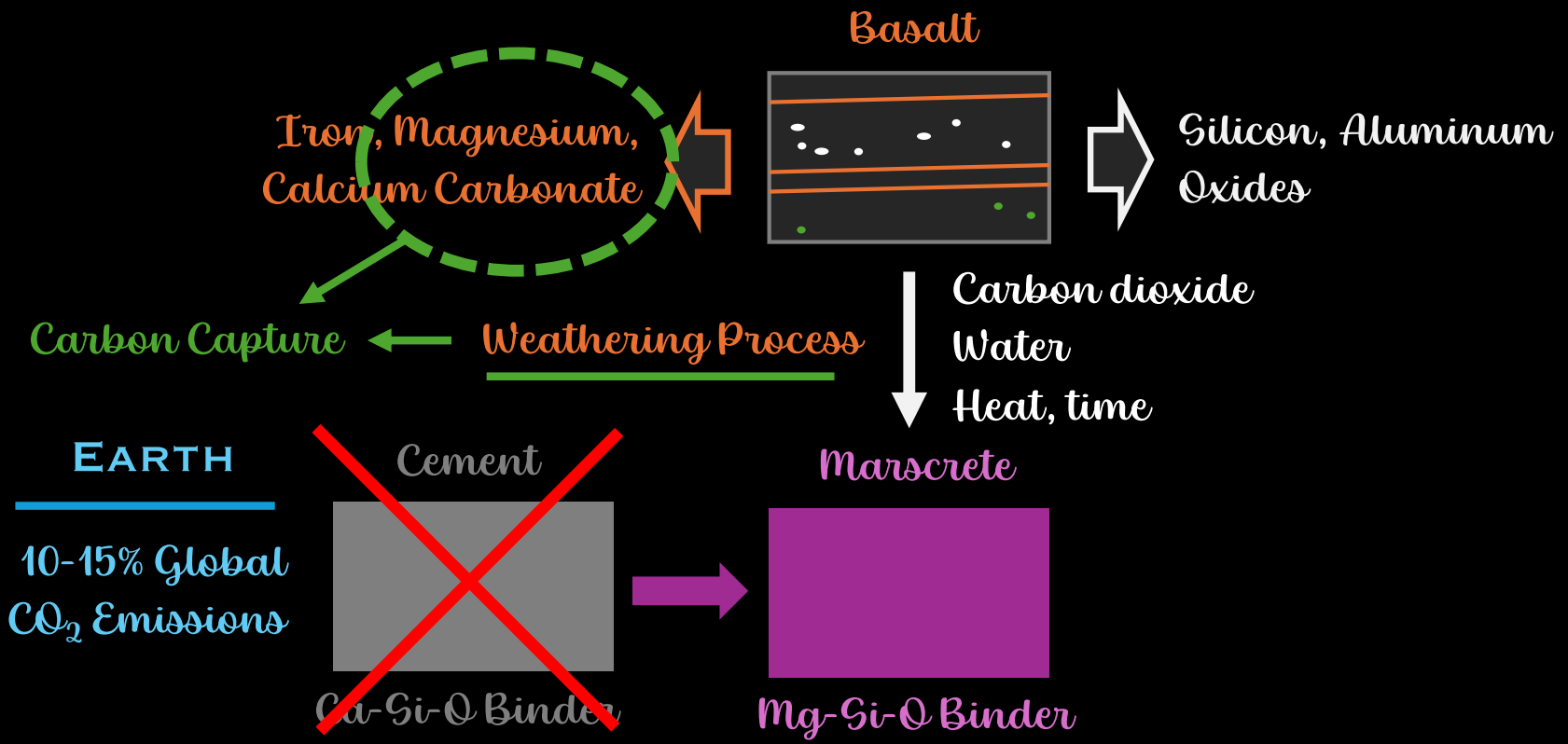
Cement

Ca-Si-O Binder

Concrete Manufacture



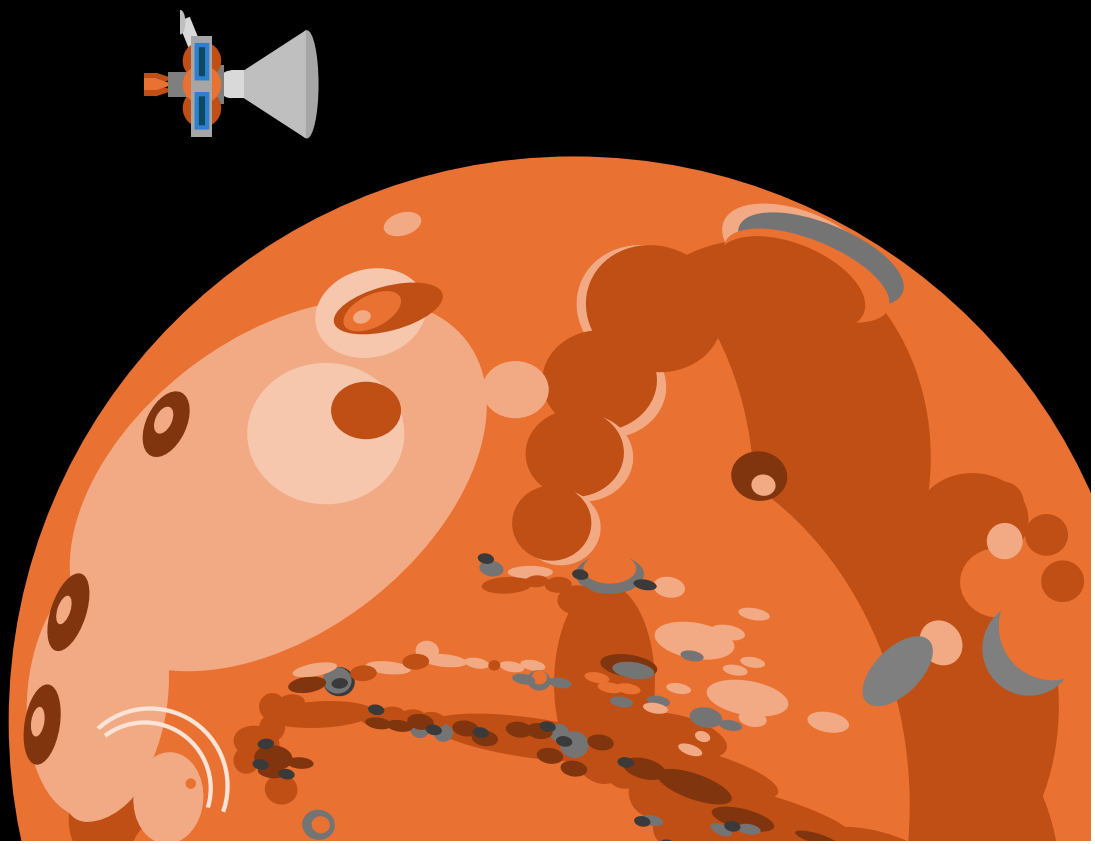
Concrete Manufacture



What Do Humans Need to Survive?

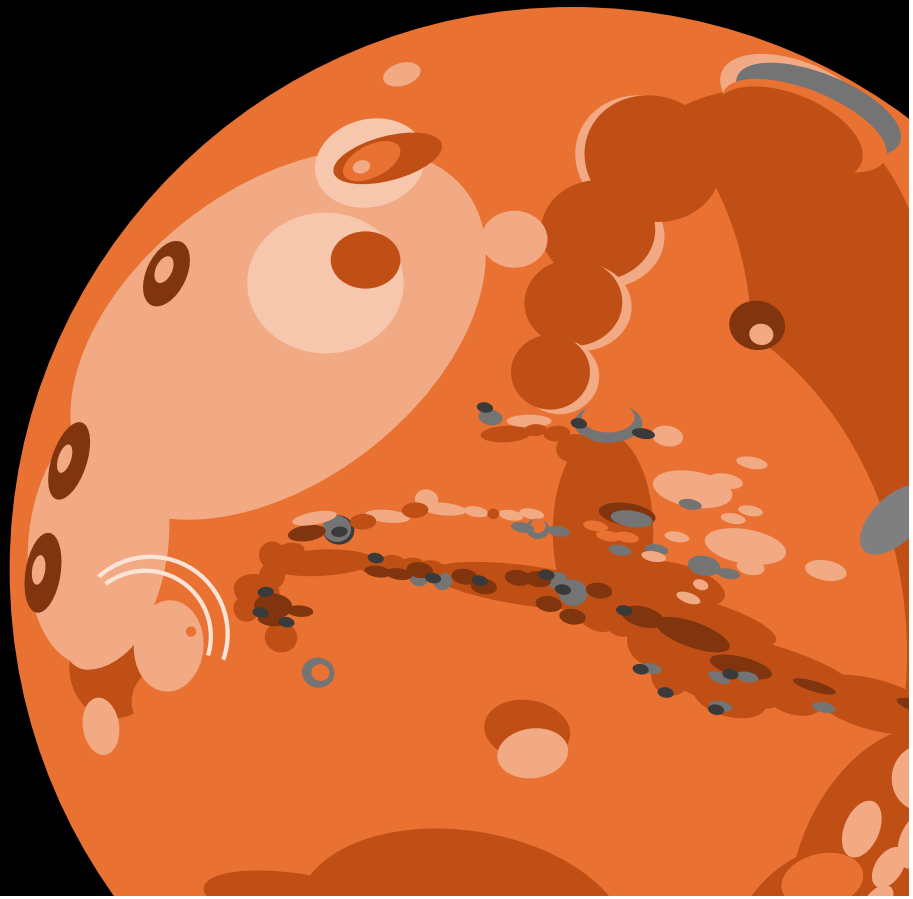
- Food and Water
- Shelter
- Clothing

- Companionship
- Fulfillment
- Aspiration

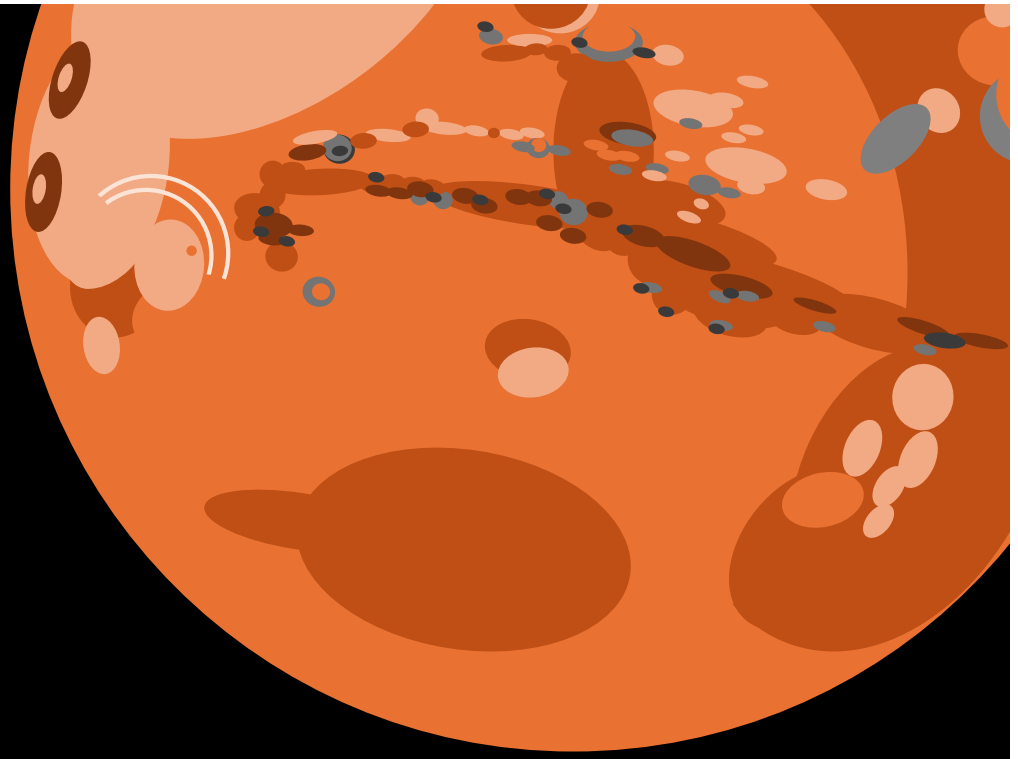


What Could We Learn From Mars?

- More efficient, lower maintenance green energy
- Solar-powered smelting and manufacture
- Lower dependence on fossil fuels & petroleum chemistry
- Alternative building materials
- Enhanced ore mining
- Solutions to climate change



Questions?



Thank you for your attention!