



Mars to Table: Sustainable Food Production on Mars

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ABSTRACT

This project explores how a hybrid-powered greenhouse system can provide sustainable and nutrient rich food for astronauts on Mars. Using renewable energy, controlled agriculture and water recycling, the system reduces reliance on processed foods from Earth and improves astronaut health for long durations on Mars.

HYPOTHESIS

A hybrid-powered greenhouse system will increase food sustainability and improve nutritional outcomes for astronauts on Mars.

BACKGROUND

Current space missions rely on processed and shelf-stable foods that lose nutritional value over time and limit dietary variety. This impacts astronaut health during longer duration missions. On Mars, food production is further challenged by several factors. These conditions highlight the need for controlled and sustainable food systems that can support long-term human survival and astronaut dietary needs.

Mars Challenges:

- Low sunlight and dust storms
- Extreme temperatures
- Radiation exposure
- Poor soil quality

Research Question:

Analysis

Agriculture

- Hydroponic and soil systems
- Crops (greens, grains and legumes)
- Larvae-based soil enrichment

Greenhouse

- Insulated, pressurized structure (using silica aerogel)
- Temperature and radiation control

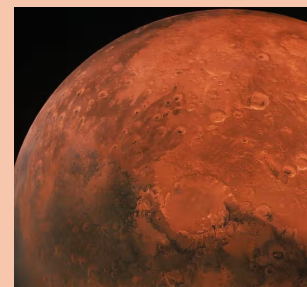
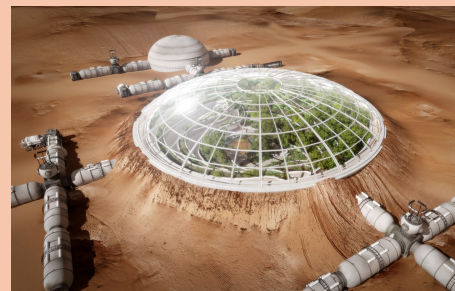
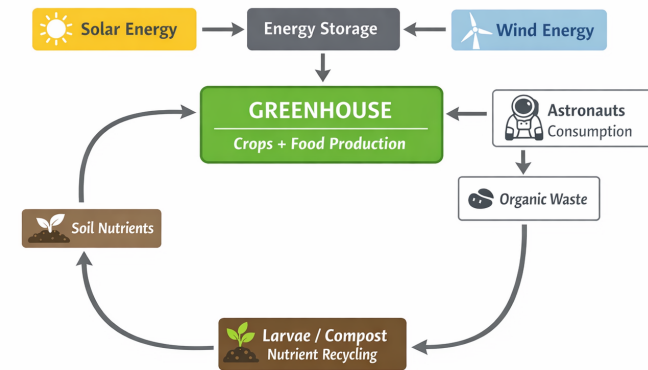
Energy

- Solar (clear days)
- Wind (dust storms)
- Energy Storage

Water & Nutrients

- Closed loop water recycling
- Liquid vitamin supplementation

Closed-Loop Mars Greenhouse System



FUTURE DIRECTION

Conclusion:

Hybrid powered greenhouses can support sustainable food production on Mars to reduce reliance on Earth based supplies.

Impact:

Overall astronaut health improves, thereby enabling long duration missions. Which in turn can support Mars habitation.

Future Work:

Mars simulation testing would be needed. Crop optimization and energy efficiency can continue to be improved.

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