

50th STUDENT CONFERENCE (E2)
Student Team Competition (3-GTS.4)

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EFFECTIVENESS OF PLANT GROWTH IN A PROPOSED HYPOBARIC AEROPONIC CHAMBER
ON MARS**Abstract**

In anticipation of prolonged crewed missions to Mars, a consistent and sustainable food supply must be established. Cost-saving measures and long mission periods restrict the ability to send an adequate supply of fresh food as the majority of the payload for every mission. Efficient and reliable crop growing and harvesting techniques that can be practiced on Mars will drastically reduce transportation costs. Additionally, a current NASA study led by Dr. Gioia Massa is investigating the hypothesis that farming and fresh produce has nutritional benefits as well as positive effects on astronauts' mental wellbeing. The purpose of this project is to investigate the growth of plants under low pressure. Our team will conduct growth experiments at pressures as low as 30 kPa with supplemental oxygen (roughly 30% of sea-level atmosphere). A proposed Martian Growth Lab operating at low pressure has less structural requirements, is less prone to leaking, and uses less energy compared to a fully pressurized lab. However, further investigation is required to validate results by replicating previous experiments, gathering data, and optimizing growth conditions. In response, a clear acrylic partial vacuum chamber was designed and constructed to house plants for low pressure growth experiments. An aeroponic system was selected to minimize water usage and achieve higher growth rates. The chamber pressure is being maintained with a vacuum pump and carbon dioxide is being dosed into the chamber with a solenoid valve. Pressure, temperature, humidity, and carbon dioxide levels are being measured in addition to visual plant inspections and weight measurement. An equivalent atmosphere chamber subjected to the same conditions excluding pressure serves as a control. Results from these experiments can be used to inform a full-scale design of a Martian Growth Lab, and its ability to operate at various atmospheric pressures. Given favorable results from these experiments, the proposal of a Mars based aeroponic growth lab would be more attainable.

UBC Mars Colony is an undergraduate engineering design team at the University of British Columbia (Vancouver campus). There are over 20 undergraduate students that have contributed to this project since its conception in April 2020. The team meets once a week only and has operated within a limited budget of \$25,000 for the entirety of this project.