CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
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Project Number
J1704

Project Title
A Prototype for a Lunar Plant Growth Chamber

Abstract

Objectives/Goals
Space travel is a major concern for the 21st Century. Astronauts will need to provide much of their own food for lunar habitats and deep-space travel. The engineering goal was to build a 4:1 scale prototype for a Lunar Plant Growth Chamber (LPGC). This project was inspired by the NASA Lunar Plant Growth Chamber Design Challenge. Multiple prototypes were built and evaluated. Each prototype was judged on a 48 point evaluation scale. The 48 criterions were divided into 5 sections (transportation, set-up, usage, harvest/store, production materials). Each criterion was judged on a 1-5 scale.

Methods/Materials
Three prototypes were designed for preliminary evaluation. They were then evaluated against the criteria and scored comparatively. Based on the results a final prototype design was synthesized from the best of these results. The final prototype was constructed and evaluated against the criteria. Sweet basil plants were grown in the chamber as a functional test.

A wide variety of materials were used in the construction of the final prototype chamber including: 3/8 and 1/4 acrylic sheets, aluminum electronics box, 12 volt battery, DC-AC inverter, switches, wire, rubberized canvas, LED light array, DC pump, plant nutrients, acid, plants. We found that the selection of materials is a non-random pursuit in developing an engineered product. Re-stated, material science plays a key role in the design of a LPGC.

Results
The final prototype design scored 35 more design points over the next highest prototype. The final prototype was superior in every evaluation criteria except for one. When the sweet basil plants were placed in the chamber all of the plants survived and grew as expected for a period of one week. On average the plants grew 2 cm and produced two more leaves. Other plants were also evaluated as potential plants for a hydroponic system used in the LPGC: bib lettuce, cinnamon basil, bell peppers, and watercress.

Conclusions/Discussion
The final prototype LPGC scored best against the 48 criterions as compared to the earlier prototype designs. The final prototype design proved to be effective at growing plants of potential use on the lunar surface. The engineering team believes that the prototype should be finalized as a design giving due attention to space qualified materials.

Summary Statement
The design of a prototype Lunar Plant Growth Chamber (LPGC) for use as a part of a manned lunar habitat.

Help Received
Dr. John C. Howe provided general mentorship and parents provided financial support.