Contact: [[email protected]](http://www.cloudflare.com/email-protection)

### Tags: Hardware

*We believe the brave astronauts living on Mars deserve and need more than a tin can for their habitat. So we designed a greenhouse, or actually a garden, for them. In addition to working as a life-support system, our design will provide scenery, variety in food and rewarding work and therefore, a decent environment from mental perspective as well. It is scalable, self-deploying, self operating and later on modifiable to better suit being a part of the astronauts' living environment.*

This project is solving the [**Deployable Greenhouse**](https://2013.spaceappschallenge.org/challenge/deployable-greenhouse) challenge.

**Description**

**The Concept**

The core idea of concept is to build two types of space:

1) Well protected shelter where humans can live and work most of the time and 2) Openly connected garden-like greenhouses providing enough shelter from radiation to allow short refreshing nature moments.

In addition to working as a life-support system, our design will provide scenery, variety in food and rewarding work and therefore, a decent environment from mental perspective as well The solutions described below make it deployable, sustainable, flexible and expandable.

**Creative aspects:**

We used a combination of two types of shelter ("hard" & "soft") to provide sturdy shelter and at the same time the possibility to enjoy a more "open" environment. We utilized material from the planet surface to provide shelter against radiation and small meteors i.e. sand blown into cavities in the outer shells of "hard" shelters. Reaction capabilities of the structure will allow it to be open in a normal situation but isolate damaged areas.

The modular structure will also allow expansion of the colony when more inhabitants arrive. Soft shelters could possibly be upgraded to hard ones by filling their top layers with sand thus allowing flexibiilty.

**Space Veggies in the press**

* [Gizmag](http://www.gizmag.com/international-space-apps-challenge/27397/) : "A particular standout, the Space Veggies project, created a design which would conserve weight during space travel by using Mars sand to cover and protect the greenhouse. Its video is also worth a watch."
* [National Day of Civic Hacking / We Love Data Challenge](http://hackforchange.org/challenge/we-love-data) : "An inspirational example"
* [Al Jazeera / Opinion text by Rayna Stamboliyska](http://www.aljazeera.com/indepth/opinion/2013/04/201343094222643764.html) : "...nor were we daring enough to grow space veggies."

**Main technical solutions**

The whole [structure](https://docs.google.com/file/d/0BzZSz5ppBpjOMUo1UU1DM29HSkU/edit?usp=sharing) is based on the same type of inflatable shell. To provide more shelter, sand can be blown into and on top selected parts of the structure to provide heavy [protection against radiation](https://docs.google.com/file/d/0BzZSz5ppBpjOeVJmRlF2MGR0Zmc/edit?usp=sharing) and small meteors. Smart doors combined with a modular structure will allow it to be open in a normal situation but isolate damaged areas.

The main [energy](https://docs.google.com/file/d/0BwUMXszIBEDWeFpVSWxwWTdwVmc/edit?usp=sharing) source is a SAIRS unit (a nuclear reactor capable of producing electricity) with photovoltaics, thermal generators and possibly wind as an additional power source.

[Growing the plants](https://docs.google.com/file/d/0BzZSz5ppBpjORHMzZ2huZWtqQm8/edit?usp=sharing) is done with aeroponics and later, organic soil. Gases are collected from the martian atmosphere if necessary. Light supply is ensured with artificial lighting supplementing natural light.

The greenhouse is used as the main life-support system. It’s designed to produce enough of food, oxygen and clean water and at the same time improve the psychological sustainability of the colony.

Scalability is achieved through modular structure. This allows expansion of the colony when more inhabitants arrive.

Deployability arises from a combination of smart packaging, utilization of on-site resources, robotics, nuclear energy and a supply of "kickstart resources" (nutrients, gases, water). One of the main contributing ideas is the inflatable structure with a self-organizing roof pattern to enable cost effective radiation shielding with Mars soil collected on site with the help of wind.

Other solutions: The different modules are connected openly so no separate atmosphere controls are required. The modules can be isolated with airtight doors reactive to alarms if damaged to protect rest of the habitat.

**Utilization of on-site resources:**

· Sunlight: used for lighting, photovoltaics and photosynthesis

· Sand: used for protection and possibly for anchoring the structure if necessary

· Wind: used to collect sand, possibly wind power for niche applications

· Pressure difference: used to support the structure

· Temperature difference: thermal electricity for niche applications

**Facilities required by the biomass cycle:**

* Greenhouse units
* Drying facilities for food and possibly sludge
* Plant shredder
* Composting facility
* Water purification facility

**Equipment required in addition to minimum life support:**

* Robotic arms
* Sand blower
* SAIRS unit & solar panels for energy
* Air blowers
* Atmosphere measurements and control units
* Water impurity detection equipment

**Possible upgrades:**

· Using plant-based materials for building (wood) and solidifying the sand cover ("bio-cement").

· Using water in place of sand for radiation protection in the greenhouse parts of the structure if it can be produced in large quantities.

**Future of the design on Mars / Moon**

This could in theory be used to build a very large long-term network-like colony for people travelling to Moon or Mars. On the other hand, a colony that could start production of more advanced habitats on site would be the ideal goal for this design. This design would be in its element as a "bridge-head" colony between first research missions and a large stable colony.

**Collection of detailed design material**

* [The structure](https://docs.google.com/file/d/0BzZSz5ppBpjOMUo1UU1DM29HSkU/edit?usp=sharing)
* [Pics of the structure](https://drive.google.com/folderview?id=0BwUMXszIBEDWU18tNGFCYV9MaGc&usp=sharing)
* [Plants and groving them](https://docs.google.com/file/d/0BzZSz5ppBpjORHMzZ2huZWtqQm8/edit?usp=sharing)
* [Energy solutions](https://docs.google.com/file/d/0BwUMXszIBEDWeFpVSWxwWTdwVmc/edit?usp=sharing)
* [Radiation & protection from it](https://docs.google.com/file/d/0BzZSz5ppBpjOeVJmRlF2MGR0Zmc/edit?usp=sharing)

**The team, process and collaboration**

It all started from a twitter message which Lauri picked up about the event. The first team members joined after he called out to his friends in search of a team. A couple of brainstorm sessions and it was clear we needed some biology experts, which we found through a student organization in Helsinki University. Our to-be radiation expert simply saw the messages we sent in our open FB group and asked if he could join. Of course he could! Then we traveled to the Tampere event, where we found our local reinforcement. Our 3D modeler was spotted looking for a team on NASA's site, exactly what we needed next. What a bunch! We were surprised how such a group could function so well when some were located in Helsinki, others in Tampere and Sebastian in Dresden. Virtual work actually produced real-life results :)

So, the team has currently 11 active members, who have all contributed significantly, and still continue to do so.

We all started with very little actual knowledge on the subject. Some had thought about this kind of stuff (for example: http://stellarmorning.com). But no one had done any planning or calculations. As our team members are engineers, physicists, designers, architects and biologists by education we did have the basic knowledge on natural phenomena and such. The rest was learned during the event. And boy did we learn. And I guess our enthusiasm and energy convinced others too as we got some pro bono professional help with our video having the opportunity to welcome more people into our team.

**Current status and future prospects of the project**

We have a concept, and it actually seems to be quite smart. It's flexible, modular and therefore scalable. It protects but allows as open an environment as possible.

**Project Information**

* License: [Creative Commons BY 3.0](http://creativecommons.org/licenses/by/3.0/)
* Source Code/Project URL: <http://spaceveggies.com/>

**Resources**

* Related Blog: "Have a Stellar Morning": <http://haveastellarmorning.com/>
* The presentation we gave in the Tampere event: <https://docs.google.com/file/d/0B52-ijh1Iy18THhvaENTb3V0aTQ/edit?usp=sharing>
* Our project material: <https://drive.google.com/#folders/0B52-ijh1Iy18Vk1KTnhGTmc4S00>