A Step Away from the Red Planet

Shaping the Red Planet for Tomorrow's Growth

Summary

Over the years the human survival instinct and the fear for their own extinction on earth due to several factors such as global warming, volcanic eruptions, pandemics, artificial intelligence or natural disasters have caused an arduous search for the preservation of humanity. For this reason, with the purpose of giving an answer to the riddle of life that will guarantee the existence of the human species in the future it is proposed that the best solution is to colonize other planets. In this way, Mars is the most suitable planet to inhabit due to its abundant liquid water in its Surface, similar to the earth's.

In this way, the current Project is focused in the use of three 3D printers as a strategy for the creation of furniture, tools and necessary items for living and working on Mars. Likewise, each one of these elements count with a detailed description of the size, material and application in the environment taking into account the resources, manufacturing techniques and needs according to the conditions of the martian atmosphere. Therefore, the use of technologies and the use of data about Mars will allow us to know what the mankind's home on other planet would entail. In conclusion, to preserve the human life we need new survival alternatives such as the fact that equipping a habitat on Mars would ensure the possibility that in a future it could harbor life, and also give new knowledge, promote a colonization and a human evolution.

Detailed Description of the Project

The project is responsible for proposing a series of indispensable implements to meet the needs of a habitat in which man has the ability to survive and preserve their offspring, thus prolonging the disappearance of human beings. Therefore, its operation lies in using three 3D printers that can make objects of metal, plastic or concrete, likewise as a method to save supplies multitasking tools will be designed or with several assembly parts, which simplify the time, the use of materials and create a

comfortable, sustainable and suitable environment for human development. Similarly, the main benefit of equipping the Red Planet for a future is based on the preservation of humanity with a higher probability of subsisting, even the fact of facing new environments would produce an evolution in man to get to adapt, it also promotes new knowledge that inspires scientific advancement and the use of technologies through 3D printing encourages learning. Indeed, society has two options if it wishes to survive, the first is to continue on Earth, which sooner or later will disappear, and the second is to explore different places and become a multi-planetary society.

Tools List:

1.) Sustainable farm.
    a.) Water channels
    b.) Tools for cultivation (axe, hoe)
2.) Equipping a camp
    a.) Entertainment
    b.) Furniture
    c.) Kitchen
    d.) Water filters
    e.) Knife
3.) Rover
    a.) Wheel

Sustainable Farm.

Water channels. A seedbed will be designed in the form of a rectangular prism of 0.3m wide by 0.3m high by 0.6m long that is to say with a volume of 0.054m^3 in the 3D concrete printer to avoid its rapid deterioration, three of these will be united from the use of the architecture of the "legos" managing to take advantage of the spaces. These will have two layers, in the upper one will be the soil and seeds, in the lower layer will be installed an irrigation system by micro-drip filtration

because a conventional irrigation system would not work the same as in the ground taking into account gravity.

Cultivation tools. When making a seedbed, large cultivation tools would not be needed, for this reason it is planned to implement an adaptable tool that fulfills the function of a shovel and a hoe. This consists of three parts, the upper part would be metallic with a shovel shape that ends in an edge, having an adaptable union that allows to change the inclination of this, (it will measure 12cmx15cm), followed by a cane with a flat tip that allows the union with the upper part between it will measure 30cm and a diameter of 3.5cm long, the other tip would have a screw type spiral shape to join the last part which is a removable plastic handle of diameter 4.5cm and length 9 cm.

Equipping a Camp

Entertainment. With the 3D metal printer, two power blocks will be manufactured to keep the physical condition of the crew members in shape, these help reduce space inside the habitat or ship they may have, and it is also an effective way to keep the crew members' concentration.

Also with the plastic printer can be designed games that implement logic such as cubism pieces that can be manufactured in the 3D plastic printer. Likewise, competitive games such as chess could be manufactured by making the board with a metal sheet and plastic pieces with a magnet.

It is important the mental health of the crew, and free time away from research, and work assigned upon arrival on the planet.

Furniture. To equip a kitchen it is necessary to take into account that in Mars there is no an atmosphere like Earth’s so the combustion is not generated by the lack of oxygen, preventing the operation of a stove, for this reason it is proposed that with the help of the 3D printer metal resistors are manufactured exposed to costant electrical energy generating heat allowing to save oxygen and have a stove in the conventional way. This resistance would be manufactured with a size of 12cm to heat the pots proposed in the following subtitle.

This system of resistors would be supported by a structured concrete cabinet made with the help of the 3D printer of approximately 1mx0.9mx0.6m. In the remaining space underneath, different concrete drawers will be printed to store provisions and smaller elements, taking advantage of the maximum amount of space possible. A plastic folding chair will be manufactured in such a way that it will be able to become a table, as many will be manufactured according to the number of members of the mission to Mars.

Kitchen. With the help of 3D printers to obtain the basic elements to consume food, to save the design of a fork spoon would be used, making the shape of this 5cm, attached to a stick with a length of 6 cm (with spiral termination as a screw to join a handle 2 cm in diameter by 9 cm in height all this made of plastic.

A glass of 7 cm in diameter of cylindrical shape with a height of 10 cm is manufactured, these according to the number of members of the trip, as well as flat plates of 20 cm diameter, these two made of plastic, for greater durability.

To manufacture the pots it is necessary to take into account that to manufacture the parts that support the pot we need a base that supports this part. The pot is made of metal and the part to hold it is made of plastic (a non-conductive material) so the support for the printing moment must be made of metal to keep the shape of the plastic and to be able to be removed from it. Therefore, a pot will be made, 20 cm in diameter and 15 cm high, forming a hollow cylinder, a frying pan with equal measures and a pot, all with the same dimensions.

Water filters. Implement a system to collect urine in toilets to be reused in a distillation process that subsequently passes through an activated carbon filter that will make its consumption possible, the same can be applied to different fluids such as sweat and tears. The collection system can be 3D printed, specifically the concrete container with a volume of 0.125m^3 and the plastic hoses of 3 cm in diameter for pieces of 20 cm long to carry the urine to a distillation system. Several of these will be manufactured to separate fluids such as sweat and tears.

Tools. A 10 cm removable plastic handle will be manufactured, and different tools needed, such as screwdrivers, hammers, adjustable and wrenches, the latter made of metal with a screw-type spiral termination so that they can be adjusted on the handle according to the need of the moment, all this using the 3D plastic and metal printer.

Rover

Wheel. Using the 3D metal printer the wheel of the rover with perseverance model will be made taking as reference the measurements of the curiosity rover model, which are 50.8cm diameter, 40 cm wide and the skin which has a thickness of 0.75mm. The construction of this is divided into 3 pieces adding the skin which are shown below.

Software

The proposed designs must be implemented through a software, in this case the most suitable could be "Solidworks" being this a good CAD program to model the parts and structures that were previously raised.

Hardware

According to the challenge, to make possible the development of this project and the designs proposed in the description it is necessary to have the three 3D printers, but not only with this, different materials are also necessary, such as, different types of plastics to guarantee flexibility and hardness at

the same time, different metals, such as iron and aluminum, and a fast drying concrete, all this to guarantee efficiency.

Space Agency Data

CHAPEA

CHAPEA is a series of analog missions that will simulate year-long stays on the surface of Mars. Each mission will consist of four crew members living in Mars Dune Alpha, an isolated 1,700 square foot habitat. During the mission, the crew will conduct simulated spacewalks and provide data on a variety of factors, which may include physical and behavioral health and performance.

The 3D printed habitat will include private crew quarters, a kitchen, and dedicated areas for medical, recreation, fitness, work, and crop growth activities, as well as a technical work area and two bathrooms. (Mars, Administración Nacional de Aeronáutica y Espacio, 2021).

This information was used to determine the different activities that can be done during an expedition for a long time like the one to Mars, it also shows some elements that can be modeled by the 3D printer, for example tools, furniture and some rooms necessary for the mission.

The power blocks

Inside the Human Exploration Research Analog, or HERA, crew member Jared Broddrick lifts a dumbbell equipped with adjustable colored weights, called a power block. The crew performs a mix of cardio and resistive exercises to stay in shape throughout the 45-day simulated journey to the Martian moon Phobos.

During a HERA mission, crew members have scheduled exercise time as do astronauts aboard the International Space Station. HERA includes two power blocks that can adjust to a maximum weight of 35 pounds. The power blocks require less room than a set of dumbbells, which helps save space in the compact habitat. (Mars, National Aeronautics and Space Administration, 2022).

The search for tools for entertainment, mental health care, and exercise to obtain sweat that will later be filtered for consumption as water, was based on NASA techniques used by Jared Broddrick, with adjustable colored weights, called a power block.

Rover

Each wheel has a diameter of 20 inches (50 centimeters) y 40 centímetros de ancho. La «piel» exterior está hecha de aluminio —en concreto, la aleación AA 7075-T7351— de solo 0,75 milímetros de espesor, el grosor más fino que se puede fabricar de este tamaño.

The information was used in order to define the necessary list to build the missing wheel of the rover, with the measurements of the curiosity wheel model, which are very similar to those of the Perseverance wheel. This is separated into three parts and a fourth part which would be the "skin" of 0.75mm thickness, as it is the minimum thickness allowed by the material. In addition, the images provide a visual aid for the exact design of the wheel.

Description of the experience

The team members can affirm that the experience has left significant contributions in the lives of the participants.

The preparation of the challenges leads you to explore new areas of knowledge, and to research with documents provided by the National Aeronautics and Space Administration (NASA), as well as archives of other research and projects related to the topic.

Accepting the challenge not only implies testing your computer and literacy skills, but also social and teamwork skills, task delegation, and leadership. The experience is innovative and therefore helps you to project yourself into the future, to analyze your skills, and to improve them. Knowing that it is possible to participate with teams from all over the world, and still have a chance to come in first, is exciting. These are once in a lifetime opportunities, that's why it has been taken advantage of to the fullest, and developed carefully, paying attention to every detail.

We work inspired by the desire to know, what will there be tomorrow, as well as the awe towards space, and the knowledge prior to the realization of this project. In addition, we are focused on Mars, because it is the new goal of many astronauts, to go and discover the mysteries of the "Red Planet", as well as Valentina Tereshkova, (the first woman to go into space) who would go even if there is no return ticket.

There were setbacks in the development of the activity; there was a modification in the facilities planned for the development of the activity, so we had several connection failures, but that was not an impediment to finish the challenge. Everyone as a team made a significant contribution, taking advantage of the resources and means available.

We thank our teachers, Yonathan Alvarado, Ivan Parada, Jhonatan García, Leonardo Piratoba and Manuel Pabón. They were guides and chose us to develop the challenge, who had confidence in our abilities, and helped us in the process of solving the project. To our school Liceo la Presentación, for lending us their facilities for the realization of the project. And to the National Aeronautics and Space Administration (NASA), for opening this challenge to young people from all over the world, who taught us with their research and data.

REFERENCES

Mars, K. (5 de Agosto de 2021). National Aeronautics and Space Administration. Take it from **https://www.nasa.gov/chapea/about**

Arduino, G. (15 de Diciembre de 2020). *CNN*. Take it from **https://cnnespanol.cnn.com/video/filtro-purificar-orina-astronautas-agua-potable-tierra-tecnologia-guillermo-arduino-encuentro/**

Pérez Gómez, J. C. (2017). *DISEÑO DE UN MODELO DE RECOLECCIÓN Y PROCESAMIENTO DE LA ORINA HUMANA PARA SER UTILIZADA COMO FERTILIZANTE.* Take it from **https://repository.uamerica.edu.co/bitstream/20.500.11839/869/1/3092196-2017-1-II.pdf**

Marin, D. (5 de Abril de 2020). *Las ruedas marcianas de Perseverance*. Take it from **https://danielmarin.naukas.com/2020/04/05/las-ruedas-marcianas-de-perseverance/#:~:text=Las%20ruedas%20de%20Curiosity%20tienen,)%20y%20Perseverance%20(NASA).**

Kumanchik, B. (6 de Mayo de 2016). *NASA 3D Resources*. Take it from **https://nasa3d.arc.nasa.gov/detail/scarecrow**

Mars, K. (28 de Septiembre de 2022). *National Aeronautics and Space Administration*. Take it from **https://www.nasa.gov/image-feature/exercising-in-isolation-hera-crew-member-lifts-power-block**

NASA Jet Propulsion Laboratory (5 de septiembre de 2015) NASA 3D Resources. Take it from **https://nasa3d.arc.nasa.gov/detail/mars-rover-curiosity**