Power

To generate energy, we will mainly use photo-voltaic modules. These will be almost always working due to the great sun-exposure available in the Moon's South Pole. The problem with solar panels is their inability to store energy. So, if the panels ever stop producing energy, the base will need a backup power solution. For this, we will use hydrogen fuel-cells that consume stored hydrogen and oxygen, producing water and energy. This water can be used by humans or converted back into hydrogen and breathable oxygen, which consumes energy from the solar panels, consisting in a way of storing it.

Water

Our main source to obtain water on the lunar soil consists on collecting subterranean ice on the poles with a diamond heated drill, melting this ice. Then an also heated tube transports the water to the moon camp, while completing the fusion process. Finally, the base has a WWTP, which treats the water to make it potable, as well as a whole water retention and reusable mechanism, including not only water used for the daily chores, but also excreted water by astronauts (sweat and urine). This process then creates a renewable water cycle within the station itself.

Protection

The Moon is exposed to great amount of radiation from the Sun, as it doesn´t have an atmosphere nor a magnetic field. As our Moon Camp is located in the Moon's surface, it is plenty exposed to the permanent radiation waves and momentary storms. Therefore it is built with quite dense materials, putting great amounts of mass between the astronauts and the radiation source, which is a way to avoid radioactive exposure. This technique comes from a NASA study. In addition, the external walls of the Moon Camp are electrically charged in order to deflect the radioactive particle's trajectory. The astronauts' suits are equipped with the same electrically charged surfaces, besides being quite dense to assure the protection from radiation. These two alternative techniques are also being explored by NASA.

Air

Besides using photosynthesis to produce oxygen, we will use Lunar Regolith which is made up of 40–45% oxygen. But this oxygen is bound up chemically as oxides in the form of minerals, so is unavailable for immediate use. To extract it, we will use Molten salt electrolysis: First, the regolith is placed in a mesh-lined basket. Calcium chloride - the electrolyte - is added, and the mix is heated to 950 degrees Celsius, which doesn't melt the material. Then, an electrical current is applied. This extracts the oxygen, and migrates the salt to an anode, where it is removed.

Food

Despite taking some packaged food to the moon, our astronauts have to cultivate food once they set our Lunar base in order to survive.

We found a way of growing food without using fertile soil or solar radiation – a Hydroponic system.

With hydroponics, it is possible to grow potatoes, peanuts, tomatoes, peppers, etc... only using water solutions, nutrients provided by fertilizers, and coconut core as a substract.

With this method, it is possible to grow 1 kg of tomatoes with only 70 liters of water (using regular agriculture we would need 400 liters).

Location:

Our Moon Camp is located on the surface of the Schrödinger Valley, in the South Pole, and it was chosen for many favorable reasons to our astronauts' living. Firstly, the South Pole is almost permanently exposed to sunlight, allowing the astronauts to do their tasks without the need of an artificial and expensive light source, and also increasing the solar panels efficiency. Secondly, the location near a moon crater in the South Pole allow the astronauts to obtain water, which exists in the form of ice under the surface. Last but not least, the Moon Camp is built on a valley, a few meters below de surface level, which gives the astronauts some protection against radiation storms, the impact of meteorites and extreme temperatures, even though it's not completely effective, therefore the structure also needs additional artificial protection.

How to build

Both the spaceship and the Moon base's outer structure need to be light but resistant to various threats. Because of this, it will be made from an aluminium and carbon composite. The inside structures do not have to be as resistant which allows them to be made out of different carbon fibre composites that will be coated to look like more pleasant materials.

The spaceship will be bigger than the Moon base for the base to be carried inside of it in big pieces that can be easily assembled by the astronauts when they land. Whilst building the base, they will be living inside de spaceship and powering their equipment with hydrogen fuel-cells, consuming stored oxygen, and hydrogen.

As the Moon camp will be constructed in a valley, it has four legs that make contact with the uneven soil and adjust themselves to make the centre sphere perfectly upright.

A day on the moon

The main purpose of the astronaut's journey to the Moon is to expand our scientific knowledge. For this, their main objective is to conduct scientific experiments, for example: learning more about certain materials' behaviour in vacuum and low gravity conditions; investigating the Moon's soil to conclude about it's composition and the evolution of our Solar System; or even to investigate the physical and phycological effects on people of long term missions in space, which will be useful when planning other missions in the future.

For these experiments, astronauts will have 3 rovers available so they can travel the moon surface and collect data, a lab, a meeting and reporting room, where they can discuss about their findings and report it to the scientist on Earth, and a workshop where they can build and 3D print objects necessary for these experiments and for everyday life, out of new or recycled materials, to help reduce waist.

Astronauts also need to keep themselves in healthy physical and mental conditions, which is hard due to their isolation and the reduced gravity that causes bone and muscular atrophy. To ensure that, they will be obliged to workout in the gym every day, doing cardio exercises in a microgravity treadmill and doing resistive exercises with dumbbells. The astronauts will also have several forms of entertainment available, such as playing basketball in the gym (which will be hard due to the reduced gravity conditions), reading books in the living room, listening to recorded music or playing it themselves in the piano, watching movies and series by streaming them from Earth, playing games together, or video chatting with their loved ones living on Earth. These fast and reliable communications between the Earth and the Mooncamp are only possible because of free-space optical communication, which uses laser beams to transport information at a very fast rate.

Another system that will improve the crew's mental health will be strict schedules. The day will start with the lights inside the Mooncamp lighting up automatically. Then the astronauts will get ready to start their workday. Throughout the day they will not only do scientific experiments, but also clean the base, take care of the hydroponic farm and the WWTP, build and print new objects to improve the base, cook, workout and many other chores. In the end of the day, they will have some free time to enjoy themselves.

Description

Our Moon Camp is made up of a sphere with four leg-shaped structures that attach to it and contact the ground. There's also a separated structure which hosts the WWTP and the machines needed to run the base, bellow the main sphere, to ensure the gases emitted don't get into the astronauts' living space.

The main sphere is divided into seven floors that host the hydroponic farm, the bedrooms for the four astronauts in mission, the living room, the kitchen, the gym, the bathroom, the meetings room, the workshop, the lab and in the highest floor there's the communication room.

The four legs also serve as storage for breathable air, hydrogen and oxygen which serve as the backup power solution.

Next to it there's the rocket that transports the structure to the Moon, which is also used for storage, a satellite to ensure communications with Earth and solar panels.