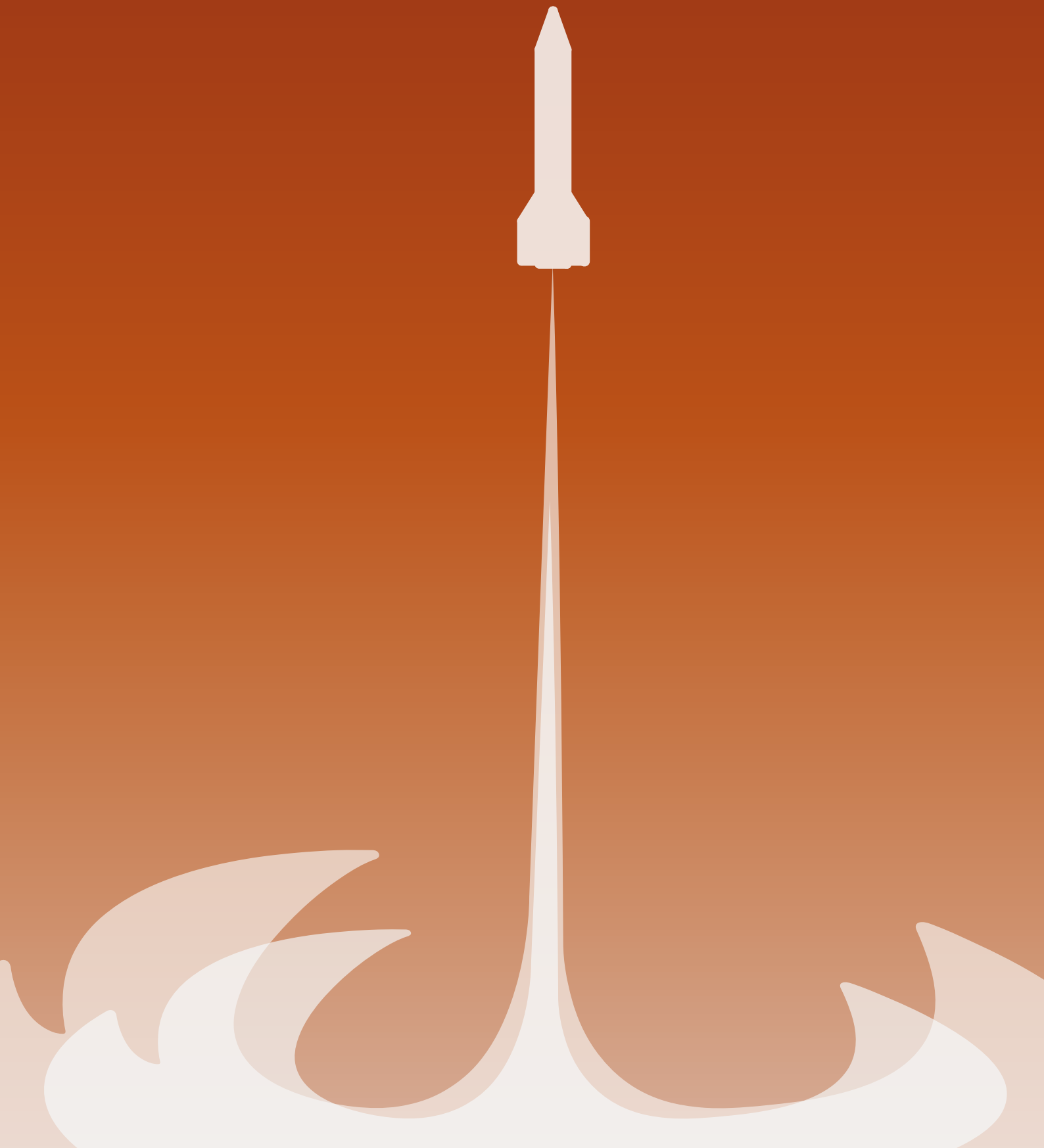
interplanetary living

The universe is vast, and plans to settle down on other planets are already being made. So how would our lives look if we settled down on Mars? Can this place ever be called home?



kinga lachwa

When we arrive on Mars, we will be very limited in what we can produce. The futuristic visions commonly found in concept art are far from the reality of initial Martian settlement. Pioneers will have few resources available to them and they will spend a long time trapped in cramped conditions before achieving a space that they can truly call home.

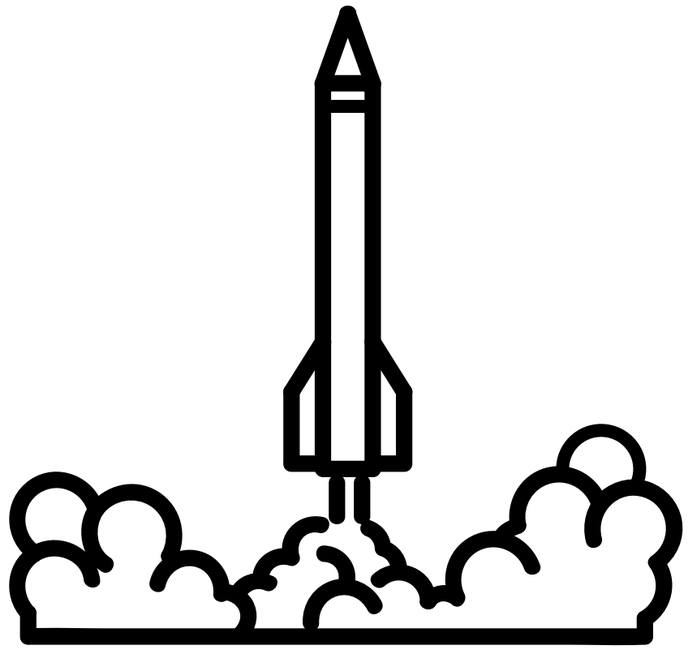
By combining key materials brought from earth with raw materials refined from the Martian environment, we will be able to produce 3D printable compounds for creating useful objects. The use of these printers will allow custom items to be designed on Earth for specific purposes and sent to Mars for production.

This collection is a conceptual study of items we could produce through these means. The aim is to help the astronauts feel more at home by providing traditional earth like designs, that still possess futuristic and exciting qualities.

content

The human race has asked many times if there are living organisms outside of Earth. With methane recently detected on mars, many scientists are curious how it's formed. On Earth methane is emitted from landfills, coal factories, livestock. It also is found naturally in wetlands, volcanoes, oceans and wildfires. It is a gas that on Earth is directly linked with living organisms. So how is it occurring on Mars? The probes we send to Mars can only collect at a slow speed, and are not always able to gather the data we are after. By sending a human there we could collect a much greater amount of data. This would be a massive contribution to our research today in exploring planets in our solar system and help us get a greater understanding of if there are living organisms on mars or were there at any time in the past.

Plans for Mars have been talked about for many years. After the mission to the moon the general public had a hunger to know more about our own solar system and understand where we come from. Missions have been planned multiple times but are often shut down due to lack of funding. Today we have both private businesses and non profit organisations that are pushing to develop the possibility to go to mars. They focus on everything from how we will get there, what equipment is needed to how we will survive in the extremely hostile environment.



A mars mission is not a short trip, it will take us about 8 months to travel there. The next window for the mission to fly back from mars will be about 3 months after we land there, but that wouldn't give the crew enough time to produce enough fuel for the return journey. They would need to wait for the next window. With a window every 26 months to fly to mars, the mission becomes a long trip. We will need to set up a settlement on mars to protect us from the radiation, solar blasts and cold weather, building a habitat that can provide us all the necessary elements of survival.

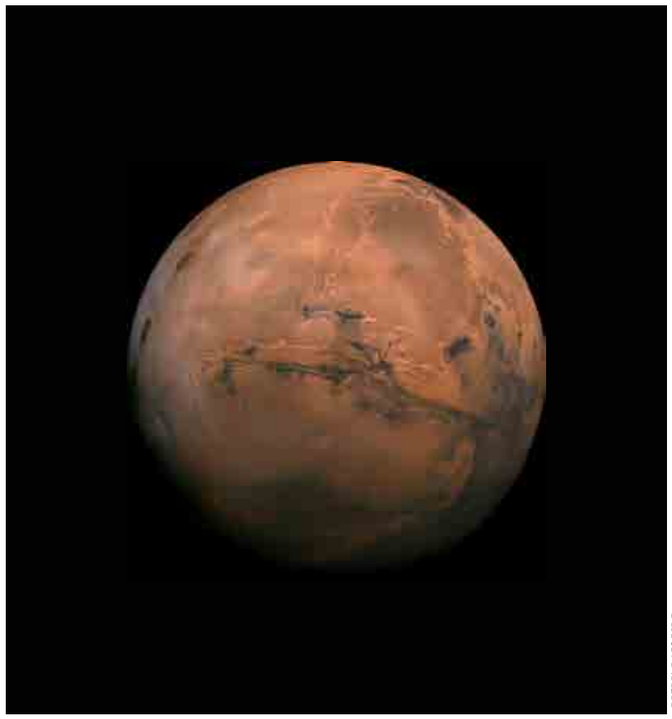
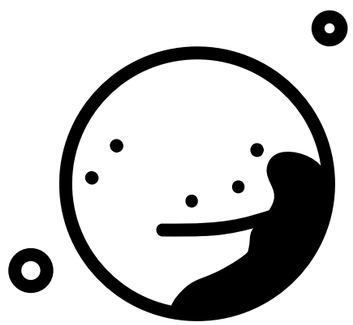


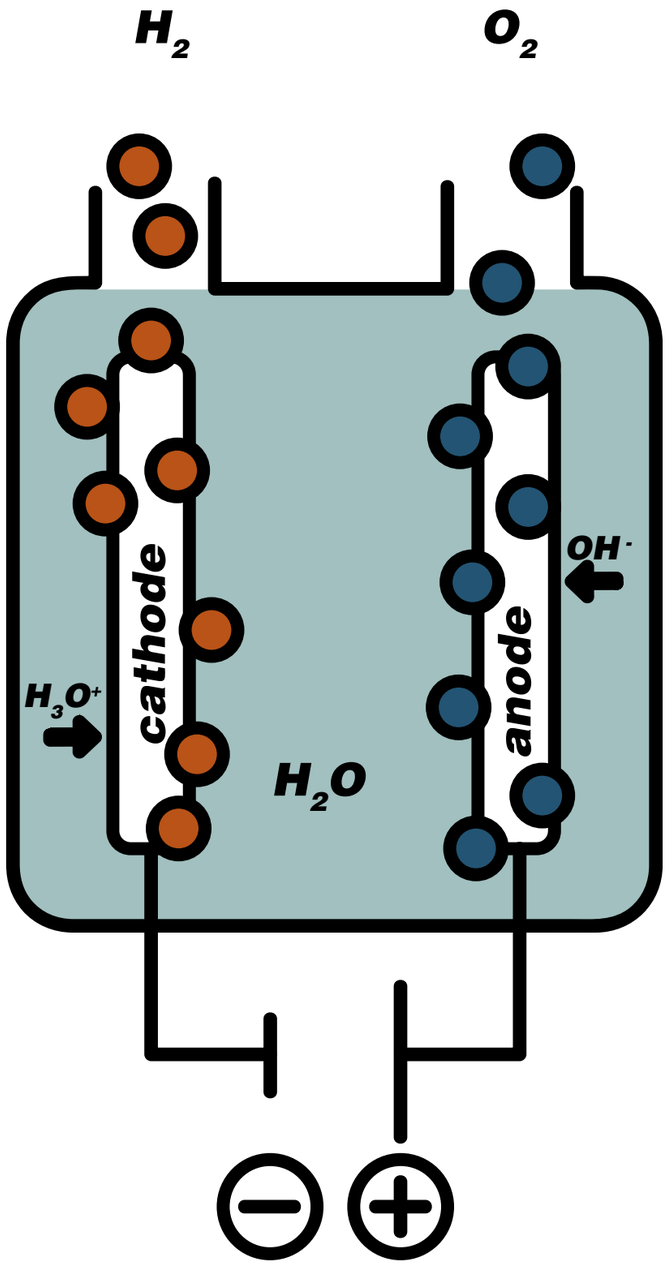
Photo: NASA

mars

Mars, the fourth planet from the Sun, is about half the size of Earth. It never comes closer to Earth than about 60 million kilometers. Being further from the sun makes Mars colder than Earth. On average the surface temperature is about -60 degree celsius. We can see it as a red shining star in our night sky. The red color comes from the oxidised iron (rust) dust covering the surface and filling the air, this gives it the red color.

Topographically Mars has two sides to it. The northern hemisphere has smooth plains and has a much lower elevation, while cratered and hilly highlands in the southern hemisphere make its geography very different. Near the equator of Mars there is a huge plateau called Tharsis bulge that has the four biggest volcanoes on Mars, including largest volcano in our solar system, called Olympus Mons. East of Tharsis bulge lies one of Mars' most distinct topographical features, Valles Marineris, a canyon more than 4,000 km long and 200 km wide with a depth of up to 7 km, this makes it 10 times more grand than the Grand Canyon. On the poles of Mars there are Earth-like polar ice caps. They are mostly water ice and in their winter seasons they get covered with frozen carbon dioxide (dry ice). During their summers the sun changes the CO2 directly to a gas that get blown away from the pole creating great winds.

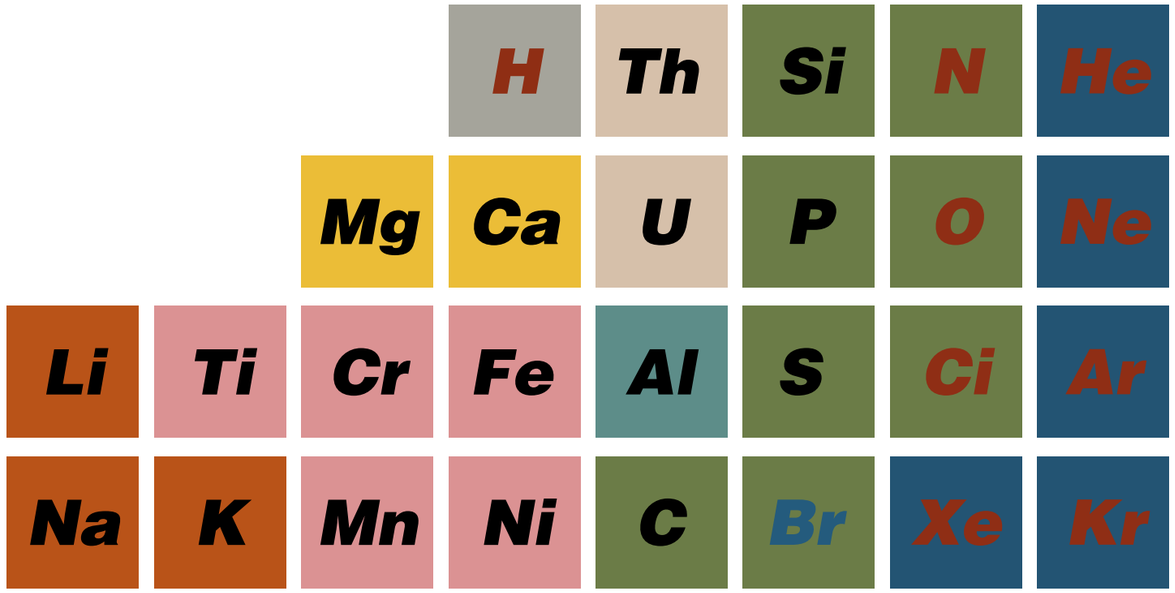




air and water

We have sent several probes to Mars to investigate the planet. We know that the soil has water in it and we would be able to extract the water for drinking. The probes have also found simple organic molecules in rock samples, so we know that the soil contains the ingredients for supplying life. A newer discovery shows us evidence of methane on Mars.

Surviving on Mars will be hard, but it is not impossible. Research at Stanford University shows us a new energy efficient way of splitting water. Extracting water from the soil and separating water molecules into hydrogen and oxygen atoms will be crucial on Mars. The Hydrogen will be used to make hydrogen gas for everything from welding to making rocket fuel. We have known how to do this for many years but it's not until now we have found a new cost efficient way that gives us cleaner molecules. This method is using a single low cost catalyst to extract hydrogen and oxygen gas. This will create breathable air for us humans on Mars and fuel.



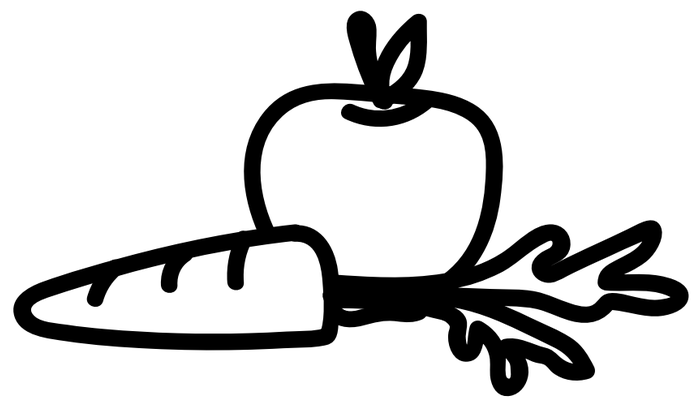
materials

So what is on Mars? In the atmosphere we find 96% carbon dioxide, 1.9% argon, 1.9% nitrogen, and traces of free oxygen, carbon monoxide, water and methane. Data collected from orbiting spacecrafts and probes landed on Mars leads us to believe that the most prominent materials found on the martian outer layer are silicon, oxygen, iron, magnesium, aluminum, calcium, and potassium. The elements titanium, chromium, manganese, sulfur, phosphorus, sodium, and chlorine are available in smaller quantities, but their presence is still very important.

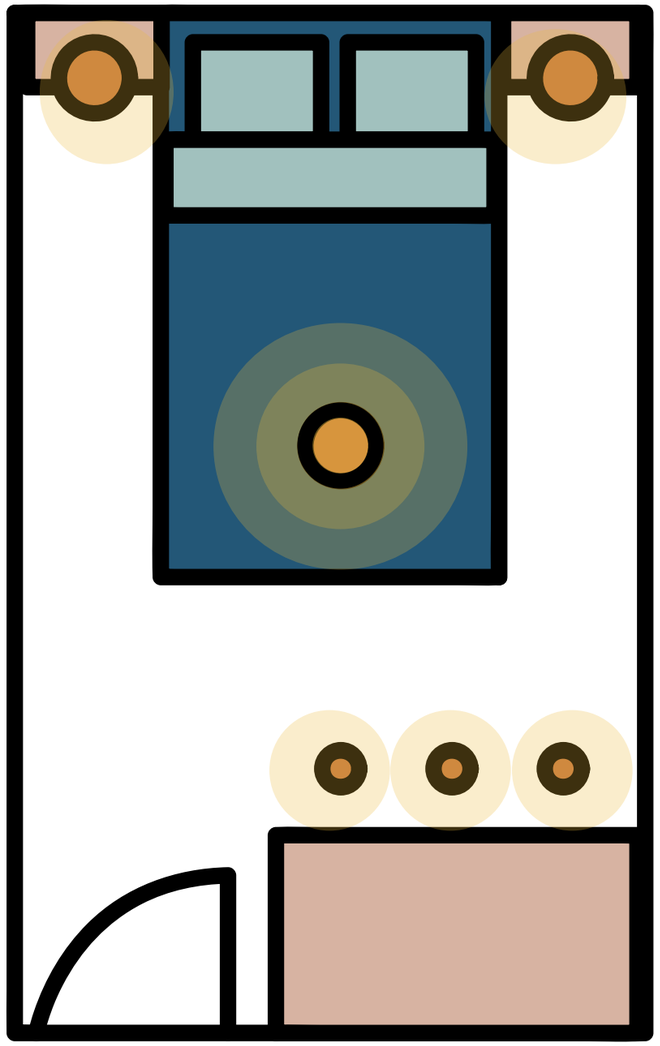
Mars' thin atmosphere contains mostly carbon dioxide and the pressure on the surface is less than 1% of Earth's. During the winter a third of the atmosphere freezes to cover the polar ice caps. This lack of a thick atmosphere means Mars has no protection from asteroids or comet impacts.

food

NASA and other labs are testing how our seeds from earth will grow on Martian simulated soil. The tests are comparing earth soil, moon soil and martian soil in its growing capabilities and safe to consume. The Martian soil is a volcanic soil and there has been concern over whether the plants can grow. In the experiments that have been done, scientists have found promising results showing the the produce is healthy and good to eat with some help. Adding some organic nutrition to the soil made the plants have stronger roots and grow faster and better.



EXPLORE



living on earth

Earth has everything for us to survive, we have water, air, food, shelter and all the extras. You never think twice when making a cup of tea, eating a fruit or going out for a walk. This is all second nature for us, and if you are lucky to be in a hot climate layers of clothing will not be necessary. All this affects our mental health, not being limited in by our environment. Living in a small space with other people can be intimidating, especially when you don't have a large private space or the possibility to enjoy free time in the nature.

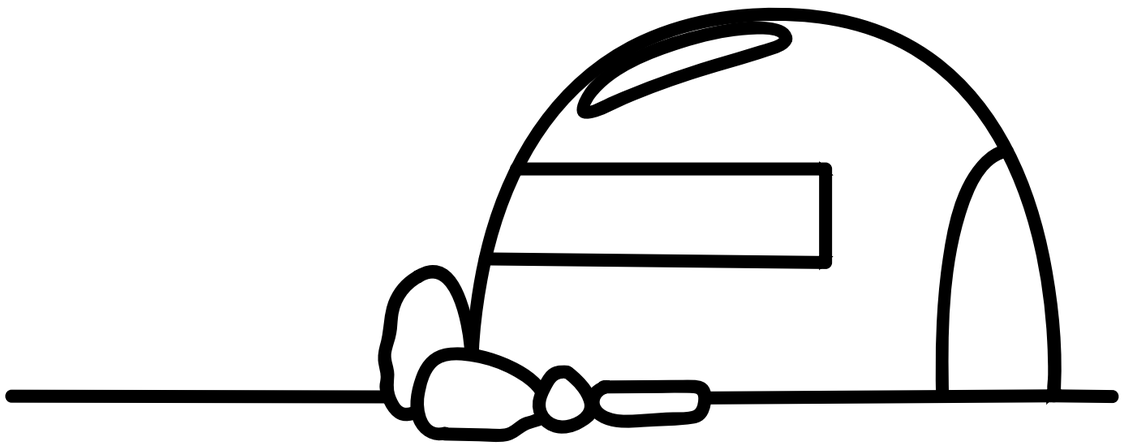
On Earth we focus more and more on living in compact spaces. As capital cities all around the world become increasingly crowded, interior design companies push a big number of space saving solutions.

At IKEA there are many room and even home concepts that fit in a small space. The theme is always comfort, lighting, practicality, and plenty of storage space.

Photo https://www.jeffreydonenfeld.com

polar research

Compact and remote living environments happen on earth already. At the Amundsen Scott South Pole Station, Antarctica scientists spend up to three months based in living quarters that resemble the inside of a shipping container. They stay busy and wear themselves out during the day, but there is not much to be said for the prospect of returning to the room to relax.



living on mars

Some initiatives are carrying out simulations on Earth to investigate the effects of long term isolation with other humans in a confined space.

The Mars Desert Research Station in Utah has crews on rotation throughout the winter months where they pretend to be in a Martian environment, carrying out experiments and going on EVA missions.

The HI-SEAS facility in Hawaii runs longer experiments also focused on teamwork and personal interactions. For the fifth time, six astronaut like candidates will spend 6 to 8 months in a mars like environment.

In a much more extreme simulation, the Mars500 experiment run by the Russian Institute for Biomedical Problems in Moscow ran a 520 day long experiment ending in 2011. All participants emerged in good health.

These experiments are all great simulations to study how we would interact with each other on mars. We learn how it will affect us mentally and physically
and what aspects we need to prepare better, but nothing will truly be the same.

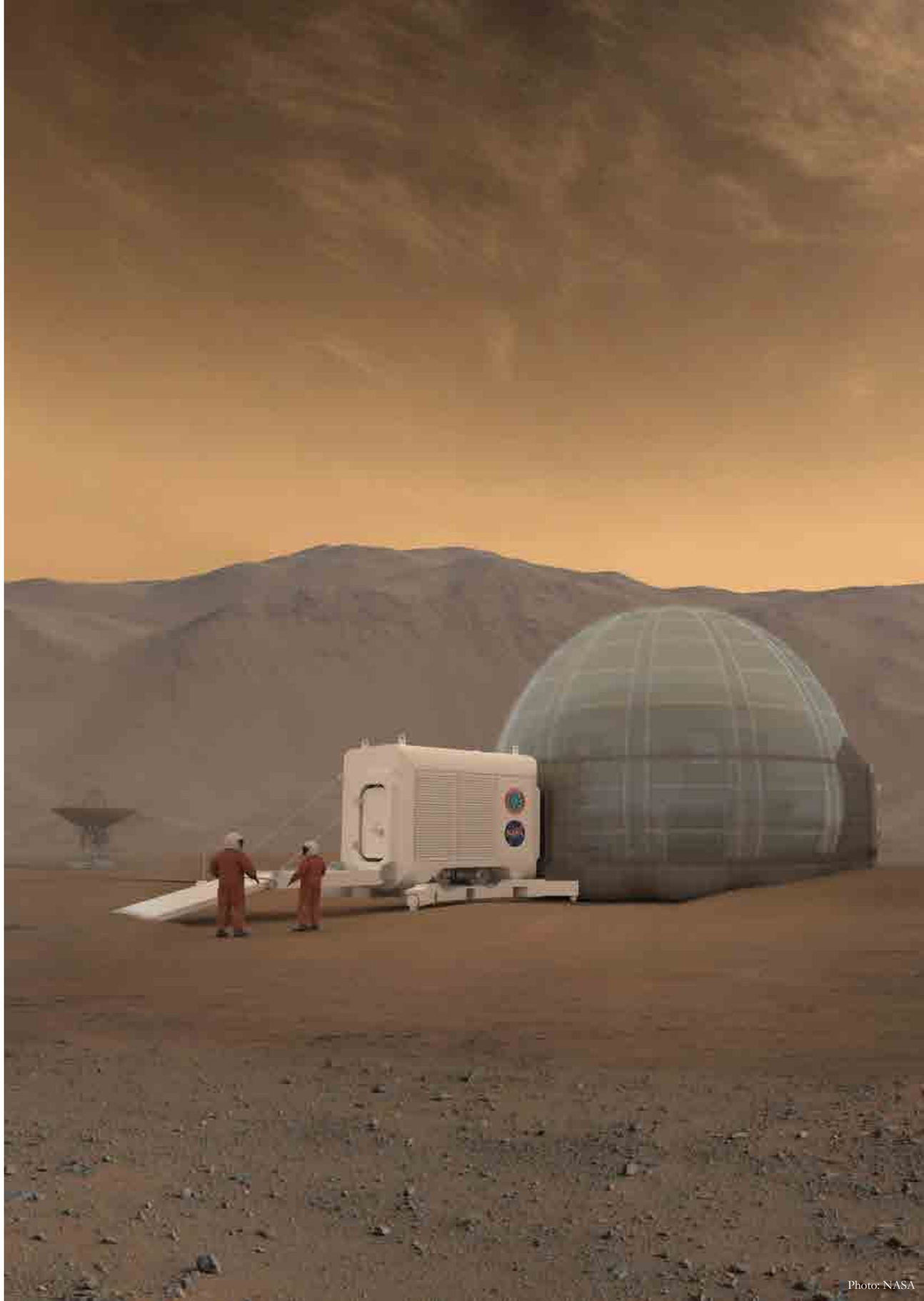


Photo: NASA

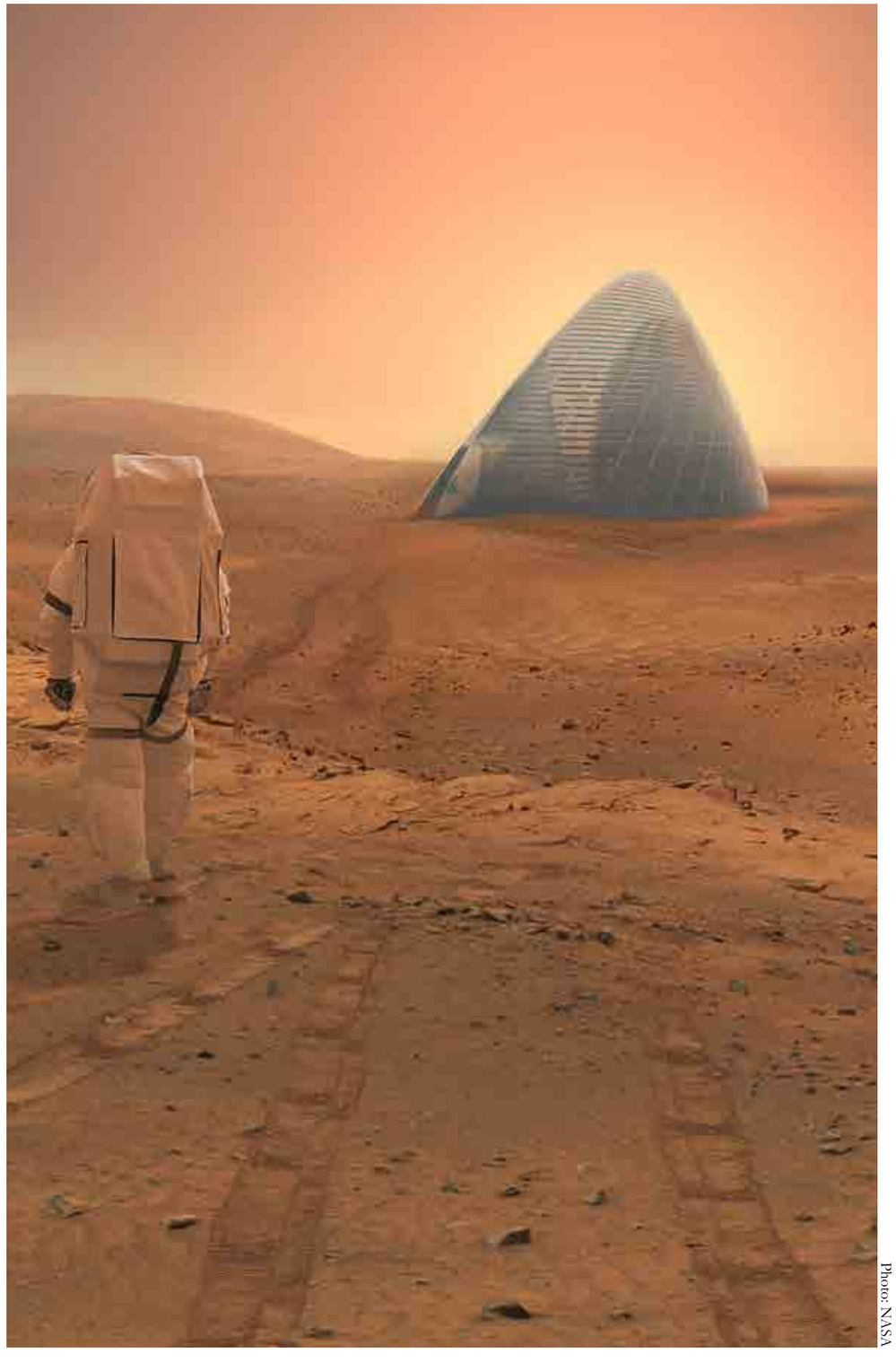


Photo: NASA

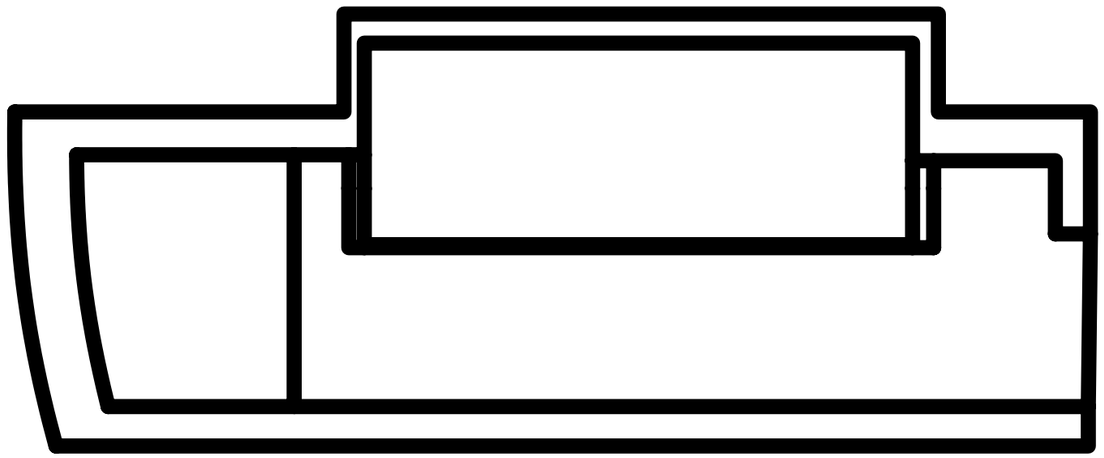
NASA have had competitions for ideas how this settlement could be made and what it could look like. Some ideas explore settlements that are under ground and let the surface of mars protect us from all the outer danger, while others experiment with modular habitats on the surface that we can expand with time. All these habitats that are designing a first settlement base present an extremely compact living space, with everything stripped down to a minimum to focus more on the work space. This seems like a dangerous focus. Of course the main goal is to build and survive, but living away for roughly 3 years astronauts will need down time with space to replenish energy. It is true though that these habitats are all small. There are no resources or time to build big lush spaces. Everything needs to be compact, and it can't be escaped that workspace and survival will be prioritised before any parts to make a home look and feel nicer.

Being in such an extreme environment and so far from any sense of home with a extreme high chance of death will be mentally challenging. it will be important to make the environment you stay in comfortable and a place you can relax and recharge your energy for the next day's mission. Creating a space that will be a place you can relate to and not feel like a lab space all the time is one way of helping a person to feel rested in their down time.


STUCK ON
MARS

light

During the Stockholm Design Week, Philips were presenting optimal placement of light. They compared two identical rooms with one room using traditional lights with traditional placements, and the other with how Philips suggests to install their lights. The room with traditional lights had plenty of naked bulbs and harsh casting lights which did not create any atmosphere. In the improved room Philips combated this with their Hue bulbs that were placed considerately and fit for purpose. In the office room Philips lit up the area evenly and did not direct the light to the eyes or the work so the contrast was never very big whilst looking around.



compact living

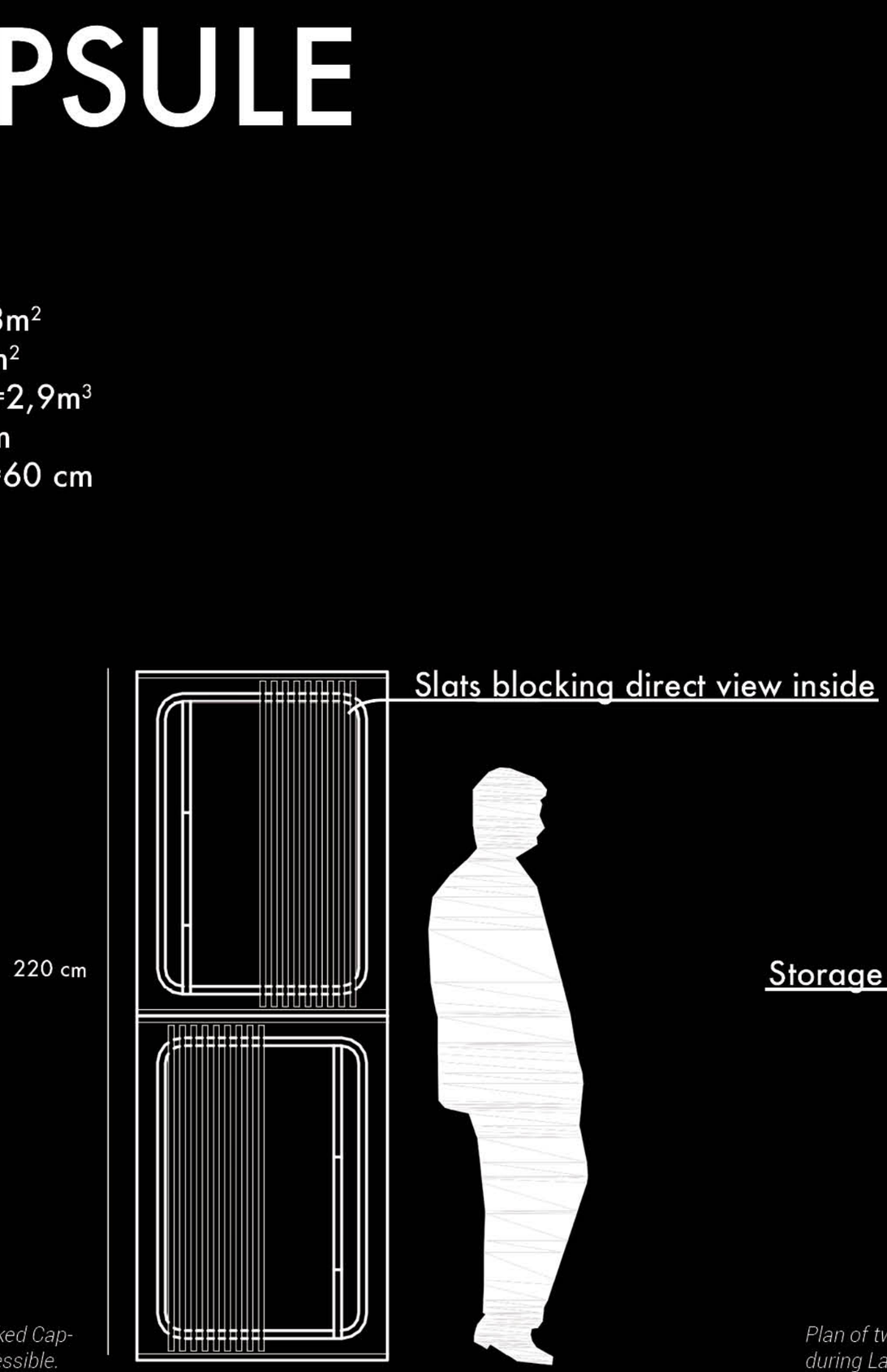
This light problem is seen in the habitats we create for long isolated trips here on Earth. This happens at Utah mars experiment settlement, Hawaii's mars experiment and even at the South Pole research station where the crew live there for months at a time. The rooms provided are very small and often have a big fluorescent light in the ceiling and sometimes a bedside light or a desk light which casts a beam.

Above is a plan of one of the bedrooms that are in Utah's mars experiment settlement and has been used for several months for experimenting how it will be to live on Mars. The rooms are tiny and gives no room for any more objects to be placed in the space. In a room like this placing the light in the corners provides the light needed without taking away any crucial space.

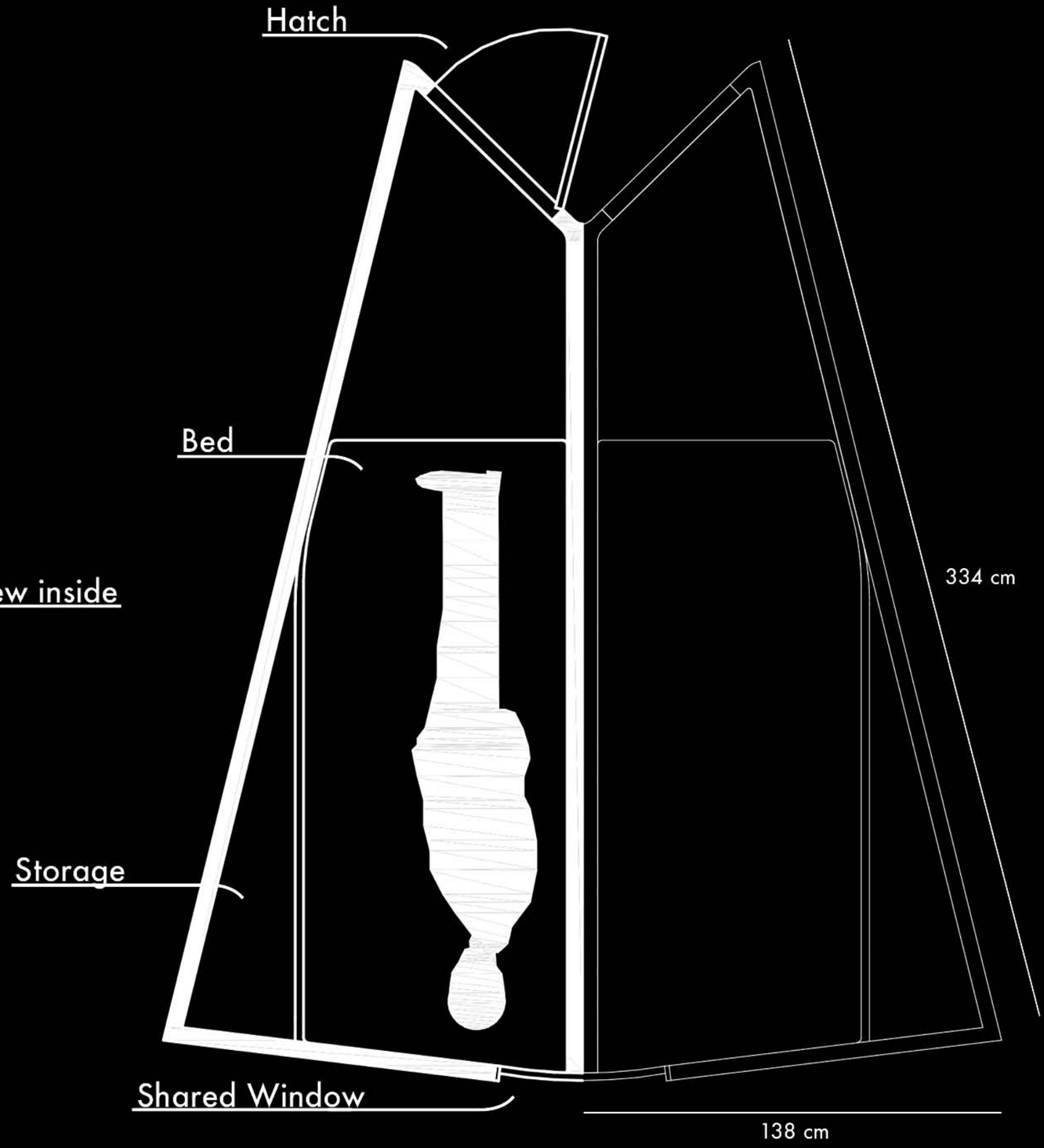
CAPSULE

Stats:

Area=2,4m²
Bed Area=1,8m²
Storage=0,3m²
Volume Total=2,9m³
Height=105cm
Hatch Width=60 cm



Direct view of the stacked Capsules. Both Easily Accessible.

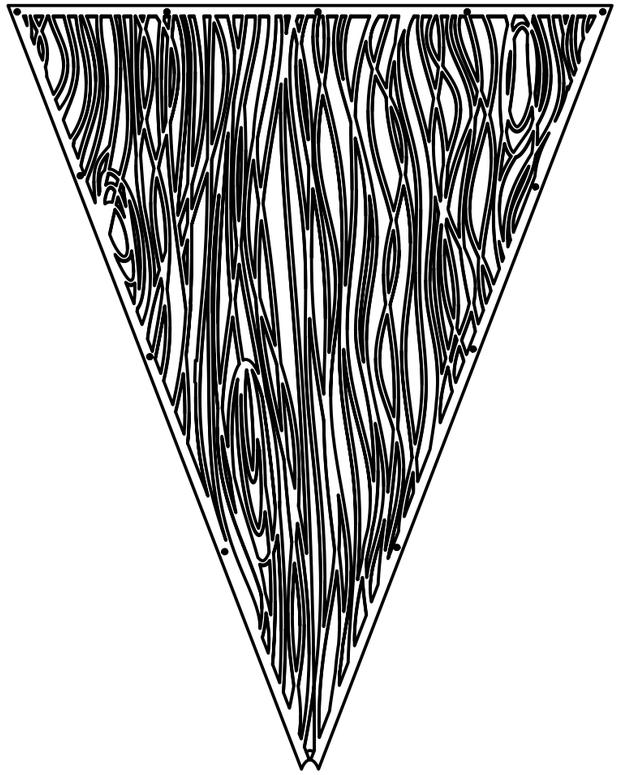


Plan of two of the 104 capsules. Each Capsule will feature a bed which will double as the seat/mattress during Launch and Re-Entry.

Photo: SpaceX

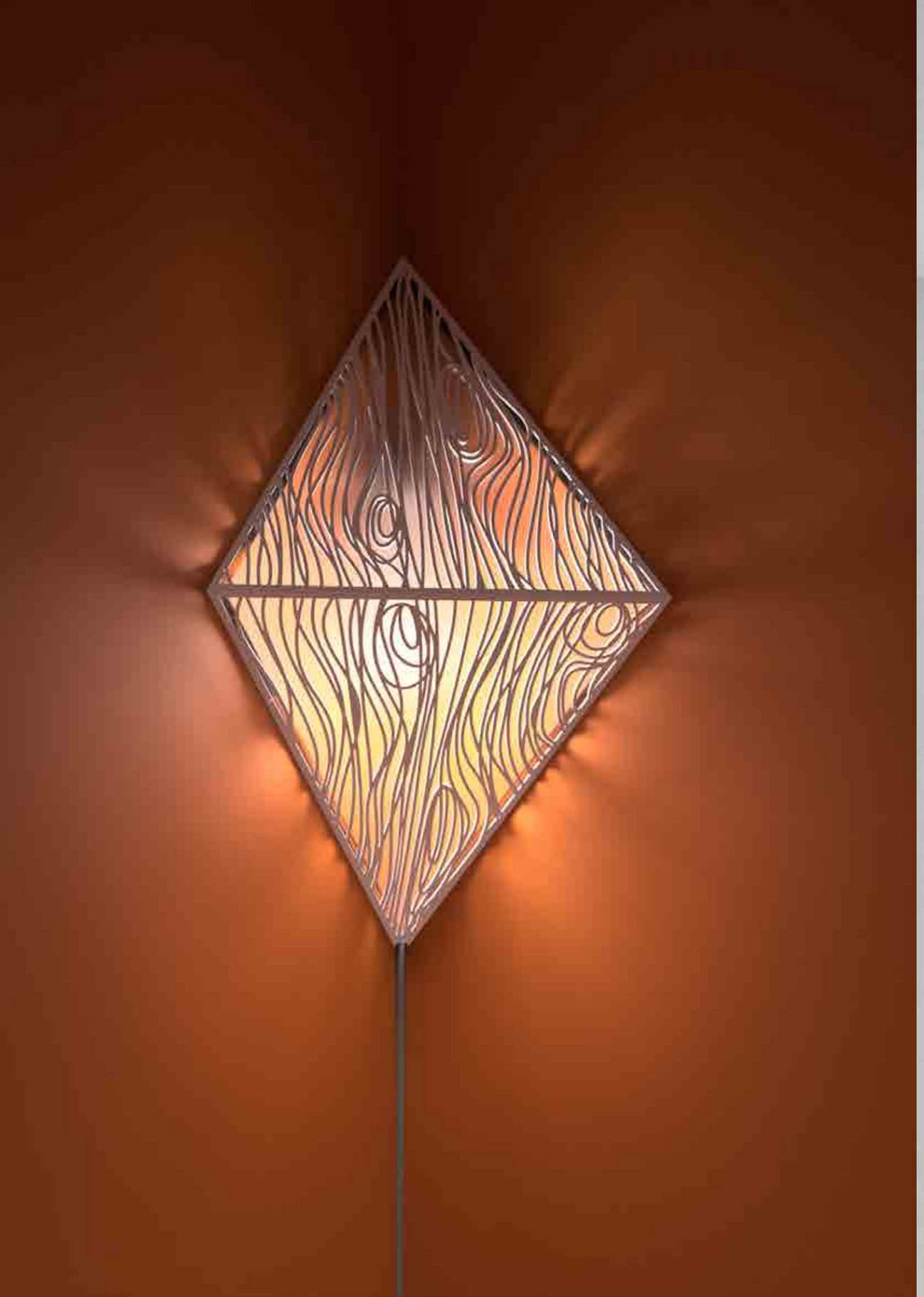
Here is a concept of a capsule on the SpaceX spaceship they are planning for mars. It's a very small room where you can keep your personal belongings and take rest. This will also be the only private space available for you on the spacecraft for the 8 months long trip to mars. When landed on mars we will not have a settlement ready for us to move in to so this capsule will be your room until the settlement is set up. This might be very challenging for people having all their privacy stripped away from them for a very long time. Of course the team that will be sent off will be trained and needs to be able to work in this environment, but as humans we can not predict how we'll react landing on a alien planet and being trapped there for a few years.

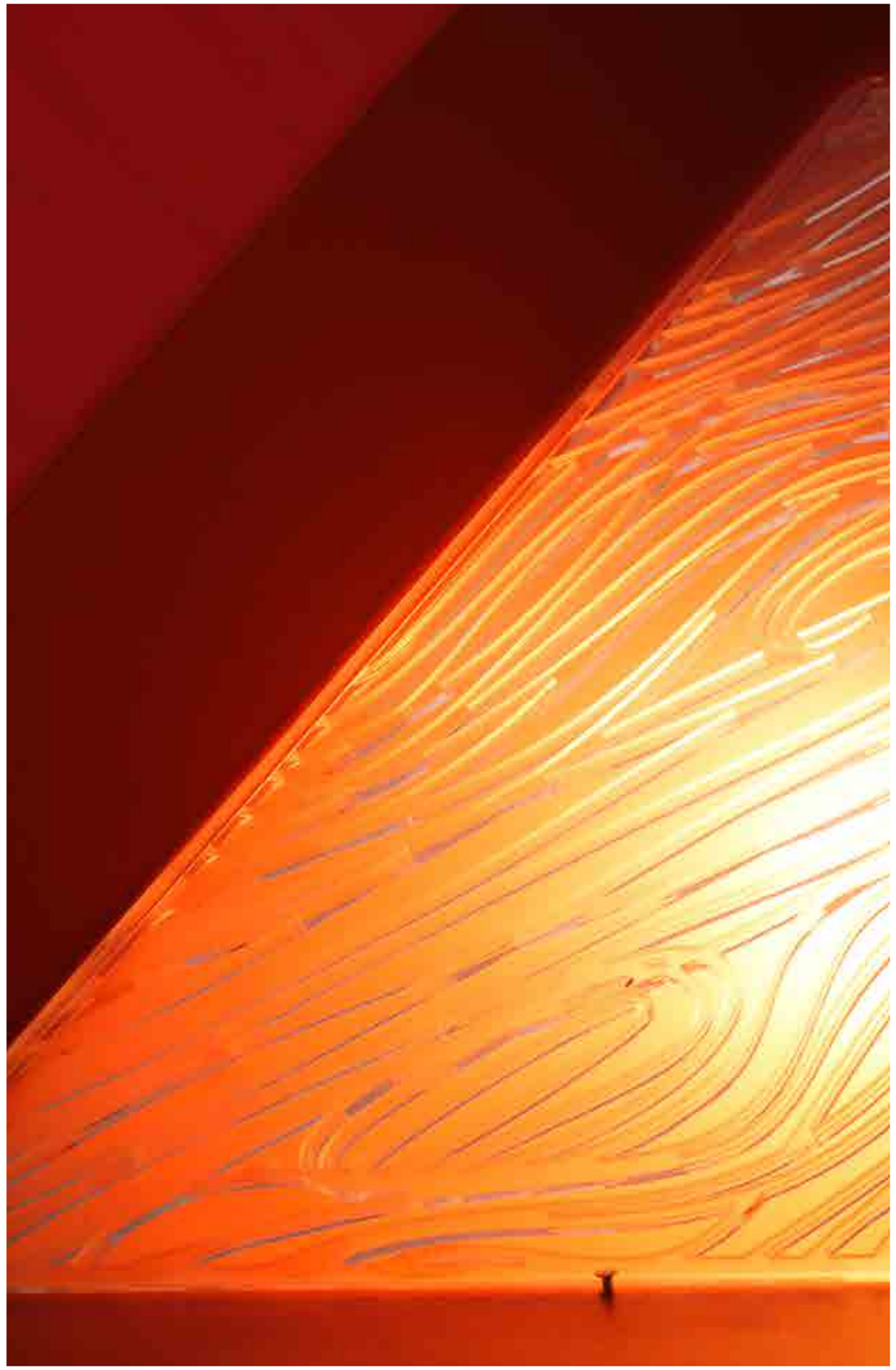
For some of the crew this might never be an issue, but facing death so closely can always change a person. So giving our explorers a space they can rest in and receive the privacy they need can benefit both their mental health and their performance during the day.

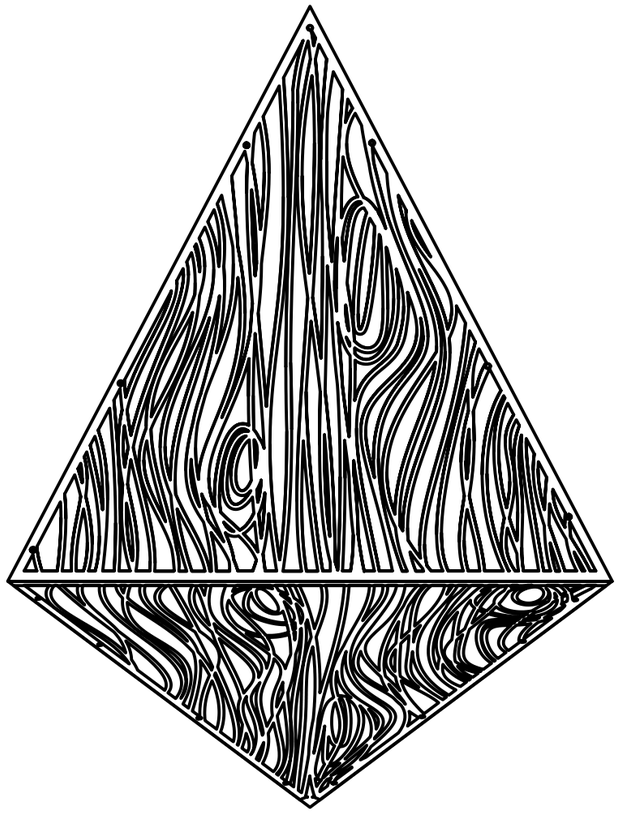


ceiling corner

I took the the inspiration for the Philips light solution and designed a pair of corner lights. The rooms on mars will be very small and therefore the most efficient placement for lights will be in the corner. A space that normally would not be used for anything and by lighting up the dark shadows in the corner helps to widen the room and give an illusion of a larger room.

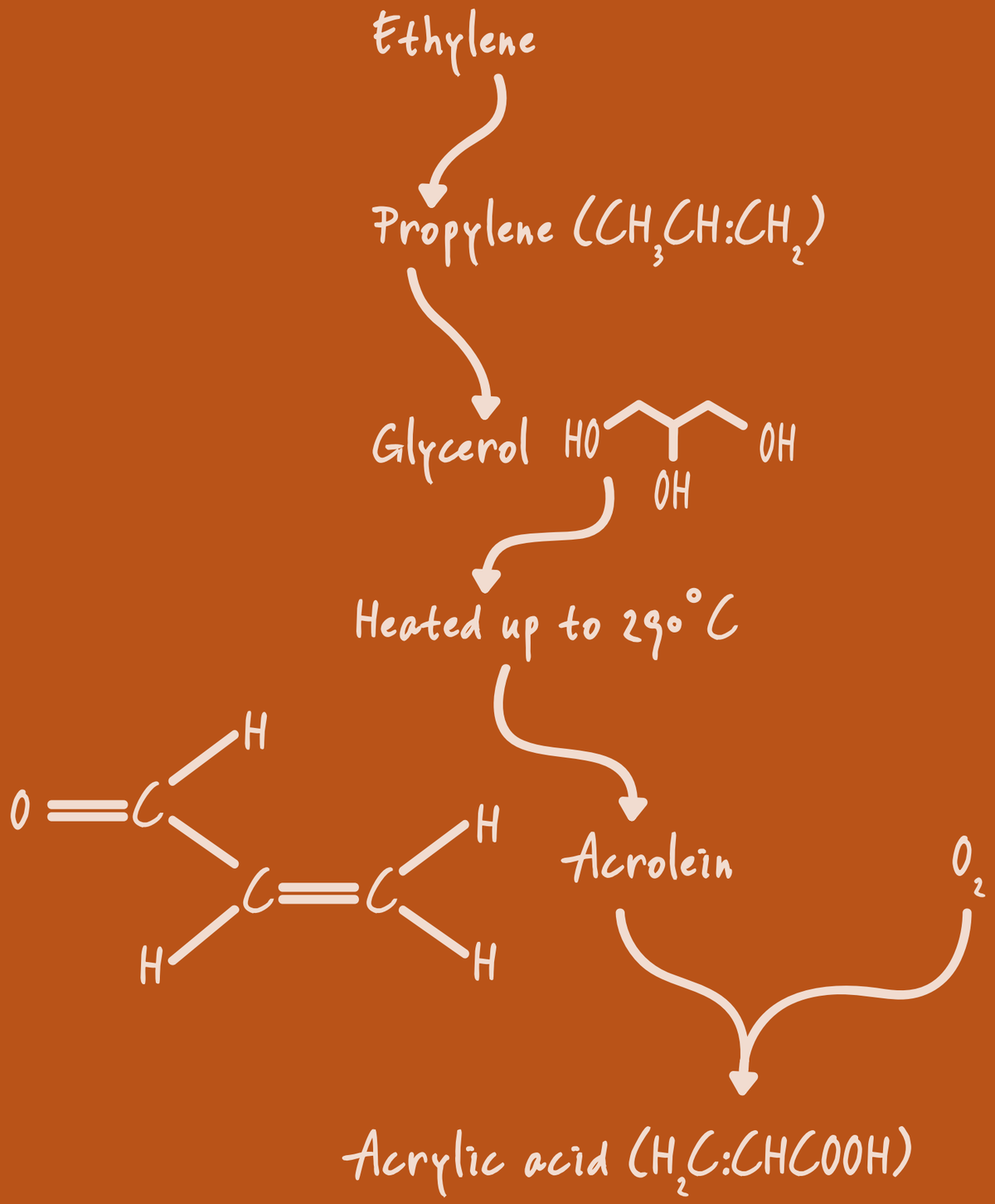






wall corner

As well as a ceiling lamp, it makes sense to have a lamp that can be used lower down on the wall. This is perfect for illuminating a bed or desk area with some diffused light.



Producing acrylic is well within reach on Mars. This schematic outlines the chemical pathway required to obtain Acrylic acid.

Synthesis of chemical compounds will be key in our ability to survive for long periods of time.

The 12 chemical building blocks

CO_2 (carbon dioxide) and N_2 (nitrogen) from the atmosphere of Mars.

H_2O (water), NaCl (salt), and hydrated $CaSO_4$ (gypsum), silica, alumina, magnesia from the regolith of Mars.

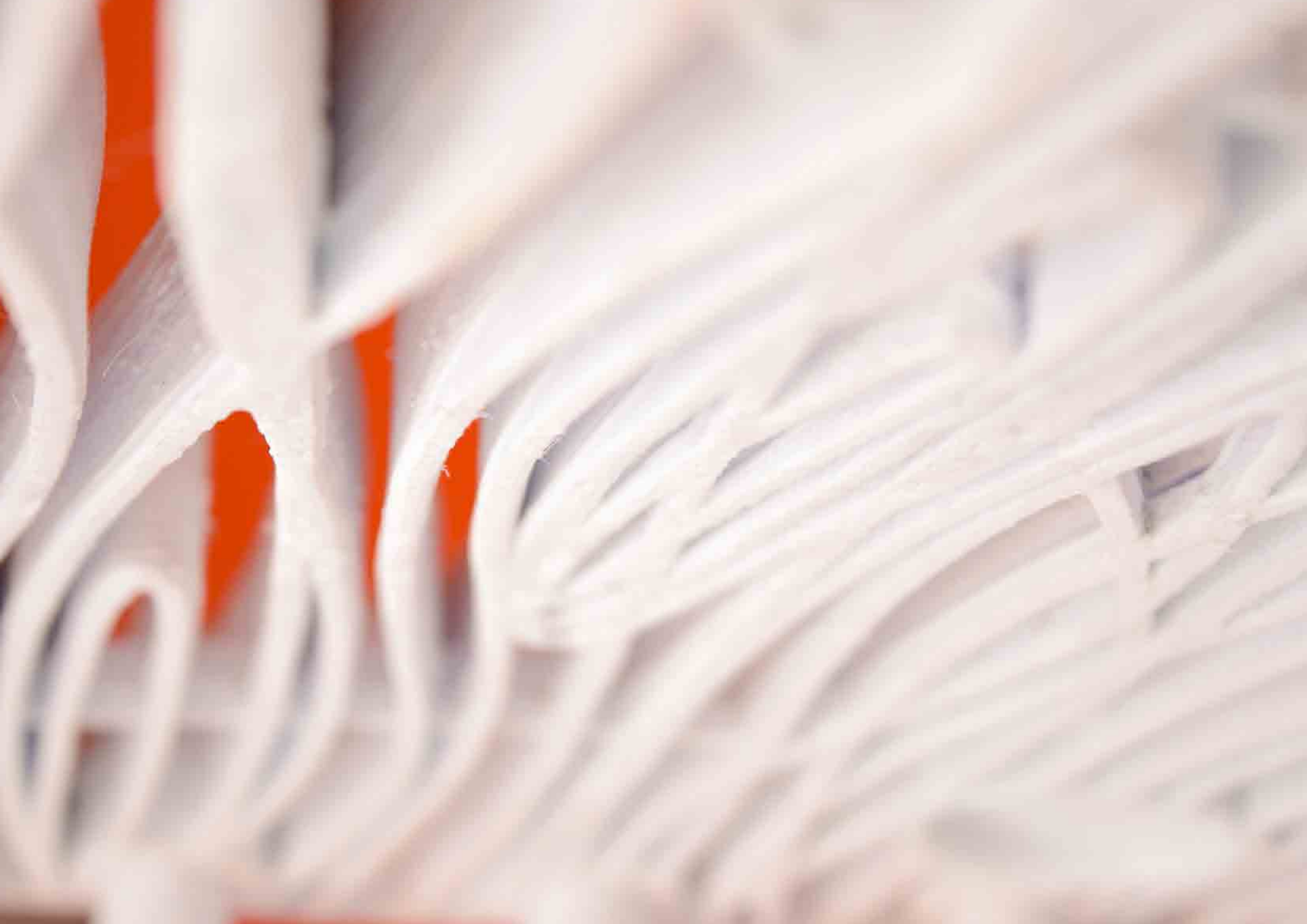
CO (carbon monoxide), CH_4 (methane) from the making of methane fuel.

H_2 (hydrogen) and O_2 (oxygen) from the electrolysis of water to obtain oxygen.

chair

The Russian astronaut Mikhail Kornienko was asked what he missed from Earth and wanted resupply of while being at the space station for a year. He answered “Simply pictures of Earth. Just views of nature.“

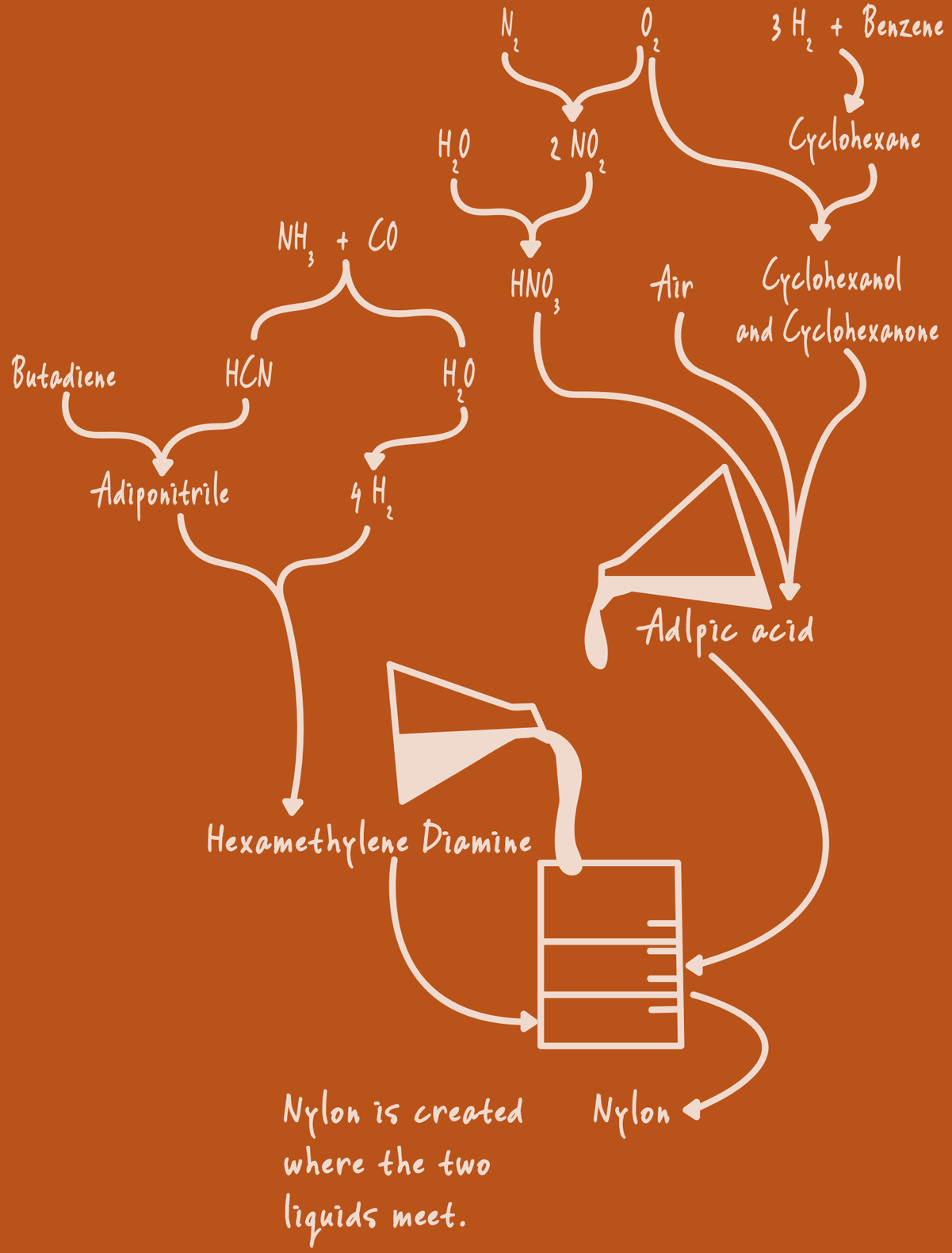
When starting to settle in on mars and creating a more home like environment we will not have access to organic materials like cotton and wood. To give us a sense of belonging and reminder from earth I have incorporated a wood inspired texture in a traditional chair design.

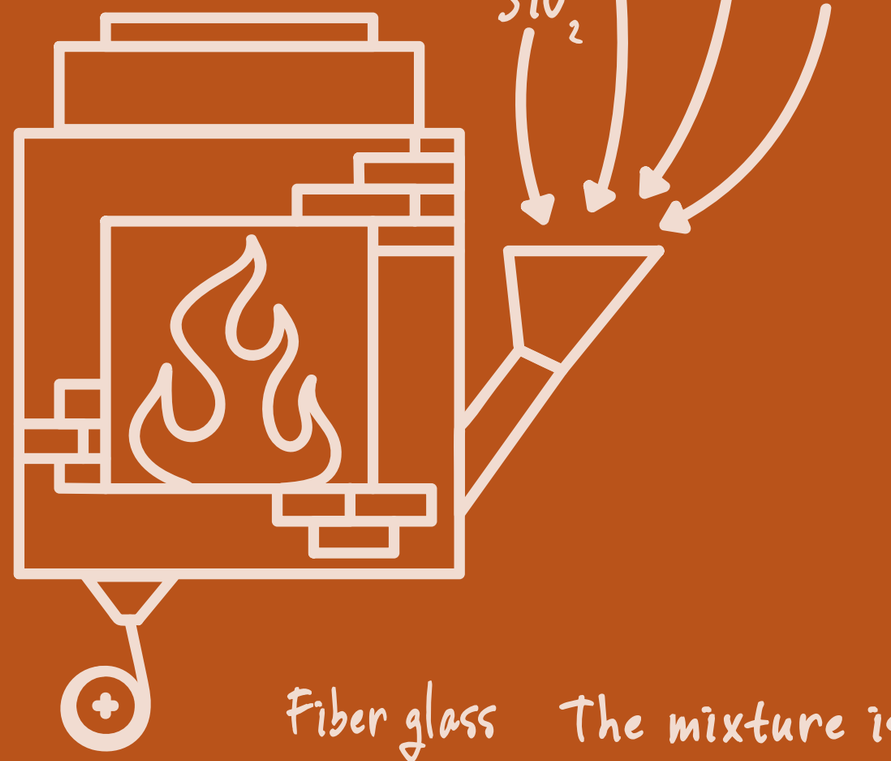


The windsor chair was first created in poor villages and was a chair that was cheap and easy to make. It took some time for the chair to bloom and quickly it was shipped around europe and america. Today we see it as a very traditional design and everyone recognizes it.

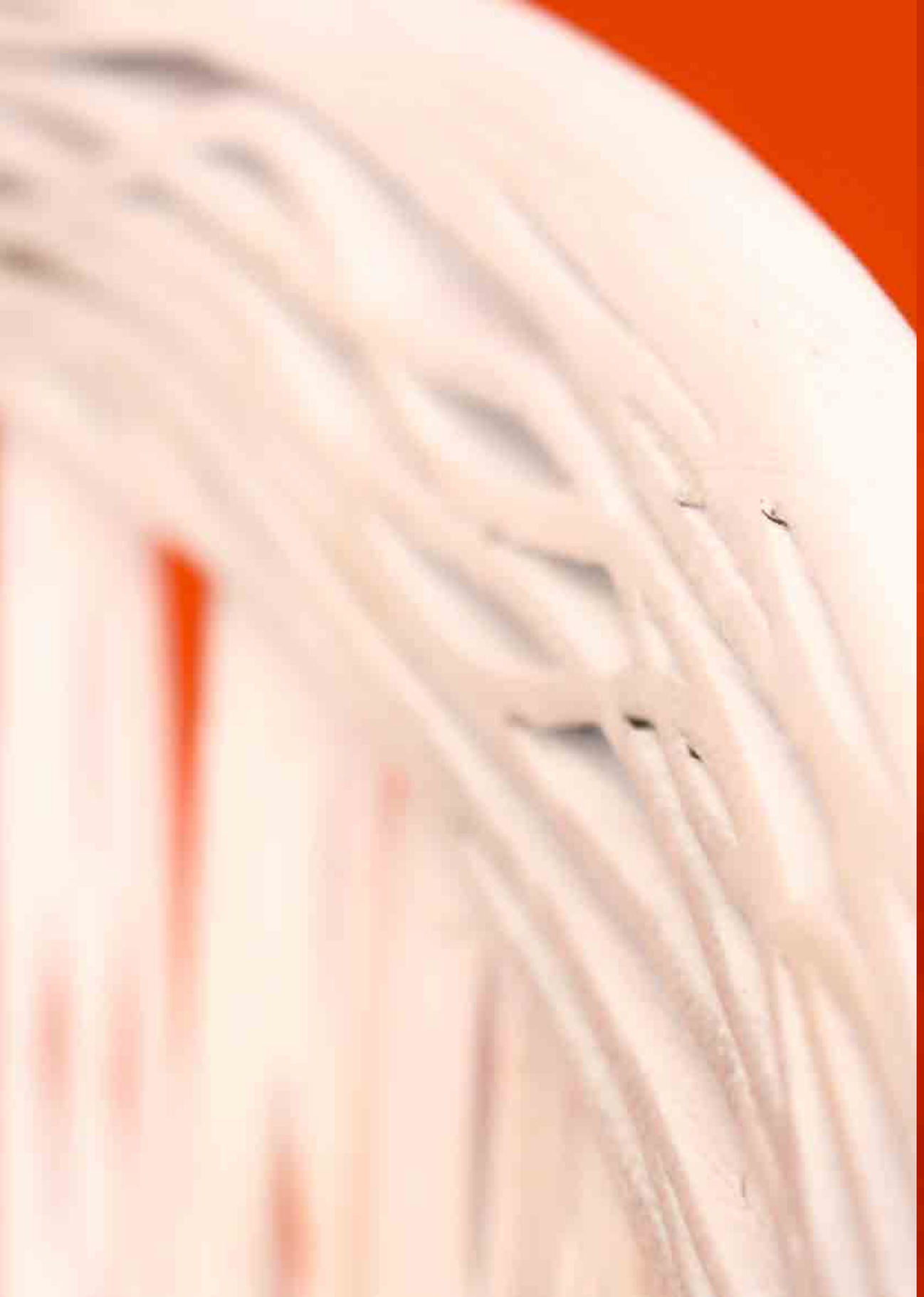
Combining the traditional design and the wood inspired texture with modern production produces this traditional design suited for the future. This 3D printed chair will be easy for the explorers to assemble and use.

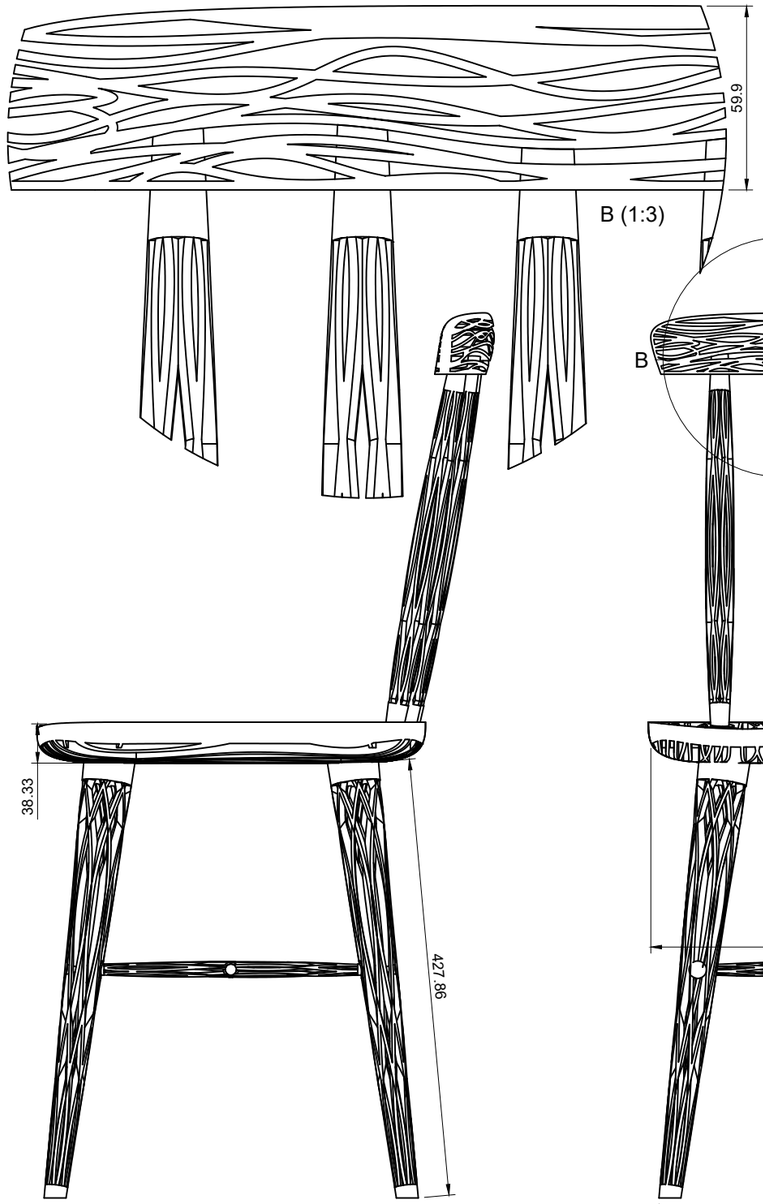
3D printing the chair in a fiberglass reinforced nylon or metal will make the chair very durable. Making the design of the chair be hollow creates a more cost and material efficient design. The seat is engineered so it gives great strength even with large amount of material cut from it.

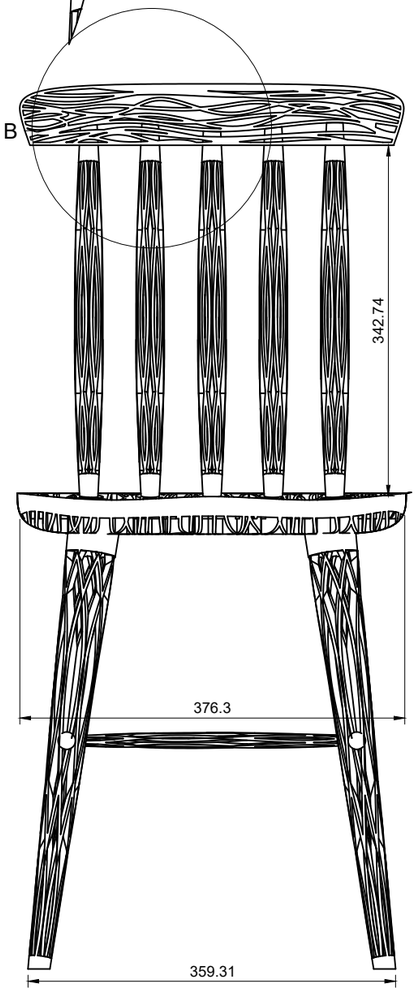


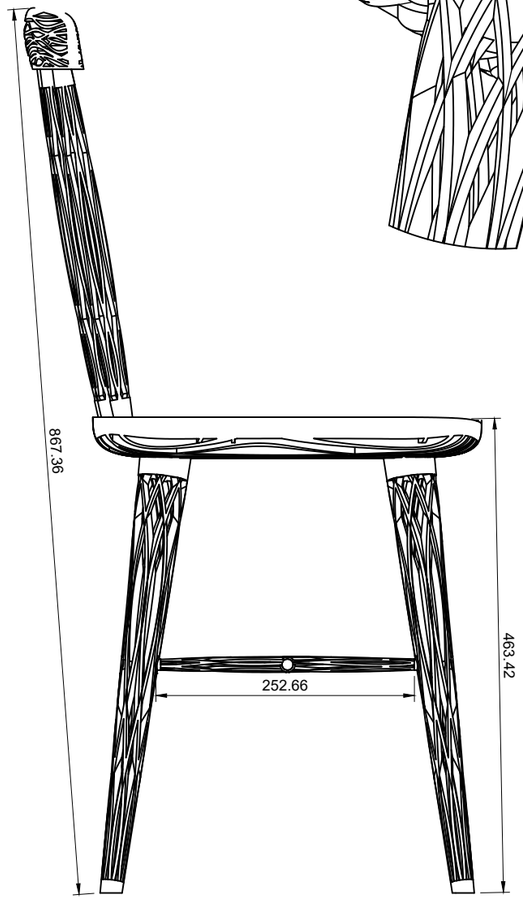


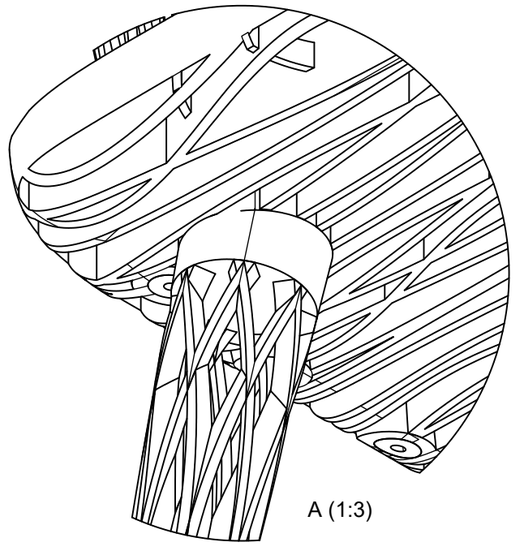
The mixture is heated up to 1000 and melts to glass. Thin threads are wound up creating fiber glass.











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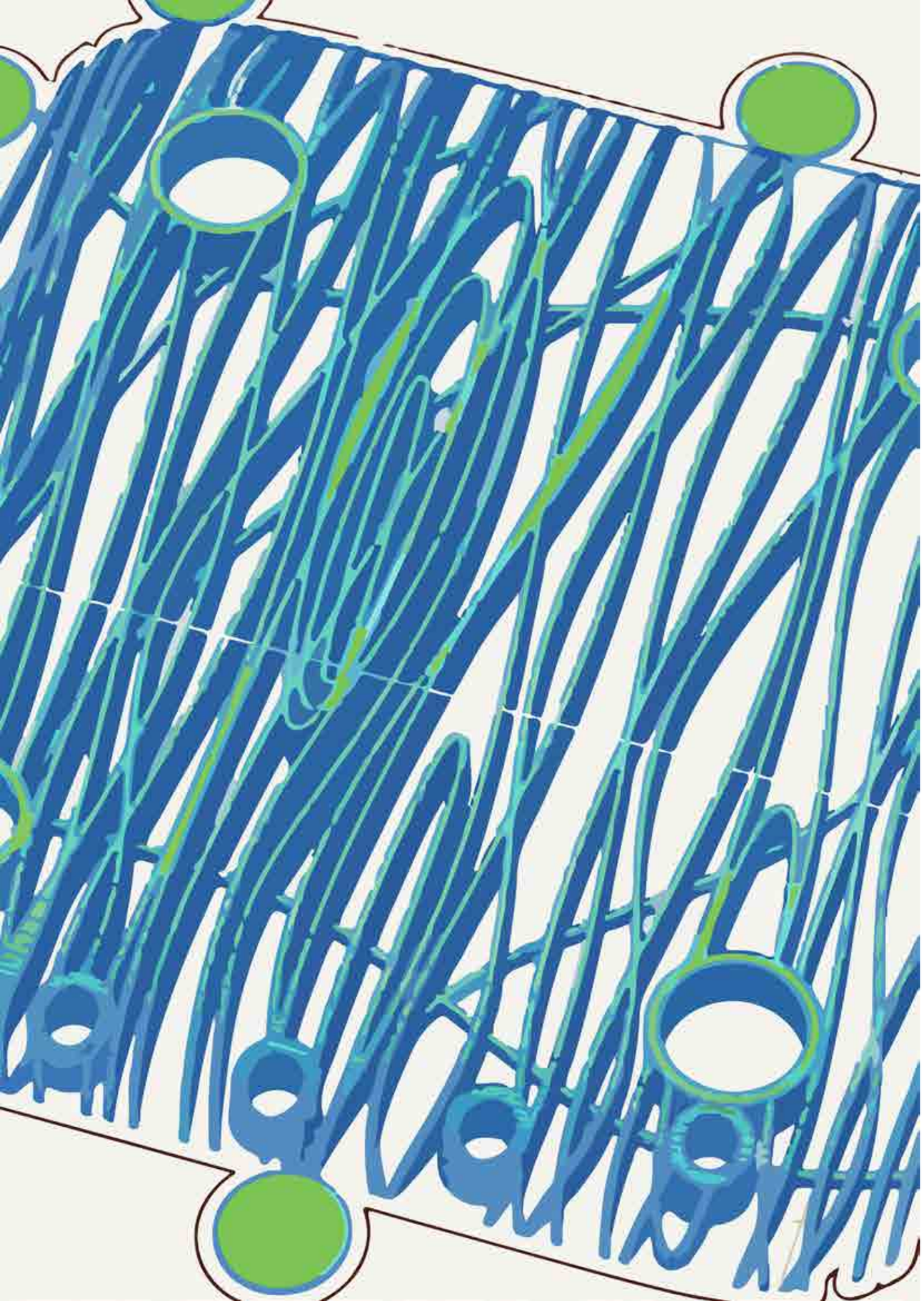
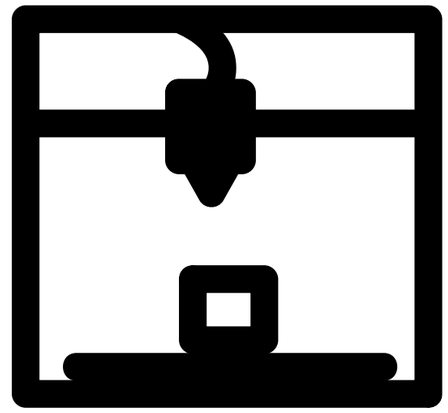




3D printing

With a small crew the man power to have a person that creates object for comfort and a better living will not be available. So designing on earth and letting it be machine made on mars will be a great way to help our crew produce object they would not have time to design, make and produce.

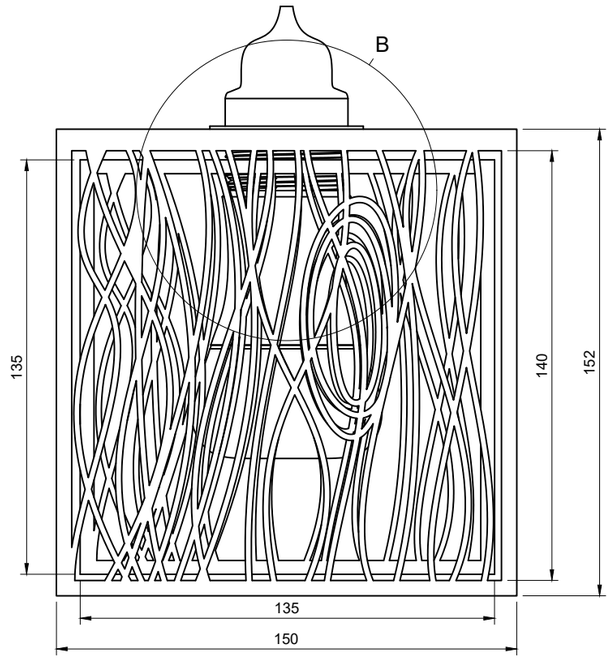
With help of 3D printing technology and its ability to create objects in all different materials through computer modelling technology. With creating models that will be easy assembled makes the product easy accessible and ready to use.

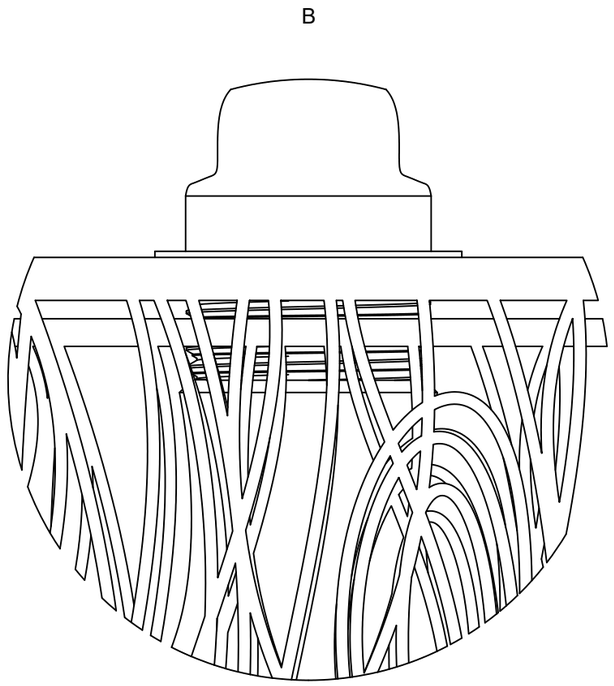
Today the printing finish is maybe not the most desirable and generally needs some polishing to do afterwards but as a first of furniture on mars this will be a great starting point to get interior design made while working on exploration.

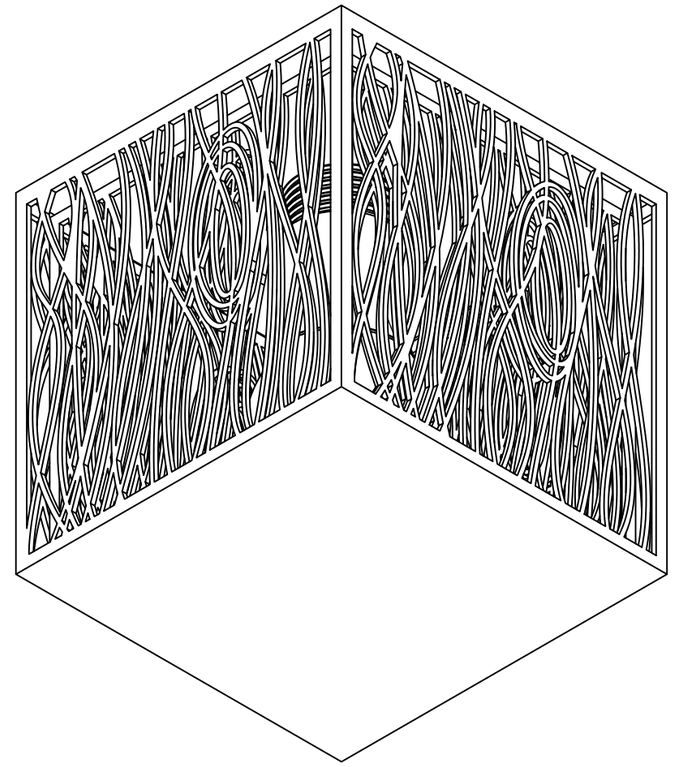
3D development

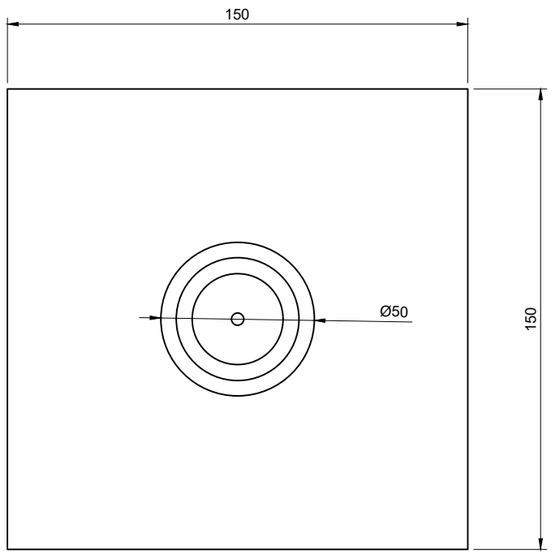
I iterated on a few different concepts before arriving at the corner lamps.

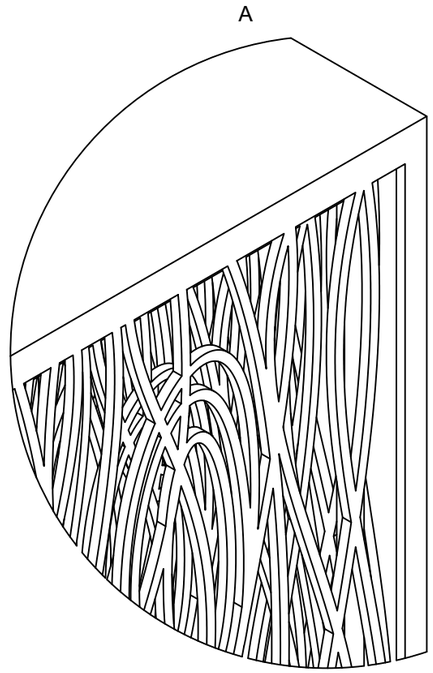
Using 3D modelling software and sketches I was able to quickly test prototypes and analyse their visual and mechanical effectiveness.











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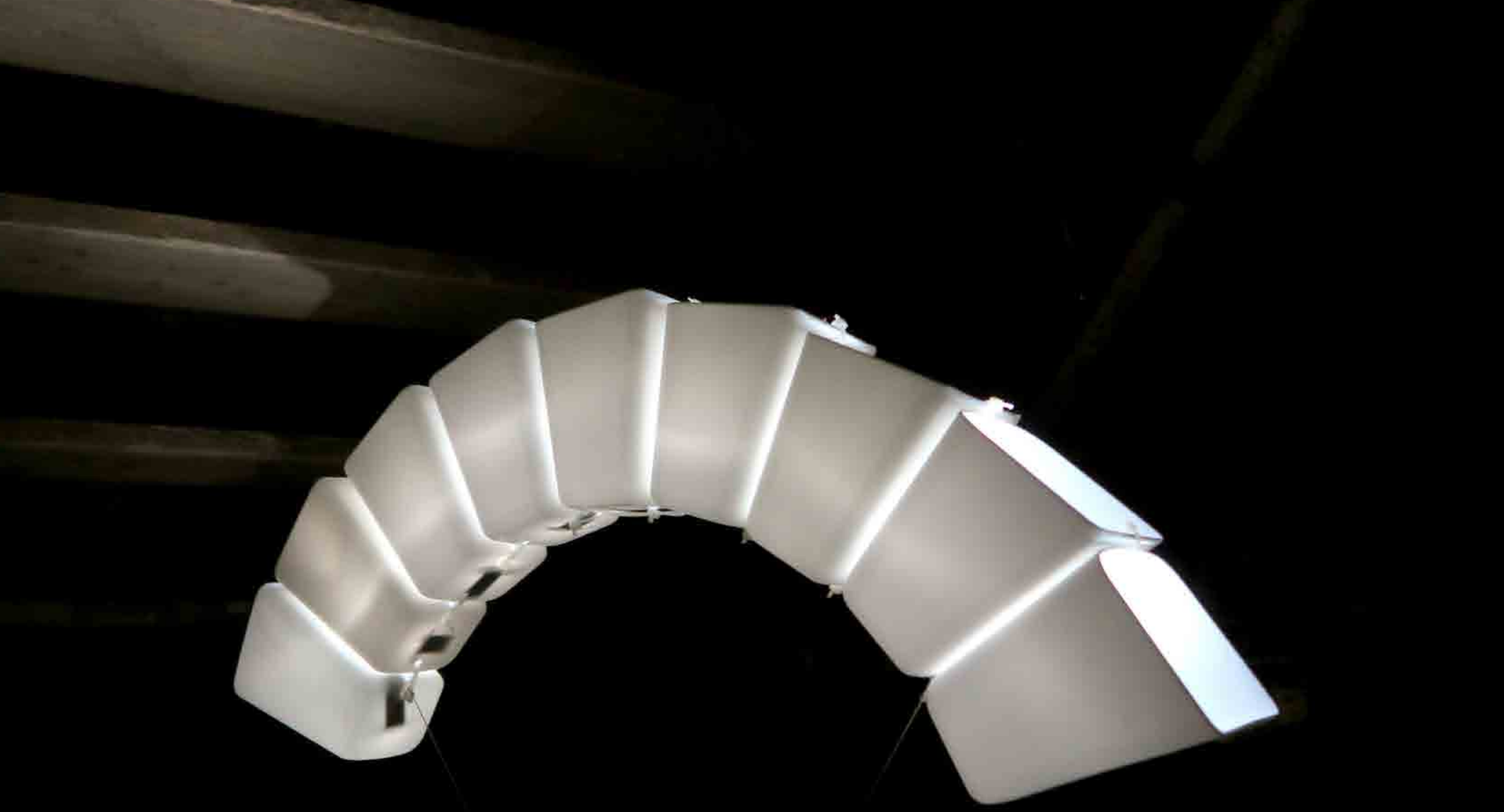
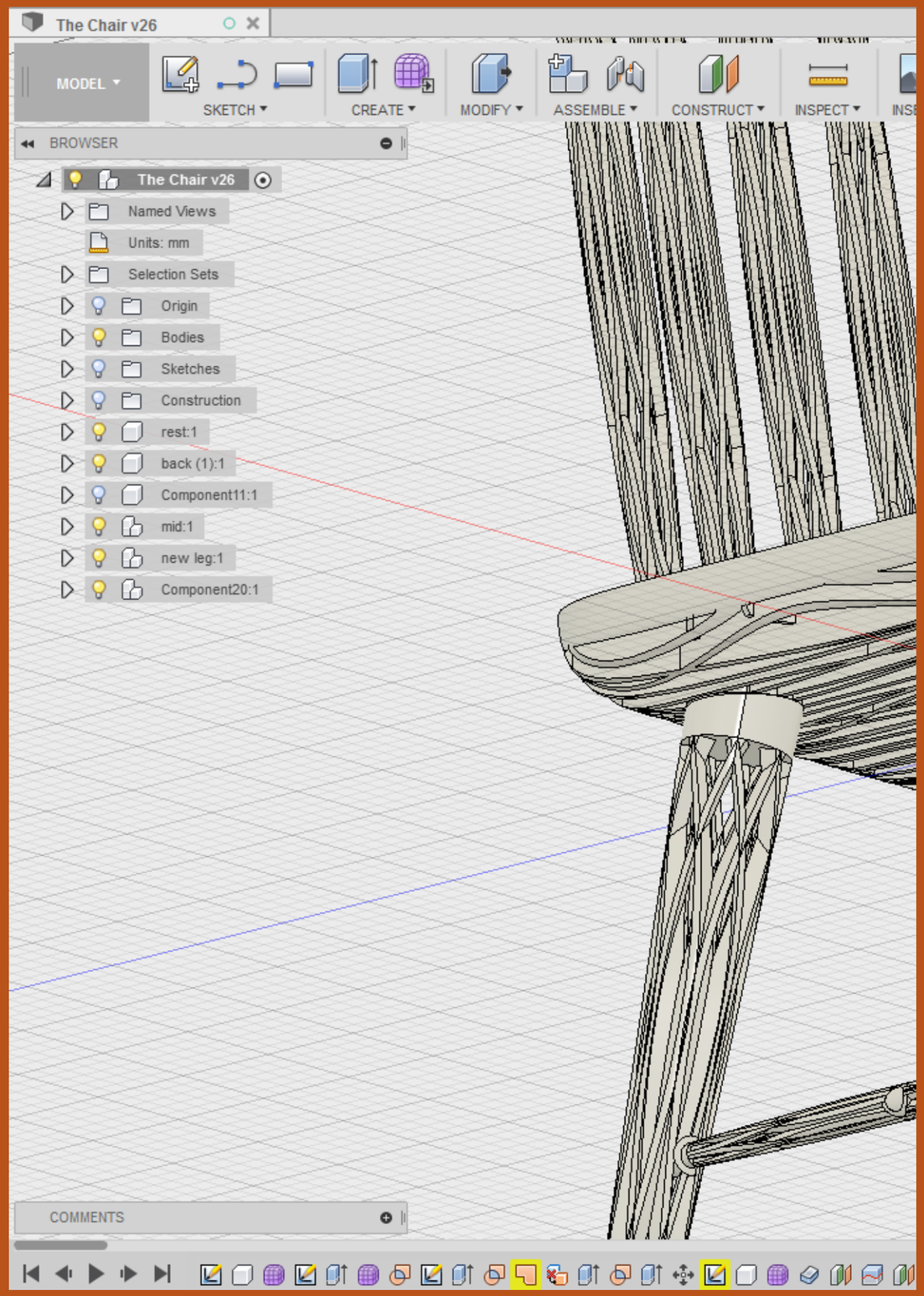
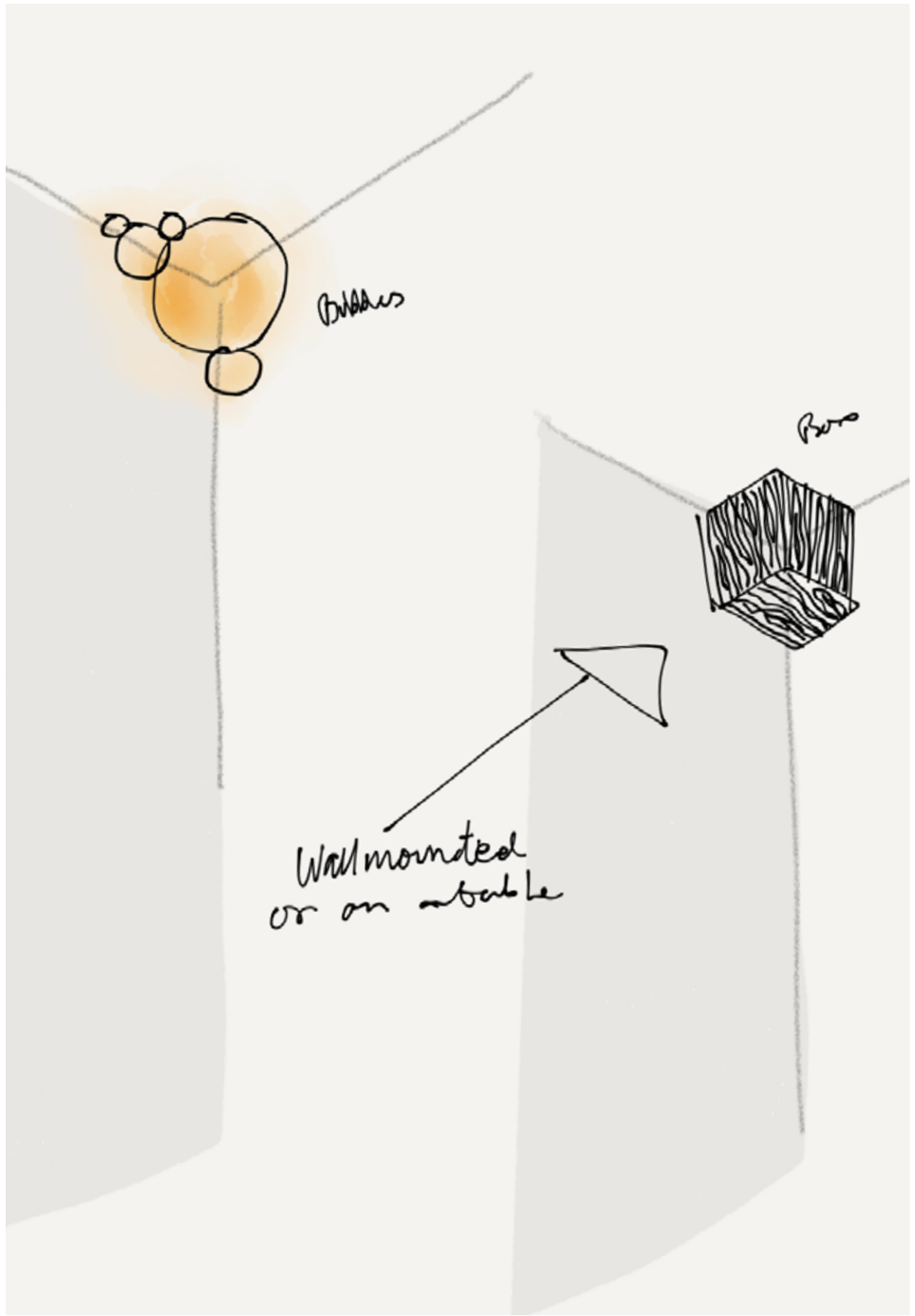
		Title: Box Light	DWG No.
			Rev. / Date of issue / Sheet 1/1

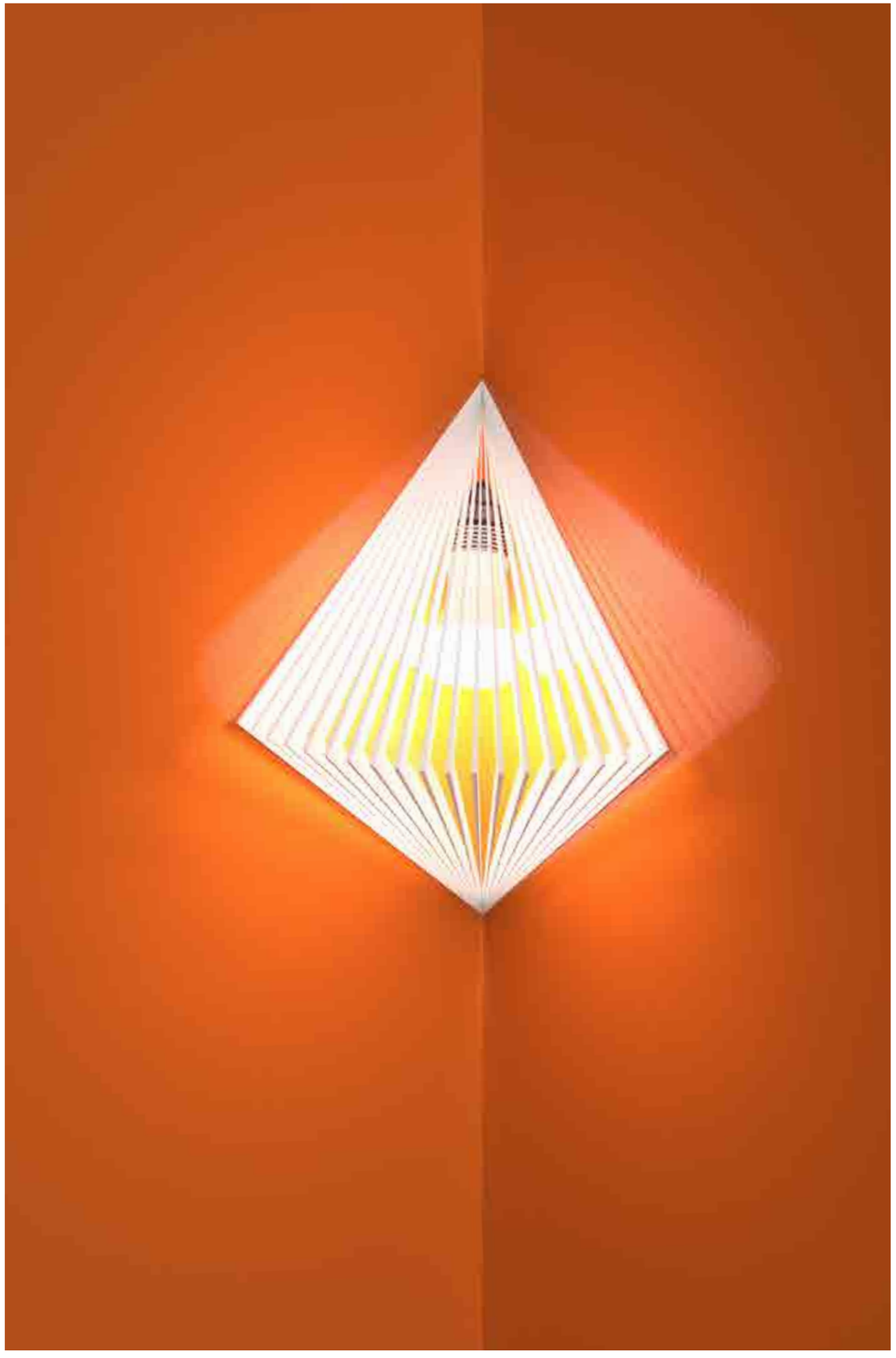


cad programs

Through my journey of finding a cad program that suits me I tried most available programs on the market. From really simple ones like sketchup, autocad to more advanced ones like 3Ds max, solidworks, modo, and plenty more. Eventually after trying out almost all I could get my hands on and trying to learn different softwares I came a cross Fusion 360. It is a program developed by Auto desk and it is similar to solidworks but simplified and quicker to learn and create great design without thinking about restrictions programs can have.




Bubbles
Bowl
Wall mounted
or on table



Instructions

Welcome to Mars.

You must survive by collecting resources and building up your base, whilst staying alive.

Stars

These are your life points.
If you run out of stars, you are out of the game.
If you collect 50 stars, you win the game.

Walls

Protect your base by building walls. Some events will reduce your stars, but walls can reduce the damage.
If you build 6 level 2 walls, you win the game.

Furniture

Build furniture to gain more stars. Each piece you build gives you extra stars. Trading does not grant extra stars to the receiving player.

Teddy: 1 star
Picture: 1 star
Blanket: 2 stars
Lamp: 3 stars
Chair: 3 stars

Camps

Building a camp over a resource tile makes that tile yours. One camp can be built per turn, and a tile can only have one camp. Some event cards allow you to collect resources from every camp you own.

Tiles

There are different kinds of tile you might find while exploring the surface.

Resource - Iron, Ice, Lava, Sand. A standard resource tile. It can have one camp built on it by any player.

Treasure - A rare tile that grants great rewards to the person who uncovers it.

Doom - A destructive tile that will damage or destroy the player who discovers it, or sometimes a player they choose.

Empty - An uneventful empty tile.

Setting up

Each player chooses a colour. This will be the colour of the player's home tiles, camp flags and player token.

Place the smaller home tile for each player in the center of the playing area. Surround the home tiles with an even spread of Resource tiles.

The youngest player plays first.

Each player starts with two Camps (flags). Place one camp before the game starts.

On your turn

1. Pick up an orange event card, do what it says.
2. Move your player token. You can move freely through the explored area, or choose to explore a tile space off the edge of the board.
3. If you move to an unknown space, turn over a white tile card to determine the tile type. If the tile is a Doom (blue cards) or Treasure (yellow cards) tile, pick up a corresponding card and do what it says.
4. If you wish, you may now trade with other players. You can swap anything except camps and stars.
5. If you wish, you may now build a camp on your current tile. A camp can only be built on a Resource tile. Only one camp can be built per tile. You can only build one camp per turn. Claim your resource tile by putting a flag in it.
6. If you wish, you may now build walls and furniture.

Winning the game

The game is won when the first player gains 50 stars, or builds 6 level 2 walls (glass or obsidian).

Losing the game

You lose the game if you run out of stars

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