
MOON.
origin point

MOON: origin point

At the current rate of usage of non-renewable resources the most optimistic rates show that they will eventually be depleted in period of 10 to 80 years, depending on resource.

As technology advances the idea of traveling between planets becomes morea thing of the present. Using planets and/or satellites for purpose of gathering of recourses will, eventually, become only option for further explorations of space.

The Moon, Earth's natural satellite, was the only place, so far humanity set foot on. Also, Moon is abundant with resources, and due to it's position and properties we have mining post, not far from Earth, that could provide us required resources in near future. As well as mine, Moon can be used as ground zero, starting point, for further exploration of galaxy and even the universe.

The idea of moon mining exists for a while now. There are projects and people who already started investing in research of technologies that will generate minerals from Moon, and allow their usage on the planet Earth.There have been many studies and surveys of Moons surface, all leading to same conclusion: within next 30 to 50 years, mining on Moon will not only be economically feasible but also a condition for Earths survival and expansion.

Moon: origin point project is created as an proposal on how to start that expansion. The project consists of two parts. First part is grid of artificial satellites aroundtheMoon that will provide energy for the mining and the superstructure itself. This will be used as starting point of every mining expedition as well as storage space, habitat for people on expedition and in laterphases of project as ecosystem / self-sustaining habitat of up to 20 million people . Also, this structure is easily replicable, so when needed another one can be created on a suitable location.

Goal of this project is to create a structure that will be, with few exceptions in the very beginning, able to support itself in every way, as well as life and all functions inside of it.

The project will be accomplished through phases.
In first phase we create a grid of satellites launched from Earth. These satellites would form a grid around parts of the Moon where insolation is most suitable for energy gathering. Each one of these satellites would be able to send gathered energy via laser to any location where its needed, or if the location is not within the line of sight it would be able to send it to another satellite that is better located for energy transmission. Each satellite would also be equipped with lasers that would serve as an asteroid shield, in order to protect the surface structures and satellites from damage.

Second phase is creating modularhexagonalboundary of structure itself on Moon's surface and setting receivers for energy. As nanobots start to create the materials necessary for the structure'sgrowth they create additional power nodes that are used for receiving energy from satellites.

The starting point for growth of the structure will be preassembled energy receiver with function of controlling and supplying nanobots with energy. From that point on, nanobots will start creating hexagonal shape and superstructure itself. Due to ability of nanobots to replicate themselves structure would be completed within a few months. This, of course, is case when there is enough energy from satellites and raw materials provided. This whole process is preprogrammed by humans, yet there is no need for presence of them on the Moon while the structure is being grown.

In phase three structure is completed. Habitat for humans is created. The protective, semi-transparent shell is formed and the dome is being filled with atmosphere that would be created from materials present on the Moon itself. Oxygen can be created from the Moon soil /with added production of iron and other usable materials and using only power provided by solar satellites/.Fertilizers can be created with different chemical processes using lunar soil, and water can be extracted from lunar ice caps or created from residual O2 and H2 from industrial processes. With completion of this process the colony is ready to house a larger number of humans. Simultaneously with creation of atmosphere we are creating the ecosystem for the dome. Since most of the materials needed for growing plants can be found on Moon or recycled from human presence on the Moon, we can efficiently, using advanced technologies like aeroponics, create enough plants for food and for creating a sustainable habitat in the dome.At the same timethe project ismostly independent from importing large amounts of plant life and fertilizes from Earth.

At this stage, the phase four, the structure is ready for spreading and new growth, again using modular hexagon and systems mentioned before.The further phases that will include spreading of structure and creating new hexagonal modules is repetition of phases two, three and four.

Benefits of creating structure like this are various. First benefit is that we have new source of resources, for planet Earth as well as for spreading mankind throughout the Universe. We have a large, modular colony that would have its own atmosphere and plant life, creating a habitat that is not that unlike habitats on Earth. Within this colony we can house a large population, relieving the strain of human numbers on Earth. We can easily replicate and expand this colony and create more space. With mining this colony is economically independent and can repay itself. Constant flying to the moon and back, mixed with new generated resources will, eventually, encourage further development of space transportation. An experimental habitat created on the Moon will be a stepping stone in further development of habitats in space that can be placed elsewhere.

URANIUM *used in nuclear reactors, weapons will be depleted around 2042.*

OIL *used as fuel will be depleted around 2046.*

GAS *used as fuel will be depleted around 2049.*

COAL *used as fuel will be depleted around 2056.*

TITANIUM *used in aircraft, armour will be depleted around 2057.*

TANTALUM *used in mobile phones will be depleted around 2058.*

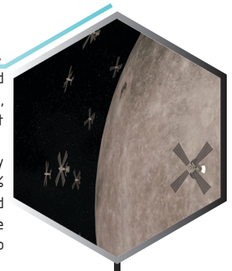
RARE EARTHS *used in hybrid cars, wind turbines*

ALUMINIUM *used in transport packaging, construction, electronics will be depleted around 2091.*

PHOSPHORUS *used in fertilizer pesticides, matches will be depleted around 2094.*

PLATINUM *used in fuel cells catalytic coverters, jewellery will be depleted around 2118.*

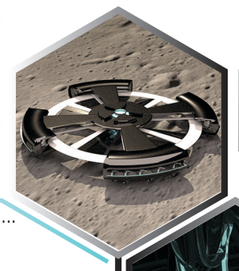
**deplatation of non-renewable resources at the current growth rate.*
Source: minerals - US Geological Survey, Adroit Resources, World Bureau of Metal Statistics, Internation Copper Study Group, World Gold Council, Minormetals.com, Roskill Nickel Report, Smill, Silver Institute, WNA, Lead and Zinc study group, Wikipedia.
fossil fuels - BP statistic review of World Energu 2010



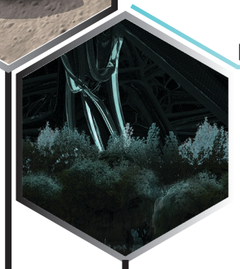
Creating the grid...

...we started by creating a grid of satellites around the moon, with purpose to supply constant solar energy for the structure. Satellites are geostationary and produce approximately 44% more energy then ground-based solar panels. Cradle to grave cycle is approx. 10 years, due to space based hazards...

...considering the fast depletion of resources on the Earth mining on the Moon could become very important and profitable, there for structure will pay off in a very short period of time. Some of the resources that can be found on the Moon are helium-3, silica, alumina, lime, iron (II) oxide, titanium-oxide...



Rentability...



Home sweet home...

...the final part of creating the true habitat in the structure is forming a sustainable ecosystem using a large scale aeroponic systems for initial growth of the organic matter...

2042-2049

2053.

2056-2058

2066.

present

2055.

2056.

2088-2118

industrialized countries

developing countries

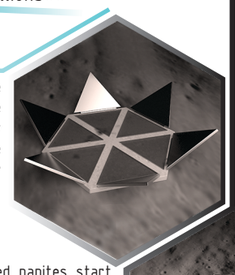
1.5 billions

10 billions**

***chart that present potential growth of population.*

Structure is designed to comfortably house up to 20 million people. Even more if necessary. Estimate is 75ppl/ha.

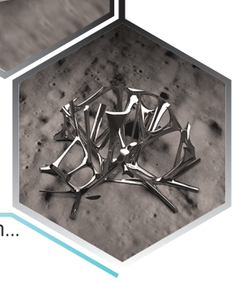
With structure this large we can easily help with overpopulation problem, that is even now forseable.



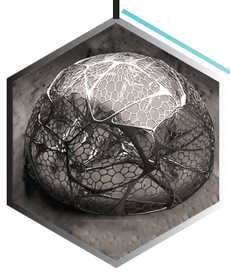
Dropping the seed...

...reciever is droped on the Moon's surface with the purpose of collecting energy from the satellites and there after releasing nanites for initial reproduction process.

...when released nanites start to reproduce themselves, create needed elements and materials for the structure. Via programming inbedded in them they create the structure itself...

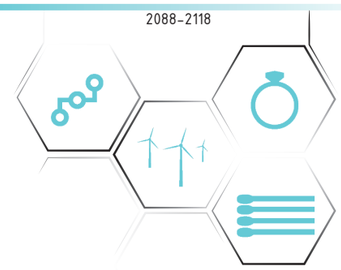


Beginning of growth...



End of growth.

...theoreticly, nanites can finish entire structure in a very short period of time. When the structure is finished process of populating the habitat as well as mining can begin...



Humans have been fascinated with the Moon for millennia. From the discoveries of Aristotle and Galileo to modern science explorations, the moon has held profound mysteries and endless possibilities. In recent decades, the desire to tackle this new frontier, and to travel through the galaxy in search of sentient life, has prompted scientists and entrepreneurs alike to tackle head-on what many believe to be the first step in interstellar travel: a colony on the moon.

We know there's lots of water ice on the Moon, and the rocks have oxygen locked up in them, so potentially there's a way of creating water and air for future denizens. Quite a bit of work has already been done in this area, and its potential is bright. Other reasons to go – potential cheap energy from helium-3 mining, tourism, and the like – are too vague at the moment to count on.

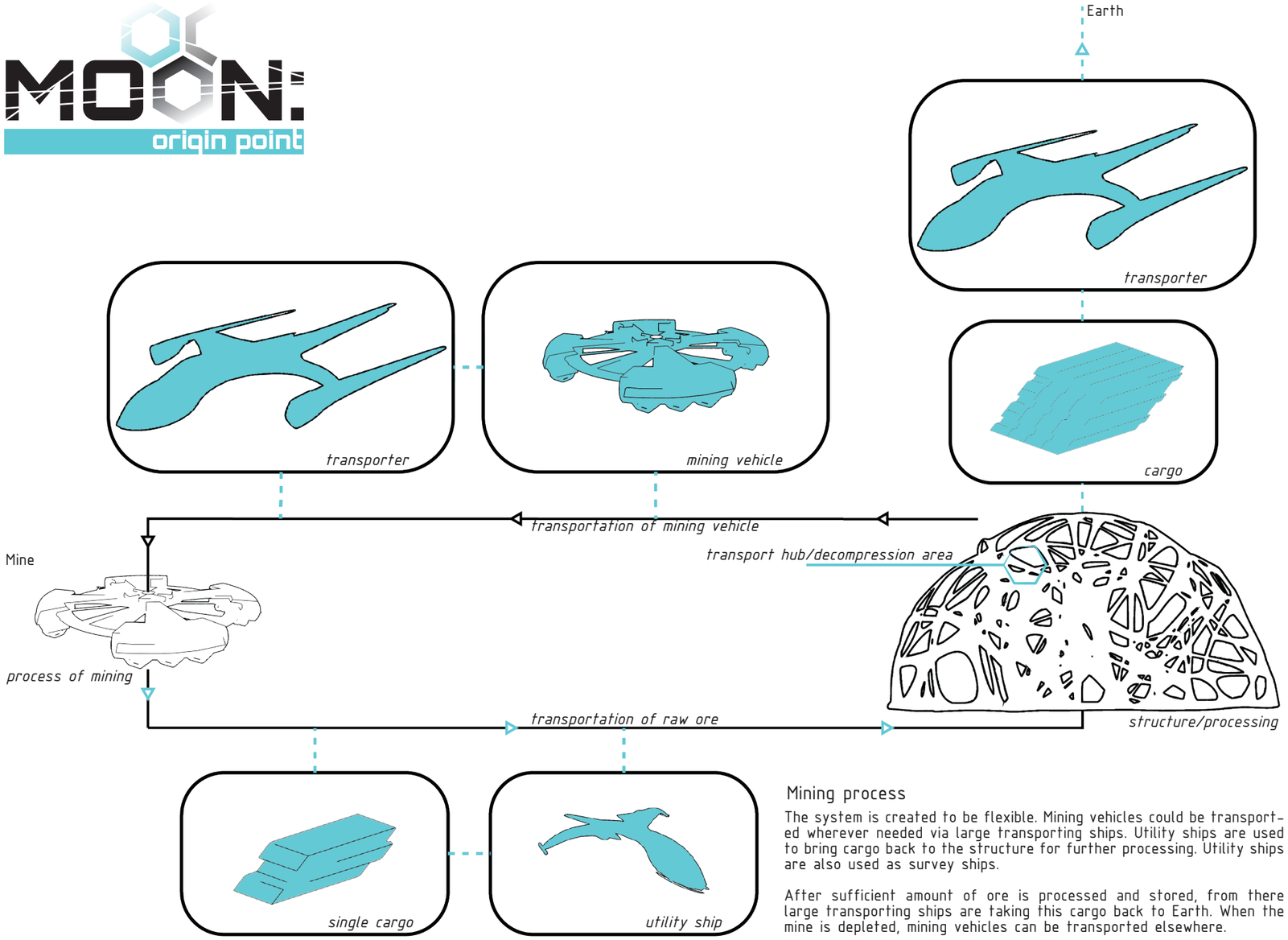
When we believed that the moon was just a dusty mass, the lack of water was a huge argument against colonization. The weight alone would make transporting water from Earth prohibitively expensive. However, scientists have recently discovered approximately one billion gallons (3.8 billion liters) of water ice in one moon crater. Conceivably, colonies built near ice deposits would have a natural supply of water. There would have to be purifying systems for removing toxins like mercury, as well as systems for reclaiming gray water. When melted and broken down into its components, water ice could also be used as fuel for rockets.

From Earth, a trip to the moon takes a little less than three days. Communication is quick, with just a 3-second lag time. The views are spectacular. One side is always facing Earth; the other side, the sun and stars. On the bright side of the moon, it can reach a sweltering 224 degrees Fahrenheit (107 degrees Celsius). The permanently shadowed side fairs little better, with temperatures dropping below an alarmingly cold -397 degrees Fahrenheit (35 degrees Kelvin). While you might be spending most of your time indoors, there are still meteors to contend with. According to NASA, the moon is continually hit by flying chunks of ice and rock.

After years of study, we also know that there's nothing, aside from the dangers of freezing and asphyxiation that poses an imminent threat. Craters and lack of atmosphere may hinder mobility, but the next generation of spacecraft, vehicles and support systems provide practical solutions to those issues. A moon colony would strengthen research and advancements across the fields of science, and it has the potential for expanding our knowledge and understanding of the universe.

timeline

MOON:
origin point

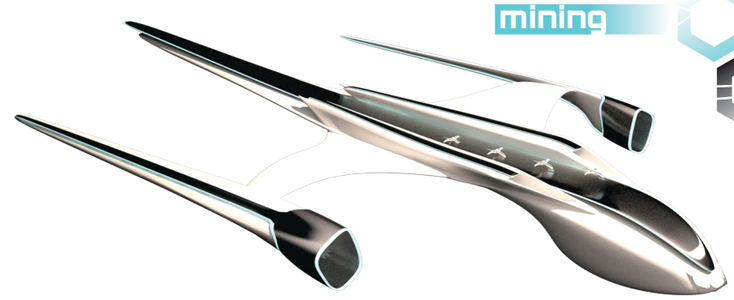


Mining process

The system is created to be flexible. Mining vehicles could be transported wherever needed via large transporting ships. Utility ships are used to bring cargo back to the structure for further processing. Utility ships are also used as survey ships.

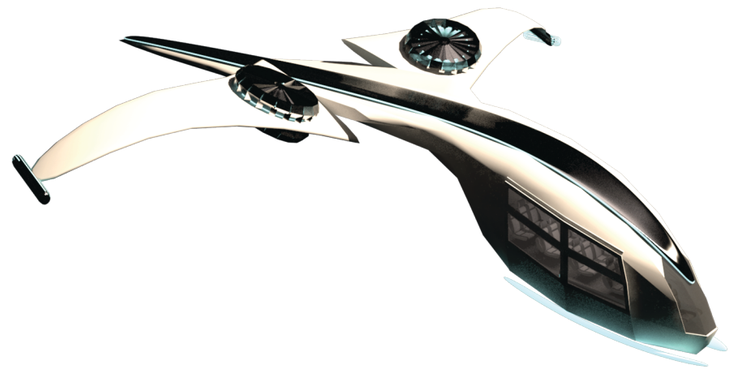
After sufficient amount of ore is processed and stored, from there large transporting ships are taking this cargo back to Earth. When the mine is depleted, mining vehicles can be transported elsewhere.

mining



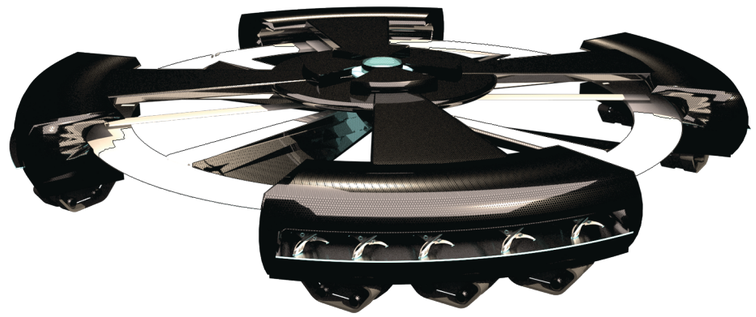
0 70 140 210m

Transport ship



0 3 6 9m

Utility ship



0 30 60 90m

Mining vehicle

Hydrogen reduction

Products of hydrogen reduction are pure iron, titanium dioxide (TiO2), and water, which is split to recover the hydrogen and produce oxygen.
The basic process is to separate ilmenite from lunar soil, crush it to a fine powder to maximize the surface area, and then heat it in an enclosed reaction vessel in the presence of hydrogen gas. The steam produced in the reaction is then condensed and split to produce oxygen and recover the hydrogen.

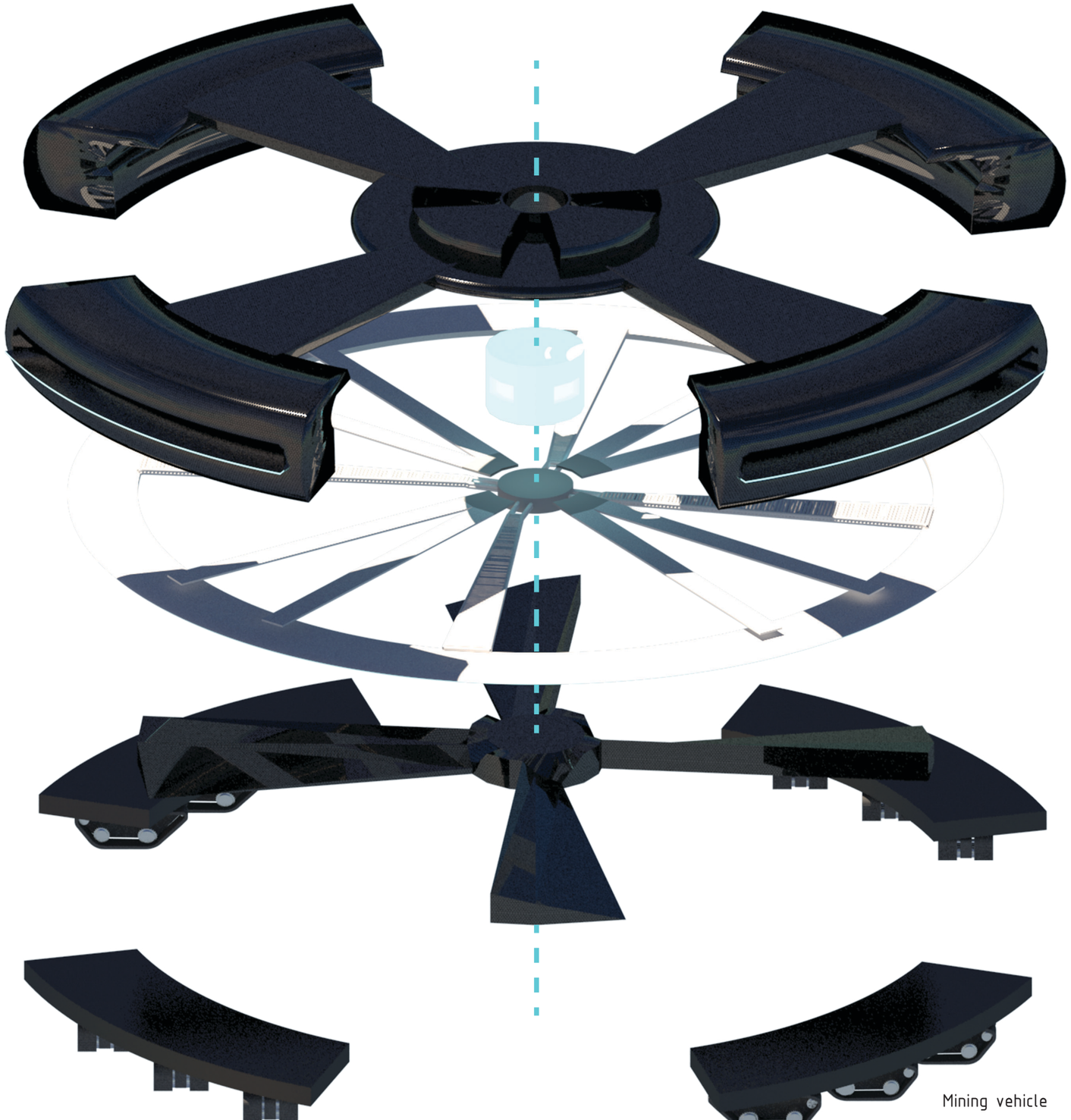
Reduction: FeTiO3+H2 ---->Fe+TiO2+H2O
Water Splitting: 2H2O ---->2 H2+ O2
Net Reaction: 2FeTiO3----> 2Fe+2TiO2+ O2

The iron produced in the process could be separated out by carbonyl extraction, or by grinding the result again and using a magnet. The titanium dioxide could also be further reduced to produce metallic titanium and additional oxygen.

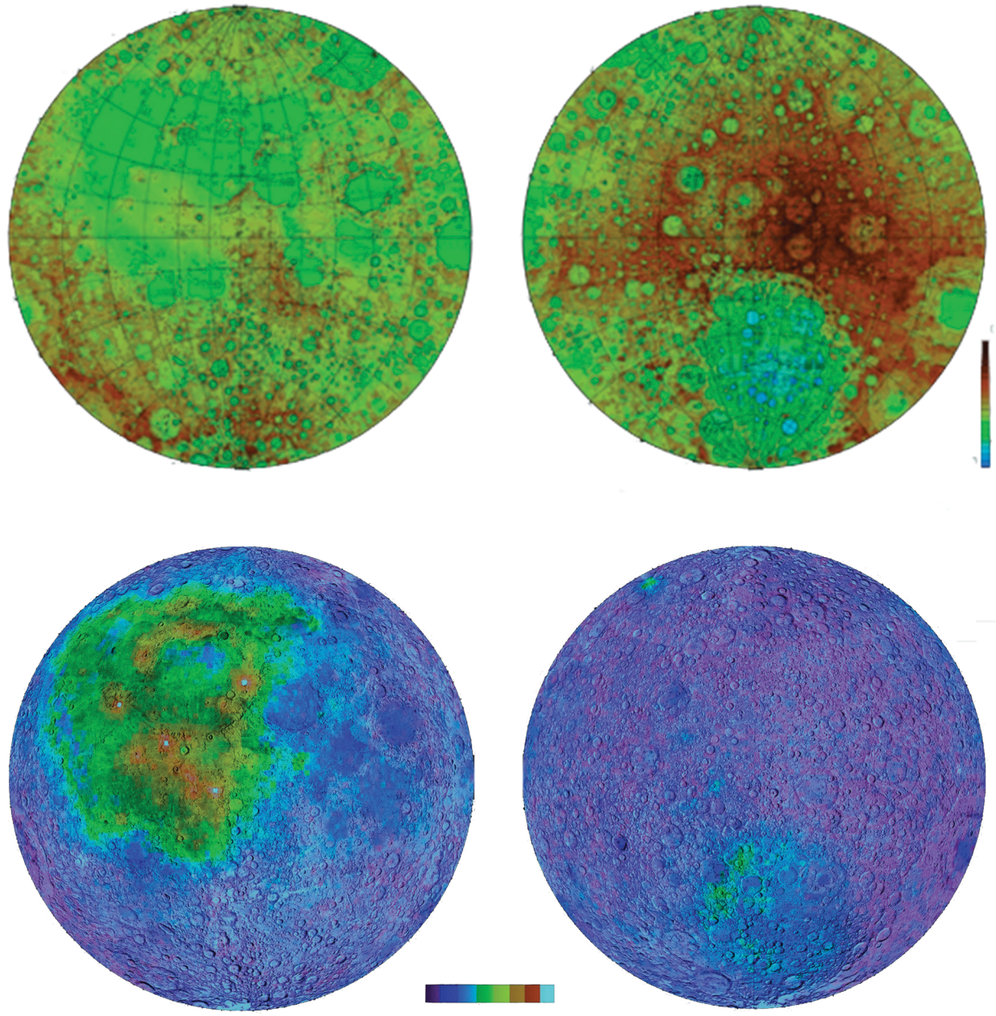
Carbonthermal reduction

Oxygen can be retrieved from Ilmenite (FeTiO3) and Rutile (TiO2) by means of carbothermal reduction. In experiments, powdered carbon and powdered ilmenite/rutile were evenly mixed and then heated to 1500 degrees Celsius. The end products of this reaction are Oxygen and a high strength Ceramic-metal composite (Cermet) of Iron (Fe) and Titanium Carbide (TiC) which has high chemical stability . While this method provides a means of retrieving all of the oxygen from ilmenite/rutile and a potential for producing reinforced, high performance and wear components and cutting tools from lunar regolith, it is at the cost of highly valuable carbon needed for biological processes.

Ilmenite: FeTiO3 + 4C ---->Fe + TiC + 3CO
Ilmenite and Rutile: FeTiO3 + nTiO2 + (4+3n)C ---->Fe + (1+n)TiC + (3+2n)CO



Mining vehicle



Maps of thorium

Thorium is used as a marker for groups of usefull elements in lunar soil. It is easier to detect thorium and deposits of it are indicators of existance of other, more usefull elements that are harder to detect.

Lunar mining

Through the next century the most valuable mineral deposits on the Moon will be those containing volatile compounds. Of most important are hydrogen, oxygen, and later possibly Helium3. The Solar wind has been imparting these compounds into the lunar regolith for billions of years.

The weakness of this plan is that the valuable materials are not concentrated. We will have to process many tons of regolith per hour to extract commercial quantities of volatiles. The regolith rock is available on the surface and already ground up. The volatiles stick best to small particles which eliminates the difficult processes of mining the rock and grinding it up ourselves. Some types of regolith have held on to their volatiles better than others and these can be identified by their mineral content from low lunar orbit. Those rich in Titanium are particularly attractive. The biggest advantage however, is that the volatiles can be removed by simple heating, i.e. Volatile Scavenging.Simple sifting the regolith to sort out the fines is what greatly concentrates the ore. No chemical process is then necessary.

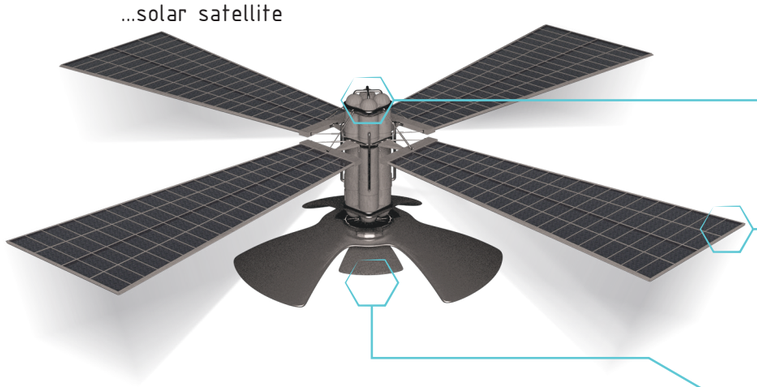
If you are handling lunar regolith for any reason, it is a very simple process to magnetically sort out certain iron bearing minerals. The magnetically sorted fines certainly constitute an ore concentrate that contains:

Ilmenite (FeTiO3)
Iron fines consisting of microscopic iron particles embedded in glass beads
Fine dust sticking to the other particles
Nanophase iron deposited on smaller grains of regolith that may be picked up during sorting

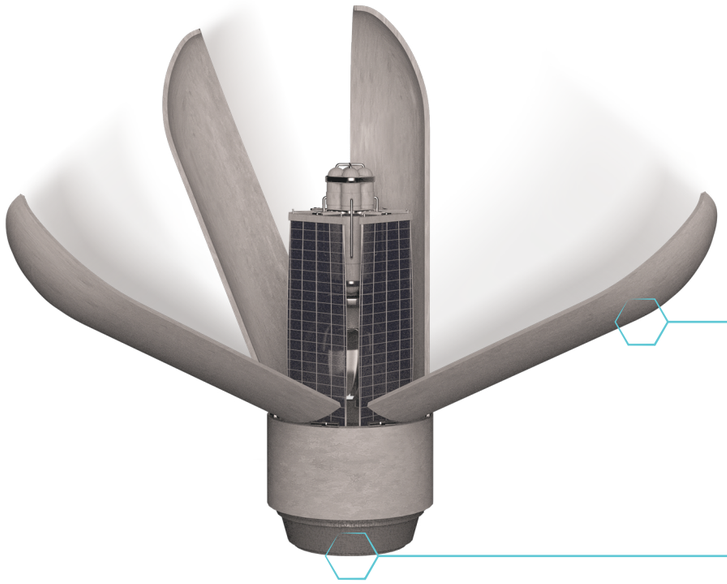
The most important of these components is Ilmenite (FeTiO3). This mineral contains a lot of oxygen that is only lightly bound in the compound and can be recovered chemically. Magnetically sorting the regolith produces a true ore concentrate of great value to lunar settlers. Heating it in a hydrogen atmosphere at 1200 C for an hour will generate significant amounts of water vapor. This is one of several forms of limonite.

Reducing ilmenite (FeTiO3) to produce oxygen, iron, and titanium in a lunar context has produced a number of proposals, many of them specifically aimed at oxygen production. Ilmenite is attractive for this purpose as the iron oxides Ilmenite contains require less energy to reduce than any other oxide on the lunar surface. For this reason, proposals which have oxygen production as the primary goal usually focus on reduction of the iron content of ilmenite.

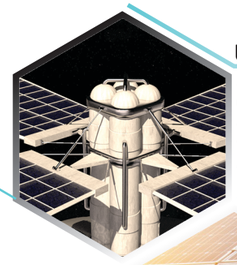
...solar satellite



...capsule: opening phase



...capsule

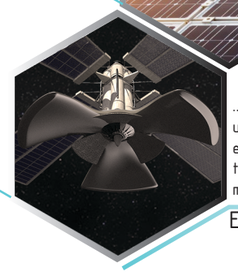


Utility module

...module that hauses laser components, transformers and capacitators. Here as well are backup batteries and trusters.

Solar Cell

...with 44% better efficiency then on the Earth's surface and nearly 100% exposure to sunlight solar cells are by far the best solution, at the moment, for powering space structures. Expected usage cycle is about 10 years...

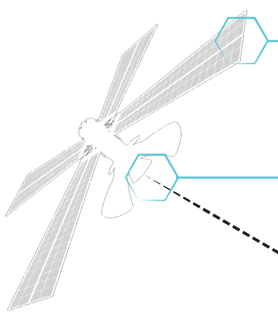


...solar-powered laser that is used to transmit gathered energy from the satellite to the recievers with the minimal loss in the efficiency.

Energy transmiter

fairing: the part of the protective shell of the satellite that is meant to be discarted when the satellite reaches predefined hight.

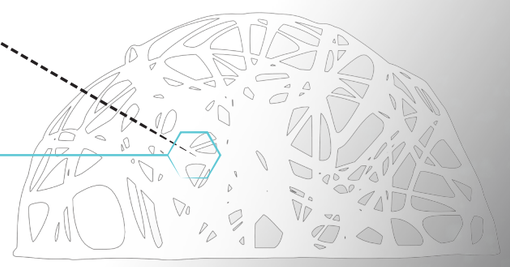
SLS: ...rocket system that is still in the developing phase, and is designed to carry stellite capsule on the top. It should run on the solid fuel and be able to reach stable orbits beyond the Moon with a human crew. It is expected to be up and running in the late years of the current decade.



. ...sun light is transformed into DC, later on DC is transformed into AC in order to power the laser beam.

....laser beam is powered with AC and is used to send focused beam of photones, geathered on the large surface of solar panels, to the relatively small surface of the structure /reciver/.

....laser beam is converted into DC via reciever's photon collector. Later on, DC is transformed into AC for further usage.



The solar energy available in space is literally billions of times greater than we use today. The lifetime of the sun is an estimated 4-5 billion years, making space solar power a truly long-term energy solution. As Earth receives only one part in 2.3 billion of the Sun's output, space solar power is by far the largest potential energy source available, dwarfing all others combined. Solar energy is routinely used on nearly all spacecraft today. This technology on a larger scale, combined with already demonstrated wireless power transmission ,can supply nearly all the electrical needs of our Lunar colony.

Advantages of space solar power are:

- solar power does not emit greenhouse gases, on Earth as well as on Lunar-based structures, with exception of launching the satellites.

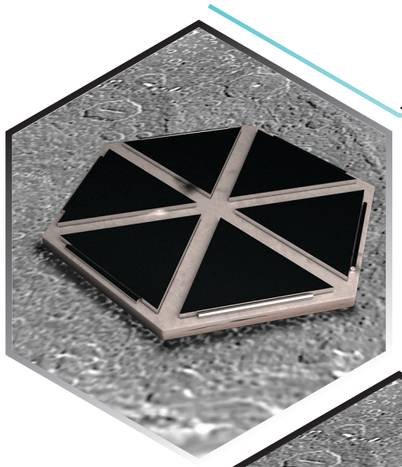
-does not pollute and depend on fresh water resources.

-does not produce hazardous waste.

-space solar power is available 24/7 in huge quantities. It works regardless clouds, daylight or wind.

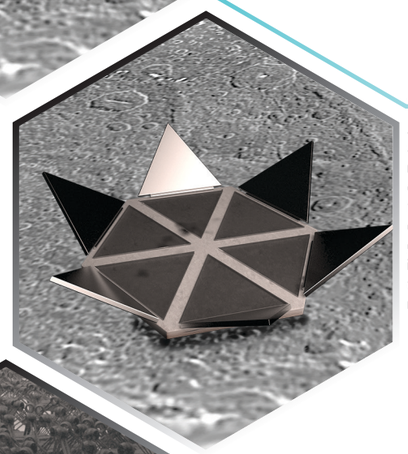
-it can be distributed to the Earth and vice-versa.

beginnings



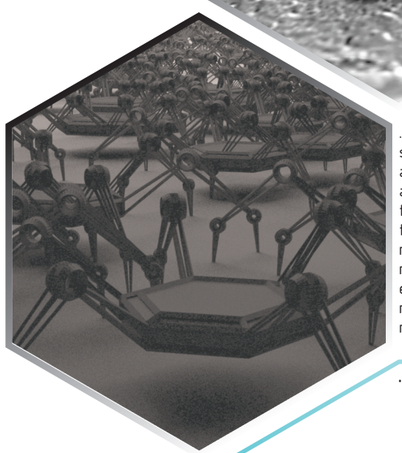
...dropping the reciever...

The reciever is preassembled object, that is used as a shell which protects the sensitive equipment during the landing and provides the computing power for controling nanites and as intial source /reciever/ of energy...



...pre-growth...

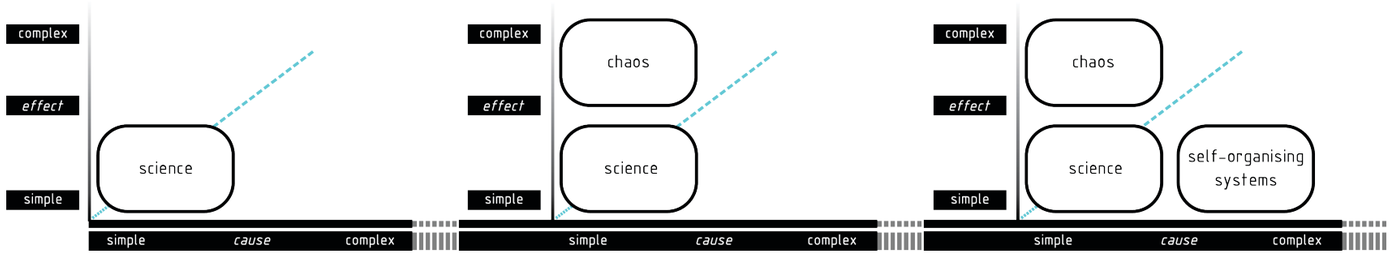
...in this phase, when the reciever lands, and begins it's function as the energy reciever and nanites control center, it opens and releases intial batch of nanites that will start the reproduction and construction process. As the structure grows, it will transfer it's energy recieving function to the growing structure, but will maintain the command over the nanites.



...when released these robots are fully self-supporting and are capable of affecting things at microscopic level. They are so small, in fact, they can build things with molecules and even change the molecular structure of existing materials. They can brake down existing materials and extract the necessary elements for building something entirely new. This allows us to create the necessary materials on the site itself.

...release 'em!

...programming the nanites...



...there are new kinds of problems if you want to program the nanites: *fitting the large program into nanite(s) and getting a complex effect from the program-nanite relation and how can we get trilions of nanites to work together.*

...classical view of science...

...there are causes that change from simple to complex, and there are effects that, also, range from simple to complex.
Science tries to find simple causes and underlying laws, so this seems to necessarily means it explains simple effects. It is considered that *simple cause can only lead to a simple effect.*

...theory of chaos...

...since the classical science can not give us the effects that we need in programming the nanites we have to think outside the box.
The chaos science shows us that classical science and intuition are simply wrong. The reason that this theory is new is because it needs a large amount of computing power to explain and explore the *complex* behavior of the *simple* equation..

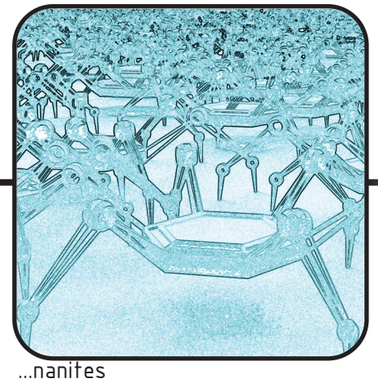
In some simple equations we have equilibrium and expected behavior for small values of unknowns, this changes dramatically when unknowns values are increased. This leads to *chaotic behavior of the simple equation.*

...theory of self-organising systems...

Many of these systems are characterized by some parameter. When this parameter is too small, the system is static. When it's to large, the system is random. When it's just right the system has structures on all scales, it is on the *edge of chaos.*

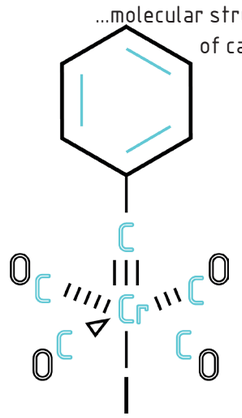
Getting the parameter right can lead to organizing huge numbers of components with minimal programming . With this we can control the nanites , and create the shape we need, certain that they are accurately creating what we want.

...program matrix



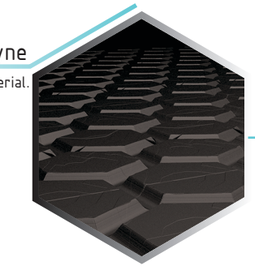
...nanites

...molecular structure of carbyne



...carbyne

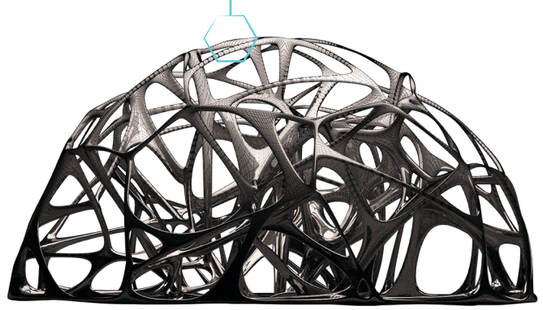
...detail of material.



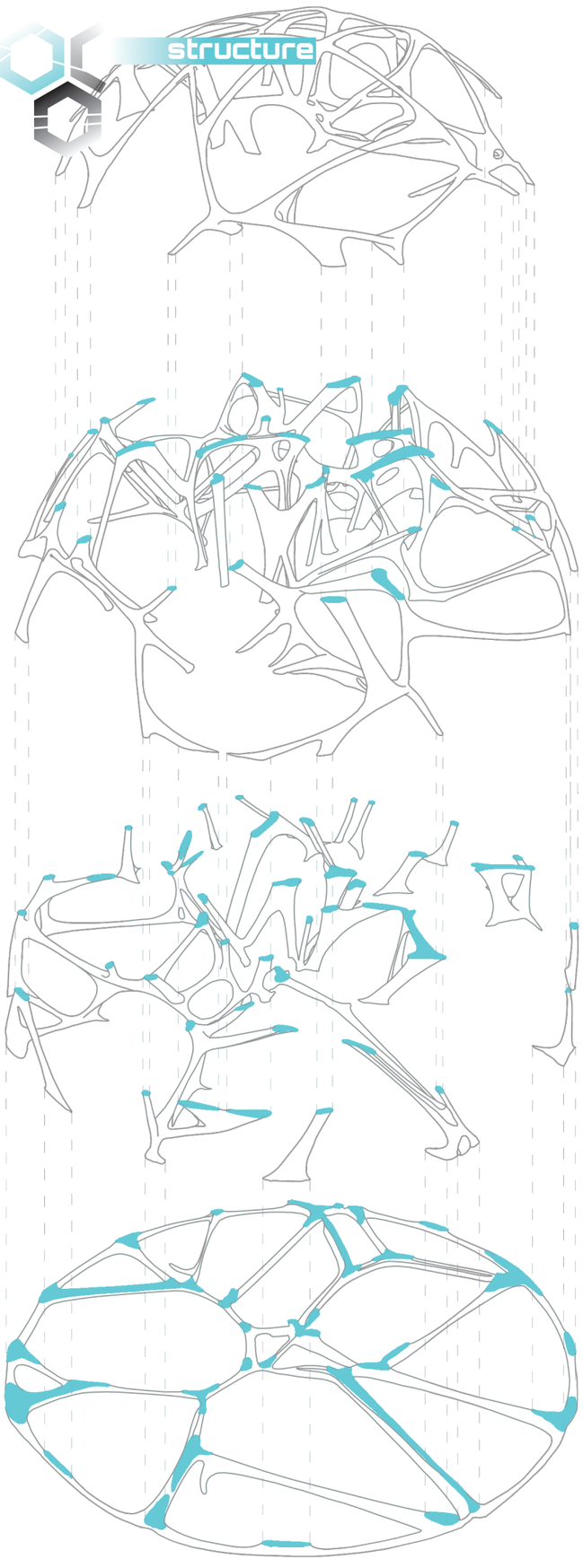
...a new form of carbon, dubbed carbyne is stronger and stiffer then any other material. In fact, carbyne is about 2 times stronger then graphen and carbon nano-tubes, which until now were the strongest materials known to man.

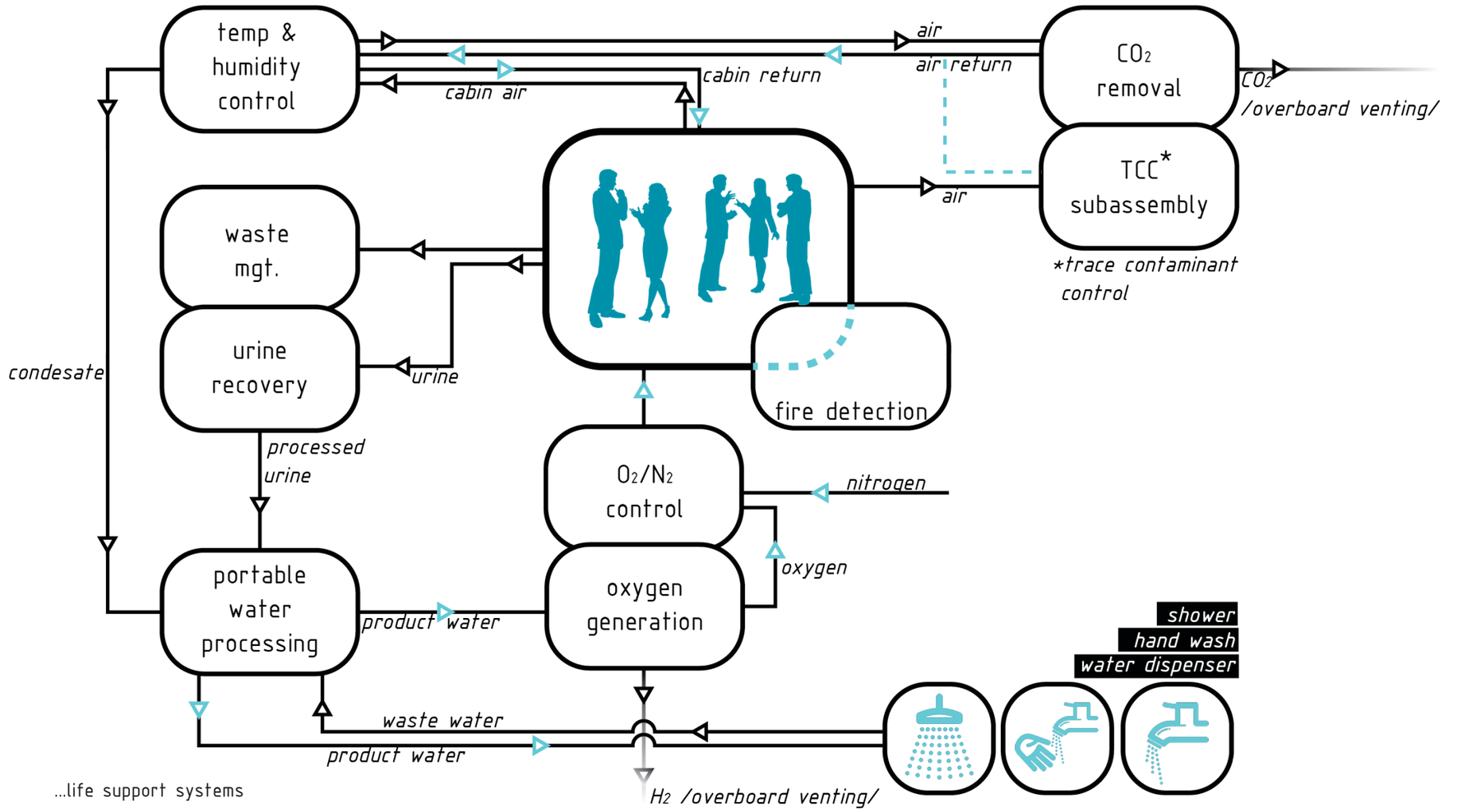
Carbyne is an indefinitely long chain of carbon atoms, joined together by sequential double bonds or alternating single and triple bonds.

Carbyne has a long list of unusual and highly desirable properties, that make it an interesting material for a wide range of applications, from nanoelectronics/spintronic devices to hydrogen storages to higher density batteries. Hydrogen storages and constructive properties, and abundance of carbon on lunar surface pointed out carbyne as perfect material for this structure.

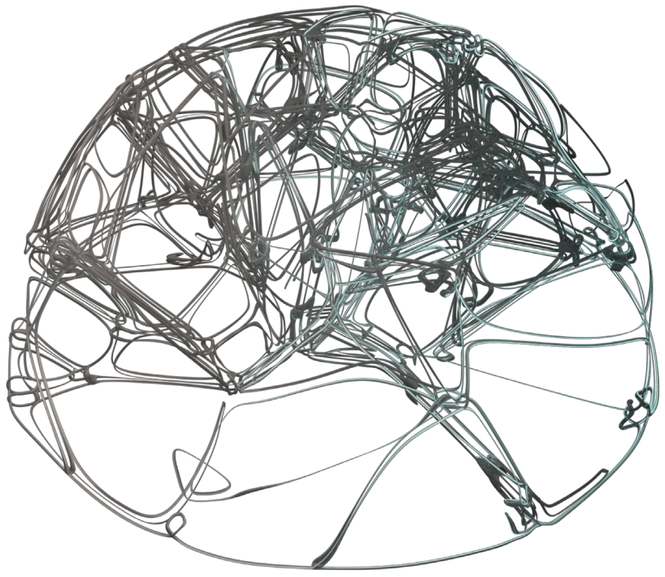


structure



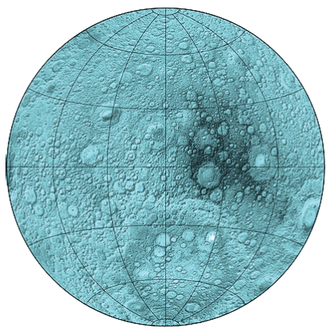


...life support systems



...location and gravity anomalies...

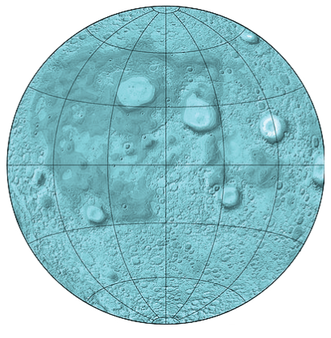
For the location we choose one crater on the near side of the Moon. The reason why near side of the Moon is chosen is mainly psychological, since this would be
The reason why crater is chosen is the presence of *mascons/lunar gravity anomalies, created when moon's surface suffers impact of meteorites. Gravity field in mascons is stronger then elsewhere/.*

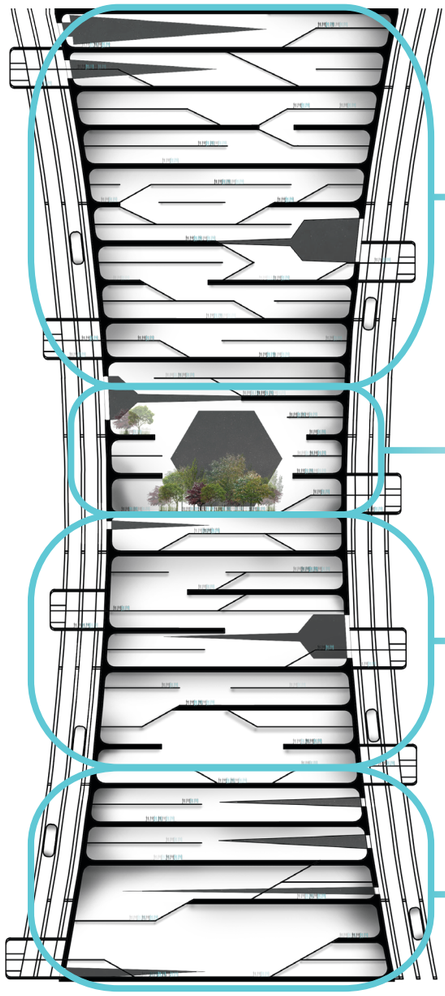


...ITS - internal transport system...

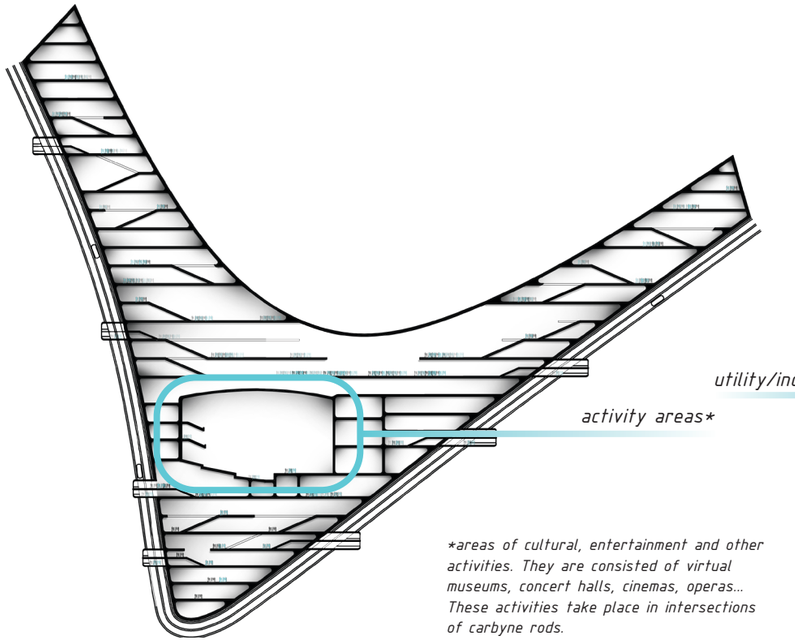
Within the structure we created a network of comunications that would be used as a one type of public transport.

ITS consists of tubes that are located around the structure, to which it is connected with bracing points, where people can enter and exit the transport. Tubes provide the vacuum and traffic lines for high-speed EM elevators/capsules/. This transport system would be used as vertical and horizontal.

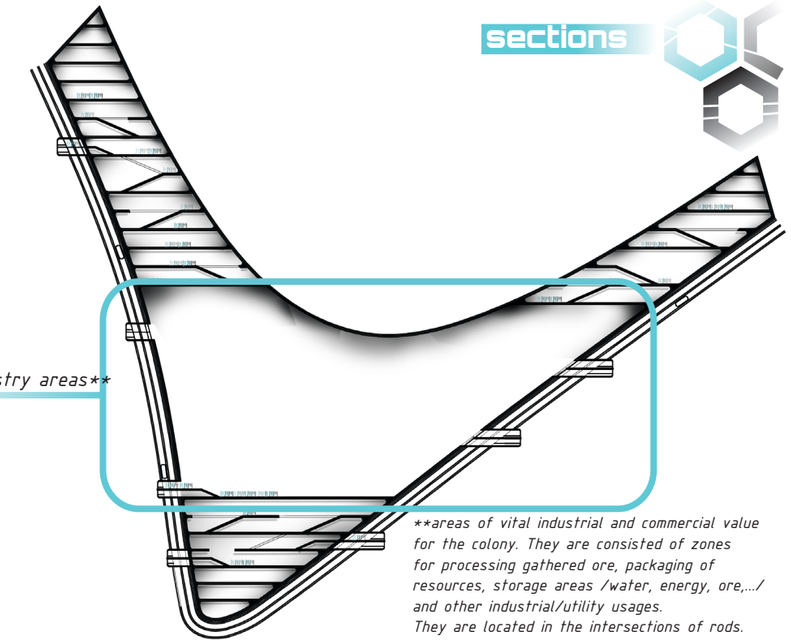




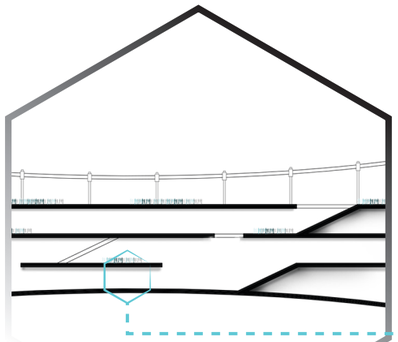
sections

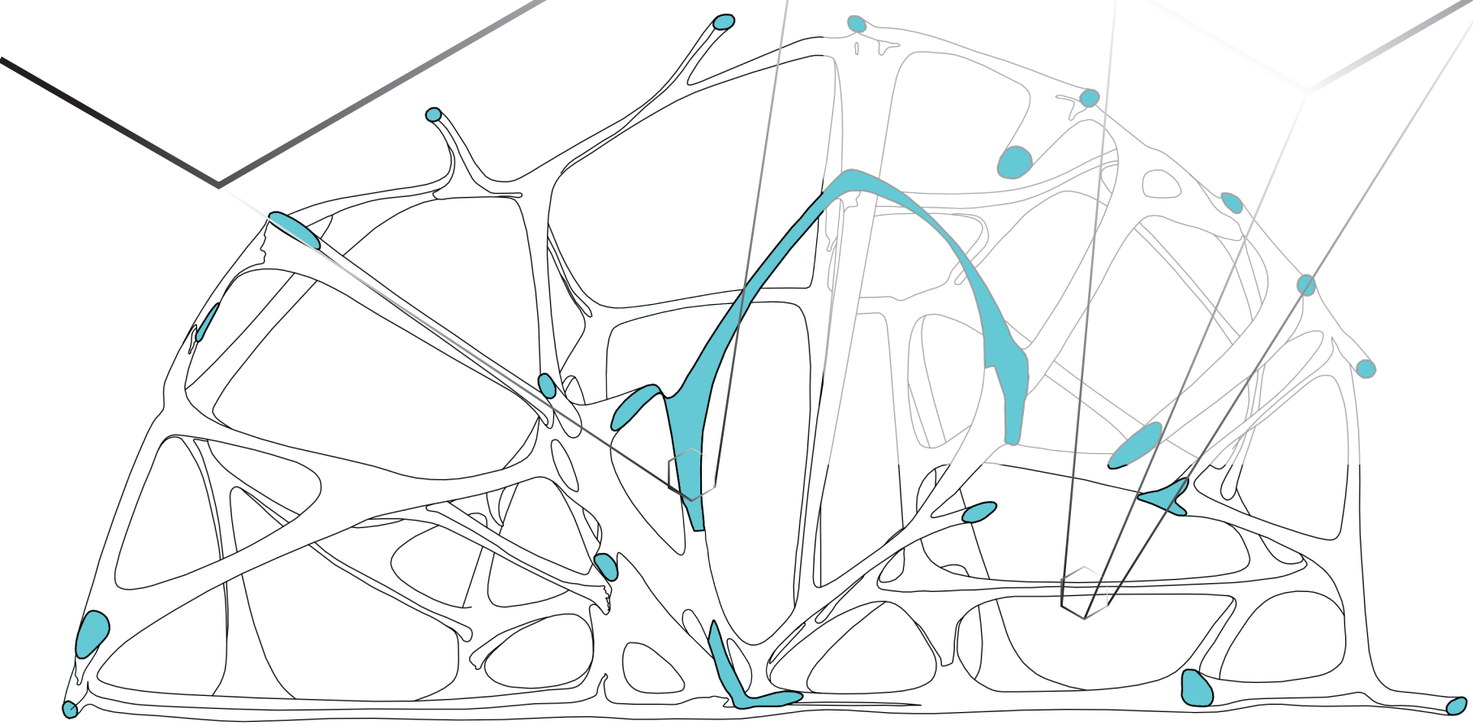


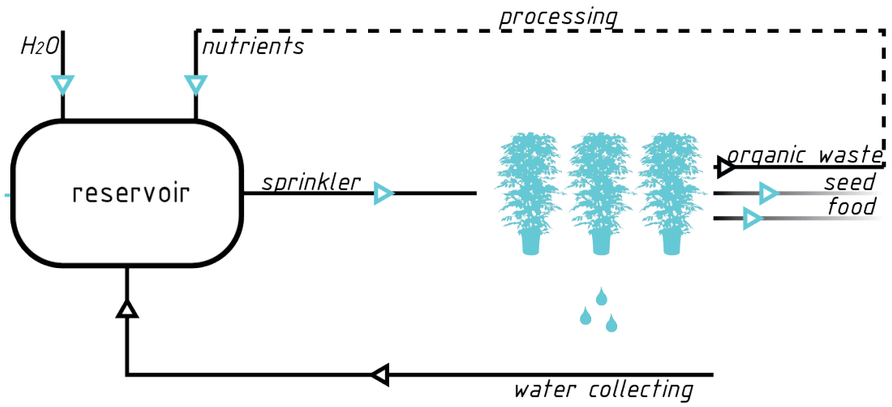
*areas of cultural, entertainment and other activities. They are consisted of virtual museums, concert halls, cinemas, operas... These activities take place in intersections of carbyne rods.



**areas of vital industrial and commercial value for the colony. They are consisted of zones for processing gathered ore, packaging of resources, storage areas /water, energy, ore,.../ and other industrial/utility usages.
They are located in the intersections of rods.







Aeroponics systems

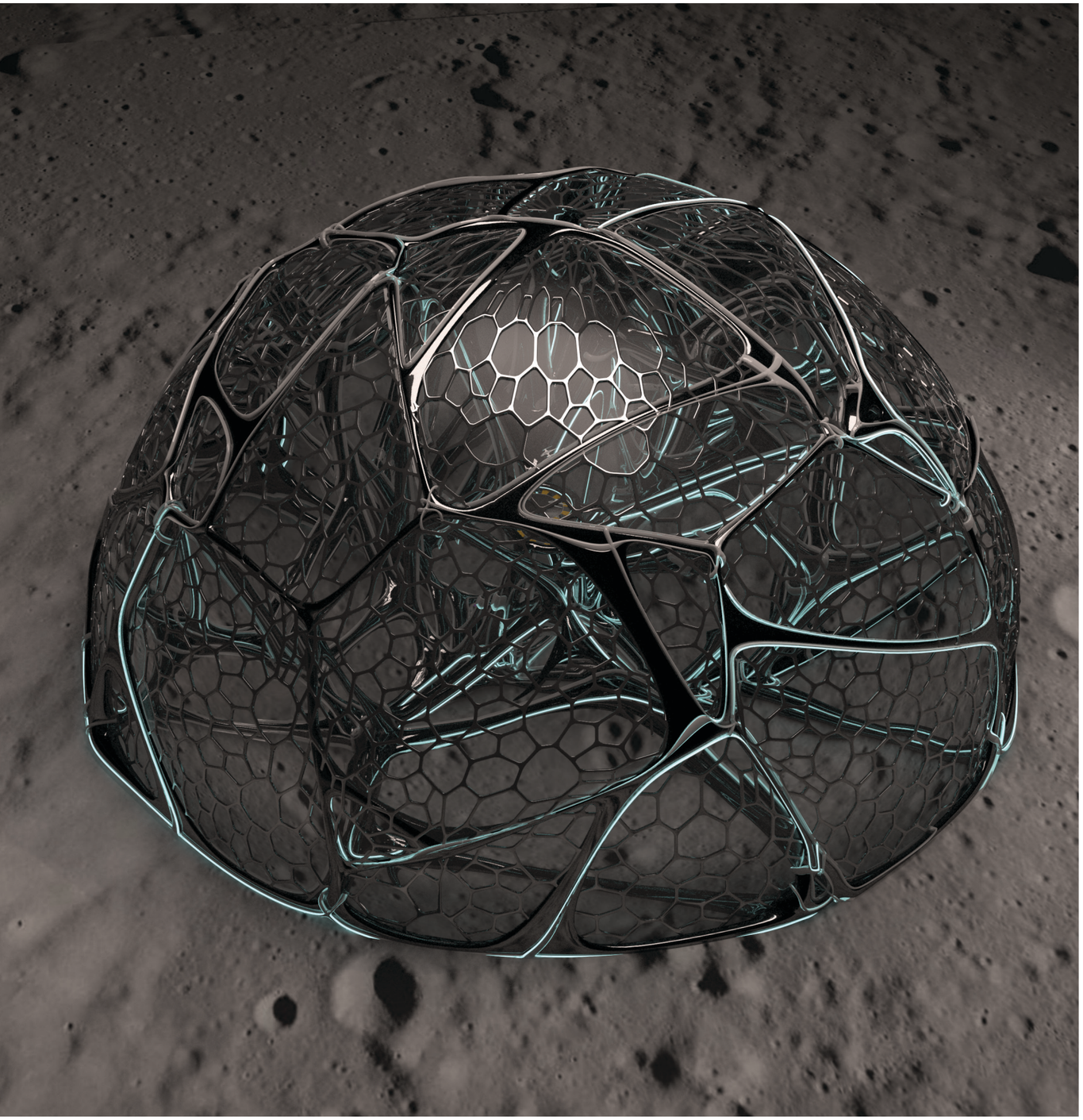
The basic principle of aeroponics growing is to grow plants suspended in a closed or a semi-closed environment by spraying the plants dangling growths and lower stem with atomized or sprayed nutrient rich water solution.

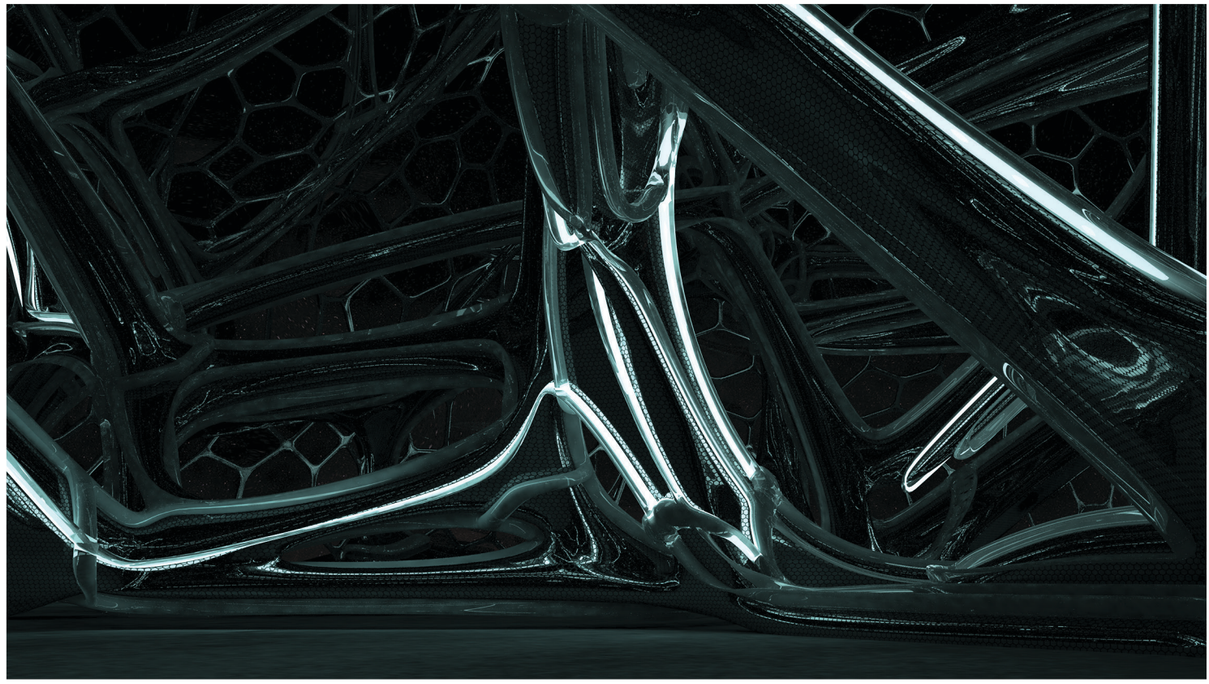
The leaves and crown, often the "canopy", extend above. The roots of the plants are separated by the plant support structure. Many times closed cell foam is compressed around the lower stem and inserted into an opening in the aeroponics chamber, which cuts on labor and expenses. For larger plants, trellising is used to suspend the weight of vegetation and fruit. Ideally, the environment is kept free from pests and disease, so the plants may grow healthier and more quickly then plants grown in soil.

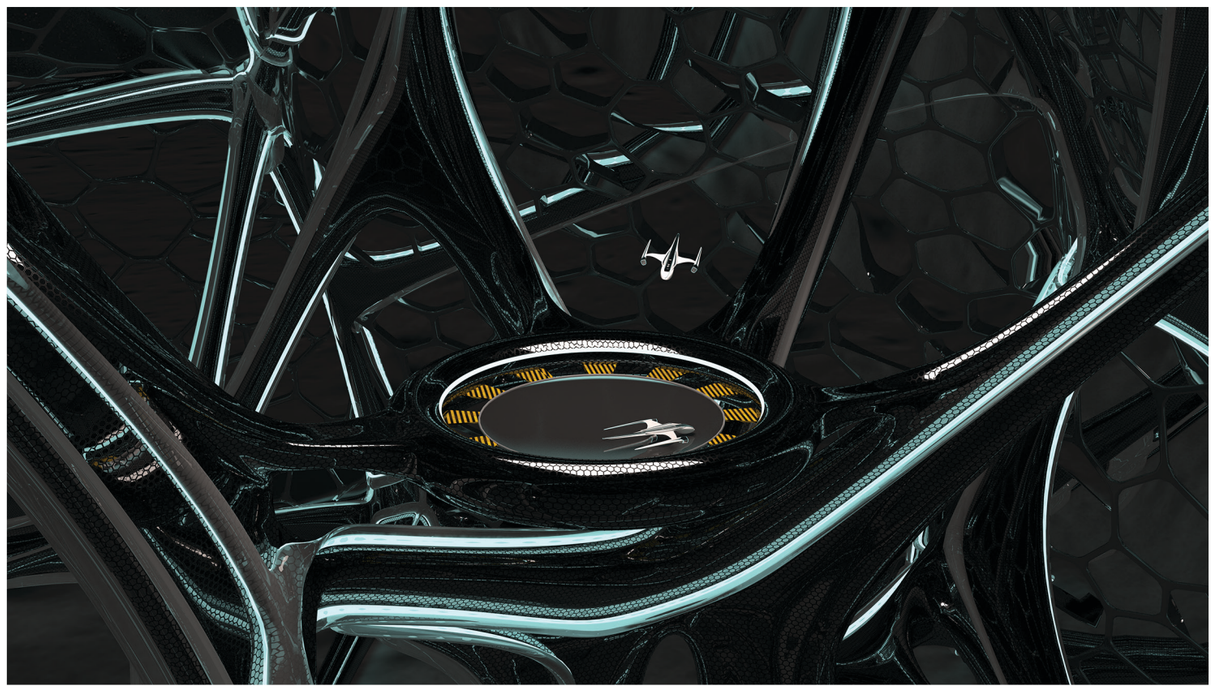
Aeroponics equipment involves the use of sprayers, misters, foggers or other devices to create the fine mist of solution to deliver nutrients to plant roots.

Aeroponics systems are normally closed-looped systems providing macro and micro-environments suitable to sustain a reliable, constant air culture.

Commercial benefits of aeroponic crop growth are less water usage, less fertilizer usage, no pesticides and huge increase in yields /up 90% less water, 95% less fertilizers, theoretically no pesticides for up to 140% larger yields then standard growth methods/.

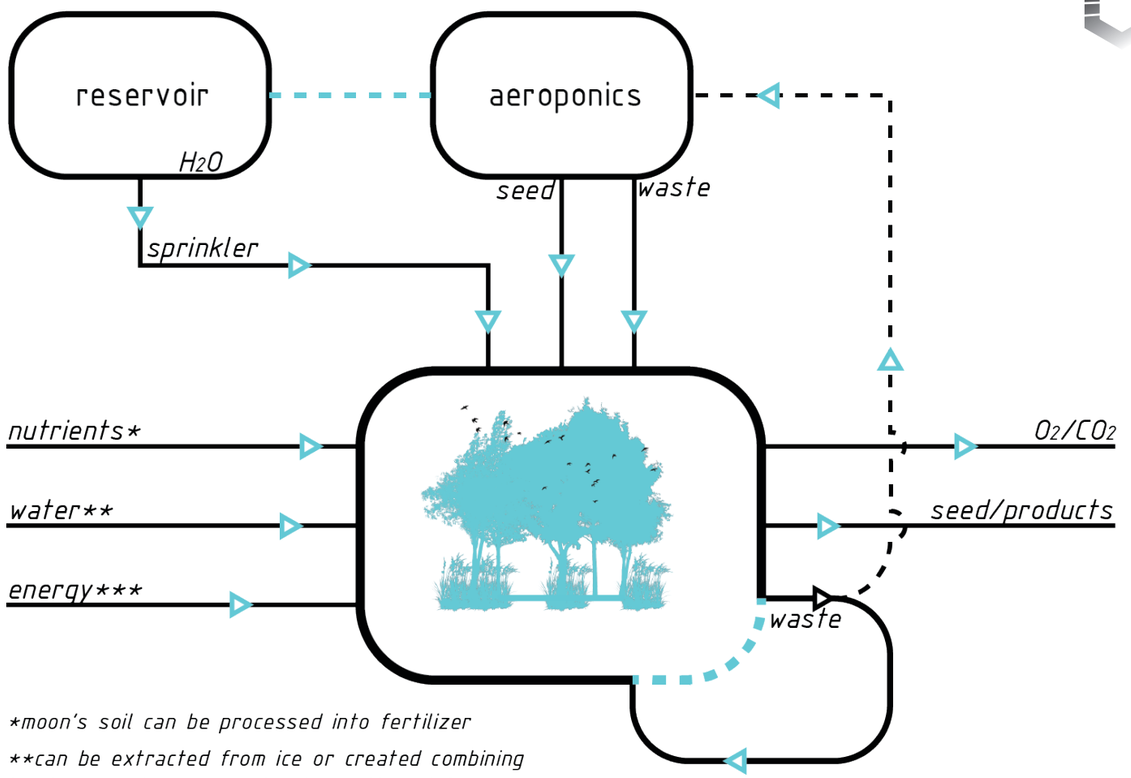






MOON:
origin point

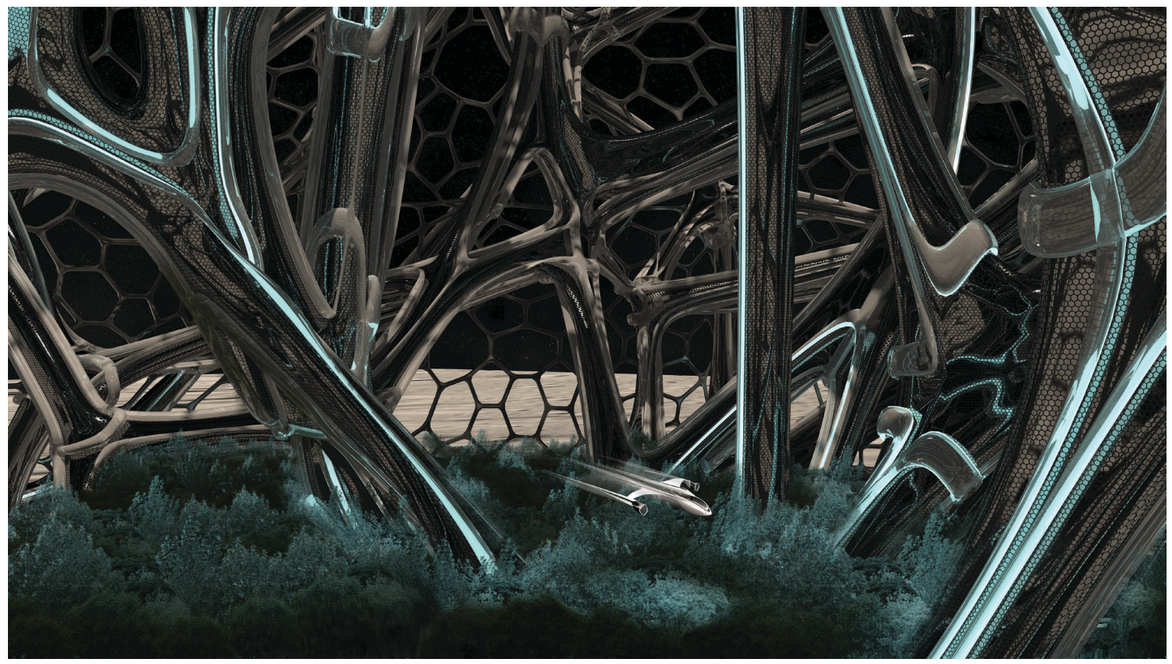
ecosystem



*moon's soil can be processed into fertilizer

**can be extracted from ice or created combining hyrdogen and oxygen molecules gathered from different industrial processes

***generated from satellites or as a back-up /supplemented from fission of H3



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" INNOVATION AND ARCHITECTURE FOR SPACE"
"ARCHITECTURE & SEA LEVEL RISE"

LEGAL WAIVER

I undersigned ..Milojе Krunić,.....

For the project team..Aleksandar Copić, Nikola Radojičić, Mina Stević, Nikola Protić

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