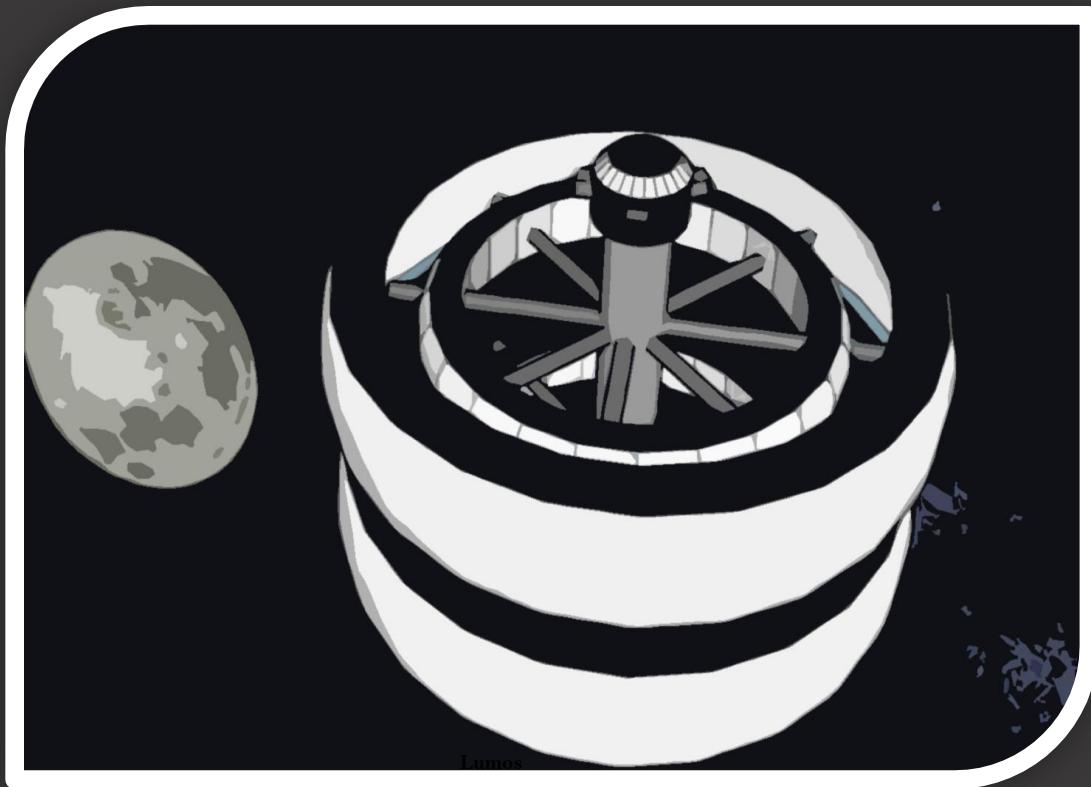


LUMOS



Lumos

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We are grateful to our mentors in the Aerospace Society of our school, Delhi Public School RK Puram who were the guiding light behind this project and helped us at each step, giving valuable feedback, making it a great learning experience. Without them, this project would not have been possible.

We are immensely indebted to our parents for boosting our morale and providing support for the project.

We would also want to thank Google for their free 3D modelling software, Sketchup, **The 3D Warehouse**, Canva where we made flowcharts and graphics and Bloxburg (Roblox).

We would also like to mention that we derived a lot of inspiration from the following grand prize winners of the previous years: Cicada [2018], The Freyr Project [2015], VONA [2014] and Hyperion Space Settlement [2011].

Finally, we would like to say that the overall experience of preparing this project was wonderful and we really enjoyed and learned a lot during researching and compiling the document. We are thankful to all those for their support and encouragement throughout this incredible journey.

It was truly an unforgettable experience!



Introduction

“Phew!” we said in unison, as we put the final hoarding in place. Such a relief! Everything was ready. The premier was to start in 10 minutes. I was having goosebumps. My heart rate was increasing second by second and there were butterflies in my stomach. I was so scared. By my side, I could see that Kahini, Manaal and Shivam felt the same. Our hard work for years depended all on this one moment when we reveal Lumos to the whole world. Everything depended on this. Everything. The Future Of Lumos.

A never-ending 2000 foot long red carpet rolled up right till the entrance of the planetarium. The streets were thronging with nearly 10,000 space enthusiasts, screaming and cheering on the top of their voices, all waiting to catch a glimpse of Lumos. There were camera crews, photographers, the paparazzi, and correspondents of all major television channels hoping to be the first to cover this great milestone event. Inside the planetarium, awaited a full-blown 4D Screen and a seating capacity for over 1,000 VIP guests, the first row being reserved for celebrities and space legends. On the other end, there were huge crowds at the stalls selling souvenirs and memorabilia of Lumos. An equally large number were gathered near the specially-built photobooth with an outer space background, waiting to get dressed in a spacesuit and getting their pictures clicked.

Seeing Jim Bridenstine, Elon Musk, Jeff Bezos and Al Globus walk over to their seats, I felt giddy with excitement that I was almost within touching distance with those who inspired us throughout this overwhelming journey. Over the deafening “woohoo!”, I could hear two teenage girls in an animated discussion about who’s got more likes on their Instagram posts of them attending the premier. While people were taking countless selfies and rushing for autographs, we couldn’t think of anything but the reactions of everyone to Lumos.

It was almost time. We clutched each other’s hands and walked up on stage to a roaring applause and loud cheer. It felt completely surreal and for a moment, I was just awestruck and completely froze on stage. Suddenly, I felt someone nagging me from behind. It was Manaal and Kahini, shaking me from my stupor. We then thanked our generous sponsors and mentors - NASA, Bigelow Aerospace, National Space Society, Aeross - The Aerospace Society of our school and to all those who helped us along the way. The curtains drew open. Lumos was now ready to be unveiled.

1, 2, 3, Camera... Lights... Action!





*The stars will never be won by little
minds; we must be big as space
itself.*

Robert A. Heinlein



Executive Summary

When most of the resources are depleted in 2045, when the population rises to its maximum, the atmosphere is not well balanced, global warming is at its peak, A spark of hope rises among the people, Lumos, in those times of dependence when there is no hope left for life. Lighting up people's gloomy, hopeless minds, displaying numerous possibilities. An inspiration, a spur of creativity and possibility, a **beam of optimistic light**. Not only will it consist of the mandatory resources needed by the inhabitants, but it will also consist of maximum places of entertainment that are vital for physical and psychological peace.

Aim:

1. To provide strong and safe structure

a. Structural design - To sustain life, Lumos has a powerful and secure structure. It will be constructed in LEO and then taken to **LLO** since an asteroid named 3554 Amun will be captured in LEO and we have ensured that the building will be finished before the asteroid arrives. The construction period will be from 2033 – 2047. Lumos' major hull components will be a central chamfered cylinder with tori attached to it by spokes. It will also consist of docking and thrusting sections, rims in the spokes so that the tori can have different RPM's. Torus A and C are residential tori while Torus B is for recreational purposes. Torus D is for industrial and research purposes. The first level consists of torus A and B while level 2 consists of torus C and D.

2. To ensure amazing living conditions outside Earth's cradle

a. Life support - Some resources are essential for humans such as water, plants, food etc. All of these are easily available on Earth. But what about space? In Lumos all these resources will be made available to inhabitants by growing crops using nutrient film technique, meat will be produced by in-vitro meat production etc.

b. Human life design - Lumos will have a total of **7000 residents including staff**. There are 670 employees. Residential and community design contain the area, number and design of the different structures present in Lumos. Education is a right of every child and it will be assured that all the students are educated in Lumos. Government is essential to take care of corruption in settlement. There is also a map of the residential tori. **We had also held a poll for the public regarding space settlements.**

c. Operations - This includes the energy source, which for Lumos, in the **helium 3 fusion reactor** as the primary source and **Lithium Nickel Manganese Cobalt Oxide** as the secondary source.

There will also be a use of many types of robots. This also includes the illumination of Lumos using the "**dynamic lighting system**". As for the transportation methods, there will be numerous types, including cycles, gyrospheres, etc.

3. To entertain the inhabitants of Lumos

a. Recreation - Lumos will have different places full of entertainment to satisfy the residents. All the recreation places will be present in torus B. It will consist of an amusement park named Seorabeol which will have exciting rides. There would be an area which will be divided into different sections dedicated to 5 different places on Earth- Dubai, China, India, Hawaii and Egypt. There will be microgravity exhibitions also. Performances such as theatre, dance, music etc. will be presented. Lumos will also have a zoo with holograms. Lumos will be the host of the legendary **Space Olympics** which will have 4 sports- catch the cash, obstacle race, quidditch and wizard chess. Space Olympics will be held every 3 years.

4. To sustain Lumos and earn money through extraterrestrial resources.

a. **Lunar Base** - Lumos has a lunar base present in the **South Pole Aitken Basin**. The moon will be mined for extraction of precious and rare metals and gases. Some of these metals such as Helium-3 and Platinum are rare on Earth and will be sold for profit. Solar energy is the primary energy source and hydrogen fuel cells are the backup source for running the lunar base.

b. **Asteroid mining** - We will be mining **3554 Amun** which will reach near Earth around 2065. We have accordingly planned to construct Lumos before that. For transportation of materials obtained from 3554 Amun, solar sails attached to shuttles will be used. There will be various compartments present in the shuttle. Solar panels and hydrogen fuel cells will be used as energy sources for asteroid mining. For asteroid capture, a machine called Duo will be sent to LLO which will consist of different parts for various purposes in it.

Purpose

Why do we need to build a settlement and take such a big step when Earth is providing us with everything we need? Why not just stay in our comfort zone? Why do we think it will lead to benefit? What is the need to promote space tourism? Why not just send robots to explore space? Is it a risk to build the first settlement in space or will it be beneficial? After looking at many aspects, we decided to build Lumos.

2. Economic justification

Perhaps the key factor of our settlement is to sustain it and for this our economic status needs to be up to the point. Now the question arises, what are the resources which will keep up our economic level? For example, Rocket burns up a lot of fuel and is very costly, instead, we will be using solar sails which are very cost-efficient. We will be **mining the moon**, for our profit, valuable materials will be sent to Earth, some materials that are plentiful on Earth and not expensive but very useful will be used in our settlement factories while some materials will be used there and then on the moon. We're going to have plenty of facilities for space tourists. Just like on Earth, we will collect money through taxes, house rent, and many other ways.

3. Tourism

Space tourism is one of the ‘hot topics’ that many people look up to. There are numerous proposals on the web describing the future of humanity in space. Lumos offers a very comfortable and suitable environment for tourists from everywhere. There is a wide range of recreational facilities that we offer that everyone will enjoy, children and adults alike. Lumos also provides space hotels and residential areas for 7000 people. Private agencies and companies will also collaborate with us for various experiments in microgravity which will lead to profit.

4. Exploration and Research

Space Exploration is a huge and important step for human mankind. It is the future for humans to learn more knowledge about our universe. Experiencing and researching various new topics in space can be interesting, making us learn something more. Keeping a settlement in the future will expose us to many mysteries in space. Lumos is the start of unveiling these secrets.

5. The Host Of The Legendary ‘Space Olympics’ -

Along with offering many recreational facilities such as microgravity performances and sports, Lumos is also the host of the legendary ‘Space Olympics’ that will take place every 3 years, which will be the host to hundreds of talented sports enthusiasts, testing each other’s skills and meeting new people.

6. Promotion And Awareness -

Our goal is to create more awareness about space tourism and the many opportunities it can provide which can strengthen society and the economy manyfold. Lumos aims to provide more information and knowledge to the people about space. As our tagline goes, “**While we are the first, we will make sure we are not the last.**” And that is exactly what we plan to do - To encourage and promote space tourism which would lead to many more space settlements in the inner solar system. *And farther beyond.*

Naming

“The Earth is the cradle of humanity but mankind can't stay in the cradle forever.”
~ Konstantin Tsiolkovsky

The name of a settlement is very important and signifies the meaning and hope that the settlement reflects. What Lumos reflects is success, huge economic profits, great milestones in the scientific and research industry, a lot of happiness, prosperity and peace, new perspectives about space, and the many opportunities it beholds. In other words, a ray of hope and light to encourage and promote space tourism which would lead to many more space settlements. We considered many names and decided our settlement would be named, “Lumos”.

Lumos was one of the first spells that the great Harry Potter had learned at Hogwarts School Of Witchcraft And Wizardry in the fictional fantasy series written by the millionaire author Joanne Rowling. Lumos, as mentioned previously, was one of Harry Potter's **first spells** and Lumos is also the **first settlement in space**. Lumos is derived from the Latin root, 'Lumen' which further originates from the Latin word 'Lux' which means **light**.

This name is very significant and its meaning is very deep which is that Lumos will provide **a ray of light and hope in the dark and unknown - Space**. This light will be the guiding light behind many other space settlements as they follow Lumos' steps and venture into the dark and unknown. The light that is produced in the wand by enchanting 'Lumos' in the Harry Potter Series also keeps away the ghosts and bad omens and symbolically even the space settlement will prove to be economically independent and will keep away potential threats. This wand lighting charm in the series also discloses and illuminates magically hidden pieces of architecture and other instruments. In the same way, even the space settlement will lead the way to many other inventions and huge milestones in the scientific and research industry and will also reveal the curtain behind many other opportunities.

And so today we present to all those reading this;

Lumos - ‘While we are the first ones, we will make sure we are not the last...’





STRUCTURAL OVERVIEW

“Science can amuse and fascinate us all, but it is engineering that changes the world.”

~ Isaac Asimov



Location

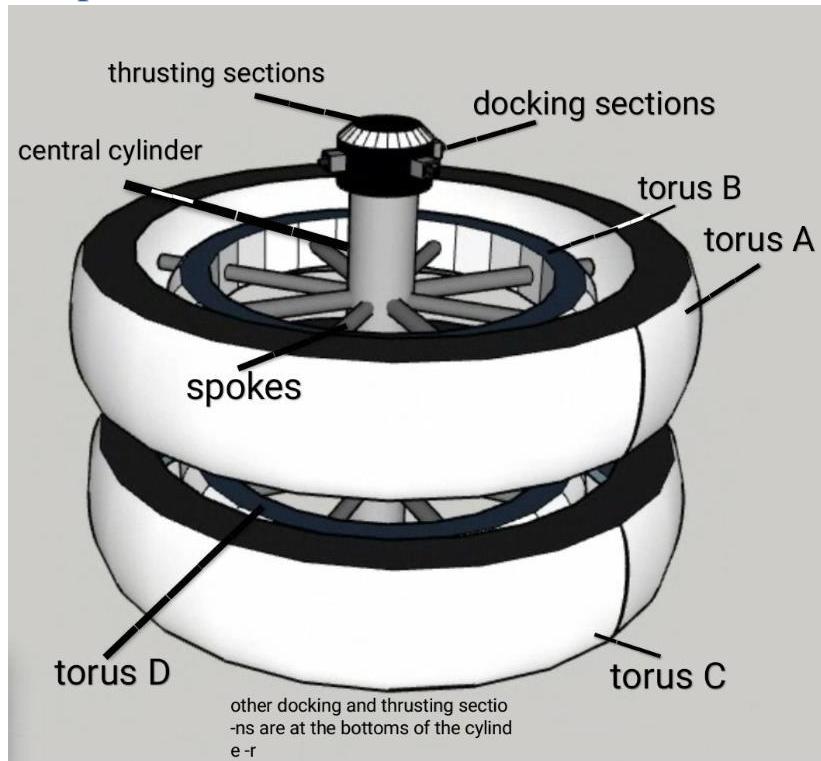
Location	Pro's	Con's
Geosynchronous Orbit	<ul style="list-style-type: none"> • Good Location for placing satellites. • Very beautiful views. • It is one of the best locations for broadcasting. 	<ul style="list-style-type: none"> • Tough to broadcast near the polar region. • Weak coverage at higher latitudes. • Problem of Space Debris. • Already very crowded with satellites. • Orbital Decay due to atmospheric drag.
L4	<ul style="list-style-type: none"> • Very stable • Not much use of thrusters to keep it centered in its position due to gravity dimples. • Best Location for major development. 	<ul style="list-style-type: none"> • They might collect and retain some space debris. • L4 can be a little far from the moon and earth compared to LLO, since the resupplying would take more time from L4.
LEO	<ul style="list-style-type: none"> • Short Distance from the earth, leading to less travelling time. • Has a perfect amount of solar power and heat distribution • LEO is in the earth's magnetic field. It is said that the radiation is much higher outside the earth's magnetic field, so the radiation will be much lower in LEO. • Easy and Fast Communications • A beautiful view of the earth 	<ul style="list-style-type: none"> • It can be very unmaintainable because of orbital decay. • It has a lot of space debris which collides a lot, leading to huge problems. The collision of two things can create a lot of space debris fragments. • It has short days and nights which lead to less utilization for solar energy.

We decided to choose the **LLO (Low Lunar Orbit)** as the location of Lumos.

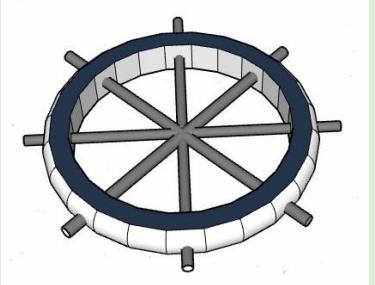
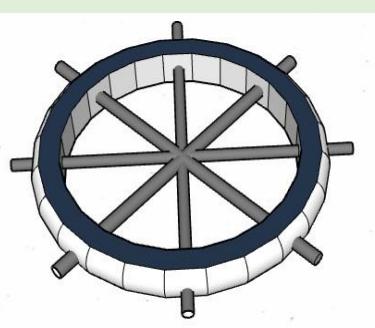
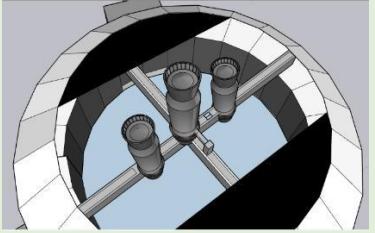
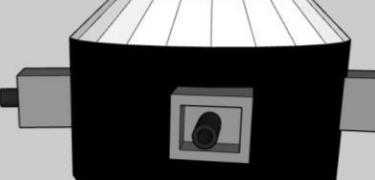
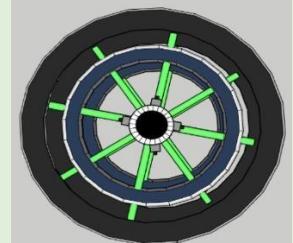
Lumos will be placed in the LLO (Low Lunar Orbit). We will be positioning our settlement at **86° (frozen orbit)**, as it is very stable and it doesn't change its position from mascons. This location is ideal for Lumos as we will get all the minerals that have been mined in a short period of time, as it is very close to the moon. Unlike LEO which has a lot of space debris, **LLO doesn't have any space debris**. Due to this, there won't be any orbital decay on our settlement, therefore improving the sustainability.

The main disadvantage is of the **gravity perturbations and the mascons**. These mascons have a very large magnitude which could cause the lunar orbit to change significantly and could also make it unstable. One example is of the PFS-2 which was placed at an orbital inclination of 11 degrees and lasted only 35 days in lunar orbit before crashing onto the lunar surface. The only way to overcome this con is to place Lumos in one of the “frozen orbits”. There are four “frozen orbits” where a spacecraft can stay in the low orbit indefinitely. These are located at 27°, 50°, 76°, and 86°. Placing our settlement in one of these “frozen orbits” will also reduce the usage of station-keeping propellant and the gravity anomalies and perturbations will be cancelled out. We choose our location at the **86° frozen orbit** because it is very stable which is very beneficial for us and it doesn't change due to mascons. Also, we will be able to acquire the benefits of a **polar orbit**. Lumos will be positioned in a **low orbit of 100 km**. The reason for choosing this is that Lumos will remain stable and prevent extreme gravitational pull.

Major Hull Components



Name	Function	3D Design Of Component
Central Cylinder	There will be a high-speed elevator in the main cylinder in between. This will be used for transportation in the levels of the settlement. This will not rotate.	
Top Torus A (Outer)	This torus will be used for the residential area where all the staff, tourists, permanent residents, etc. live. This will rotate to generate artificial gravity.	

Top Torus B (Inner)	This torus will be the recreational area where people would enjoy many types of games including, Virtual Reality, Hologram Museums, Space Olympics, etc. This will also rotate to generate artificial gravity but the rpm will be comparatively lesser because we will also have microgravity sports.	
Bottom Torus C (Outer)	This torus will also be used for the residential area where all the staff, tourists, permanent residents, etc. live. This will rotate to generate artificial gravity.	
Bottom Torus D (Inner)	For this torus, there will be two purposes - Research and Industrial. The torus will be divided into half for these two purposes. The first half would be used for research purposes. The second half would be used for industrial purposes , where there will be agriculture, perfect crystal etc. (<i>Refer To Perfect Crystals Industry</i>) This will also rotate to generate artificial gravity.	
Thrusting Section	(<i>Refer To Thrusting Section</i>) The thrusting sections are located in the chamfered cylinder which is non-rotating.	
Docking Section	(<i>Refer To Docking Section</i>) The docking sections are located in the chamfered cylinder which is not rotating.	
Spokes	There will be transportation spokes from the central cylinder to the inner torus and spokes from the inner torus to the outer torus. People can transport using many modes of transfer. (<i>Refer To Transportation</i>)	 Spokes are highlighted in green

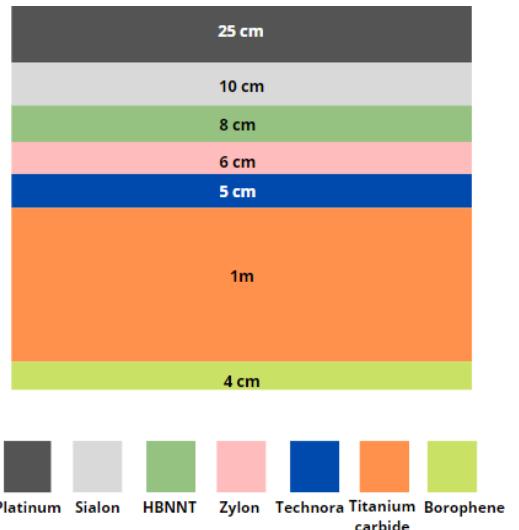
Dimensions Of Hull Components

Hull components	Dimensions				Surface Area	Volume
	Height	Length	Major Radii	Minor radii		
Torus A (Residential)	-	-	223 m	162 m	1426197 m ²	115521982m ²
Torus C (Residential)	-	-				
Torus B (Recreational)	-	-	180 m	120 m	852733 m ²	51164029 m ²
Torus D (Research and Industry)	-	-				
Spokes	-	-	6 m	-	1730 m ²	9230 m ²
Chamfered Cylinder	81 m	-	13 m	-	7680 m ²	43000 m ²
Upper Docking Section	55m	-	85m	-	45690 m ²	1250000 m ²
Lower Docking Section	55m	-	85m	-	45690 m ²	1250000 m ²
Upper Thrusting Section	25m	-	50m	-	23562 m ²	196000 m ²
Lower Thrusting Section	25m	-	50m	-	23562 m ²	196000 m ²

Construction Materials

Material	Total Quantity For Torus A And C	Total Quantity For Torus B And D	Source	Useful Properties
HBNNT	750000	21344	Earth	Great radiation shielding and very strong.
Sialon	65000	22345	Earth	Good thermal shock resistance.
Zylon	50000	18455	Earth	Excellent thermal stability and strong.
Technora	55000	23455	Earth	Heat resistant.
Titanium Carbide	55000	39876	Earth And Moon	Heat shielding coating.
Borophene	19674	19674	Earth	High electric conductivity.
Platinum	25000	10000	3554 Amun	Highly dense and malleable. Very corrosion resistant.

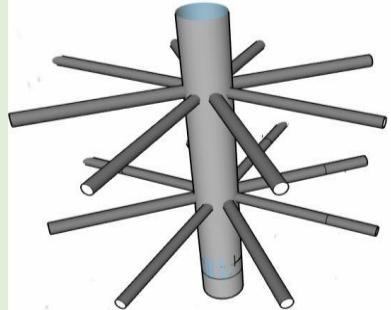
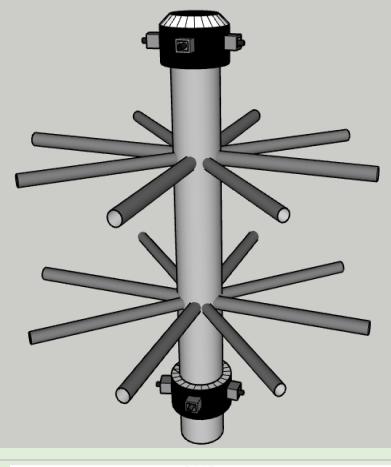
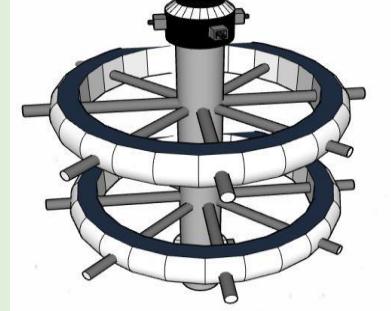
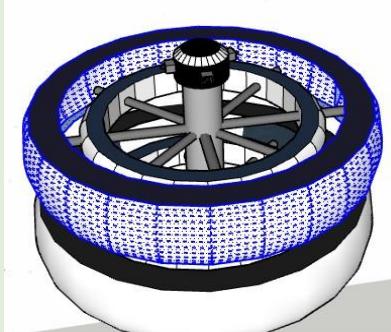
Construction Materials Layer Concept

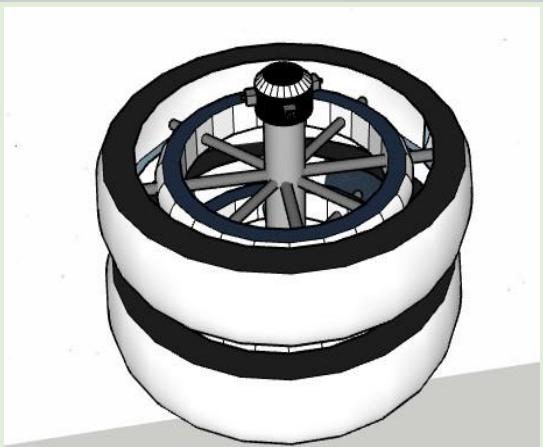


Construction Sequence

We chose to **build Lumos in LEO** and then we will transport it to LLO. Why not just build it in the LLO only? The reason is that we will be mining an asteroid called 3554 Amun which will come near the Earth in 2061. (*Refer To Asteroid Mining*). The construction process will be completed by build-bots and the tiling and interior construction will be done by consilio robots (*Refer To Automation*). Our construction will start from its center to the ends.

Table for construction sequence

Step	Construction sequence	Time required	Image
Step 1	<p>The build-bots will start constructing the settlement beginning with the central cylinder. In the first step, the build-bot will build the spokes for the tori in level 1 and level 2.</p>	3 years	
Step 2	<p>After the welding of joints built in the first step, consilio robots will tile the central cylinder and the spokes for the tori in levels 1 and 2. This step will also include the construction of the lower and upper docking and thrusting sections which will be constructed by build-bot and will also be tiled by consilio bots. The upper and lower docking and thrusting sections will be constructed of zylon which has high tensile strength and excellent thermal stability.</p>	2 years	
Step 3	<p>After completion of the second step, the build-bot will build the mesh of torus B and D which are both the inner torus level 1 and 2. The tiling of torus B and D will be done by consilio bots.</p>	2 years	
Step 4	<p>This step will be started after the completion of step 3. In this step, Torus A and C mesh will also be constructed with the holders by build-bots. The holders will be connected to the spokes. They will also be tiled in this step by consilio bots.</p>	3 years	

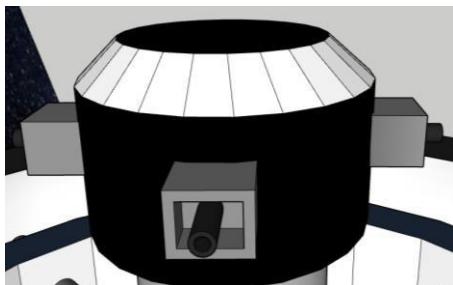
Step 5	After the basic structure has been built, industries will be built, residential and recreational facilities will be constructed, human life supports will be constructed, pressurization of volumes, sealing of hull components, and then Lumos will be ready. The materials that will be used for construction purposes in the settlement will be sialon, technora, titanium carbide, aluminum and platinum.	4 years	

Total Time Taken To Construct The Settlement – 14 Years (2033 – 2047) Docking Section

There are eight docking sections in all. The main function of these is to receive and transport goods, cargo, and people.

Upper Docking Section

There are four upper docking sections located on the **chamfered cylinder**. The purpose of the upper docking sections are to be more of a port for the tourists for transportation back to the Earth.



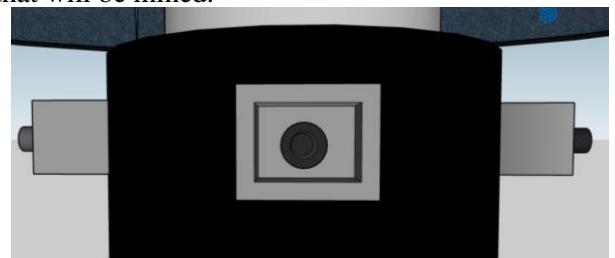
Ion Thrusters have proved to be very efficient for in-space propulsion. Spacecrafts like Deep Space 1 used ion thrusters and changed its velocity by 4 kilometers per second and the amount of xenon also reduced drastically by around 75 kilograms. The main advantage of ion thrusters is that they achieve high specific impulse because of the fact that they accelerate the exhaust to a very high speed. There was a test conducted by the NSTAR about the life span of electrostatic ion thrusters and they resulted in up to approximately 3.5 years of constant thrust at the highest power. The thrusters that were chosen are helicon double layer thrusters.

Mechanism

- With one open end, gas is released into a chamber that is tubular shaped and a specially shaped antenna is wrapped around this chamber.
- Radiofrequency power is coupled with this antenna.
- Due to the electromagnetic wave, the gas breaks down and consequently, a plasma is formed.
- The plasma is then further heated.
- The properties of this plasma change very fast and result in the double layer.

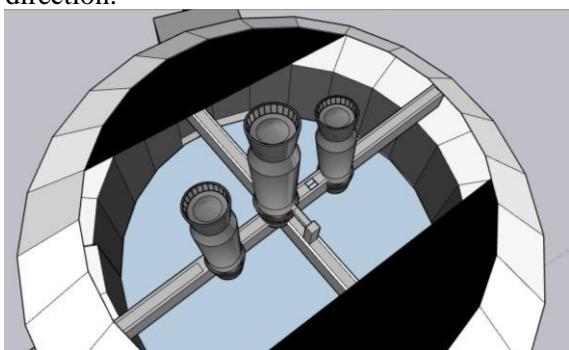
Lower Docking Section

There are four lower docking sections located on the chamfered cylinder. The purpose of the Lower Docking Section is also to serve as a sort of port for cargo, goods, metals to the settlement and some to the Earth such as lunar materials and the asteroids that will be mined.



Upper Thrusting Section

The location of the upper thrusting section is on the chamfered cylinder. It will have **three main helicon double layer thrusters** - the radius of the middle one being 8m and of the other two being 6m. The main function of these is thrusting Lumos in the downward direction.

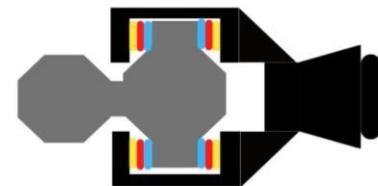


Lower Thrusting Section

The location of the lower thrusting section is beneath the chamfered cylinder. This will also have three helicon double layer thrusters whose function will be to thrust Lumos in the upward direction. The radius of the middle one is 8m and the radius of the other two is 6m.

Artificial Gravity

Pseudo Gravity will be generated by means of rotation. Making use of electrodynamic technologies to generate artificial gravity is a very good method for Lumos. The method for generating artificial gravity is to use an electrodynamic rotation generator which by means of velocity control which will be achieved if we use a unified trajectory control system that consists of propulsion and steering systems.

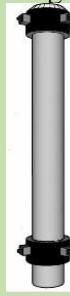


SCM's (Super Conducting Magnets) will be put on the exterior of the rotating hull component. These sets will be placed in facing pairs and will generate a permanent magnetic field. There might be external electromagnetic disturbances and to reduce that, the **null-flux coils** would be placed over the propulsion coils, even in an overlapped manner. Advantages of using null-flux coils are that they are very stable. They also have high mechanical strength. There will also be a significant gap between the null-flux coils and the rotating module system which will improve the safety and would also lead to a decrease in the construction costs. This system is noiseless and very efficient. The gravity calculation for each hull component has been done using the formula given below - $A_C = \omega^2 \times R$

$\omega = A_C$ radians/second

Rpm = $60 \times A_C \times R \times 2\pi$

Where, A_C = centripetal acceleration, R =Radius , ω = angular velocity [VONA 2014]

Residential Torus A 	Radius = 223m Required Gravity = 1 g $= \frac{30\sqrt{\frac{1}{()}}}{223}$	1 g 0.7 rpm	This is very healthy and mentally ideal for residential torus A and is also earth-like gravity that is very ideal for residing.
Residential Torus C 	Radius = 214m Required Gravity = 1 g $= \frac{30\sqrt{\frac{1}{()}}}{214}$	1 g 0.7 rpm	Is psychologically perfect and is also earth-like gravity which is very appropriate for living which will be comfortable for people.
Recreational Torus B 	Radius = 156m Required Gravity = 0.3g $= \frac{30\sqrt{\frac{0.3}{()}}}{156}$	0.3 g 0.4 rpm	The recreational torus will have 0.3 gravity for macro-g sports, performances, and tournaments for the entertainment and happiness of tourists.
Chamfered Cylinder (includes docking and thrusting sections) 	_____	0 g	The docking and thrusting sections are also located there. It will be very difficult to dock ships in a rotating module. This will also help in easy storage.
Industrial Torus D	Radius = 156m Required Gravity = 0.5g $= \frac{30\sqrt{\frac{0.5}{()}}}{156}$	0.5 g 0.5 rpm	A lower gravity level will help in the shifting of materials and workload for heavy machines. It also saves energy for fuel.

There will be a separate rim with holes which can be fitted by the spokes, connected to the residential tori. To maintain the artificial gravity of the two tori, there will be a moment where the spokes are pushed into the whole of the rim, preventing the whole torus from rotating. This period of time will be used by the people to transport either way from the torus to the transportation cylinder.

Lubricants

For Lumos, we will be using solid lubricants as liquid lubricants easily squeeze out, while solid ones don't get out of place. Solid lubricants also reduce the dependence on friction between two surfaces rubbing on each other. The lubricants used will be **Ceramic-based self-lubricating material, Polymers, Graphite, Tungsten disulfide, Boron nitride, Polytetrafluoroethylene, Dry Moly Lube, Molybdenum disulfide.**

Thermal Rejection And Radiation

Inspired by the TCS (Thermal Control System) of the ISS, **Retractable Thermal Radiators** will be used which are based on the process of conduction. In this process, there will be a water loop and an ammonia loop. The water loop will be executed as a cold plate which will absorb the extra heat generated from the Helium 3 fusion reactor through the process of convection. The heat absorbed from the cold plate will then enter and go through the **ATA (Ammonia Tank Assembly)** to enter the ammonia loops. These ammonia loops will then go to the radiators releasing the heat into open space. This way, Lumos will have an ideal temperature balance. The machineries won't get overheated or damaged.

Advantages of this Process:

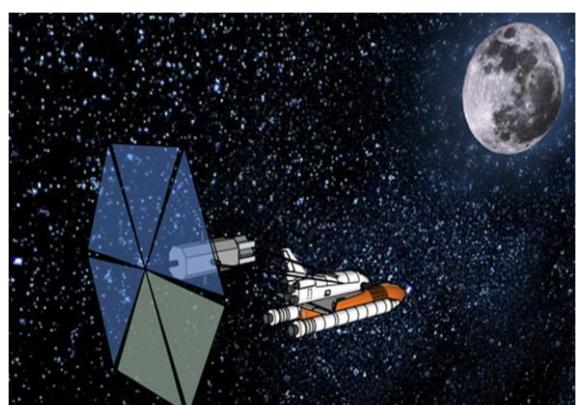
1. There will be stable temperatures in the settlement.
2. Nothing will get overheated and get damaged.
3. This process makes the heat rejection faster.
4. It doesn't cover too much volume outside the settlement, reducing the maintenance of this area.

Window Materials

Materials	Properties	Thickness
Aluminium Oxynitride Glass	Radiation resistant and very hard.	10cm
Polycarbonate	Can be easily molded and are strong.	8cm
Perlucor Material	Durable and thermal stability	5cm
Electrochromic Glass	Reflects infrared light.	3cm
Poly (Methyl Methacrylate)	Reflects gamma radiation rays.	2.5cm

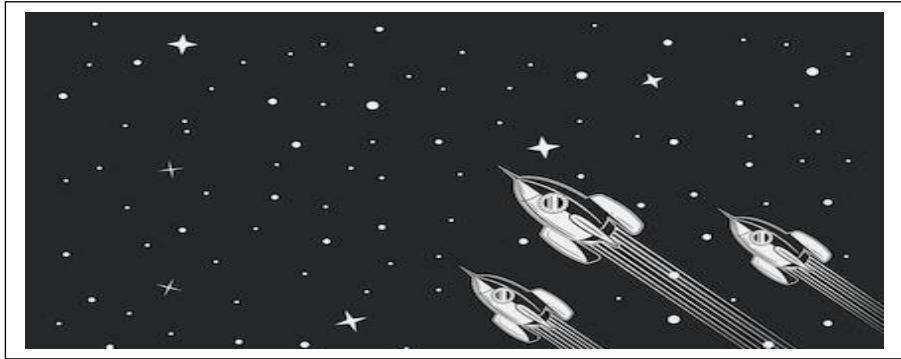
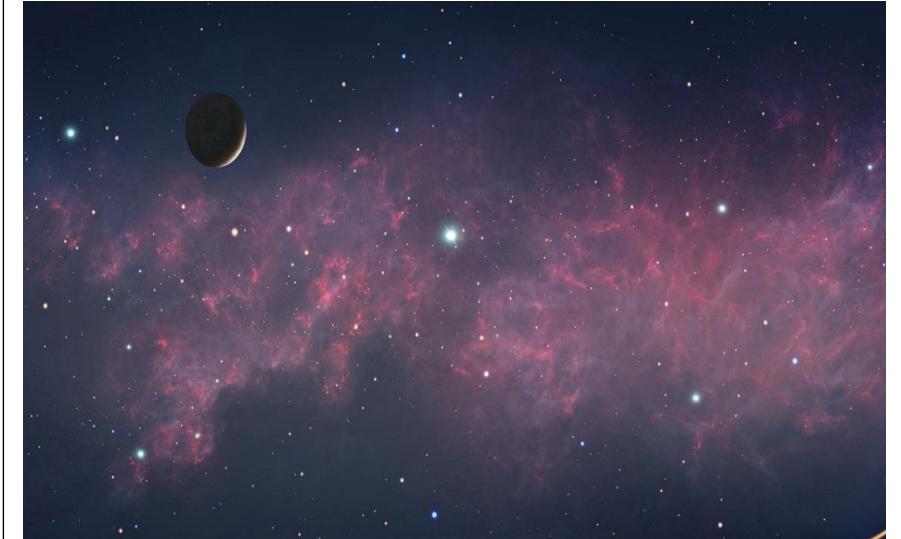
Propulsion

The distance between LEO and LLO is around 25,000 km approximately. After Lumos is built, a space shuttle would especially be launched in space with **strong lasers** called **SULF**. The **solar sails** would move according to which direction Lumos has to be transitioned by moving opposite to that direction. The space shuttle will keep moving behind Lumos. The shuttle won't use solar sails but will use engines only. Once it will reach LLO all the temporary sails will be removed and transported back to Earth by the same shuttle which brought the lasers.





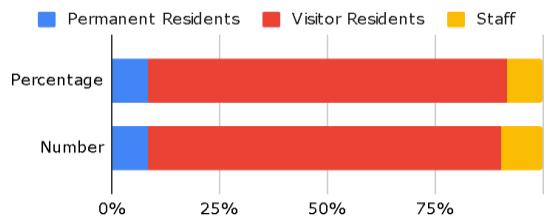
HUMAN FACTORS



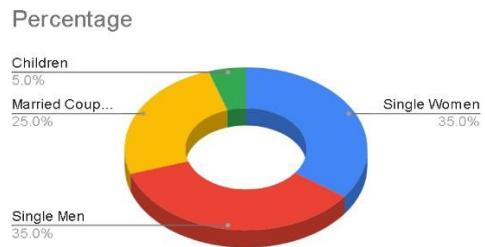
(Refer To Bibliography For All Image Sources)

Demographics

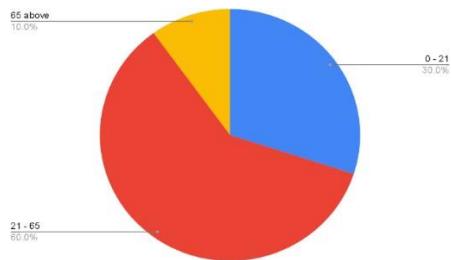
	Permanent Residents	Visitor Residents	Staff	Total Population
Percentage	65%	25%	10%	100%
Number	4550	1780	670	7000



	Single Women	Single Men	Married Couples	Children
Percentage	35%	35%	25%	5%
Number	1827	1827	1305	261



Age	Percentage	Number
0 - 21	30%	2100
21 - 65	60%	4200
65 above	10%	700



Consumables

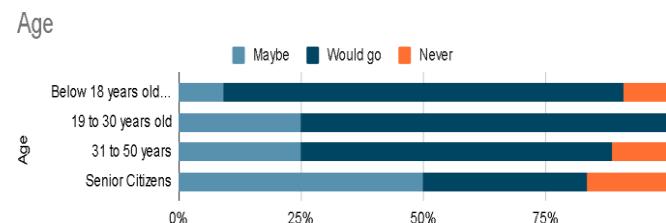
Item	Amount Per Meal	Number of meals per month	Total Amount per person per month (in kg)	Total amount 7000 people per month (in kg)	Total amount for 7000 people per year (in kg)	Source
Rice	100 g	20	2	14000	168000	Produced locally
Flour	100 g	25	2.5	17500	210000	Produced locally
Vegetables	150 g	60	9	63000	756000	Produced locally
Fruits	100 g	30	3	21000	252000	Produced locally
Drinking-Water	2 L	Everyday	60	420000	5040000	Earth
Milk	200 ml		6	42000	504000	Produced locally
Tea	minimum quantity	As required	0.5	3500	42000	Produced locally

Eggs	1/3 (unit)	Everyday	60 (units)	420000	5040000	Earth
Coffee	minimum quantity	As required	0.5	3500	42000	Produced Locally
Chicken/Fish/Soyabean	100 gms	20	2	14000	168000	Produced locally and Earth
Pulses	minimum quantity		1	7000	84000	Produced locally
Salt	minimum quantity		0.5	3500	42000	Earth
Sugar	minimum quantity		1	7000	84000	Earth
Cooking Oil	minimum quantity	As required	1	7000	84000	Earth
Butter	minimum quantity		0.2	1400	16800	Produced locally
Spices	minimum quantity		0.1	700	8400	Produced locally
Protein Bars	50 g	50 gm	15 (units)	105000	1260000	Produced locally
Nut (almonds, walnuts, cashews, etc)	minimum quantity	minimum quantity	0.5	3500	42000	Produced locally

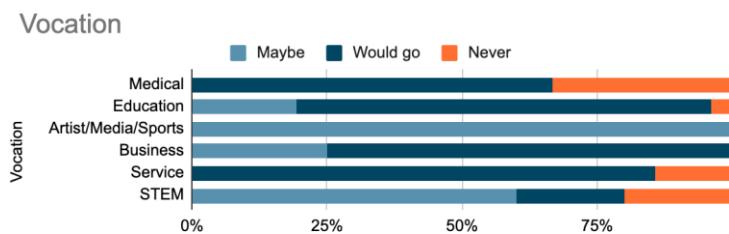
Poll Analysis

We conducted a survey to see whether people of different backgrounds would like to go to Lumos noting that they would be away from their families and friends but with also everything they require. A couple of questions were asked in the form and detailed analysis and prediction have been given of each question below. We received 105 responses.

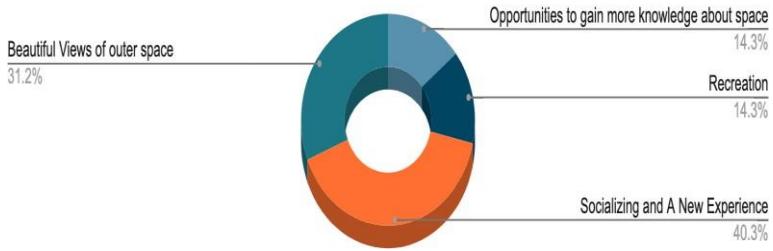
Age Factor - The first question that the survey asked was the age range of the people filling the form. This was very important to know as the age also changes the requirements and wants and if we could know that, we could introduce more things and stuff to do which that particular age group would love to do. The prediction was that the younger people such as people below 18 and between the age 19 to 30 years would mostly want to come to Lumos because it would be a very fun, thrilling, and completely new experience (which could actually make their "Instagram go viral!") Well, the prediction proved partially correct. The result was that 42% of those below 18 years old answered yes with the most number of agreements to living in space. The second maximum agreements were received from the age category 31 to 50 years old. Surprisingly, only 5% of 19 to 30-year-olds answered yes. Only 4% of the Senior Citizens answered yes.



Professional Factor - We could gather more data about what kind of people would like to come and what all they would like to do which is very beneficial. The prediction was that people more into media, sports, and children and teachers (in the education field) would love such an experience because students and teachers are always looking to explore new things and especially children love mysteries and what could be more of a mystery than space? The prediction proved to be partially correct with the most number of agreements from the education community (50%). The second maximum agreements were received from the medical field with 20% probably for research and new opportunities and experiments. However, people more into media and sports only answered with 2.5% yes. Many people in service were also interested.



Favourite Activity



Favorite Activity - We wanted to see different people's interests when they were asked this question in the survey if they were living in space. This would help us know more about the people living in the settlement so that we can incorporate those in Lumos. In the survey, we were given 4 options: Beautiful Views of outer space, Opportunities to learn more knowledge about space, recreation and Socializing, and a New Experience. We had predicted that there would be more people interested in the recreational part, since there are many types of activities they could play, like spacewalks, VR, etc. But, most of the people in the survey had chosen "Socializing and a New Experience". 31.2% of the people chose Beautiful Views of outer space and Opportunities to learn more knowledge about space had a percentage of 14.3 which tied with Recreation. Recreation had a percentage of only 14.3 but Socializing and a New Experience had a percentage of 40.3. This states that people would like to meet other people and gain experience of this adventure.

Community Design

Neighborhoods

The two residential tori A and B have been divided into four neighborhoods/constituencies in each one: **Gryffindor, Slytherin, Ravenclaw, And Hufflepuff (inspired by the Harry Potter Series)**.

Gryffindor And Slytherin Neighborhood - The Gryffindor Neighborhood has the same facilities as the Slytherin Neighborhood. In the Harry Potter Series, the students selected to be in the Gryffindor and Slytherin House possessed qualities of bravery and courage and the desire to be a leader. In the same way, at Lumos, the Gryffindor and Slytherin Neighborhood are the place for young leaders, innovations, and ideas to grow. These neighborhoods are very modern and have supermarkets, big buildings, offices, and government buildings too.

Hufflepuff And Ravenclaw Neighborhood - The Hufflepuff And Ravenclaw Neighborhoods have the same facilities. The main specialties of these neighborhoods are greenery, nature, beautiful views, more open spaces, etc. This doesn't mean that these neighborhoods wouldn't have any modern facilities, they will have modern facilities as well but more open spaces.

Residential Design

Type of house	Number of floors	Dimensions	Area
Duplex	2	Length = 12 m Width = 7 m	84 m ²
Condominium	5	Length = 22 m Width = 9 m	216 m ²
Cottage	1	Length = 10 m Width = 8 m	80 m ²
Bungalow	2	Length = 14 m Width = 7 m	98 m ²
Villa	2	Length = 20 m Width = 8 m	160 m ²
Space hotel	3	Length = 49 m Width = 16 m	784 m ²

Interior Layout Of Duplex

12 m



Interior Layout Of Bungalow

14 m



Interior Layout Of Condominium/Apartment

22 m



Interior Layout Of Villa

20 m



Interior Layout Of Cottage

10 m



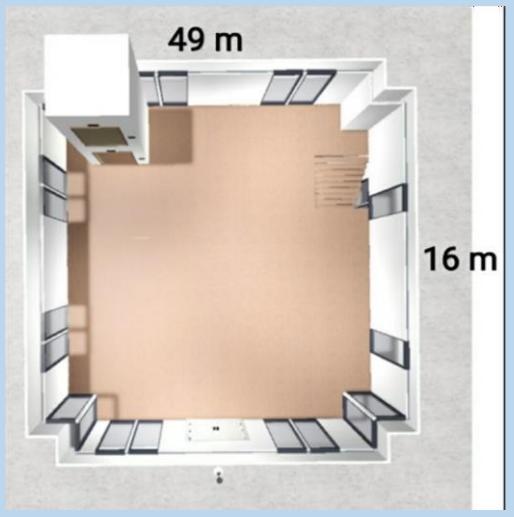
Space Hotels

There will be 4 space hotels named - Euphoria, Moody moon, The Mississippi Hotel, and Hotel Agoura. Euphoria hotel will be located in Gryffindor in Torus A. Each hotel will be 49m long and 16 m wide. Each hotel will have three levels and a terrace. The height of the first level will be 5 meters tall. The height of the second and third levels will be 4.5 m tall. Therefore, each hotel will be 14 m tall. Each hotel's area will be 784 m^2 . All the hotels will have a similar structure.

First Floor Of Each Hotel



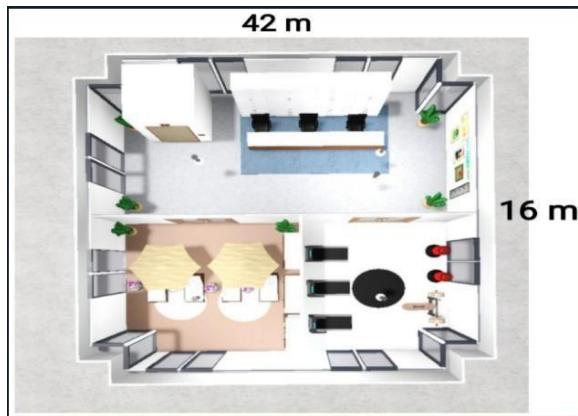
Second Floor Of Each Hotel Containing All The Rooms



Exterior Of Each Hotel



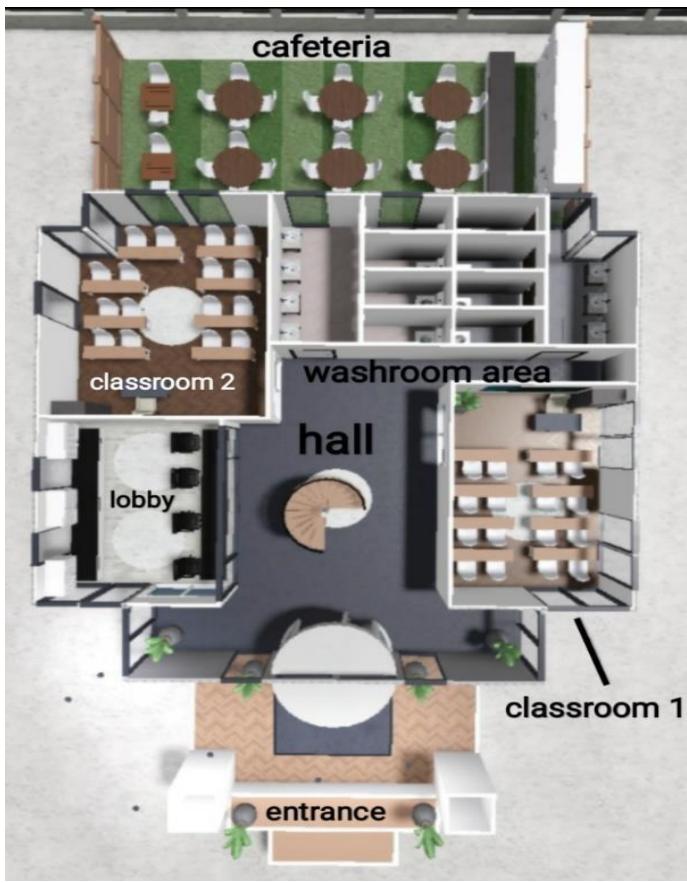
Third Floor Of Each Hotel



Education

In Lumos, all stages of education will be present- kindergarten, primary school, elementary school, and graduate schools. The fee of children of age 6 years up to 15 years, there would be no fee. The education system will ensure that the fees for the children of age 16 and above are also not very high and the government will provide the children excelling with scholarships up to 80%. There will be campuses in total. There will be 1 campus in each residential torus. **There will be a total of 2 campuses in the settlement.** There would be 4 major aims of the educational system of Lumos - academic development, social development, physical development, and linguistic development.

Interior Layout Of The Schools



Exterior Of The School



Administration

'The Ministry Of Magic'



Legislature

Each of the constituencies will vote for two persons who they think is the most ideal person for being a part of the legislature. However, these laws have to be passed/approved by the **Prime Minister who is the head of Lumos**. The position of Prime Minister is very significant as he/she is the leader of the whole settlement.

Executive

The Executive consists of the police department, security department, the prosecution department, etc. There will be a **chief/head of each of these departments** who will be the leader of the respective department.

Judiciary

There will be only one court which will be located in the There will be 8 judges and they will be selected on the basis of their scores in the law exam. The minimum age requirement of taking this exam is 37 years and the retirement age is 60 years.

There will be **forums/meetings every week** between the ministers and members of departments to discuss issues, ask questions, debate on various topics, and have press conferences.

Fundamental Rights are also a very important part of Lumos' constitution.



Recreation

“All work and no play doesn't just make Jill and Jack dull, it kills the potential of discovery, mastery, and openness to change and flexibility and it hinders innovation and invention.” ~ Joline Godfrey

SPACE OLYMPICS

To promote sports, Lumos will organize space Olympics **every 3 years**. As the Olympics will take place every 3 years, the sports complex where the Olympics will take place will stay empty which will lead to loss instead, the rest of the time residents of Lumos will use the sports complex. There will be **5 tournaments** to compete in and there will be wizard chess, quidditch, catch the cash, and obstacle race.

Quidditch – The inspiration for Quidditch was taken from the ‘Harry Potter Series’.



Wizard chess - The inspiration of Wizard Chess was also taken from the ‘Harry Potter Series’. The hall in which it will play will have an area of 150 m^2 with a length of 15 m and a width of 10 m. The hall will be 10 m tall.



[Wizard Chess Image Link](#)

Catch The Cash



The hall's area will be 288 m^2 with a length of 17 m and a width of 16 m. The height will be 12 m.

Lumos Space Olympics Logo



Obstacle Race - There would be 5 levels of different difficulty levels. Each participant will be provided with shoes with boosters which will help them go up faster. So the area of the hall will be 130 m^2 with a length of 13 m and a width of 10 m. The height will be 23 m.



Theatre And Auditoriums

To make these rooms soundproof, there will be **acoustic wedges panels** mounted on the walls. The length of these is 24m and the width of it is 16m. So, the total area will be 384m^2 .

Paradise

To comfort our residents, Lumos will have a fair named paradise in the recreational torus which will consist of some unique cultures of different countries and some places. Different sections will be made in the fair for Egypt, India, Dubai, Hawaii, and China. There would be pathways and some open areas also in the fair which will altogether have an area of about 150 m^2 . The total area of the fair will be 975 m^2 .



There would be exhibitions, art galleries and museums displaying artwork, micro-g experiments etc.

Amusement Park

Lumos will have an amusement park named **Seorabeol** with exciting rides and stalls.



Seorabeol

Lumos will also have a **paintball arena** with soft walls.

Holographic Animal Zoo

Lumos will be using hologram machines to project animals to the zoo in Lumos. These hologram machines are designed in a way that the audio of the animals can also be set and the holograms will move naturally like the animals do on Earth. We will be using 7D hologram projectors. There would also be an aquarium present in the zoo which would contain the hologram of water and the aquatic animals.

Virtual Reality

In these VR rooms, there will be a proper VR headset and a VR treadmill so that people can walk to the place in their game. There are many facilities such as VR Mall, Laser Tag, Concerts And Museums.

Gaming Arcade

It will have various games such Pac Man, Galaga, pong, donkey kong, space invaders, Galliano, dig dug, etc.

Space Walk

Tourists will be allowed to spend a time of 1-hour maximum. Doffing and donning of the spacesuits will take place in the airlocks. (*Refer To Airlocks*)

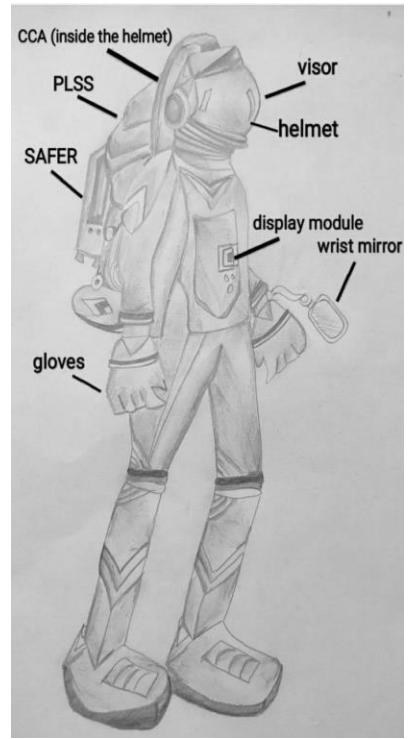
Lumos Settlement Day

Every year, there would be a large assembly where all the people in Lumos would gather to recite the preamble and would wear the Lumos Shirts.



Space Suits

Component	Function
Pressurized Garment	The pressurized garment in the spacesuit is designed to protect the people from any damaging conditions in space.
Cooling Garment	To keep the temperatures stable, and helping the blood circulation, there will be a cooling garment made of water tubes and stretchy spandex. There will be extra absorptive adult diapers present as well.
Gloves	Spacesuits will use the ECHGS (Evaporative Cooling/Heating Glove System) that allows the astronaut to hold extremely hot and cold objects (-200F to 200F) with flexibility in the fingers and wrist.
Primary Life Support System (PLSS)	The spacesuit will have a PLSS (Primary Life Support Subsystem) , a backpack that holds essentials. It will supply oxygen from the tank by the cubical cord. There is also a Carbon dioxide Eliminating Device so that the person does not suffocate. It will also have a device that alerts the astronaut if there is any failure in the spacesuit so that the person can immediately be pulled back to the settlement.
Simplified Aid For EVA Rescue	The spacesuit will have ' SAFER ' (Simplified Aid for EVA Rescue), a jetpack mounted to the backpack of the spacesuit. If the person gets untethered and floats away, it will help him/her go back by using nitrogen thrusters. It will have 24 small thrusters on it which can be activated when required.
Communication	The astronauts will wear a cap inside their helmets which is called CCA (Communications Carrier Assembly) which comprises a microphone and radio.
Helmet	Helmets will be made of polycarbonate, a highly-strengthened bulletproof plastic. Sometimes, the astronaut's face can get itchy, for this, there will be a small foam block to scratch the itchy areas.
Visor	A gold visor glass will reflect infrared light helping much clearer vision in space.
Wrist Mirrors	For the astronaut to view and control the display modules on the front of its spacesuit, they will wear wrist mirrors on both their wrists.
Tethers	Tethers connecting the astronaut and space settlement will be made of high-strength flexible fibres like Spectra with excellent UV resistance.



People in Lumos would also go to outer space for research purposes as well as recreational purposes. A spacesuit is a very essential part for people to go to outer-space. A spacesuit will help protect astronauts from the extreme temperatures, dust, debris, radiation and other dangers in space.

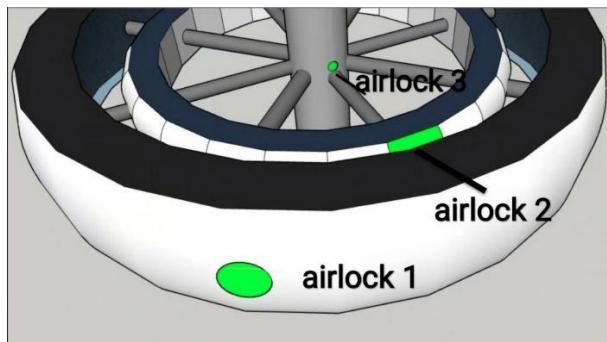
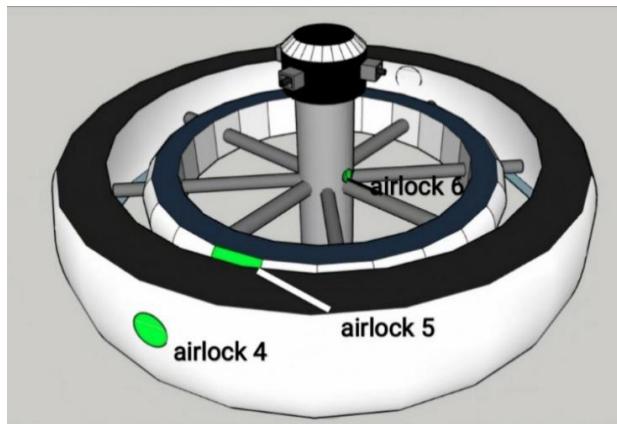
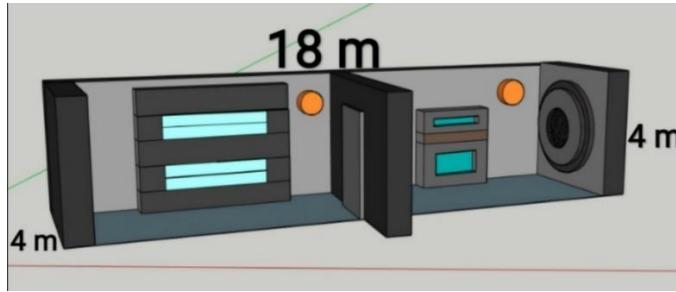
Airlocks

There are **10 airlocks** in the settlement to separate habitable areas from unpressurized regions.

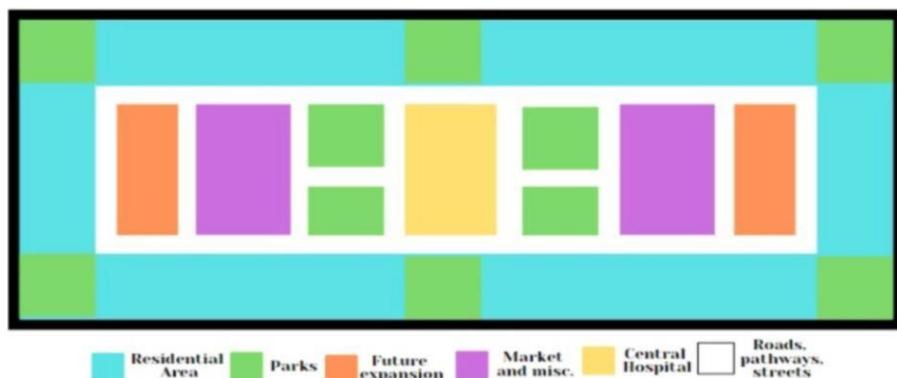
Components

Chamber One: There will be a “**camp-out**” procedure implemented before a person goes out for a spacewalk. Taking inspiration from the “**Quest Joint Airlock**”, there will be a reduced nitrogen atmosphere in order to purge out the nitrogen from the individuals’ bloodstream, avoiding decompression sickness at a low-pressure atmosphere. This will also store the spacesuits. The people will also follow the steps for donning and doffing of the spacesuits by a tutorial video or a person guiding them. This will contain all the EVA essentials.

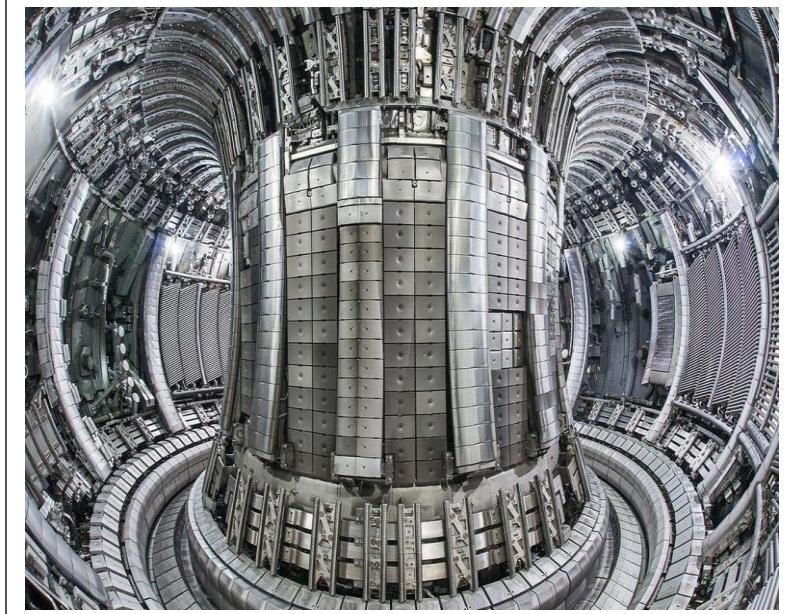
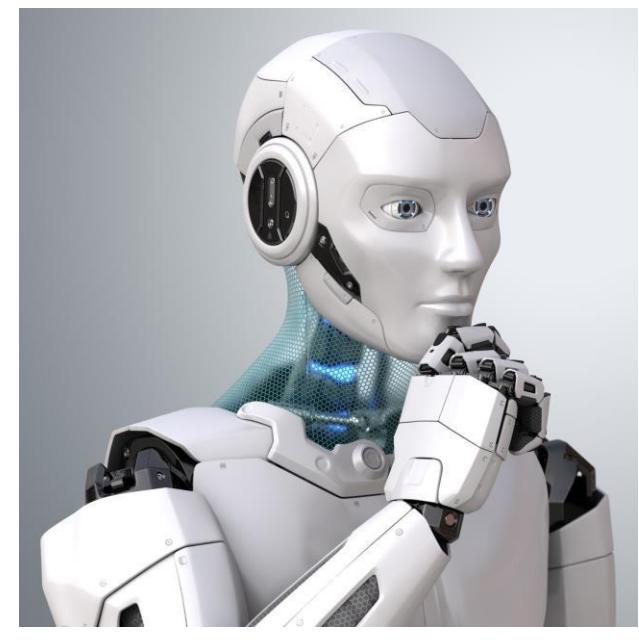
Chamber Two: After the person has gone through chamber one, they will go into the final chamber which will be properly depressurized. There will be a double scan of the person if there is any fault in the spacesuit so that they are ready to go to outer space.



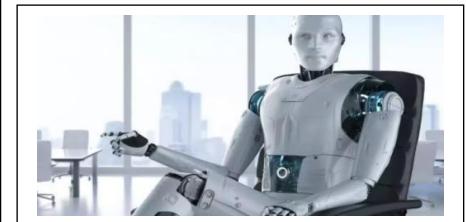
Other airlocks are included in the opposite side as well.



Internal Layout Color Coded Map For Tori A And C (Residential)



OPERATIONS AND INFRASTRUCTURE



(Refer To Bibliography For All Image Sources)

Energy Source

Primary Source

For Lumos, we will be using a Helium 3 Fusion Reactor. As helium 3 is abundant on the moon in large amounts and we have planned to mine it, we can use this isotope for running Lumos.

Helium 3 Fusion Reactor

Deuterium and tritium are used in a fusion reactor. But, since tritium, which is an isotope of hydrogen, is a scarce earth element, and about only 20 - 30 kg of tritium is found on earth, it is extremely expensive. Tritium also wastes a lot of energy and radioactive waste. To replace tritium, we will be using deuterium and helium 3. Using the helium 3 we mined on the moon would be ideal for this. Helium 3 is a clean energy that doesn't waste any energy and doesn't produce any radioactive waste. Deuterium is an isotope that will help helium 3 undergo the process of nuclear fusion. We will get helium 4 and another high energy proton, these will give us a lot of energy. It is said one kg of helium 3 could give us energy for many years.

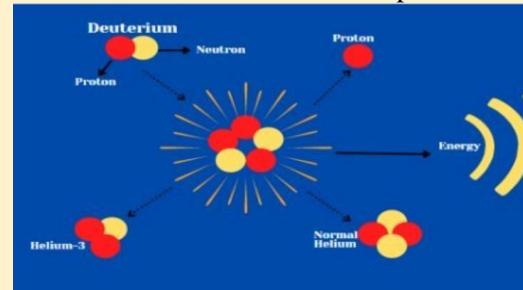
One reaction of helium 3 and deuterium can produce about 18.5 MeV. One advantage of using this process can be that they are charged particles that could be used in magnetic or electric fields and be used for energy conversion. There are two ways for a helium 3 and deuterium reactor: Tokamak or IEC (Inertial Electrostatic Confinement) to run Lumos. But for Lumos, we will be using the IEC.

Residential - In Lumos, the power supplied to the residential tori will be supplied by a piezoelectric module. The power supply is for **56000 kW/day**.

(Refer To Electricity Flow)

IEC: Inertial Electrostatic Confinement

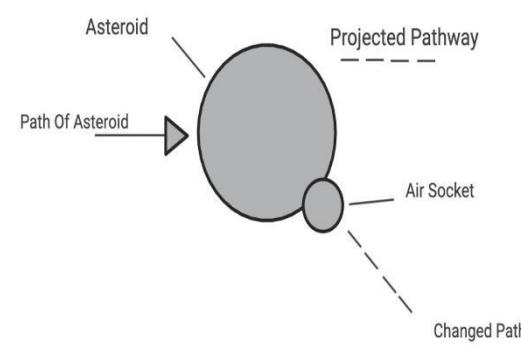
This process uses the electric fields to confine the plasma in the fusion reactor. In the IES, there will be gaseous fuel at a low temperature filled inside a small vacuum chamber. The inner grid and the outer grid of the chamber are charged and have a difference of 100kV. These charged particles reach a very high energy as they oscillate in the center. This layout is designed in such a way that the negatively charged electrons and the positively charged particles in the plasma remain close together, as they often move in a different direction. Most of the layouts of the IES achieve this across a potential well, and then these particles move due to their inertia. This process is similar to the Colliding Beam Fusion, except the beam is linear instead of spherical.



Backup Source

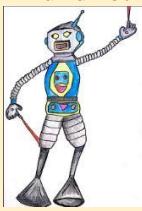
In case there is some issue in the helium 3 fusion reactor leading to an electrical shut down in the settlement, we will be needing some type of backup source. For the backup energy source, we will be using "**Lithium Nickel Manganese Cobalt Oxide**". These batteries are the most powerful and lightest batteries. It is a low maintenance battery that has a long shelf life and is also rechargeable. It produces high power energy which has a lot of thermal stability. **Why not Solar Panels?**

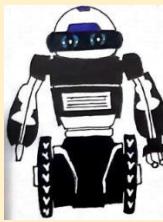
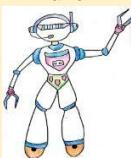
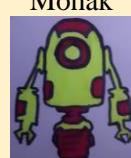
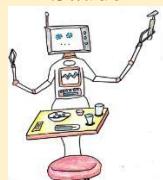
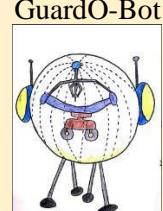
Solar panels are an extremely common energy source used in many settlements, but because of our location, in LLO (Lower Lunar Orbit), it is said that it does not receive much sunlight. Without the adequate amount of sunlight falling on the settlement, solar panels won't give too much energy for the settlement. Solar panels are also costly and have to be made on earth.



For minor sized asteroids, **parabolic reflectors** will be used as an advanced backup plan. **PXCM honeycomb shield** would also be used as a prevention step for such advanced contingencies. Incase of any major asteroid, **thrusters will be used**.

Automation

Purpose	Robot Name And Drawing	Functioning	Number
Fire	FURI-9 	It will contain a wireless thermal camera, sodium bicarbonate sprinklers and a fire detector sensor.	15
External Construction	BuildBot 	BuildBot has gecko-like nano-pressure adhesives on each foot and will be equipped with various tools it would need for construction.	115
Interior Finishing and Tile Laying	Consilio 	It would have a vacuum lifter system in case objects have to be relocated and will have flexible legs and arms.	100
Recreational Facilities	DuxBot 	As for spacewalks, DuxBot will be monitoring the people and helping them out with their AI knowledge if they have some issue.	15
Agriculture	AgriBot 	Plant growth would be monitored and they would help in the harvesting of crops.	70
Household Activities	Grihasthi 	Grihasthi will have a vacuum cleaner which moves freely with its sensors, to vacuum the floor. They will also have the ability to cook for people.	85
Air Contamination	Shodhak	It is very reliable and also has a long-life span and is made of stainless steel and polyamide. It is	10

		also equipped with an air injection, sealant, brush cleaning and disinfection module integrated with a camera.	
Water Contamination	Pure-2 	This robot has the ability to fix broken, leaking or ageing pipes, etc. It will be using tough reinforcement materials like fibre-reinforced-polymers (FRP).	10
Restaurants	Mohak 	These robots will serve and take orders in restaurants.	20
Hospitals	Saúde 	It will help in transporting and carrying medical instruments, medicines and other materials. It will also help serve as a 'companion robot' to elders.	40
Delivery	Entrega 	It can independently deliver stuff to people but just needs a voice note.	20
Safety Of Residents	GuardO-Bot 	It is integrated with two cameras that can rotate up to 300 degrees which would help to monitor the whole area in a very efficient manner.	30
Trash Disposal	Garb-Bot 	Garb-Bot is also equipped with small trash cans which it will segregate the waste as recyclable and non-recyclable. This will prove to be very efficient as the recyclables could be used.	30

Types Of Industry And Research

Name Of The Laboratory	Purpose
Communication Research Laboratories	These laboratories will focus on the developing communication. The scientists will also check the radio transmission from satellites.
Agriculture Laboratories	These laboratories will study the growth of the plants and will also collect different data related to it such as crop failure and will try to improve it.
Astronomy Laboratories	These laboratories will focus on space bodies. They will also assure that Lumos is protected at all times.
Radiation Laboratories	Scientists will monitor the various changes in radiation levels. They will focus to protect and shield Lumos from various kinds of radiation.
Microgravity Laboratories	These scientists will also ensure that the rotation is going on smoothly. They will also study other biophysics and will also research on micro-g effects.
Metallurgy Laboratories	These laboratories will study the multiple metals samples brought from the moon such as aluminum, titanium, etc, and from the asteroid 3554 Amun.
Pharmaceutical Laboratories	Scientists will study and research various solutions in the laboratories and develop medicines/vaccines for various diseases.

All these laboratories will be located in Torus D.

Type of Industry	Dimensions of Industry
Furniture Industry	Length = 24 m Width = 14 m Area = 336 m ²
Pharmaceutical Industry	Length = 21 m Width = 12 m Area = 252 m ²
Food Industry	Length = 23 m Width = 13 m Area = 299 m ²
Perfect Crystals Industry	Length = 18 m Width = 10 m Area = 180 m ²
Transportation Industry	Length = 22 m Width = 12 m Area = 264 m ²

Perfect Crystals Industry

We will be manufacturing crystals in space. Crystals have many uses on Earth such as use in microchips, video cameras, radiation detectors, digital watches, high-power semiconductors, etc. We will be exporting these crystals to Earth for profit, using them in Lumos for various purposes as crystals grown in microgravity are said to have lesser defects as compared to those grown on Earth - can even be called "perfect crystals!" These perfect crystals grown in zero gravity can have multi-purposes such as they could be used for cosmic ray detection, substrates for infrared sensors and even in X-Ray Diffraction Analysis too.

Communication

Internal Communication

Wind Back Time Watches

Lumos will provide smartwatches to each resident. Their name will be 'Wind Back Time'. These watches will also have an assistant named Jarvis. (The inspiration of the assistant's name was taken from the character of 'Iron Man' from Marvel).



Wind Back Time Watches

Hologram – The inspiration of this device was taken from the movies, Black Panther and Ralph Breaks The Internet. The hologram would pop up whenever a call is accepted.



[Hologram Phone Image Link](#)

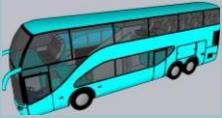
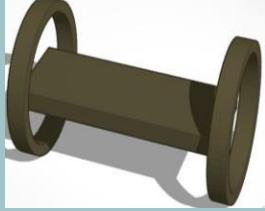
Bandwidth for External Communication

Lumos requires a large amount of bandwidth which is easily possible on Earth due to the fast rate of data transfer in **fiber optic cables**. Each strand of these cables is 10 times thinner but can still carry 25000 telephone calls. We will be using them for internal communication as they are very efficient. Lumos can also use optical data transmission by lasers. This method has been proved by NASA's LADEE spacecraft in 2014. It demonstrated downlink speeds of up to 622 Mbps and uplink speeds of up to 20 Mbps. It is a good method but there is just one issue that while communicating in the settlement, the residents will be able to see lasers reaching the phone and the others will also be able to see. This won't provide the residents with privacy. There are 7000 residents in Lumos. We assume that a minimum of 15% of residents will be concurrently using the uplink/downlink system on board. Lumos must have the aptitude to support about 7000 connections or more. All of them will though not be active constantly. Therefore, Lumos must have the aptitude for an uplink of 46 GBps. Downlink won't be a big concern.

Note: For external communication, optical data transmission by lasers will be used. In this process, three satellites are also included. They are known as trinity points.

Transportation

Internal Transportation

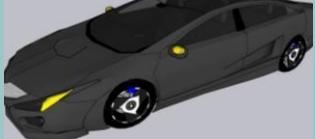
Vehicle	Maximum Capacity
Bus 	20 people
Gyrosphere 	2 People
UrmO 	1 Person (short distance)

Elevators

6-7 people

External Transportation

We will be using solar sails attached to shuttles as our transportation system. The space shuttle will be made of aluminium covered with LI-900 silica tiles. The solar sails will be made of aluminium as it is strong, durable, and also very reflective. The solar sail will be 125 yards long and 55 yards wide. We won't use solar energy to push our space shuttle but instead, we will point very strong lasers towards the solar sail of the shuttle which will move fast. As a backup, there will be rocket boosters also because we need to take as many safety measures as we can. There would be a red button, if there is some damage in the solar sails, the tourists can press it, and automatically rocket boosters will open and there would also be fuel available on the shuttle. There would always be a certified astrophysicist who can help them in such situations. We are also using solar sails in the transportation of materials from the moon to LEO.

Electrical Vehicle 	3-4 People (family size)
Canguro 	1 Person (short distance)
Cycles 	2

Illumination

For Lumos, there will be a “Dynamic Lighting” system.

Dynamic Lighting System

The Dynamic Lighting system will give natural lighting like that in the natural environment of Earth. The light patterns are produced for both night and day cycles as well as different seasons. The dynamic lights change their intensity and color during the whole cycle in the entire day. It is known that if the citizens control their space according to their moods, needs, and personal activities, they can create a pleasant atmosphere in the settlement. Dynamic Lighting benefits in these cases for better concentration and performance. In Lumos, there will be different time periods of the day and night cycle during different seasons.

Season	Day Period	Night period
Spring	12 hours	12 hours
Summer	14 hours	10 hours
Fall	13 hours	11 hours
Winter	11 hours	13 hour

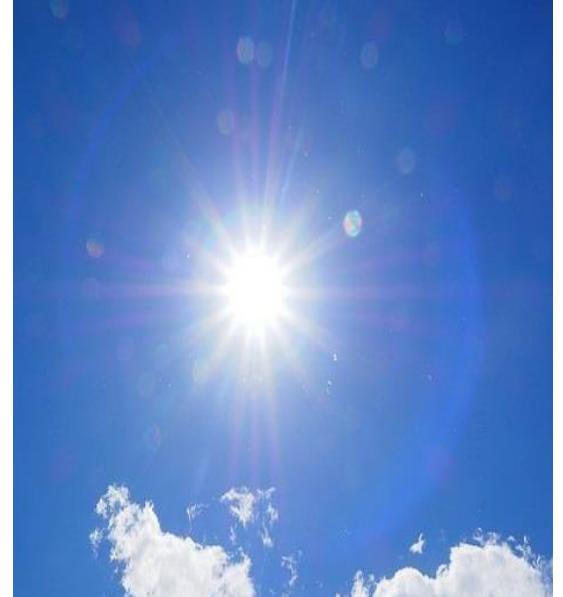
Lighting Mechanism

There will be **TOLED (Transparent Organic Light-Emitting Device)** as the lighting mechanism for artificial lighting in Lumos. The ceiling of Lumos would be made of TOLEDs which are transparent and thin.

Electricity Flow

The Helium 3 Fusion Reactor will be used to generate electricity (*refer to energy source*). To transport electricity to the settlement, there will be “**optic cables**” used. Instead of opaque wires, we tend to keep a transparent conductor of electricity for the wire and an electrical insulator as the coating since opaque wires are a bit messy to look at and create irritation to the citizens and don’t match the environment. We will be using “**Aluminium-Oxynitride**” as the material used for the wire in the cable. It is said that they are often used in aerospace due to its transparent properties, heat conductivity and firmness. They are also available in adequate quantities. For the covering of the wire, we will be using “**Clear Silicon**” which is an insulator of electricity. It is a transparent, multipurpose adhesive which is waterproof, and is a very protective seal for the wires. There will be many optic cables attached to various parts in the settlement to give electricity supply.

Electricity Required For various parts of Lumos *Kilowatts per day*	
Residential	56000 kW/day
Recreational	46000 kW/day
Research and Industry	30000 kW/day
Agricultural	2100 kW/day
Docks	3800 kW/day
Thrusters	147000 kW/day



LIFE SUPPORT



(Refer To Bibliography For All Image Sources)

Water Production And Management

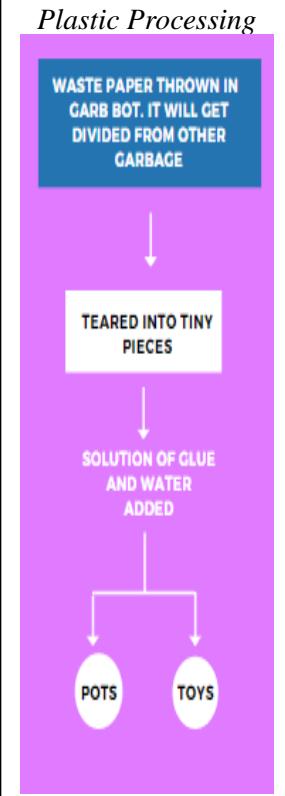
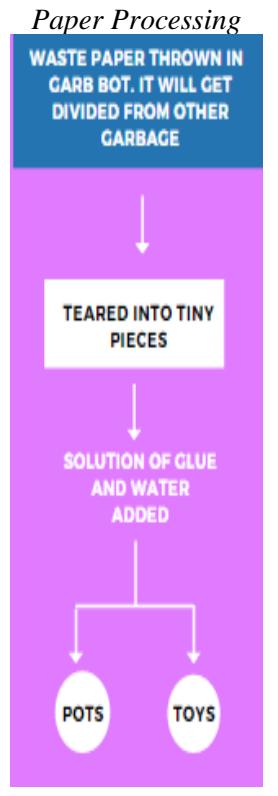
WATER MANAGEMENT

In Lumos, there will be an underground water piping system that will supply water to the residential, agriculture, industrial etc areas. To transport the water to these areas, there will be **CPVC (Chlorinated Polyvinyl Chloride) pipes** which are very efficient in terms of energy for the settlement. These pipes have excellent thermal insulation, holding temperatures up to 200° Fahrenheit, and reducing the amount of condensation of water vapor. These pipes, made of thermoplastic, are very strong and flexible as well. In case there is some water leak from the pipes, there will be a robot called "**Pure-2**" which is a robot used for fixing leaking pipes. This robot will help prevent the water from getting contaminated and saving gallons of water across the settlement. (*refer to automation*). It is said that graphene, is a very good water filter.

Water Production



Trash Disposal



Area For Distribution (per day)	Amount of water in litres
Residential	30000
Industrial	25000
Agriculture	6000
Back-Up	145000
Total: 206000l/per day	

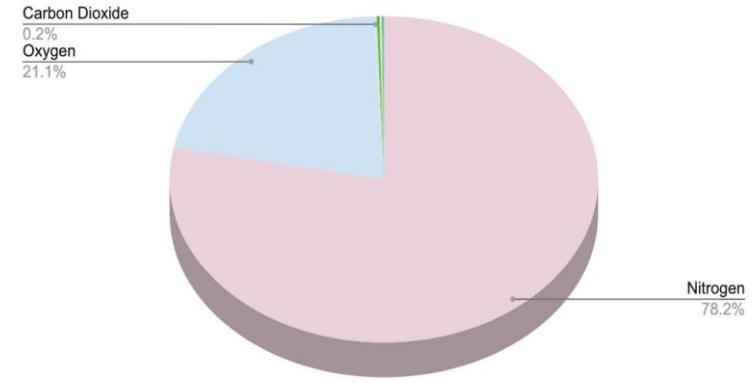
Metal Processing



Kitchen Waste

We will be using automated kitchen composters to recycle kitchen waste to fertilizers which will be used in farming in Lumos.

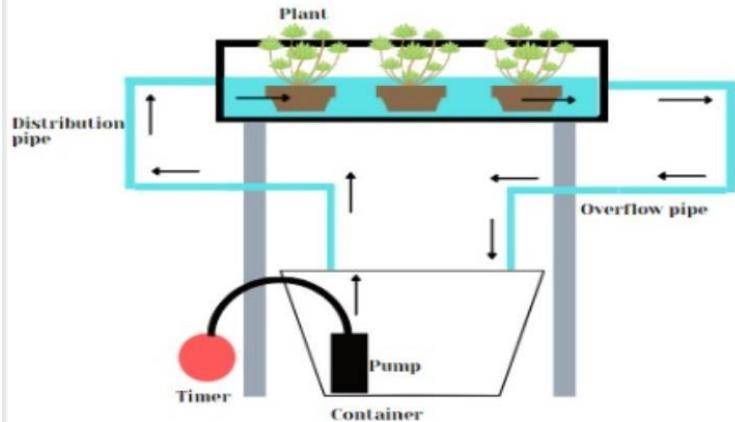
Composition Of Air In Lumos



Agriculture

Name Of Crop	Consumption (gram/person/day)	Total Consumption (Kilograms/per day)
Wheat	178	1246
Rice	100	700
Maize	85	595
Barley	61	427
Tea	55	385
Coffee	67	469

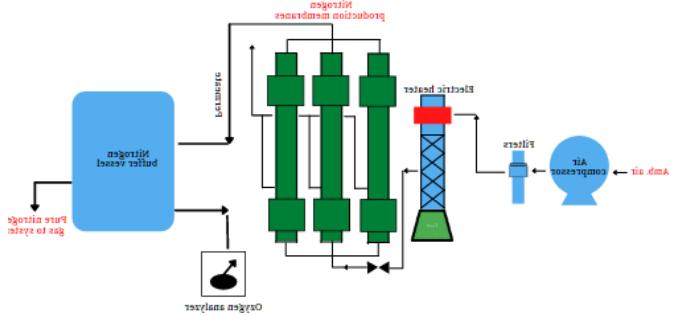
Two methods used for growing the crops are **Fogponics** and **Nutrient Film Technique**. Plants grow faster using such methods, the energy cost is reduced drastically and also, space required for the growth of plants is lesser as compared to other processes such as organoponics and geoponics.



NUTRIENT FILM TECHNIQUE

Meat will be produced in Lumos using **in-vitro meat production**. LED lights are very suitable for the growth of crops. Harvesting of the crops would be done by **Agribots** (*Refer To Automation*). Crops would be stored in a **dry, clean area with low temperature**. There will be **polyamide(nylon)-polyethylene barrier vacuum pouches** which will be used to package the vegetables and fruits harvested. Food and groceries will be transported to stores using **refrigerated machines** and transportation vehicles. Now all the fruits and vegetables will be available in the market for sale.

Nitrogen will be extracted from **Earth**. Nitrogen can be extracted by cryogenic distillation, pressure swing adsorption, or membrane nitrogen generation. We will be using a **membrane nitrogen generator**.



Membrane Nitrogen Generator

Pressure Swing Adsorption processes will be used for extraction of argon and other gases which use the fact that gases appear to be drawn to rigid surfaces or "adsorbed" under high pressure. We decided to go ahead with the **hydrogen reduction of lunar soil** for oxygen and hydrogen extraction since it doesn't require too much energy relatively and oxygen is in abundance on the Moon. HEPA Purifiers, CO₂ scrubbers, Electrochemical Oxygen Generators, LiOH absorbers and carbon monoxide scrubbers will be used for the purification and replenishment of various gases. To increase the temperatures in summers, the principle of **Joule Heating** will be used while for decreasing the temperature in winters, a **thermoacoustic refrigeration system** would be used.

Season Name	Humidity Level
Summer	32% - 36%
Winter	27% - 31%
Spring	33% - 39%

There will be many humidifiers inserted into the walls to release mist for humidity such as **Evaporative Humidifiers** and **Desiccant Dehumidifiers**.

Psychological Impacts

Psychological Problems	Solutions
Stress	
Insomnia	
Boredom	
Aviophobia	Professional Medical Help Diary Writing Actigraphy Smart Headbands
Kenophobia	Recreational Facilities Cognitive Behavioral Therapy (CBT)
Solipsism Syndrome	Entertainment Fitness
Depression	Proper Eating Habits Open Spaces
Isolation	Earth Like Environment

Physiological Impacts

Physiological Problem	Solutions
Loss Of Bone Density	Russian Chibis Suit which acts like a vacuum cleaner sucking the fluids of our lower part of the body and preventing the blood to go in an upwards direction, Moonwalker System which is a vertical standing treadmill with a suction chamber that helps to bring the blood back to the leg. exercise programmes, proper diets, etc
Kidney Stones	Flexible Ultrasound System (FUS) and Tractor Beam. These detect the kidney stones and create pressure near it to drag it.

Lunar Mining

To make Lumos self-sufficient, we decided on the idea of mining the moon which would serve as one of the purposes of our settlement and also provide a good economic justification. This will have many advantages and would also start some research and economic activity in Lumos which would be very beneficial.

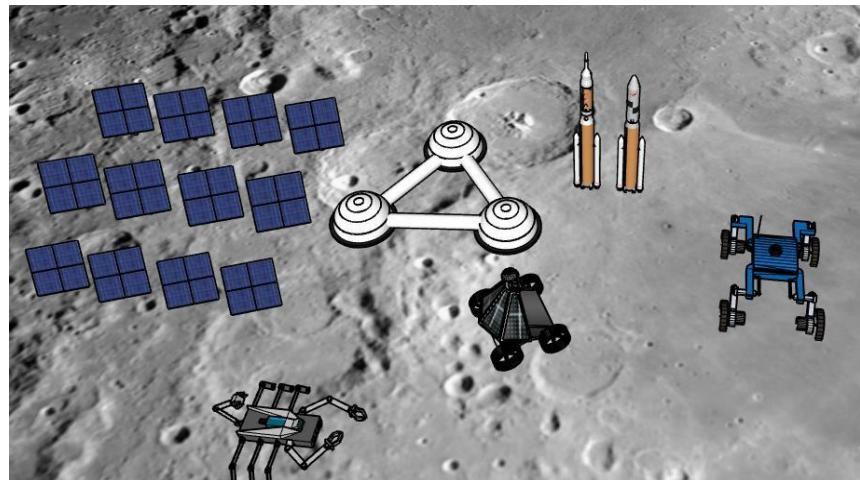
Lunar Infrastructure

The location of the lunar base is in the South-Pole Aitken Basin i.e, one of the biggest impact features of the moon. It has near constant solar illumination, contains water ice and the Shackleton Crater lies inside the **South Pole Aitken Basin** which is said to be helpful in radio transmission.

Energy Source

Solar Power: We will be using solar power as the main source to run the base. This will be very appropriate as our location in the Lunar South Pole has a near-constant solar illumination. **Hydrogen Fuel Cells:** If there is any electricity cut or any malfunction, we will be using hydrogen fuel cells.

Moon Dust - If inhaled by human beings, moon dust can lead to several respiratory diseases. A coating will be applied consists of **indium tin oxide** which will basically help in dissipating the electrical charges of the lunar dust. We can then mix this with a paint and apply this coating on various surfaces, which will prevent moon dust from sticking onto them. (*refer to Automated Systems*)



Lunar Base

Metal Processing

Silicon - The processing plant will be needing a solar furnace for the high temperatures, electrical power, plumbing, gas chambers and a condenser as well. The process of fluoride extraction would be used to process silicon.

Helium-3 Production

For the whole production of ${}^3\text{He}$, the following processes would be executed:

- Extraction
- Purifying

Mining The Lunar Regolith

For the mining and collecting of the lunar regolith, we will be using a **RASSOR** robot. We will also be using the

Bucket Wheel Excavator.

Beneficiation

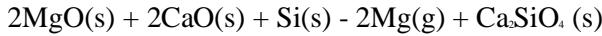
Course Sieve - The collected lunar regolith will be transferred to the course sieve for finer grains particles through a conveyor belt.

Electrostatic Separator – The regolith would be passed into an electrostatic separator then.

Heating - After the separation, ${}^3\text{He}$ would be heated in a range of 700°C to 750°C using pipes liquid lithium heating pipes. It will then be passed through a gas extractor.

Aluminium - Aluminium will be processed using **low-temperature carbochlorination** and Alcoa Electrolysis (**ELYSIS**).

Magnesium - The process of **silico-thermic reduction of olivine** to extract magnesium would be used. In this process, the temperature is increased to about 1000°C and basically the reducing agent is ferrosilicon which contains about 70 to 80 percent silicon.



Iron - Electromagnetic Separator

We will be using an electromagnetic separator for iron from titanium.

Titanium - An **ilmenite electrostatic separator** will be used for extracting Titanium. To separate the iron from titanium, we will be using **magnetic energy** which will attract the iron and this will be a very cost-efficient way. Next, we have to separate titanium from the titanium dioxide and for that, we will have to pass the titanium dioxide into an **electrolysis cell**, which will separate the titanium dioxide.

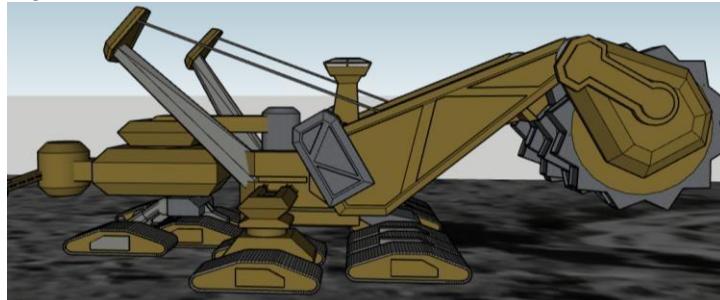
Automated Systems - Robots For Mining

1. RASSOR

RASSOR stands for Regolith Advanced Surface Systems Operations Robot. RASSOR is a teleoperated portable automated robot with a high space regolith mining ability.

2. Bucket Wheel Excavator

We will also be using the Bucket Wheel Excavator which is mainly used for taking away the top 3-5m of the lunar regolith.



3. Lumo

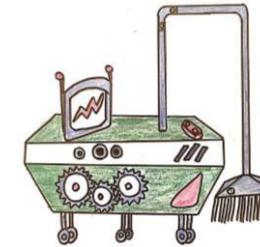
Wheels: There will be around 6 wheels in Lumo carrying the weight of the robot. Each wheel will carry about 100kgs. The rims of these wheels will use aluminium which has a good tensile strength.

Storage: The mined lunar regolith will be stored in the storage area with a lot of volume capacity.

Wire Brush Excavator: It is said that these will be more effective to mine the lunar regolith from other methods like, drilling, or using a shovel.

Power Source: Lumo will be using Lithium Iron Phosphate. These batteries have an excellent electrochemical performance with low resistance and have a long cycle life.

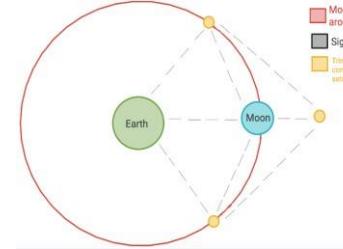
Antennas: There will be antennas used for communications from earth.



Dusty - Dusty consists of brushes - The purpose of these brushes is to eliminate the dust from surfaces by brushing them and will use shape memory alloys.

Communication

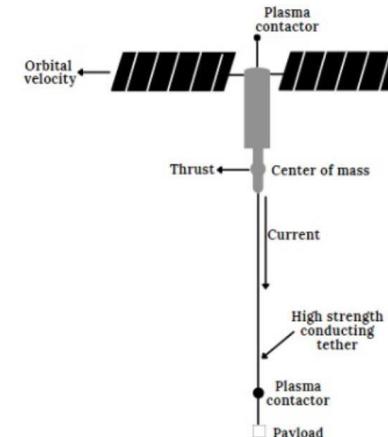
There will be 3 communication satellites in orbit. **The Scientific Certification Systems (SCS)** will also have upgradability because there might be need of some changes. These satellites will be constructed of aluminum and will be tiled. This method was proved by NASA's LADEE spacecraft in 2014.



Cislunar Tether Transport System

Solar Sails will be powered using this. This system requires zero net energy which would be very beneficial for us. We will need one cislunar tether transport system in LEO.

Cislunar Tether System



Asteroid Mining

One of the purposes of Lumos is Mining 3554 Amun which is worth a sum of approximately 22 trillion dollars which will lead us to profits. It is an M-type asteroid. 3554 Amun will be the closest to Earth on 23 March 2061. **Duo**, The asteroid capture machine will capture Amun and will take it to the lunar surface where it will be mined.

Resources And Financial Worth

Platinum - 6,000 billion dollars.

Iron And Nickel - 8,000 billion dollars.

Cobalt – 6,000 Billion Dollars

Transportation

Shuttle Propulsion Methods

Shuttles attached with solar sails will be used for transportation. **Draco thrusters** were used in a space shuttle called Dragon and it was launched by SpaceX. Our space shuttle will also have Draco thrusters as a backup. These thrusters will be portable. There will be 6 such thrusters in each shuttle.

Fuel

The laser sails do not require any fuel as it runs on the lasers beams shifting them. As in for the thruster. The shuttle will have the Draco Thruster which normally uses a mixture of : **Nitrogen Tetroxide Oxidizer**: They are very stable at room temperature and can be stored easily.

Monomethylhydrazine Fuel: For very low tankage and fuel maintenance system weight, they can be easily stored.

Solar Panel: There will be PV Solar Panels to generate electricity.

Hydrogen Fuel Cells: There will be fuel cells (these do not require recharging) if there is any fault in the shuttle.

Communication: Lumos will use the 3CS Communication System for the mining of Amun. These work very efficiently and send high-quality data.

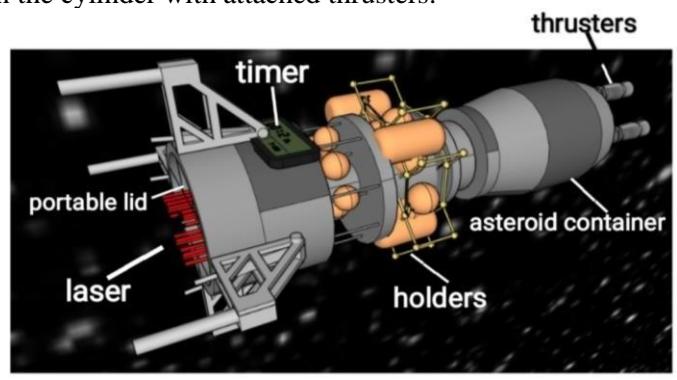
Asteroid Capture

There will be a machine called **duo** which means divided into two.

The machine will have the following parts:

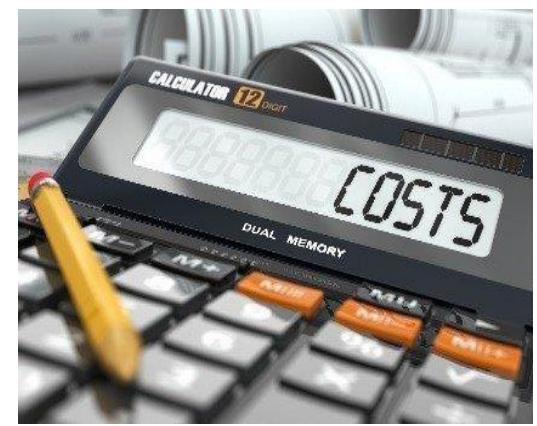
1. Cylindrical tank
2. Laser
3. Thrusters
4. Holder's arms
5. Camera
6. Timer
7. Sensor

These are the steps by which the asteroid will be taken to the lunar surface: The timer will be set in the duo according to when will come close enough to the machine so that the duo can capture it. The timer can also be reset. As a backup, there would be cameras inserted into the machine which would show if there is 3554 Amun near it. According to the time set or according to the camera, its holder arms will catch 3554 Amun. Then, it will bring its arms near the lasers which are connected to the open mouth of the cylinder, and will pass the asteroid through the lasers. The laser will divide the asteroid into two pieces. The divided two pieces of 3554 Amun will be taken to the lunar surface in the cylinder with attached thrusters.





BUSINESS PROSPECTS AND COSTS



(Refer To Bibliography For All Image Sources)

"Space travel is life-enhancing, and anything that's life-enhancing is worth doing. It makes you want to live forever."
 - Ray Bradbury

Investment

Sources And Obtaining Of Investment Funds

The aerospace industry is experiencing a new era with more and more companies and large firms investing in various space-related activities such as asteroid and lunar surface exploitation, space tourism, technologies for space exploration, etc. More investments and funds will eventually lead to higher accessibility of space since one of the major drawbacks keeping us back from further exploration of space is the extremely high costs. **Huge companies and small private companies** alike encourage space tourism and are readily investing in such efforts. Mining has also become a huge market and Lumos is mining 3554 Amun (worth 22 trillion dollars, theoretically) and the lunar surface as well which would lead to a lot of profit. **The Government** could play a major role by granting loan guarantees. Legal framework is also very important for this. **Wealthy benefactors and various entrepreneurs** would also choose to invest in Lumos. **Sponsorships and investment summits** can also prove to be helpful and various lotteries could be organized which would make more people aware of Lumos and invest in it. Incentives can be given such as the person who would win the lottery would have the opportunity to have the villa (best residential accommodation in Lumos) for free. New 'Space Guys' have also emerged such as Elon Musk, Jeff Bezos, Robert Bigelow, John Carmack (to name a few) who will be ready to invest in the first space settlement. To obtain investment funds, a proper business plan with profits, code of ethics, legal framework, and sustainable practices can impress and persuade them to invest in Lumos. **Bootstrapping** is a good method that can be used as well. This process involves receiving investment for other business activities, offering a satisfactory return on this investment, and then investing the profits into space tourism. [Cicada 2018]. Promotion can also be done in various conferences, meetings, parties, releases, workshops, premiers, etc. such as the Lumos premier, which ended up attracting thousands of space enthusiasts.

Revenue

	Permanent Resident	Short Term Traveler
Number Of People	4,550	1,780
Travel Cost (Per Person) (USD)		100,000
Fee Per Day Of Stay (Inclusive of food, housing, accomodation, medical, etc) (USD)	500	700
Average Length Of Stay (days)	365	60
Total Revenue (USD)	830,475,000	374300000
Total	1,204,775,000	

Industries	Revenue (USD)
The Transportation Industry	10000000
The Furniture Industry	1000000
The Pharmaceutical Industry	10000000
The Food Industry	15000000
The Perfect Crystals Industry	7000000
Total	43000000
Lunar Mining	150000000000
Asteroid Mining	400000000000
Grand Total	551,247,775,000

We will also get a lot of profit for selling the materials we mined on the moon and 3554 Amun. This will increase the revenue collected. We will get about 150 billion dollars from lunar mining and around **400 billion dollars from asteroid mining**.

Financial Aspects And Costs

Torus A and C Materials	Total Quantity	Cost
HBNNT	750000	400000
Sialon	65000	600000
Zylon	55000	800000
Technora	55000	120000
Titanium Carbide	55000	700000
Borophene	19674	280000
Platinum	25000	200000

Torus B and D Materials	Total Quantity	Cost
HBNNT	21344	100000
Sialon	22345	450000
Zylon	18455	70000
Technora	23455	120400
Titanium Carbide	39876	100000
Borophene	19674	398760
Platinum	25000	140730
Misc.	-	150000000

Window Materials

Materials for Windows	Total Quantity (Kg)	Cost
Aluminium Oxynitride Glass	16500	66000
Polycarbonate	15000	30000
Perlucor Material	14500	58000
Electrochromic Glass	14000	250000
Poly (Methyl Methacrylate)	13200	20000

Operations And Infrastructure	Units	Cost Per Unit (\$)	Total Cost (\$)
Gyrosphere	3000	10000	30000000
UrmO	5546	2045	11341570
Electrical Vehicle	6567	35000	229845000
Canguro	2950	22036	65006200
Elevators	6	56789	340734
Bus	100	60000	6000000
FURI-9	15	56734	851010
BuildBot	115	68963	7930745
Consilio	100	62389	6238900
DuxBot	15	87932	1318980
AgriBot	70	73256	5127920
Grihasthi	85	64389	5473065
Shodhak	10	74368	743680
Pure-2	10	57896	578960
Mohak	20	79657	1593140
Saúde	40	89776	3591040
Entrega	20	76890	1537800
GuardO-Bot	30	65000	1950000
Garb-Bot	30	86500	2595000
Communication Research Laboratories	2	10000	20000
Agriculture Laboratories	2	10000	20000
Astronomy Laboratories	2	15000	30000
Radiation Laboratories	2	20000	40000
Microgravity Laboratories	2	10000	20000
Metallurgy Laboratories	2	15000	30000

Pharmaceutical Laboratories	2	13000	26000
Furniture Industry	1	10000	10000
Pharmaceutical Industry	1	12000	12000
Food Industry	1	140000	140000
Perfect Crystals Industry	1	120000	120000
Transportation Industry	1	150000	150000
LED	75	50	3750
Helium 3 Fusion Reactor	1	140000000	140000000
OLED	500	50	25000

Internal Infrastructure			
Duplex	100	100,000	10000000
Condominium	30	400,000	12000000

Cottage	310	60000	18600000
Bungalow	292	80000	23360000
Villa	200	120000	24000000
Space hotel	4	907200	3628800
Restaurant	3	50000	150000
Library	2	130000	260000
Parks and gardens	6	60000	360000
Clinics	4	80000	320000
Hospitals	2	300000	600000
Paradise	1	270000	270000
Wizard Chess	8	60000	480000
Quidditch	6	120000	720000

Catch The Cash	7	100000	700000
Obstacle Race	5	8000	40000

Art Gallery	2	95000	190000
Museum	2	130000	260000
Theatres	5	140000	700000
Amusement Park	1	900000	900000
Holographic Animal Zoo	1	148100	148100
VR Rooms	20	90000	1800000
Paintball Arena	8	90000	720000
Gaming Arcade	3	83000	249000
Cafe	3	300000	900000
Mall	2	240000	480000
Grocery store	7	70000	490000
Utensil store	6	60000	360000
Furniture store	5	90000	450000
Toy store	1	32400	32400
Chemist store	4	15000	60000
Electronics store	4	70000	280000
Stationery store	2	60000	120000
Gyms	2	100000	200000
Haircut stores	2	60000	120000
Spas	2	80000	160000
Toiletries store	4	50000	200000

Gyms	2	100000	200000
Haircut stores	2	60000	120000
Spas	2	80000	160000
Toiletries store	4	50000	200000

Asteroid Mining

Name	Units	Cost Per Unit (\$)	Total Cost (\$)
Shuttle With Solar Sails	1	1	450000000
Draco Thrusters	6	40000	240000
Monomethylhydrazine Fuel	20000 litres	100/litre	3750000
Nitrogen Tetroxide Oxidizer	20000 litres	100/litre	1120000
Solar Panel	15	4000	60000
Hydrogen Fuel Cells	4	10000	40000
3CS Communication System	1	10000	10000
Asteroid capture machine	1	625971	625971
Misc.	-	75000000	

Lunar Mining

Solar Panel	25	1241	31025
Hydrogen Fuel Cells	65	985	64025
Rassor Robot	40	29846	1193840
Bucket Wheel Excavator	10	156000	1560000
Hydrogen Reduction Plant	8	97524	780192
Electromagnetic Separator	10	85678	856780
Lumo	20	74500	1490000
Dusty	57	68971	3931347
Shuttles attached with solar sails	3	134567	403701
Cislunar Tether System	2	100000	200000
Lunar Base Construction	-	168900	100000
Misc.	-	100000000	

Cost Of The Orbital Space Settlement: \$780000000

Cost Of Asteroid Mining: \$530000000

Cost Of Lunar Mining: \$110000000

Overall Cost: \$1420000000

Market Research

Segmentation

- Demographics - High Income and Wealthy Individuals.
- Psychographics - High-risk taking propensity
- Lifestyle - Individuals who have done trips to exotic places

Targeting

- Demographics
 - High Income & Wealthy Individuals (to be able to afford to make an investment in Lumos).
 - Owners of high-end properties and private islands.
- Psychographics
 - High-risk taking propensity like Investors in new age products and technologies like AI/ML, Robotics.
- Current Investors in space exploration companies.
- Lifestyle
 - Individuals who have done trips to exotic places or excursions like trip to Antarctica or have already enrolled for space trips or moon exploration.

Positioning - The potential for space travel is incredibly high, as people would be involved in discovering it differently. As Lumos will be the first settlement in space, having 4550 permanent residents and 1780 visitor residents. We have focused on creating affordable visiting opportunities for Lumos to attract visitors—costing according to age, requirements, and facilities. The cost should be perfectly balanced for people to visit Lumos. While researching, we came across multiple explanations about the future of humankind in space. For visitors from anywhere, Lumos offers a very relaxing and suitable climate. There is a wide variety of leisure services that we provide that everybody can enjoy, children and adults alike. Lumos also offers space for all residents in hotels and residential areas. Private agencies and corporations will also partner with us on several microgravity projects that will contribute to benefit. Lumos will have a comfortable and pleasant environment with greenery all around, just like on earth. It will make people feel like they are home, all safe and sound.

Marketing Mix

- Create a website and interactive videos with all information & details.
- Sponsorship of events, premiers, competitions and lotteries.
- Organize Roadshows and Seminars for in top 20 cities of the world e.g. 46% of US millionaires reside in California and Florida.
- Focused Digital marketing using e-brochures & emails in relevant magazines, technical associations.
- Set-up a centralized sales team to cater to queries and engage with prospects.

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LUMOS CODE OF ETHICS

RESPONSIBILITY

We take responsibility for our actions, principles, and values. All of our actions are solely for the benefit of the community at Lumos.

HONESTY

One of the core values of Lumos is honesty. We believe that honesty is necessary for effective communication and actions, which has a significant role in everything.

UNITY

"Together we stand." Unity is integral and everyone is equal and a friend at Lumos. Gwendolyn Brooks once said, "We are each other's harvest; we are each other's business; we are each other's magnitude and bond."

COMMITMENT

We are fully committed to work for the benefit of our community, investors, and employees.

HUMBLENESS

Criticism is acknowledged at Lumos and we are working to make the infrastructure etc, and lives of people better at Lumos.

CONFIDENTIALITY

The data of the people is totally secure and confidential. No data will be revealed to unauthorized access.

FREEDOM

Inhabitants of Lumos have complete freedom to practice their own choices and live a lifestyle of their choice.

RESPECT

We respect everyone here, their choices here at Lumos. We believe that respect is crucial for a community to be content and satisfied.

The Gantt chart illustrates the project timeline and task dependencies. The tasks are categorized by color:

- Research** (Yellow): Finalizing Lumos team, Construction studies, Conference with Space authorities, Approval from countries, Approval from space authorities, Raising funds.
- Construction** (Pink): Construction of lunar base, Thrusters, Vehicles and robots, Importing materials for construction, Construction of Lumos.
- Transport** (Orange): Capturing 3554 Amun, Transporting Amun 3554 to Lunar surface, Transfer orbit from LEO to LLO, Full extraction of asteroid.
- Settling** (Purple): Interior designing, Life support systems, Starting rotation, Testing of settlement, Final finishes, Transportation of people, Settling in.
- Asteroid Tasks** (Blue): These tasks are listed on the right side of the chart and include: Lumos team interviewing, Finalizing Lumos team, Construction studies, Conference with Space authorities, Approval from countries, Approval from space authorities, Raising funds, Construction of lunar base, Thrusters, Vehicles and robots, Importing materials for construction, Construction of Lumos, Capturing 3554 Amun, Transporting Amun 3554 to Lunar surface, Transfer orbit from LEO to LLO, Full extraction of asteroid, Interior designing, Life support systems, Starting rotation, Testing of settlement, Final finishes, Transportation of people, Settling in.

Epilogue

The planetarium echoed with thunderous applause and I blinked myself out of my stupor enough to steady myself. Manaal, Kahini and Shivam standing next to me were taking a bow to the standing ovation that Lumos received. We could see friends and family rushing to congratulate us and soon, we were enveloped in a group hug.

From the corner of my eye, I could see, people thronging the reservation stalls to purchase our brochures and book their stay in Lumos. Nothing could be more satisfying than to see the faith and belief people had invested in Lumos.

At last, we wondered if we had reached the end of our journey with Lumos. Or had we just started a new one? We really didn't know the answer to such questions that popped up in our minds but all we did know was that -

**LUMOS WILL BE THE ULTIMATE LIGHT THAT
TRAVELS INTO SPACE.**



**“While we are the first ones, we will make
sure we are not the last.” ~ Lumos**



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