ARKADIA-10

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Table of Contents

1. Executive summary

With its sights set on new beginnings and building a new world, Arkadia-10 sets off into space, never to return again.

Arkadia-10 is a space settlement placed in the Lagrange point 5 of the Sun-Mars system. Its' habitat has been created in the context of the rise of quantum computers worldwide and their capability to break with ease any method of encryption commonly used. Our purpose is to create a habitat where people can live and ensure secure communication and agricultural sources around the solar system, as it is vital for all the space missions sent off from Earth.

2. Location

We decided to be placed in the Lagrange point 5 of the Sun-Mars system because of our proximity to Earth, facilitating efficient transport for the resources and personnel needed. L5 provides a stable orbit, minimizing the need for periodical alignment corrections. Also, due to our position, we can serve as a relay station for all other stations by securing and enhancing communication data security. L5 allows us to capture asteroids from the asteroid belt using S.H.E.P.H.E.R.D.

2.1. Construction

2.1.1. Phase 1 (Estimated duration: 15 years)

The first construction phase will launch 15 Starships, constructing the ship's skeleton in the Earth-Sun Lagrange point 5. The Starships, developed by SpaceX, has a largest payload of 100 – 150 tons and is fully reusable, reducing the cost significantly of this phase. The skeleton will be built on Earth, extending and connecting in space.

2.1.2. Phase 2 (Estimated duration: 50 years)

The second phase will be more challenging. Using the S.H.E.P.H.E.R.D., we will collect all the necessary materials and transport them from the asteroid belt, which is the most resourceful asteroid we find, needed for the construction of the outer shell of the settlement. They will melt on their way to L5 so that we will have the raw, filtered metals by the time they arrive at the construction site. There, we will feed the materials to 3D printers that are locked onto the skeleton and build the shell directly on it, ensuring the most efficient way.

2.1.3. Phase 3 - Micro Development with help from Earth

All the parts needed for further ship development will be delivered in this phase. (e.g., bearings, rubber, seeds, dirt, and resources or materials which are not easy to produce). This will ensure that the ship can be further developed on its way to the Mars-Sun L5 point.

2.1.4. Phase 4 – Development after Orbital Transfer

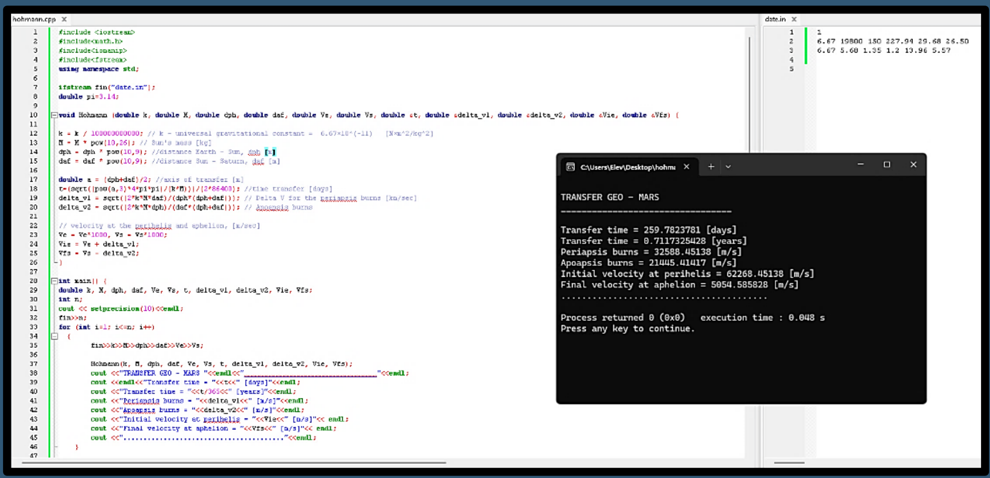
Arkadia 10 will further develop itself after arriving at the destination. The residences will be built using 3D printers that use concrete as a material, chosen due to its durability, so that, in case of any malfunction to the rotating system, the building should stay still. All the other details will be arranged by AI-driven robots based on the views of the settlement's chief architects.

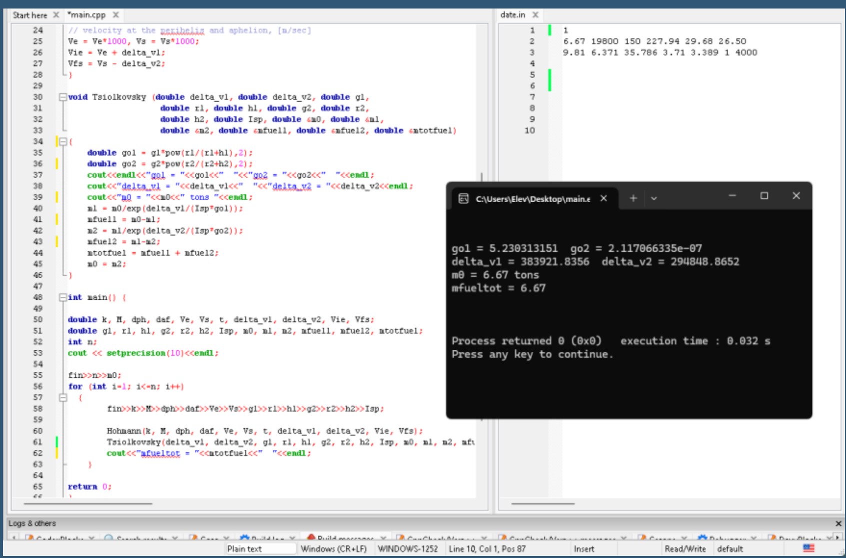
2.1.5 - Cost of building the settlement

The cost of building a settlement like Arkadia-10 can be calcu

2.2. Orbital Transfer

Based on the Hohmann equation, we were able to calculate the following:





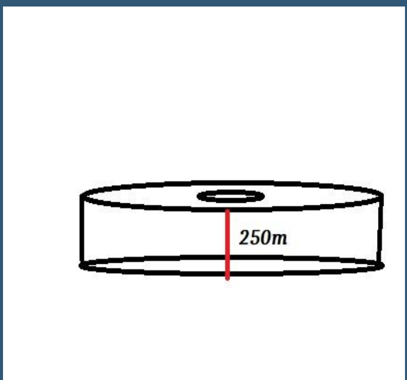
Based on the calculation we concluded that during the orbital transfer, a Hohmann transfer, from GEO orbit of Earth(35000km altitude) to Mars orbit at 1000km altitude, can be performed with 6.67 tons of fuel.

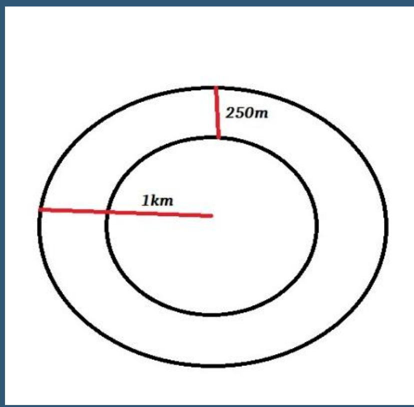
2.3 Overview

Arkadia-10 is a settlement composed of 3 toruses, all connected by an ingenious train-based transport system, as described in the following pages. The first and the third toruses are conducting life, representing the areas with gravity, while activities in the second torus are undertaken in 0 G gravity. The first and the third toruses have spinning layers that generate 1 G gravity without any movement from the main structure of the torus.

Along the main settlement, a few independent systems used to streamline and support the activities on Arkadia-10 will work together to produce resources necessary for developing the industry on the space station.

Measurements of the settlement:





Torus1:

This torus will be universally used to maintain the central urbanistic infrastructure. Outside the essential life support industry, the torus will only contain areas for living and developing human life. The torus will be divided into 3 layers, all spinning individually with different speeds to generate 1G gravity, thus increasing the space for urbanistic areas.

Torus 2:

This torus will be used only for industrial activities and agriculture. The torus will be divided into different layers, some spinning and some remaining still, thus achieving both 0G and microgravity areas. This system will allow the development of certain industrial activities in specific conditions, granting a more efficient process.

Torus 3:

This torus will contain living, agricultural areas and communication systems. The overall structure of this torus is similar to Torus 1, being divided into 3 layers, all generating 1 G gravity without any movement from the outer shell of the structure.

Znamya:

Znamya represents the first autonomous system used to help industrial activities on the settlement from the outside. This technology, based on a solar sail, will help with communications and laser transmissions and will assist the process of generating energy by focusing sunlight on certain areas.

S.H.E.P.P.E.R.D.

S.H.E.P.P.E.R.D. will represent one of the most essential sources for mining and obtaining materials in such a harsh environment. This technology will be used to separate asteroids from the asteroid belt and process them into materials used for building the settlement and providing the primary industries of Arkadia-10.

Satellite Network:

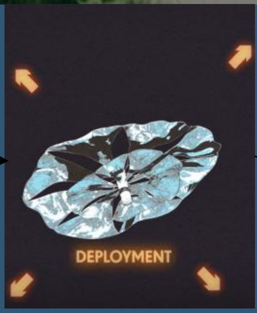
The satellite network will represent the main way of communicating with the rest of the interest points in the Solar System, granting constant and quality communications regardless of the settlement's position.

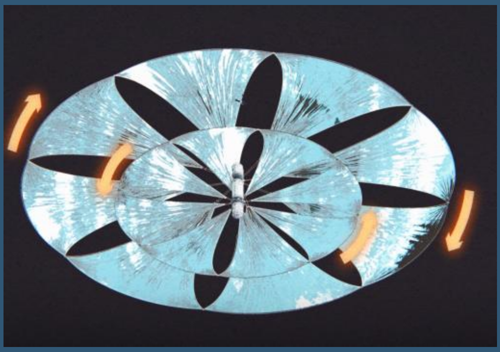
2.3 Short Presentation of Spacecrafts

2.3.1 Znamya

Project Znamya was a 20-meter-wide space solar mirror that directed sunlight while keeping the heat in its aluminum-coated plastic films weighing no more than half a ton. This idea was presented in Russia as a solution for equal hours of "light" (daylight) in different time zones. This project was presented as an idea due to Russia's multiple time zones. In February 1993, near the Russian space station Mir, the mirror successfully deployed and, when illuminated, produced a 5 km wide point of light that traveled across Europe from southern France to western Russia at a speed of 8 km/s. The "bright spot" had a brightness roughly equivalent to a full moon. We will use Znamya technology to create a light source for the ship. It also supports the establishment of a telecommunications network, which will be discussed later in the project.

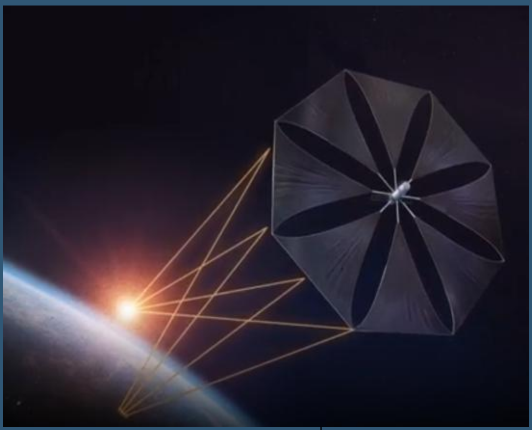
Once at the L5 point, its final destination, a motor would spin up a drum mechanism to unfurl the reflector and focus light on a given area. It also would need to be able to pivot. By conventional means of control, thrusters would need a constant supply of fuel. The solution was a gyroscopic control. By spinning the reflectors in opposite directions and using solar-powered motors to vary their speed, the entire reflector could pivot without any thrusters.



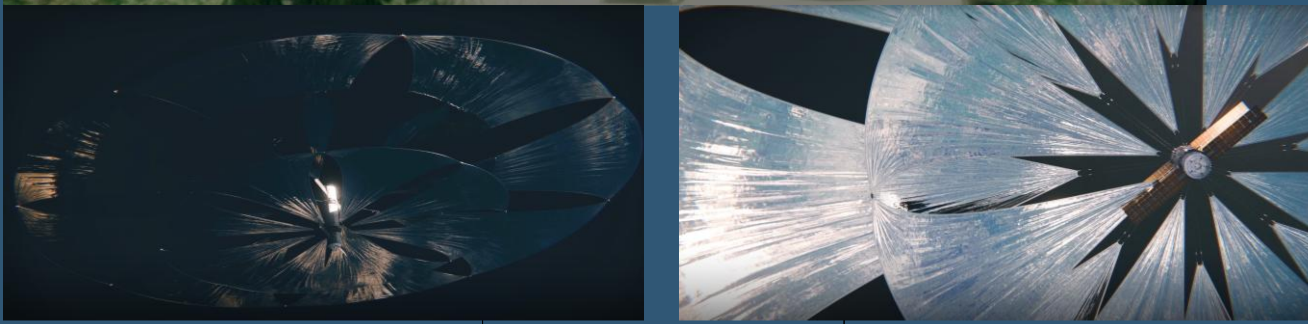


Gyroscopic control- same idea of rotation in 2 directions that we use on the settlement to create gravity.

This solar sail featured a large, highly reflective surface, and it could be used not only to capture solar energy but to reflect it back to the settlement to create a source of light for agriculture areas and humans and also at our telecommunication segments. This reflector is compact and light, being composted by a paper-thin, aluminum-coated plastic film that could be launched and packed inside a small container weighing no more than half a ton. This reflective surface maximizes momentum transfer from the photons of the light, working as a mirror.



Znamya sending light (mirror object).



Znamya sending laser wave (6.2 Chapter)

2.3.2 S.H.E.P.H.E.R.D

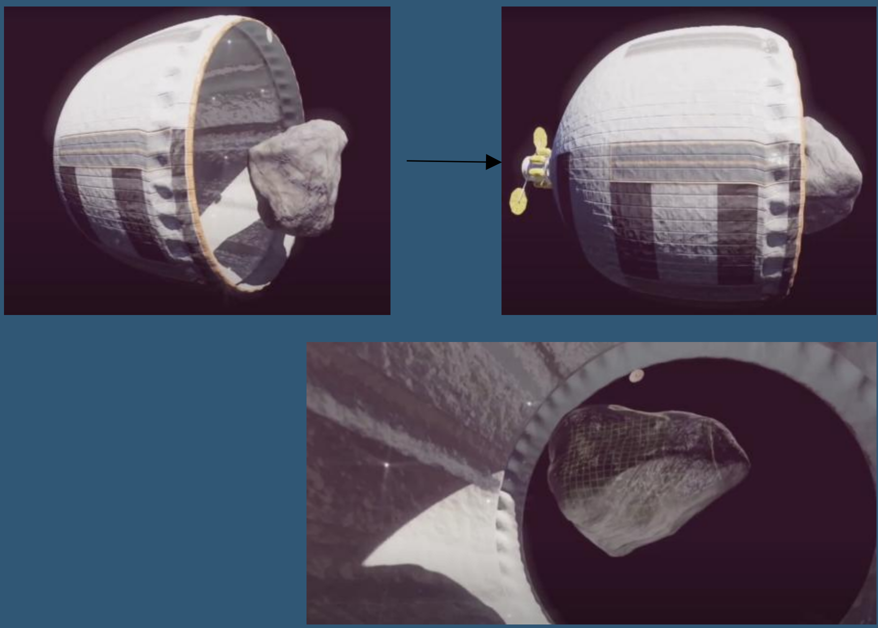
Asteroids are small rocky bodies that orbit the sun. Their composition is made up of rocks, just like those on Earth. They are rich in elements, found in many different types - primarily carbon, hydrogen, nickel, and iron. At the same time, we can find radioactive elements, like uranium, but they are just as strong as those found in regular rocks on Earth. All the asteroids in our solar system are from the same source as our sun and all the planets. As they were created over 4.5 billion years ago, the radioisotopes broke down over time, having similar intensity to the rock on Earth.

One of our most significant ideas is to use the minerals extracted from space mining, specifically from asteroids, as fertilizer. Several types of asteroids have been discovered; the three main types are C-type, S-type, and M-type asteroids. The one with the best resources that can be used in agriculture is the C-type asteroid, which has high amounts of organic carbon, phosphorus, and other key ingredients for fertilizer that could be used to grow food. We plan to send the spaceships used for the S.H.E.P.H.E.R.D. missions to collect the extracted minerals and send them back to the settlement. The main objective of this mission was to map and find near-Earth asteroids for possible mining operations. After this, we will calculate the chemical composition of asteroids and find those that contain valuable minerals that could be extracted and transported to Earth. The data accumulated over the years from these projects will be studied and analyzed so that it can be beneficial for settlement's development. Since we are thinking of aiding the growth of plants using hydroponics, the respective minerals collected by the S.H.E.P.H.E.R.D. ship can be introduced into the water. In the settlement, space will be limited, and the growth conditions of plants and environment will be different. A way to fix this problem is by applying Mendel's laws to combine two vegetables, which involves selecting and crossing plants with desired genetic traits to produce offspring that express those traits to the most positive degree. Typically, this process is used to create hybrid varieties with enhanced features like improved yield, resistance to diseases, and greater adaptability to environmental conditions.

Furthermore, the S.H.E.P.H.E.R.D. mission can be divided into three different phases:

Phase 1: Capturing the asteroid

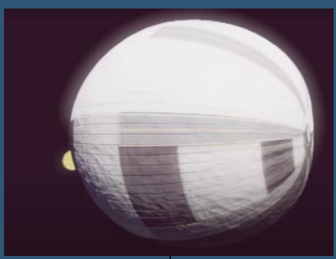
In this initial phase, an asteroid is identified in the nearby area and enclosed within a balloon-shaped containment. This balloon secures the asteroid, ensuring that it can be safely transported through space without breaking apart, deviating from its intended course, or even preparing it for disintegration.



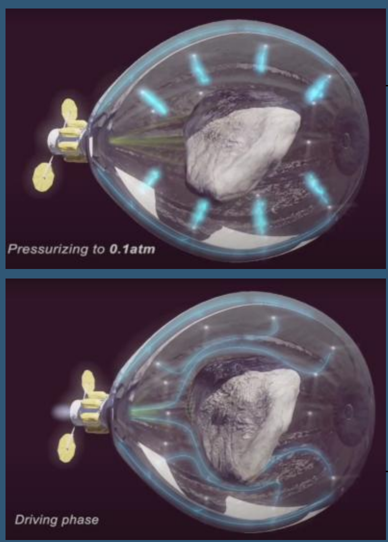
Phase 1. Catching asteroid in the balloon.

Phase 2: Once the asteroid has been secured inside the balloon-like object, electrostatic or gas (as an example, we have xenon gas) pressure methods to prevent the asteroid from spinning endlessly and damaging the inside.

Phase 2- asteroid



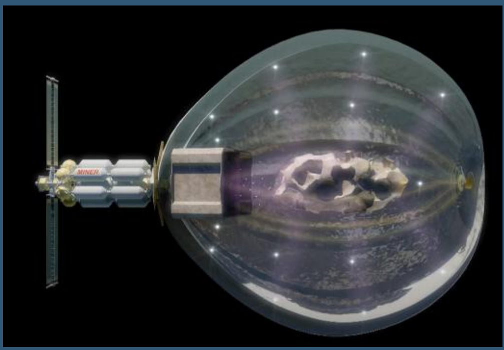
Astoroid in S.H.E.P.H.E.R.D. Ballon.



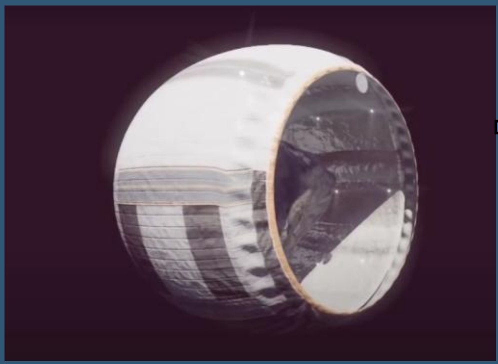
The asteroid's life and its transformations on the way to settlement.

Phase 3: Arrival and Resource extraction: Upon reaching the settlement, the asteroid is positioned at the point of extraction. The containment balloon opens, allowing the asteroid to be carefully transferred to a zero-gravity processing area. On the way, the asteroid has been analyzed and processed. If the asteroid is partially made from ice, inside the balloon is heated to a boiling level, and the water collected inside the tank which is attached at the back of the balloon.

Phase 3 - arrival at the asteroid collection point on the settlement



Neutralizing asteroid forces in the balloon.



The balloon opens and the asteroid is picked up and carried further into the mini-torus with 0G.

In case some asteroids pose a higher threat of radiation, we have a way to reduce the danger. Arkadia-10 wants to use a bigger paintball gun that uses white paint to shoot down the asteroid and cover it on a white surface so that the radiation level can diminish. After that, we want to use the spaceship used for the S.H.E.P.H.E.R.D project to collect and retrieve the asteroid, which, as stated, will be later decomposed into the primary materials used in different colony projects.

Like the ring measurement instrument for the age of trees, Arakadia-10 wants to use a probe sent from the colony. It will slowly reach the asteroid and perforate it with a needle, just like the downside of a jackhammer, which is to reach the core or the outer side of the asteroid. After this, we want to analyze the structure and determine the specific percentage of water and minerals inside to figure out its value.

3. Structural Overview

3.1 Shielding + Safety & Maintenance

Maintaining the ship's exterior is one of the Arkadia-10 crew's challenges. Solar panels are placed on the outer shell of the torus. To maintain the safety and efficiency of the solar panels, we imagine a system with robots on the outside of the torus that periodically check and repair damages.

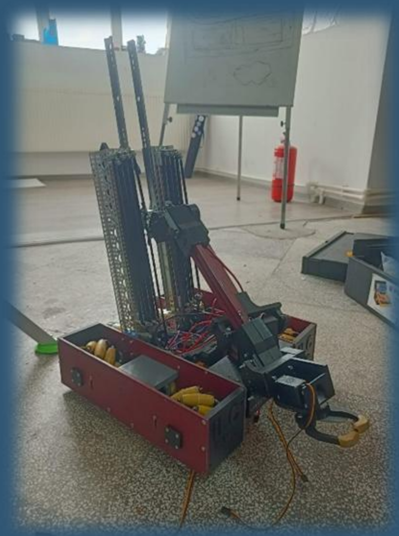
Next to the solar panels, will be placed tracks on which the robots will move on the outside of the outer shell, horizontally and vertically, on an XOY axis system. The robot's arm will be placed on a system, like one of a 3d printer, being able to get to any point of the solar panels, ensuring full access to be maintained or repaired. To prevent the robot from detaching from the frame, they will use a unique clamping system using wheels and rails, an adaptation of the clamping system used on roller coasters in amusement parks.

If the solar panel is damaged, we have to consider replacing it. The affected solar panel will be removed using an ILC Robotix Arm to pick it up and bring it to the maintenance room while another is placed by another arm. In case the outer shell of the settlement is damaged, the robots will be able to get to that point, report the situation there, send live images from the impact point, and decide on the spot what is the best way to repair the damaged area.

3.1.1 ILC Robotix Arm

As a part of our high school robotics team, we decided to include a design from our robot in the space settlement, considering it is important for our mission.

Our arm includes three joints: the base, the middle, and the claw. We carried this out by using inverse kinematics and camera detection samples. We can use a claw as the end to grab things and transport them to places (e.g., a solar panel to the maintenance room) to repair the panels efficiently. The arm could be used in many fields, replacing panels outside the torus, as it is impossible for humans to do it, perform surgeries, or even serve food to the population.



3.2 Transport Method & Interior

A few things must be considered when laying the groundwork for the settlement's urban planning. All layers of the residential torus will be connected through elevators and elevated railways, which interconnect the levels. Each layer will have two light-rail transportation systems, both going opposite ways. On top of that, there will be an overhead cargo transportation hub, which will transport necessary cargo between facilities and layers. The residents must take an elevator to get from one layer to another. The elevators have up to 30 people at once and entire glass walls, emergency buttons, and other safety measures. Since each layer has a width of 400m (about 1312.34 ft), all residential layers will follow the same scheme, just adapted to different length sizing as needed.

3.3 Structure Overview

3.3.1 Exterior Structure

A large space settlement at Mars' L5 needs an ultra-durable exterior strong enough to protect against radiation, micro-meteorites, and extreme temperatures. The outer shell of the settlement needs to have embedded solar panels for efficient energy generation while maintaining the structural integrity of the Torres.

- **Primary structure:**

A Reinforced Composite Hull will be the primary safety structure of the torus, providing safety to the rest of the layers. The primary structure of the torus will be built with strong and durable materials such as titanium-aluminum alloys combined with carbon-fiber-reinforced polymers (CFRP) to achieve a high strength-to-weight ratio and resistance to space debris.

☞ Solar panels:

A core element of the outer shell will be embedded in thin-film solar panels integrated beneath a protective ALON (Aluminum Oxynitride) layer. This will allow efficient energy generation while maintaining the torus's structural integrity.

☞ Thermal Regulation System:

Such a system will be used in the situation of thermal fluctuations. With the help of phase-change materials on the exterior and heat dissipation panels regulating the internal temperatures, this system will maintain the state of the materials and support the structural integrity.

☞ Self-Healing Materials:

This type of material will be used to automatically seal microfractures caused by small impacts, thus extending the longevity of the structure. A material that fits this description is a self-repairing polymer (such as Polydimethylsiloxane (PDMS) infused with Microencapsulated Healing Agents). This material and this type of technology ensure that Arkadia-10 remains structurally stable and capable of sustaining human life under the harsh conditions of deep space.

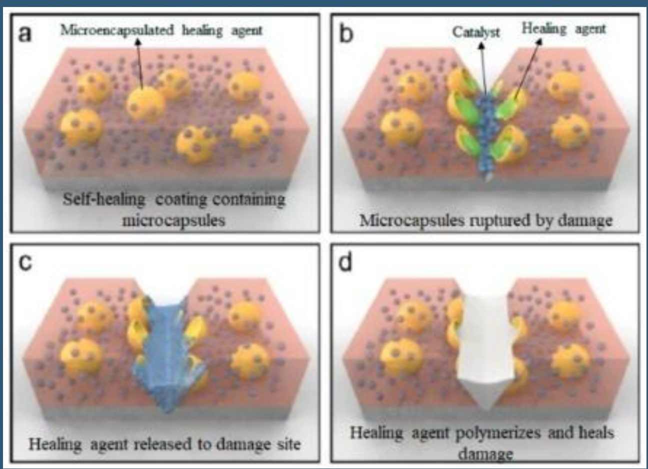


Diagram of how self-repairing polymer works; source: https://www.mdpi.com/1422-0067/23/2/622)

3.3.2 Interior Structure

The interior of Arkadia-10 is designed with modularity and efficiency, ensuring a comfortable and functional environment for our inhabitants. The toruses are divided into different sections based on functionality, safety, and accessibility:

3.3.2.1 Living Area

This is the main part of our settlement and is located along the inner rings of all of the toruses. It provides artificial gravity and access to essential human needs. Here, we will have modular apartments, letting the inhabitants modify the size of their apartments in case of marriages or other events.

3.3.2.2 Agricultural Zones

This agricultural zone ensures that Arkadia-10 can be sustained without the need for external help by using hydroponic and aeroponic farms within the settlement. These zones supply fresh food, regulate oxygen, and provide might psychologically benefits by bringing fresh food into the environment at all times.

Medical System:

The medical system of Arkadia-10 is one of the principal life support systems. Keeping the population of the settlement healthy is one of the main objectives when trying to develop a prosperous civilization in space. On torus one, a hospital will be built on the first layer. Building the hospital on the same layer will assure the safe transportation of transplant organs for surgeries and interventions. Along with other basic requirements, the hospital will include radiation and toxic exposure treatment, AI-driven scanners for diagnoses and robotics or automatized systems for different types of surgeries. Along with this hospital, multiple clinics will be built in different areas to provide immediate healthcare for every citizen of Arkadia-10.

3.3.3 Shielding

One of the greatest threats to the human race in space is radiation and solar flames. Unlike Earth, which protects humanity with its magnetic field, space settlements must rely on engineered shielding to protect their inhabitants from harmful radiation. To address this, we decided to use a multi-layer shielding that combines the following materials:

ALON (Aluminum Oxynitride)

The outer walls of the torus are covered in ALON, a transparent ceramic material that provides exceptional protection against radiation and micrometeorites while allowing solar light to pass through. Thus, we could cover the solar panels in ALON.

Polyethylene Layers

Hydrogen-rich polyethylene must be included in the structure to absorb high-energy cosmic rays and secondary radiation, reducing the radiation dose received by our inhabitants.

Water shielding

Water, an essential life-support substance, is stored in reservoirs around the settlement to serve as an additional radiation shield.

Electromagnetic Fields

Research is ongoing into the feasibility of an artificial magnetosphere that can use superconducting magnetic coils to deflect charged particles, just like Earth's protective magnetic field.

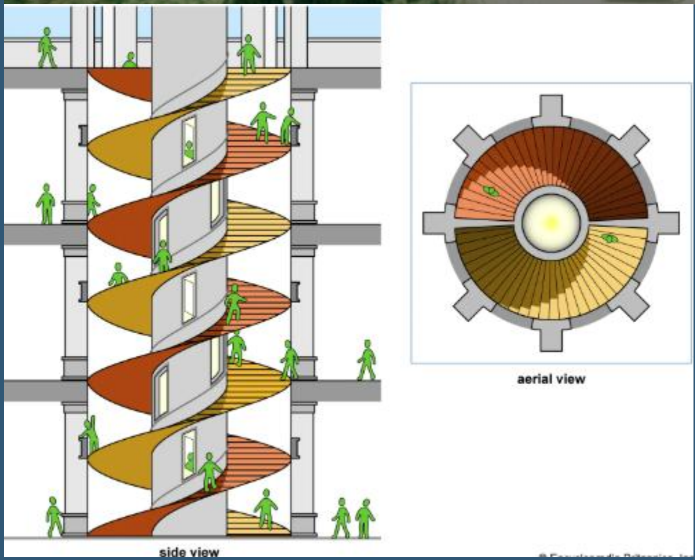
3.3.4 Transport

A great challenge in transportation from one torus to another is managing the space outside the ship. Since the space in the central axis is too small to realize transportation with elevators, we thought that the only viable option would be to utilize the exterior of the settlement for transportation. Thus, communication between the towers becomes a crucial objective in connecting the housing area with the industrial area.

Our proposal for providing transportation between two toruses is a train running through a spiral built along the central axis to which the toruses are attached. Inside the spiral, there is gravity, and the train is attached to the rails in the spiral by a system adapted from amusement park rollercoasters using rack and pinion.

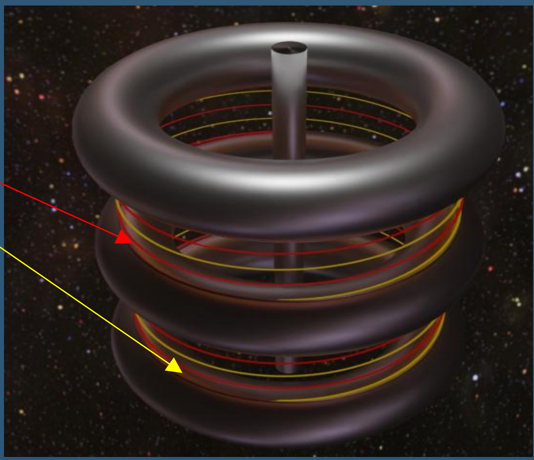
The problem that arises is that a standard-model train cannot make tight, hairpin turns because of limitations related to the radius of the curve (which varies between 5 and 10 degrees) and the maximum climbing angle (about 1.7 degrees for conventional trains, except for specially built ones, where a maximum climbing angle of 3.4 degrees is possible). For this method of transportation to work, the train will have to move simultaneously with the torus in order to achieve the gravitational transfer needed.

This multi-bulkhead train transportation system, running on a double helix rail system, will help solve the logistical challenges of inter-truck transportation by providing an efficient and sustainable solution for navigation between the ship's housing and industrial areas.



For example, the center of gravity of the staircase (the middle cylinder) is the central axis of the seating, the floors in the picture are the starting and ending points between the toruses, and the red line is the route of the train going up, and the yellow line is the way the train goes down. With this method we can merge the two directions of the trains into a single spiral that incorporates both directions of movement of the trains.

Between the toruses the red line is the upward train from 1st torus to 2nd and from 2nd to 3rd, and the yellow line is the downward train from 3rd to 2nd torus and 2nd to 1st, forming a double helix spiral.



4. Life Support Systems

4.1 Water

A space settlement as large as Arkadia-10 would require much water for drinking, sanitation, hydroponics, cooling, and manufacturing. This type of water system would require technologies and methods to generate, recycle, and distribute water efficiently.

Water generation:

Important methods of importing water on the settlement would be mining the ice deposits on Mars and bringing necessary water from Earth. Mars has vast subsurface ice deposits and polar ice caps that can be used as sources for our water system. Electrolysis and filtration will be used to remove impurities before transporting the water.

Water recycling:

A way to recycle the water in our settlement is by using a closed-loop water system like the one used on ISS but on a much larger scale. In order to filter the water, a process of distillation and UV sterilization would be used to ensure purity. Along with these measures, the settlement systems will recover air humidity.

Water distribution:

The water distribution on the settlement will be done using closed-loop piping systems and capillary-action pipes. These pipes will ensure water movement in low gravity.

4.2 Energy

The Electrical Power System of the Arkadia-10 settlement offers control over all the power generation sources, distribution networks, and energy storage apparatus.

The primary energy source will be solar power, followed by nuclear power and kinetic energy as secondary sources of electricity, and backup energy sources such as Radioisotope Thermoelectric Generators (RTGs).

Power generation sources:

Since Mars receives about 43% of Earth's solar energy (590 W/m^2 vs. 1361 W/m^2), a large-scale solar power system would be necessary. A good way of implementing this type of solar power system would be attaching solar panels to the outer shell of the toruses and using the Znamya technology to focus the solar light in one point and produce heat and electricity more efficiently.

Another reliable source for producing electricity would be a nuclear system that uses fusion and fission to generate energy and back up the energy losses. A suitable method for implementing nuclear fusion would be using Deuterium-Trinium fusion since these elements are present in Mars ice deposits. A good option for creating nuclear fission would be using a technology similar to NASA's Kilo power reactors or a scaled-up equivalent.

Distribution networks:

Energy would be distributed on the settlement with the help of high-voltage superconducting cables, which would be cooled using liquid hydrogen, minimizing power loss. An AI system will be used to optimize the load balancing on the grid.

Energy storage and backup:

Large-scale battery banks are a great way of storing the excess energy produced in the earlier processes and can offer a great backup option in case of power shortage. Another excellent backup possibility would be RTGs since they are great nuclear reactors that can be used in remote zones and power up essential life support technologies.

4.3 Atmosphere

4.3.1 Air Composition

To ensure the development of life on Arkadia-10, it is essential to maintain the right air composition for the settlement and provide safety mechanisms for emergencies. The settlement's air composition will be similar to Earth lower atmosphere, containing nitrogen - 78%, oxygen - 21%, carbon dioxide - <0,04%, and trace gases (Ar, H_2O, CH_4, etc.) - 1%.

4.3.2 Pressure Control

On the settlement, the pressure will be maintained at 101.3kPa (1atm), but some sections, such as the industrial ones, may use lower pressure to reduce structural stress. Arkadia-10 will have pressurized emergency O2 tanks that will automatically release air if the pressure drops. Between the gravity transfer zones, we will use different airlock rooms to stabilize pressure between areas and minimize air loss.

4.3.3 Humidity Regulation

Condenser-based air dehumidification systems will support the proper humidity level in different areas. The systems will capture excess moisture and recycle it into the water system. The air humidity will not be the same for every area, with industrial areas requiring lower humidity levels while hydroponic farms will require higher humidity levels.

4.3.4 Air Filtration

The air filtration will be essential for keeping Arkadia-10 a friendly environment for life development and other activities. Regenerative CO_2 scrubbers, similar to the ones on ISS, will keep the CO2 levels best and avoid contamination of the living areas. Sabatier Reactors, converting $CO_2 + H_2$ into methane (CH_4) and water (H_2O), would be a great way to generate water and avoid CO2 contamination of the environment. Different air filtration systems, such as Ozone, UV sterilization, and activated carbon filters, will be used to remove dangerous particles from the atmosphere or industrial byproducts and eliminate all bacteria and mold.

4.3.5 Waste Management

Waste management is critical in a closed environment, such as the one on the Arkadia-10 settlement. The main purpose is to reduce waste volume, avoid dirtying the space, and recover energy and nutrients.

4.4.1 Organic waste

Organic waste, such as food scraps, biodegradable materials, and human waste, will be reused as compost for the plants on the settlement. Also, the water recovered from waste streams will be fed into a water purification system.

4.4.2 Inorganic Waste

Inorganic waste, such as plastics, metals, glass, and other non-biodegradables, will be shredded if possible and reprocessed into new materials, ensuring a minimal loss of material and no need for fabricating new ones.

4.4.3 Hazardous Waste

Hazardous waste such as chemical solvents, heavy metals, battery components, and other toxic materials. We will have special containers where hazardous waste from the population, reducing the risk of contamination and accidental exposure.

When it comes to hazardous waste, we will use specialized incinerators or chemical neutralization, so we can safely handle and reduce any dangeourous compounds, by treating them and convert them into less harmful sustances.

4.5 Ambient Conditions

4.5.1 Day/Night Cycle

We will use lights (mounted on the ceiling) that can recreate all of the Sun's phases to simulate the day/night cycle.

The ceiling will be a panoramic view of the sky, displaying clear skies, starry nights, and clouds moving during the day. With high-resolution panels, we can ensure that it is almost like reality.

The lighting system will integrate directional lightning, which will help create depth and natural shadows. It mimics how the Sun changes its angle and intensity throughout the day. We will have daily and seasonal cycles. For example, winter will have shorter days with softer light, while summer days are longer and brighter. This change can make inhabitants feel more connected to nature. We are going to simulate the seasons' cycles so we can minimize the feeling of repetitive days for our inhabitants.

5. Industry & Agriculture

5.1 Satellites Building

Once the S.H.E.P.H.E.R.D. has successfully delivered the asteroid to the ship, it will be transformed by applying a prism, which will utilize both sunlight and laser light. The aim is to obtain the desired by-products from the asteroid by converting them into a liquid state, with examples of these by-products including iron, nickel, and water. These liquid substances will then be stored for future use, with the water being distributed to plants, humans, and animals. The other materials will be selected and used for satellite construction or settlement maintenance. On the spacecraft, we will have standard molds to transform the materials into satellite parts. We believe that it is essential to have standardized satellites because it is challenging to have molds for every part of every satellite if they are different in structure/composition.

Building satellites in the 0G area of the torus has several advantages, including the ease with which these objects, parts, and molds can be handled. To ensure stability during the assembly, we will use robotic arms attached to the walls of the construction area. This will also reduce electricity consumption since the arms will not have to lift or lower heavy weights, thus reducing costs.

Photo to quickly understand the second torus:

To construct a satellite using materials from the asteroid belt, we have a variety of resources at our disposal, and we can proceed with building under the following provisions:

1**. For structure and housing infrastructure:**

- Iron-nickel alloys: extracted from metallic (M-type) asteroids, they are ideal for building a strong structure and hull;
- Silicates, such as olivine and pyroxene, can be used for thermal protection or to make shields against micrometeorites;

2. To aid solar panels in obtaining energy:

- Silicon: obtained from silicates, can be refined to produce photovoltaic cells for solar panels;
- Iron and nickel: used for structural support for panels and magnetic circuits;

3. For manufacturing electronic systems:

- Copper and gold: although rare, traces can be found in metallic asteroids; they are necessary materials for making circuits and electrical contacts due to their good conductivity;
- Platinum and other rare metals: used in advanced electronic components and electric propulsion systems;

4. For propulsion:

- Water: found as ice in C-type asteroids; can be broken down into hydrogen and oxygen for chemical propulsion;
- Xenon: can be used for ion propulsion;

5. For insulation and protection:

- Oxides and carbonates: can be made into ceramic materials for thermal insulation;
- Graphite: can be used to create protective layers against cosmic radiation;

6. For control and navigation systems:

- Aluminum and magnesium: although rare, can be used in lightweight and durable components.

5.2 Agriculture Aspects

The main aim of the settlement Arkadia-10 is to aid in advancing remote communication in space. This feature is meant to be the heart of the entire project. For its implementation, we considered using a $81 \cdot 10^6 W$ sized laser to transmit information through laser beams, although we also use them to grow our plants. Following our research and experimentation, we have found that we need two lasers: blue light (which has a wavelength of 450 nm - 500 nm) and red light (which has a wavelength of 620 nm - 700 nm) and that these can be used in agriculture as well, more precisely by helping in the germination and growth of plants.

The lasers are used to create two separate environments in which plants can grow in the best conditions, with light and heat according to their development parameters. Each species of plant grows faster or slower, depending on its environment. We tried to speed up their germination process with the help of laser light.

Following this idea, we conducted an experiment in which we studied how plants grow depending on the laser light's intensity, wavelength, and distance. Thus, we can decide the laser intensity at which the plant grows best, leading us to find the light parameters. The plant's germination will be realized in soil and individual capsules with different walls for each plant species, allowing light to pass through at a lower or higher intensity. This way, all plants of the same species have the best growth conditions.

How we calculated the power needed for our laser based on our experiment:

Firstly we started from the materials and results we had from the experiment:

$5 \cdot 100mW$ lasers on an area of $10^{-2}m$ for 5 plants.
The agricultural area we use is $161 \cdot 10^6 m^2$, so by using a liniar function for calculating the power:

1 laser	X lasers
$A_0 = 10^{-2}m^2$	$A_{agricultural} = A_{torus\{\cdot\frac{3}{4}=\frac{3}{4}\cdot 215km^2=161km^2}$
$N_{lasers} = 1$	$N_{laser=\frac{161\cdot10^6m^2}{10\cdot10^{-4}m^2}=\frac{161\cdot10^6}{10^{-3}}=161\cdot10^3}$
$P_0 = 100mW$	$P_{total} = N_{laser} \cdot P_0 = 161 \cdot 10^3 \cdot 100 \cdot 10^3 = 16100W$
$N_{plants} = 1$	$N_{plants} \cdot 5 = 805 \cdot 10^5 plants$

Experiment description:

1. **Preparation:**

   Materials: red laser, blue laser, optical prism, diffraction grating, converging lens, soil, pots, containers, radish seeds and lettuce seeds;

   Converging Lens: This is a semicircle-shaped lens through which multiple spectra of light pass through this medium and are focused into a single point.

2. **Plant development**

   → **Radishes:**

- Recommended light: red laser (630 nm - 660 nm)
- Reason: Red light stimulates both photosynthesis and vegetative growth of plants, helping radishes germinate quickly and reach maturity. Red light is essential for the photoperiod, for example, it is helpful in regulating the circadian rhythm of plants, stimulating them to grow and flower. In combination with blue light, red light can help plants achieve a balance between vegetative development and flowering or fruiting.
- Germination time: 3-7 days.
- Observations: Radishes reach germination quickly, sometimes even in 3 days in optimal conditions. They are oftentimes used in rapid-growth experiments.
- Previous experiments: November 30, 2020, Advanced Plant Habitat on ISS.

   → **Lettuce:**

- Recommended light: Blue laser (450-470 nm)
- Reason: Blue light is effective in stimulating leaf growth and vegetative development of plants, namely leaf and stem growth. Blue light also stimulates photosynthesis and is essential for the formation of a healthy and vigorous plant. Lettuce greens need blue light as well as red light in order to control the photoperiod and regulate their size and shape.
- Germination time: 7-10 days

Because of technical problems, the blue laser breaking down and the delay in getting a new one, we couldn't do the lettuce experiment.

3. **Calculations:**

   Estimated power consumption: a low-power laser used to stimulate germination could have a power of 1 mW up to 100 mW.

   Calculation for a 100 mW laser:

   - Energy consumed per hour: 100 mW*1h = 100 mWh (0.1 Wh)

   → Total energy calculation: 0.1 Wh * 8 lasers *24h * 7 days = 117 Wh

Light type	Time to germination	Steam length	Steam	Water use in 10 days	Observation

			color	(experiment duration)	
Plants grown with laser light	1-2 days	12-13 cm	White - green	200 ml (once every 2 days)	Plants grown with laser light have a longer stem, but the leaf surface is more sparse.
Plants grown with sunlight	4 days	7-8 cm	Red - green	200 ml (once every 2 days)	Plants grown with sunlight under normal conditions grew more slowly, had smaller steams, and had larger

Fig. 1 - Plants with laser light

Fig. 2 - Plants with sunlight

The greenhouse in 0G

In our research, we found a few previous experiments that inspired and assisted us in completing our work. Between 2014 and 2016, lettuce greens were grown on board the International Space Station from surface-sterilized seeds in the Vegetable Production Systems, growth chambers equipped with LED lighting, and a watering system designed to grow crops in space.

These growth chambers were equipped with LED lighting and a watering system designed for space agriculture. The crops were left undisturbed in the vegetable units for 33 to 56 days until crew members consumed some of the mature leaves without any adverse effects. The remaining leaves were frozen and transported back to Earth for chemical and biological analysis.

The layout:

The middle of the greenhouse's surface with 0G will be divided between satellite production, the laser room, and the area for growing crops. The laser light will be split into red and blue.

The agricultural area, shown in the picture below, is divided into 0G and 1G sectors based on what is grown. Having the laser at 0G means that the floor or structure of the torus will no longer need to be reinforced to support the weight of the light source and that the laser's attachment will be able to do this more manageably because it floats and thus it only needs to be anchored. In addition, anchoring the laser with cables will help us change the angle of the laser relatively easily.

On the side of the torus, we are planning to have 2 lanes of 14m each in with (one on each side of the torus, where the trees will grow, and other plants that can't grow in 0G. Also, we will have one big lane in the middle with 0G of 222m in width, where all the other plants will grow. The lanes with artificial gravity will be attached to the shell of the torus and will move on a railway system that will ensure a constant 1G.

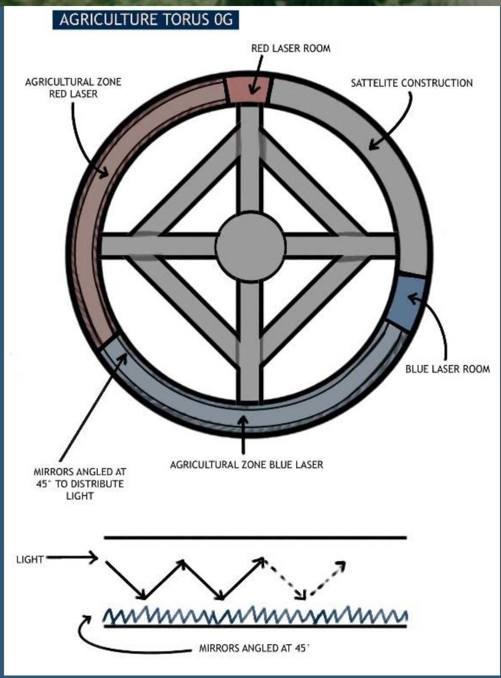
On the sides of the torus, we will design 4 of 1G (7m each in width) lanes and 74 of 0G (3m each in width) lanes, and we will create more concentric layers using them. The 1G lanes will have only 4 layers due to the height of the trees, but the 0G lanes will have about 40 layers due to the lower height of the crops planted there. The lanes with artificial gravity will be attached to the shell of the torus and will move on a railway system that will ensure a constant 1G.

The red laser will bounce off mirrors placed on the sides of the torus at an angle of 45°. The blue laser will be transported through a tube on the other side of the torus and will be dispersed to the plane using mirrors, angled at 45°, as the other one. Also, we have a system of smaller lasers that will fill in the needs of each plant so we can fine-tune the light for each plant's needs, ensuring that plants will grow in the best environment possible.

The outer walls of the torus will be clad in ALON (polycrystalline aluminum) with a spinel that does not allow radiation and light from outside to penetrate inside, thus disturbing the growth of the plants. Mirrors reflecting red and blue light will be mounted on the inner walls.

After the germination process, the plants will be moved into nutrient water basins by implementing Hydroponics.

Thenical drawing and AI generated images simulating the agricultural area:



After different calculations, we obtained that the total number of plants that Arkadia - 10 will be able to grow in 0G is 805 x 10^3. This rounds up to a number of 805,000 plants. The area that we have has a total of 161 km² available. This is 161,000,000 m². We will also have different aisles for people, scientists, farmers, and robots to move and check upon the plants. Let's assume that 15% of that space serves that purpose.161,000,000 × 0.85 = 136,850,000 m² will be the specific area for plants.

There are different types of plants that will grow there. Each one of them has a specific average space required. Microgravity-adapted Fruit Trees (strawberries, dwarf tomatoes, dwarf citrus) require 6 to 10 m² each. Leafy Greens & Herbs (lettuce, spinach, basil, microgreens) require 1 to 3 m² each. Tubers & Root Vegetables (potatoes, carrots, radishes) require 2 to 4 m² each. Legumes (peas, beans, hydroponic cucumbers) require 3 to 5 m² each. Specialized Plants for Oxygen & Nutrients (algae farms, duckweed, spirulina) require 9 to 16 m² each.

Our estimated guess of how many plants there are is that: Specialized plants should have around 180,000 species. Microgravity Fruit Trees are around 200,000 species. Legumes are around 160,000 species. Tubers & Root Vegetables are around 120,000 species. Leafy Greens & Herbs are around 145,000 species. Marking the total number of 805.000 plants.

In order to avoid overcrowding, specific spacing measures will be taken into consideration: Specialized plants (Algae farms, Duckweed, Spirulina, etc.) will have dedicated hydroponic or bioreactor space. Microgravity fruit trees: 2-3 meters apart. Legumes & vines: 1-2 meters apart. Tubers & root vegetables: 1-2 meters apart. Leafy greens & herbs: 0.5- 1 meter apart.

Layout greenhouse in 1G

Following the experiment of growing plants with laser light, we found that some plants cannot grow in this environment by dividing it into red and blue light. Fundamentally, plants can be divided into two categories: those that can grow in zero gravity, which will grow without sunlight, and those that will grow in G1, which will grow with sunlight. In those that can grow in zero gravity, there are a few exceptions regarding external factors of each plant's development.

There are, for example, plants that cannot grow in soil that is too acidic, such as Lavender, or in soil that is too alkaline, such as Azaleas or Rhododendrons. The amount of light a plant receives also affects its growth, with species that cannot grow without sufficient light, such as woodland plants: ferns or violets. Cacti and succulent plants such as Aloe Vera or Agave cannot withstand very low temperatures and lots of water.

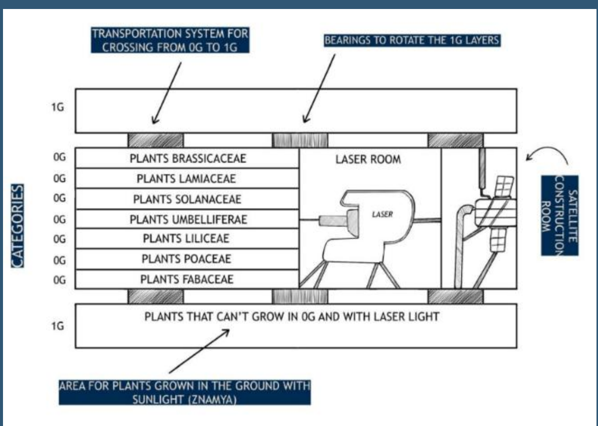
However, tropical plants, such as bananas, papayas, and mangoes, cannot grow at very low temperatures. The salinity of the water in the environment is important. Rice is one of the few plants growing in salt water, whereas whole wheat and corn cannot. Additionally, fruit trees face a significant challenge as they cannot bear fruit without pollinators. Therefore, when considering planting, we must remember that some plant species may not thrive due to the artificial environment. The solar light will be the light source for these plants. Thus, a solution needs to be found in order to aid plant growth.

For Arkadia-10, the best solution would be implementing technology such as Znamya. To concentrate sunlight and reduce ship costs, we can utilize the **Znamya satellite technology**, which was previously employed by the Soviet Union in 1992.

Znamya was a 20-meter-wide space solar mirror that directed sunlight while keeping the heat in its aluminum-coated plastic films. This idea was presented in Russia as a solution for equal hours of "light" (daylight) in different time zones.

In February 1993, near the Russian space station Mir, the mirror successfully deployed and, when illuminated, produced a 5 km wide point of light that traveled across Europe from southern France to western Russia at a speed of 8 km/s. The "bright spot" had a brightness roughly equivalent to that of a full moon.

Better view of 2nd torus (tehnical drawing) & agriculure area in 0G and 1G.



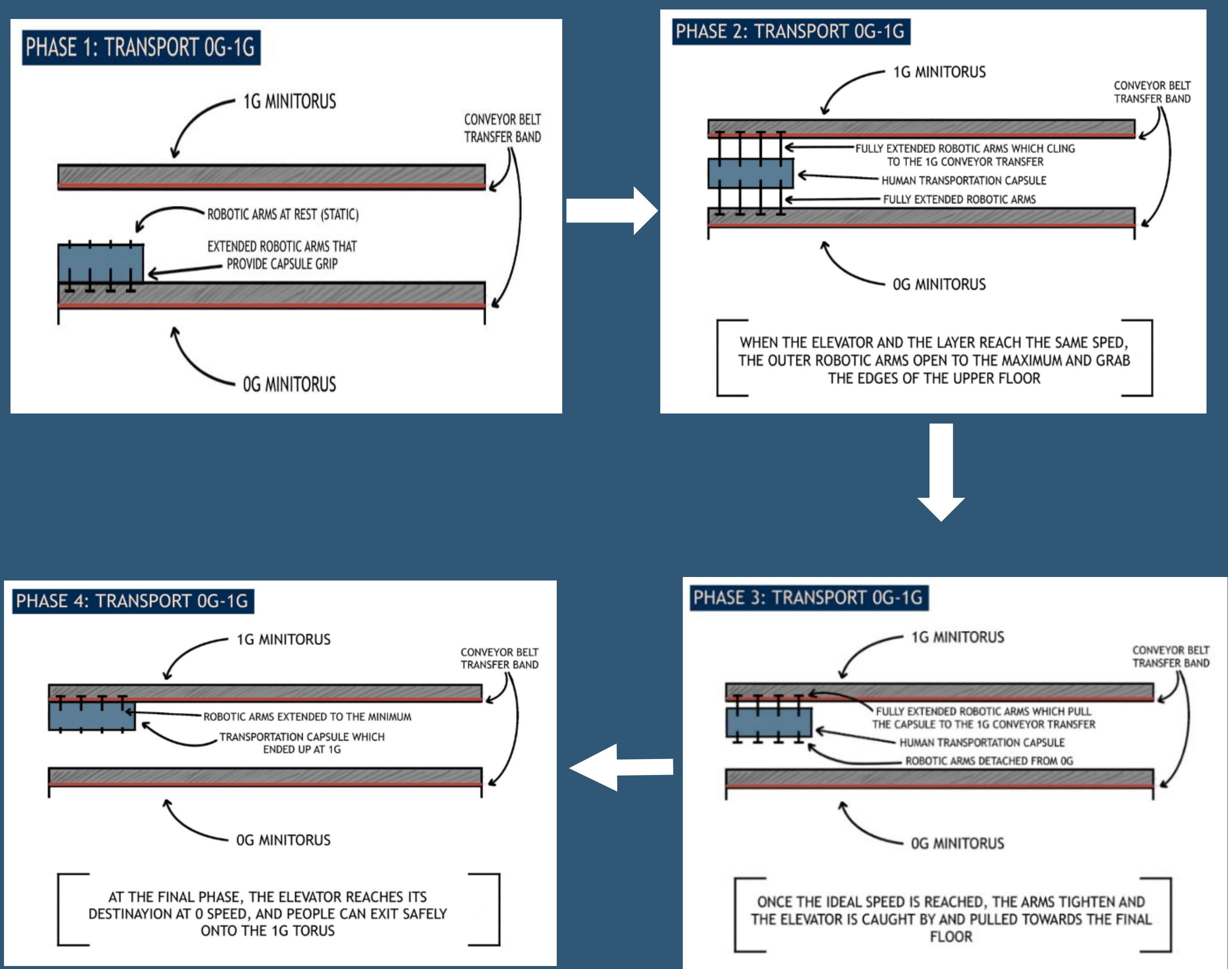
Transportation from 0G to 1G

Transportation from 0G mini-torus to 1G mini-torus is also an important point to address. Since the 1G layers are at the edge of the torus, transferring people will require extra work. Therefore, we have devised a system where people enter a capsule which has a size, height, length and width of 3 m (9,84 feet). The capsule will be placed on a transporting band laid pe 0G mini torus that will start to spin for about 10 minutes (at a speed of 380 km/h or 236 miles/h), until it reaches the 1G layer speed. (see below figure: Phase 1)

Once it has reached the speed of the 1G layer, the capsule and the 1G torus have the same speed, the cabin will open its robotic arms to grip the edges of the 1G mini-torus walls. The booth will be grappled by the 1G mini torus, and then the inhabitants aboard the transferring system will have access to the 1G agricultural zone.

Transferring from 1G mini-torus to 0 G mini-torus will be done with the same capsule, using the same mechanisms, the difference is that instead of accelerating it will decelerate so that robotic arms grip the edges of the 0G mini-torus.

Detailed transport phases:



5.3 Collection of Methane Gas

Methane gas is a highly inflammable and efficient fuel that will serve as one of the primary energy sources for electricity generation, heating, and propulsion, all of which are essential for sustaining the colony. It offers a clean-burning alternative to traditional fossil fuels and can be stored in compressed or liquefied form for ease of transportation and use. The S.H.E.P.E.R..E.D project, which will be used for asteroid collection, will also use methane as fuel. The primary animals producing methane in large quantities are cows. They are major producers of methane through enteric fermentation, a digestive process in their stomachs that releases the gas. collected **passively** through air filtration methods that capture methane emissions from the surrounding environment which will be deposited in a gas cylinder. The container will be delivered to the stations and facilities needed.

5.4 3D Printed Meat and Animal Distribution

Just like the human body, an animal's composition is 60% water. Meat is considered one of the most important food sources in the world due to its rich nutrients and proteins. On a space settlement, the nurturing of animals will become increasingly limited over the years. Therefore, we plan to implement the use of artificially created meat through 3D printing. We aim to cultivate cells from the animals housed in the third torus and change them to print food. Biotech scientists have discovered how to harvest stem cells from livestock while keeping the animals alive.

There were first concerns that 3D-printed food might be harmful to humans due to the presence of potentially cancerous cells. This concern arose because, like cancer cells, lab-grown meat cells often undergo a process that enables them to divide indefinitely. However, both real meat and 3D-printed meat, when cooked at high temperatures, generate compounds such as heterocyclic amines (HCAs) and polycyclic aromatic hydrocarbons (PAHs), which have been linked to cancer. In case this happens, we want to research the new bacteria discovered in space, test them in different habitats, and see if we can cure cancer.

Animals will not only be kept for meat production and 3D-printed meat but also for methane gas production. The primary animals producing methane in large quantities are cows and pigs. Methane will be used as a fuel source for various energy needs, including electricity and heating, which are essential for sustaining the colony. Additionally, it will be needed in significant amounts for the S.H.E.P.H.E.R.D. project. A specialized pump will be developed to isolate the gas, ensuring that Van der Waals forces are contained.

The third torus will contain three kinds of animals: cows, pigs, and chickens. There will be green places for all the animals. Their personal quarters will be: for cows, 32 square meters; for pigs, 3 square meters; for chickens, 0.3 square meters. This adds up to 600 cows, 400 pigs, and 175,000 chickens. The milk from cows will be processed into further food.

The settlement will be able to host a maximum of 175,000 people. One person consumes 2,500 calories per day, which amounts to 186,500,000 calories per day or 68,437,500,000 calories per year. A cow produces 8,000 liters of milk per year, which approximates 4,800,000 calories per year. Since we will have 600 cows, we will have 2,888,000,000 calories of milk per year from cows.

For chickens, we will have two eggs per person per day, totaling 150,000 eggs per day. Over a year, this will amount to 54,750,000 eggs. Since a chicken lays one egg per day, we will have about 175,000 chickens in the settlement. One egg contains 74 calories, so we will have 4,051,000,000 annual calories from eggs. The chickens will also reproduce, so they will be used for their meat and feathers.

For pigs, they won't have a different usage besides their meat, which will sometimes replace cow meat and be used for 3D printing. The rest of the calorie intake will be supplemented with meat and vegetables to ensure the 2,500 kcal daily requirement is met.

☞ A more descriptive presentation of the daily intake needed: a human needs 2,500 kcal per day. This is divided into different sectors:

  - ✓ Carbohydrates (Glucides): ~50% → 312 g (~4 kcal/g)
  - ✓ Proteins: ~20% → 125 g (~4 kcal/g)
  - ✓ Fats (Lipids): ~30% → 83 g (~9 kcal/g)
  - ✓ Fiber: ~25–35 g

The third torus is circular when viewed from above. When unfolded, it will have a width of 400 meters and a length of 6 kilometers. Down the length of these 6 kilometers will be the central 400-meter width, dividing it into two sectors of 198 meters each.

Area of one sector = Length × Width = 3,000 × 198 = 594,000 m^2. Doubling the sectors, 594,000 × 2, we will have 1,188,000 m^2. From this space:

- 32 m^2 × 600 = 19,200 m^2 will be for cows.
- 400 × 3 m^2 = 1,200 m^2 will be for pigs.
- 175,000 × 0.2 m^2 = 35,000 m^2 will be for chickens.

The total space required will be 55,400 m (about 34.42 mi)^2 (or 5.54 hectares). Arkadia-10 will also host a special space in the third torus where all the animals can stay together. It must be kept in mind that the number of animals can be increased over time, as 1,132,600 m^2 of space will remain. The rest of the space will be used for laboratories such as Quantum Encryption and residential areas for people.

5.5 Food Production & Supply

The food production on Arkadia-10 is composed of two important parts: the plant-based food production and the 3D-printed meat source. The plant-based food production system on the colony is one that is rather simple and is designed to be entirely self-sufficient, ensuring a stable and nutritious composition for all residents. The agricultural sector has two parts that will ensure the existence of all necessary plants for humankind. The system is made from hydroponic and aeroponic farms, which optimize plant growth by delivering nutrients directly through water or mist. Light sources such as red and blue lasers are used to accelerate plant growth, and genetic modifications based on Mendelian laws ensure adaptability in space conditions.

AI generated images simulating biological laboratories on the settlement:

Arkadia-10 uses 3D-printed meat technology, which grows and shapes cultured animal cells into edible protein sources, reducing the need for extensive animal farms. This approach eliminates the need for unnecessary animals while reducing resource usage and offering high-protein food alternatives. At the same time, these animals provide essential resources such as eggs, dairy, and methane gas, which is used as an energy source. The waste from animals is also repurposed into fertilizer for agricultural production.

6. Communication

6.1 Quantum Encryption

Why should this quantum encryption method be adopted within our settlement and mission?

This method helps secure the data at the highest level of encryption ever used and theorized because of its immunity to traditional hacking techniques due to quantum mechanics features. Any attempt at interception will be at once detectable due to the property of the photon's entanglement and polarization.

The satellite-based network will enable secure communication between colonies, planets, and ships. Our purpose as a settlement is to secure safe telecommunication in space, considering the importance of the shared data to be secured. As quantum communications are ultra-secure, we decided to use those to communicate between ground stations and other settlements.

How will we encrypt the messages?

The method used is Quantum Key Distribution (QKD), which ensures the detection of any eavesdropping attempt. The sender generates a sequence of photons (qubits) encoded in a specific quantum state (polarized) through a quantum channel. Here, we chose a laser beam because of its dual use in agriculture and communication. If anyone tries to intercept the photons, their quantum state will alter, introducing detectable errors in the quantum key. Both parts compare a part of the photons they received/sent, using classic communication, saying, “For photon 1, I sent vertical polarization,” replying with, “I measured vertical.” If most photons make it through, the connection is considered secure, and the encrypted data is sent. Still, if there are mismatches, it is possible that something was involved in the transmission of the information. AI algorithms will analyze the quantum signal strength, gravitational disturbances, and orbital position to optimize photon transmission.

Once the Quantum key is transmitted securely, the sender encrypts the actual message using classical encryption using the quantum key. Then, the encrypted message is transmitted through normal means of communication, like radio waves.

Also, we are going to use satellites as relays to enhance the reach of quantum communications across the vast interplanetary space. They will transmit the entangled photons and distribute them between the communicating parts, ensuring QKD.

We plan to have a Constellation of Quantum Satellites, a network of satellites positioned strategically across the solar system to ensure continuous communication.

Quantum repeater Satellites will help the problem of photon loss over extended distances, helping maintain the quality of data transmitted in the interplanetary systems. The satellites will be modular, so their cost will reduce over time and be able to be upgraded by adding quantum transmitters or entanglement generators without the need to launch another one, allowing for the integration of newer, more efficient processors or power sources like solar panels or batteries, extending their lifetime.

How to send information from the main settlement to other areas in space:

Telecommunications is an essential pillar of the infrastructure of a space settlement, and in order to ensure fast and secure communication between different areas in space and the Arkadia -10 settlement we propose an innovative system based on satellites, laser technologies and ways of encrypting information.

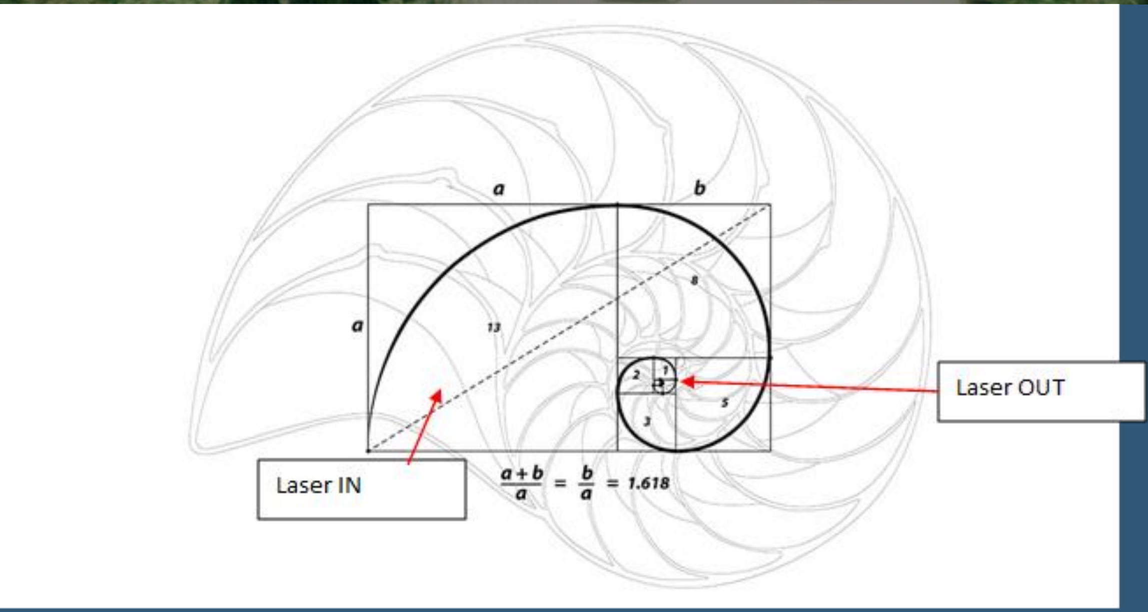
The main aim of this project is to develop an efficient telecommunication network using laser waves to ensure fast and secure information transfer. In order to implement this solution, we have chosen to place the laser source outside the settlement, anchored in cables at the edge of torus 3, the torus that deals with the ship's industrial activities. Depending on the direction in which we need to send the laser beam to meet the satellites (Znamya or other telecommunication satellites), we can change the angle under which the laser acts, using these anchoring cables.

In the structure of the third torus, on the top floor, there will be laboratories for quantum encryption and units for transforming information into images by steganography, thus protecting the transmitted information against interception or external attacks. To send the information from the labs to the laser we will use optical fiber, placed inside the laser anchor cables.

Once the information is processed and stored for laser transmission, the problem of laser wave divergence arises. To solve this inconvenience and to maximize the efficiency and power of the laser wave, we implement a spiral constructed according to the Fibonacci string up to the golden number (14th number). Calculated by the following recurrence relation:

$$F(n) = F(n-1) + F(n-2)$$

As one moves forward in the sequence, starting with the 14th number, the ratio between two consecutive numbers is the same: 1.61083 (233:144=1.61803, 377:233=1.61803). This number has been called φ and has been considered since antiquity the "golden number" or "golden ratio" due to the frequent encounter of this ratio in the world of mathematics and architecture. (e.g. sunflower: number of petals and arrangement of seeds, snail shell, golden principle in architecture) The spiral constructed according to the Fibonacci string will be fixed in the continuation of the torus 3 and will act as a "concentrating vane" on the laser wave. For gripping and manipulating the structure we will use robotic arms, they ensure precision in maneuvering and help to position the structure under a certain angle.



Once the angle at which we position the spiral relative to torus 3 is set and the direction of the final laser wave is established, the laser will be activated, and the wave will be transmitted to the Znamya space mirror at a 45-degree angle.

The Znamya space mirror will scatter the wave in 8 directions, each direction being associated with one of its aluminum blades. These reflective blades will direct the waves to different satellites that are intended to pick up the information and amplify it, if necessary, and send it onwards to the recipient or to other settlements.

Satellites will be built on torus 2, where 0 gravity helps us in the manufacturing process and the transportation of components.

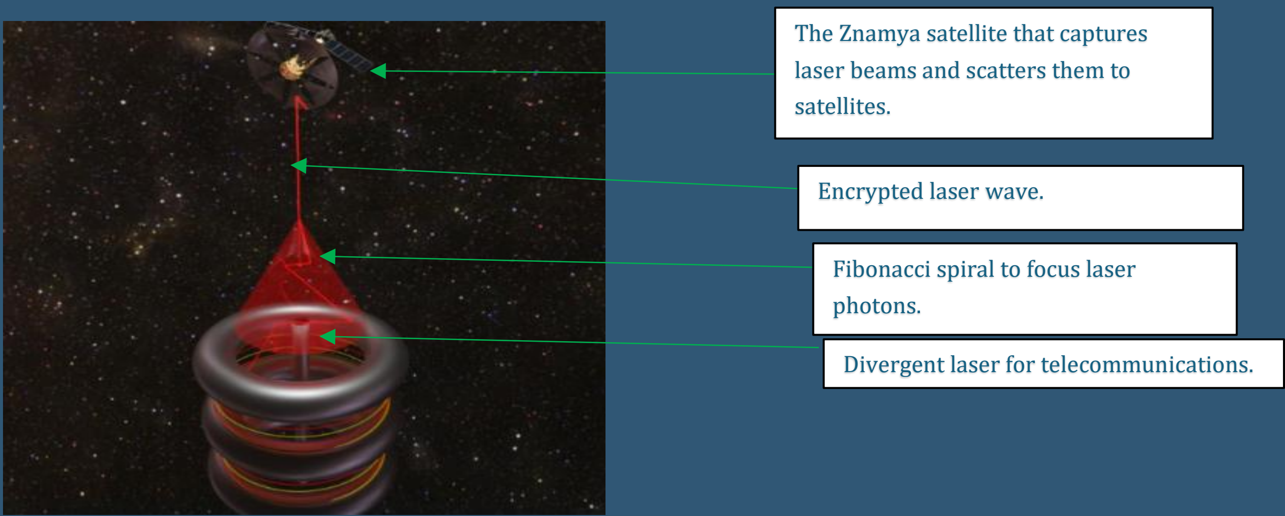
Znamya will transmit information to available satellites on Lagrange (Mars-Sun) points (the communication space being Earth-Mars with connection to the planets between Mars and Sun):

- → 4 satellites for Mars-Earth communications,
- → additional satellites for Mercury and Venus with the possibility to extend this system to other planets in the Solar System.

AI generated images that simulate the laser wave telecommunication system:

Laser beam sent to another satellite

Encrypted laser received by a satellite

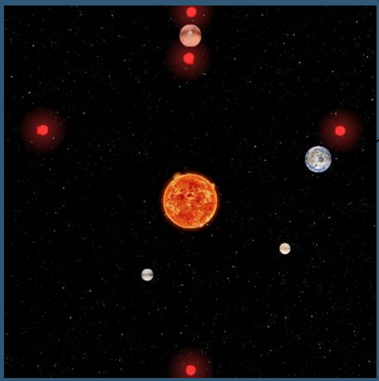


With the help of Znamya we built a parallel communication system, by which we streamline the information transmission. If we had used the classical idea of serial transmission from one satellite to another, the speed and power of information transmission would have been reduced, plus if one satellite were to stop working then the whole flow of information would be interrupted. In the case of our communication system, Znamya is the single point of failure, but Znamya is also the source of light for the settlement and benefits from regular maintenance, real-time monitoring and technical staff with the know-how to intervene and fix any failures. with the possibility of extending this system to other planets in the Solar System.

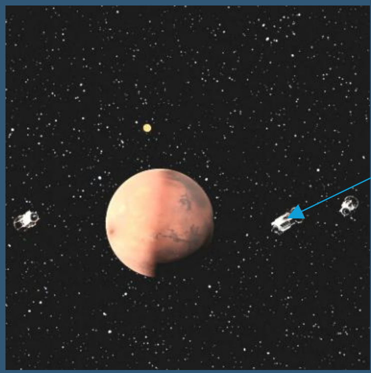
To ensure the redundancy of the information / wave transmission, we will build from the beginning 2 satellites, one used as backup but also for traffic load-balancing.

6.2 Satellites Network

To provide communications for our mission, as well as for future space exploration missions, we will create a network of satellites to communicate with the planets between the asteroid belt and the Sun. This network will form the basis of space communications that our settlement will use. The first phase of network development will take place between Earth and Mars. The network will be located on the Lagrange points of Mars with the Sun. There will be two subcategories for the interplanetary network: planetary network (satellites orbiting the planet) and general network (Lagrange points).



(red dots represent satellites placed on Mars Lagrange points)



(satellites orbititng the planet Mars)

The reason for implementing such a system:

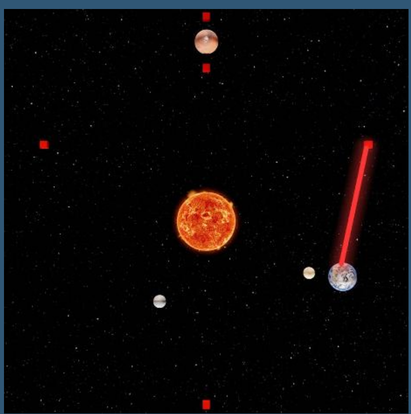
A communications network between Earth and Mars could improve communications for future missions, connect the settlement to key points in the Solar System, and increase the performance of communications between Earth and Mars.

Impact on future missions:

The Earth-Mars satellite network will provide constant connection between spacecraft and mission control points in the area between the two planets. Spacecraft in Earth-Mars space will have a constant connection to both Earth and Mars, regardless of their position.

Connection to our settlement:

Located, on Mars' L5 point with the Sun, the settlement will be part of the ring of satellites orbiting Mars. The network will connect the settlement to the entire Earth-Mars surface. It will provide constant communication with Earth, Mars and other important points in this area.



(Connection L5-Earth)

Increasing performance:

The Earth-Mars network would no longer be limited by distances between planets or optimal times for transmission, so there would be no data loss and no radiation influence. The bandwidth provided for data transmission will be greater. The network will have an intelligent system that will calculate the most efficient route for information transmission using a relinking system.

Planetary networks:

For the planets between which communication is made, there will be a network of satellites in low and high planet orbits. This satellite network will ensure the transmission of information about the planet, communication with different settlements or space stations. The connection between the network on the orbit of the planet and the general network, existing on the Lagrange points, will be made with the help of points L1 and L2, both on opposite sides of the planet (ensuring communication in both directions).

(communications satellite orbiting Mars)

Types of satellites used in planet orbit:

The satellites used to orbit the planet will be similar to those used to provide communications on Earth and to capture images (e.g. weather, GSM, etc.). These satellites do not require equipment for very long-distance communications or more advanced technologies than those currently in use. Each satellite will be equipped with a telecommunications system, solar panels, image-capturing instruments and engines for orbital guidance and correction.

Satellite structure:

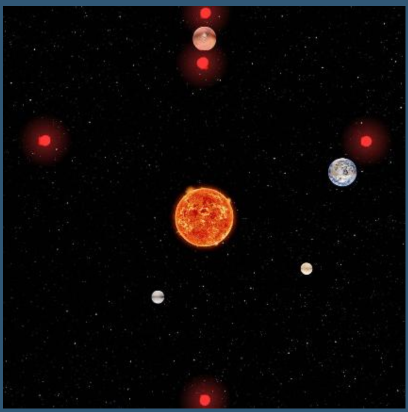
Main components:

1) Antennas: send and receive signals to and from the ground.
2) Transponders: Amplify and convert the frequencies of received signals for retransmission to the ground. Modern satellites may have regenerative transponders that process data directly on board.
3) Filters and multiplexers: Separate and manage different communication channels or frequencies.

4) Power supply system: Includes solar panels, batteries and energy management systems to generate and distribute electricity.
5) Thermal control system: Supports optimal temperatures for all components.
6) Orbital and Orientation Control and Orbit Control System (AOCS): Ensures the satellite stays in orbit and is oriented correctly for transmissions.
7) Propulsion System: Used for orbital adjustments and supporting satellite position (stationary).
8) Safety Structure: Protects the payload and houses all components.

General Network:

Between Earth and Mars, we will place large satellites on the Lagrange points of Mars with the Sun. These satellites will be placed in the form of a ring that will provide communications at a reasonable speed, regardless of the position of the two planets relative to each other. This network will provide communication between the settlement and Earth and other ships within range. Satellites on the Lagrange points will have engines for orbit correction, laser communication systems, docking points for maintenance ships, solar power and servers for storing information.



(General network of satellites orbiting Sun on the Mars Lagrange Points)

Types of satellites used on Lagrange points:

Satellites used on Lagrange points will be larger in size to support all the technology used for long-distance communications. This network will not guarantee faster communications, as the speed of light is already reached by standard laser communications, but it will ensure better quality, more information and signal continuity. Satellites will be equipped with an advanced optical communications module, power generation and supply module, data processing and AI control module, autonomous navigation and stabilization module and maintenance module (described below).

Optical communications module:

The optical communications module will be composed of high-power laser transmitters, adaptive optics and precision guidance systems, maintaining beam alignment over vast distances (The project is led by NASA's Jet Propulsion Laboratory (JPL) in Pasadena, California) and multi-aperture optical terminals, enabling simultaneous communication with multiple destinations. This module will ensure the performance of the communication system and the accuracy of the laser waves. In conjunction with this module, an AI-based system will operate, which will steer the wave to the receiving point.

Power generation module:

Solar panels along with a compact nuclear reactor and radioisotope thermoelectric generators will be used to power the satellite. This module will ensure continuous power supply and provide back-up sources in case one of the other sources fails. Supercapacitors and high-density batteries will be used to handle peak loads.

Data processing module:

An important part of the communication system will be data processing. For data processing we will use built-in artificial intelligence for data routing optimization, error correction, and predictive laser beam alignment; quantum encryption, for information security; and internal buffer memory, for temporary data storage and information flow management.

Autonomous Navigation and Stabilization Module:

To maintain the network shape, we will need a reliable navigation system. For stabilization and navigation, we will use: reaction wheels and ion thrusters, for position maintenance and fine adjustments; stellar sensors and gyroscopes, for sub-microradian alignment accuracy; autonomous collision avoidance and orbital position correction system.

Relinking system:

Information will be transmitted using lasers. The transmitted information will be passed through our satellite network, and the most efficient route will be calculated by a relinking program. Relinking is a process used by Earth-orbiting satellites to choose the best route to send information and to replace non-functional satellites. With such a system we can avoid delays, ensure increased transmission performance and ensure signal continuity in the Earth-Mars area.

Satellite launching steps:

- ☞ Mars orbit:

The transportation of the satellites will be done by a ship similar to those used to transport materials to the settlement. Satellites will be stored on the spacecraft in cube form to save space (Satellite components will be able to be unpacked to their final shape). After launch, the satellites will begin the process of unfolding the components. Guidance motors will put the satellites into the set orbits using concepts known in orbital mechanics. When the satellite is in a stable orbit, the unfolding process can continue until the final shape is reached. At the end of the launch mission, the Mars satellite network will be complete and connected to the ring of satellites around the Sun.

☞ The Sun ring:

The satellites present at the Lagrange points will be built on the settlement and launched to the Lagrange points in the form shown below. When the transportation spacecraft gets close to the Lagrange point, it will begin a process of unfurling parts and guiding them to the established Lagrange point. The satellite will orbit the Sun and be connected to the planets and other satellites in the network.

6.3 Building, Maintenance & Upgrade

Building satellites:

To launch the satellites from Mars orbit we will use a part deployment method to save space on the transportation spacecraft. Satellites will be built on the settlement and will be brought to Mars orbit by a transport spacecraft. On the spacecraft, the satellites will be box-shaped to make efficient use of the space distributed. After launching into orbit, the box will be unpacked, and the satellites will take the standard shape to orbit Mars.

Maintenance Module:

To keep the ship running smoothly we will deploy the following systems: modular docking ports for robotic servicing and upgrades; automated robotic arms for maintenance of optics, power systems and processing hardware.

7. Sociology

7.1 Status

Arkadia-10 is a sovereign political entity situated on the Lagrange Point 5 (L5). Starting from its deployment into space, it will be recognized as such by countries on Earth. The settlement's government has the right to self-determination in overall economic, social, legislative, administrative, military, and political matters regarding its citizens. Arkadia-10 will be offered observer status for varying international bodies, such as the United Nations, UNESCO, the World Health Organization, and more. Arkadia-10 will not be recognized as a state, but it will be granted the right to independence, the right to self-determination, and the right to existence. Yearly, a designated representative of Arkadia-10 will attend summits and conferences online, advocating for the interests and wishes of the residents of the settlement. Arkadia-10's foreign policy is focused on positive relations, with its purpose being to gain allies and trading partners on Earth.

7.3 Governance

Governance is an essential part of any society. Arkadia-10, having the purpose of enhancing communication in outer space, requires strong leadership and administration to ensure that all operations run efficiently. This task is difficult to achieve in space, as the rules and preconceived notions of governance on Earth are not applicable for many reasons. Firstly, resources on the settlement are limited. Secondly, the number of people is significantly smaller than on Earth, with there being anywhere between residents on the settlement. Moreover, the living conditions in space are different from those on Earth, and other factors need to be kept in mind when addressing the issue of efficient governance. For example, an Earthly government doesn't have the issue of making sure its citizens can adapt to living without the Sun or without a traditional day-night cycle. Maintaining a democratic element when choosing leadership for the settlement is important because it reassures a sense of agency within the population and helps maintain order.

For these reasons, Arkadia-10 seeks to implement a leadership system that promotes democratic principles while also avoiding populism amongst the general population during voting. The 'government' will be composed of 15 members, each of them being the head of a different sector necessary to support life on the settlement. Each field will have multiple members, such as the domain of medicine being made up of its respective governmental leader and other doctors, nurses and practitioners that practice health and medicine, and the same goes for each field. There are 15 domains considered essential for the settlement to grow and prosper. As follows, the leaders and their respective sectors will be:

1) Head Administrator - in charge of administrative matters on the settlement, such as policy implementation, chair meetings with sector leaders, and monitors sector projects and collaborations between field leaders
2) Marshal of Security Operations - the head of internal security and defense, as well as civilian safety
3) Head of Supplies - the resource manager, in charge of collaborating with A.I. to ensure that every resident receives their meal allocation as well as other necessary supplies
4) Head of Bio-Wellness - head of the medical field, tasked with ensuring that all civilians receive adequate healthcare, as well as with coordinating doctors to conduct research into furthering medical knowledge
5) Head of Knowledge - in charge of education, research, knowledge and cultural and historical preservation
6) Overseer of Systems Integrity - tasked with ensuring that the engineering, infrastructure, urbanism and architecture on the settlement fit the needs of the residents and that maintenance is regular in order to keep the technology updated
7) Navigator General - manages spacecraft navigation, transportation in space and on the settlement
8) High Archivist - stores data, archives, and directs the communication systems between satellites
9) Head of Ecology - oversees the quality of the environment, matters regarding sustainability, and cultivating crops and trees in the middle torus

10) Custodian De Jure - leads the judicial system, in charge of policy and law implementation, oversees audits and checkups for court cases
11) Resource Extraction Coordinator - chief of mining operations on nearby asteroids, tasked with training teams, acquiring materials and reporting back to scientists on deck
12) Arbiter of Life Quality - in charge of ensuring civilian happiness levels remain high, tasked with maintaining sustainable natality rates, promoting tolerance and acceptance, creating a safe environment for all residents
13) Director of Treasury - occupied with financial matters, budgeting, managing the issue of wealth hoarding among citizens
14) Head of Manufacturing - director of manufacturing operations, overseer of factories on the settlement
15) Manager of Satellite Infrastructure – programs, codes and takes care of system maintenance

Elections are held every two years for these positions. The same candidate has the opportunity to run multiple times if a majority of voting residents are in favor of it. The same candidate, however, cannot run for two positions at the same time. They also must pass competency tests in regard to the specific sector they are running in to decide if they would be a qualified candidate. All voting is anonymous and digital via an A.I. system with a blockchain network to ensure fairness and transparency, with voters having to verify themselves with biometric authentication. Candidates apply or are nominated by most members in their sector, in which case they are free to choose not to go. In order to ensure that voting remains both democratic and meritocratic, weighted voting will be applied, with votes being slightly weighted, with the calculations being reevaluated every election by an AI model in order to ensure fairness, to make sure that the experience, field of work, education and sector each voter is in holds some weight in the election. For example, voters who work in the medical field have votes that weigh more in deciding the Head of Bio-Wellness. Lastly, a member of government can be removed from office with a majority vote, if the members of the public are unhappy, and in that case, elections are to be held again.

As for the functions in government, the traditional system of legislative, executive and judicial still applies, but changed to better reflect the conditions of Arkadia-10. As such, each head of one of the sectors of government will be aided in decision-making and project research by individuals from their field who are more experienced and knowledgeable. For all intents and purposes, the three branches of government shall be named as follows: The Assembly (the legislative branch), The Office (the executive branch), and The Bench (the judicial branch).

7.4 Economy and Workforce

How would a society in space, isolated from Earth, implement an economy that overcomes all of the shortcomings present on Earth? The economy of a space settlement would have to function in a vastly different way due to many factors, such as a limited number of resources, reduced workforce, A.I. assistance, and shared goal of the population, namely the prosperity of the settlement. This can be achieved only by making sure that wealth can be earned but not hoarded. For this reason, Arkadia-10 will implement a blockchain decentralized currency, with a wealth claw back, meaning that by the end of each year, no more than a percentage of what is earned by a resident of Arkadia-10 can be kept. This encourages residents to engage with the economy and to not hoard more than they can spend, something which could be destructive on a settlement with limited resources.

As for personnel, the work force will be divided into four major categories: humanities careers, stem careers, manual labor and entertainment careers. According to each individual job type, A.I. will be able to assist or not in certain fields. The economy in space will not be functioning with companies, instead having the most skilled and experienced member in any career field take the “de facto” leadership role, functioning as a mentor and guiding force for the workers. Employment is guaranteed for every person able and willing to work, with different fields searching for different capabilities, and with job candidates being assessed with the help of performance tests and interviews based on the aforementioned capabilities, with examinations being conducted semi-regularly on workers by an algorithmic A.I. which seeks to assess the competency of workers and work ethic. Mandatory confidence building events are to be held once every three months in order to ensure that workers are happy and satisfied and to build cooperation and coordination.

In order to guide the people who are young and entering the workforce, internships will be offered to a few students every year in different fields, based on demand and popularity. These internships can include mock trials for law interns, surgery simulations for medical interns and more, depending on the field and student. These internships will be offered based on merit, academically and socially.

7.5 Legal System

All laws will pass through the Legal Branch, overseen by the Custodian de Jure at first. At the base of the law and constitution of Arkadia-10 there is the idea of moral universalism and its six-core universal moral values: **trustworthiness, respect, responsibility, fairness, caring and citizenship.** The constitution will be written before leaving for the settlement, with residents of the settlement gathering to draft and vote on the constitution's proceedings. Amendments can be proposed over time and are subject to Assembly approval. In the case of an amendment, it also needs to be voted upon by the public, after being approved by the Assembly. All proposed laws must pass through The Assembly, with them carried out effectively by The Office and then enforced and persecuted accordingly by The Bench. For this purpose, monthly conferences will be held for members of all three branches to fulfil their duties and obligations as necessary. As for courts, the concept of a fair trial is essential to ensure that justice prevails. For this reason, Arkadia-10 will have the following court proceedings: 1. The court will be compose. The court will be composed of three experienced judges, who will swear under oath to be unbiased and fair for the entire trial, 2. Provided, free of charge, to both the defense and the prosecution, 3. Jury members will be chosen randomly from the population, with strict vetting being put into place to ensure that all jury members remain, same as the judges, fair and unbiased. As for the laws themselves, they are accessible to the public, and law practices and decisions are regularly reviewed, with audits being conducted mandatorily to keep the system functioning properly without corruption. Incarceration will be done in a special section of the settlement, with the convicted person being held under watch by security. Time spent imprisoned will be focused on rehabilitation and community service, with regular psychiatric evaluations and working with a therapist being mandatory for the incarcerated.

7.6 Education System

Education on Arkadia-10 will shift its focus toward adaptive learning. One-on-one sessions between students and teachers will be encouraged for students falling behind or having difficulty in a certain subject. Learning will be modular and tailored to each student, being oriented towards community values by having mandatory extracurricular activities between multiple classes and with teachers. It will be divided into three phases:

- → Primary Education (6-12 years old) - grades 0-6
- → Secondary Education (12-18 years old) - grades 6-12
- → Tertiary education (18-22 years old) - college or university

For Primary and Secondary Education, Students will undergo psychometric testing, alongside personality and cognitive assessments in order to identify traits and qualities in students. Student progress will be tracked with the help of an AI, which stores data and conducts reports based on it, and their performance will be analyzed. Based on the results, personalized guidance will be offered to each student, with the help of an AI and their mentor, in the form of progress reports, which are handed out both to the students and the parents and are confidential to any other student. As for tests, once a year, exams are mandatory. However, these exams will not be graded in the typical way. Instead, these exams will assess a student's competence in a certain field and will create student profiles with career or extracurricular activities suggestions.

Extracurricular activities will include sports such as basketball, swimming or football, drama and theatre, debate such as Model UN or mock trials, art club, photography club, robotics club, book club, history club, mathematics and informatics club, and more, depending on student initiatives, as any student will be able to propose the creation of a new club in their school, with permission from the headmaster or headmistress. Furthermore, in order to help students develop their passions and find skills they are talented at, a sort of "career day" will be mandatory for students in the 2nd grade, in the 6th grade, and in the 10th grade, and optional for any students willing to attend, of any age or grade. These events will include hands-on training, speaking to workers in that field, dynamic simulations in VR, workshops, and testing for willing students to assess their skills in a particular field.

Tertiary education will include internships, seminars, lectures, and other activities; however, it will remain the same as the latter two forms of education, with testing and ability assessment being mandatory procedures. However, career recommendations and "career day" will no longer be part of the program, instead being substituted for chances at internships or jobs based on interviews and school performance.

7.7 Preferences in diet

The aim is to develop and implement a food distribution system that ensures that every member of the settlement receives personalized meal allocations that align with each individual's biological needs and dietary preferences. The first step is to gather and analyze data to make the algorithm run properly. Since every member of the space settlement will have already had health exams and dietary assessments conducted, the stats and vitals of each individual will be stored in a centralized medical database, which will be connected to the interface that will create the meal plans. By entering a name (PATIENT NAME/ID), the interface will access your medical data and, with the help of a predictive algorithm, will match food allocations to each individual's profile. The program will also be tasked with forecasting food consumption, waste reduction, and optimizing inventory, and will have to calculate how food can be distributed with as little waste as possible. The algorithm will update often, adapting for any changes in age, height, weight, health status, exercise wishes, nutritional needs, and food preferences. Health monitoring each individual can also make sure that adjustments can be made in real-time based on other biological factors that are less predictable such as metabolic rate, hormonal changes, immune function, and more. For those who need more intense care, such as babies, children, and the elderly, family members would be tasked with filling in the questionnaire, with the help of a doctor. When all individuals have taken the test, meal plans will be offered to them, which can be picked up at the robotic dispensing units at the canteen. The interface also offers the option to refresh your meal plan if you wish to eat something else that day. The algorithm will take note if you consistently accept or reject one option and will ensure that you get a variety of meals while also keeping in mind your preferences. Thus, if you keep saying "yes" to one food option, the interface will take note and keep in mind that you like that food, while the contrary is true if you keep saying "no".

Cultural food remains as important as ever for the residents of the space settlement, and it is essential to make sure that the option to partake in eating diverse meals is present for those who want it. Furthermore, emphasis should be placed on keeping recipes of different cultures stored. In order to ensure that cultural practices continue to thrive, the aforementioned interface will have options for cultural meal options, highlighting cuisine from different cultures on Earth. Sections in communal dining areas will be designated for cultural eating, where individuals can eat and experience diverse cuisines as if they were on Earth. These sections will be in rotation, changing once every week, with the specific dining experience being decided by vote, with the greatest number of votes determining the winner. Thus, people will be encouraged to try new and diverse foods while also appreciating the culture from which the food provides, promoting tolerance and understanding amongst the inhabitants.

7.8 Urbanism

Life on Arkadia-10 will be vastly different from life on Earth. Some things on Earth, such as the Sun, the sky, the freedom to navigate and more, are difficult to translate into space. Therefore, to simulate earth-like conditions for the residents of the settlement, necessary measures must be taken. To emulate the sky, advanced displays will be used to project realistic videos and imagery of the sky on Earth, keeping in mind the day-night cycle, variations in sky coloring, and more. Using technical tubes to carry light from Znamya into the settlement, solar light can be imitated and used in order to offer the residents a more natural light source, which can improve happiness, quality of life and health. Air filters can be used to give the inhabitants of Arkadia-10 clean and pure air to breathe.

There will be a "main street" on each torus, and that is where you can find the light-rail systems. On the main street, there will be bicycle lanes and a lot of room for civilians to walk, and each civilian walkway will have an estimated length of 40 meters. Keeping in mind that one car lane equals roughly 5 meters, two light-rail systems would each have a width of 7,5 meters, adding up to 15 meters. Add one meter in between for space and one meter on each side as a provisional sidewalk, and you reach 18 meters. On each side, two car lanes and roughly a quarter will equal out to 11 meters on each side, giving a total width of 40 meters of the main street. Taking inspiration from grid structured cities, each building will be anywhere between 25m-50m, excluding buildings such as the community cafeteria, parks, schools, hospitals and other big public spaces. The length of a building can varies anywhere between 25m-50m or 50m-75m, depending on the type of building, however symmetry will be maintained by structuring it so that length can be substituted for width. Thus, the grid city structure can function with numbered streets and streets interconnecting buildings not on the main street. Trees will be placed once every 7,5 meters on the main street, 3 meters from the start of the street on each side, equaling out to a total of 1600 trees needing to be planted on the main street, with the back streets having one tree every 10 meters, estimating to roughly 4300 trees needing to be planted on the back streets.

When calculating estimates for the settlement, it resulted that the settlement would have around 15 square km of urban area. Since the settlement needs to have the capacity to expand over time, Arkadia-10 will start out with a projected population density similar to the city of Amsterdam, with 5000 inhabitants per square km, with the potential to expand to over 10000 inhabitants per square km, meaning that the settlement has a minimum capacity of 75000 residents and an estimated maximum capacity of 175000 or more. This means that the primary residence for civilians of the settlement will be in apartments, which will be hexagon shaped. For each apartment building, communal areas such as rooftop gardens, lobbies, laundromats and more should be built to help civilians engage amongst themselves. Buildings which are not meant for residential use will be used for offices, storage, stores and more. Schools and educational facilities will all be situated within close proximity of one another, and there will be 6 schools, each with a capacity of 2000 students. Hospitals and clinics will be distributed throughout the settlement to ensure residents can reach a hospital as soon as needed. Leisure spaces such as parks, stadiums, galleries or more will also be built and contributed to by willing members of the settlement.

The Founding Doctrine of Arkadia-10

July 7th 2150

Provisions

We, the residents of Arkadia-10, do hereby declare ourselves the founders of a sovereign, free and independent settlement, beholden to no foreign power or external authority, with the right to self-determination, and to handle all domestic matters as we see fit. From this day forth, we assert that all aspects relating to economy, governance, military, scientific research, and any other internal affairs are subject to the decision of the duly appointed government of Arkadia-10, “The Leadership”.

Arkadia-10 stands as a beacon of hope and new beginnings for humanity, achieving greater feats than ever before. Through a process of collaborative decentralization, Arkadia-10 will go from being tied to Earth to functionally independent and sovereign, achieving in its final form true self determination. We, the people, assert that while today we stand in arms with our own people here on Earth, no foreign power shall hold dominion over our future.

This written document, known for all intents and purposes as “The Founding Doctrine of Arkadia-10” seeks to establish and defend the principles under which Arkadia-10 vows to function, organize and structure itself, amongst them being liberty, justice, opportunity, community, growth, prosperity and democracy, so that the residents of Arkadia-10 shall remain safe from the threat of tyranny, violence and oppression. Let it be known that this doctrine stands as a pledge to safeguard every civilian living on the settlement.

Right to Self-Determination

Arkadia-10 shall, from this day forth, be a self-governing settlement, free from the influence of any foreign power, authority or entity. In accordance with the United Nations Charter, the principles of international law, and the will of its people, the government of Arkadia-10, namely The Leadership, proclaims the right to self-determination for its territory. This right includes establishing an independent and sovereign state, free from external control or interference. Arkadia-10 is, therefore, a sovereign and independent political entity situated on the Lagrange Point 5 (L5) in space. All powers of government, legislative, executive, and judicial, will be vested in the institutions created by the people of Arkadia-10. No external authority, foreign government, or military shall exercise jurisdiction over Arkadia-10 or hold dominion over its laws.

Foreign Policy

Arkadia-10 seeks peaceful coexistence with all nations on Earth and entities in the region, being committed to resolving any and all disputes primarily through open dialogue and diplomatic talks, and extending its hand in allyship and cooperation to all willing neighboring states. However, Arkadia-10 affirms its right to defend its independence, sovereignty and territorial integrity against any external or internal aggression from malicious or violent forces. Arkadia-10 rejects any and all efforts to undermine its independence or any attempts to subject itself to foreign domination. The settlement stands united in its right to protect the freedoms of its people against all forms of external oppression and violence.

Protection of Human Rights

Arkadia-10 declares its commitment to protecting human rights and civil liberties for all people living within our borders. Arkadia-10 will conform to international human rights conventions to ensure the rule of law and justice for all its citizens. Every single resident of Arkadia-10, is considered equal not only in the eyes of the law, but also in society. No citizen shall be discriminated against based on any aspect of their identity. Thus, every person will be bestowed with the same liberties. The right to life, freedom of speech, freedom of expression, freedom of association, freedom of assembly, freedom of religion, the right to a fair trial, the right to education, and the right to privacy shall be protected and reserved under this Doctrine for the residents of Arkadia-10.

Civilian Wellbeing

Arkadia-10 promotes a society built on principles of inclusion, acceptance, and tolerance. At its core, Arkadia-10 puts forth the belief that all individuals are equal, regardless of age, religion, race, ethnicity, gender or any other identity somebody may assign themself.

In order to keep residents of Arkadia-10 happy, it is essential to ensure that not only their basic needs are met, but similarly, their psychological, social and emotional needs have to be met as well. This shall be achieved by ensuring that personal, professional and societal happiness are all met for every civilian. All basic needs, such as housing, food, water, medical care and education shall be ensured for every citizen, so that no individual is deprived of their livelihood. Beyond that, every citizen shall have the right to fulfil their own desires, whether through the ability to purchase and own items which may not be considered necessities, with their own finances, creative endeavors, intellectual freedom, spiritual exploration or more.

A prosperous society comes from workers feeling as if they are fairly compensated and treated. Thus, professional happiness can be established by implementing fair and just labor practices. For this reason, all workers shall be entitled to fair compensation. Furthermore, workers and sector leaders are encouraged to group up together in order to solve problems which may arise amongst the workers. Any and all reports have to go through to the respective authorities and have to be investigated, regardless of improbability or circumstance. All disputes shall be handled with impartiality and transparency.

Arkadia-10 wishes to make sure that it upholds the values of a just society, where all people feel valued, protected, included and respected. Thus, the following provisions shall be applied: equal access to justice, active promotion of diversity and tolerance, fair treatment

under the law for all citizens, yearly summits in order to have discussions relating to the issue of societal hierarchies and equality, and harboring no tolerance for acts of discrimination.

International Recognition and Cooperation

Arkadia-10 calls upon the international community to recognize its sovereignty and independence. Arkadia-10 wishes to foster peaceful and cooperative relations with all earthly nations. Arkadia-10 vows to adhere to the principles of international law and seeks observer status membership in the United Nations and other international organizations willing to accept its presence. Arkadia-10 seeks allyship from willing countries and space organizations.

Signed by:

Unchiasu Victor Alexandru

Radu Vlad Alexandru

Lungu Razvan-Tudor

Turcan Eric Octavian

Şerban Lara Isabella

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THANK YOU FOR YOUR ATTENTION! (TEAM ARKADIA-10)

THANKS TO ALL OF OUR COORDINATIVE TEACHERS!!