

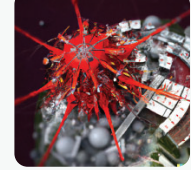
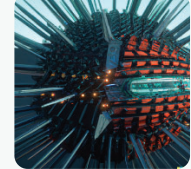
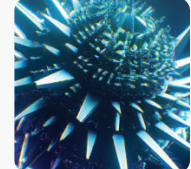
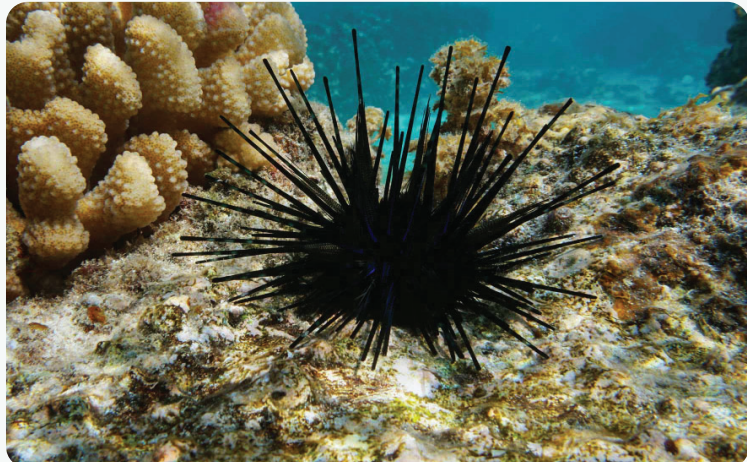


# Space Urchin

To assist in the design, AI generated images of what the Space Urchin could architecturally look like were catalogued and critiqued. We imagined the starport to be future-centric but still have an attempt at 'landing' it with real world emerging space research and discourse.

Inspired by the biological form, anatomy and the communal herd of sea urchins, this proposition imagines the starport as an interplanetary infrastructure through three principle ecologies: 'Resilient Skin Ecology', 'Space Junk Ecology' and 'Herd Ecology'. Envisioned as a multidecade project, it assembles multiple speculative and independent micro-components, completed as separate missions, over an extensive timeframe culminating in an expanded community of infrastructural-starports.

There is no end. Construction will never finish as it augments through time and space.



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# Anchor: Deployment, Expansion & Pneumatics

[1] Starship 3.0 is a fictional narrative still owned by Elon Musk.

[2] The Sea Dragon was a 1962 concept for a two-stage sea-launched orbital super heavy-lift launch vehicle by Robert Truax



[3] The Pacific Ocean is the launch site to dampen the shockwaves. The rocket will be built in a shipyard and towed out to the launch site. Above image is from <https://bit.ly/3xdHbja>.

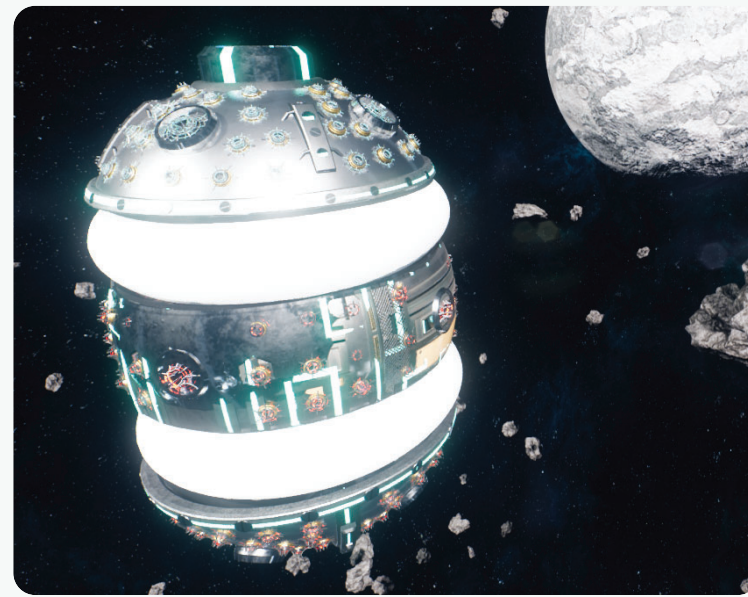
[4] Concept narrative to depict that the initial stages of the project will be operated by a 3-personnel crew.

[5] DMFs is a project by Vittoria Netti and team that organizes internal layouts of space habitats and planetary outposts based on inflatable technology.



"We thought Starship 3.0's[1] first mission was to Mars. After the success of Starship 2.0's departure to Mars - over time, we realised that if we needed to colonise other planets more efficiently and at regular intervals, we first need to help build a starport. So, we shifted our focus to assist in the construction of the first international starport and contributed our research from building Starships to assist in launching this first spaceport mission - launching the expandable sphere."

Measuring 36 meters in diameter, the expandable 'Anchor' is the first unmanned mission to constructing the Urchin. Reanimating the ambition and technologies to build the abandoned Sea Dragon[2] of the 60's space race, the Anchor will be deployed via SpaceX's scaled-up version of the Starship 2.0 and launched in the Pacific Ocean.[3]



"We were sent to 'turn the lights on' basically. The first 3-person crew sent to the Urchin. I'm not sure what was more exciting, being the first or hitching a ride on one of these Starship's en route to Mars." - Katherine Johnson.[4]

As the Urchin is deployed in position, the sphere would expand into the north and south docking hemispheres through pneumatic systems referencing 'Deployable Modular Frames'[5] space technology. The largest deployed pneumatic frame in space, it increases its overall height to 56 meters and provides two large workshop spaces in the process to assist the docking stations.

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## GAMR Unit & NASA-X1

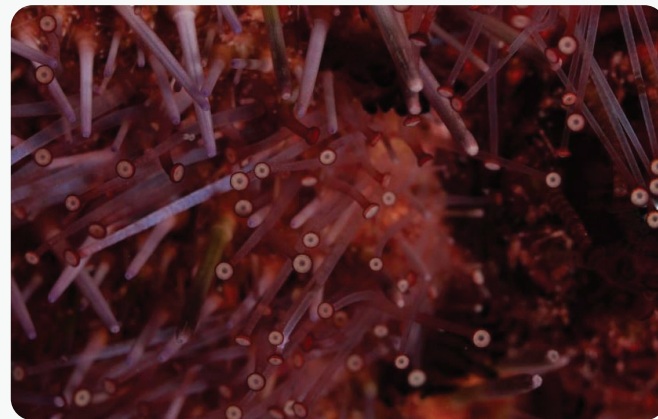
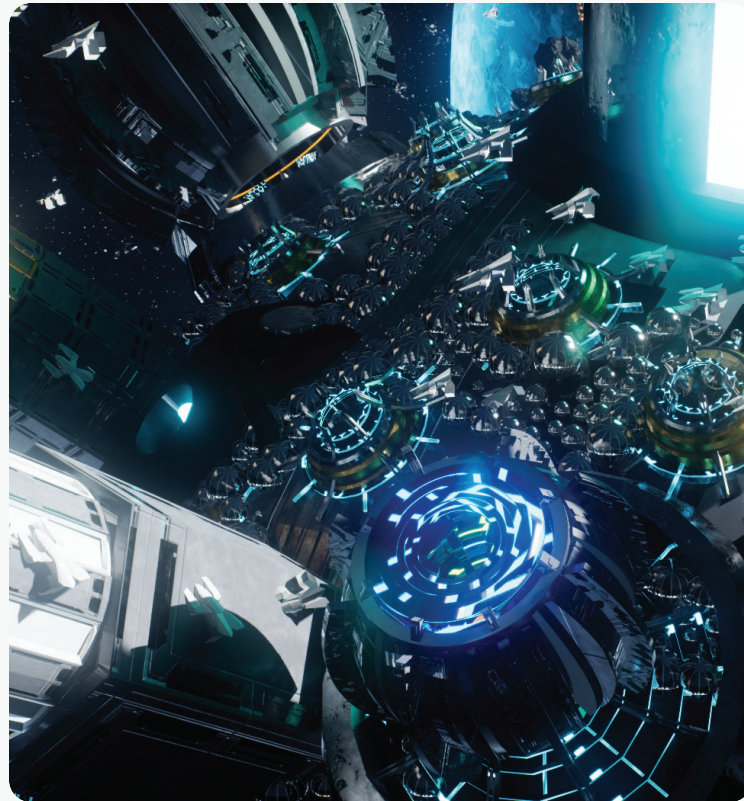
## P2

# 1. Resilient Skin Ecology

Image top:  
Closeup detail of the Space Urchin's 'living skin' that assembles an ecology of rejuvenation, repair, energy and sustenance.

Image bottom:  
Josh Cassidy/  
KQED

[6] Space repair missions can become quite costly as demonstrated by a 4-spacewalk repair missions to fix the ISS's antimatter detector costing \$2billion. Source: <https://bit.ly/3RQOTry>



*"I don't know how to describe it. It just felt... alive." – David Bowman.*

The artificial skin is an assembly of independent systems generating an ecology of resilience, rejuvenation and sustenance. Taking inspiration from the sea urchin's biological surface, the Urchin's 'skin' primarily consists of a needle-rocket system that connects to a series of docking stations on the Urchin's surface. These needles are categorised into three systems: Food Needle, Water Needle and Energy Needle. The Needles can be maintained and accessed internally. Over time, an expanded landscape of sustenance and research is constructed and grows within the first inner layer of the Urchin. As part of this ecology, a series of smaller spherical solar cells are dispersed on the surface as an auxiliary power harvesting system.

The skin is also home to the 'Collectors'. They are specialised autonomous trash collectors that would gather existing space junk to be reused and repurposed to create future exploratory and repair drones – also residing on the surface.

As technology improves, the skin will be home to self-repairing cellular materials to assist in the resilience and longevity of the Urchin. These self-repair propositions are in place to minimise earth-departing repair missions that are expensive facilitate.[6]

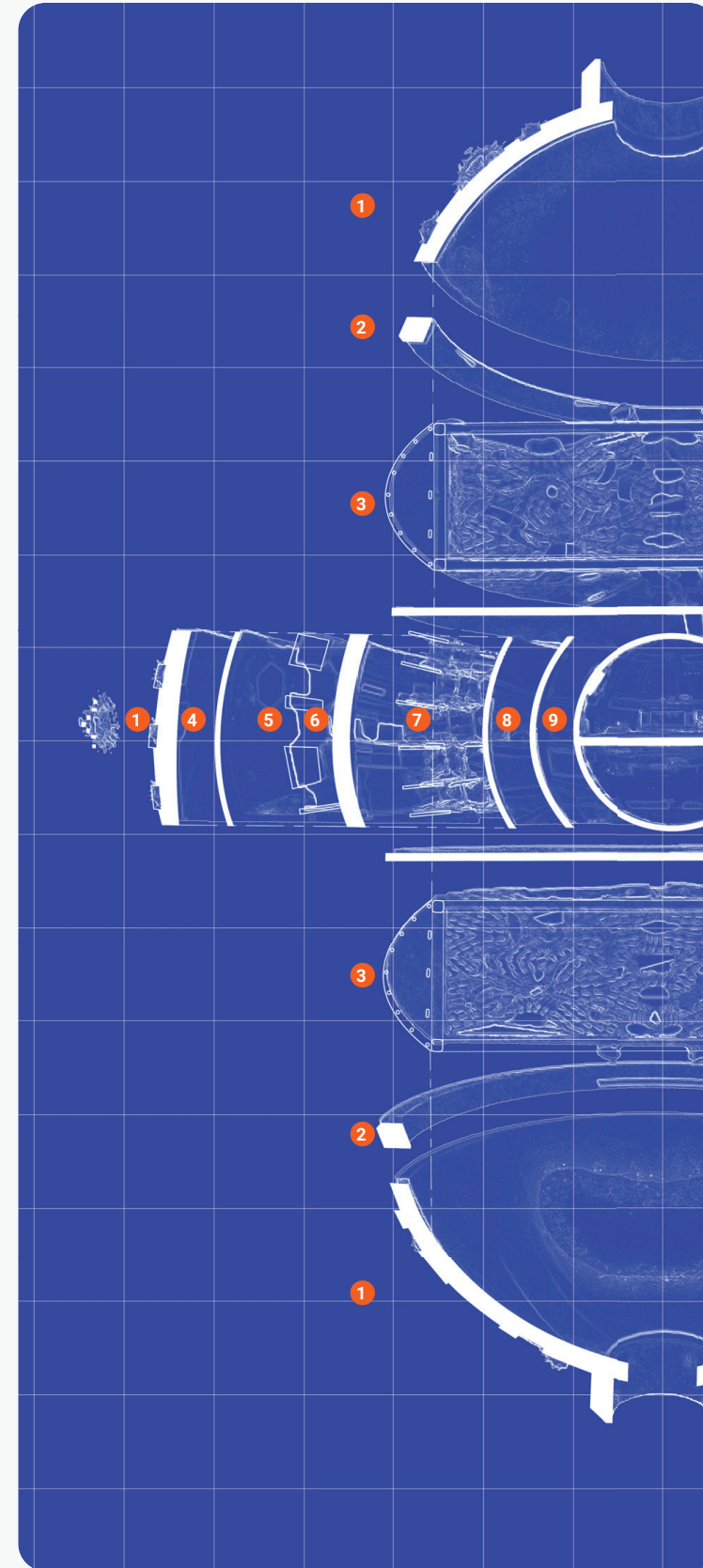
P3

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Legend:  
1. Outer Debris & Heat Shield  
2. Intermediate Strap  
3. Pneumatic Layer  
4. Kevlar and Steel Shield  
5. Needle Reservoir Network  
6. Redundant Restraint Layer  
7. Energy & Data Network  
8. Internal Scuff Barrier  
9. Lightweight Wall Module

# Independent Systems



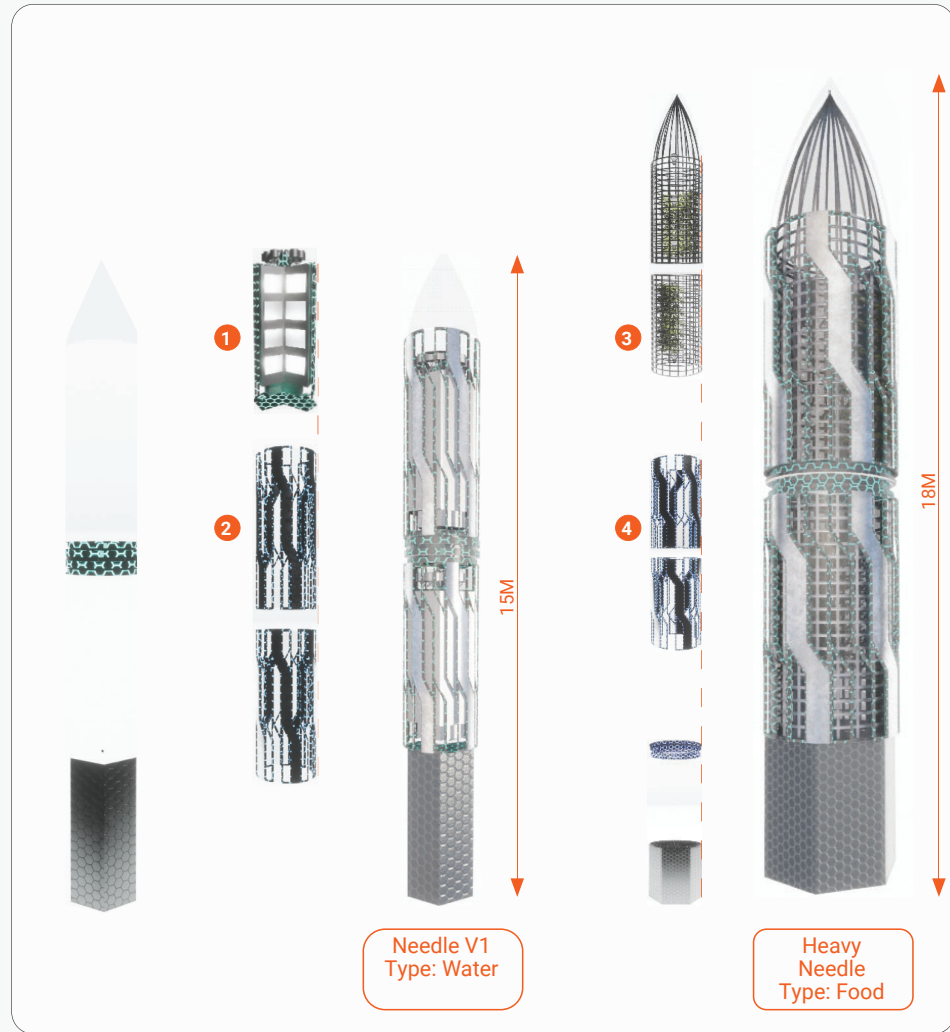
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# 1a. Food & Water Needle



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# 1b. Energy Needle



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The Food and Water Needles are independent systems that connect to the Urchin to produce food and clean and categorise water. Each needle can be specialised sent from Earth as separate missions. For example, a food needle could have technology to produce artificial meat and a separate facility can produce vegetables. A separate water needle may specialise in the production and research of drinking water whilst another water facility may focus in the recycling of black water. Over time, there will be multiple food and water needles and in the event that one breaks down, it does not compromise the facility's fundamental habitable systems.

Food & Water Needle Legend: 1. Hydraulic Regulator, 2. Cooling Network, 3. Extended Lanscape, 4. Energy Framework.

The Energy Needles are independent systems of foldable solar panels that act as the main source of renewable energy. These are supplemented by the solar orbs capturing scattered light as auxiliary systems. The energy needles could lengthen and track the sun to maximise efficiency.

Energy Legend: 1. Retractable Solr Panel, 2. Lithium Cell Frame

## P5

## P6

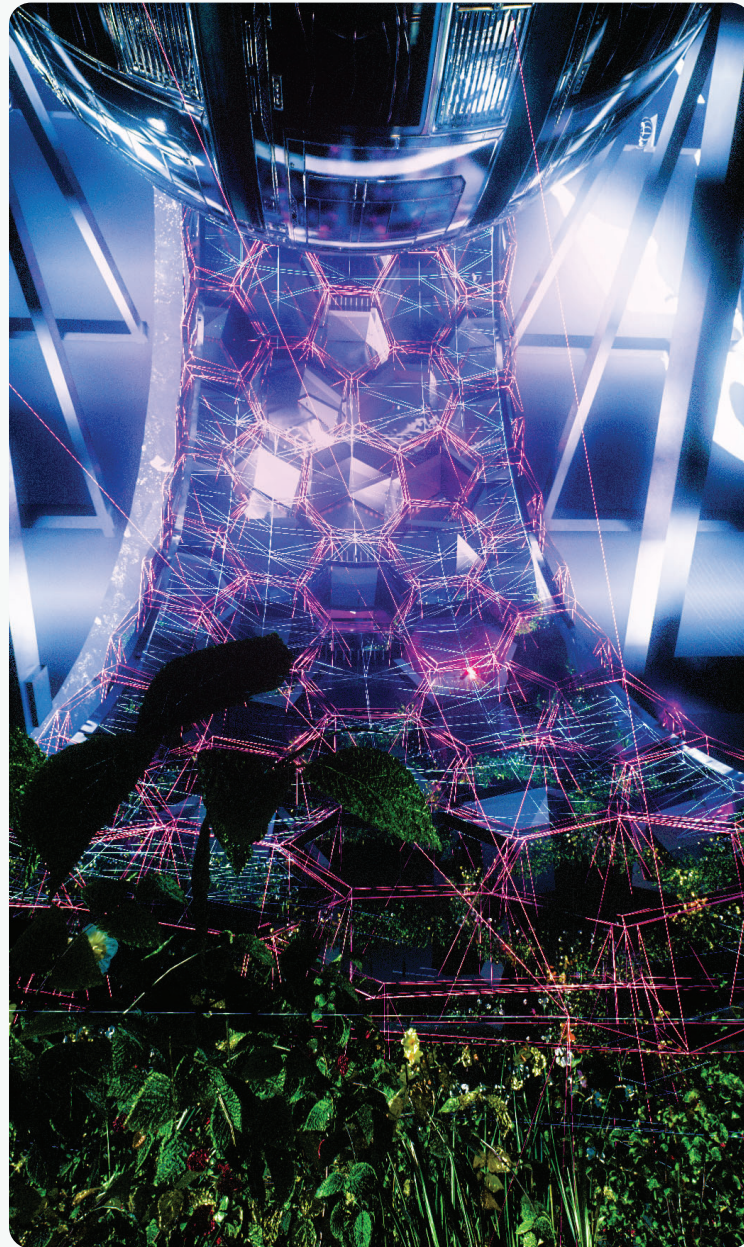


# 1c. Expanded Productive Landscape System

[7] Narrative quote from the movie, 'The Martian' (2015).



NASA has been researching the use of LED lighting specifically designed for the space station to grow plants. Source: <https://go.nasa.gov/3e-BeB4S>. Image below: NASA.



*"It's been 48 sols since I planted the potatoes so its time to rip and resow. They grew even better than I expected. We now have 400 healthy potato plants. We dug them up being careful to leave their plants alive. The smaller ones we'll reseed. The larger ones are our food supply. All natural. Organic. Urchin Starport grown potatoes. You don't hear that everyday do you." – Mark Watney, Space Botanist*[7]

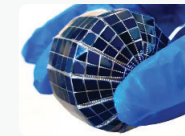
The expanded landscape is located within the first layer of the inner core. It generates an ecological relationship with the fundamental food, water and energy needles to augment the starport's production of these essential resources. It harnesses aeroponics and hydroponics food production technologies to maximise production within a limited space integrating a hexagonal structure that encompasses the inner surface. A series of varying UV artificial lights are utilised to enable a variety of plant-based consumables to grow.

With time, this space is not only imagined as a place of production but an experiential landscape that the space community can enjoy.

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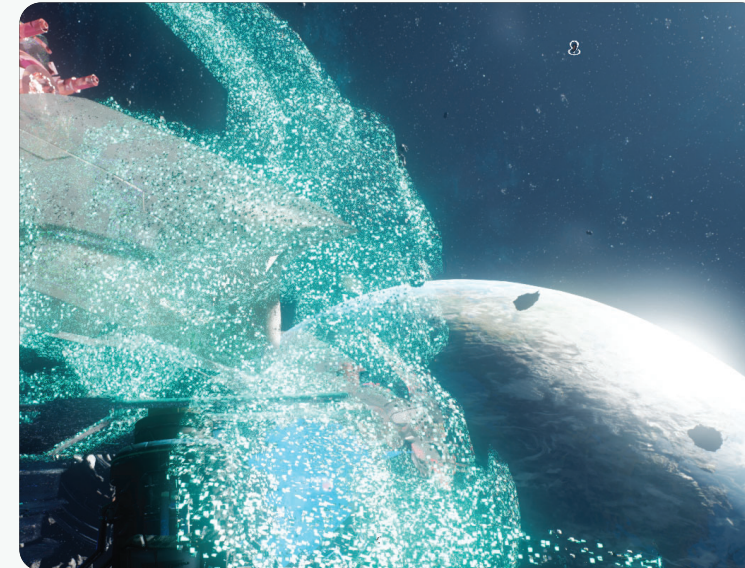
[8] There are current research that spherical solar cells have the capacity to soak up scattered sunlight. Source: <https://bit.ly/3BwXcTZ>. Photo below: NAZEK EL-ATAB/KAUST

# 1d. Solar Orbs



Smaller spherical solar cells are dispersed on the surface as an auxiliary power harvesting system capturing scattered solar light. It augments the capabilities of the energy needles.[8]

# 1e. Autonomous Regenerative System



Envisioned as a more future-centric mission phase when the starport is complete, the project proposes regenerative materials at a cellular level to generate an autonomous regenerative system in sync with repair and exploration operational drones.

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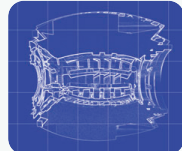
## 2. Space Junk Ecology

[9] Source: 'Space junk: a recycling station could be cleaning up in Earth orbit by 2050'. Published 26/7/2019 via <https://bit.ly/3x-fw7Cj>

[10] Image of a basking shark with an anatomically wide mouth for capturing plankton.



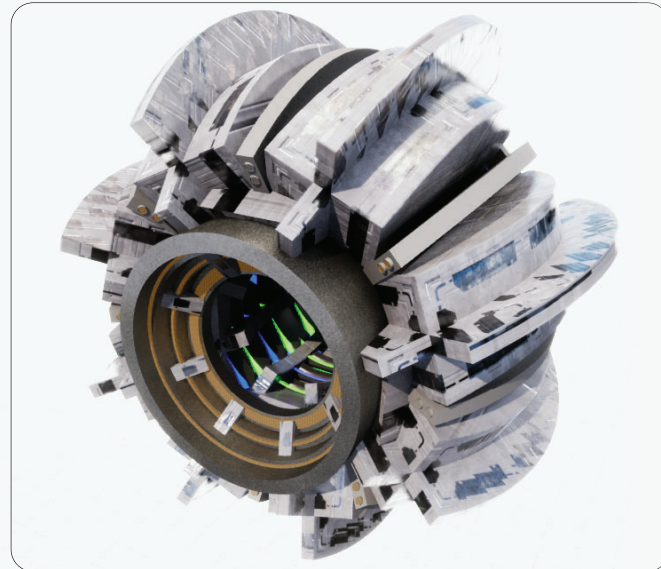
Note: Details of The Collector below.



"There are about 22,000 large objects orbiting the Earth, including working and broken satellites and bits of old rocket from past space expeditions. If you include all the equipment dropped by astronauts while floating in space and the debris from colliding satellites down to around 1cm in size, there are about one million bits of space junk in Earth's orbit." - Jez Turner [9]

To eradicate the majority of Earth-reliance in terms of costly space repair and construction missions, the Urchin will establish a circular system of capturing, repurposing and recycling of space debris. Captured debris will be reused to potentially create future drones, ships and spaces for the starport. It is imagined that the starport could capture space junk primarily from the 'graveyard orbit' and specifically hunt for required materials within the Low Earth Orbit and Geostationary Earth Orbit zones. The ambition is that, progressively, materials that are required for space are already in space for new life.

### 2a. The Collector



Inspired by the anatomy of basking sharks[10], the Collectors are autonomous mobile space trash collectors that capture and recycle loose floating materials within the LEO, GEO and graveyard orbit. The structure consists of a complex outer layer that is rough and jiggled - providing endurance to the Collector's ability to withstand debris colliding and hitting with the external surface before becoming pulled towards the vacuum mouth. The structure propels itself through space via blasters. A series of magnets attract and pull metal junks towards it and is maintained in position at the centre of the space craft.

The Collector utilizes magnetism as a method to attract and collect. It is responsible for taking rubbish from space, storing it in the middle and delivering it back to base bunker.

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[11] Narrative quote from the movie, 'Armageddon' (1998).



[12] Narrative quote from the movie, 'Interstellar' (2014).



[13] NASA Is Sending a Life-Hunting Drone to Saturn's Huge Moon Titan. Source: <https://bit.ly/3RA5ekM>



Note: Detail of the Venture Drones fabricated from recycled space junk captured by The Collector.



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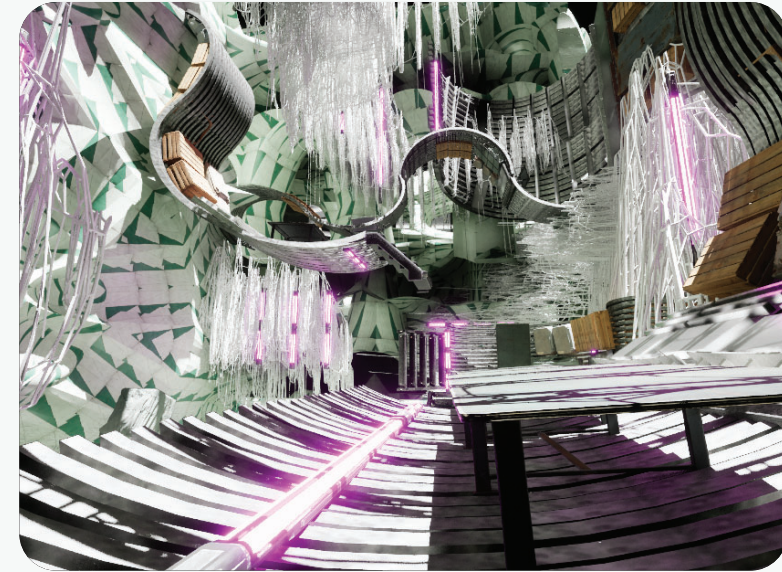
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"Young Murph: [referring to the drone] What are you gonna do with it?  
Cooper: I'm going to give it something socially responsible to do. Like drive a combine.  
Young Murph: Can't we just let it go? It wasn't hurting anybody.  
Cooper: This thing needs to learn how to adapt, Murph. Like the rest of us." - Interstellar [12]

Imagined as a mission phase towards the advanced stages of the Urchin's development, Venture Drones (VD) are developed, constructed and designed with the recycled space trash collected over time. Their purpose is to eventually become a swarm of small and adaptable AI-controlled drones that venture into the unknown in search of extraterrestrial life. They also assist in the repair of the Urchin.[13]

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## 2b. Workshop

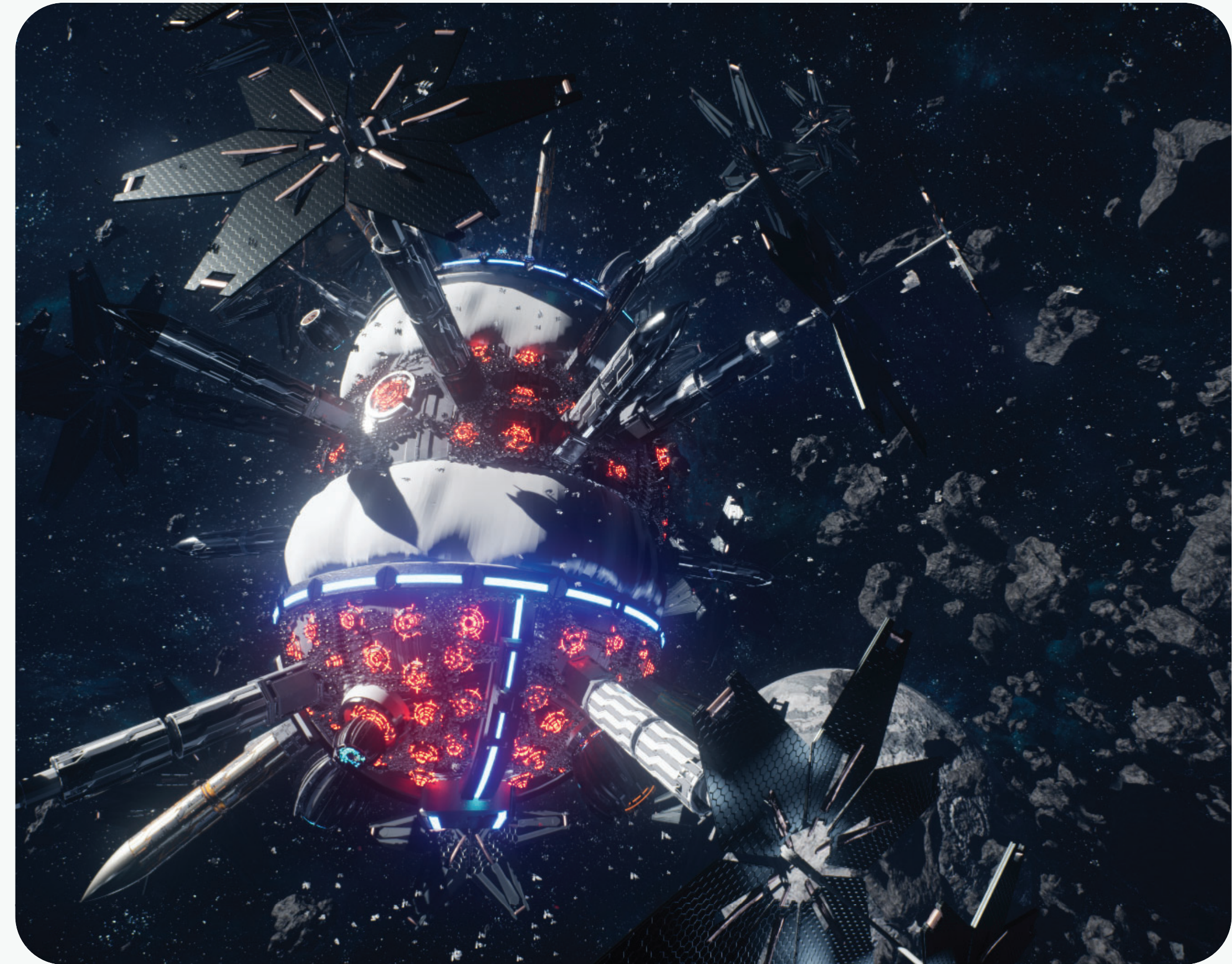


"I am not a gas station. This is a sophisticated laboratory." - Lev Andropov, 'Armageddon'. [11]

Located adjacent to the docking stations within the pneumatic structures, the workshop was envisioned as an internal space used to assist the docking stations and in the re-processing of collected space trash. It is also fitted out with the junk and debris collected from space.

### 2c. Venture Drones





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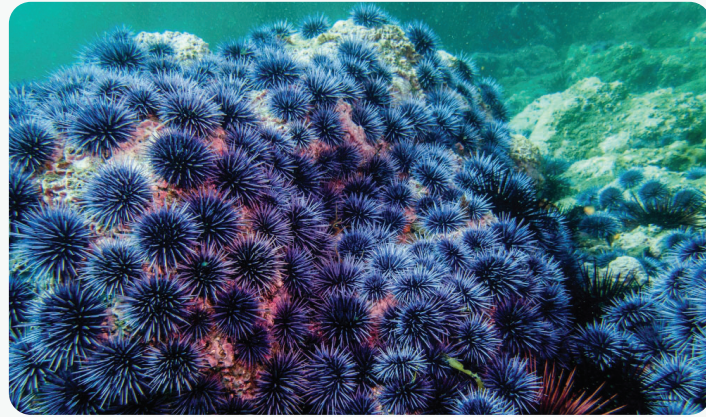
P14



### 3. Herd Ecology

[14] Narrative quote from the movie, 'The Wizard of Oz' (1939).

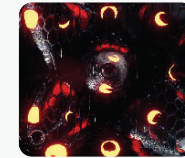
[15] Images of sea urchins forming into herd-like communities. Image credit right: Kate Davies. Image bottom: Kate Vylet.



*"Toto, I've a feeling we're not in Kansas anymore."* – Dorothy Gale[14]  
As technology advances and space enterprises blossom, the Urchin will nurture a burgeoning space community of a more developed infrastructural starport that is then more akin to a space-urban centre. Inspired by the herd-like formal behaviours of sea urchins[15] and the assembled modular systems of the project, the Urchin will continually grow and replicate itself albeit with more upgraded iterations progressively. The Herd will establish, not only new frontiers to space explorations, but new frontiers in the coming together of humanity to venture into the unknown.

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[17] Narrative quote from the movie, 'Matrix' (1999).

### 3b. The Linkage



### 3a. Command Centre

[16] Narrative quote from the movie, 'Star Trek: Generations' (1994).



*"Don't let them promote you, don't let them transfer you, don't let them do anything that takes you off the bridge of that ship, because while you're there, you can make a difference."* – Captain Kirk, Star Trek Generations[16]

Located at the core, the Command Centre is an inner sphere containing all equipment required to control and pilot the Urchin. In the event of an emergency, the command module acts as a protective bunker and if required, can act as a separate ship and pilot away from the Urchin.

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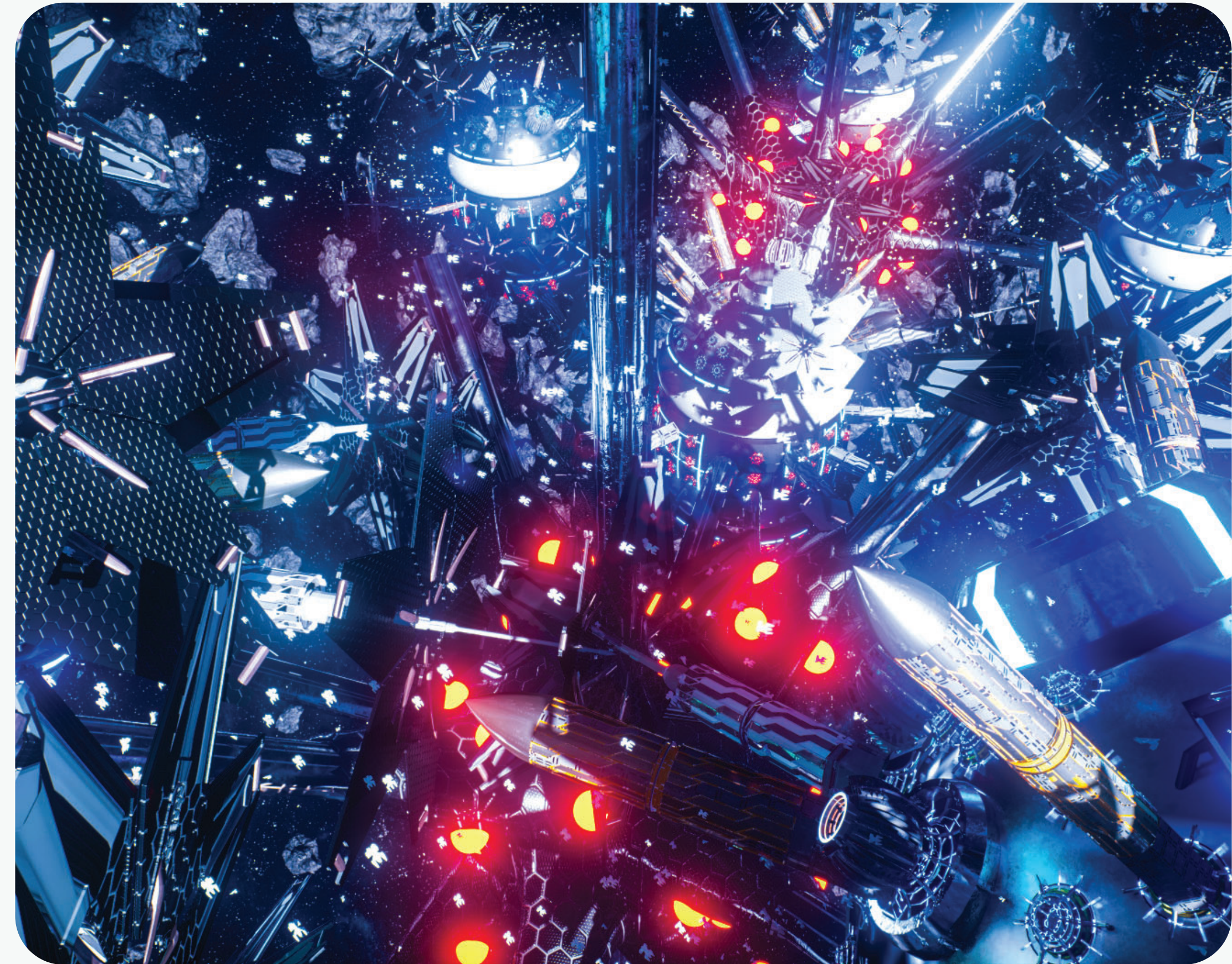
*"Have you ever had a dream, Neo, that you were so sure was real? What if you were unable to wake from that dream? How would you know the difference between the dream world and the real world?"* – Morpheus, Matrix [17]

Proposed as a future-centric mission when the first Urchin is a success, the Linkage system are a series of multi-bridge infrastructure that connects future Urchins to assemble the Space Herd collective.

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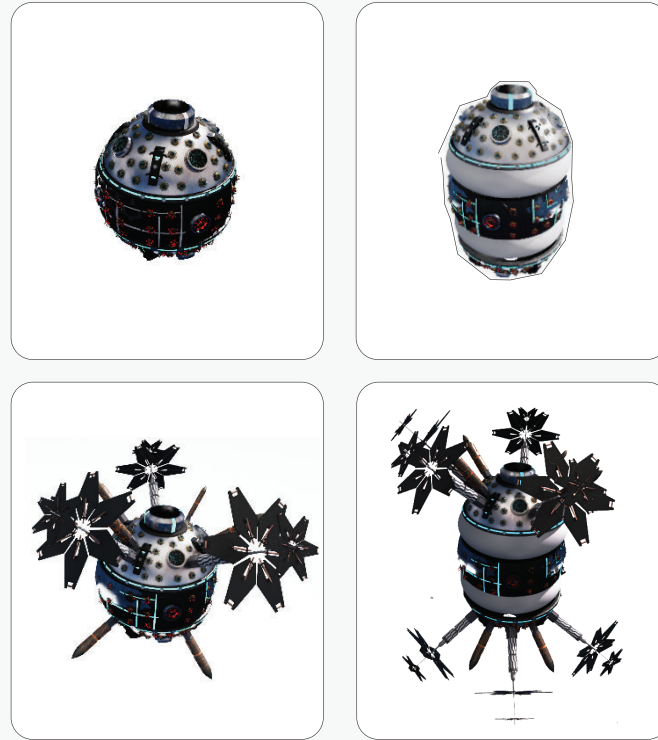
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# Exploded Axonometric

Images: Depicting the possible growth over time as more life and energy sustaining modules are brought over the missions.

L-R: Base Urchin, Inflated Urchin, Urchin at 50%, Urchin at 75% capacity, Urchin at 100% capacity, Urchin at 125%.



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- Legend:
- 1. Docking Port - North
  - 2. Workshop/Ancillary Cargo
  - 3. Command Bridge
  - 4. Human Rehabilitation Chamber
  - 5. Crew Living Quarters
  - 6. Energy & Data Network
  - 7. Docking Port - South

# Section



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