



MOTH

MARS TRANSIT HABITAT

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Daisy Meng, Connor O'Hern, Larissa Naegele, Michelle Chung, Kainoa Perez, John Doria

Instructors:

Michael Morris, Rebecca Pailes-Friedman, Melodie Yashar

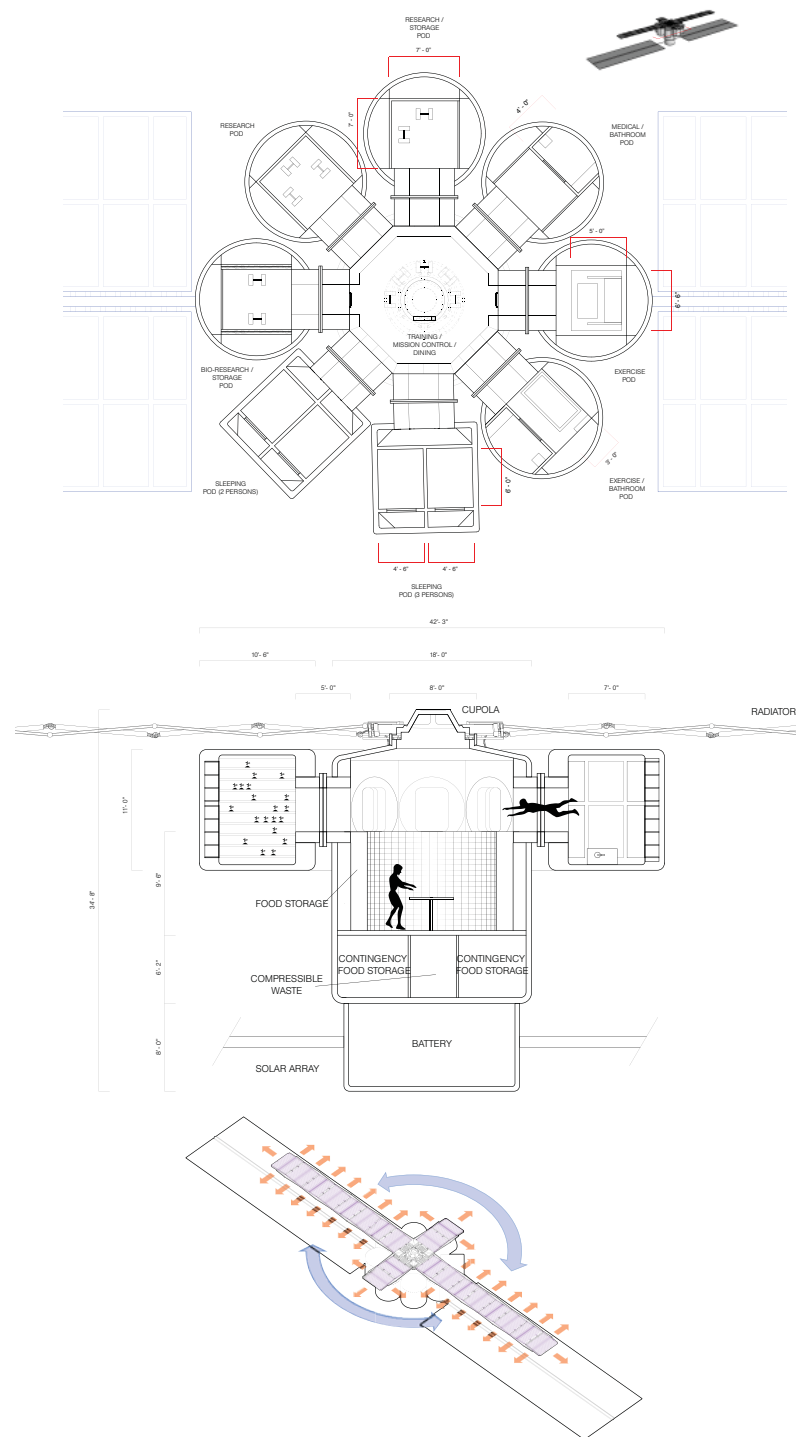


Pratt

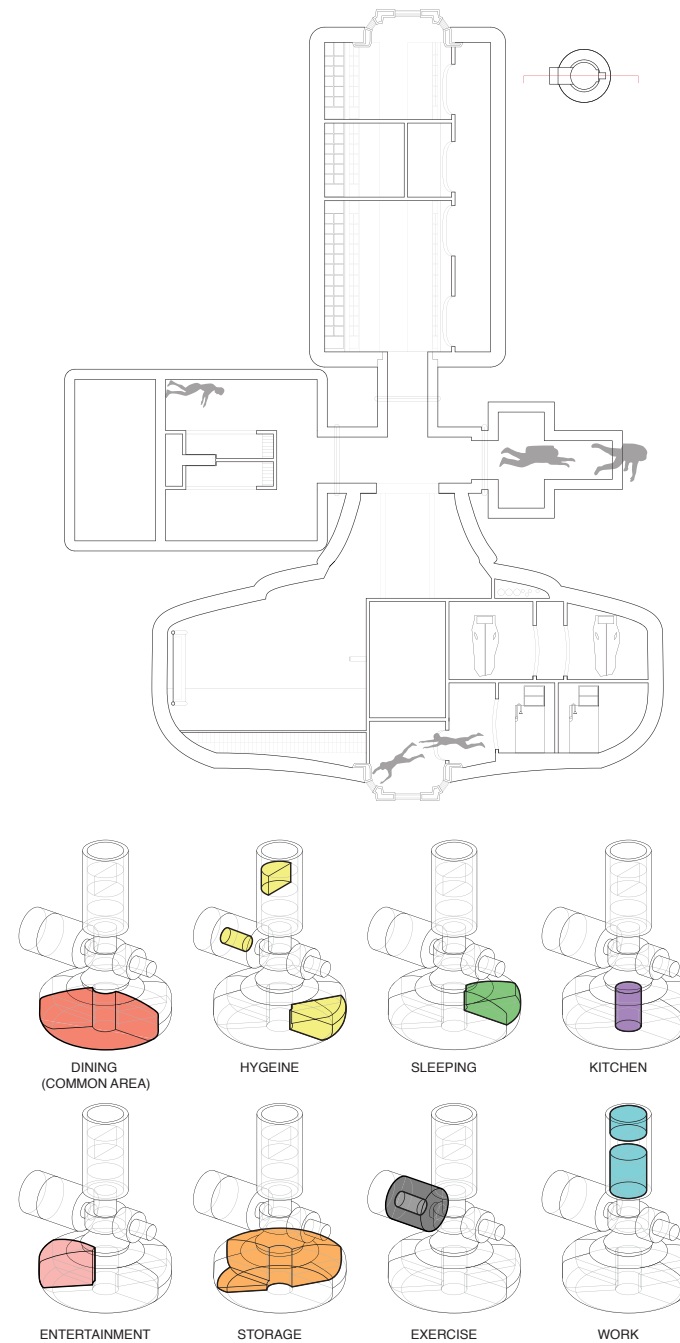


PROCESS

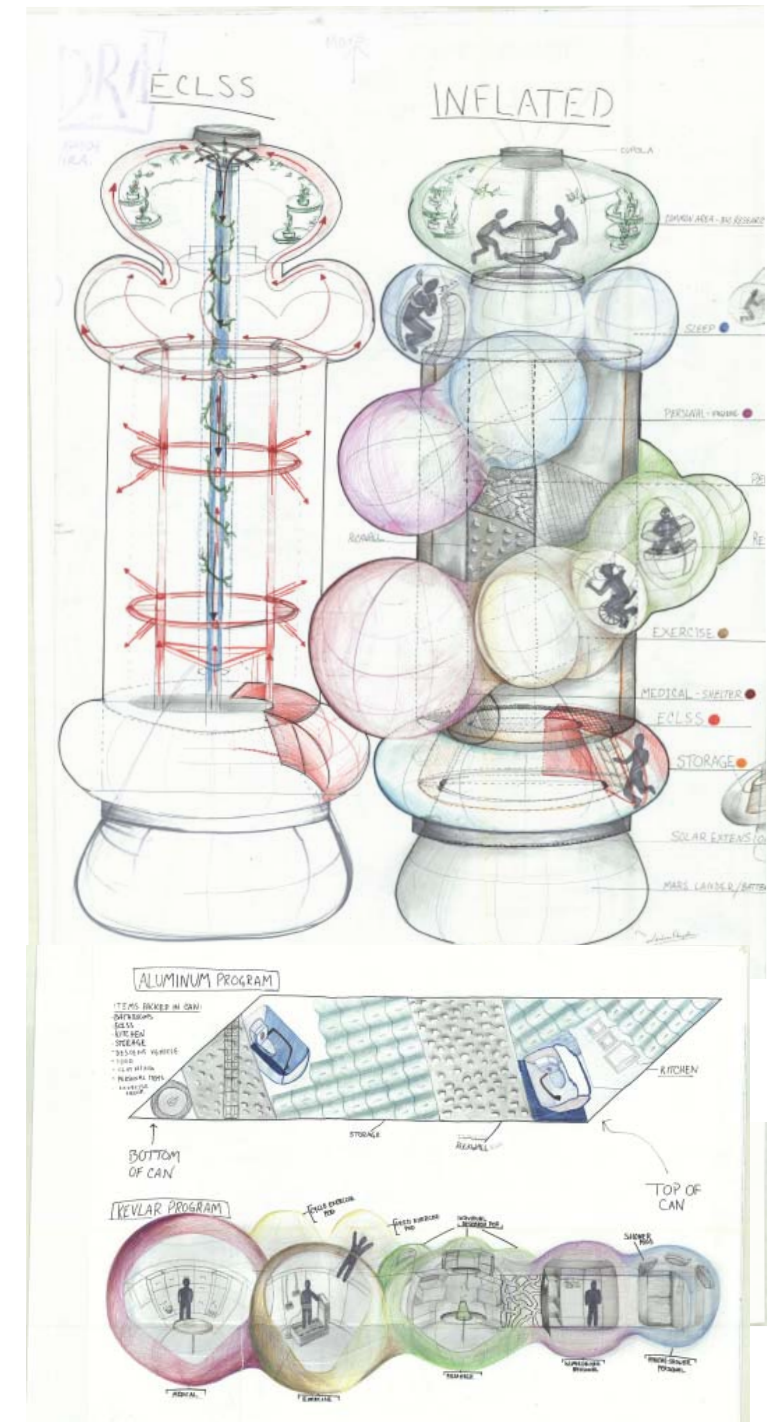
HORIZONTAL HABITAT



VERTICAL HABITAT



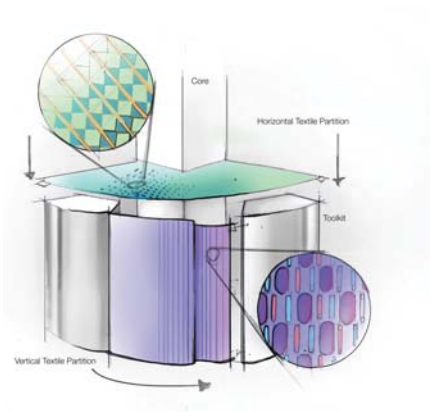
HYDRA HAB



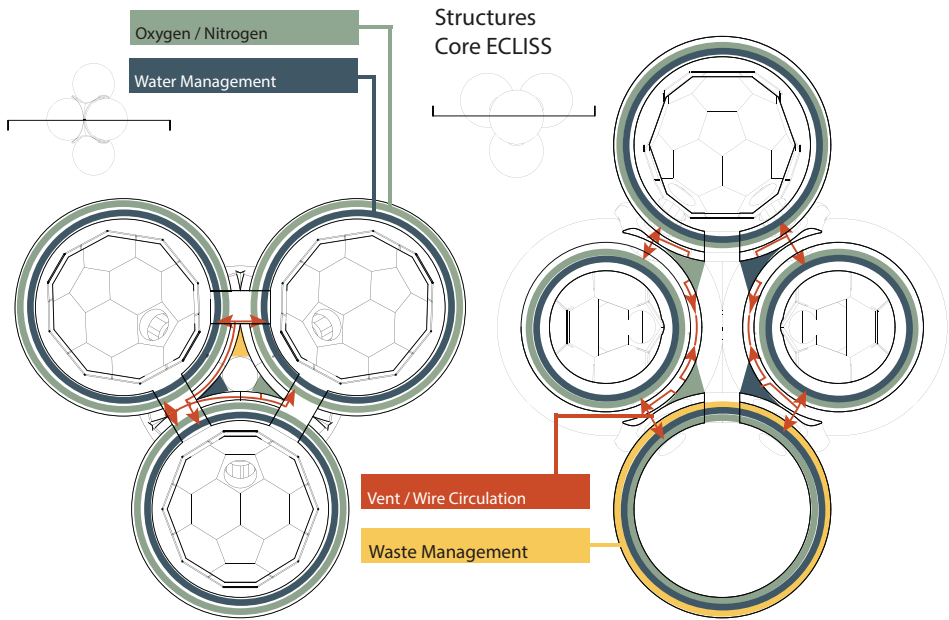
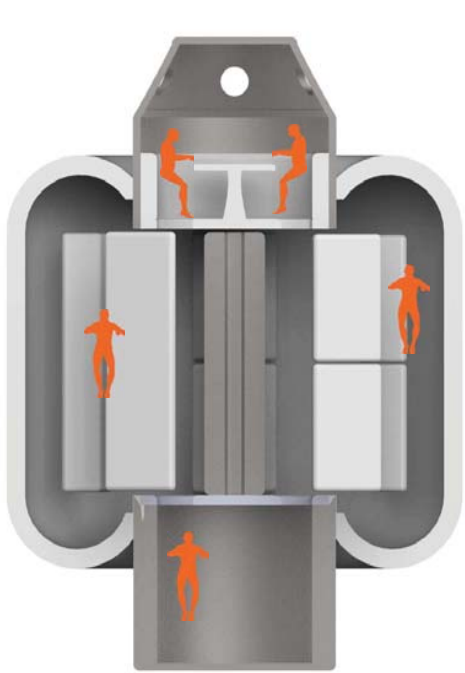


PROCESS

MOTH



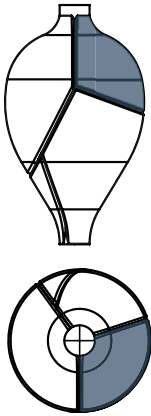
JUNO





NASA TRIP: PRELIMINARY DESIGN REVIEW

COCOONS: COMMUNICATION/TOOL STORAGE



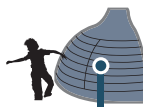
Versatility

Can plug into the core at any point to allow it to assist training, repair, and communication



Communication Panels

Two panels allow dual channels of communication



Storage Racks

Tools for experiments, training, and maintenance



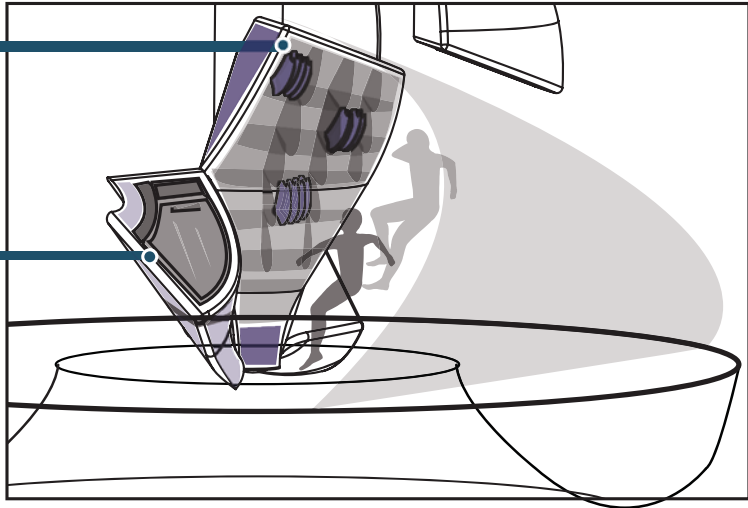
COCOONS: FOOD STORAGE

Food Storage

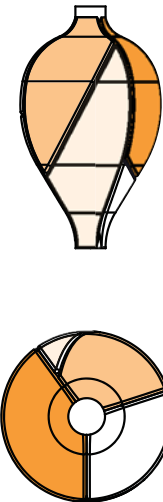
Food Storage can be organized and packed into the F toolkit.

Kitchen

A Microwave oven can be implemented on the top side of the E toolkit.

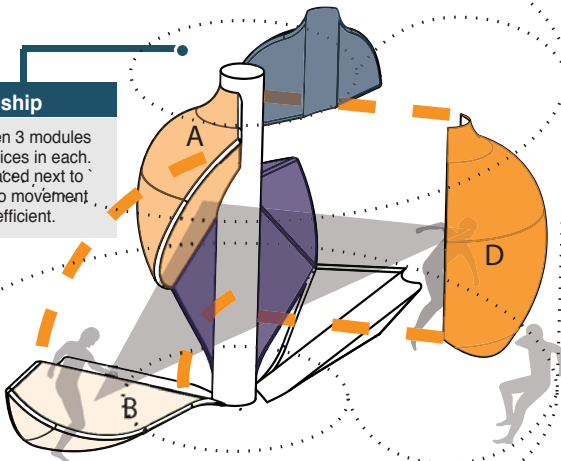


COCOONS: EDUCATION/EXPERIMENTATION/ENTERTAINMENT



Relationship

Work between 3 modules relies on devices in each. Pieces are placed next to each other so movement and work is efficient.



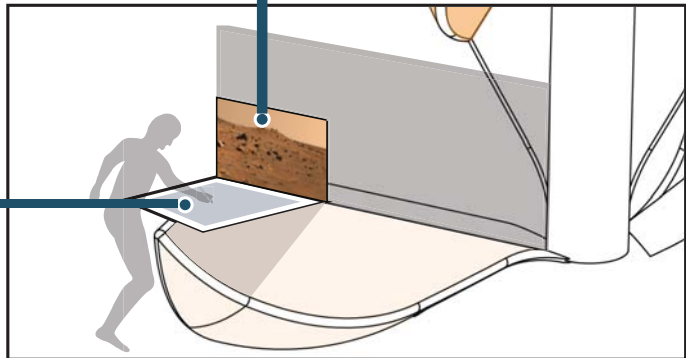
- A Experiment
- B Education/Training
- D Entertainment

Info Screen

Training instructions or info displayed here

Surface

Surface for manipulating objects -





NASA TRIP: PRELIMINARY DESIGN REVIEW



Pratt

XHAB-PROJECT

Human Centered: Designs for the Mars Transit Habitat

Designers:

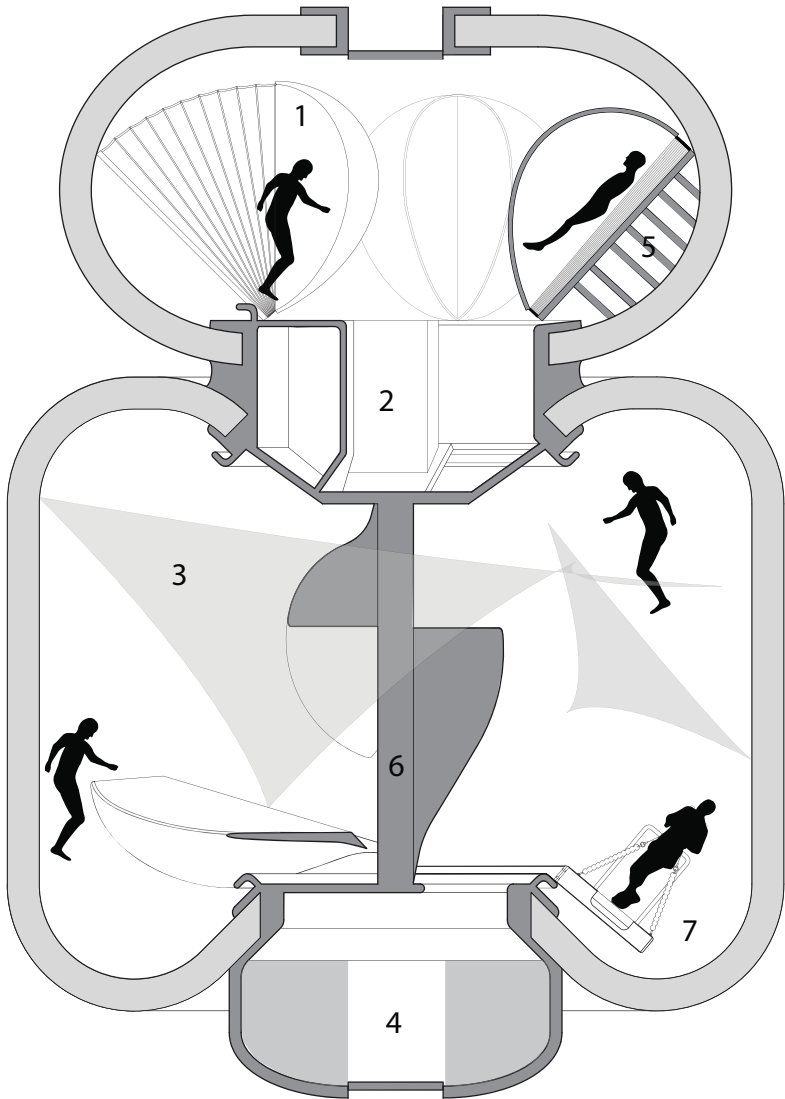
Taylor Carter
Michelle Chung
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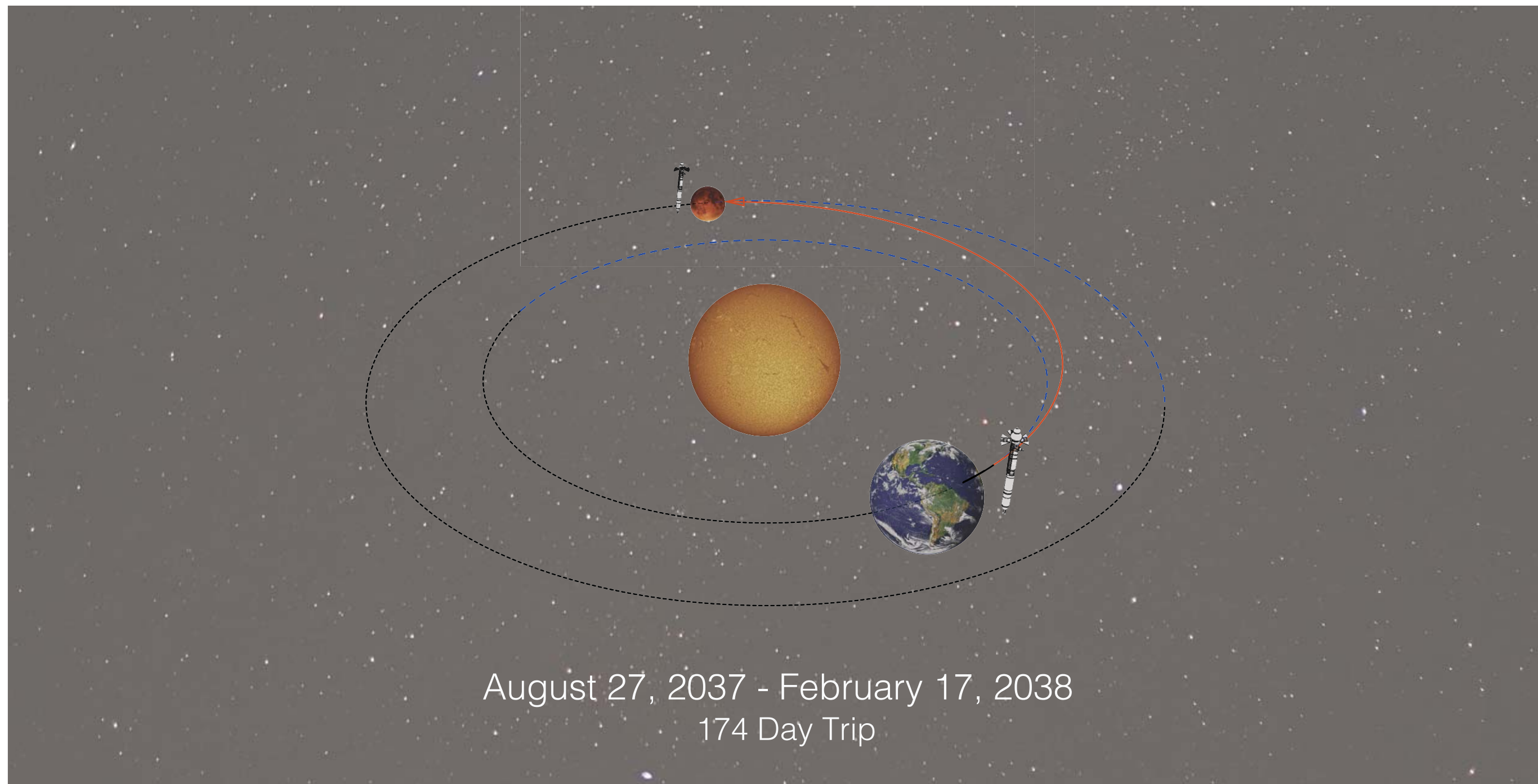
M.O.T.H



NASA TRIP: PRELIMINARY DESIGN REVIEW

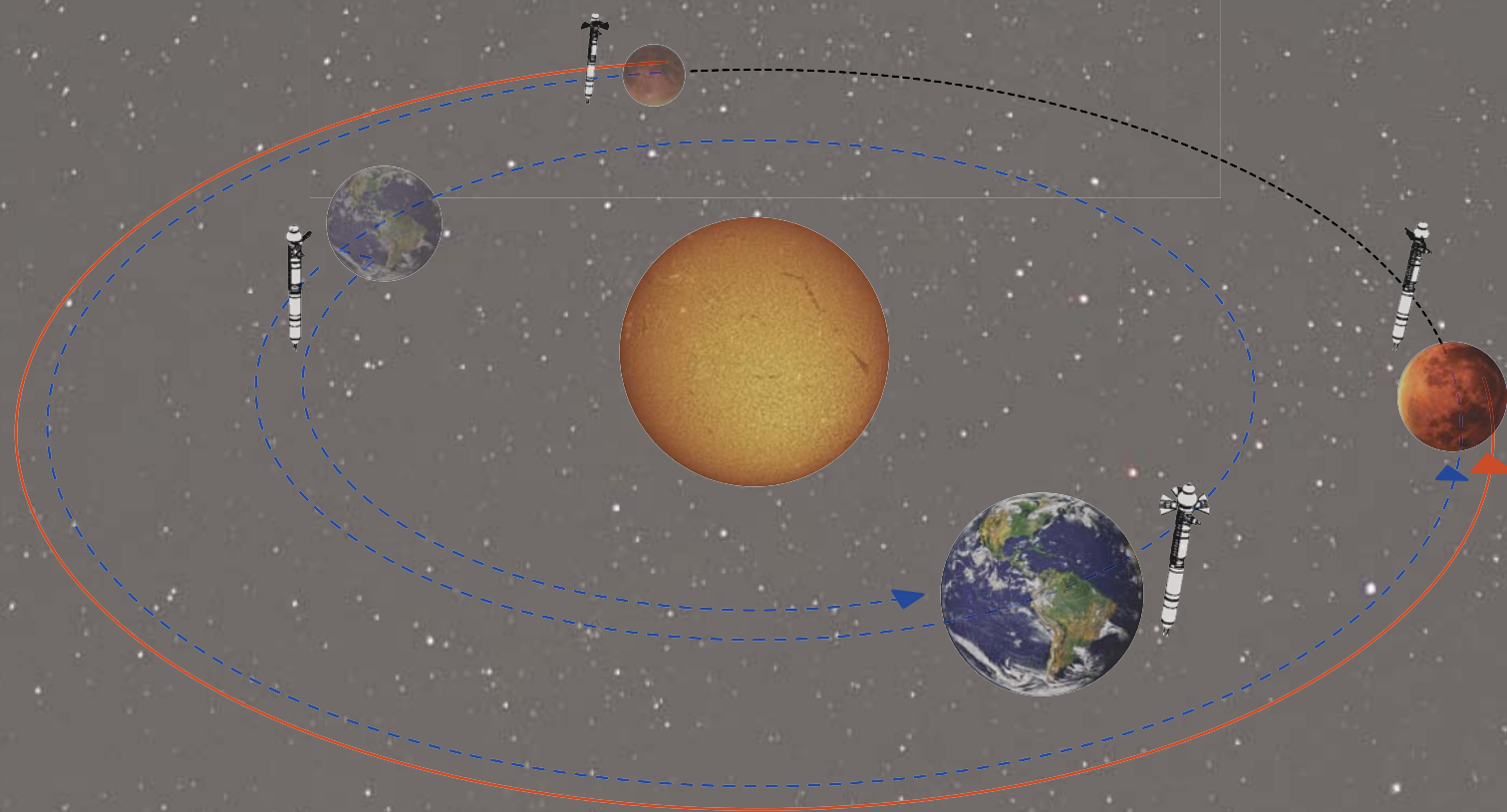


MISSION BREAKDOWN: EARTH TO MARS





MISSION BREAKDOWN: MARS STAY

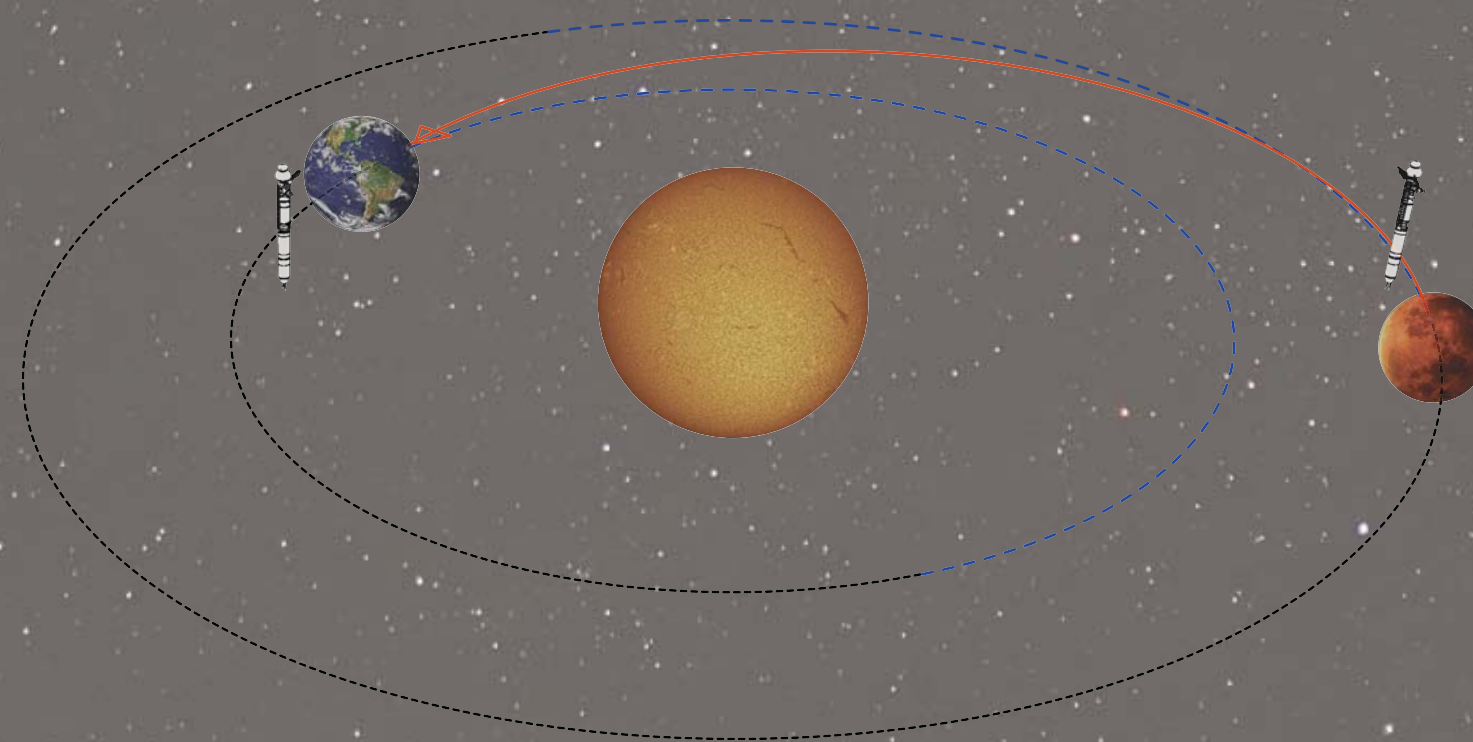


February 17, 2038 - August, 2039
539 Day Stay





MISSION BREAKDOWN: MARS TO EARTH

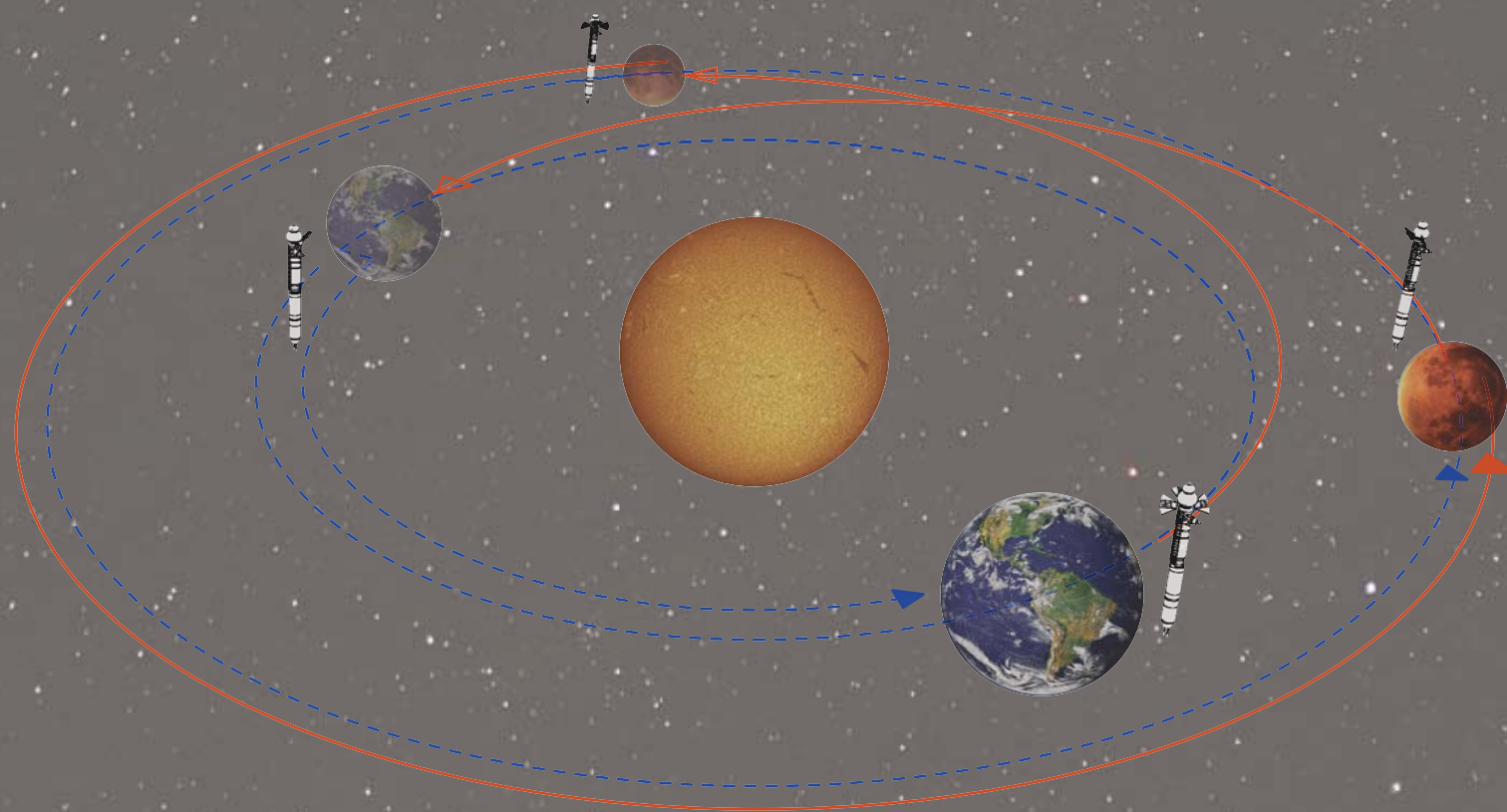


August 10, 2039 - February 27, 2040
210 Day Trip





MISSION BREAKDOWN: TOTAL STAY



Total Transhab Habitation: 375 Days (41%)







OVERVIEW

Components

Updated Mass and Volume



TOOLKIT

Design Update

Components

Fabrication



SLEEP POD

Design Update

Components

Fabrication



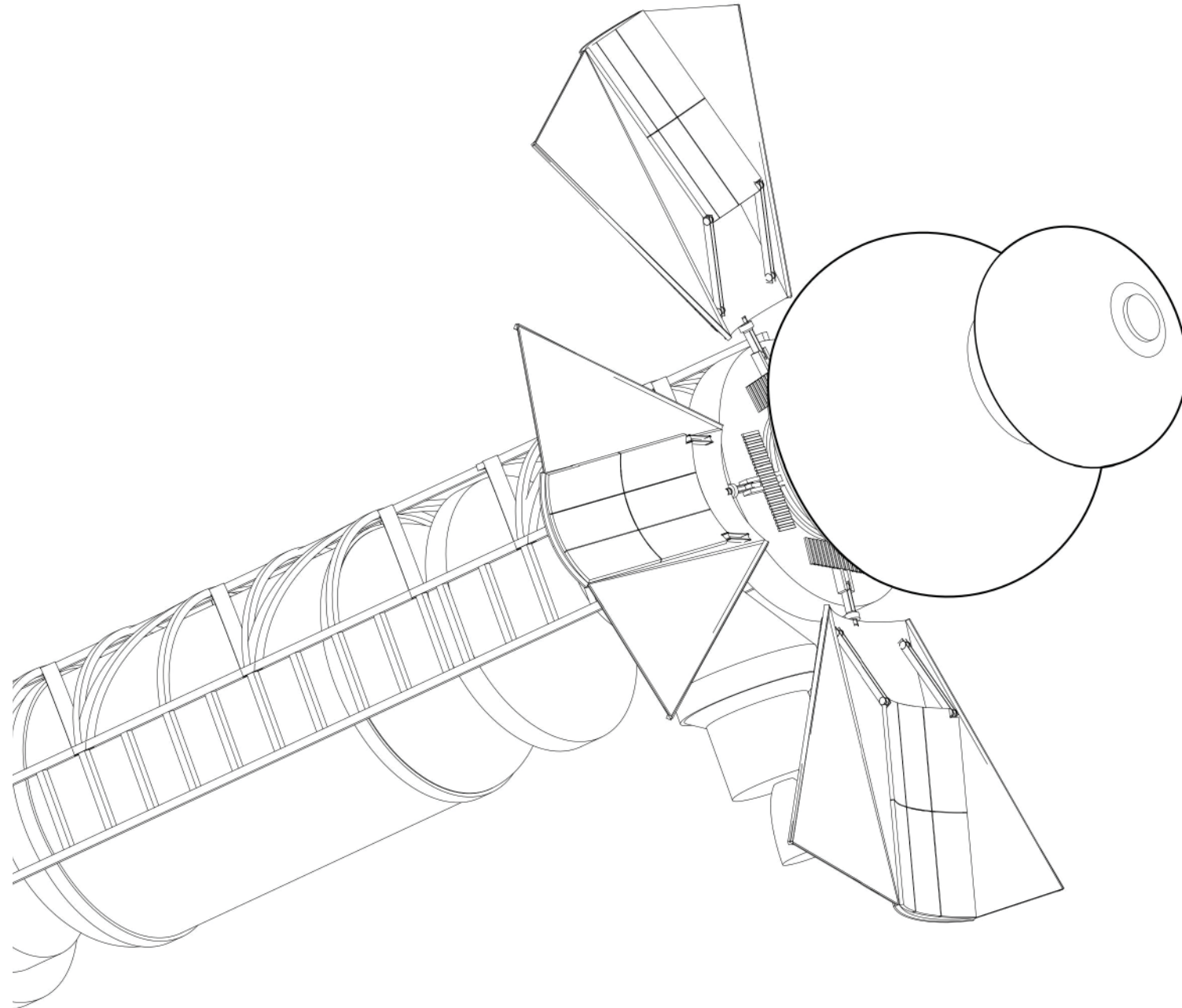
INTREPID MUSEUM

Exhibit Site

Installation of Prototypes

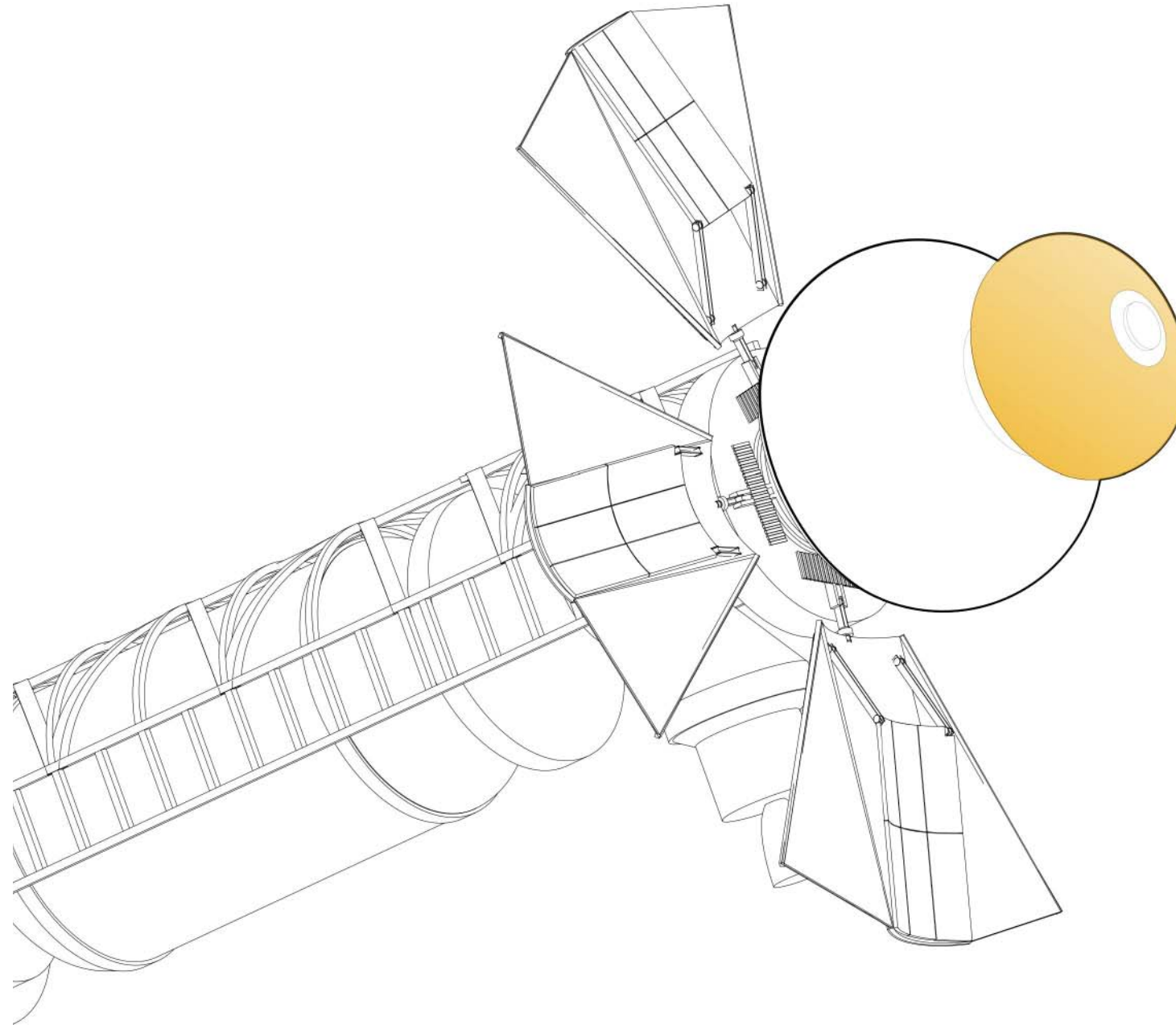


COMPONENTS



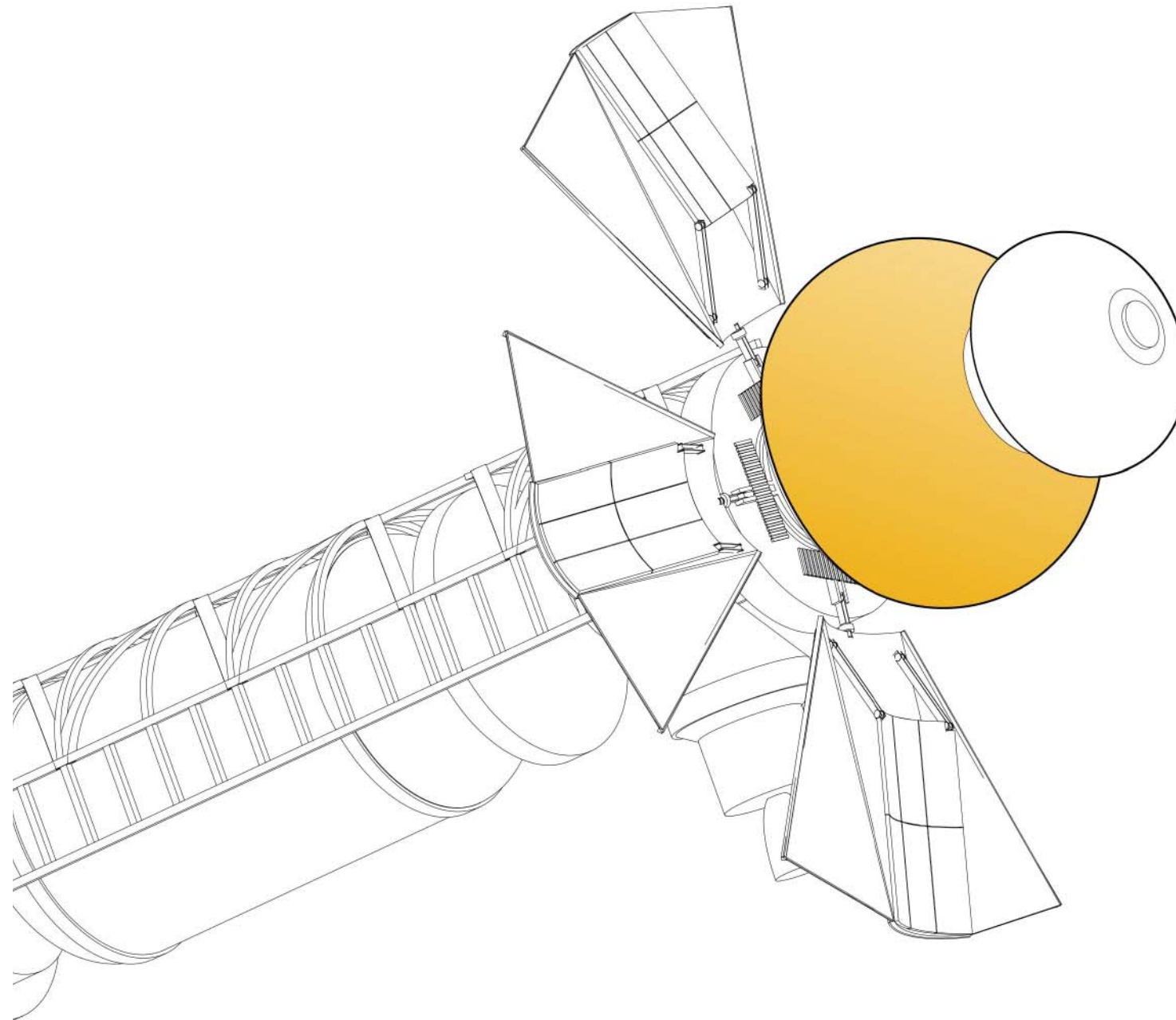


COMPONENTS: Secondary Inflatable System (SIS)



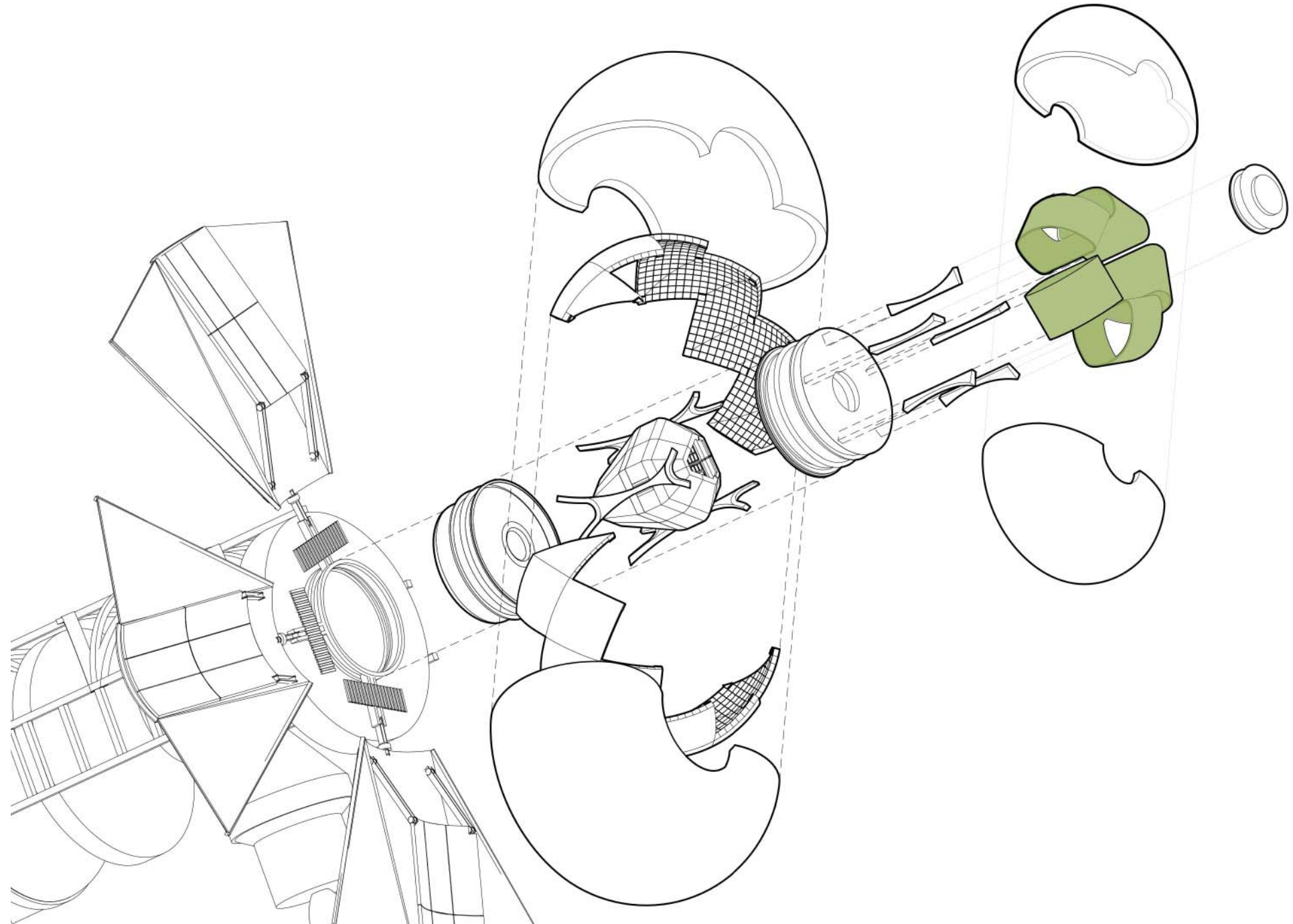


COMPONENTS: Main Inflatable



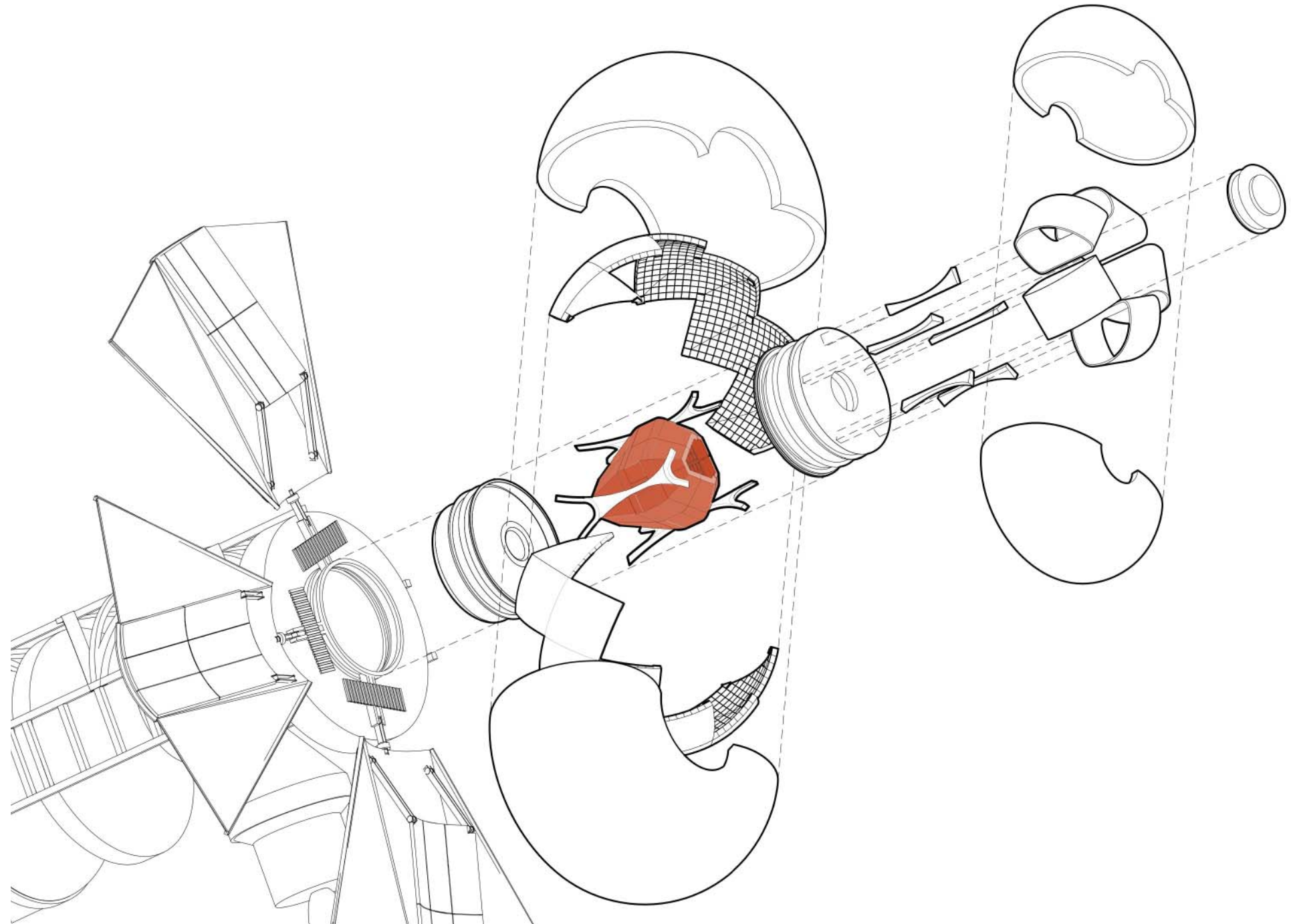


COMPONENTS: Sleeping Quarters



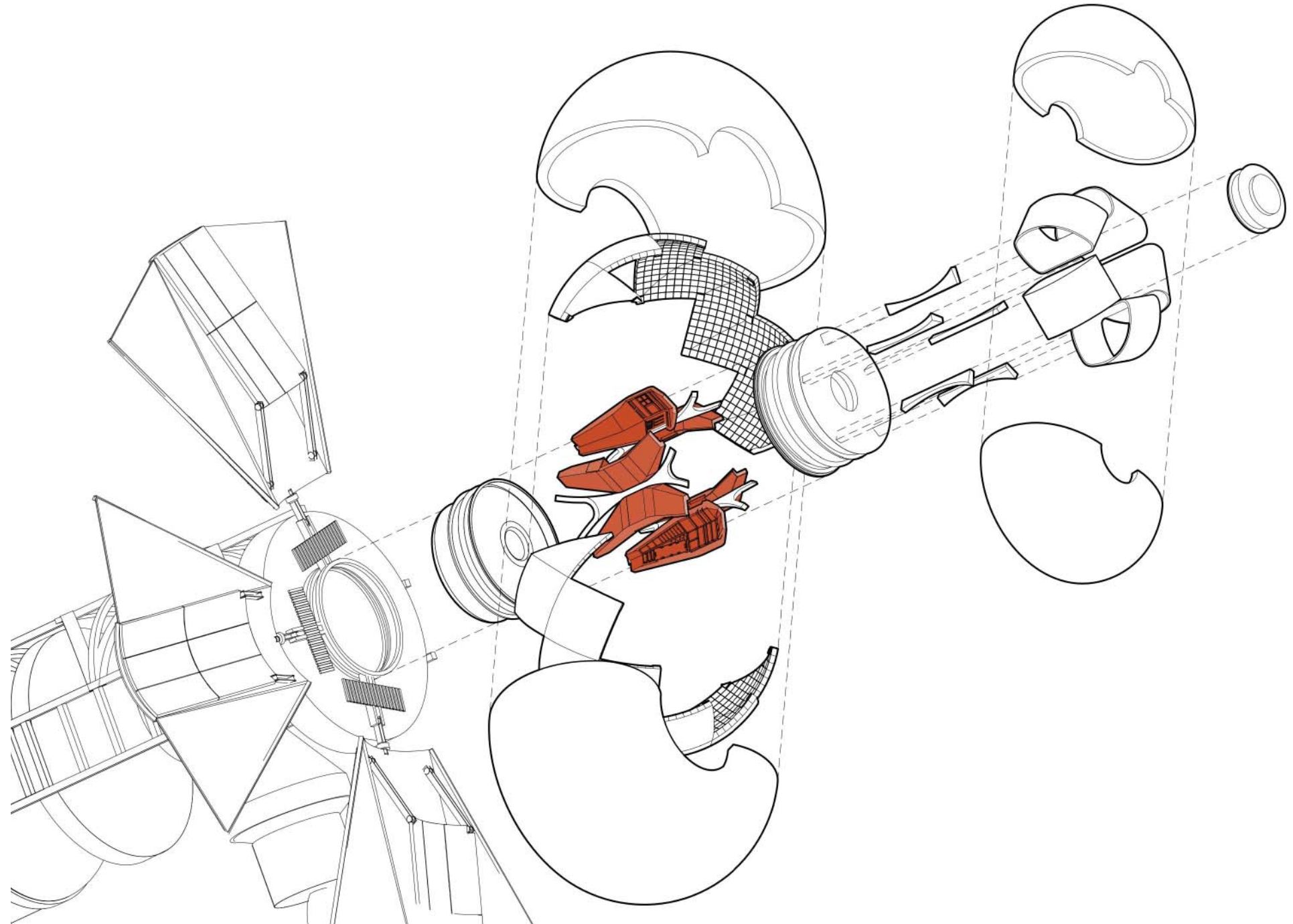


COMPONENTS: Toolkit (Closed)



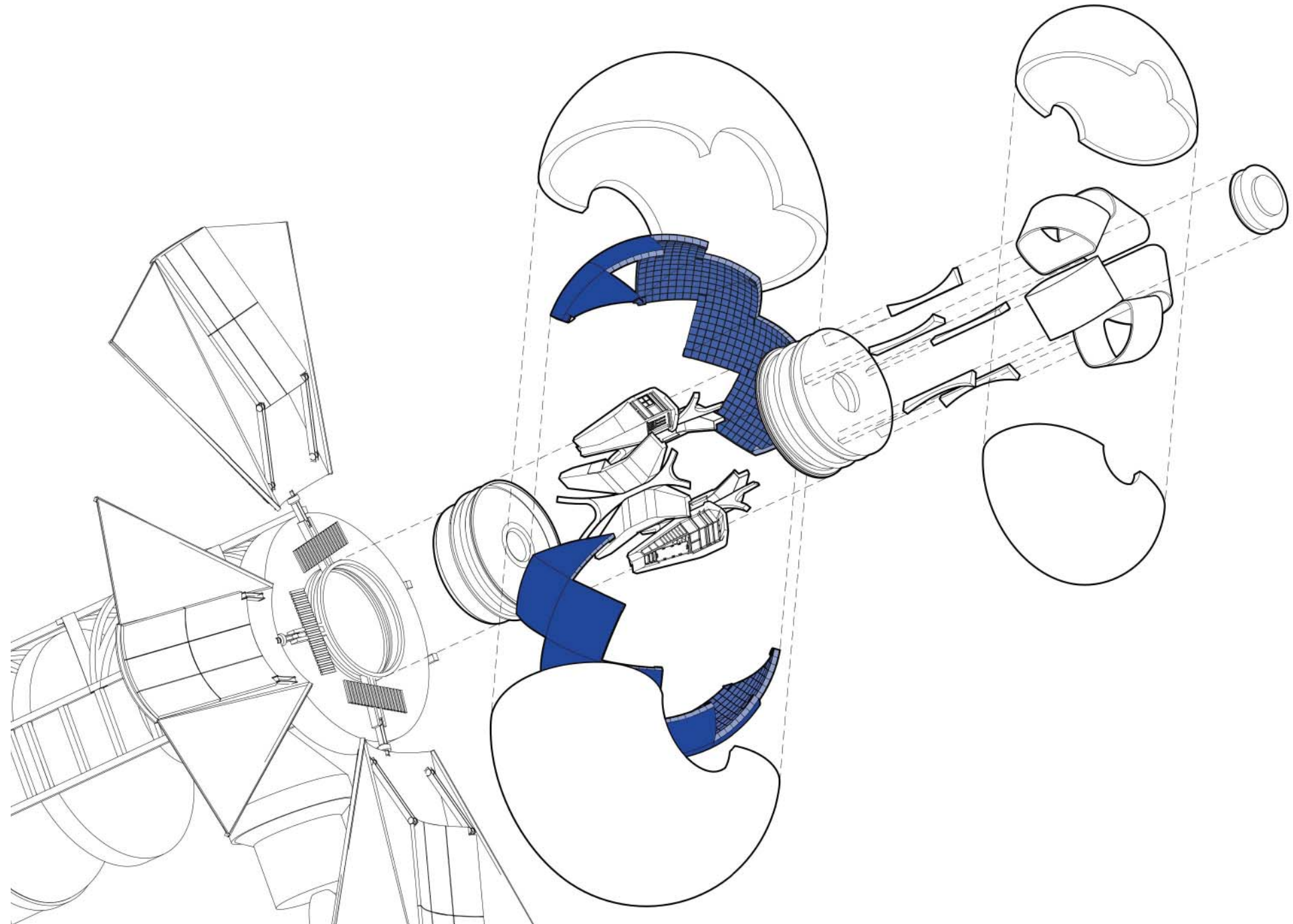


COMPONENTS: Toolkit (Open)



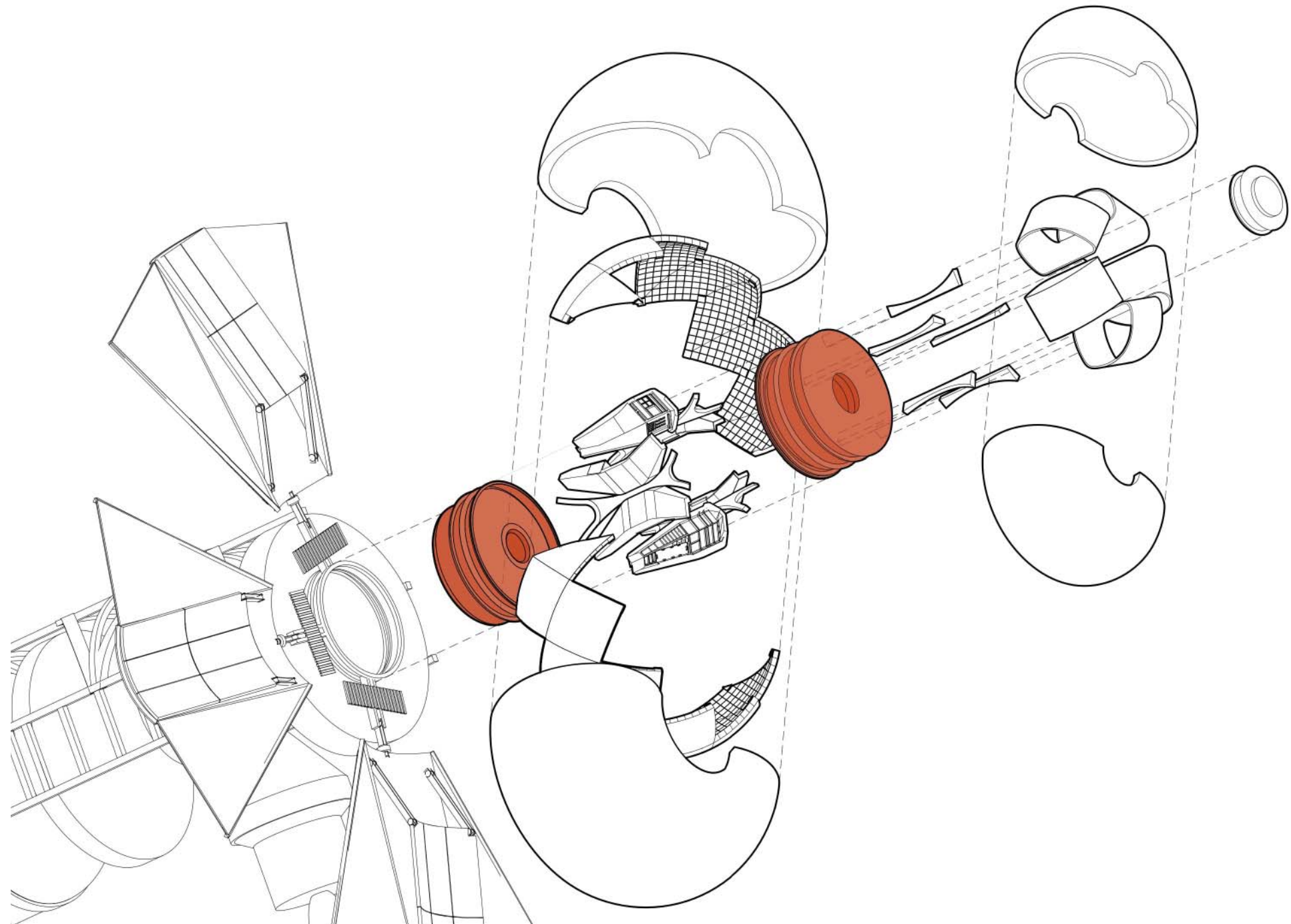


COMPONENTS: Wall Storage System



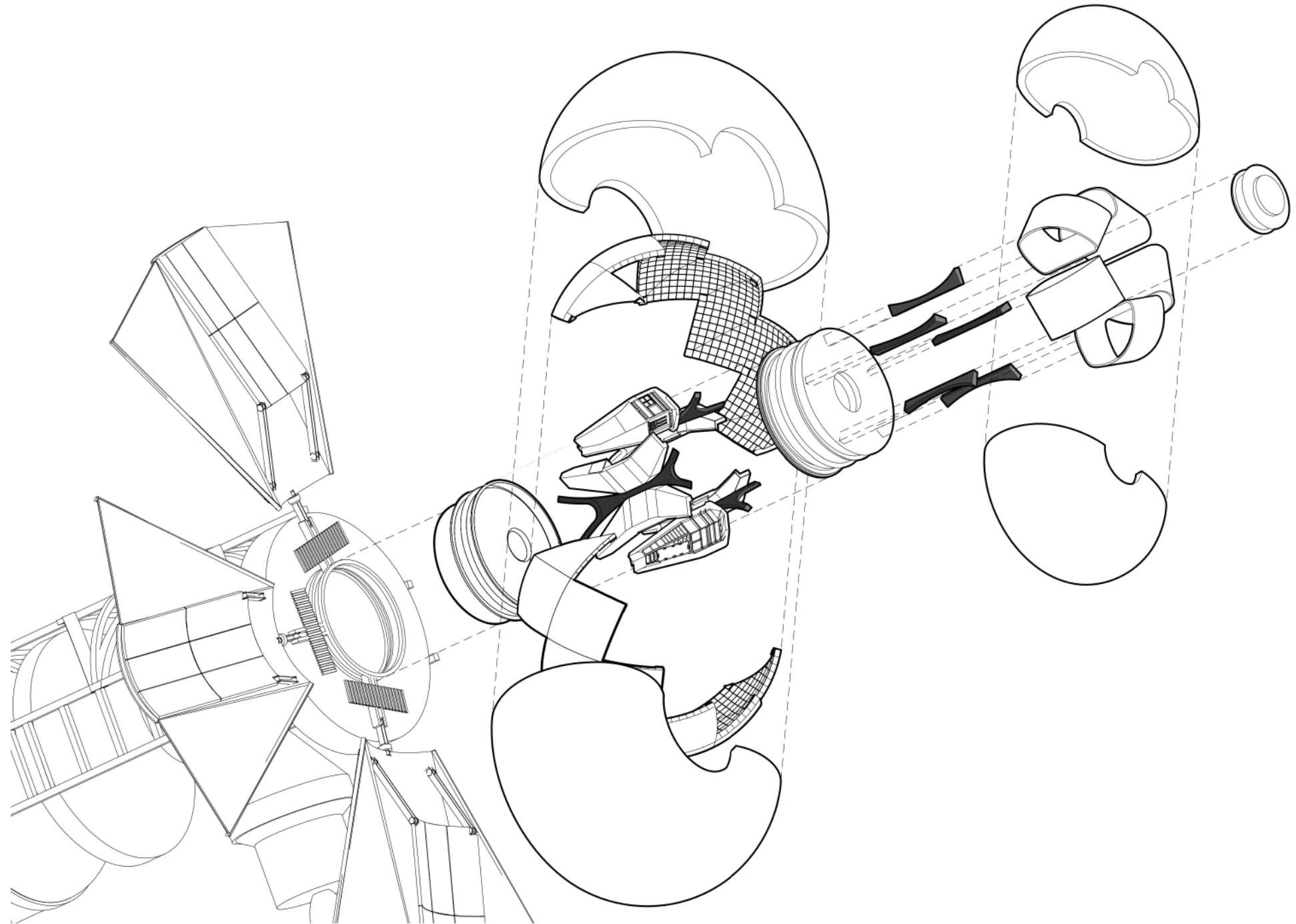


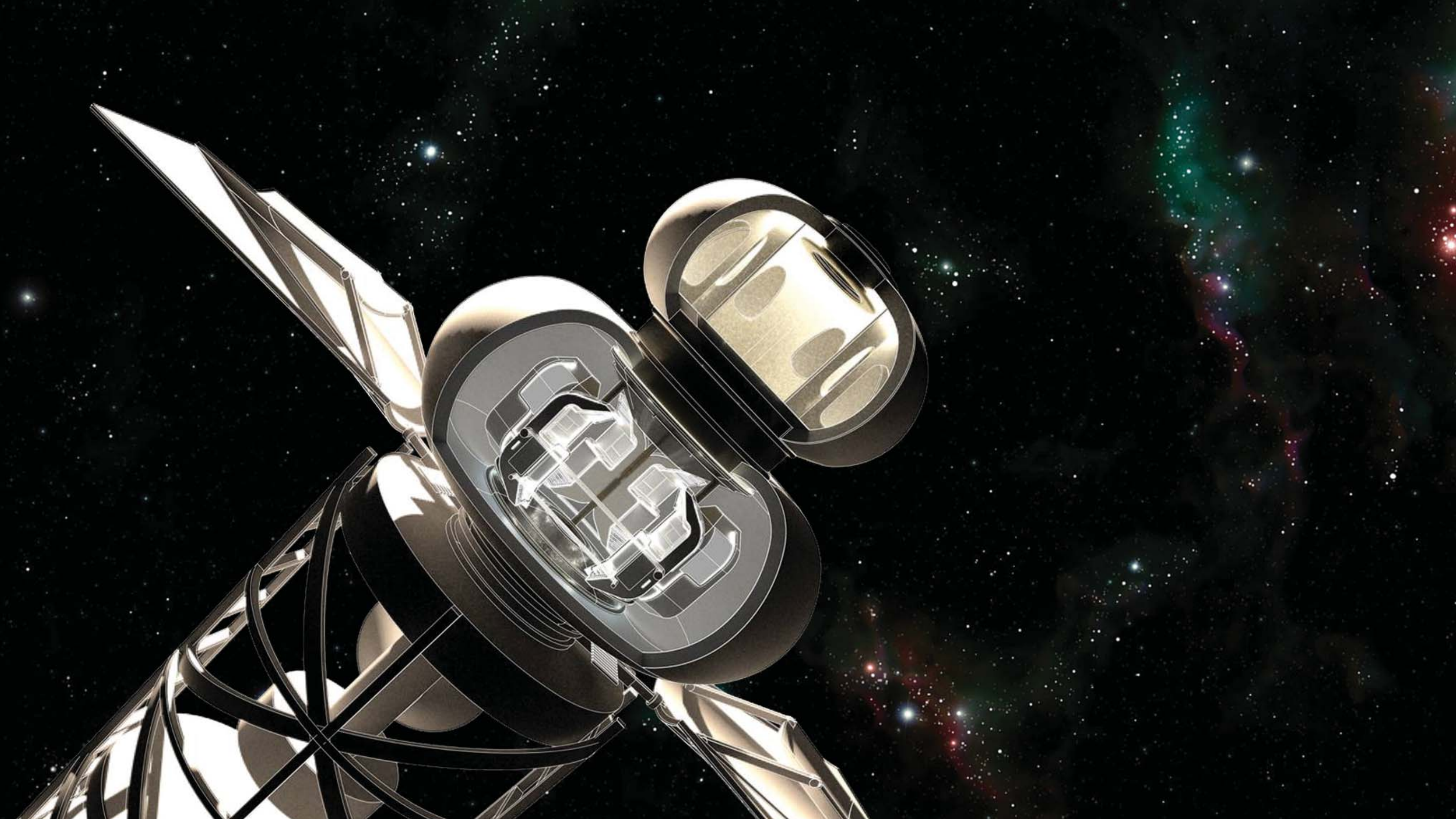
COMPONENTS: Aluminum Collars





COMPONENTS: Supporting Structure





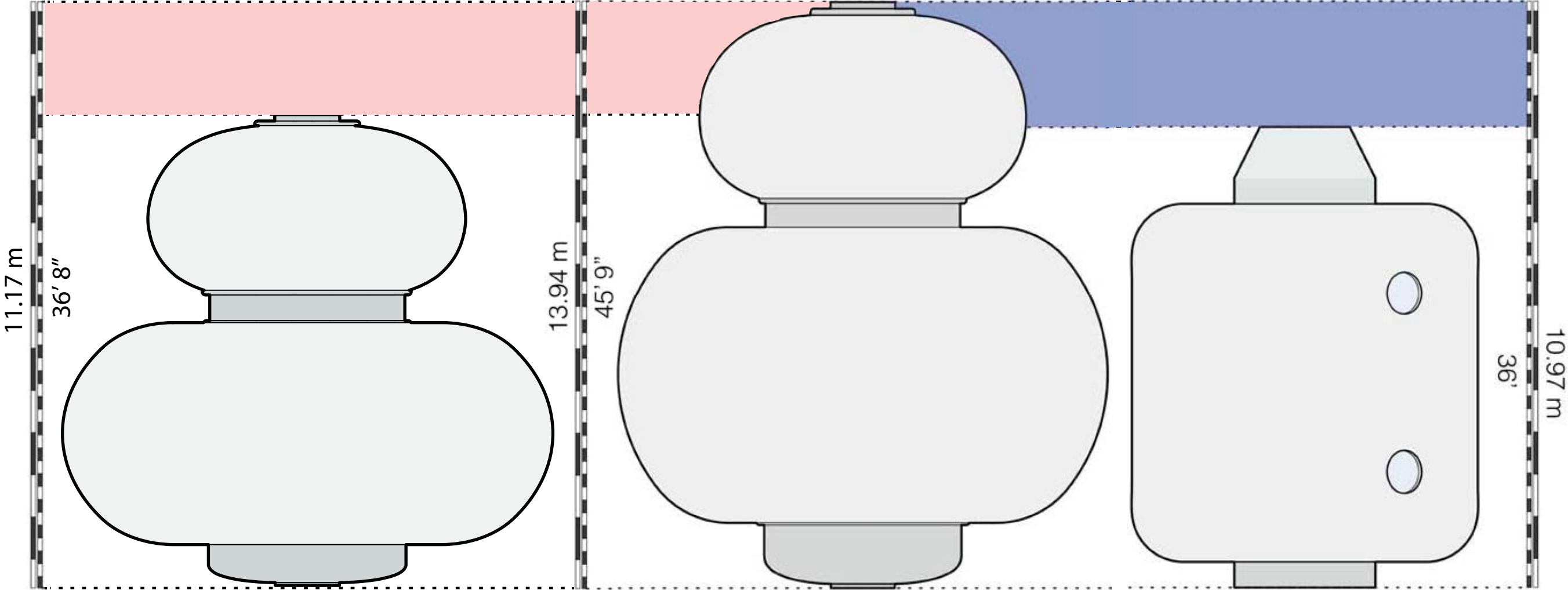


UPDATED MASS AND VOLUME

MOTH 3.0

MOTH 2.0

TRANSHAB



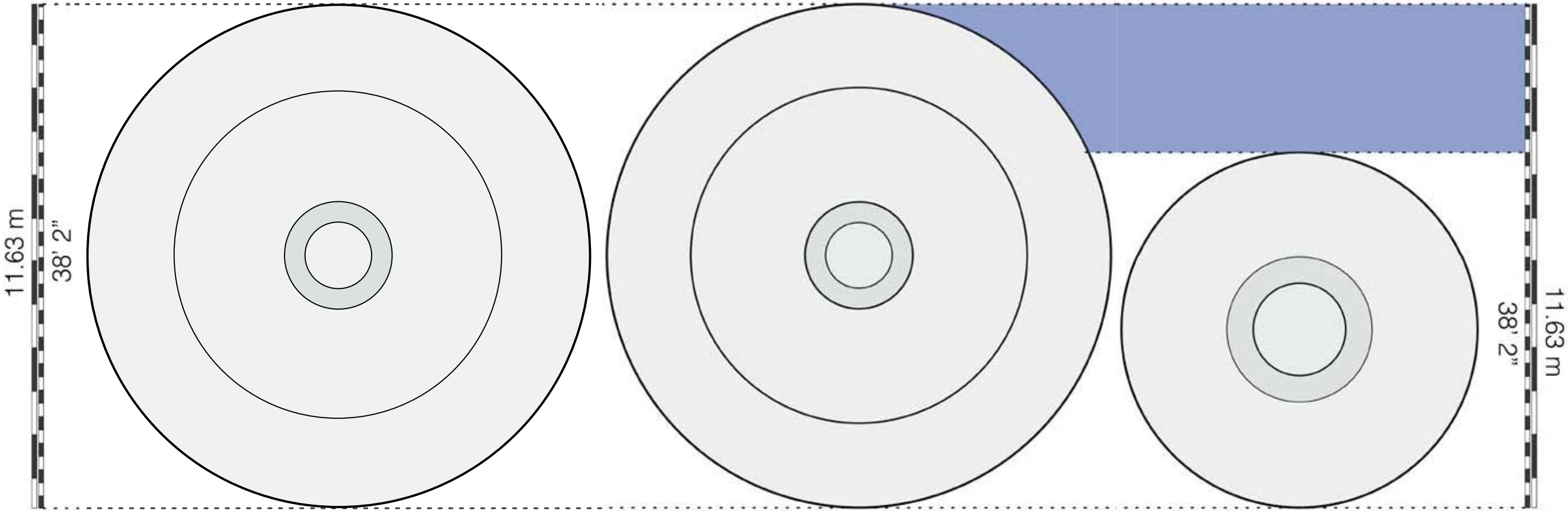


UPDATED MASS AND VOLUME

MOTH 3.0

MOTH 2.0

TRANSHAB

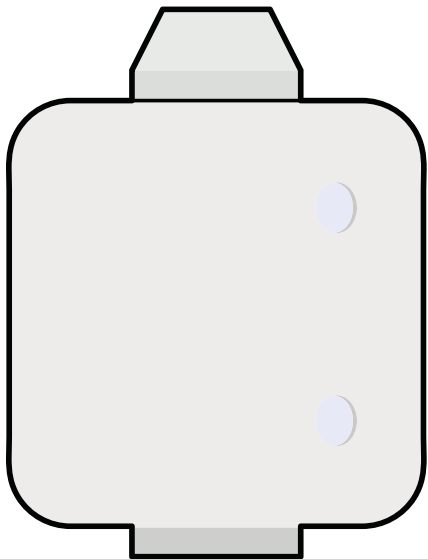
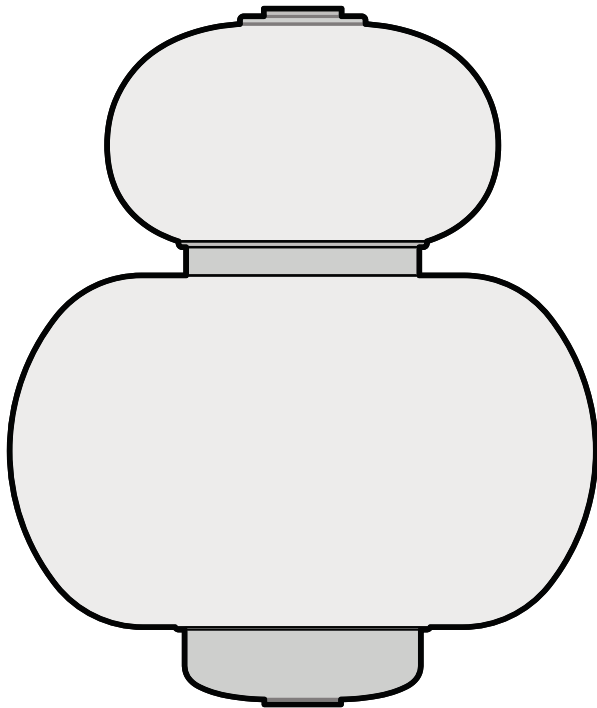
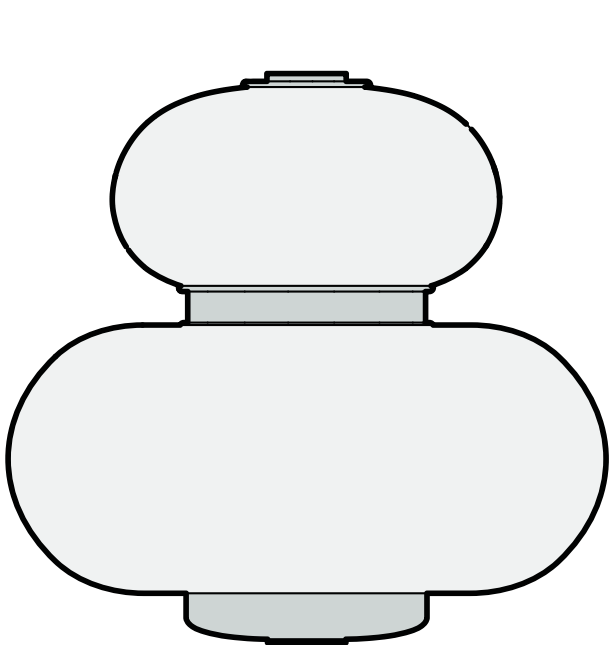




UPDATED MASS AND VOLUME

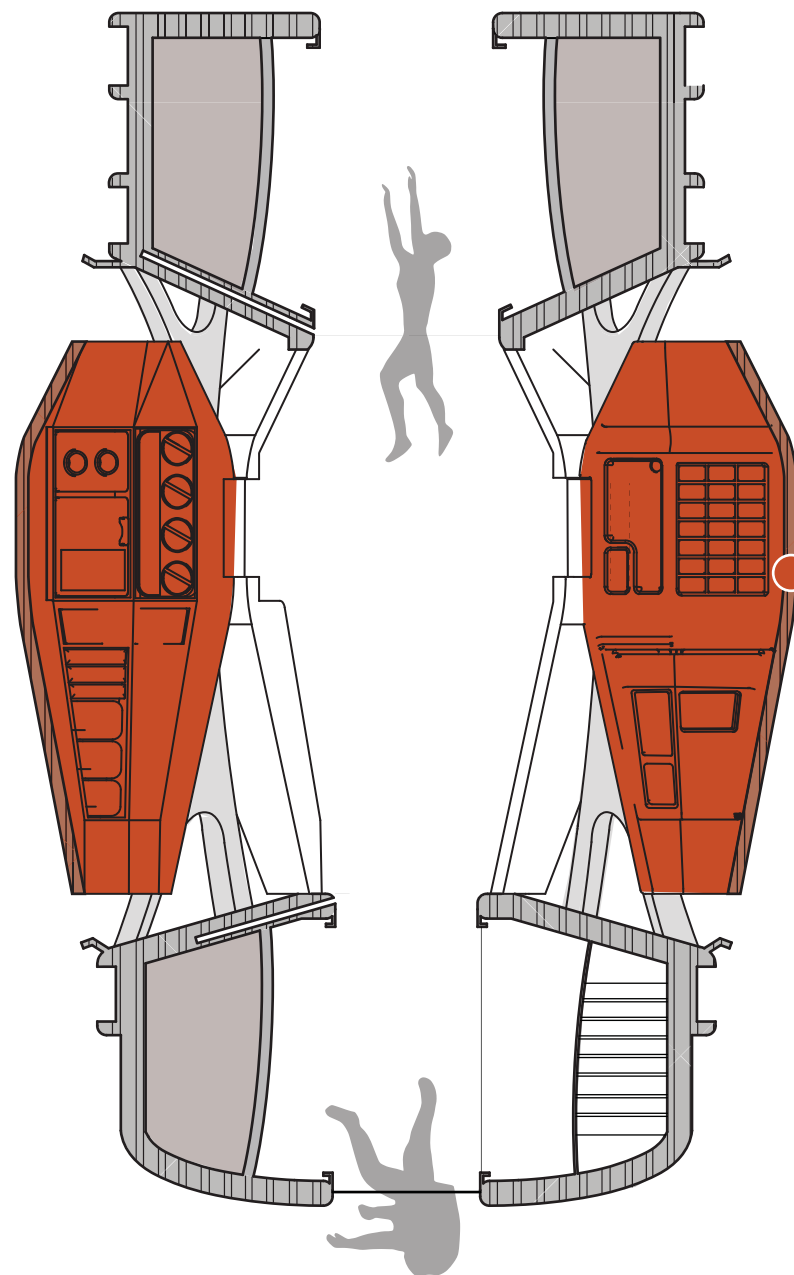
*All mass calculations and Mars Transit Habitat figures obtained with reference to "Human Exploration of Mars Design Reference Architecture 5.0"

	MOTH 3.0	MOTH 2.0	TRANSHAB
PRESSURIZED VOLUME	412.5 m ³	615.2 m ³	339.8 m ³
HABITABLE VOLUME	357.4 m ³	503.8 m ³	242.9 m ³
CREW SIZE	5	5	6
TOTAL HABITAT MASS	30,345 kg	32,536 kg	28,100 kg
TOTAL CONSUMABLE MASS	11,040 kg	11,040 kg	13,240 kg
TOTAL MASS	41,385 kg	43,576 kg	41,340 kg



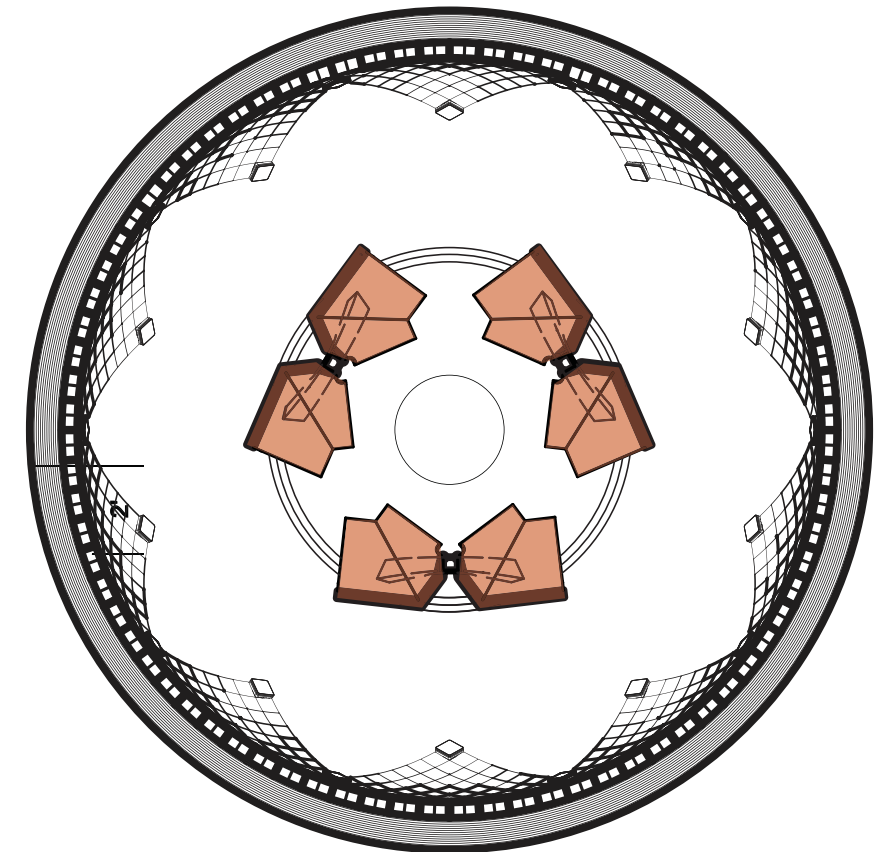


TOOLKIT: Updated Overall Design



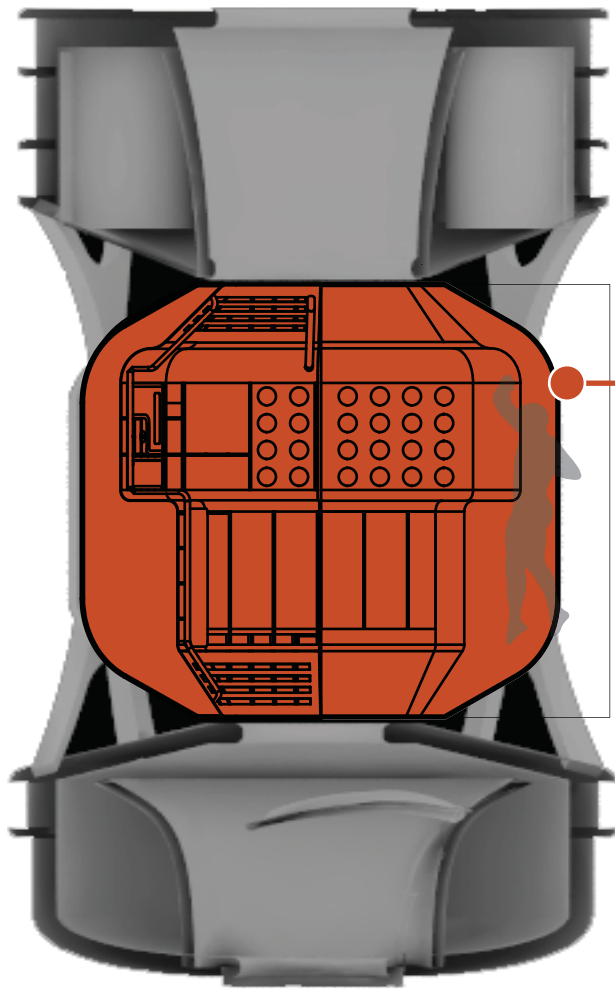
Old Toolkit From MOTH 2.0

- 15' tall toolkit allows for human to lay against toolkit for medical procedures and prolonged stays during solar radiation storms.
- gives space a sense of orientation.
- more space for the astronauts during solar radiation storm.



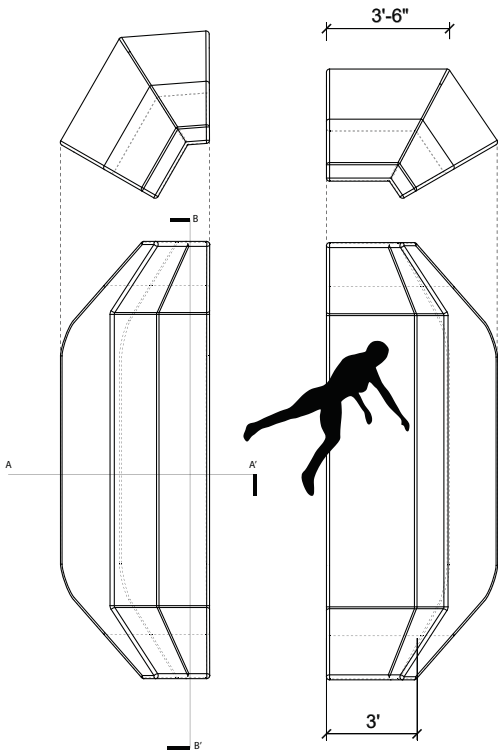


TOOLKIT: Updated Overall Design



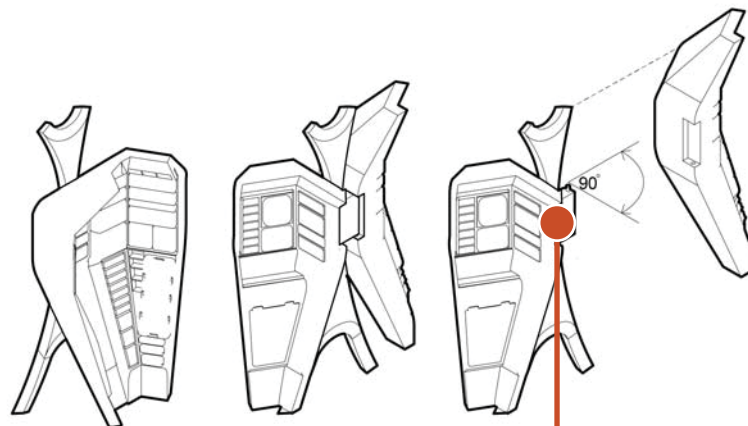
New Toolkit For MOTH 3.0

- shortened by 5' to 10'
- more functional space in the middle
- more symtrical layout that responds to the human scale





TOOLKIT: Updated Hinge



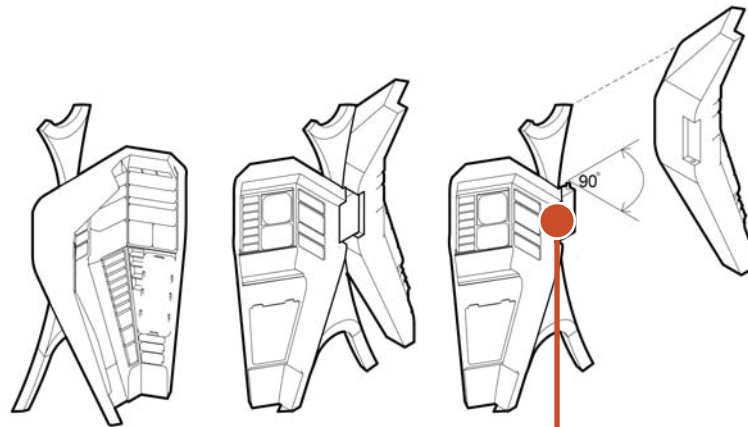
Display Hinge

Original hinge developed to allow the individual toolkit doors to open fully perpendicularly. Allows work stations to be directly across from one another to allow from maximum productivity.



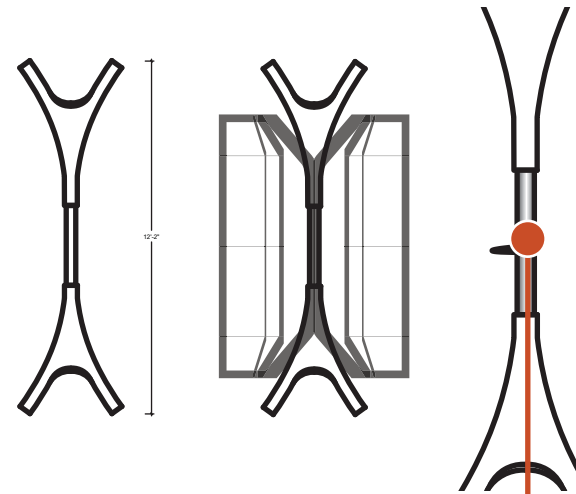


TOOLKIT: Updated Hinge



Display Hinge

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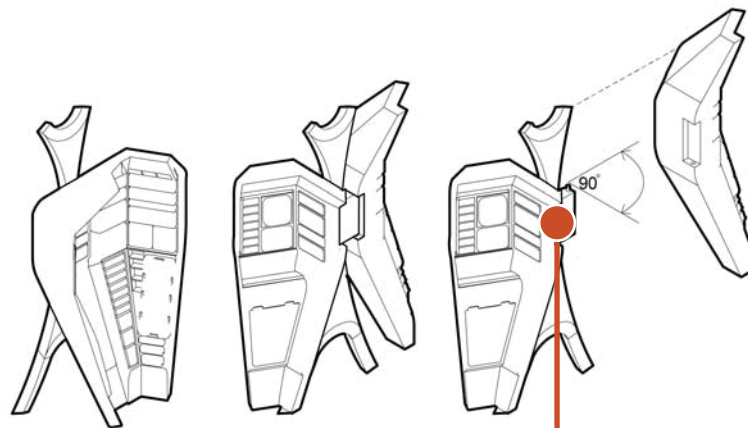
Piano Hinge

Hinge allows astronauts to rotate a whole set of toolkit doors 360 degrees to allow for efficient restocking of each toolkit.



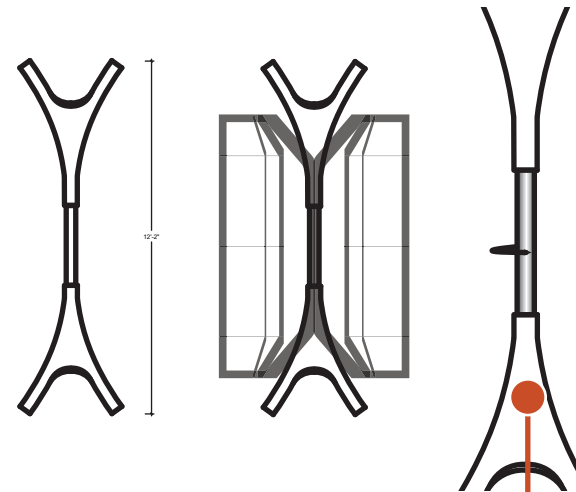


TOOLKIT: Updated Hinge



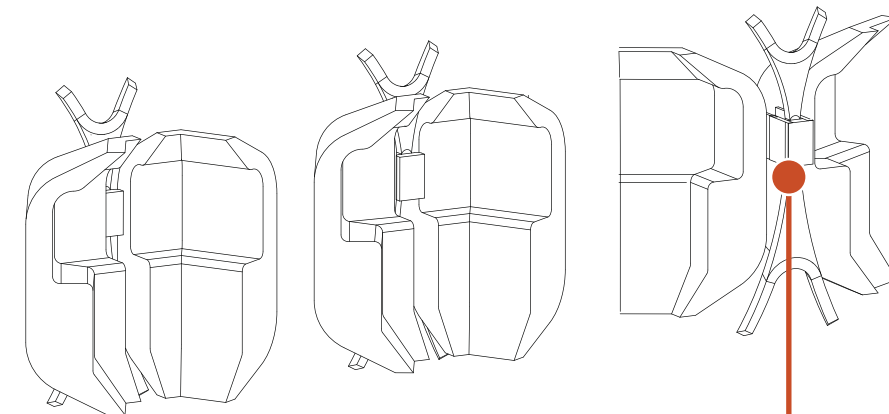
Display Hinge

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Piano Hinge

Hinge allows astronauts to rotate a whole set of toolkit doors 360 degrees to allow for efficient restocking of each toolkit.



Hybrid Track Hinge

Hinge allows each toolkit door to safely move out and pivot to open without hitting each other. This makes the toolkit open like a cabinet door.

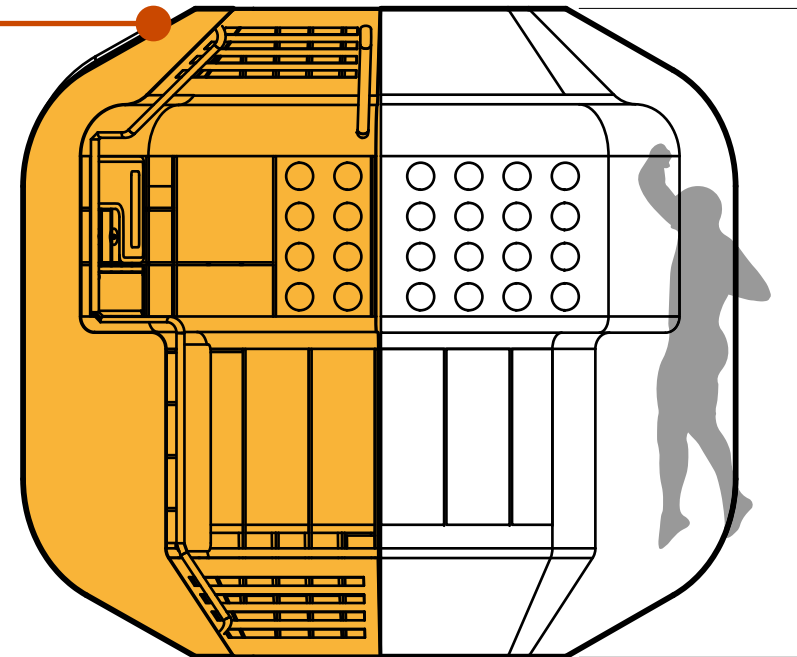




TOOLKIT: Updated Kitchen Design

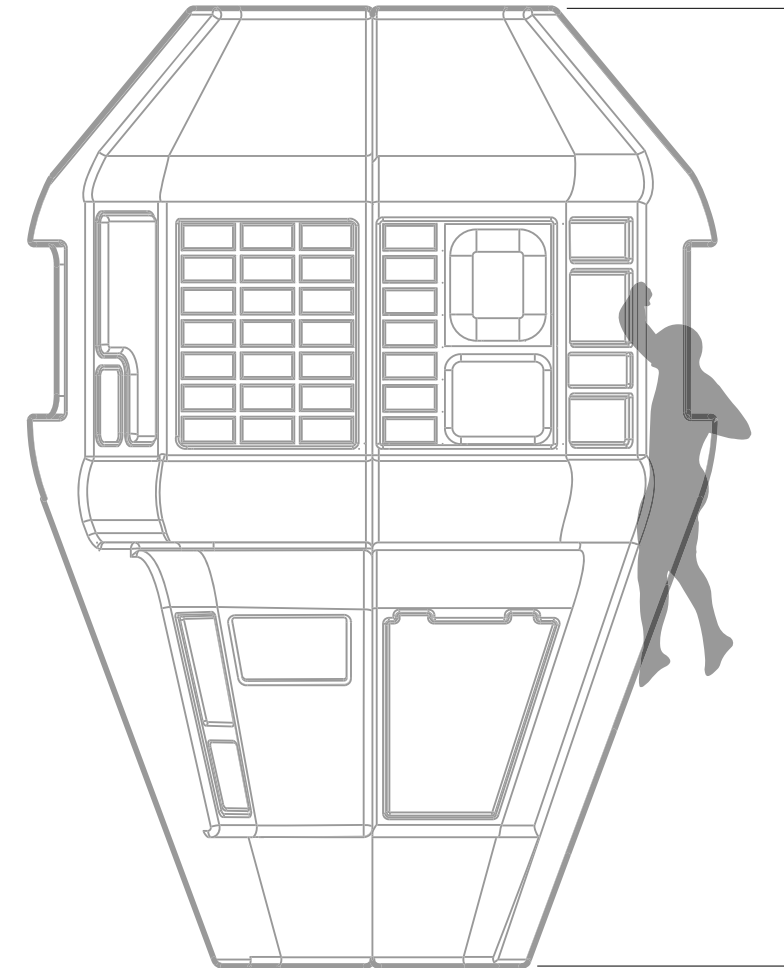
Fully detailed door (left)

The left side houses unique components, while the right side mainly houses food storage.



10'

MOTH 3.0



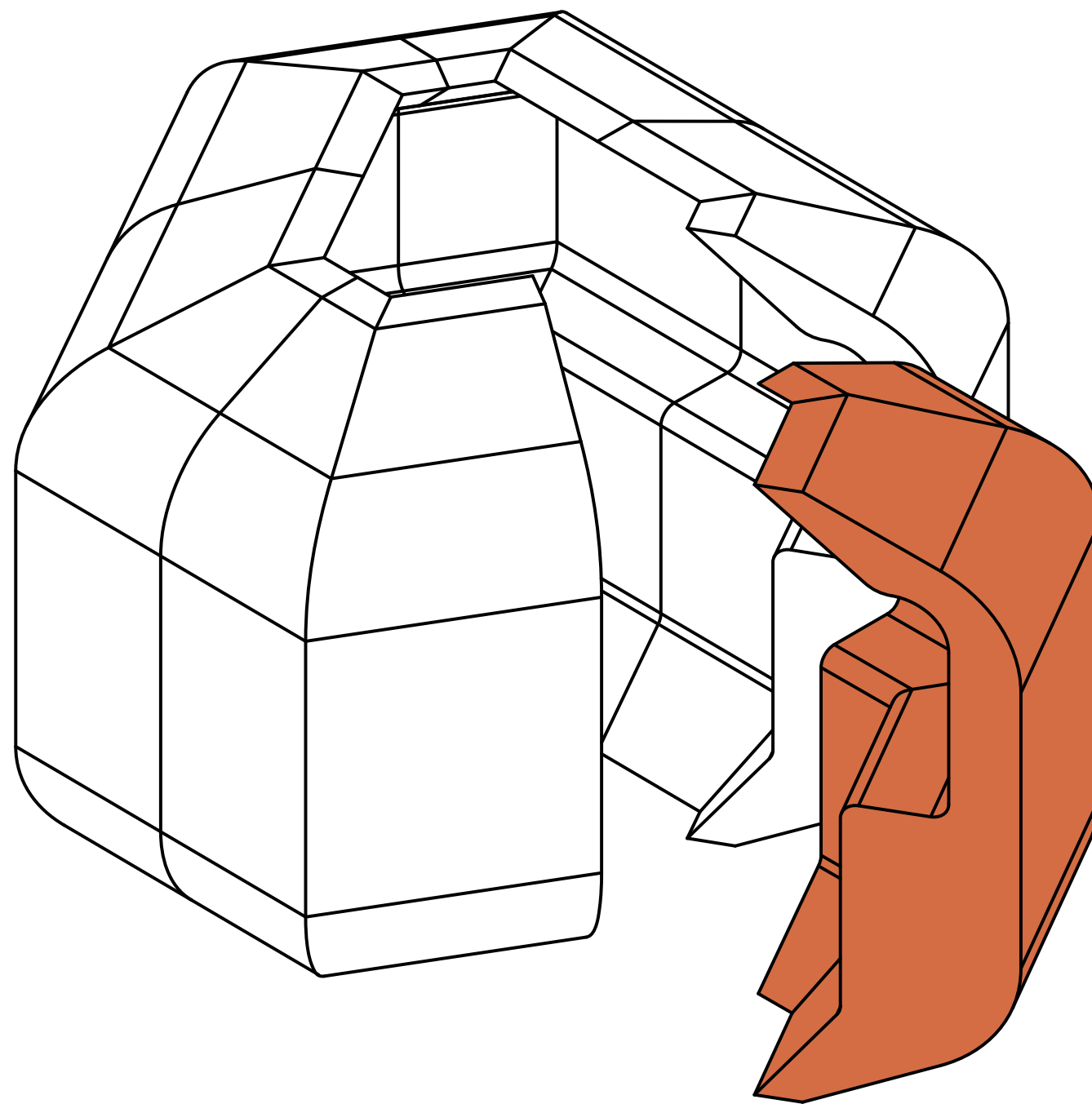
14.75'

MOTH 2.0



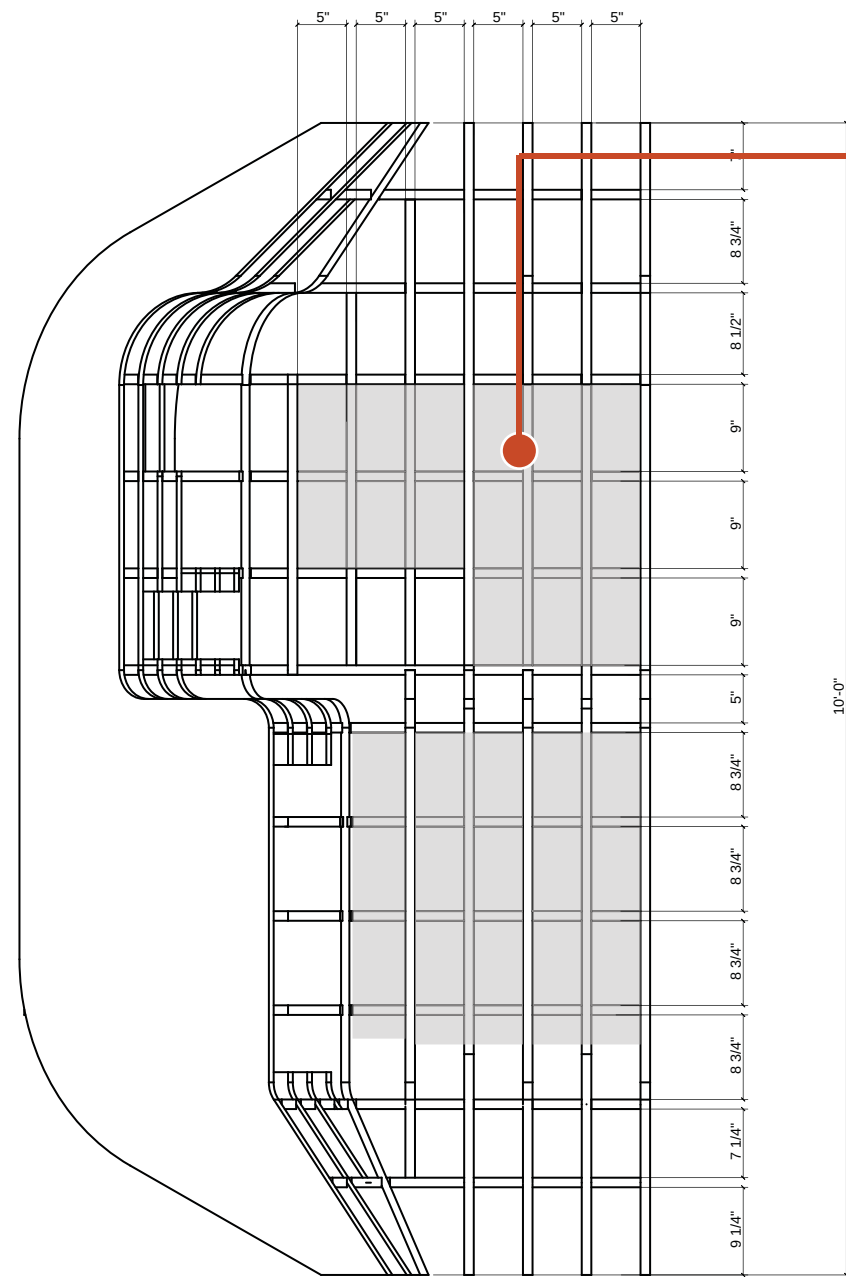


TOOLKIT: Buildout Component





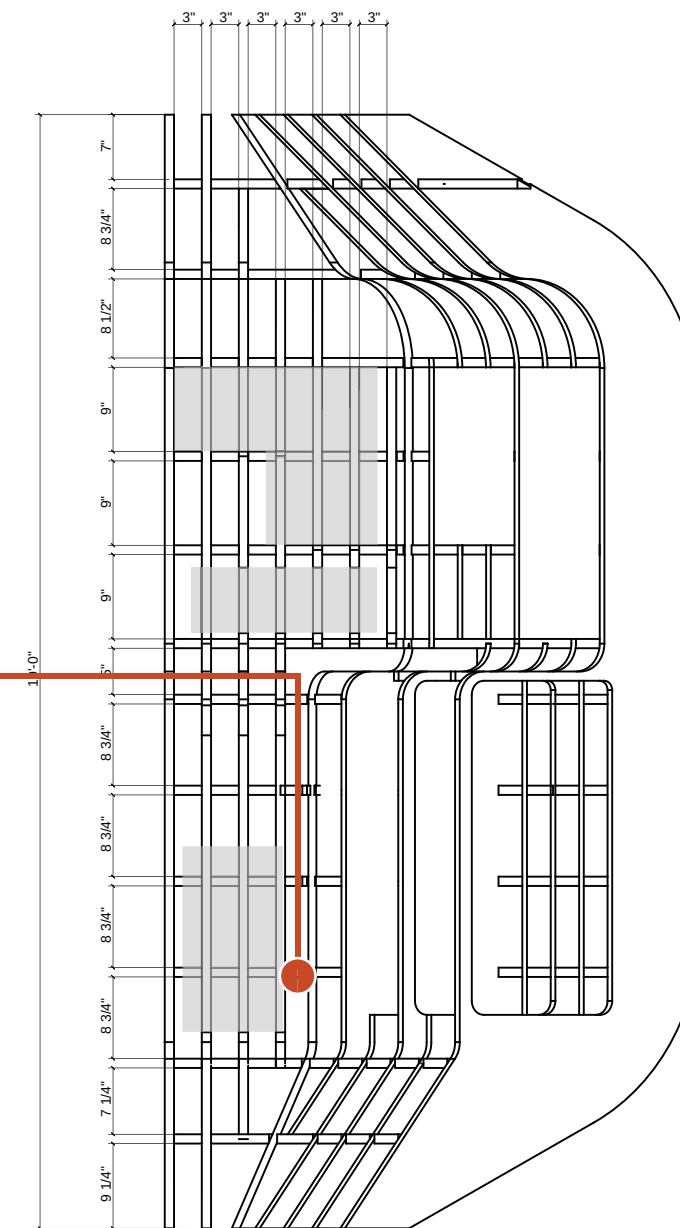
TOOLKIT: Rib System



Study Model

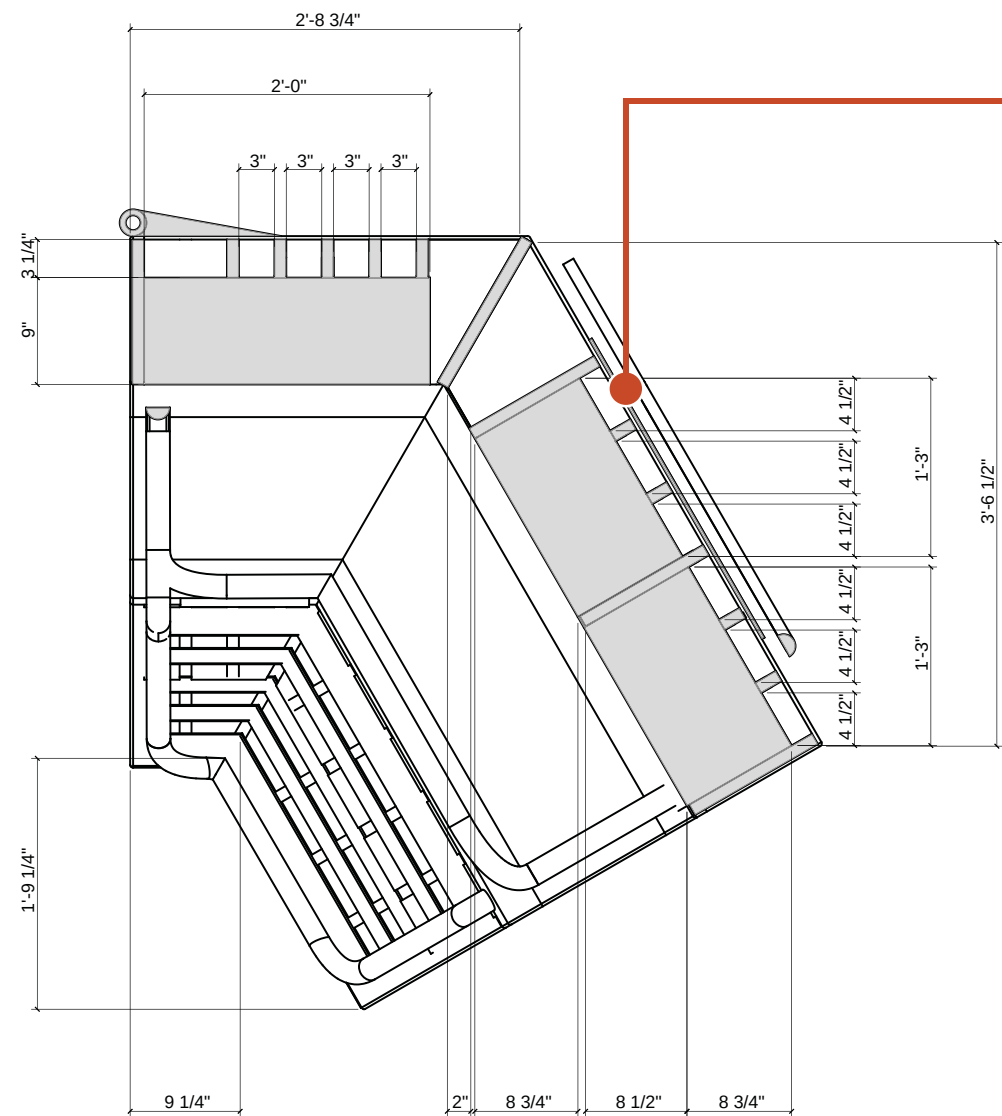


Study Model





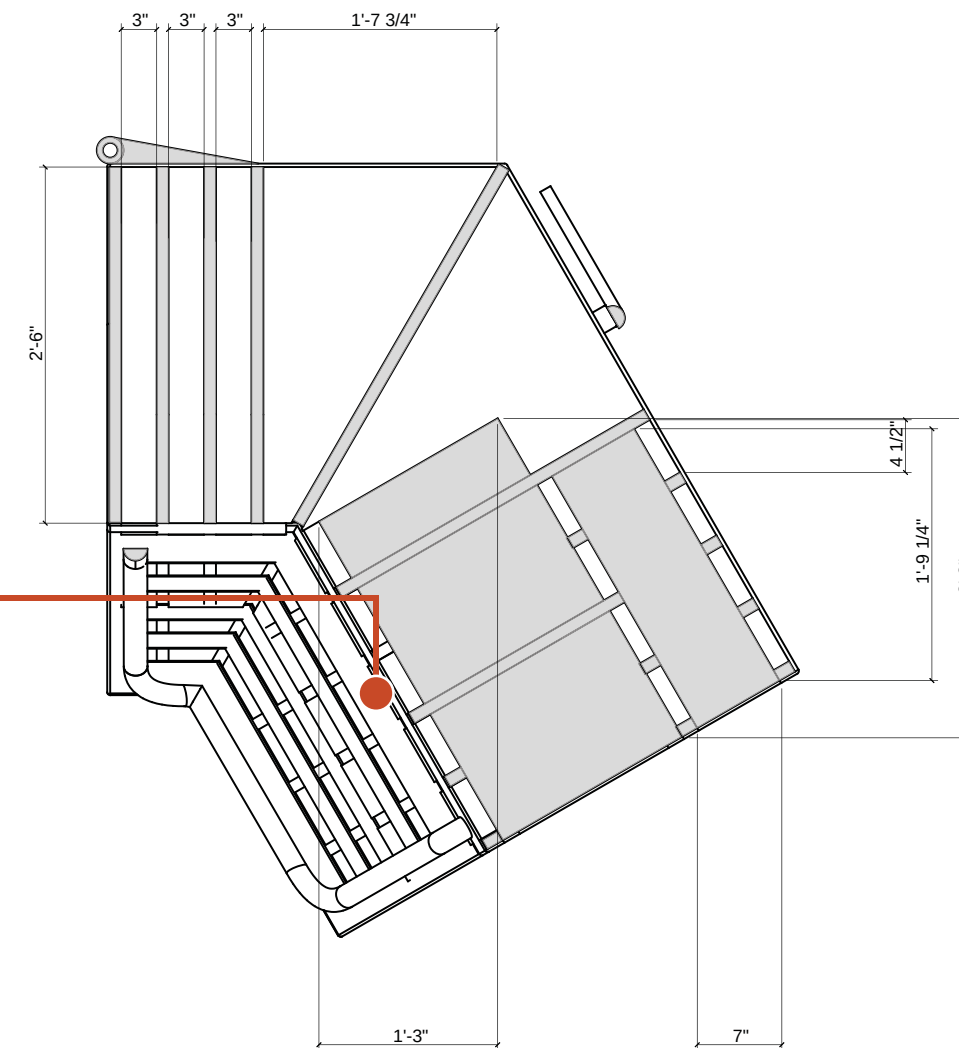
TOOLKIT: Rib System



Study Model

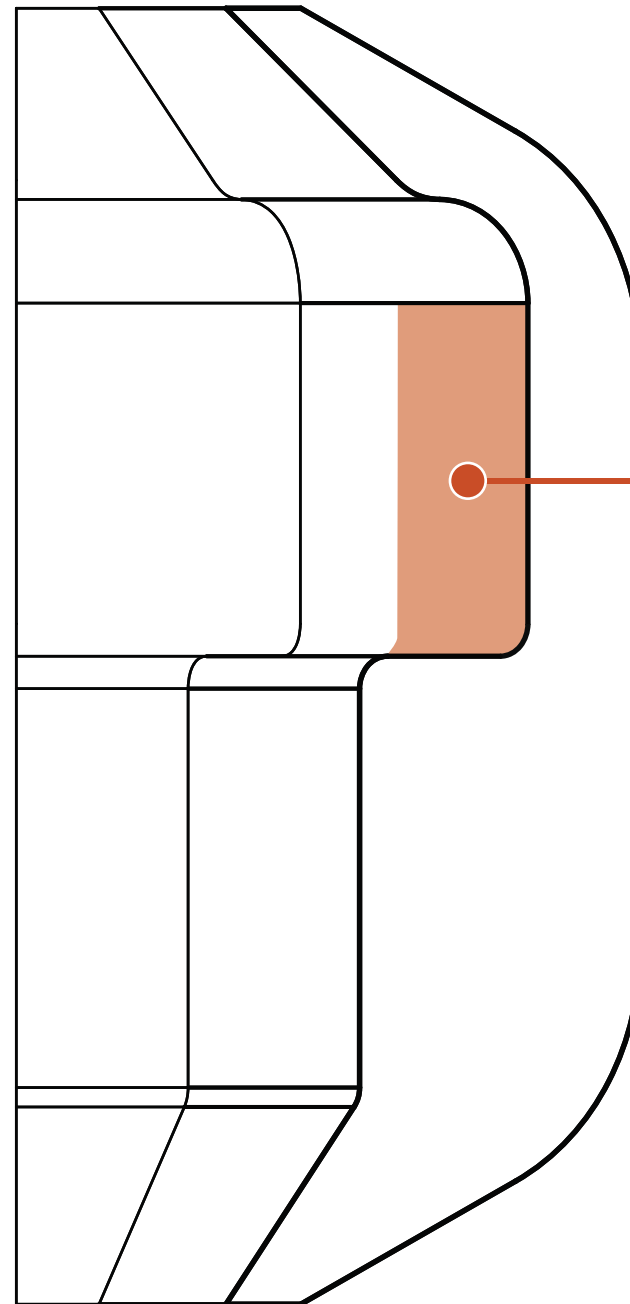


Study Model



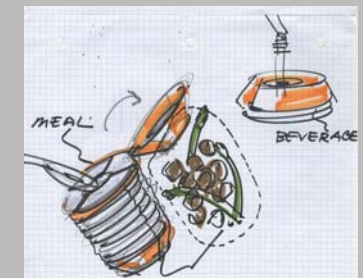


TOOLKIT: Kitchen Components



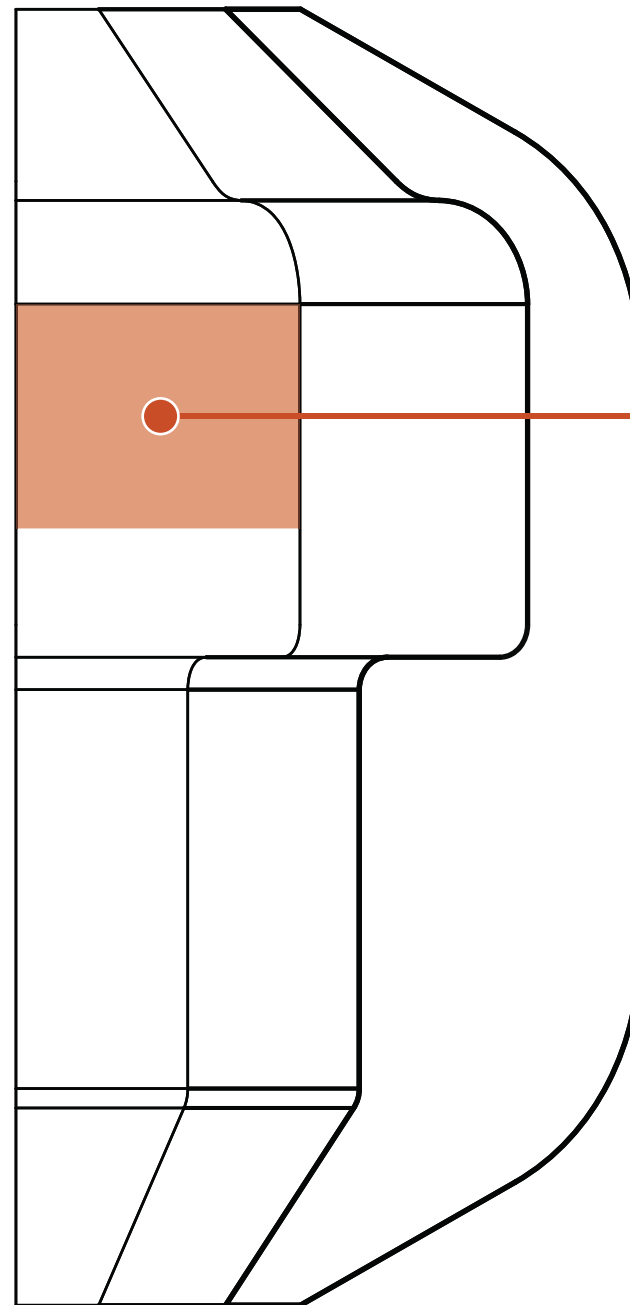
Food Storage

Food is stored in collapsible cylindrical units that slot into recesses into the wall of the toolkit. These capsules work in conjunction with the re-hydration and reheating stations to make an efficient and cohesive food prep process.



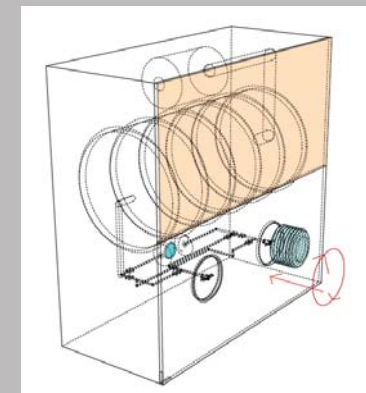


TOOLKIT: Kitchen Components



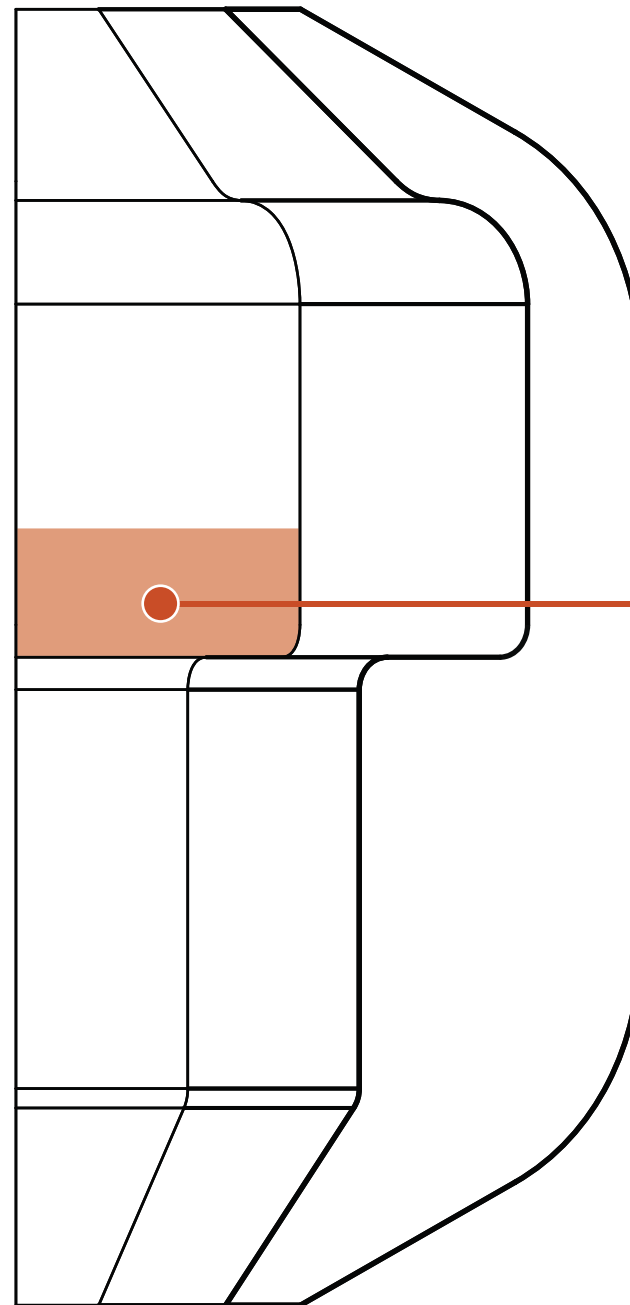
Rehydration Station

Astronauts insert and rehydrate their meals through this apparatus by setting desired amount and temperature. The food capsule system inserts and locks into the system for maximum efficiency.



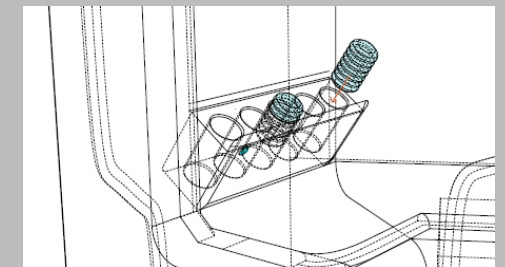


TOOLKIT: Kitchen Components



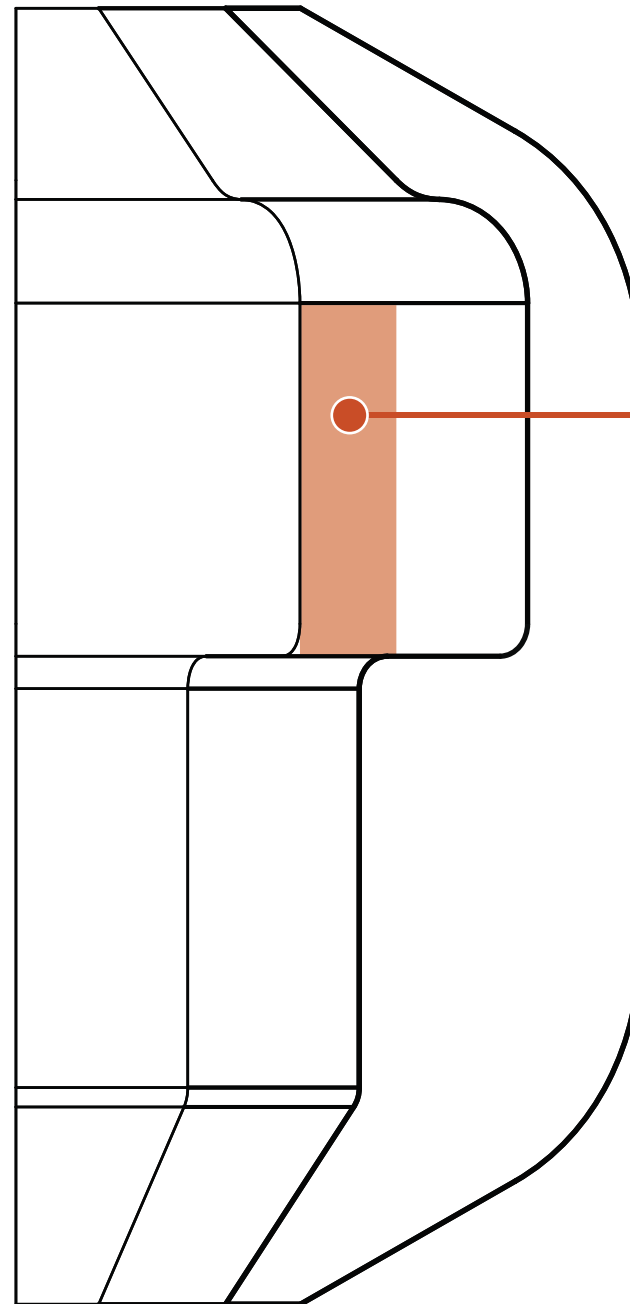
Reheating Station

Astronauts pivot the drawer out and insert capsules to heat their meals through this apparatus by setting desired temperature. The food capsule system inserts and locks into the system for maximum efficiency.





TOOLKIT: Kitchen Components



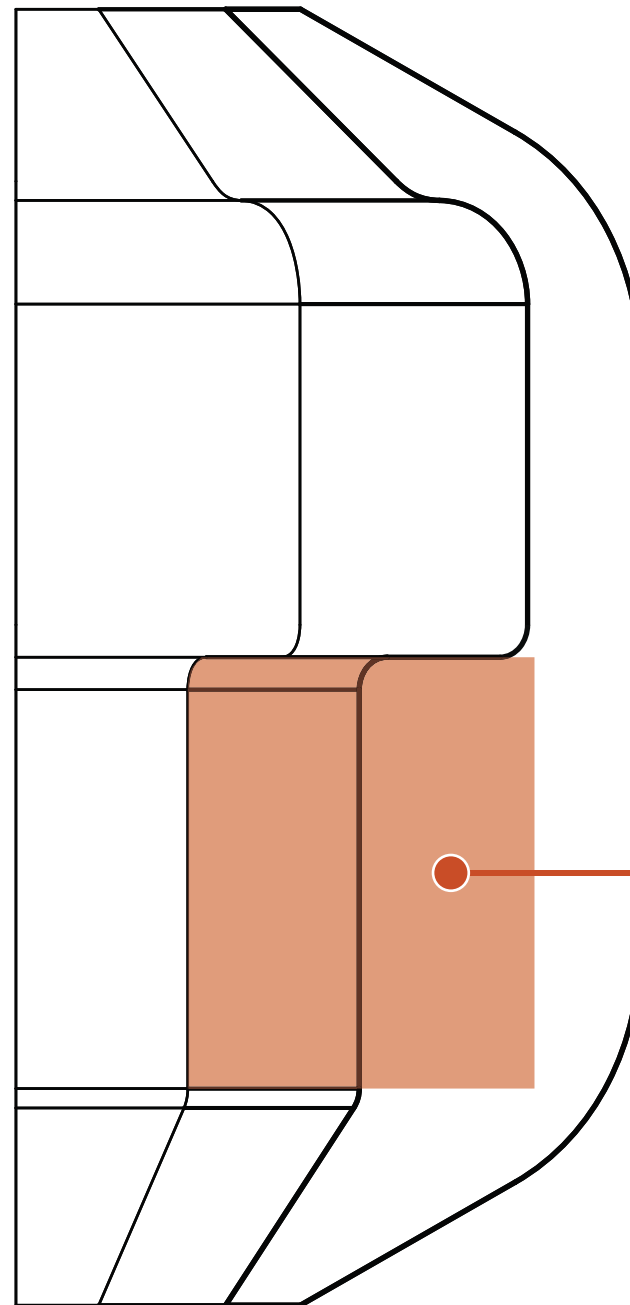
3D Food Printer

The 3D food printer allows the astronauts to have a variety of textures, flavors, and kinds of food throughout their journey. This also allows a compact method of storage for the filament needed to make food.





TOOLKIT: Kitchen Components



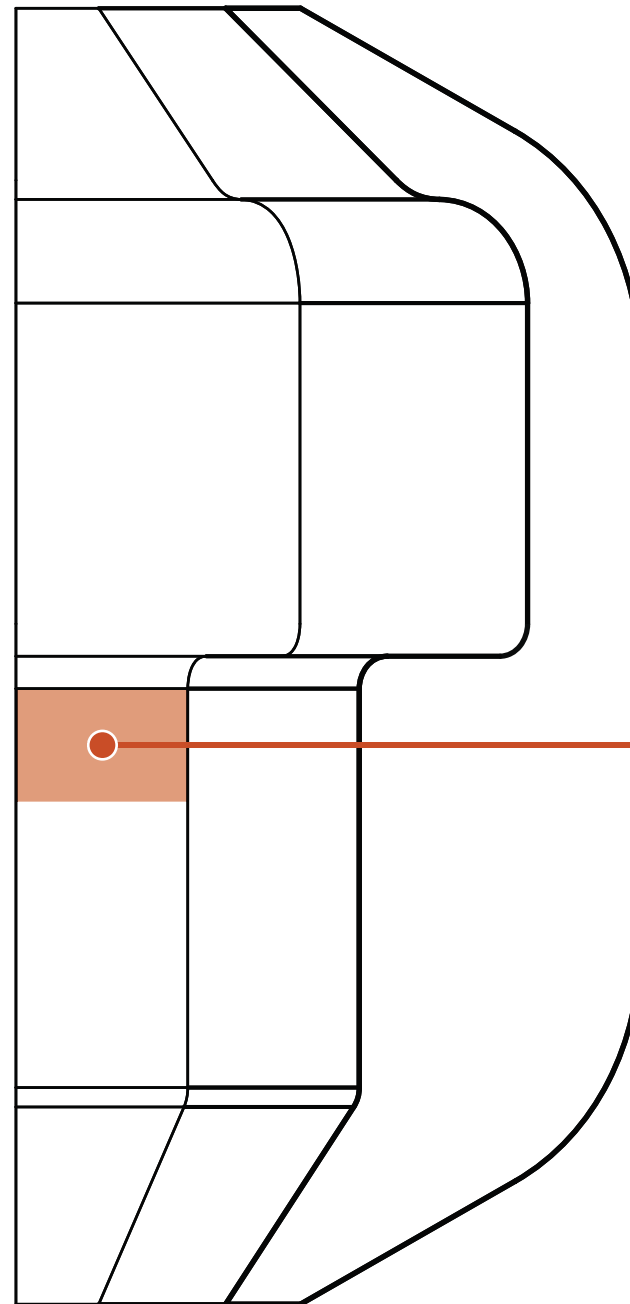
Hydroponic Garden

To give the Astronauts a diversity of textures we developed a hydroponic system that grows radishes and argula which have a 40 day growing periods and have crunchy textures. It contains removable containers for easy access.





TOOLKIT: Kitchen Components



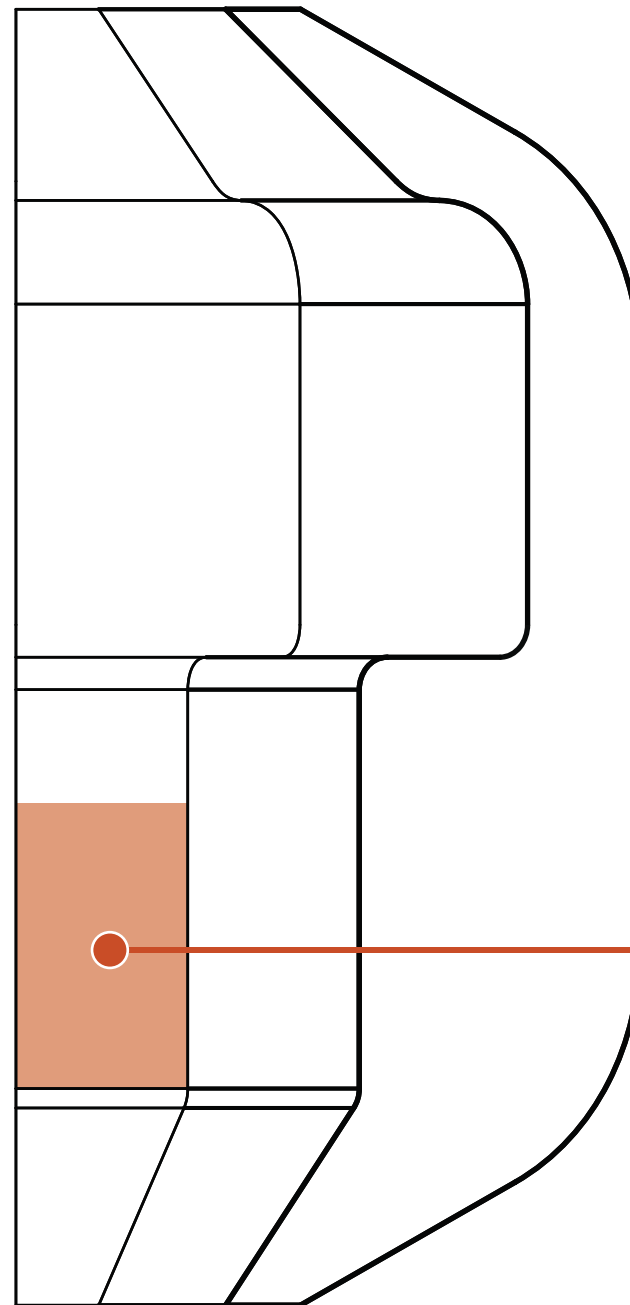
Sanitizer

Unit is used to sterilize food utensils and other tools that need to be made safe for use by the astronauts.



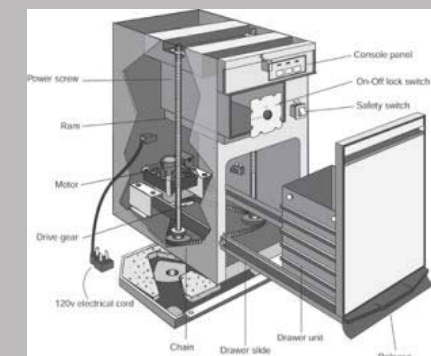


TOOLKIT: Kitchen Components



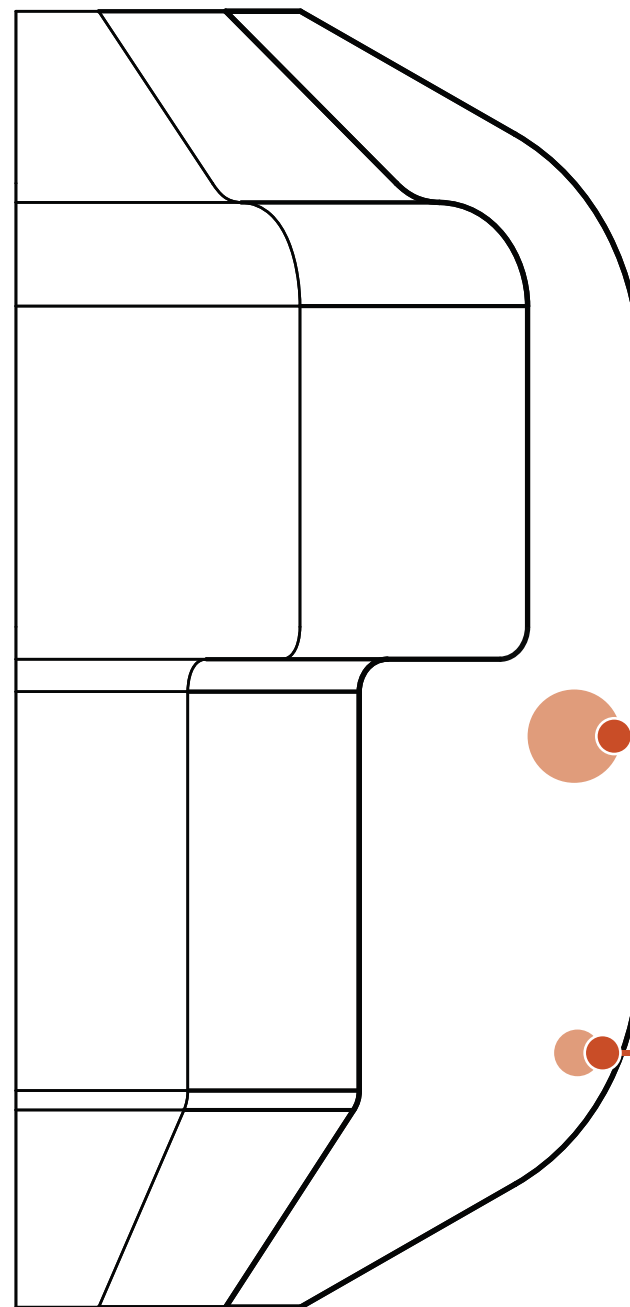
Trash Compactor

This unit compacts the various waste created by the crew into small square cubes that fit into the outer wall storage system.



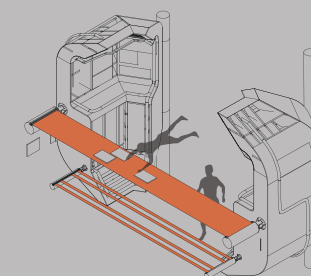


TOOLKIT: Kitchen Components



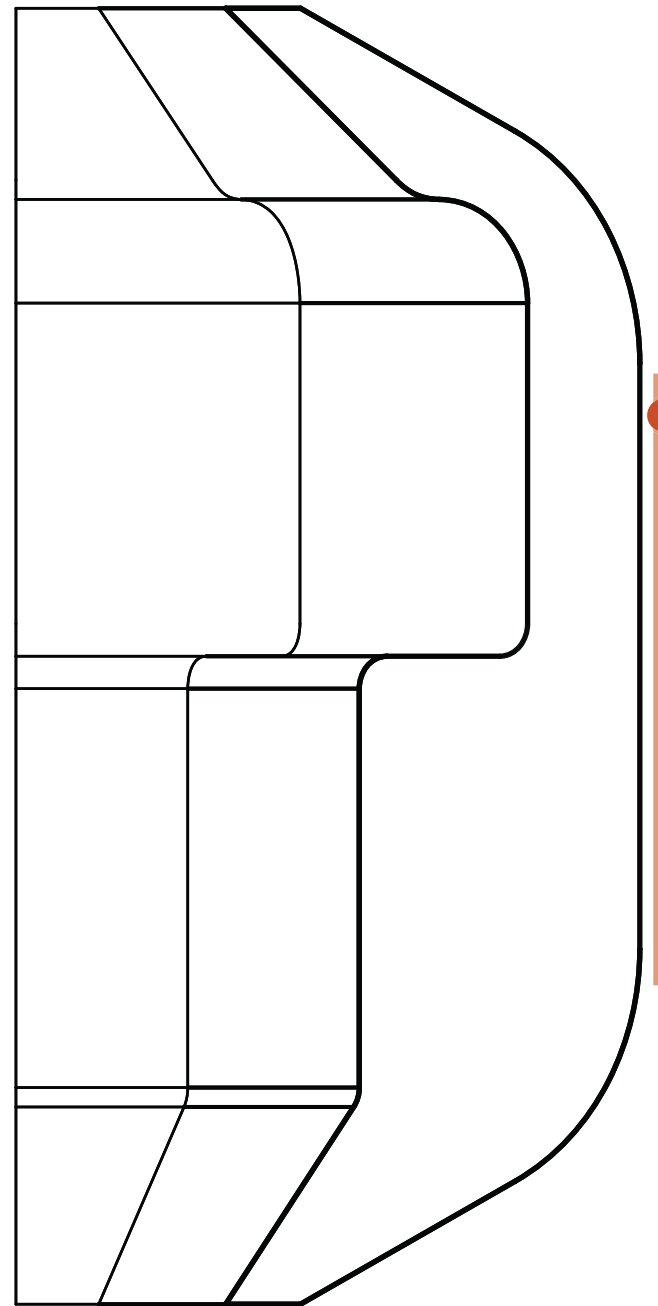
Retractable Table

The table retracts and stores securely inside of the toolkit door to allow the toolkit as a whole to close and provide a radiation shelter. The lower unit provides a place to secure their feet while eating.





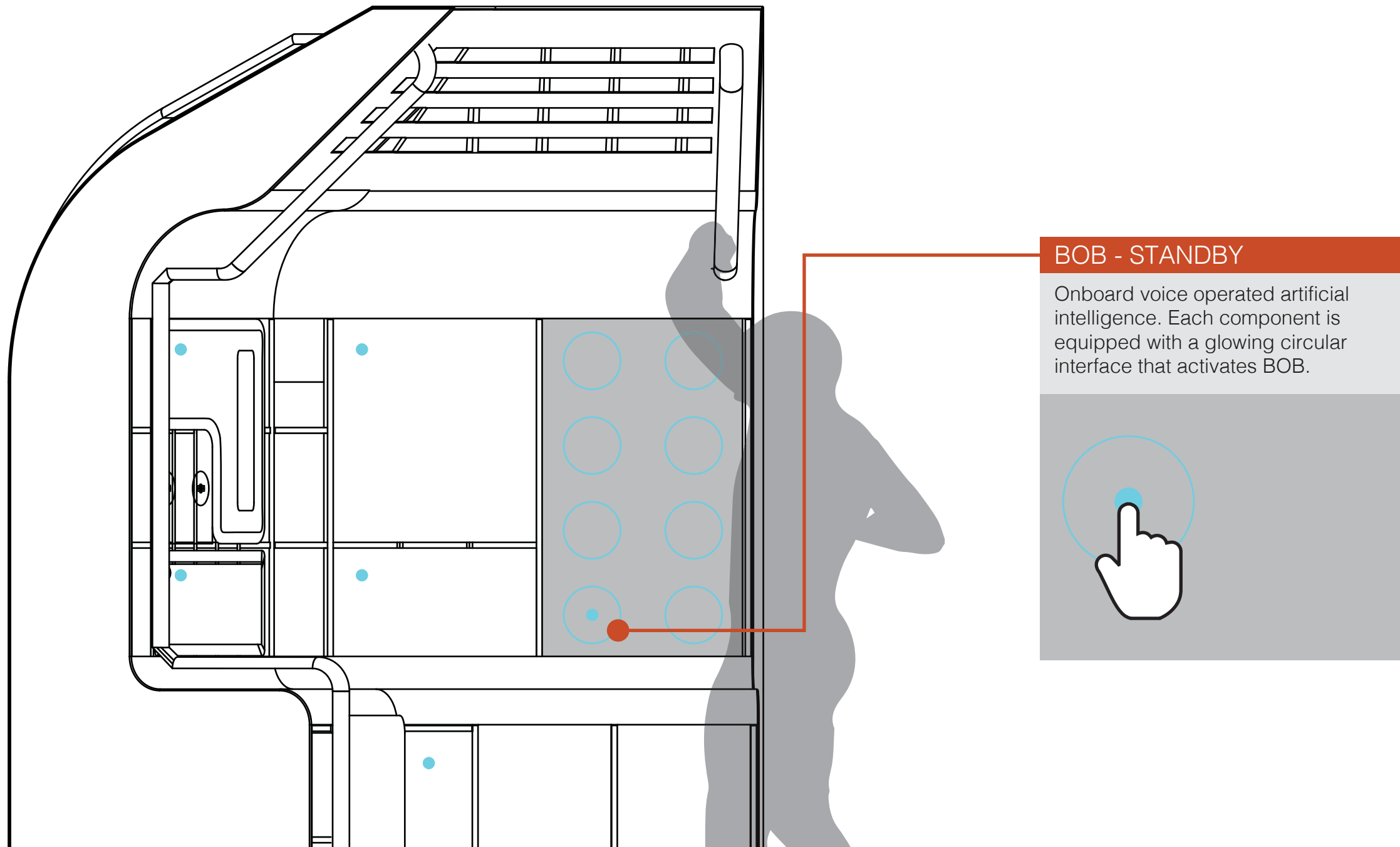
TOOLKIT: Kitchen Components

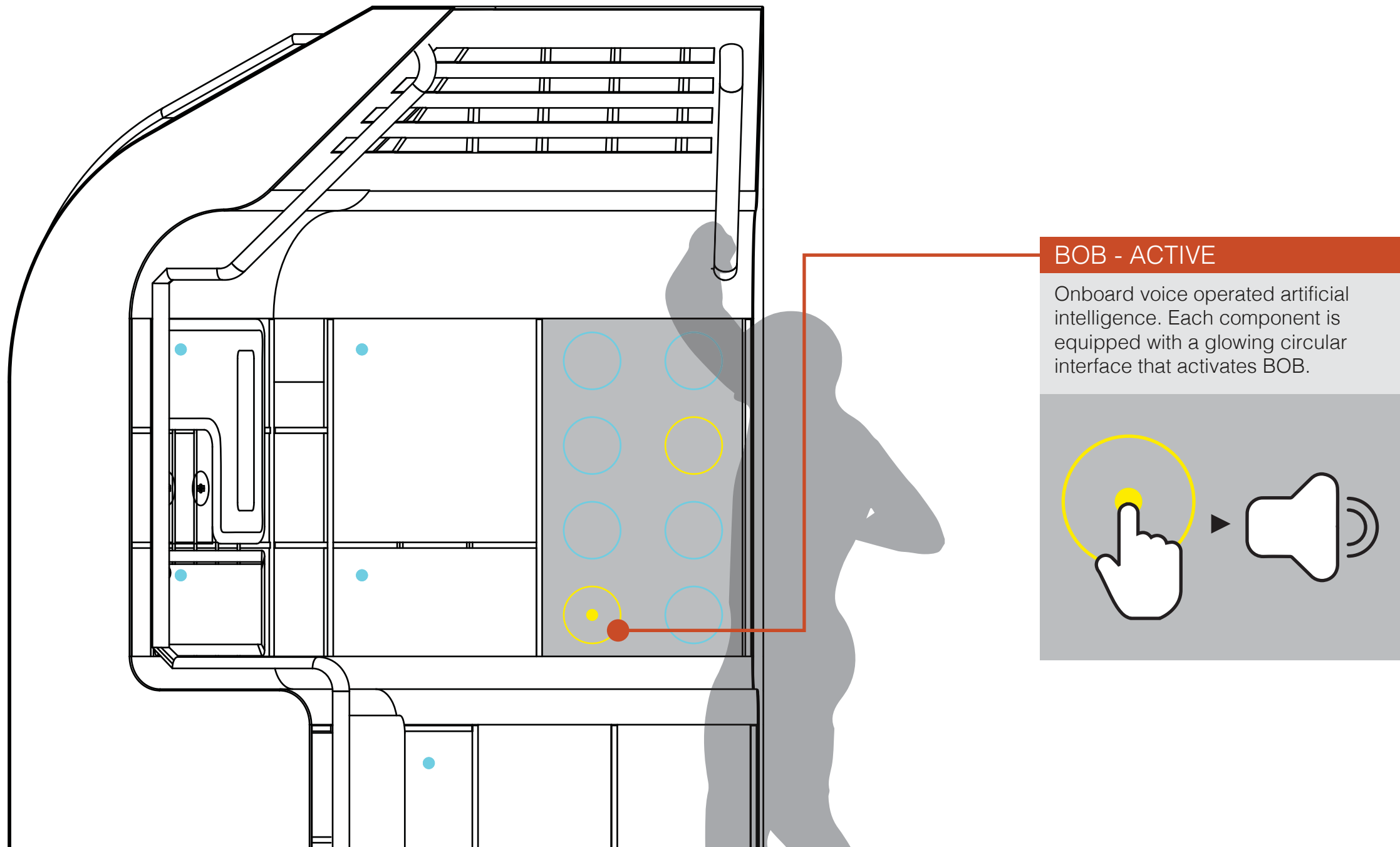


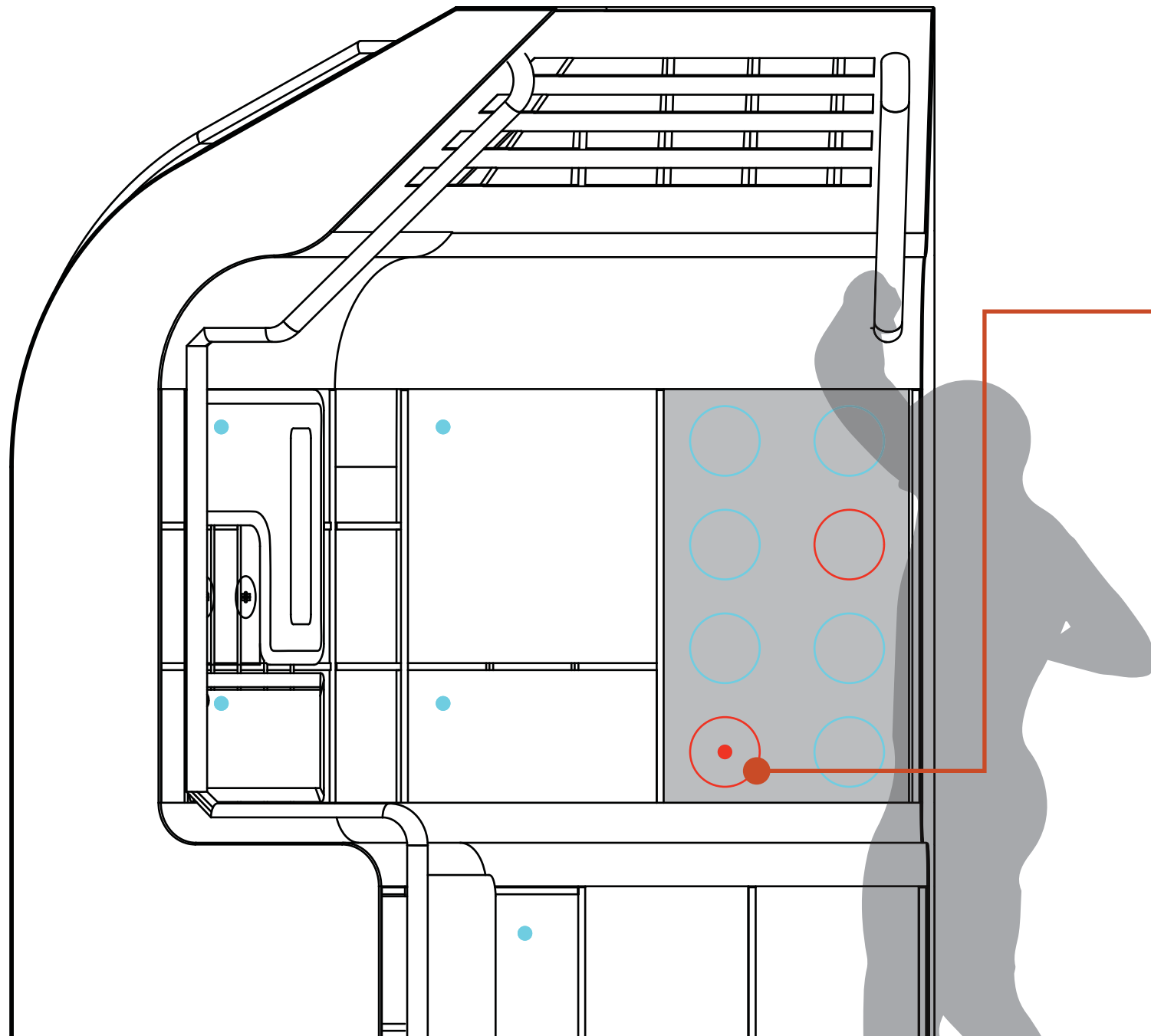
Rail System

The railings encircling the toolkit provide task lighting so they can prepare food with full illumination of their work area while providing an anchor for mobility throughout the toolkit.



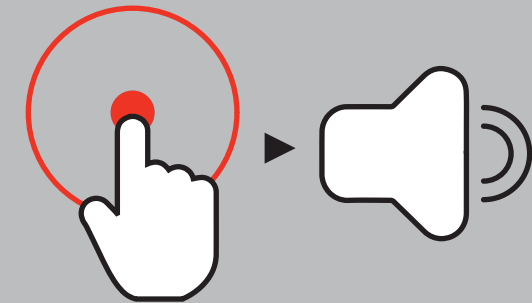






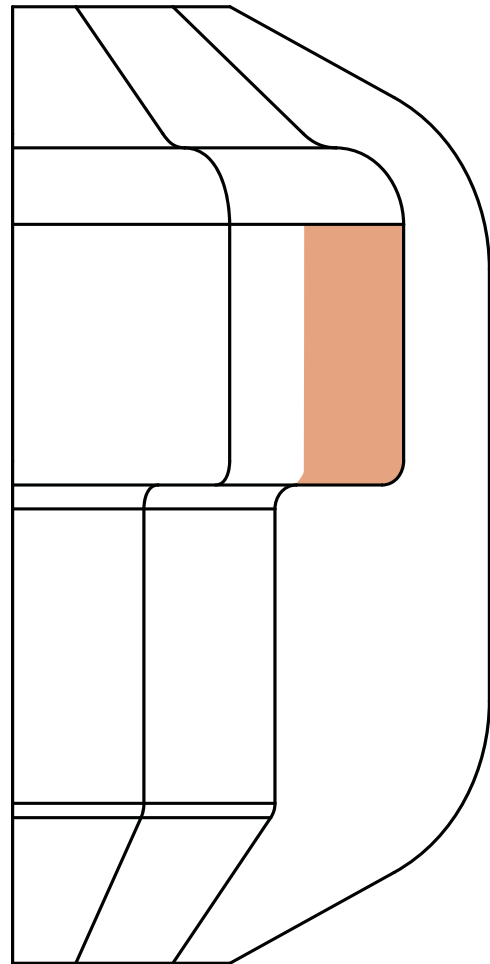
BOB - WARNING

Onboard voice operated artificial intelligence. Each component is equipped with a glowing circular interface that activates BOB.



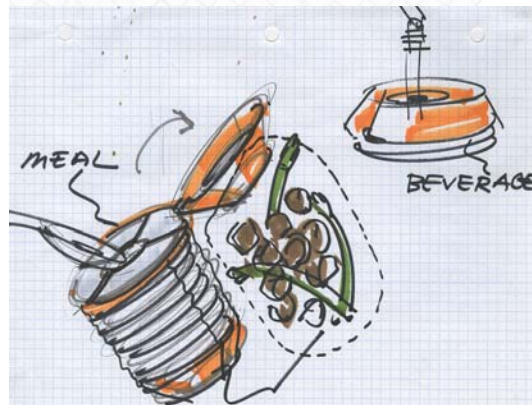
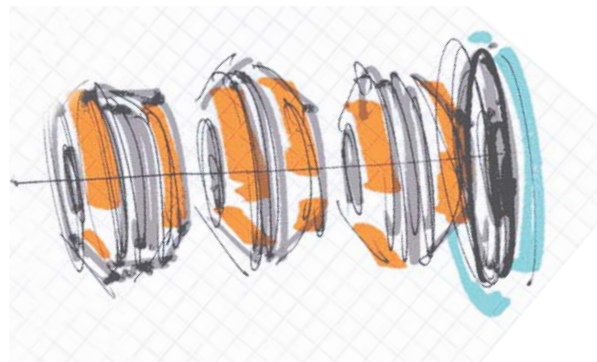


TOOLKIT: Food Storage

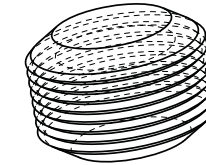


Sky Lab Precedent

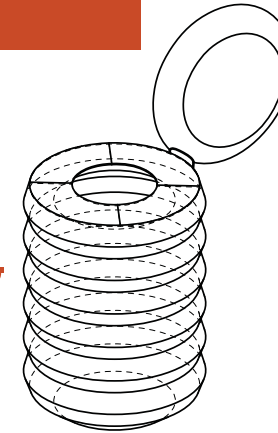
Beverage Container previously used in the 1970s Skylab Station



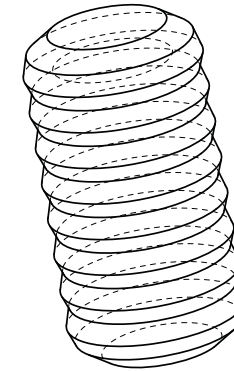
Collapsed State



Food Capsule

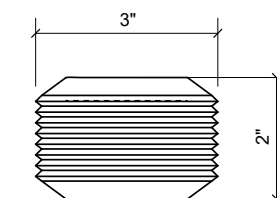
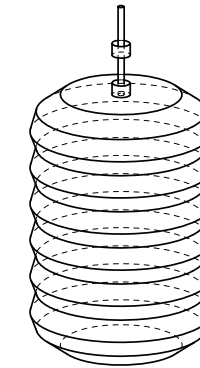


Expanded State

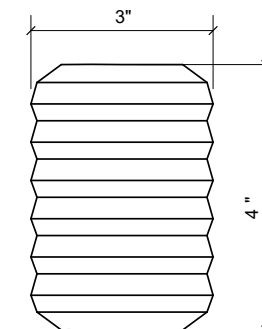


Beverage Capsule

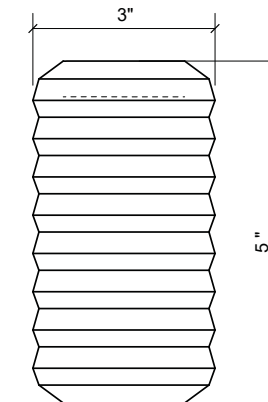
With needle slot for Rehydration station and inertable straw.



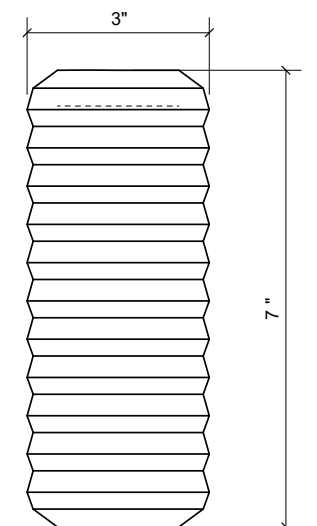
● Collapsed



● Small



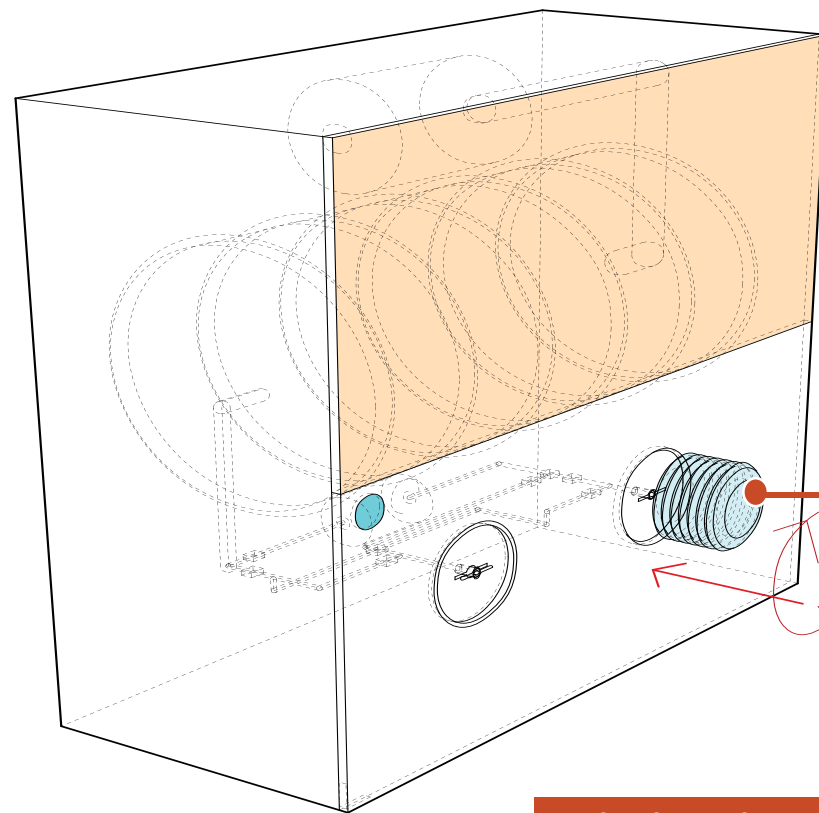
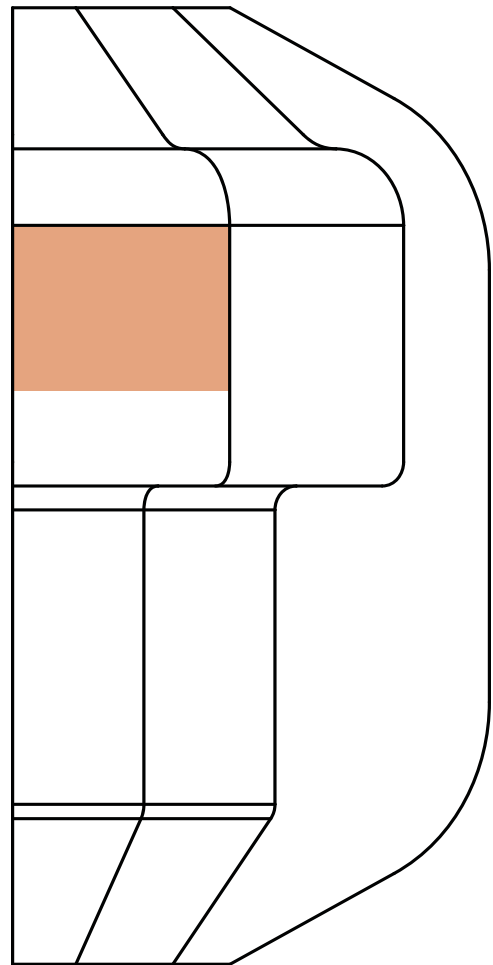
● Medium



● Large

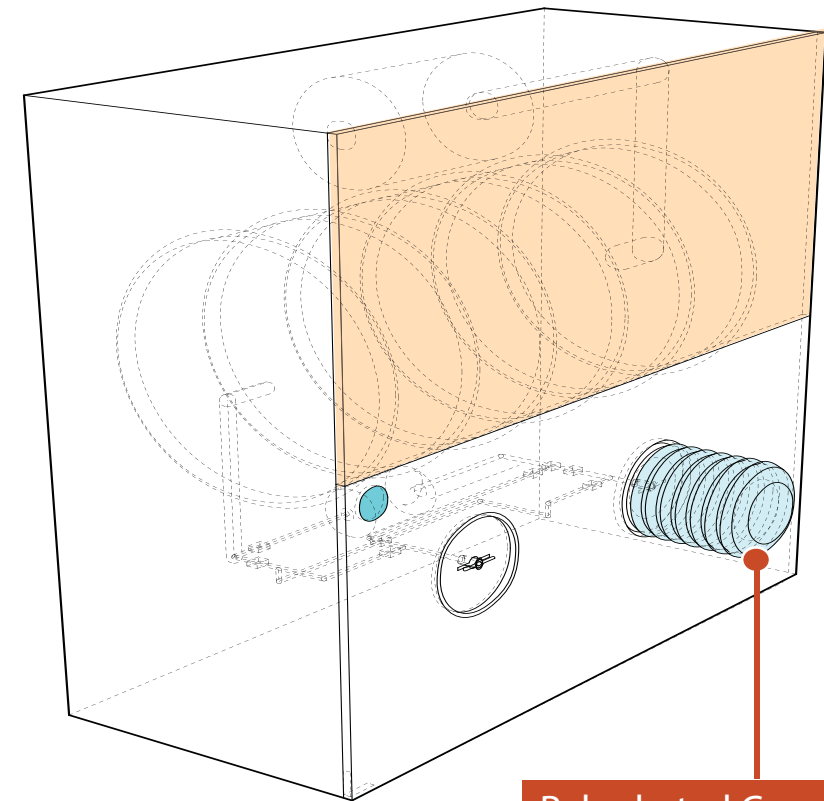


TOOLKIT: Rehydration Station



Dehydrated Capsule

Push and twist motion to lock in capsule

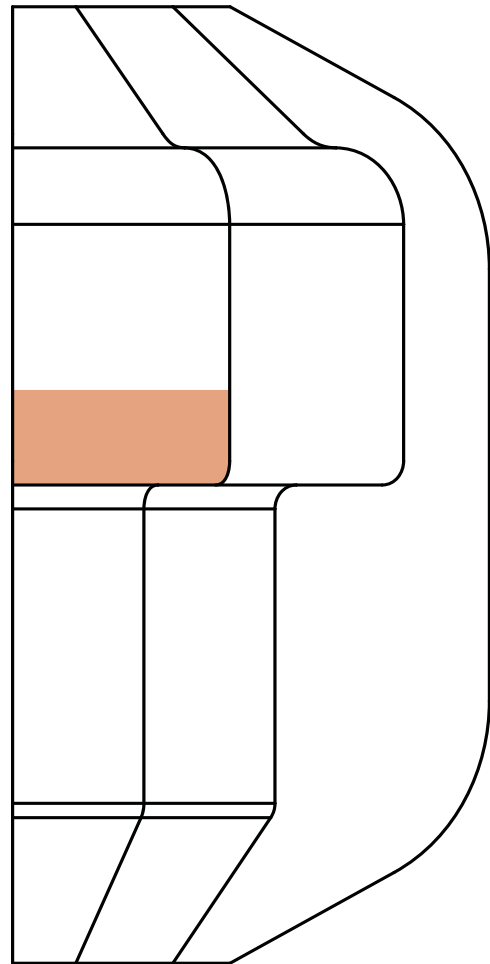


Rehydrated Capsule

Once locked in, station is initiated to dispense water and capsule expands



TOOLKIT: Reheating Station



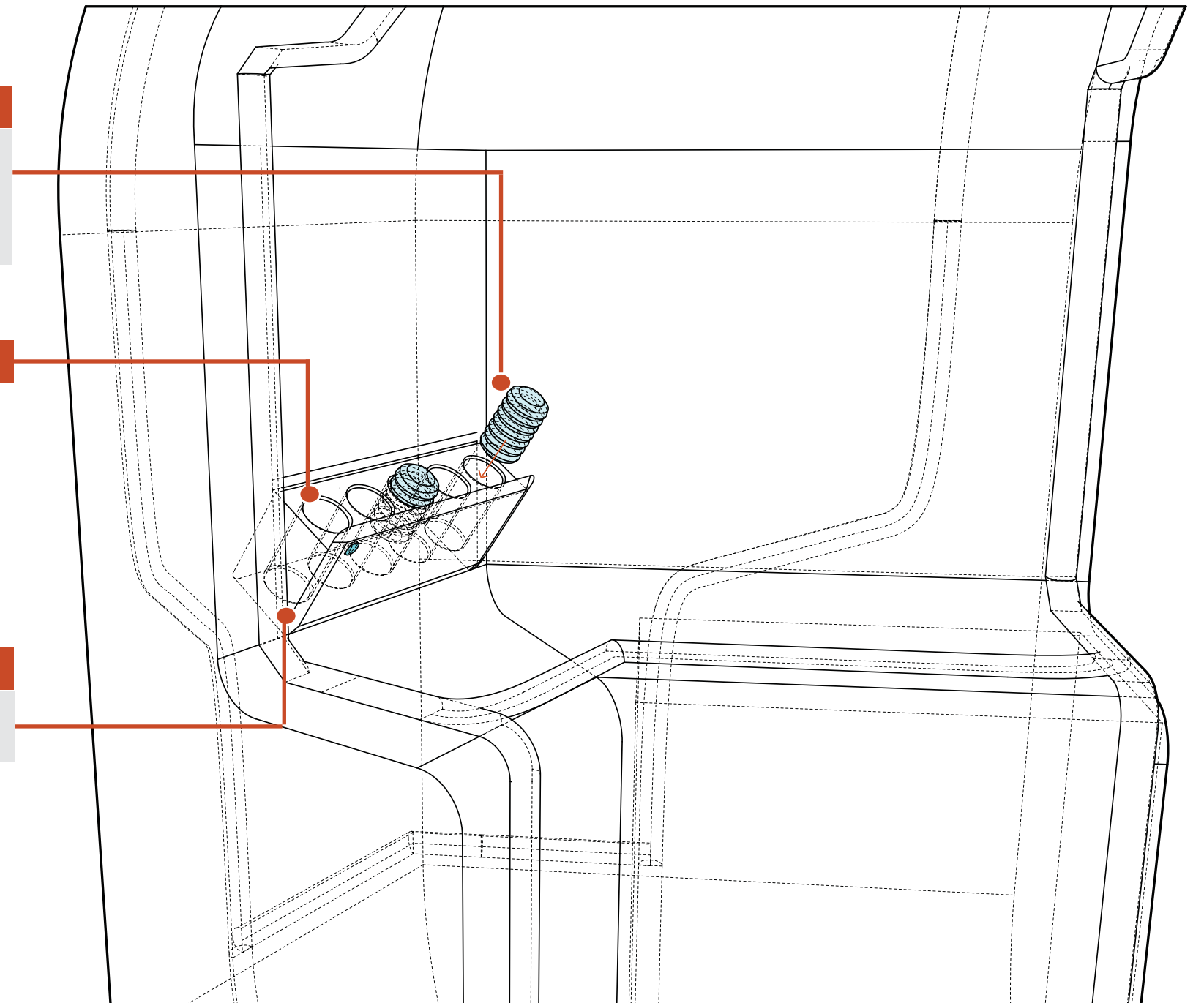
Food Capsule

Slides into heat surfaced sleeve. Stays in place by expandable lip on top that releases capsule when finished being reheated.

Expansion Seal

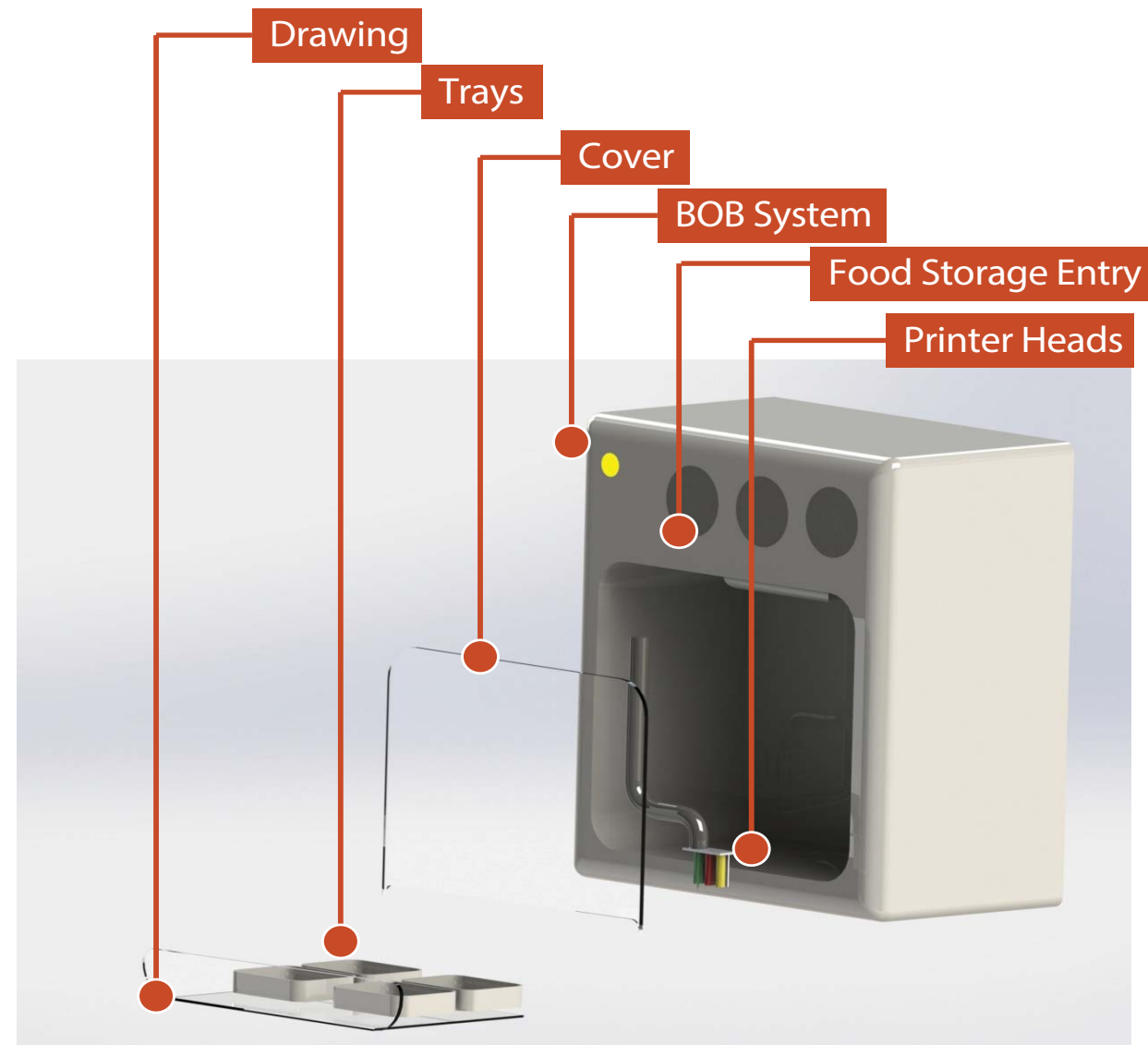
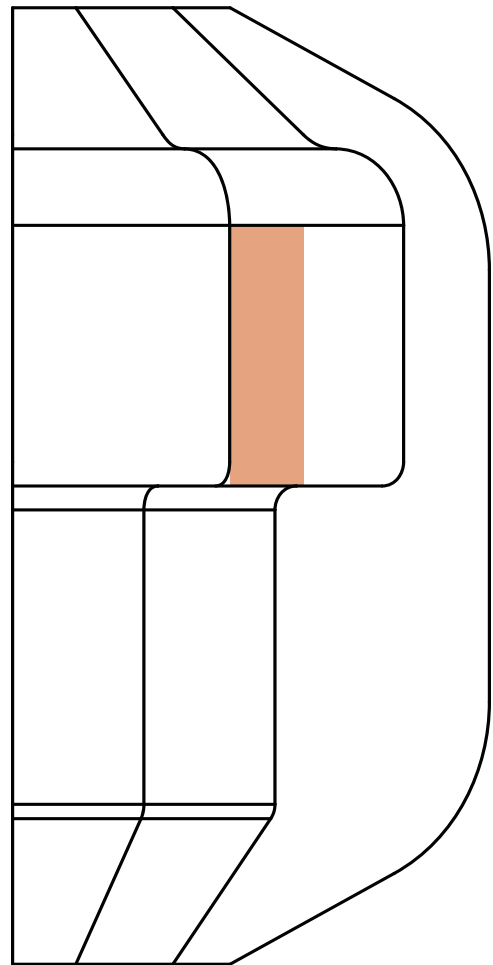
Angled Access

Allows for ease of use.



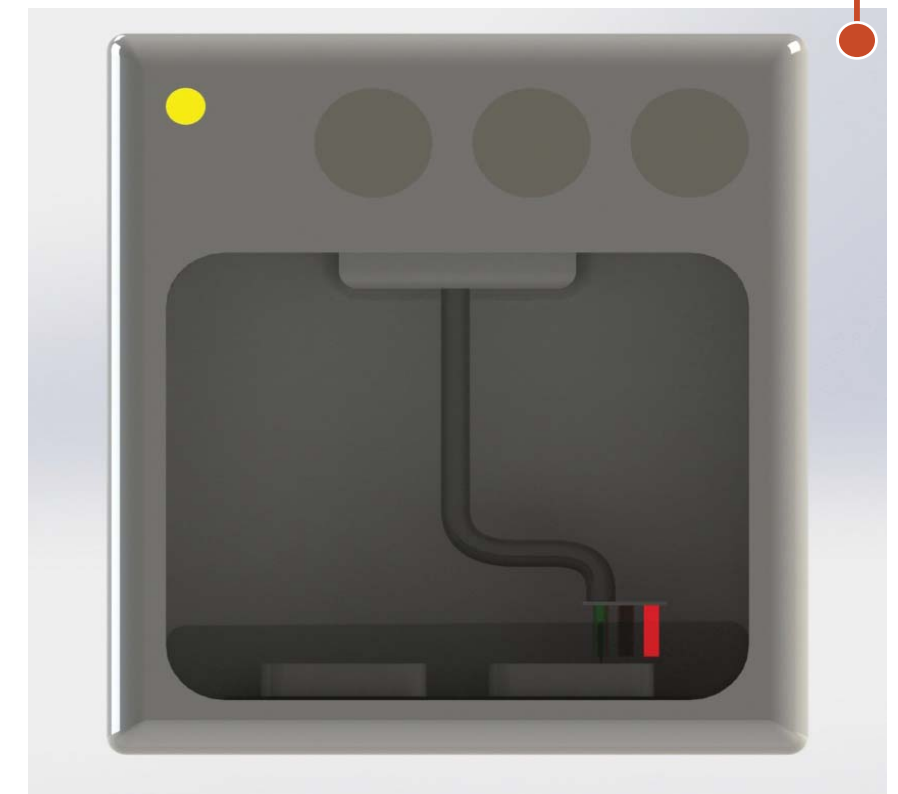


TOOLKIT: 3D Food Printer



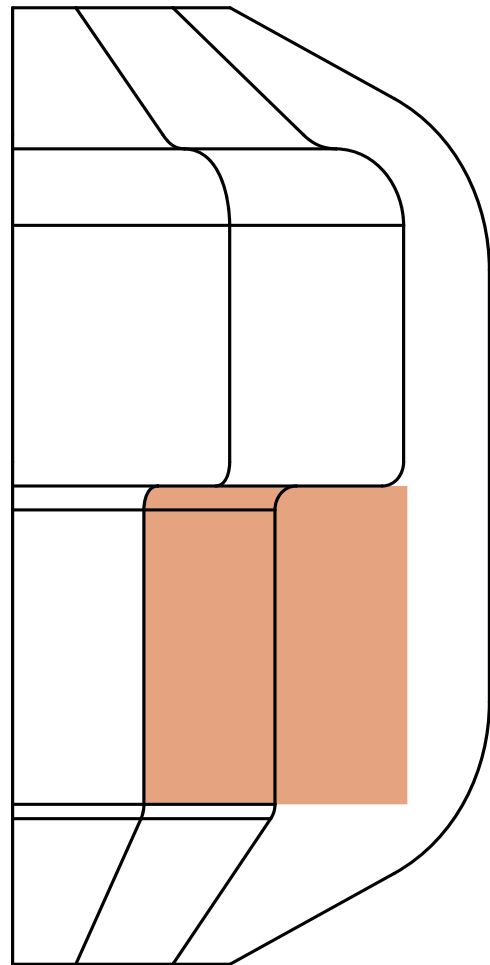
Texture

The 3D food printer can help astronauts have interesting and diverse meals. It can use food cartridges to create different textures and shapes of food.





TOOLKIT: Plant Growth



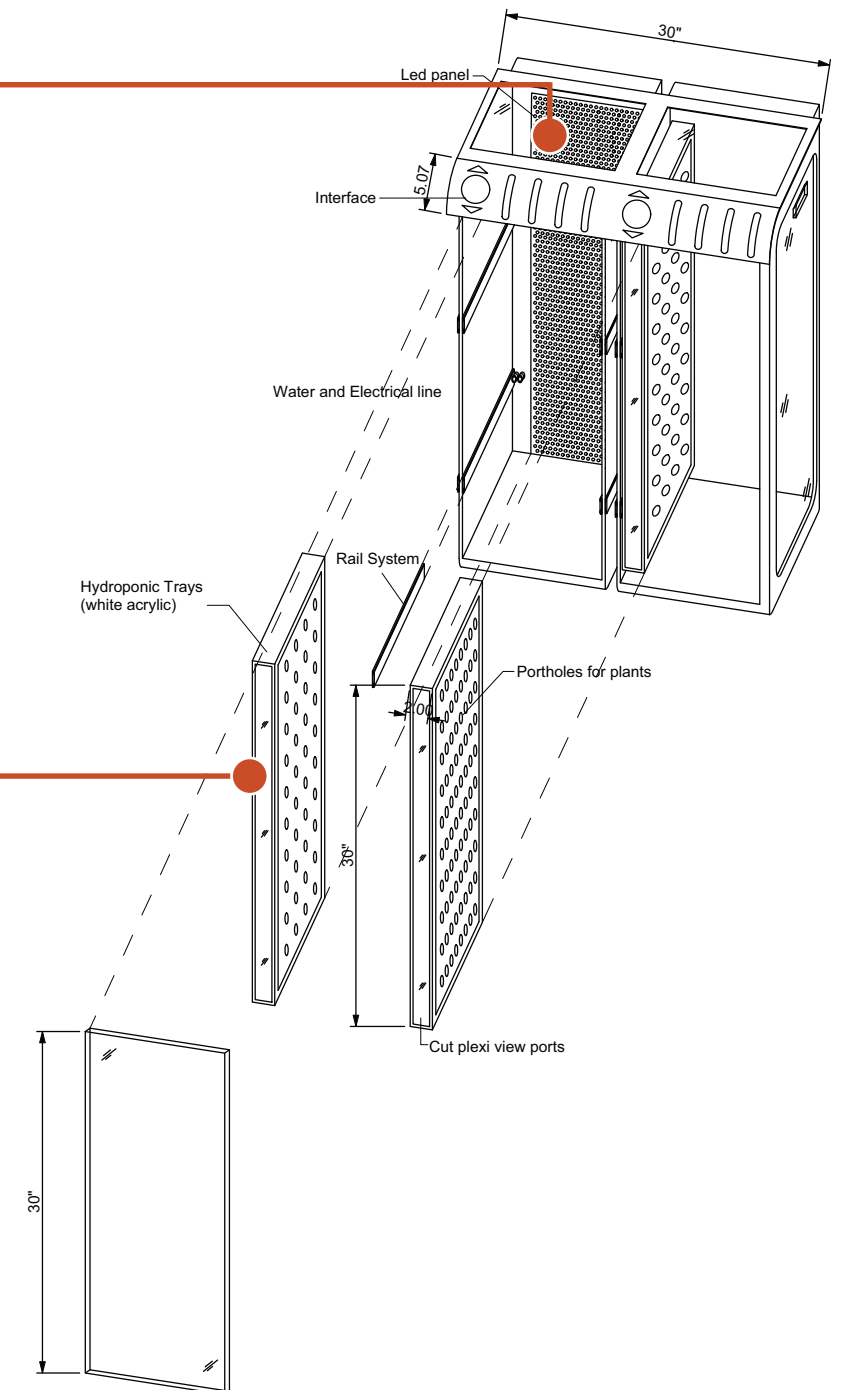
Ind. Humidity controlled Gardens

Each unit has a controlled humidity and an optimum level of lighting that serves to simulate the ideal growing cycle for the plants. RGB LEDs simulate sunlight to help the planter grow.



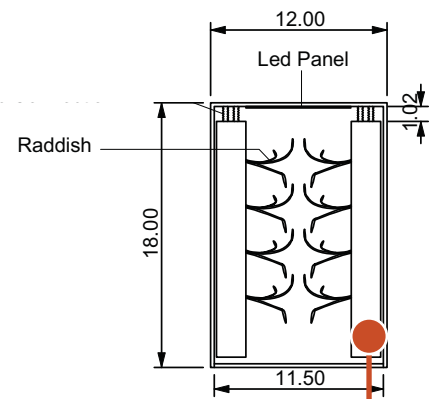
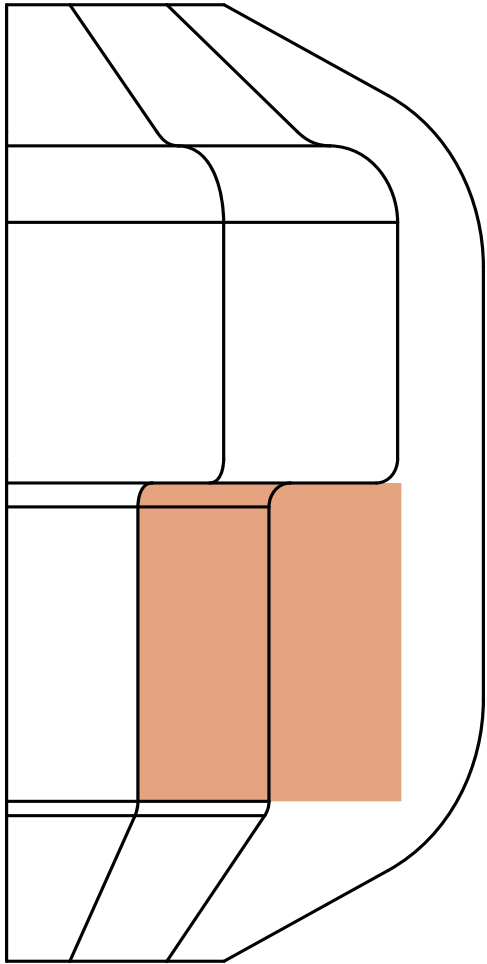
Removable Hydroponic trays

The hydroponic tray can be removed for easy access to the plants for harvesting and planting. The tray have a clear plexi side panel so that the astronauts can monitor the root growth of the plants without having to interrupt the plant's controlled environment.

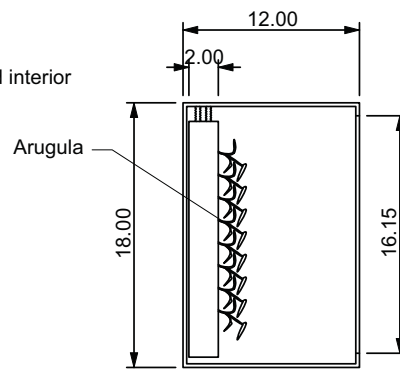
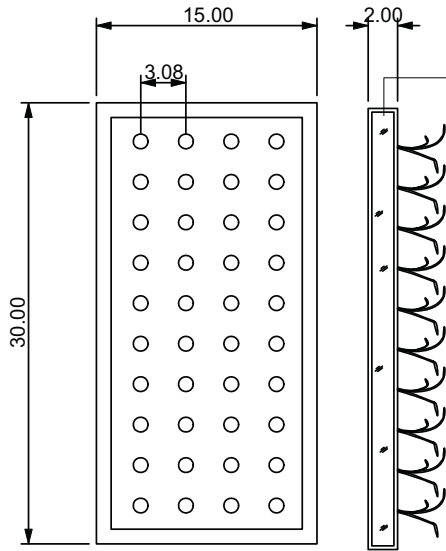




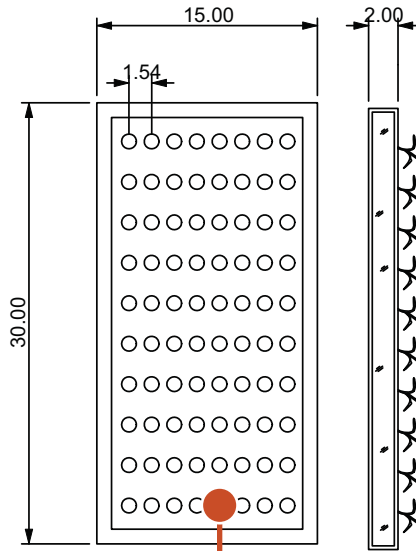
TOOLKIT: Plant Growth



Radish Planter



Arugula Planter



Rockwool Lined Interior

Rockwool material allows water to be absorbed without water escaping and floating around. Water is injected through small tubes on the edges of the tray that thoroughly soak the rockwool lining.



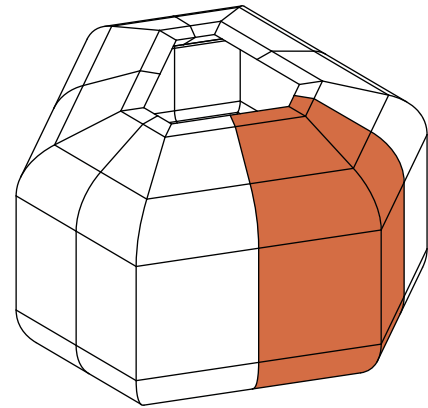
Water Injection System

Water is injected directly into the rockwool to ensure that water does not escape and float around the garden unit and larger hab. This process is controlled by BOB autonomously but can be done manually if needed.

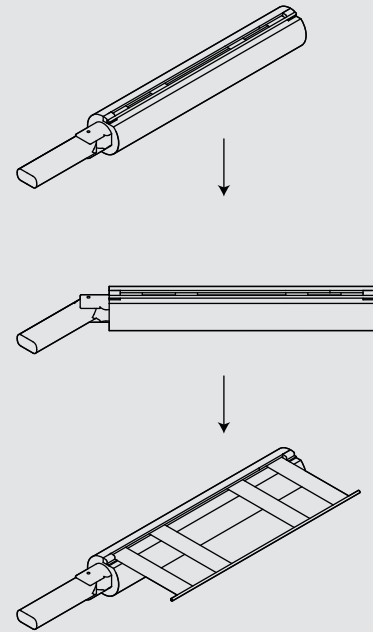




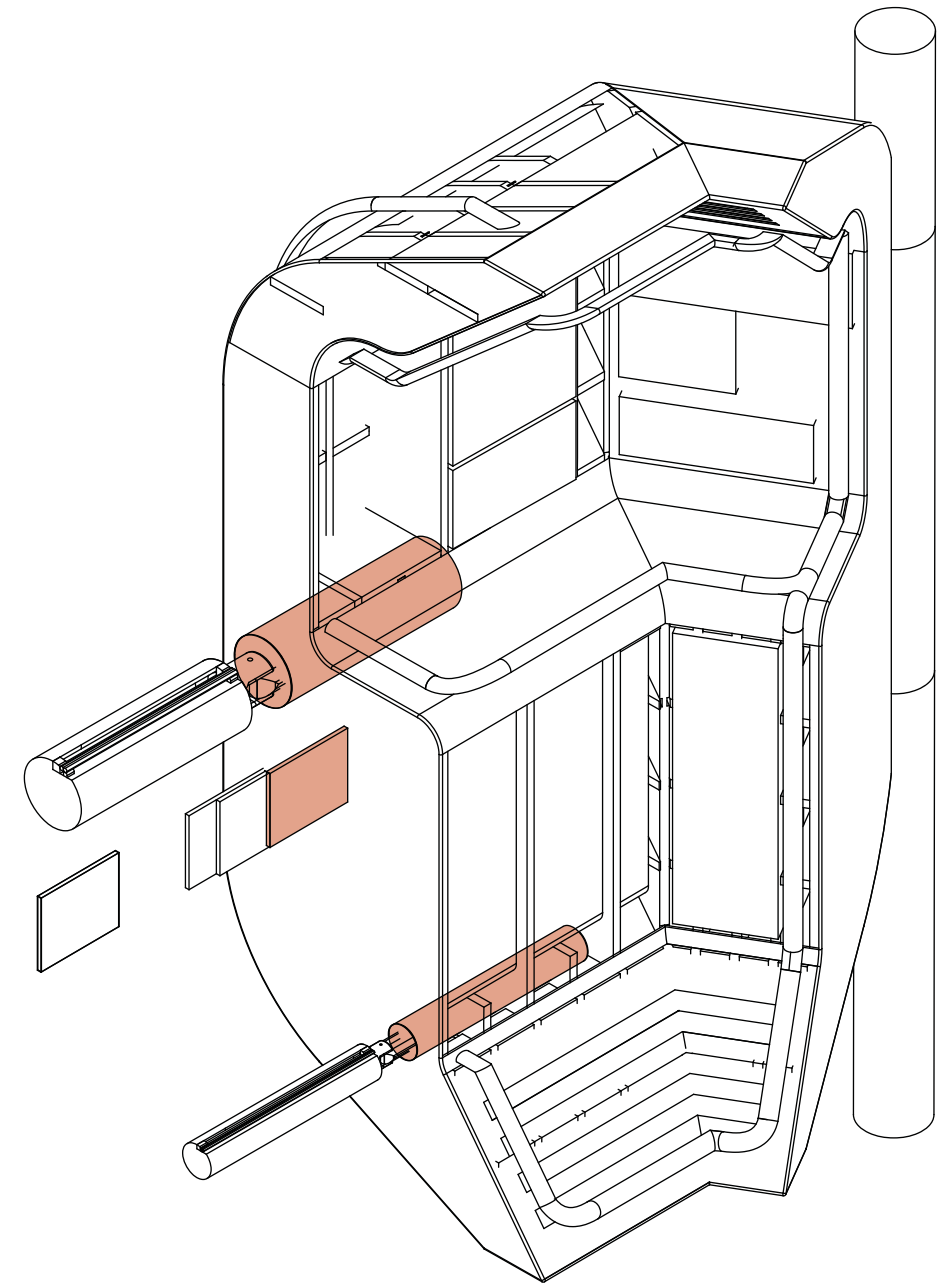
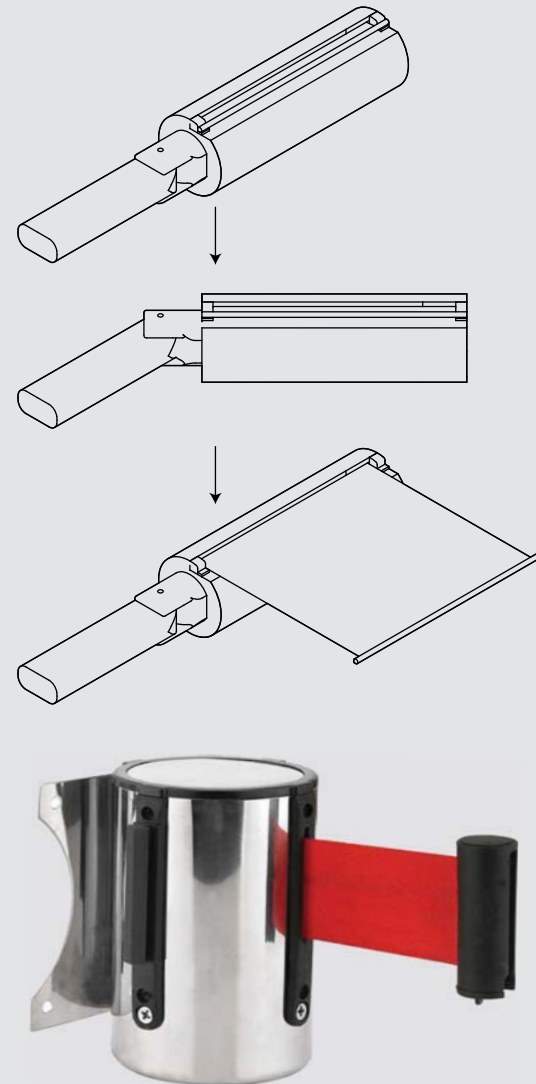
TOOLKIT: Table



Retractable Belt_Foot

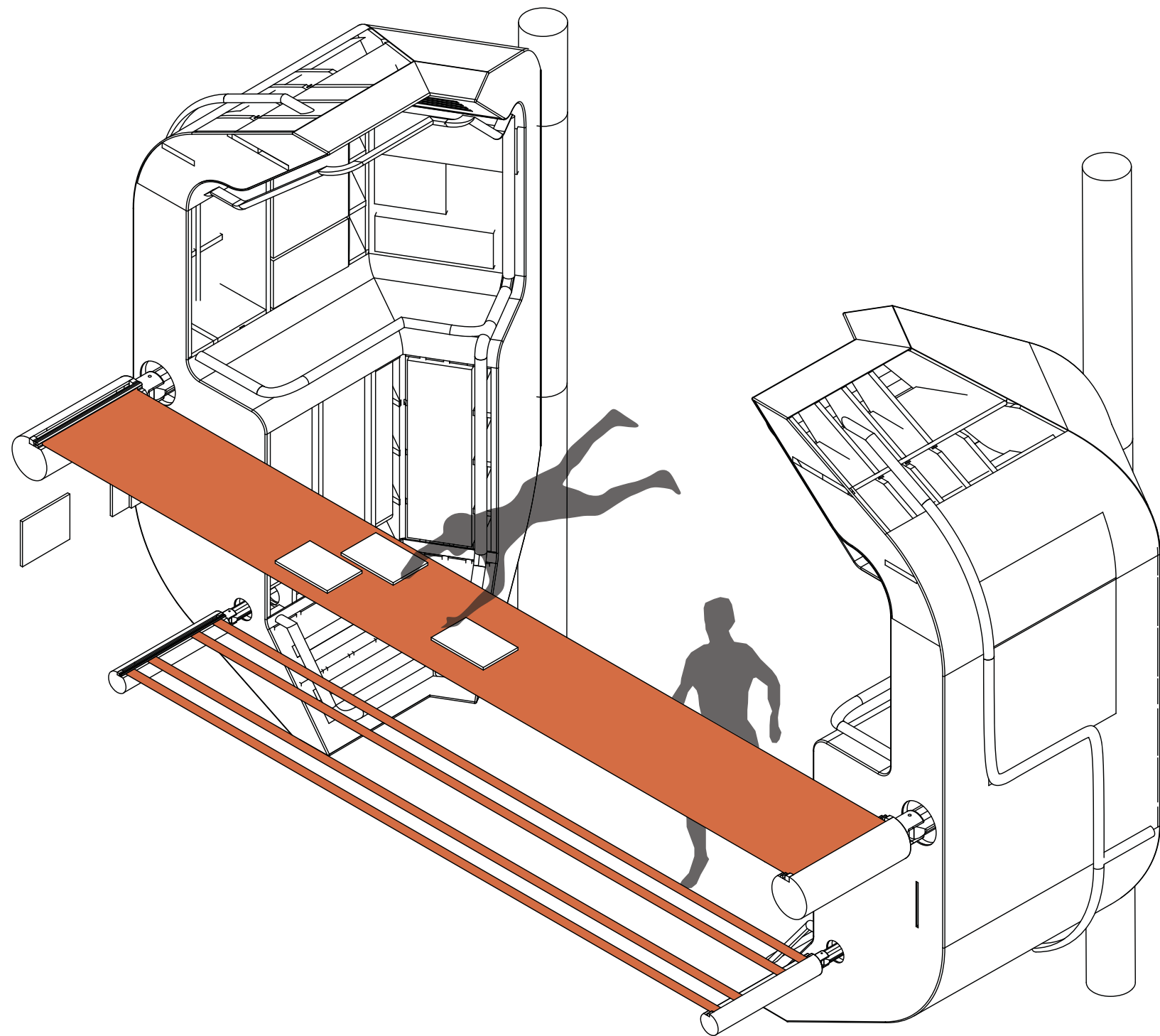
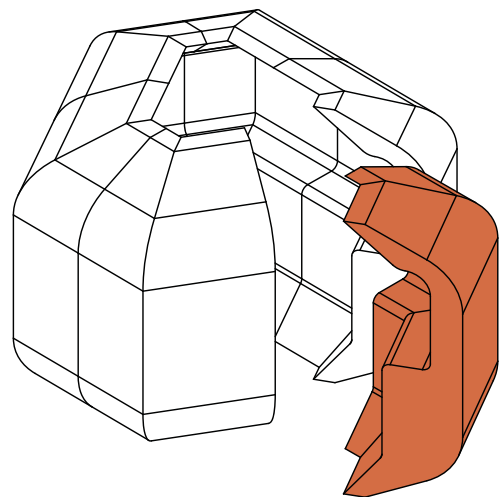


Retractable Belt_Table



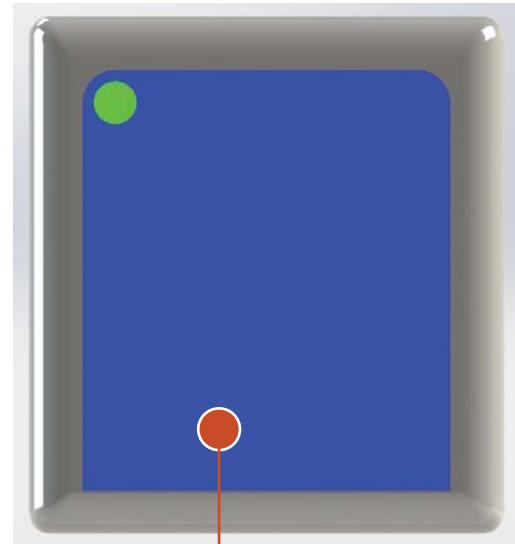
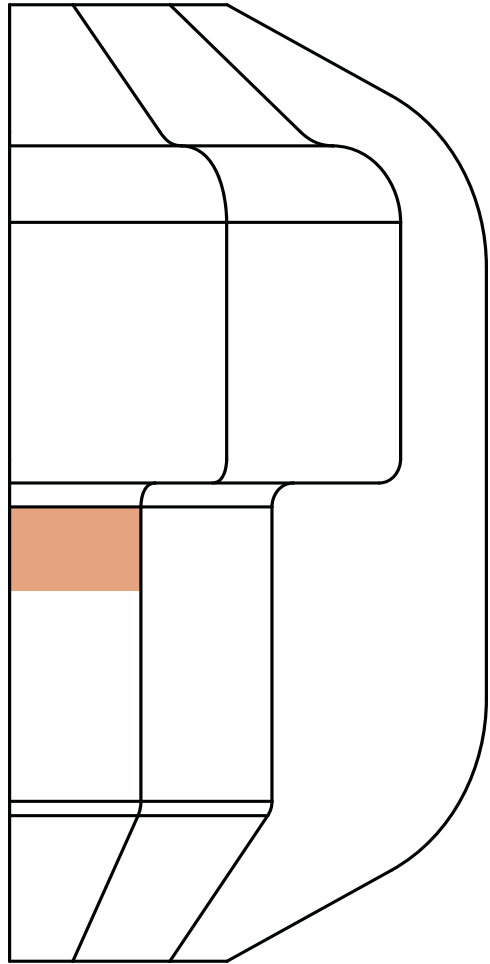


TOOLKIT: Table





TOOLKIT: Sanitizer



Working Position



Open Status

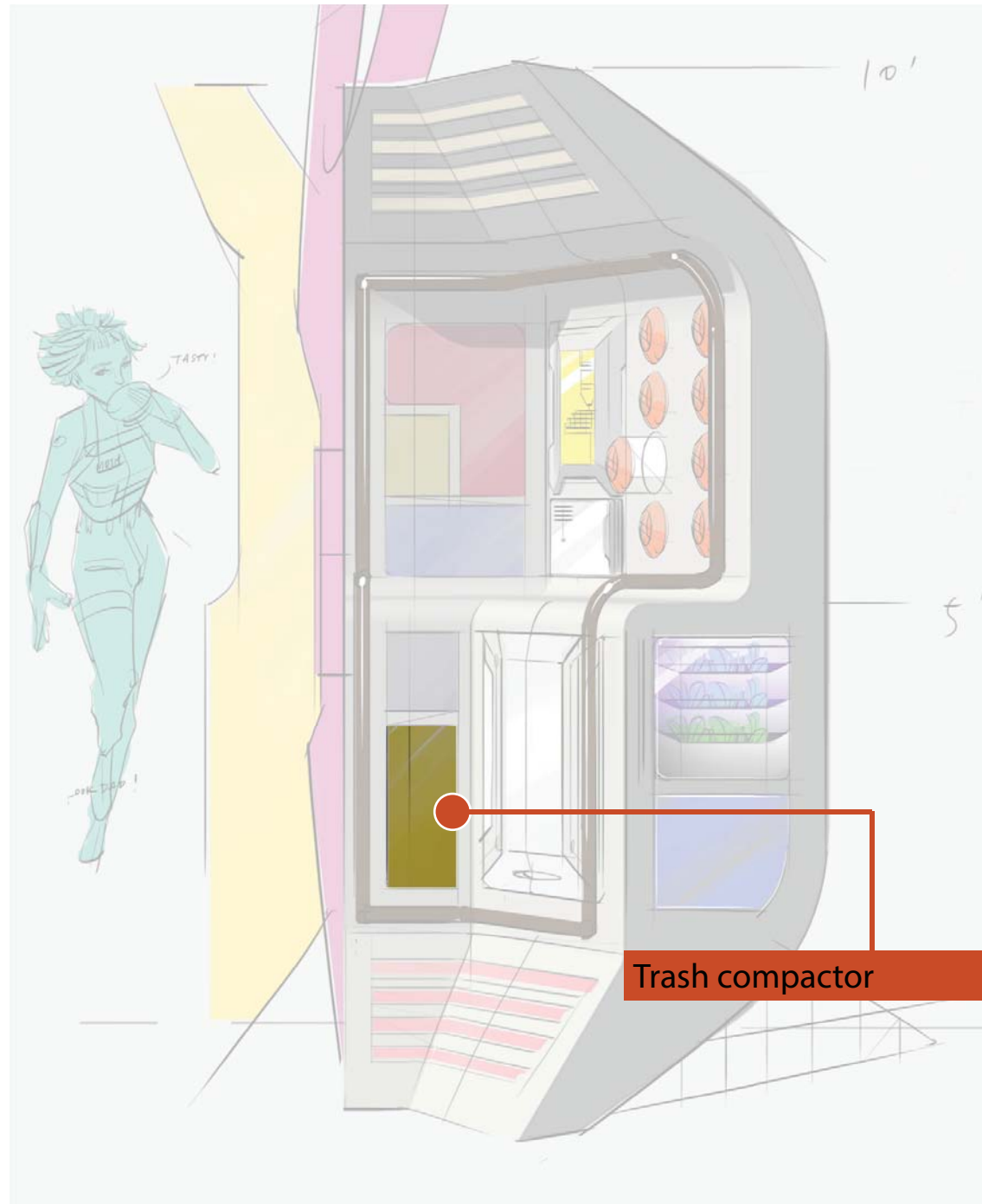
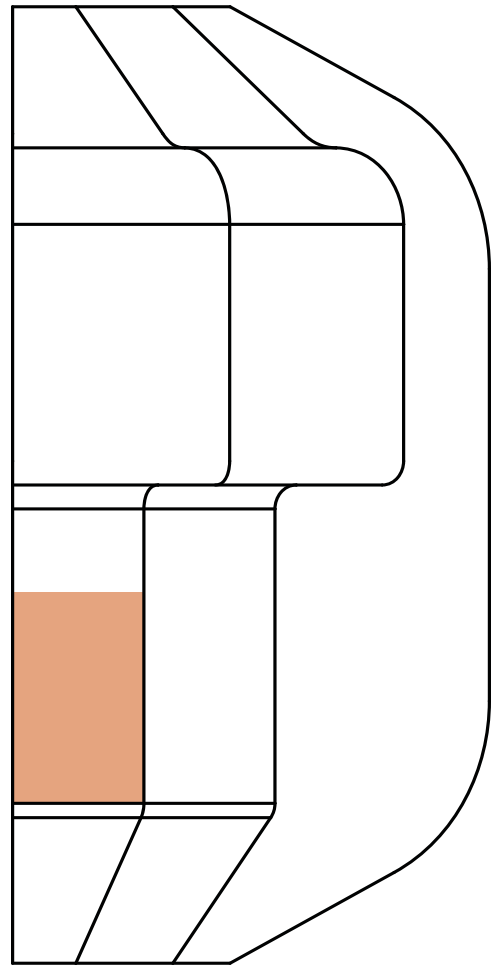


Cover-Fixed Object

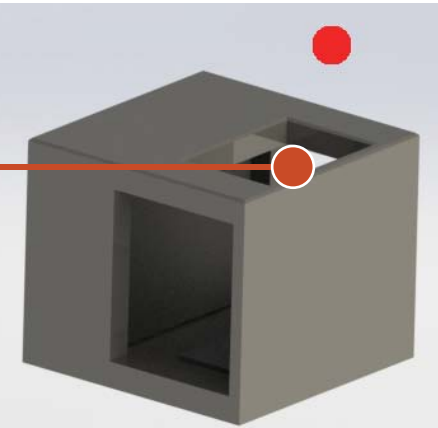




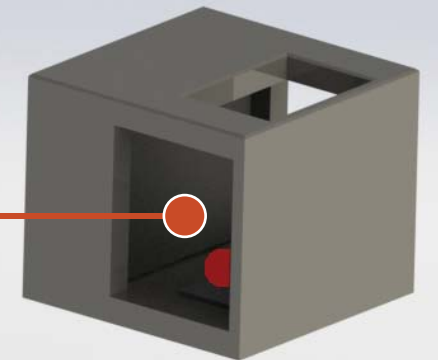
TOOLKIT: Trash Compactor



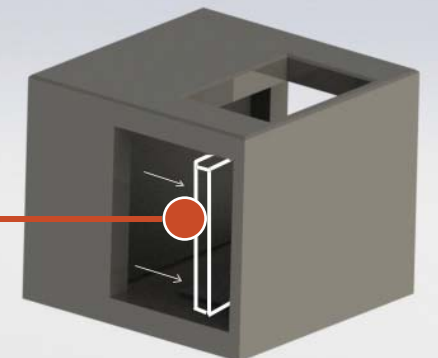
Trash enters top by suction



Trash pushed to bottom

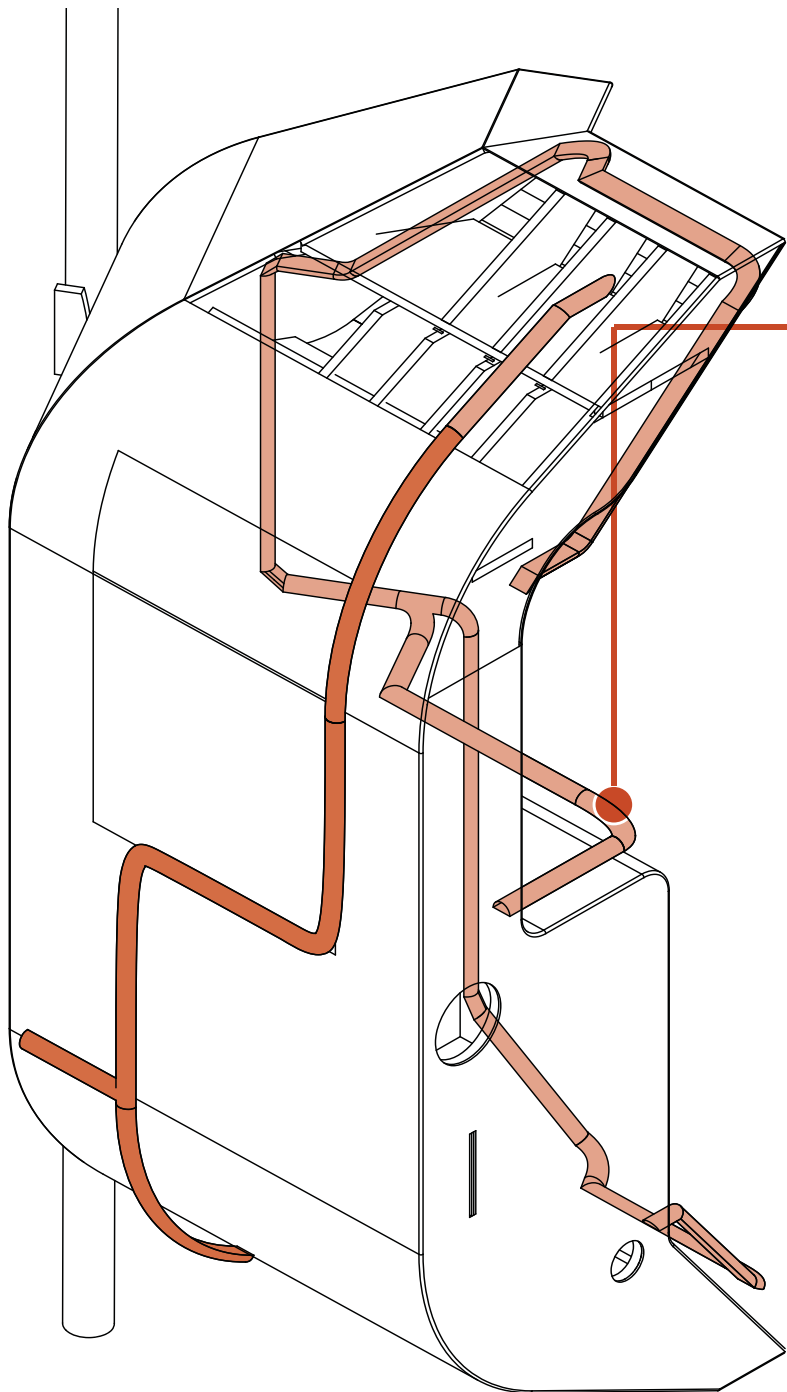


Compactor flattens trash

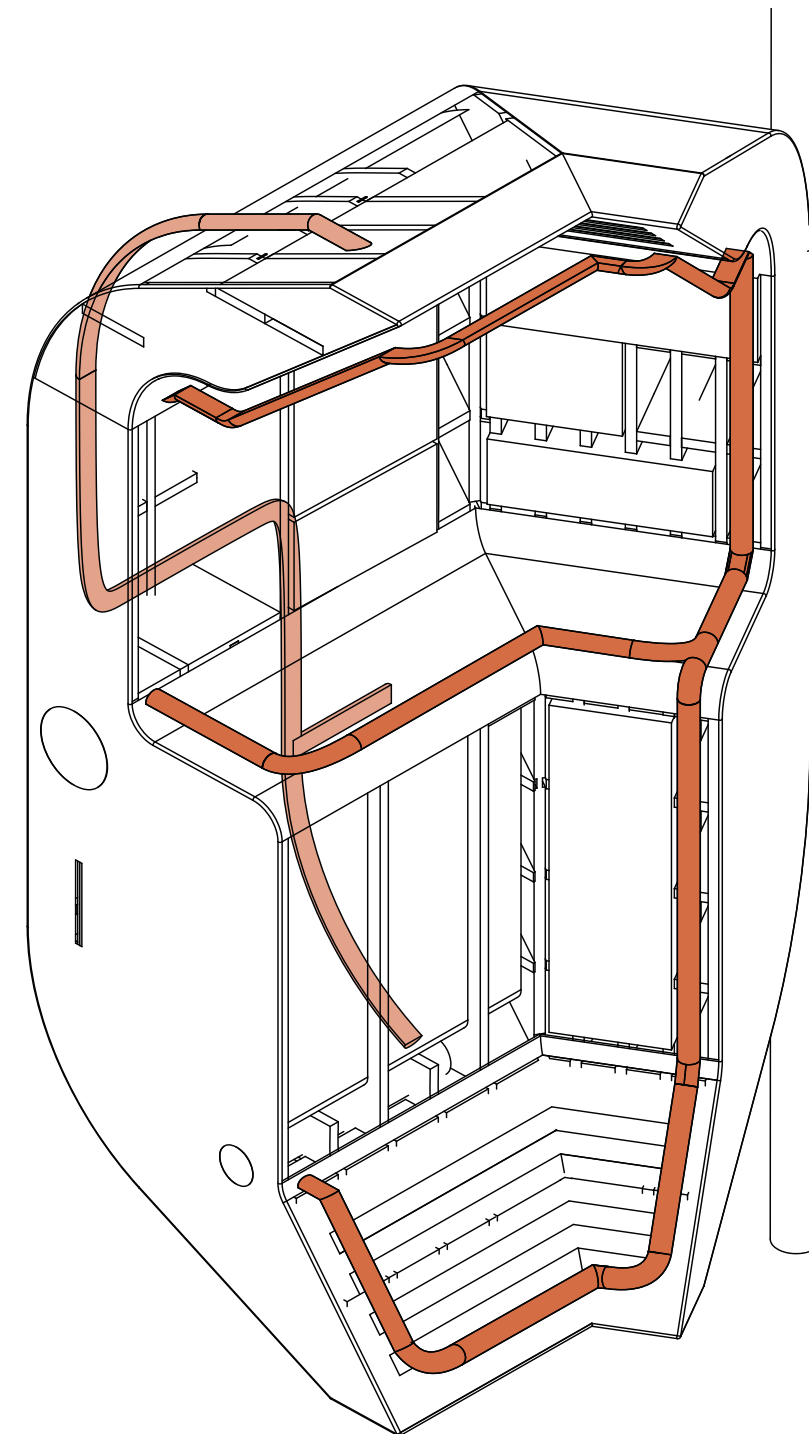
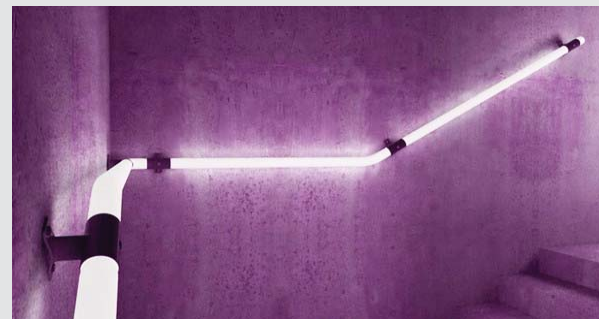
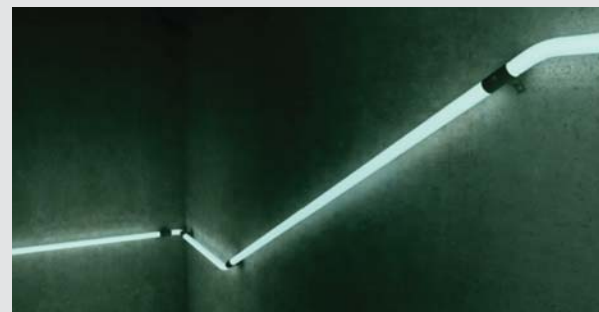




TOOLKIT: Handrails



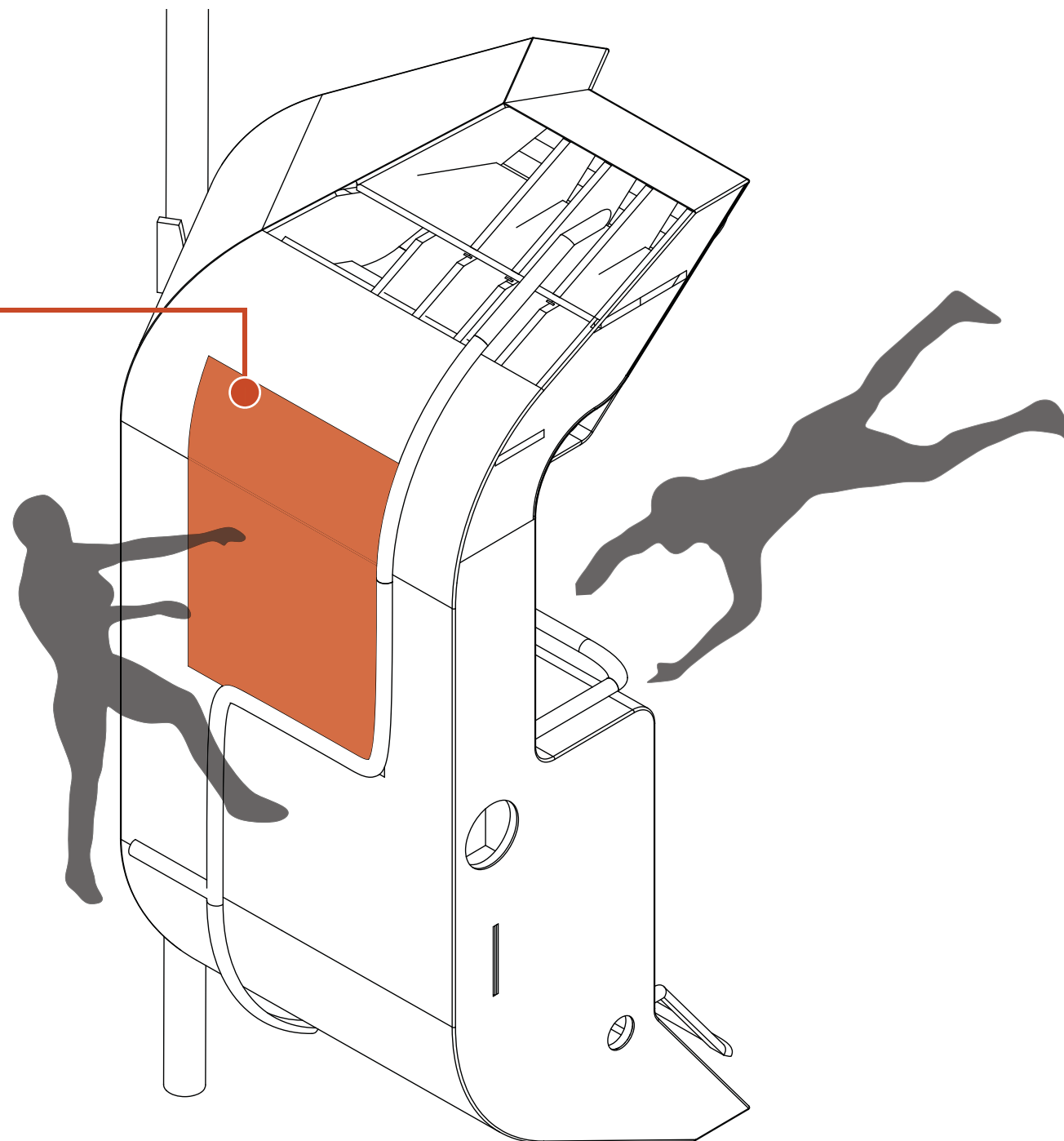
Handrail with Lighting





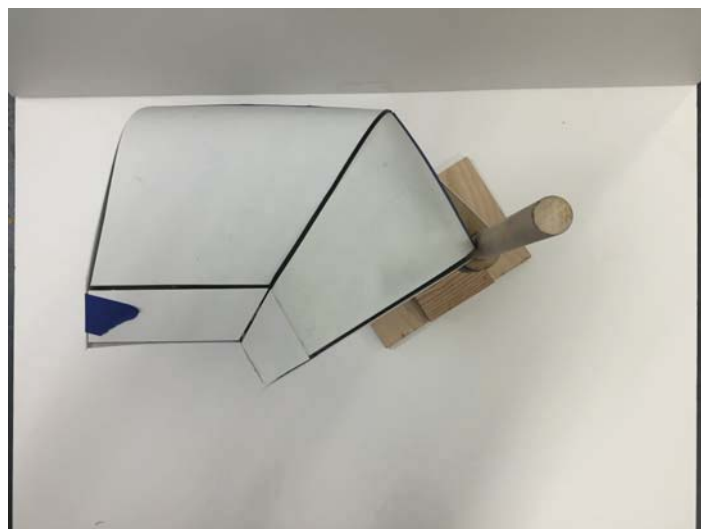
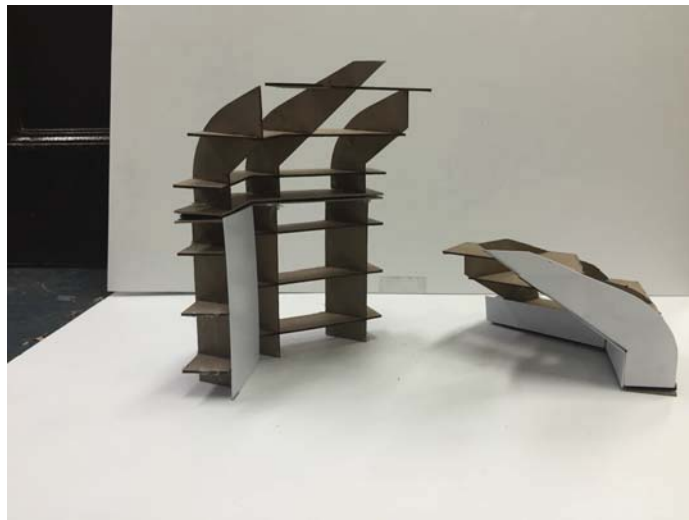
TOOLKIT: Handrails

Interactive Screen





TOOLKIT: Fabrication



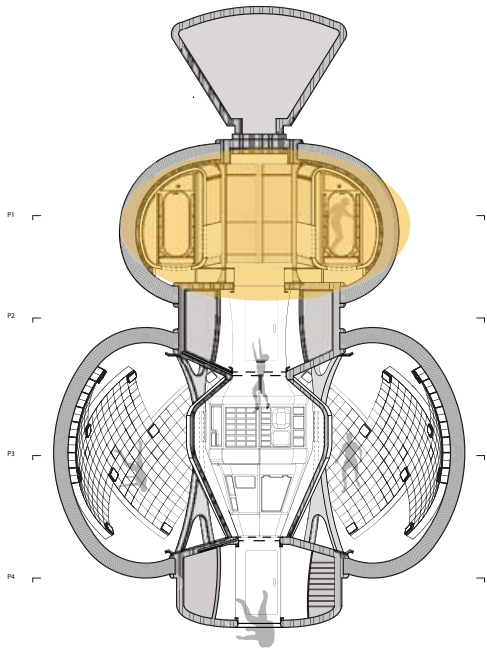


TOOLKIT: Fabrication

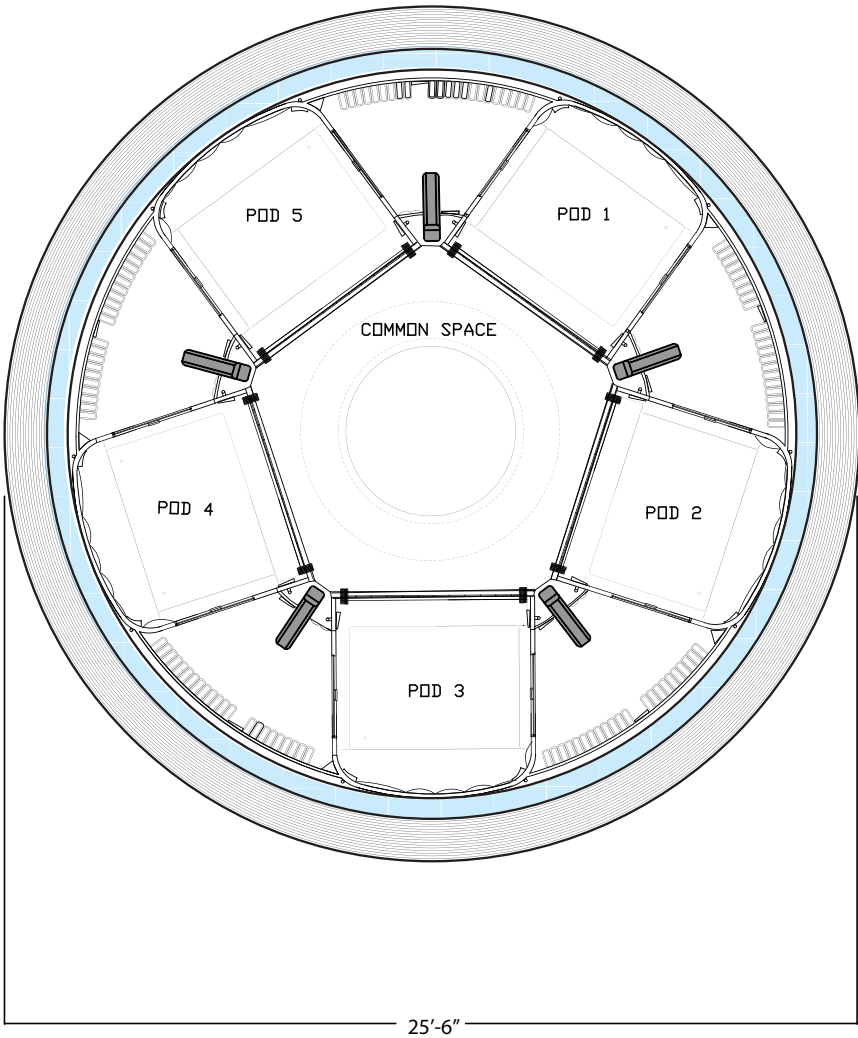




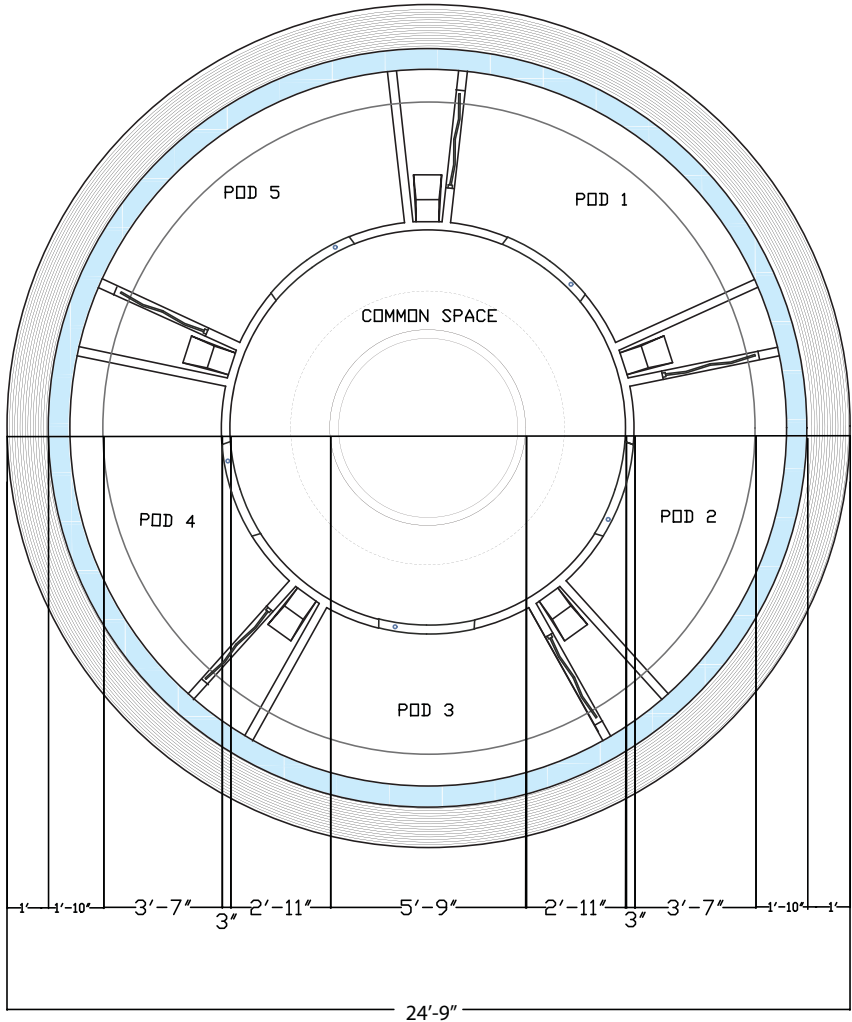
SLEEP POD: Updated Secondary Inflatable System (SIS) Design



MOTH 2.0

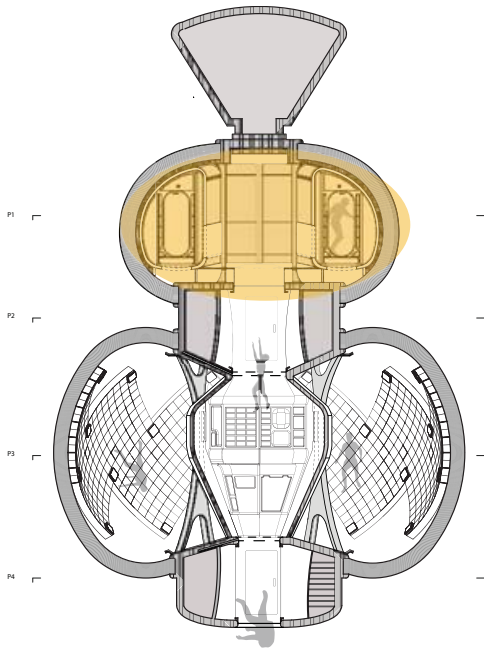


MOTH 3.0

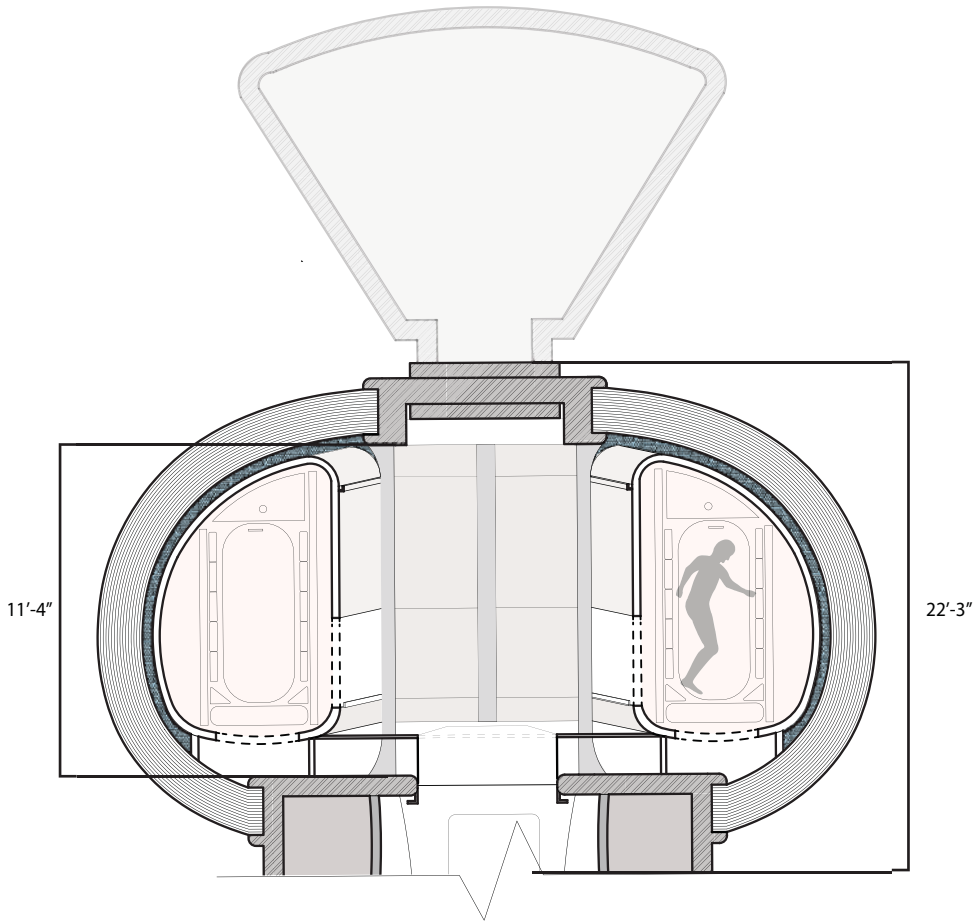




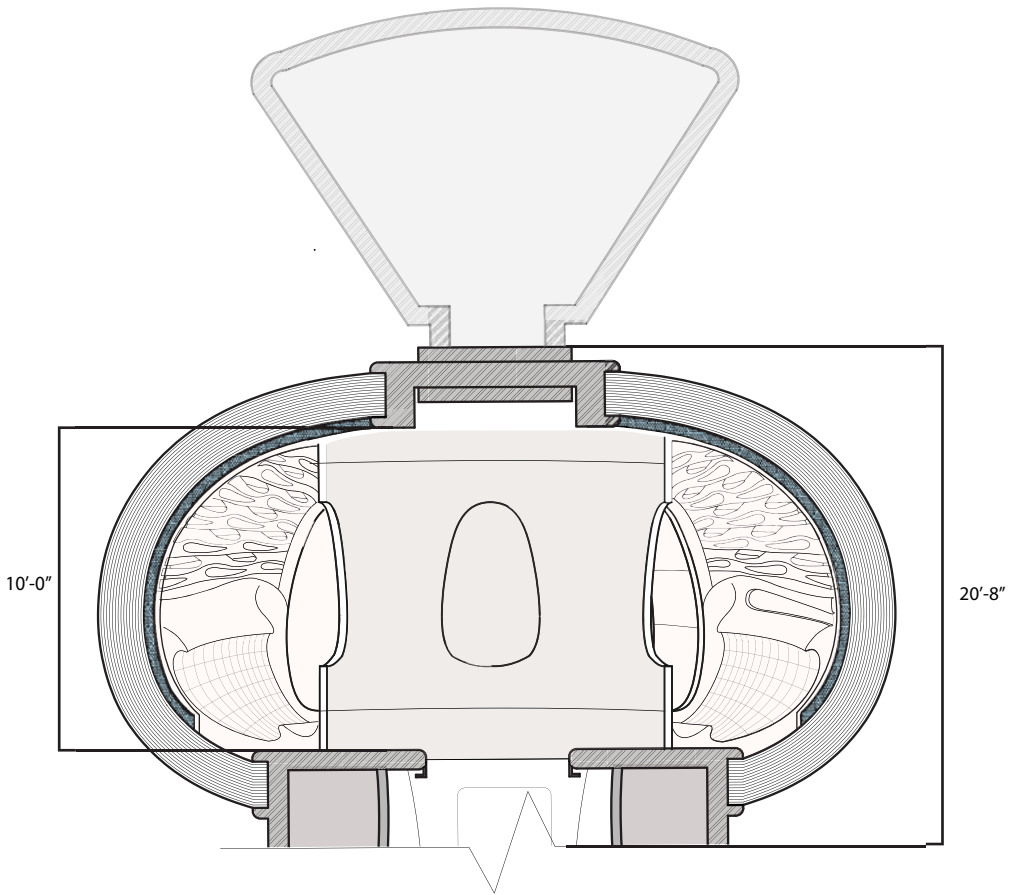
SLEEP POD: Updated Secondary Inflatable System (SIS) Design



MOTH 2.0

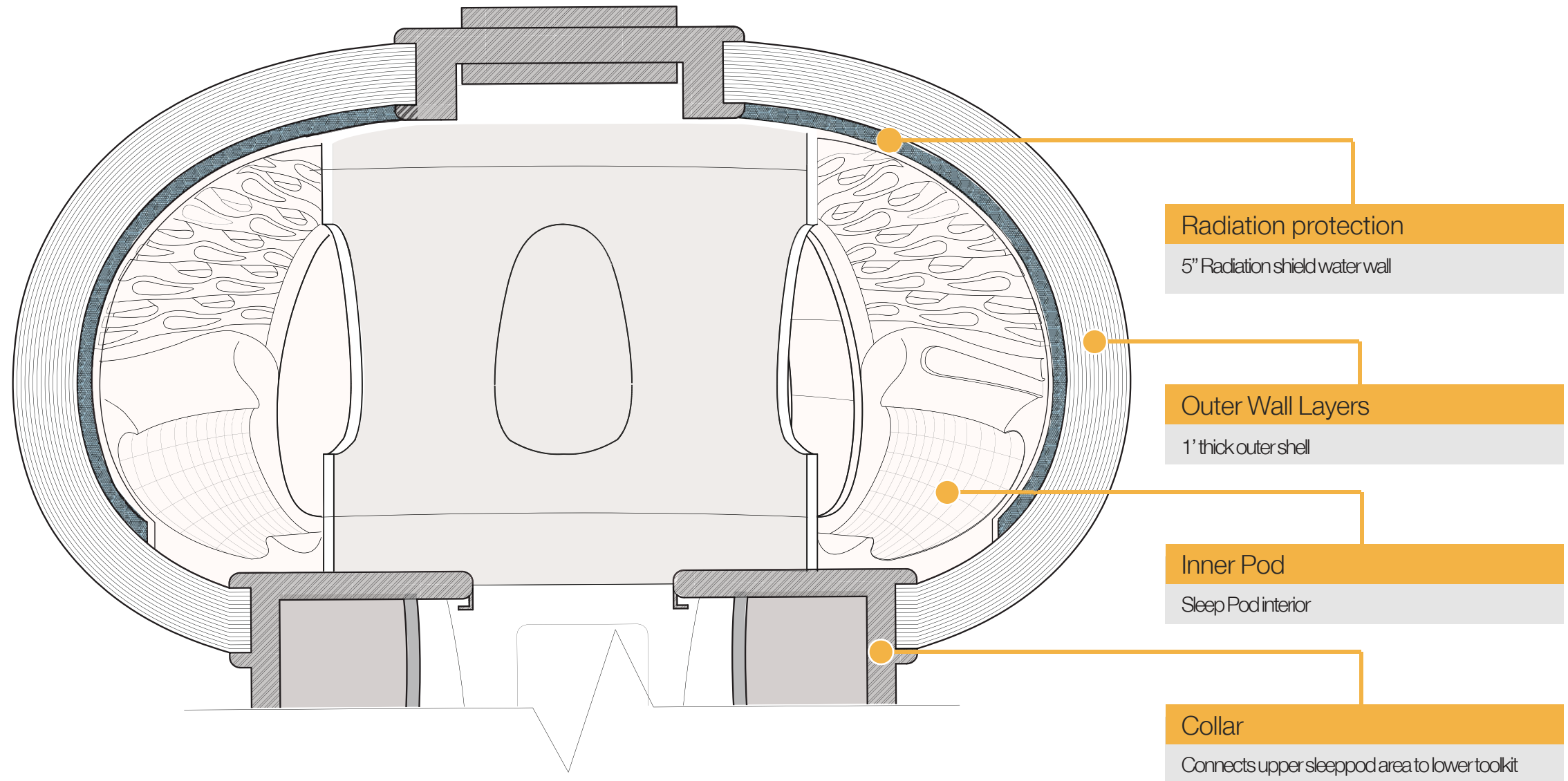


MOTH 3.0



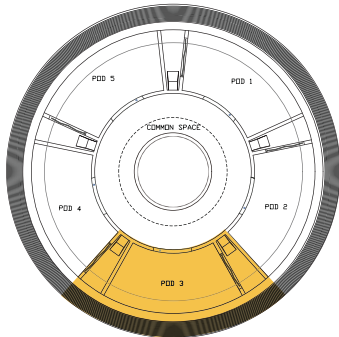


SLEEP POD: Updated Secondary Inflatable System (SIS) Design

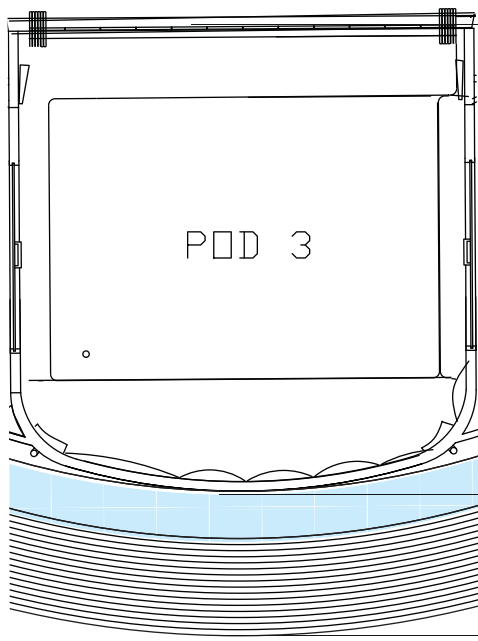




SLEEP POD: Updated Sleep Pod Design

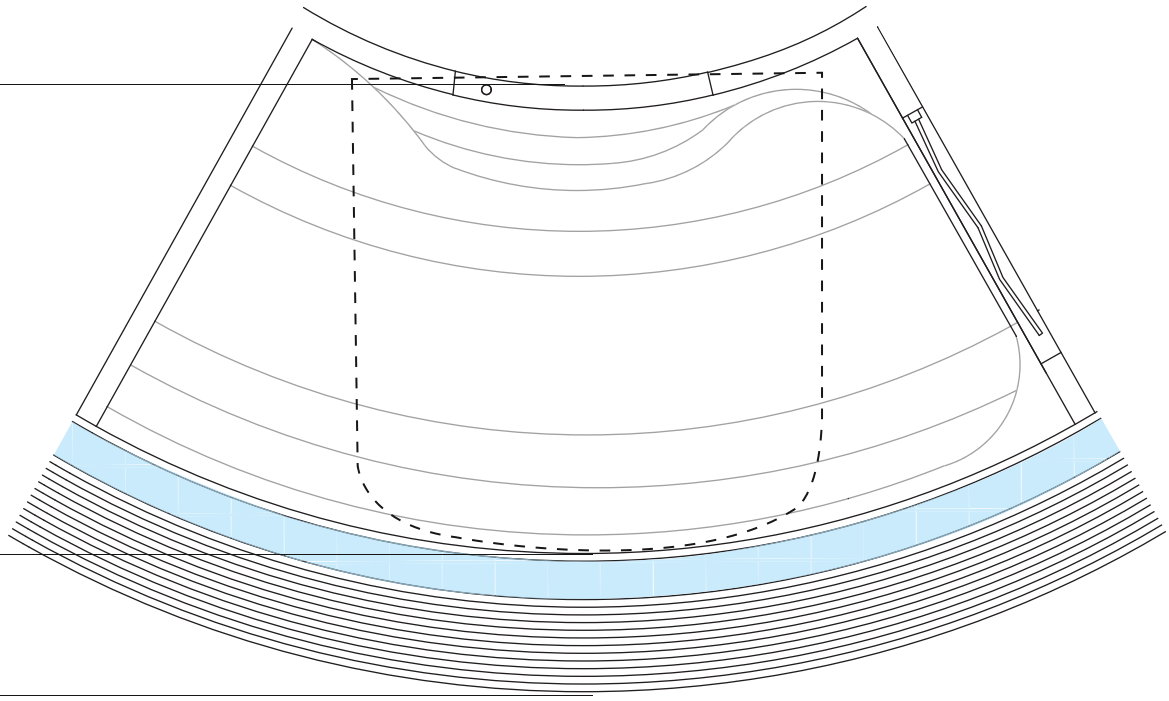


MOTH 2.0



Area: 36 sq ft.

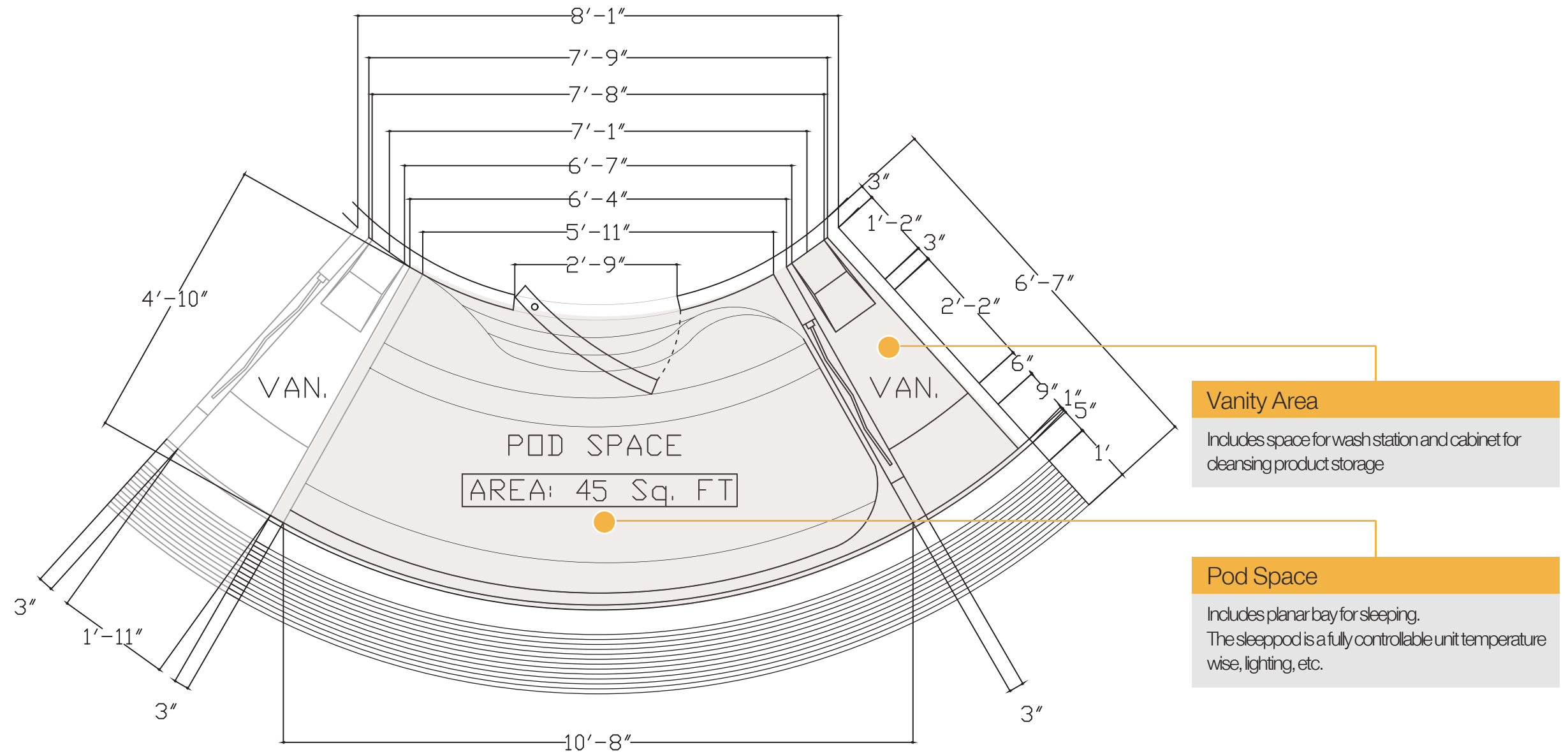
MOTH 3.0



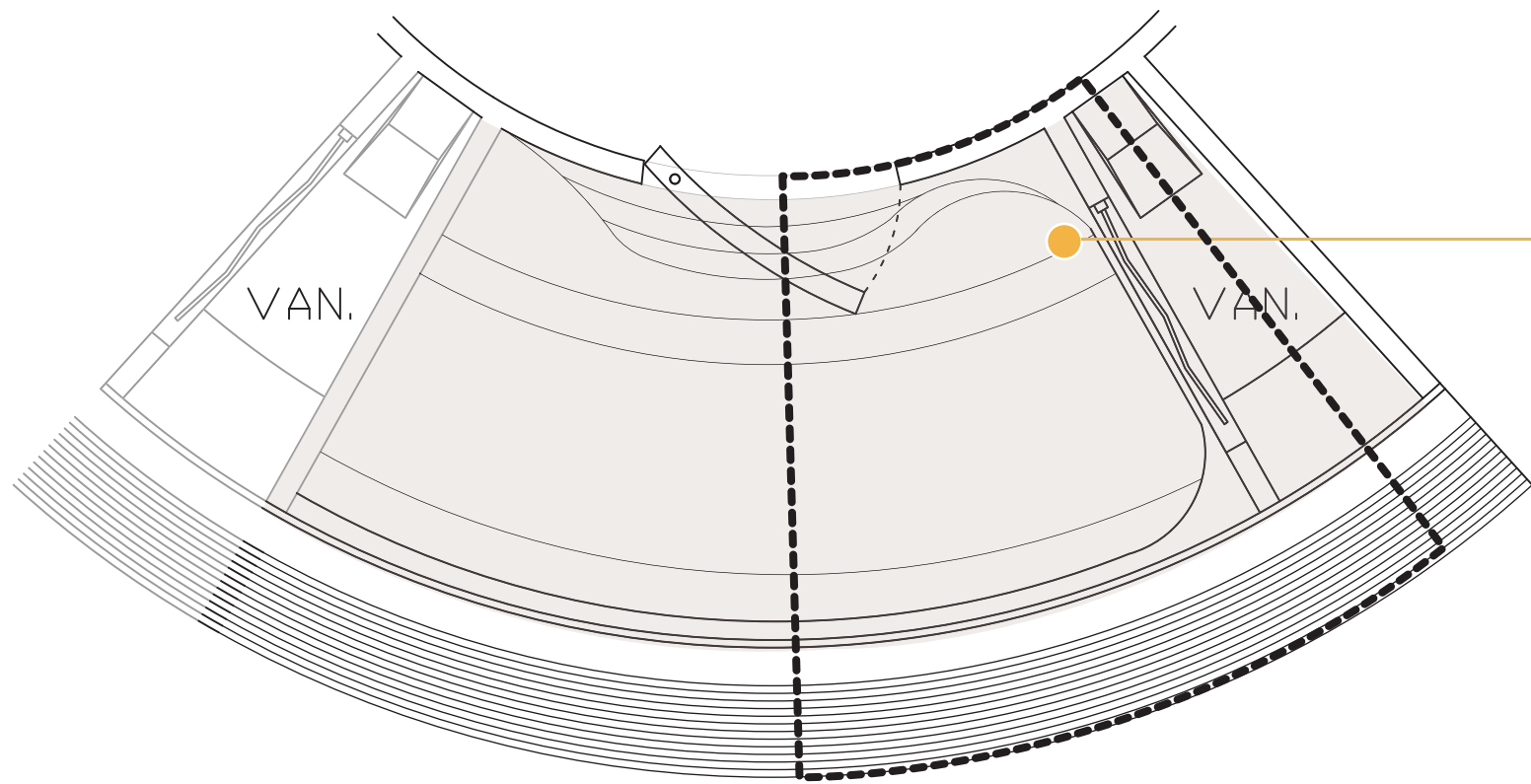
Area: 45 sq ft.



SLEEP POD: Updated Sleep Pod Design



SLEEP POD: Updated Sleep Pod Design



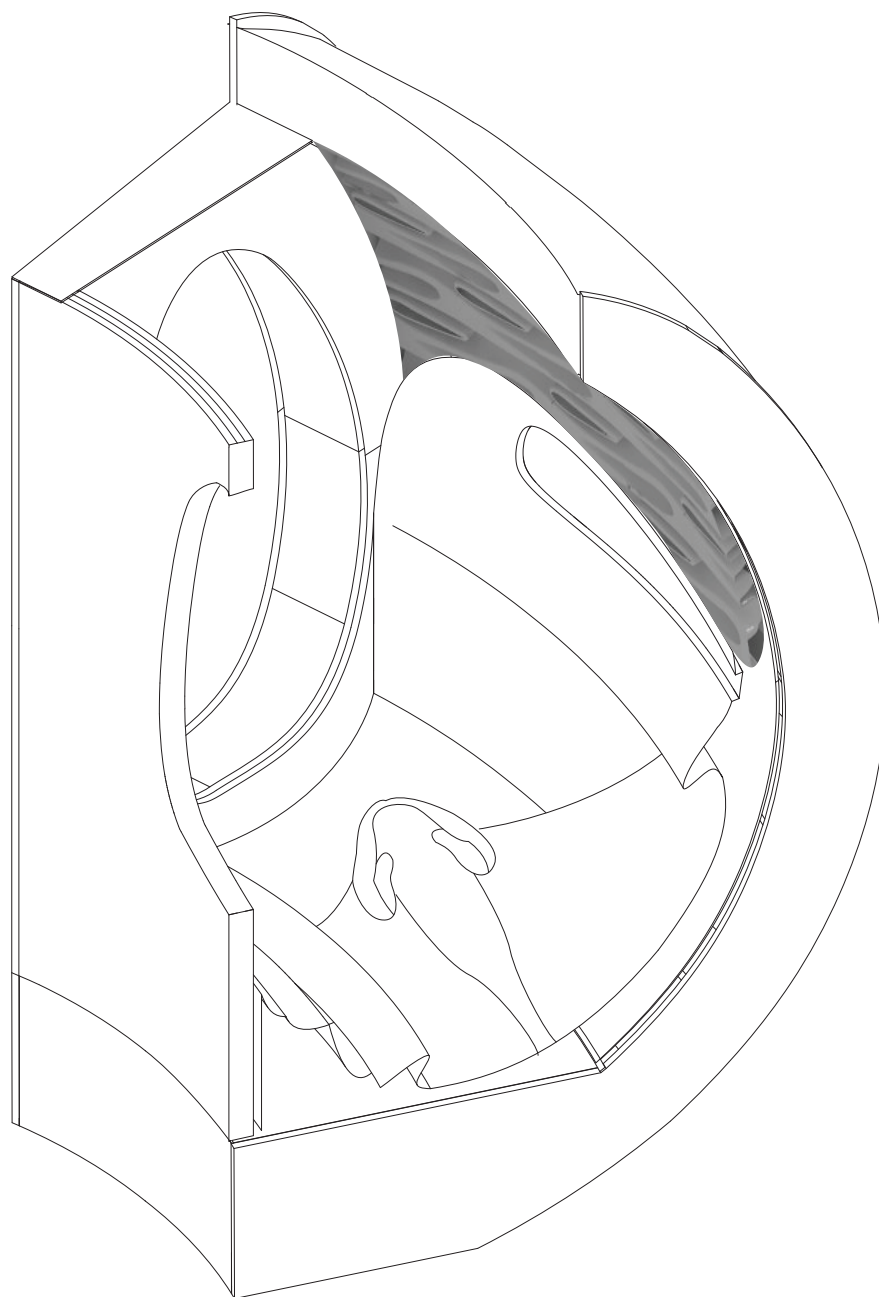
Model Buildout Area

Half of the vanity area and the sleeping quarters were chosen for full scale build.



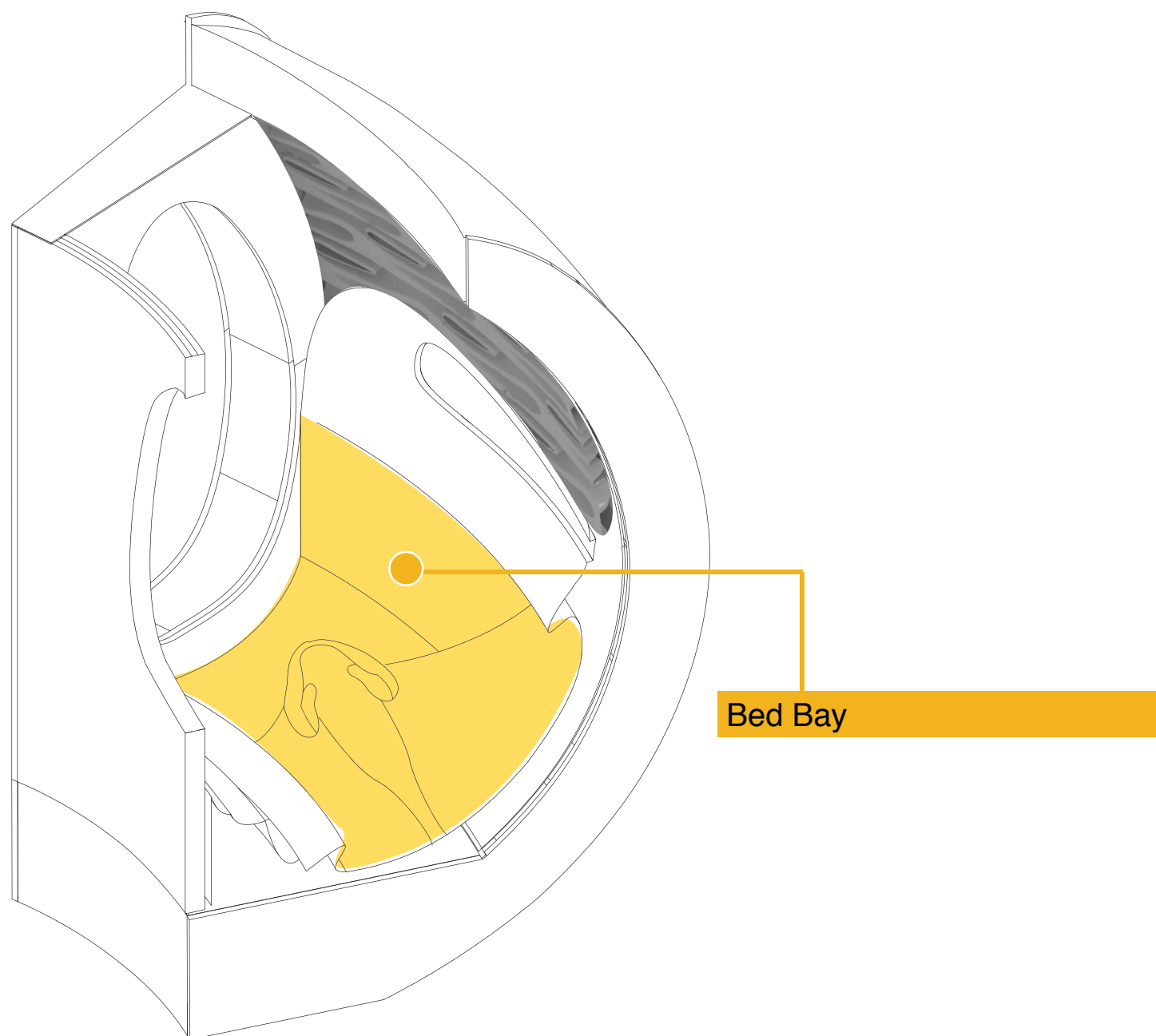


SLEEP POD: Components



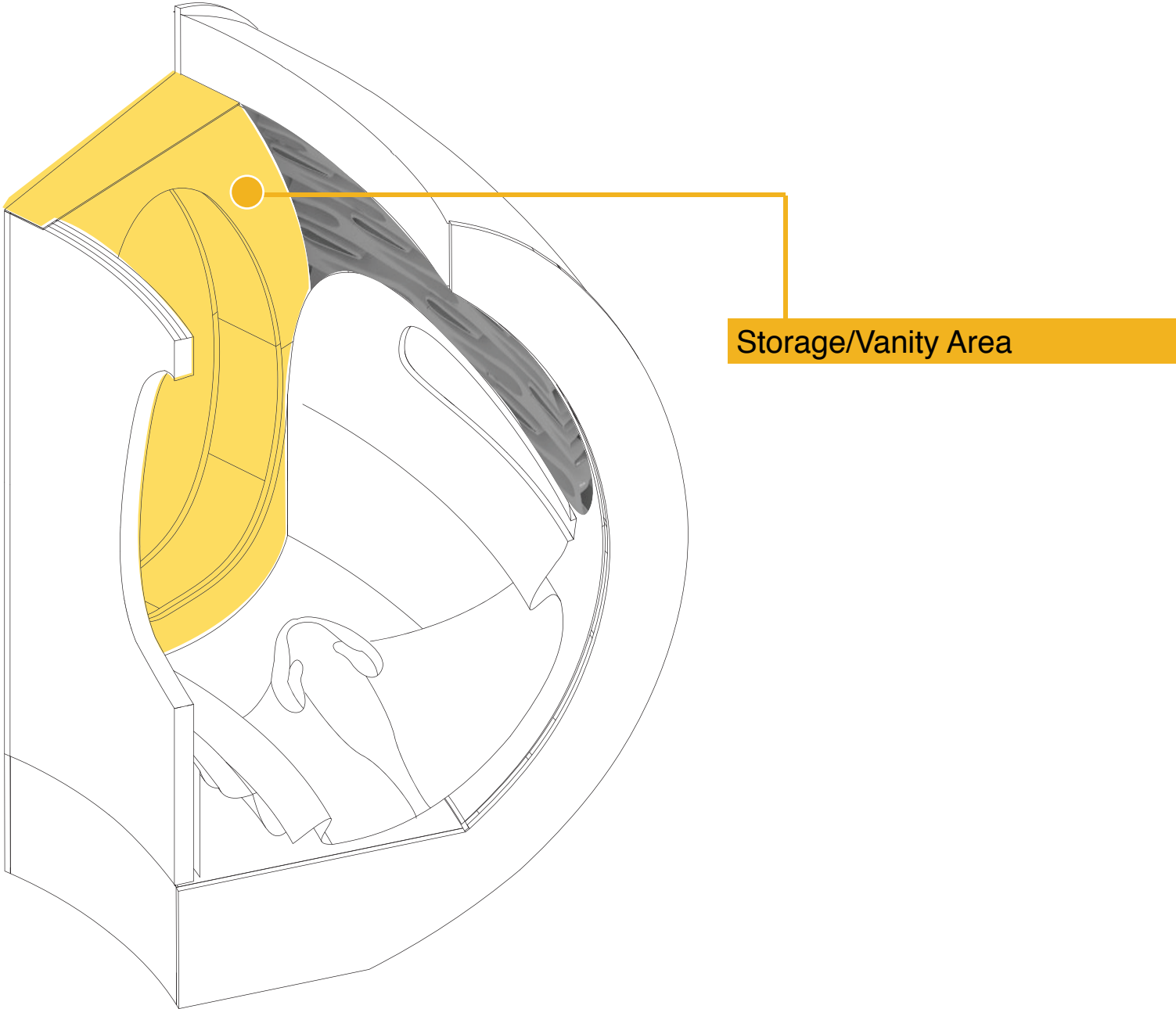


SLEEP POD: Components



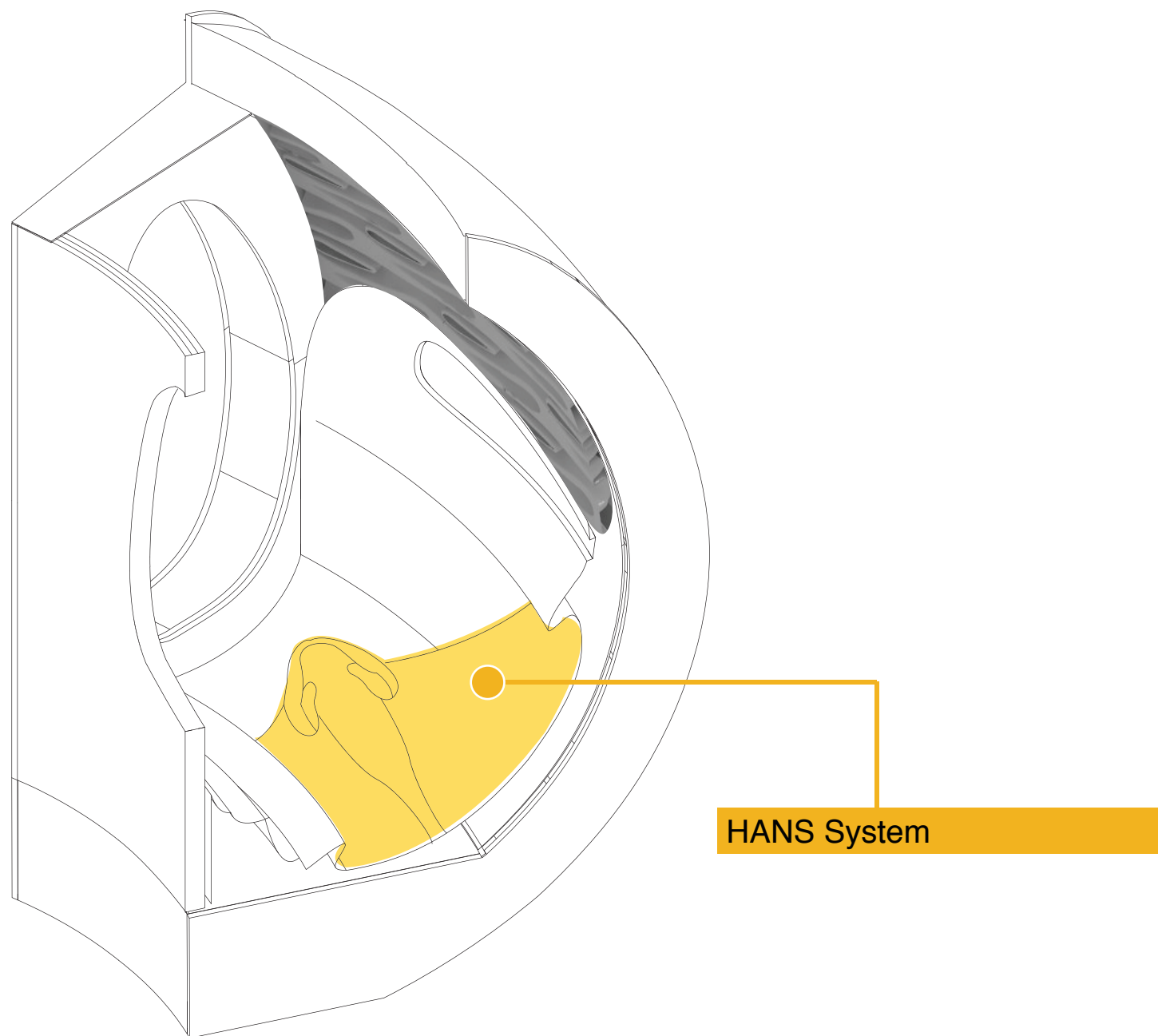


SLEEP POD: Components





SLEEP POD: Components

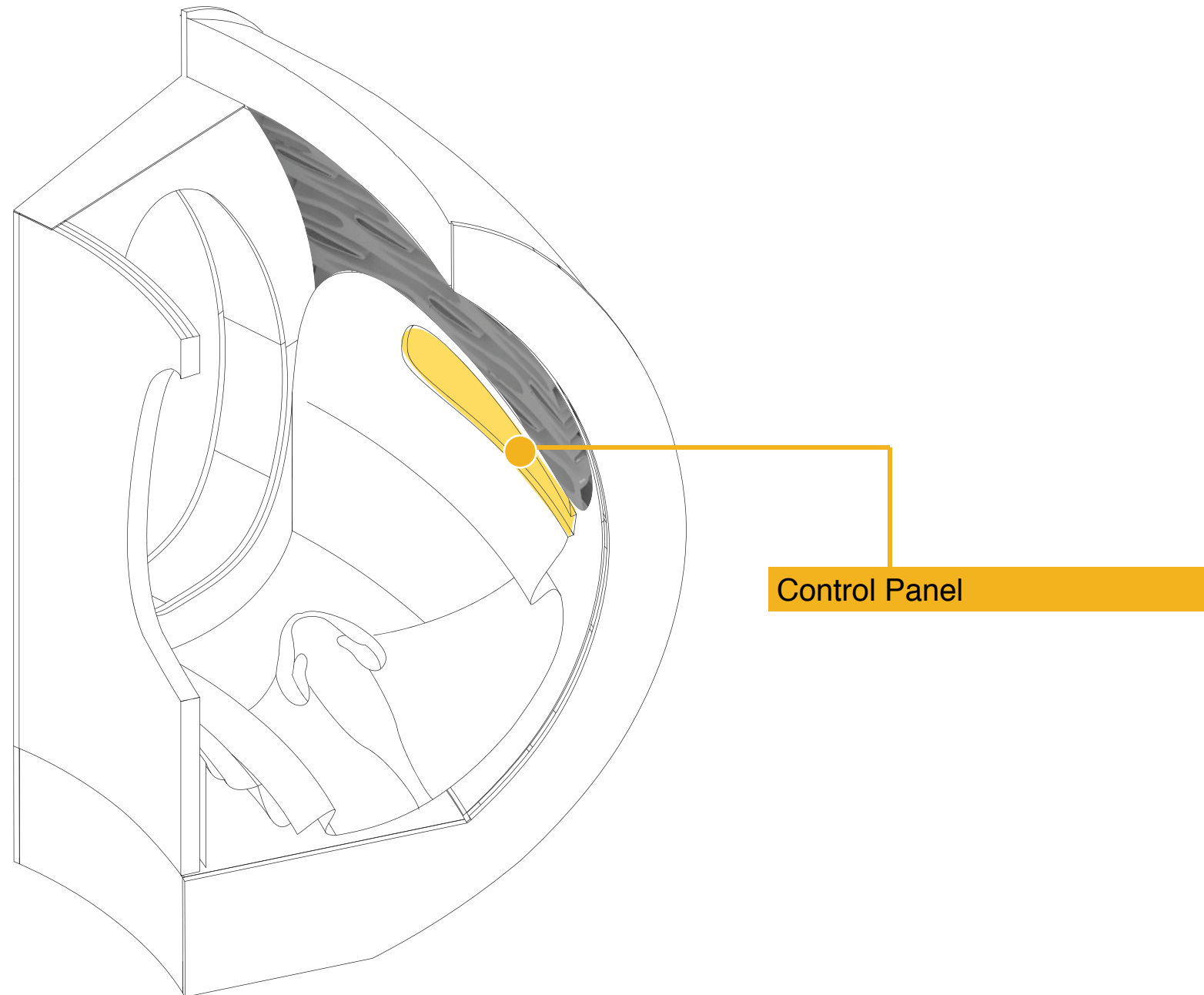


HANS System



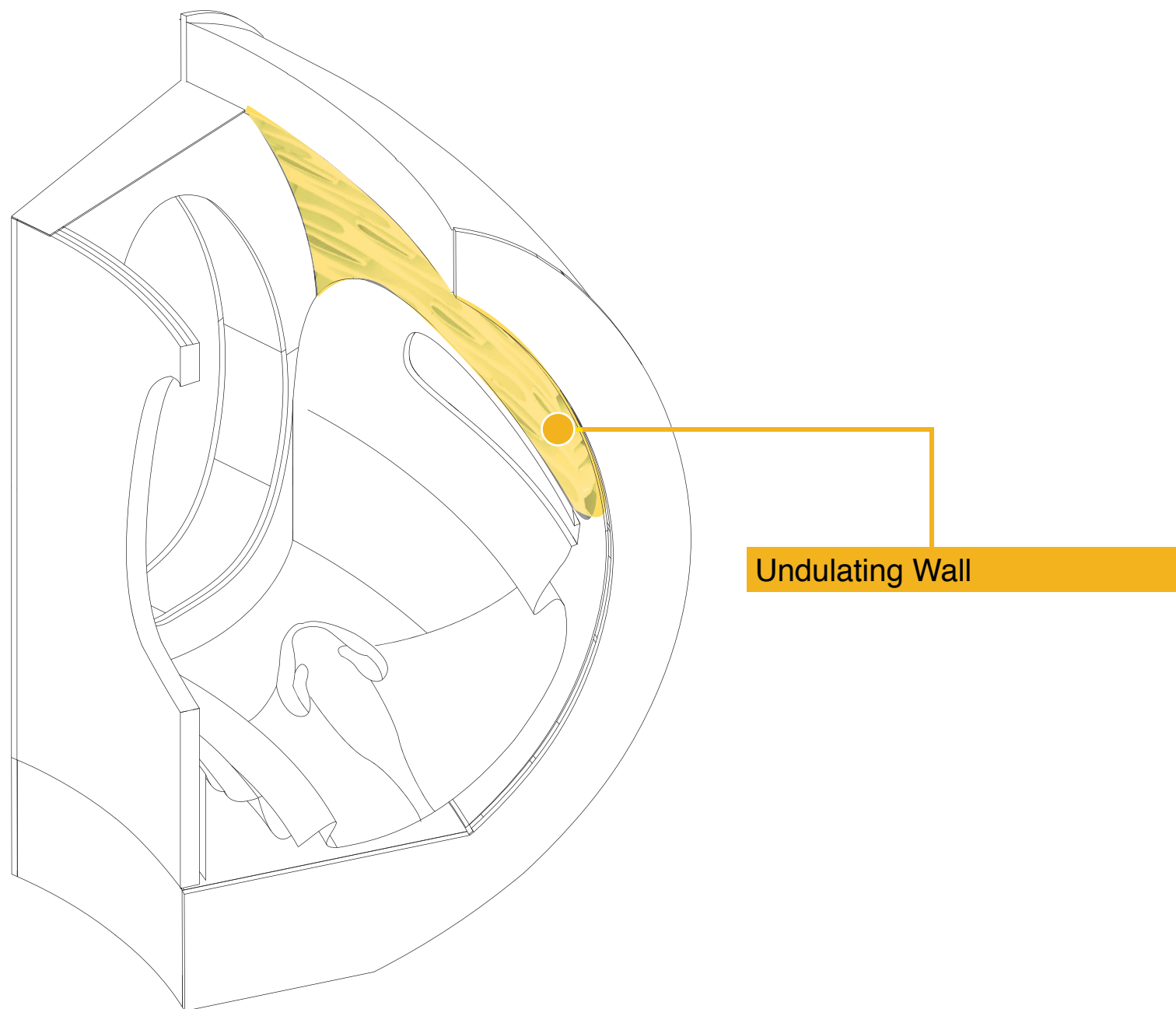


SLEEP POD: Components



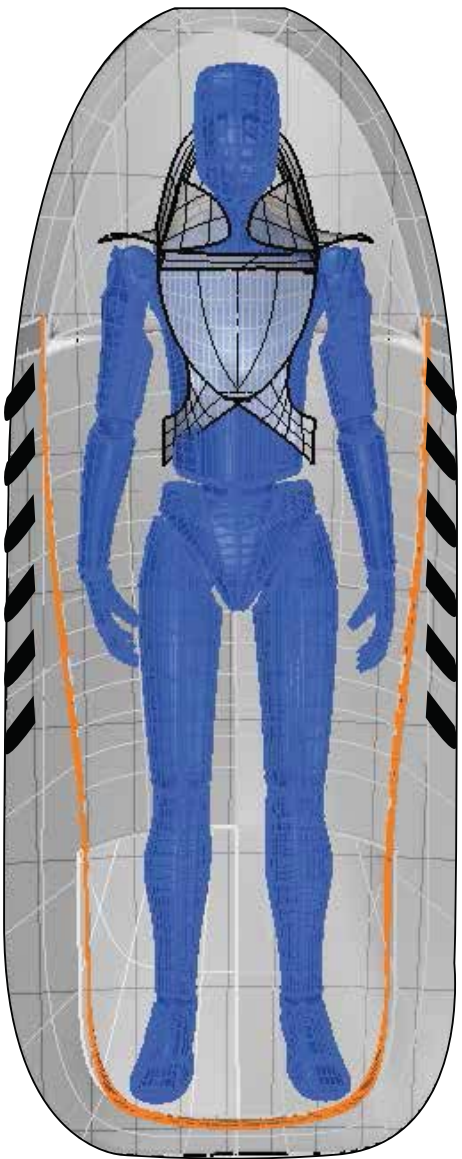
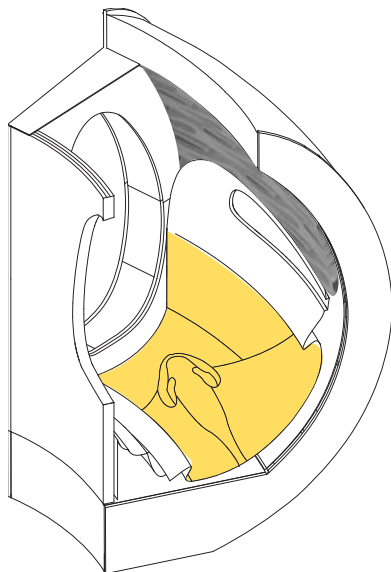


SLEEP POD: Components



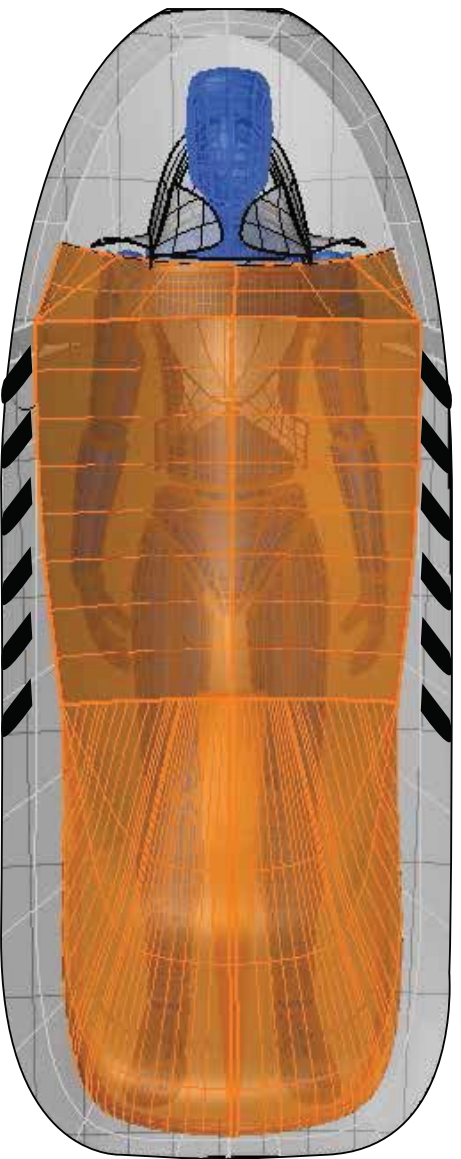


SLEEP POD: Sleep Bay: 1st Iteration



HANS Device

the astronauts strap themselves into the enclosure by putting on the HANS safety device, which keeps their head up to prevent suffocation.



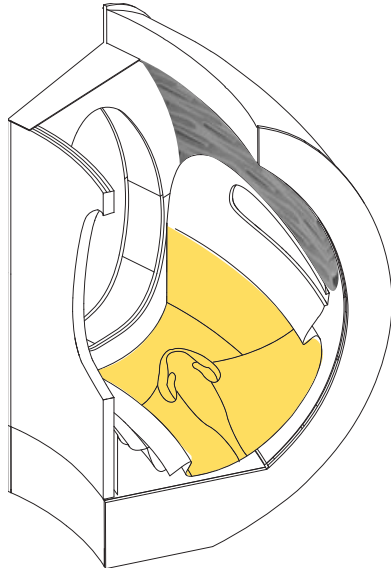
Blanket System

the "blanket" of the enclosure serves two purposes: to contain the astronaut's limbs, and to add an extra layer of radiation protection.





SLEEP POD: Sleep Bay: 2nd Iteration



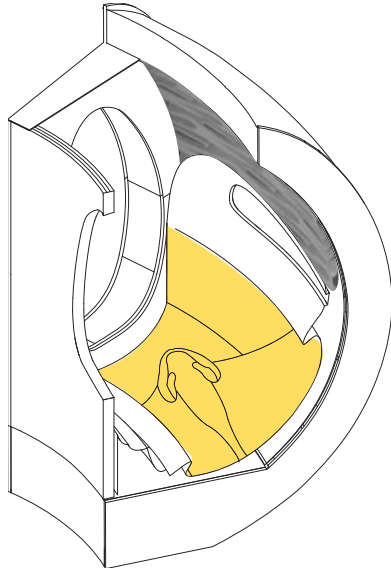
Day Bed

We reconfigured the space so that the "bed" filled the bottom area of the pod, simulating the feeling of a day bed.



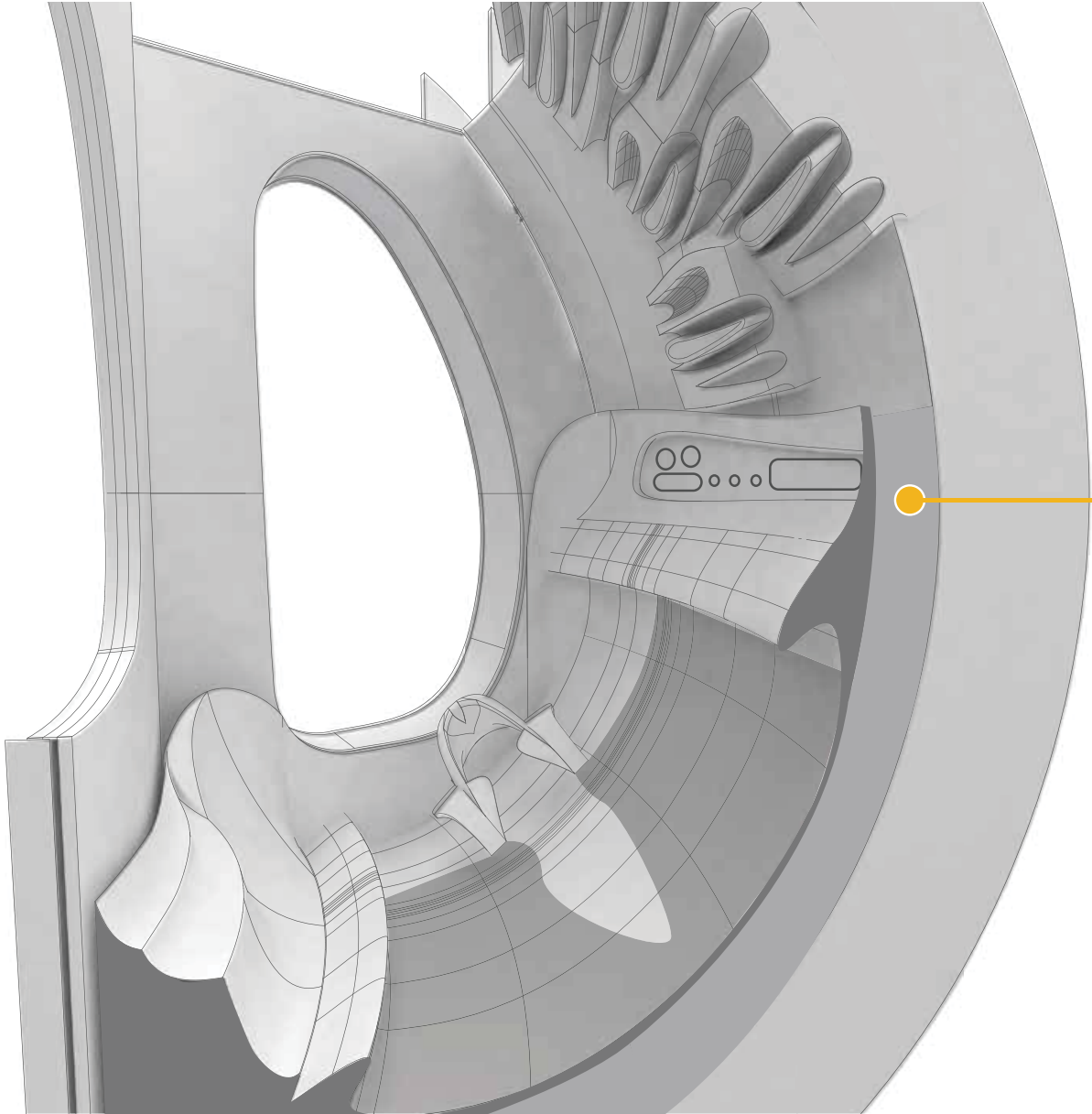


SLEEP POD: Sleep Bay: 3rd Iteration



Bay with HANS

The bay was updated to include the HANS device from the first iteration. The HANS is placed for optimal viewing of the projection wall.



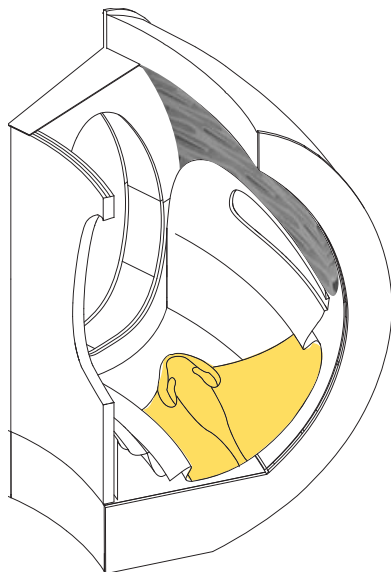
Control Panel

The control panel for the lights, projection wall, and other functions within the pod is in easy reach of the bay.



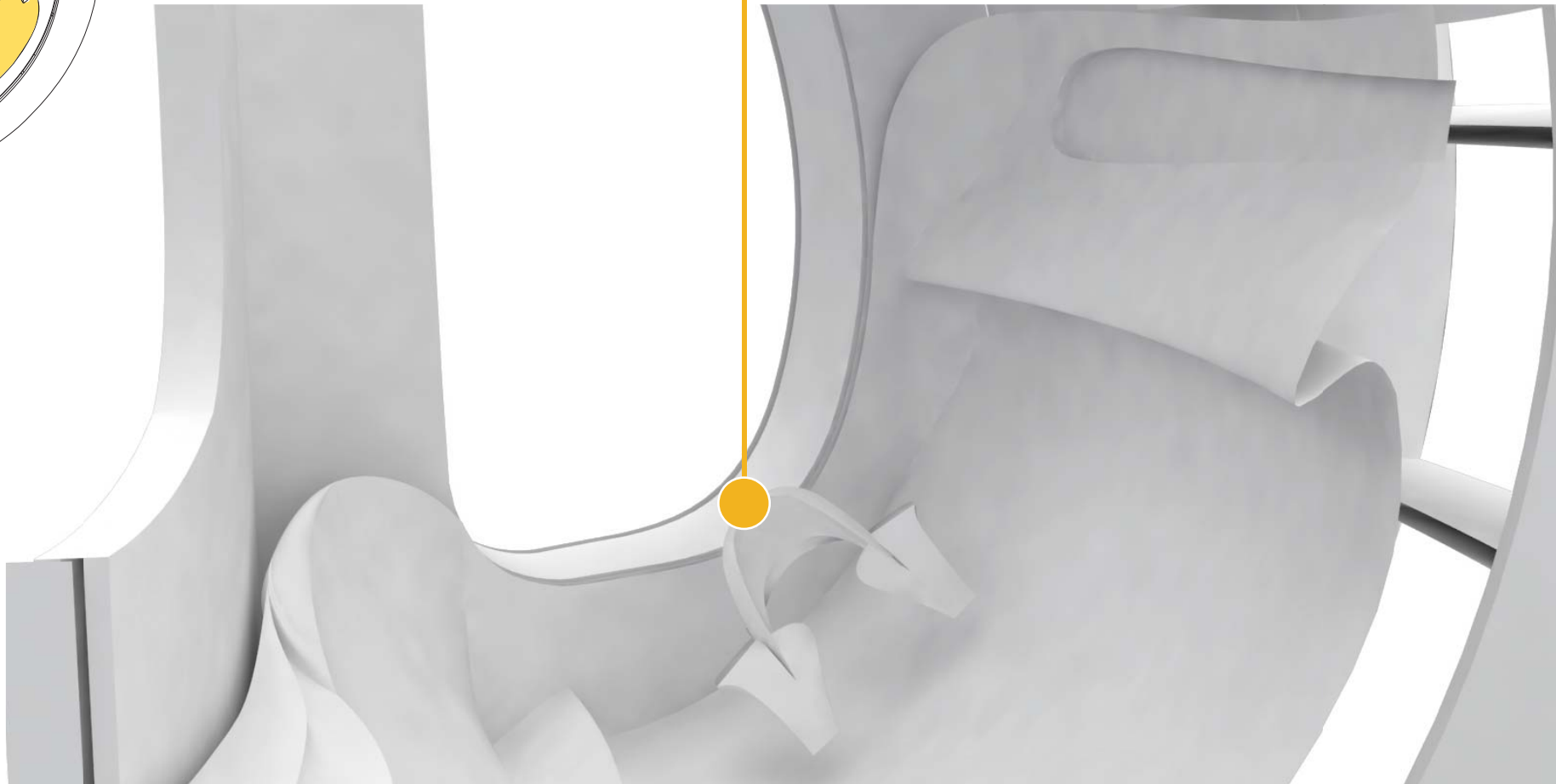


SLEEP POD: Hans Device



HANS device

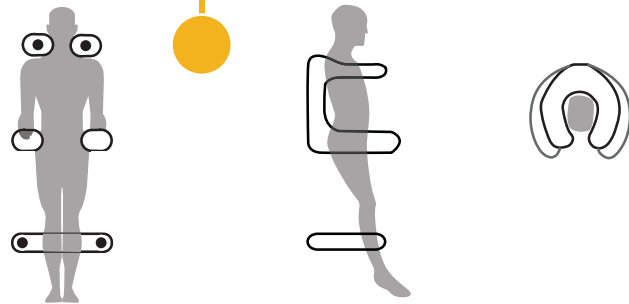
Neck/head support for sleeping.
Restrains head while allowing
movement for rest of body



Sleeping on the ISS

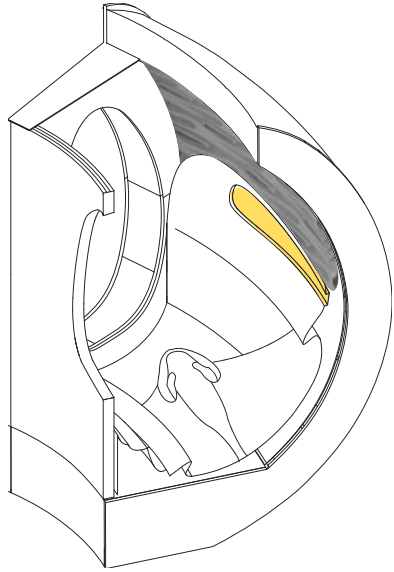


Previous Design



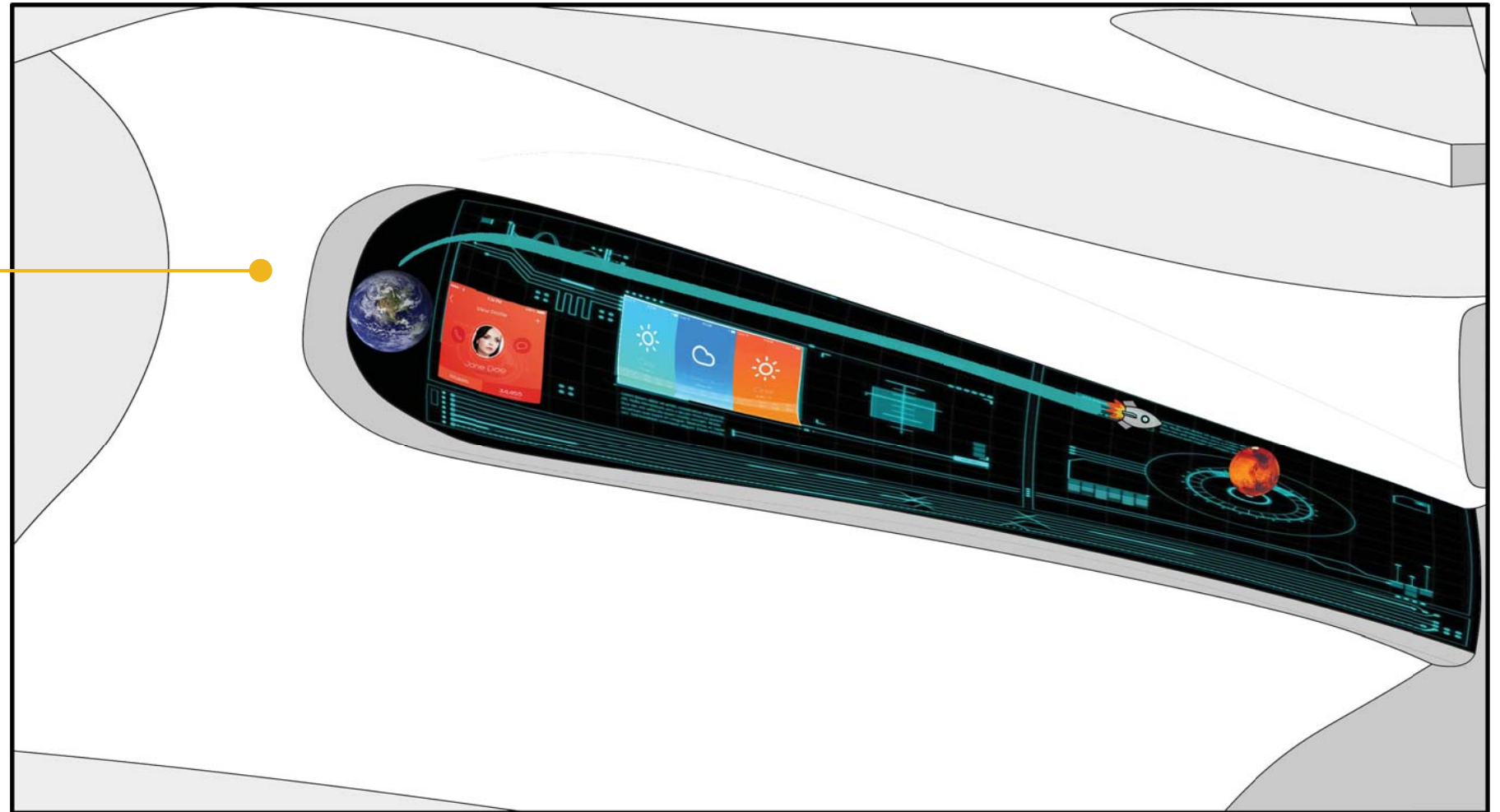


SLEEP POD: Control Panel



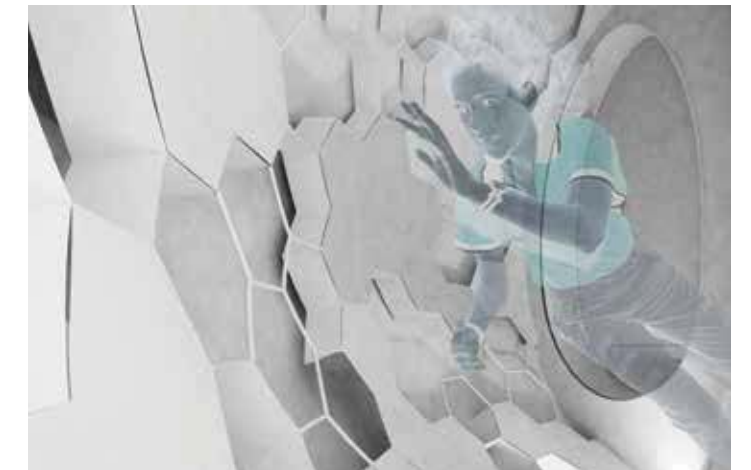
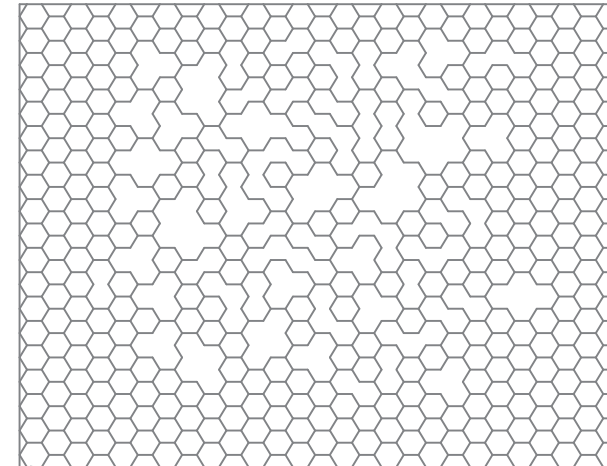
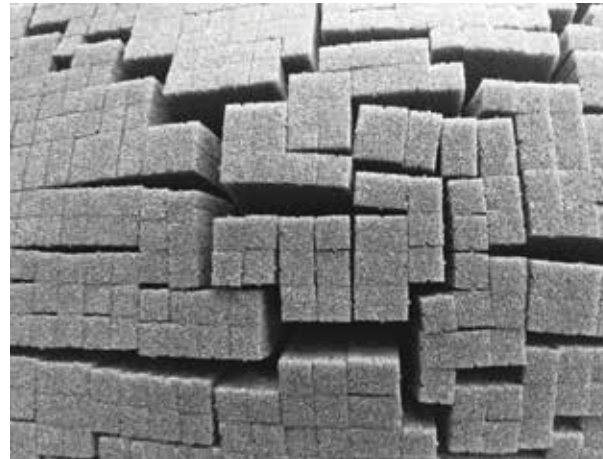
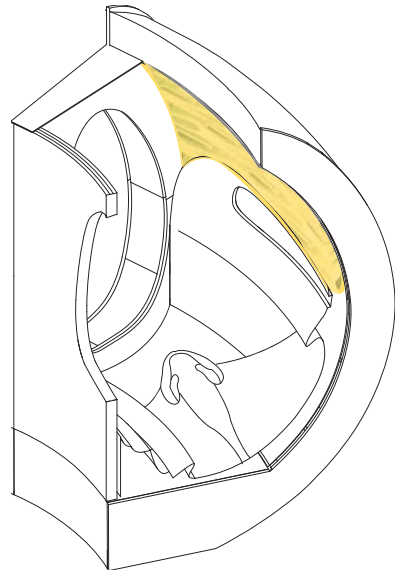
Personal Interface

The interface can be used for communication and display various information. It is also used to adjust lighting and other various settings in the sleep pod.





SLEEP POD: Storage/Handle Wall



Lighting Opportunity

We performed material experiments to determine lighting strategies with - in the wall surface. Underlit crevices provide subtle integration of LEDs.

Pattern for Function

We prototyped patterns for the wall that could easily integrate storage and handles for functionality and variety.

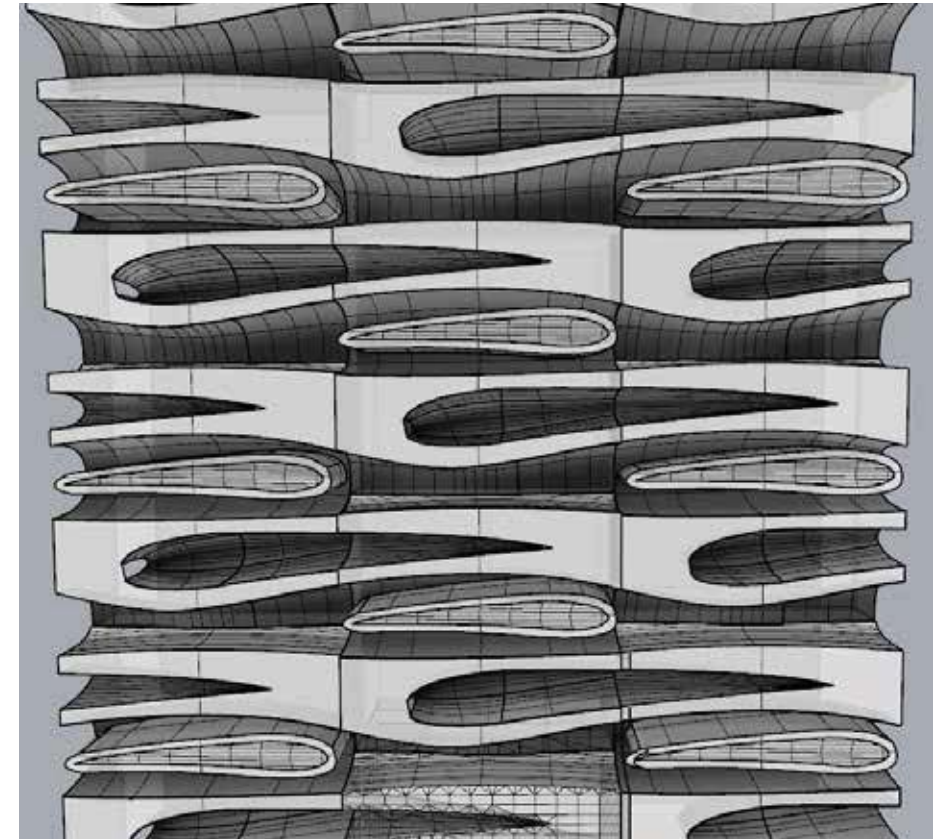
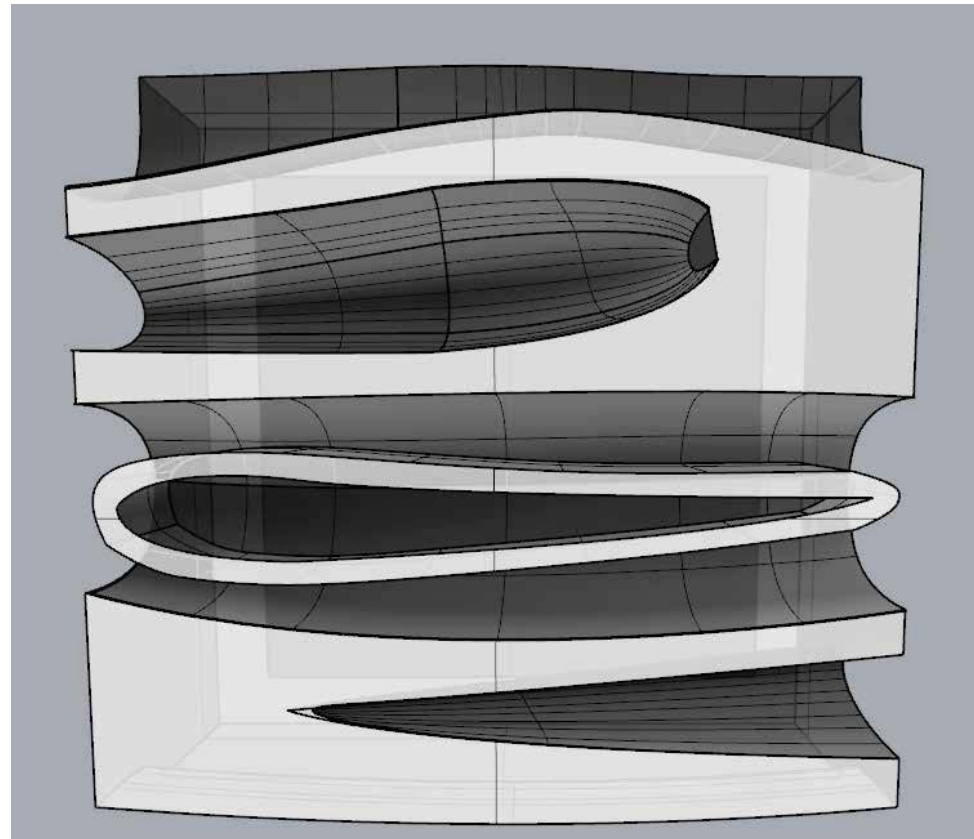
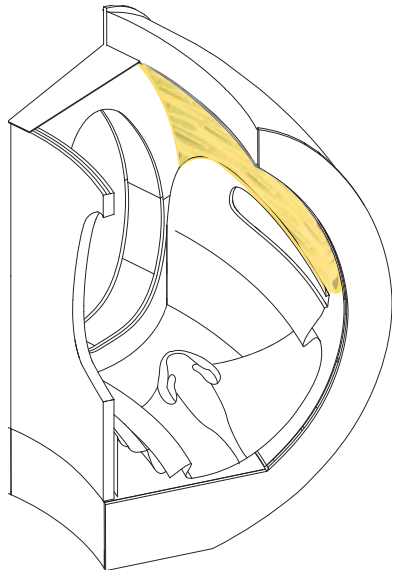
Handles for Movement

Cavities in the wall pattern would provide for ease of movement throughout the pod.





SLEEP POD: Storage/Handle Wall



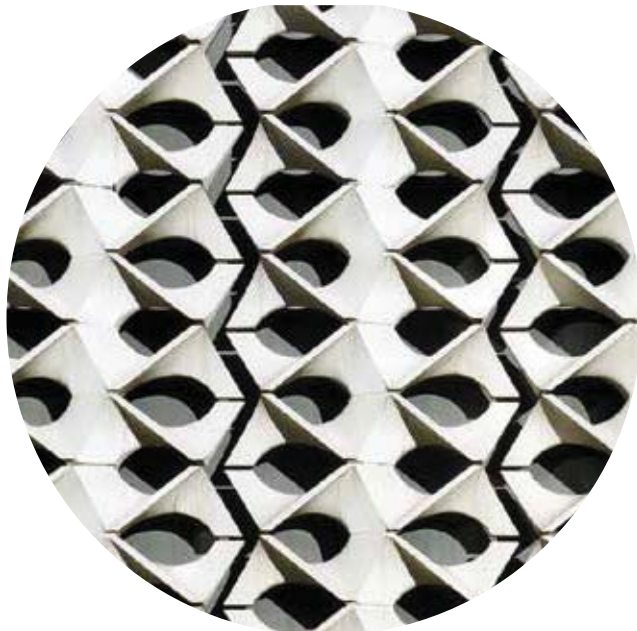
Wall pattern

The wall is designed as a system of tiles that undergo CNC operations to produce cavities for handles and storage.





SLEEP POD: Materials



Complex Surfaces

Hard and soft organic surfaces which create interest and functionality within the space.



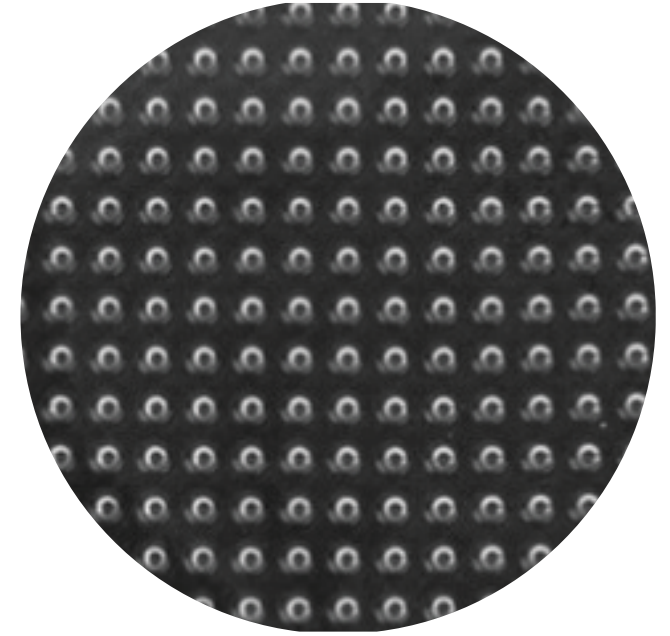
Waterproof Foam & Fabric

Soft materials which encourage comfort as well as hygiene. Easy to clean and maintain.



Touch Surfaces

Integrated responsive technology that reacts to touch for functional commands within the pod.



Grip Pads

Textured materials like hook and loop, silicone. For security in movement as well as attaching objects to surfaces.

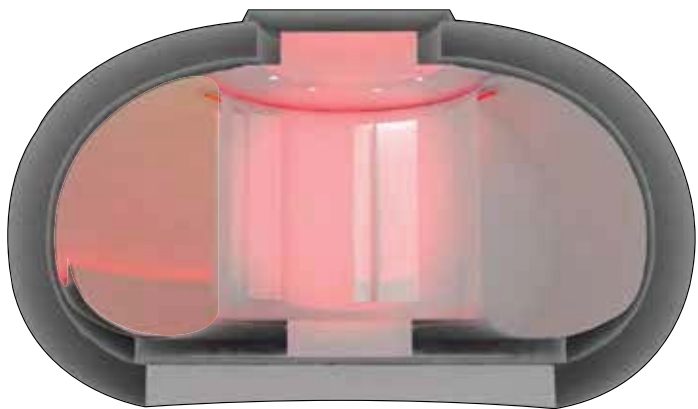
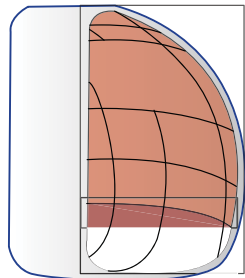




SLEEP POD: Lighting

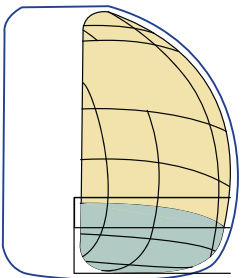
Sunrise/Sunset

The color of the LEDs integrated into the wall simulate a sunrise and sunset to maintain the astronauts' body clocks.



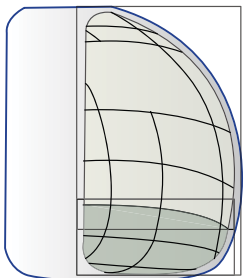
Moonlight

The color of moonlight provides for a sleep-friendly environment while providing minimal lighting to necessary functions within the pod.



Overcast

Soft daylight allows for productivity and light that is not harsh to the eyes.





SLEEP POD: Fabrication



Construction

Early models in 1/6 scale

Exploring building methods with different materials; cardboard, muslin, plastics.

Models explore how connections would be made in potential materials, and treatment of surfaces.





SLEEP POD: Fabrication



Construction

1/6 scale models explore connections between foam and tyvek

Interactions: weight, ability to stretch/pull, durability.





SLEEP POD: Fabrication



Construction

Curved rib slotting connection test



Construction

Edge treatment of cardboard test



Construction

Tyvek to cardboard to foam connection test





SLEEP POD: Fabrication



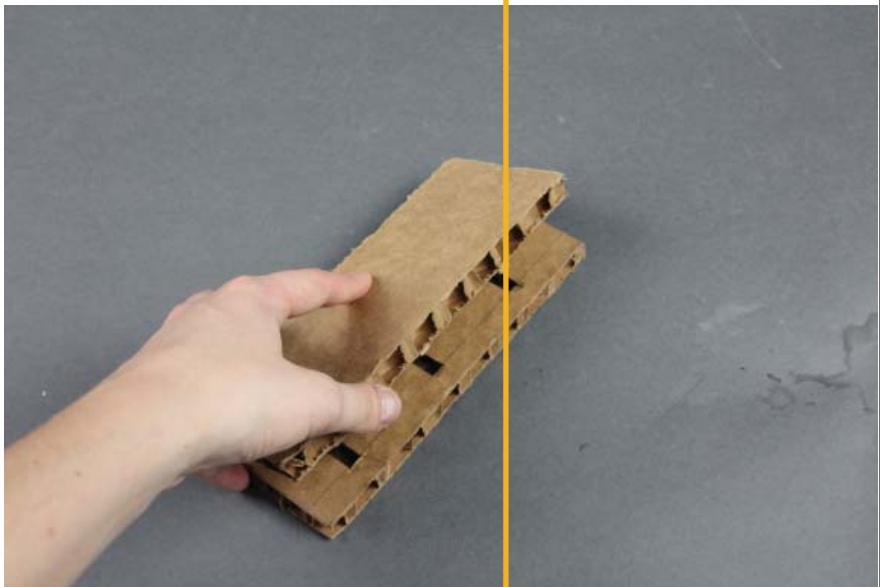
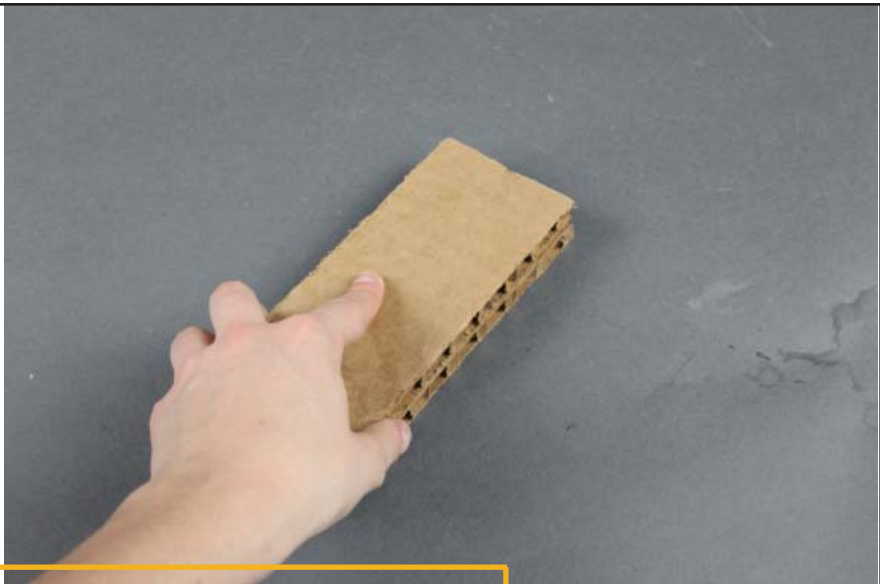
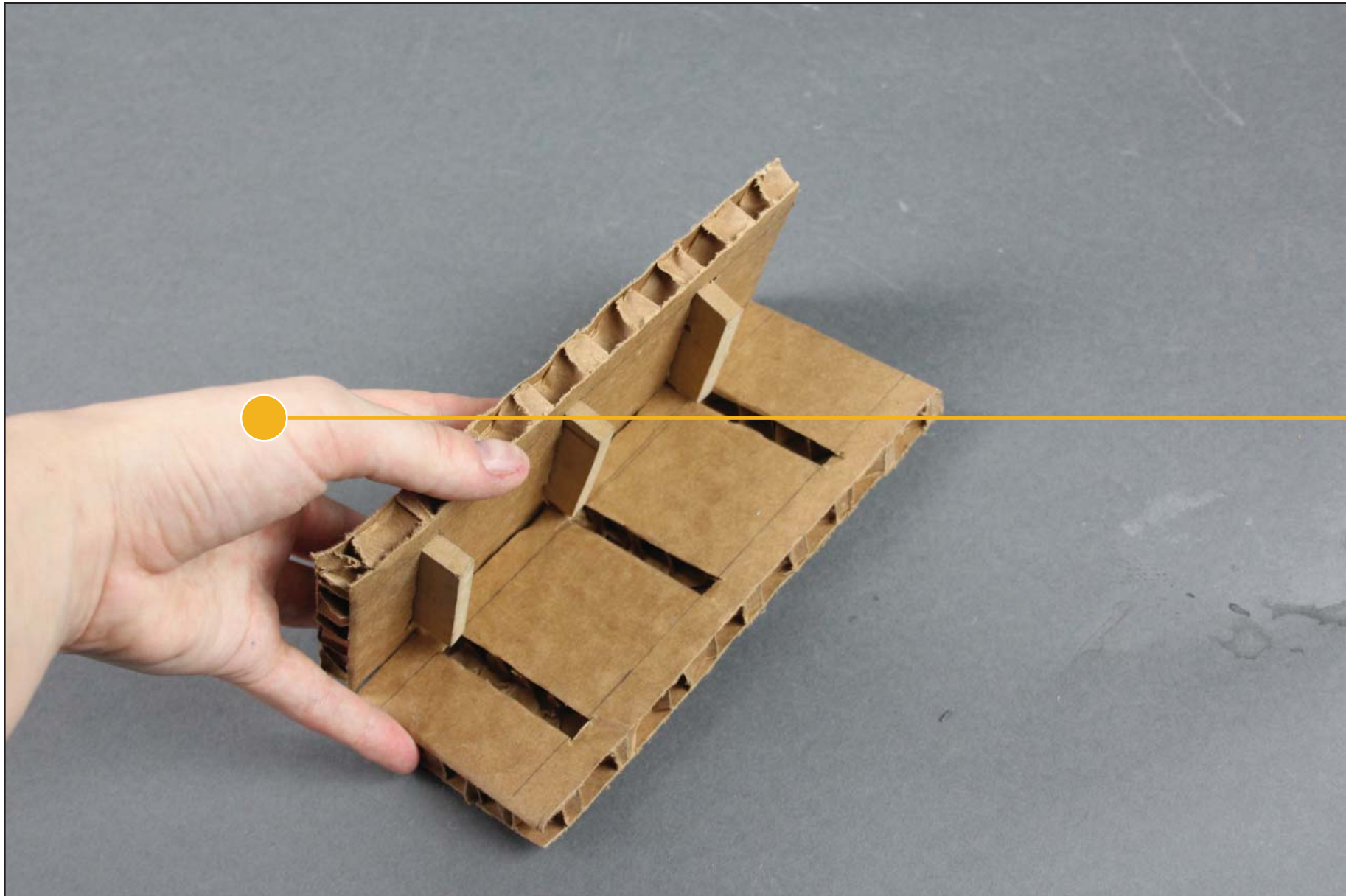
Construction

Half scale model





SLEEP POD: Fabrication



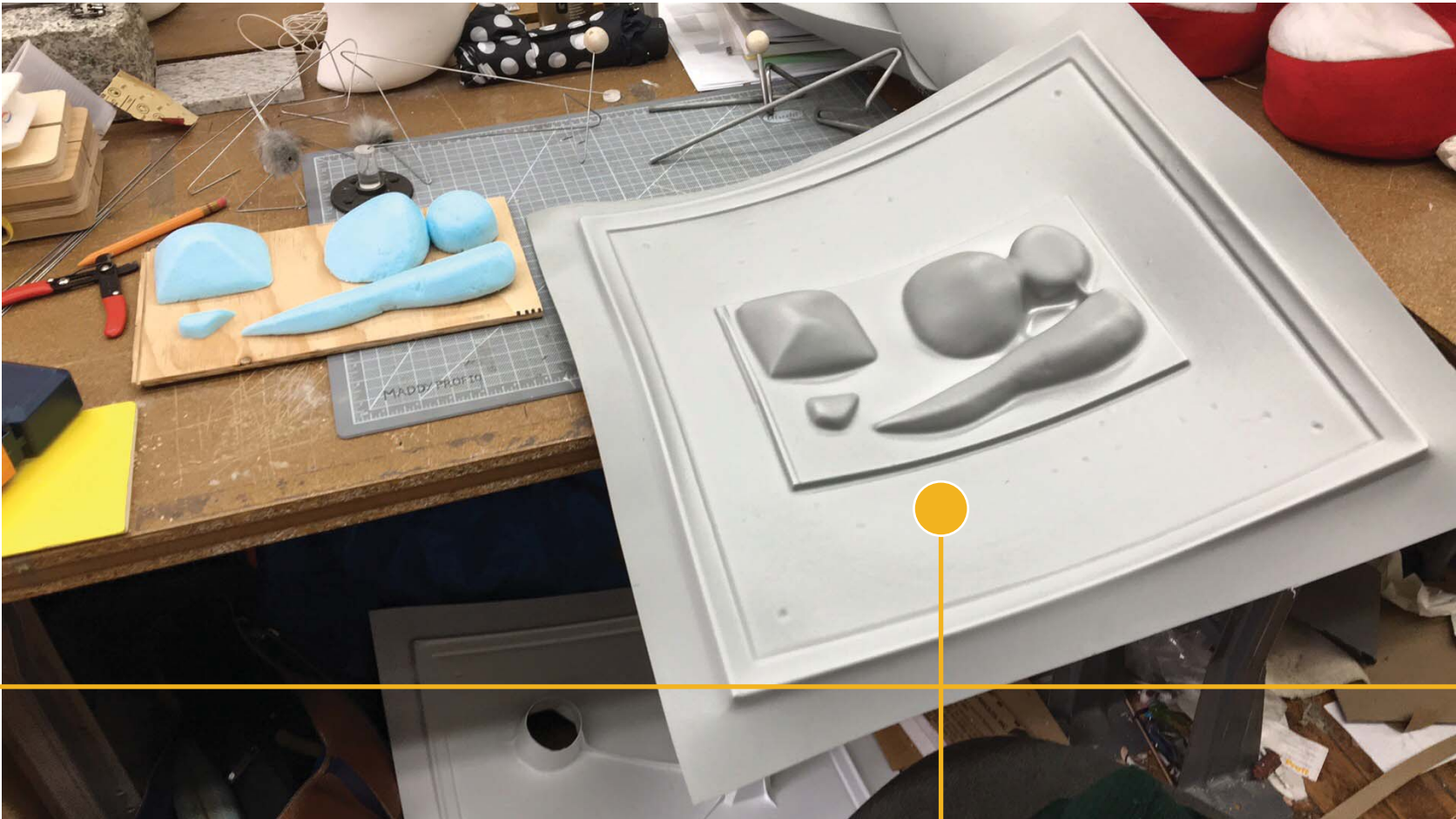
Joint Test

Male - female joint tests for connecting cardboard pieces of full scale





SLEEP POD: Fabrication



Material Testing

Vaccum formed EVA foam

Material Testing

Blue foam mold creates shape for vaccuum form test

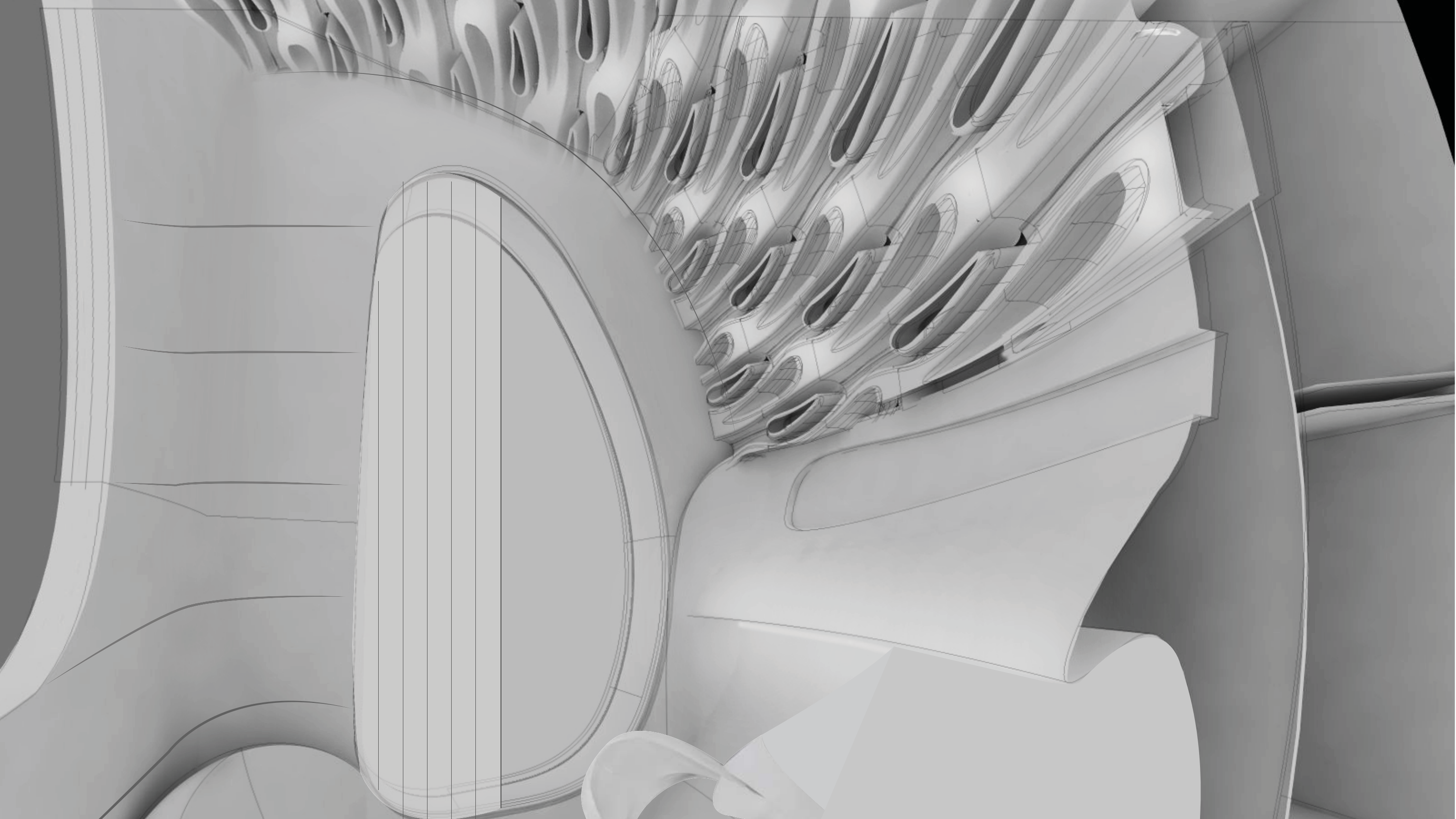


SLEEP POD: Fabrication



Full-Scale Prototype

Comprised of 6 pieces of 1 inch thick honeycomb cardboard that can be disassembled and re-assembled with bolts

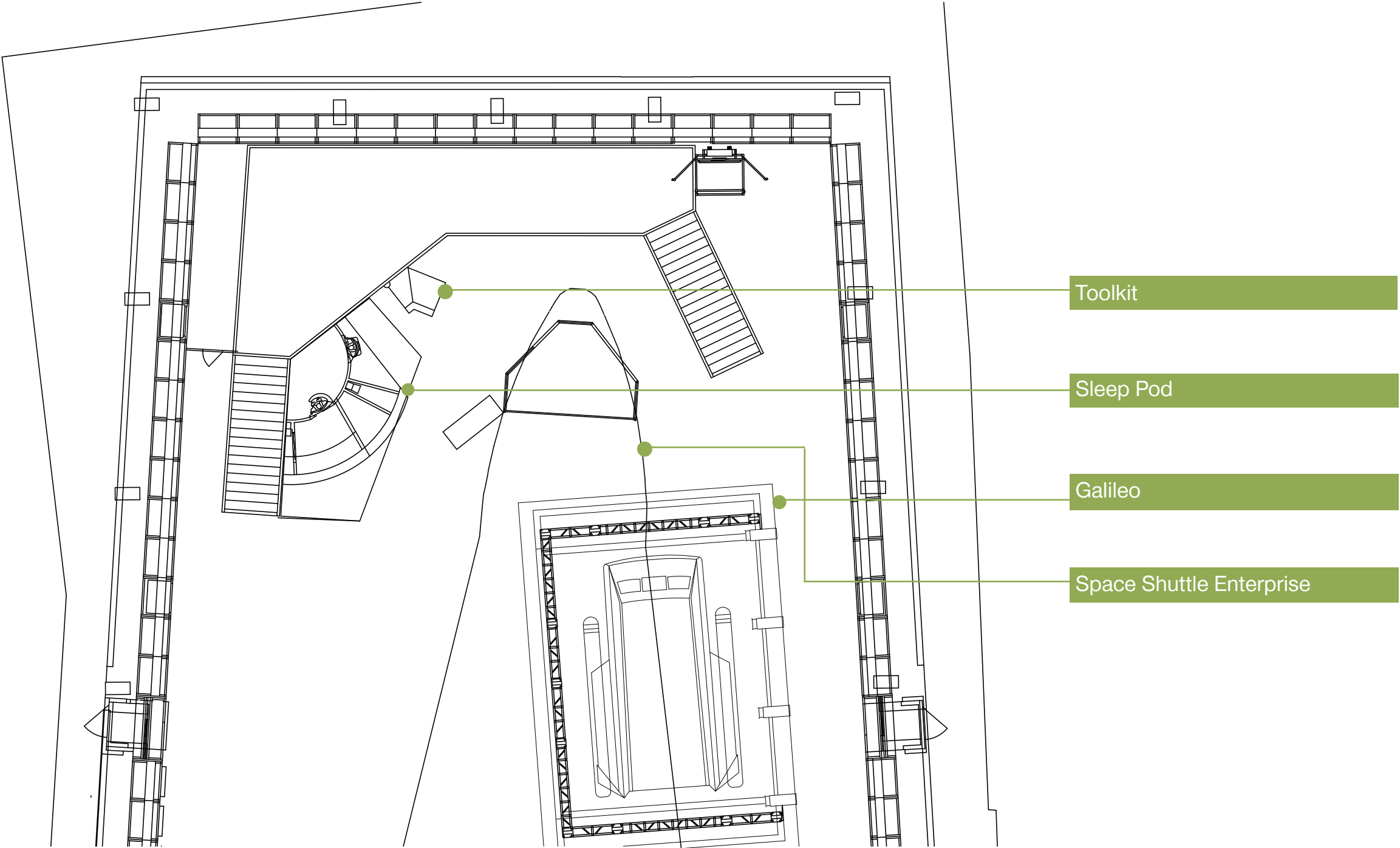


THE INTREPID SEA, AIR, AND SPACE MUSEUM

SPACE AND
SCIENCE
FESTIVAL
JULY 2016

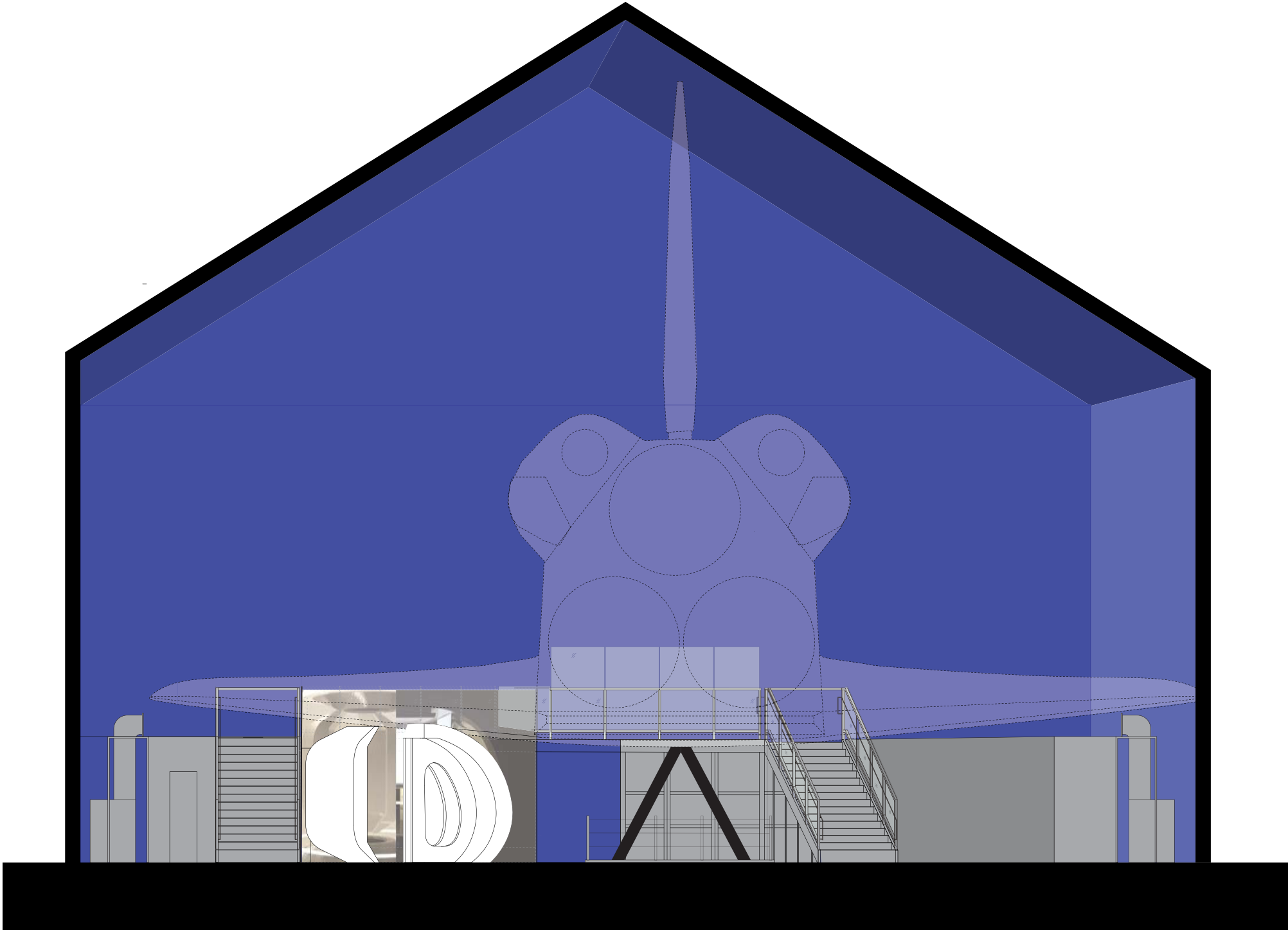


THE INTREPID MUSEUM



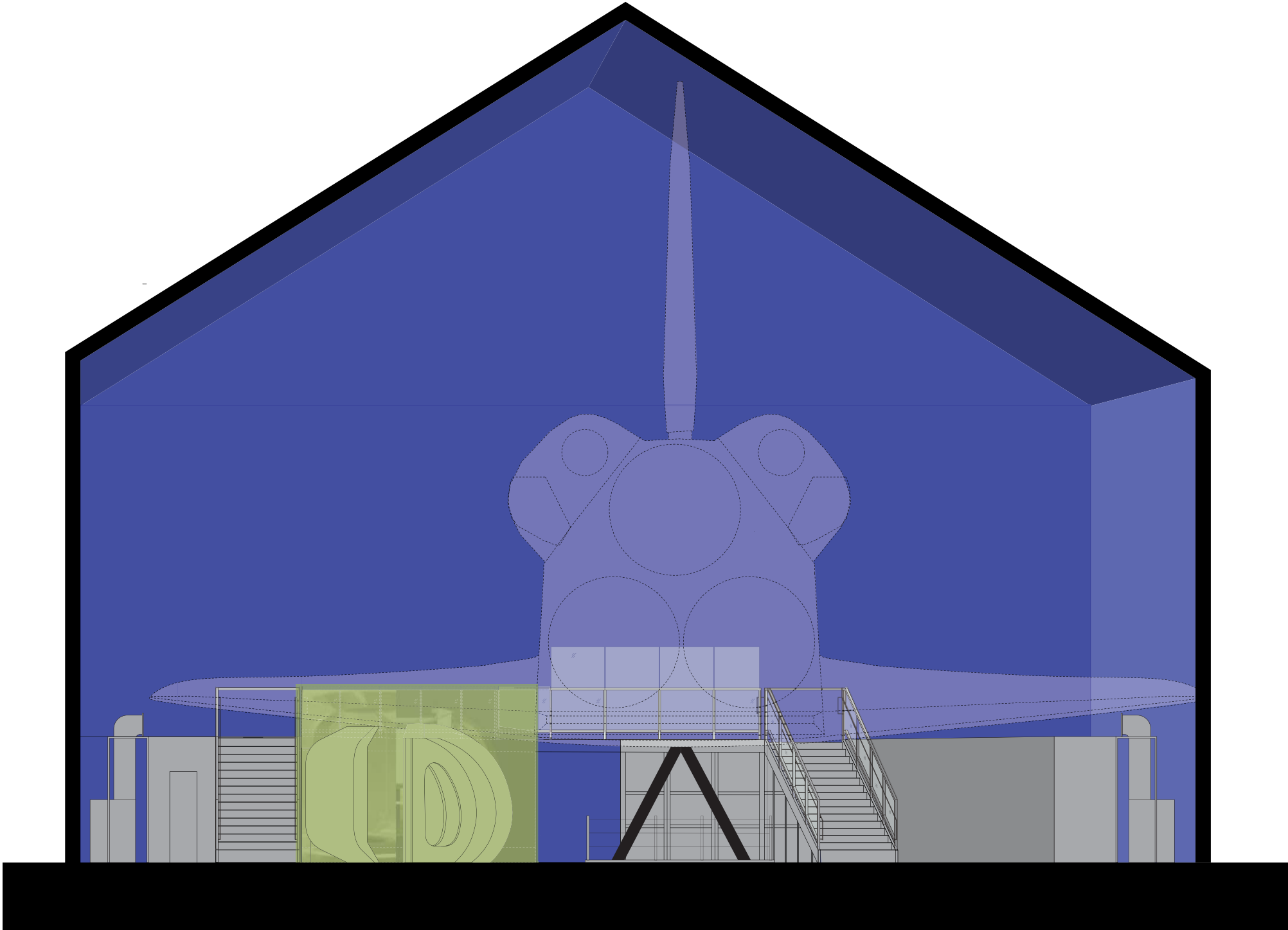


THE INTREPID MUSEUM



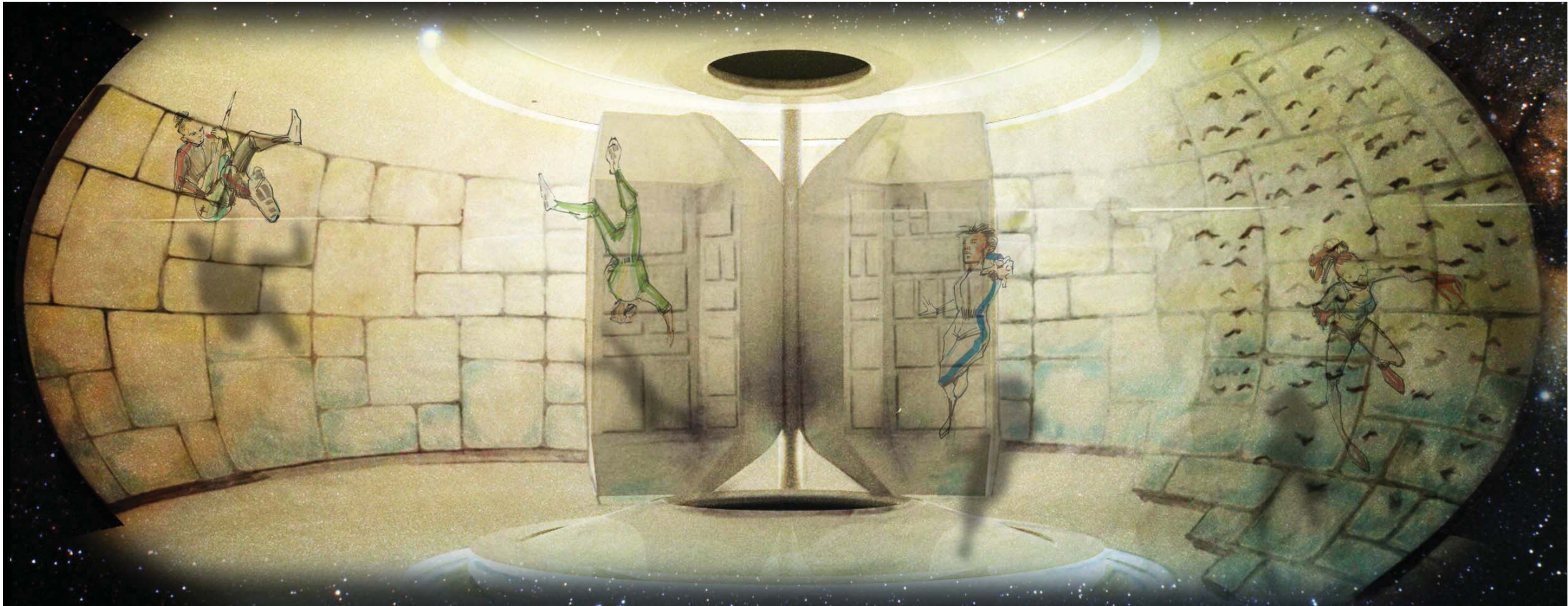


THE INTREPID MUSEUM



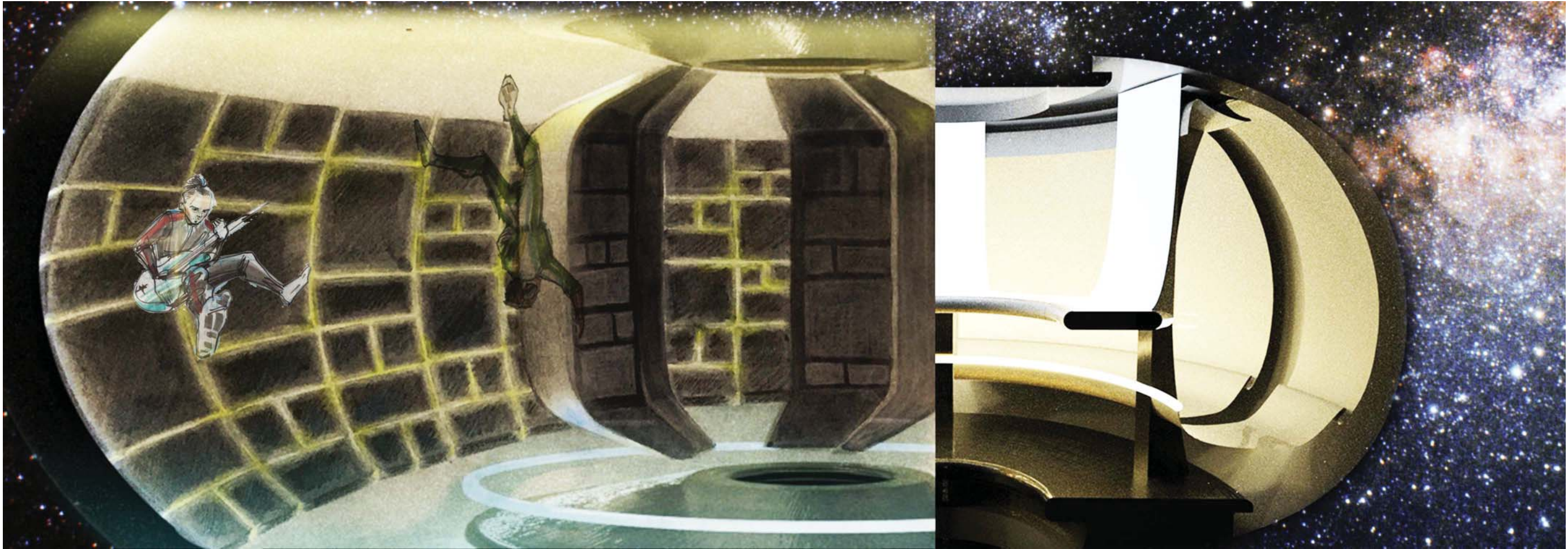


WALL GRAPHIC ITERATIONS





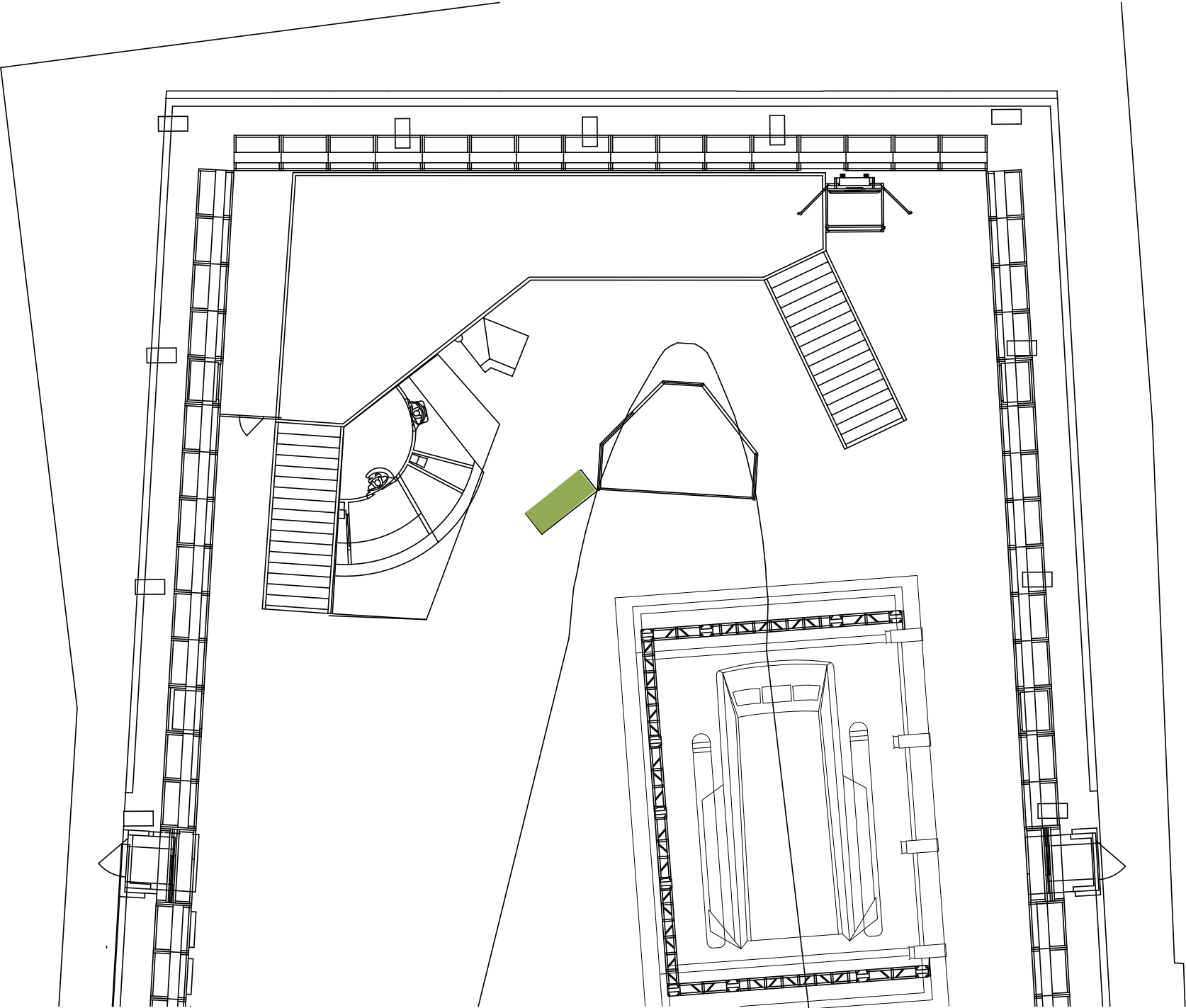
WALL GRAPHIC ITERATIONS





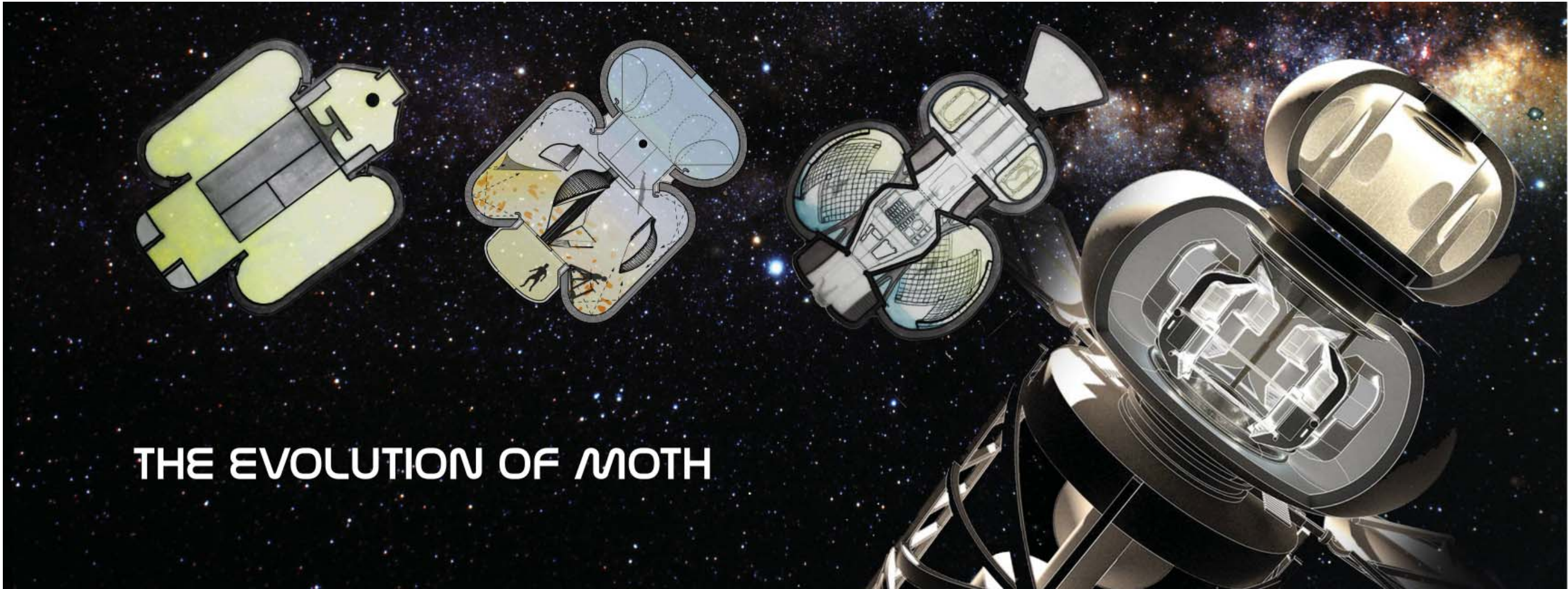


THE EVOLUTION OF MOTH



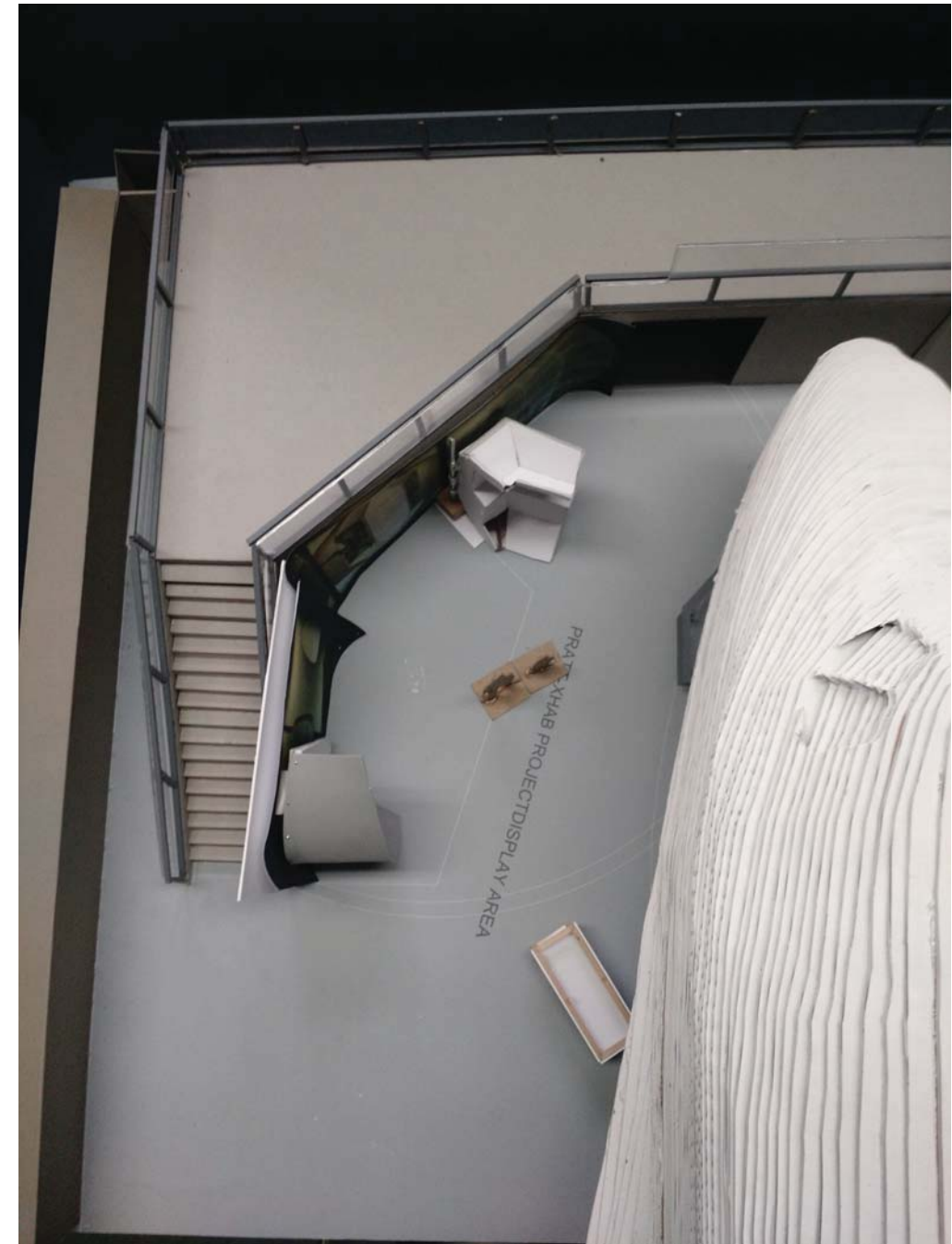


THE EVOLUTION OF MOTH





THE INTREPID MUSEUM



GOING FORWARD, WE PLAN TO FINALIZE OUR PROTOTYPES AND GRAPHICS FOR THEIR
INSTALLMENT AT THE INTREPID MUSEUM SITE IN JULY



Pratt



SPECIAL THANK YOU TO

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