FOCUS

A better life in space

IGLUNA 2020
Project Show

Professors: PhD Annalisa Dominoni, PhD Benedetto Quaquaro
Students: Dluhosch Joao, Herrera Laura, Memo Francesco, Toldo Riccardo

swiss space center

POLITECNICO MILANO 1863

introduction

team structure

Annalisa DOMINIONI
Prof PhD Design

Benedetto QUAQUARO
Prof PhD Design

Francesco MEMO
Integrated Product Design

Team Leader
Coordination team leader

Laura HERRERA
Integrated Product Design

Alternate Team Leader
Communication and first
coordination responsible

Joao DLUHOSCH
Integrated Product Design

Financial, Material and
Sponsors Team Leader

Riccardo TOLDO
Integrated Product Design

Design and Technical
Team Leader

introduction

presentation summary

why

- Astronauts' daily lives
- Design in extreme environments
- Building on cooperation
- Final goals

how

- Plan of action
- Redefining food experience
- 3D printing in space
- Local production resources

what

- Subsystems
- Archaic
- Ma.Co
- Sugamuxi
- UV Disinfection

Conclusions

Q & A

Austronauts’ daily lives

first investigation

Space Cookies with DoubleTree

Insights

Food can still be linked to the emotional side of daily routine

Preparing the meal can be explored as a pleasurable part of space living

SOURCE: The Verge

Austronauts' daily lives

first investigation

ISS microbe swab kit

Insights

Microbes are a serious concern on space exploration, and one variable that is literally part of ourselves

Surface and tool cleaning is an essential part of space habits

SOURCE: NASA

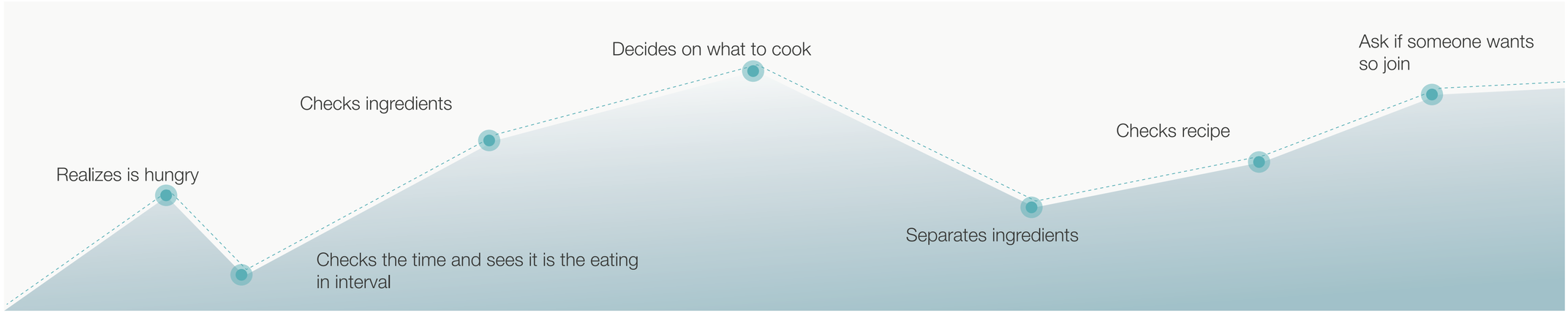
Austronauts' daily lives

routine mapping

Steps

/ preparation /

Actions



Thoughts

"That late already? I need to start cooking."	"What do we have here?"	"I wonder what I could cook with this."	"Where are the onions again?"	"Okay, so these are the steps that I have to follow."	"Maybe I should ask if someone wants to eat with me."

Feelings

Is a little stressed about the thought of having to cook.	Is curious if anything new can be cooked with the same daily ingredients.	Hopes that he can cook something nice for himself.	Stresses about the small space to cook in.	Is not so sure about the steps to take to make the recipe.	Enjoys the thought of having company for his meal.

Opportunities of each step

PREPARATION

how the food is stored. Secondly, the set of tools with which the raw foodstuffs are transformed into ingredients ready for the cooking step. Another aspect is the cleaning of said ingredi-ents, ince this is essential for a healthy and pleasant meal. Finally, there is the work area and its related furniture, with ergonomics and versatility in mind.

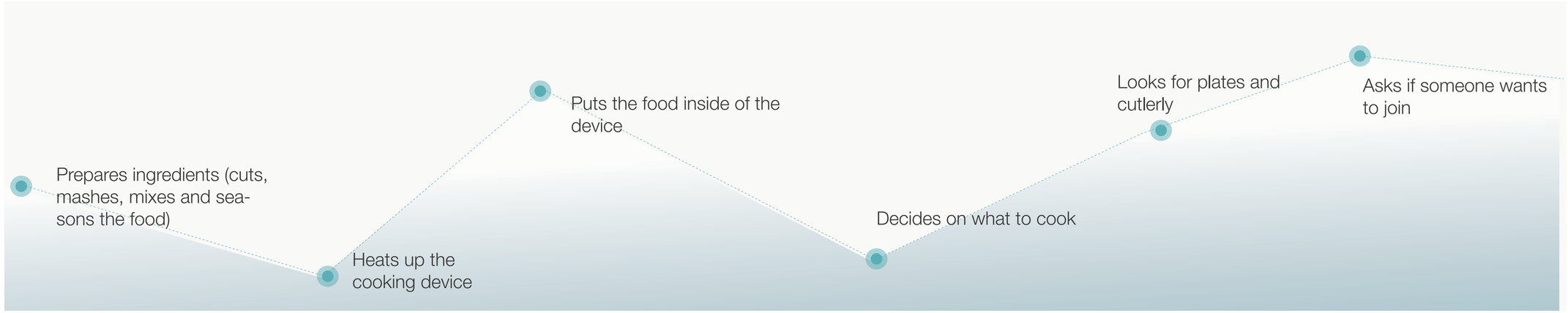
Austronauts' daily lives

routine mapping

Steps

/ cooking /

Actions



Thoughts	"Gotta be careful with these knives!"	"So, where do I turn this on?"	"Okay, I think I can put the food inside already."	"How long until it's done?"	"I think the plates are over there."	"Woah, it's smelling good!"
Feelings	Is cautious while cutting and preparing everything.	Is upset about the controls of the cooking device.	Starts to get excited about the meal he will have.	Get annoyed by the it is taking for his meal to be ready.	Gets anxious, trying to get everything ready to eat as soon as possible.	Is delighted that the meal came out better than expected.

Opportunities of each step

COOKING

As mentioned in the previous step, the tools for preparation of the ingredients could also be the same tools used during the cooking process. Such operations can include stirring, mixing, grabbing, flipping, and so on. This step also shows an unique opportunity - the transformation of ingredients into a proper meal. The most basic intervention in this topic would be work in a cooking device capable of heating, and as such preparing what is considered in Earth a home made meal.

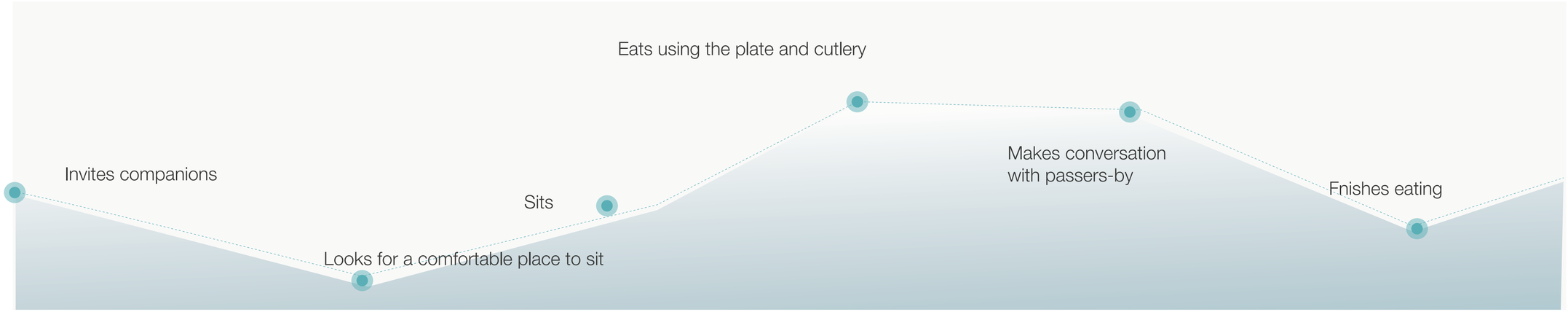
Austronauts' daily lives

routine mapping

Steps

/ eating /

Actions



Thoughts	"I should let the rest of the people know that the food is ready."	"So, where should I sit?"	"Here is fine."	"I didn't realize how hungry I was."	"It's nice to have a chat with everyone"	"Oh boy,that's enough."
Feelings	Wonders if anyone else wants to share the meal with him.	Ponders which would be the place to eat.	Is content with his usual spot.	Feels fulfilled and nourished with what he cooked.	Is happy to have such easy to talk to companions with him.	Feels a little bit sleepy.

Opportunities of each step

EATING

The eating step is characterized by mainly low-tech object archetypes. However, such objects can induce behavior and promote mental wellbeing, mainly through the socialization of the act of eating. Another opportunity that should not be discarded is considering what is necessary to eat comfortably, which translating to objects, could vary from furniture to proper lighting and even to an specific soundscape inducive to relaxation.

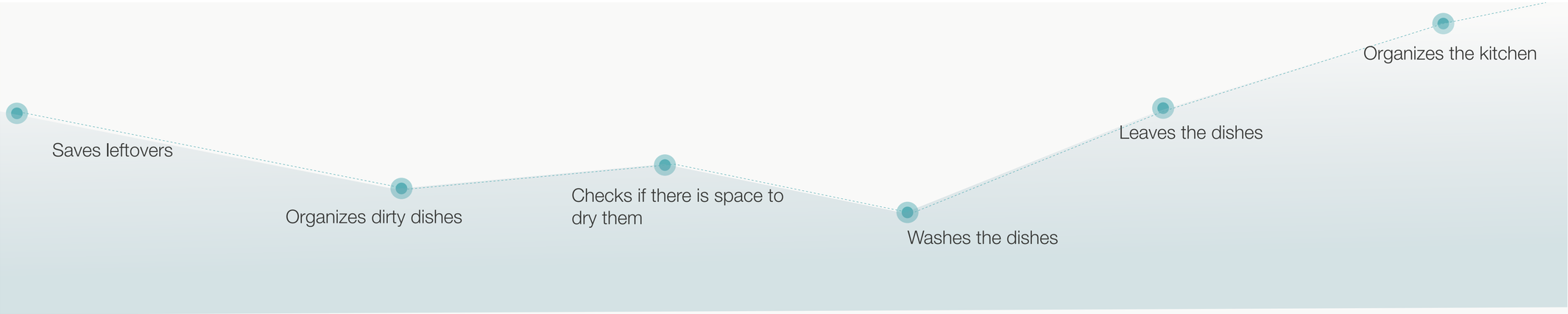
Austronauts' daily lives

routine mapping

Steps

/ cleaning /

Actions



Thoughts	"Nice, this should be enough for dinner"	"I actually used a lot of things to cook."	"Is there any space, or do I need to make some?"	"In the Moon and still have to wash dishes."	"I think they'll dry by them-selves."	"Nice and tidy, just as I found it."
Feelings	Is happy that what he cooked is enough for an-other meal.	Is annoyed by, the fact that he dirtied so many plates and appliances.	Ponders if his companions actually cleaned everything they used or not.	Is very upset about, the mundaneness of his task.	Is content that it didn't took him that long.	Feels oddly satisfied, with his organization.

Opportunities of each step

CLEANING

The final step could be also considered the most mundane one. Cleaning is an essential part of any daily life, and when related to food, it becomes central for the maintenance of the rou-tine. Here may be possible to share solutions with the preparation step of the journey, and as a result, simplify the steps or the number of artifacts necessary for each task.

design in extreme environments

main challenges

Volume and freight space

One of the most valuable resources in space missions is the freight volume available, and how small one object can be packed.

Step by step usage

Humans are constantly under stress in an extreme environment. Considering this, all non essential equipment should not need a specific instruction manual to be used.

Backup deployment

Time constraints regarding mission planning and deployment make emergency calls that were not accounted for especially difficult.

Functionality first

Function must come first. Extreme situations ask for objects where most possibilities were accounted for.

design in extreme environments

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Compact

Design solutions where the part to be transported is thought out to be as small as possible.

Intuitive

The solution itself teaches it how to be used, not requiring previous training.

Easily repairable

Use of backup parts that can be transported together with the main solution, and easily changed.

Efficient and effective

Every decision inside the solution has a specific purpose

design in extreme environments

space renaissance

Investigating other space related initiatives, we can describe a new cultural Space Renaissance among contemporary society.

This can be seen as an emerging macrotrend, spanning from private technology focused companies such as SpaceX, Blue Origin and Virgin Galactic, to streetwear and media consumption, such as the Heron Preston partnership with NASA in 2018.

We want to leverage this excitement to bring new ideas, contributing to the spacefaring missions and goals we believe in.

spaceX crew dragon - ISS docking

SOURCE: spaceX

Heron Preston x NASA 2018

SOURCE: Dezeen

design in extreme environments

designer as envisioner

As designers, our main contribution to Igluna 2020 has always been focused on envisioning possible applications through a new perspective, selecting the ones pertinent to the program and developing them together with specialized professionals in their respective areas.

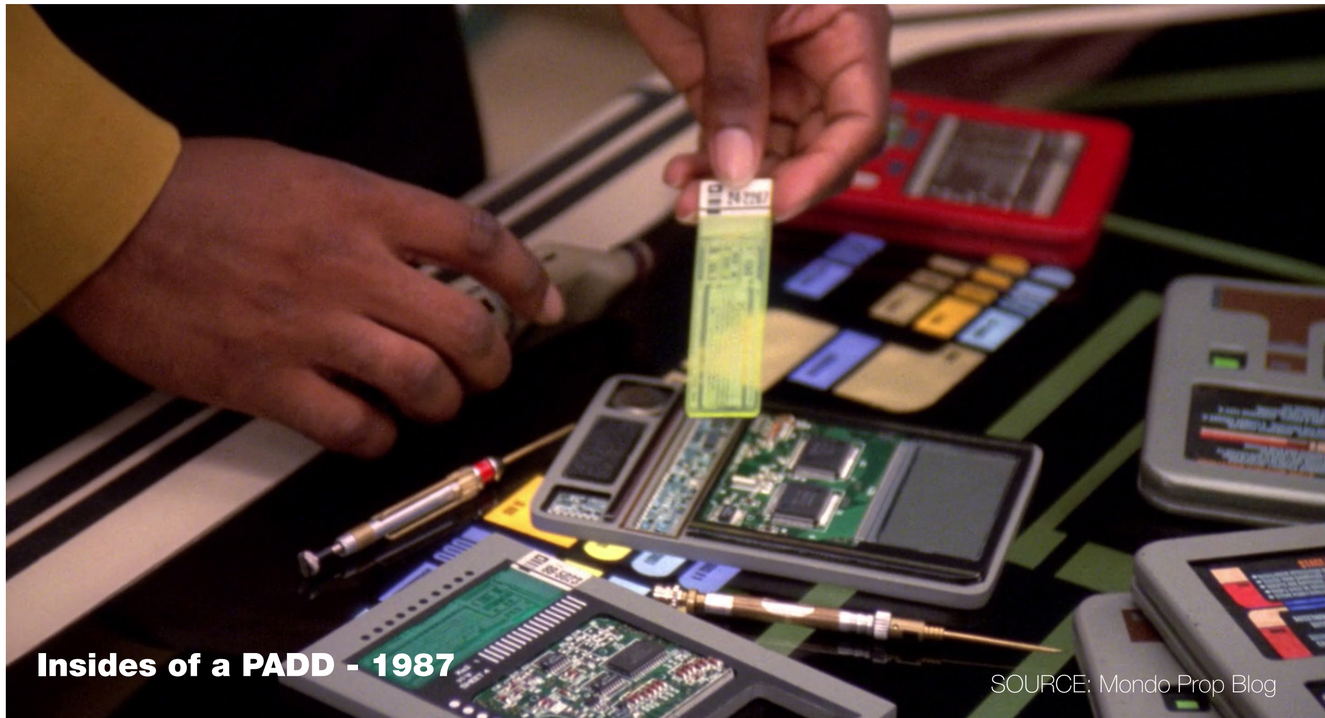
Through envisioning, it is possible to materialize futures and use them as functional references and inspirations, enhancing the reach of existing products and technologies.

materializing new visions

enhancing lateral innovation of existing technologies

Captain Kirk with communicator - 1966

SOURCE: StarTrek



Insides of a PADD - 1987

SOURCE: Mondo Prop Blog

building on cooperation

Igluna 2020

Cooperation was essential for the progress of our team. As a group of purely designers, the Igluna support team gave pivotal engineering criticism, making us approach the developed subsystems with feasibility in mind.

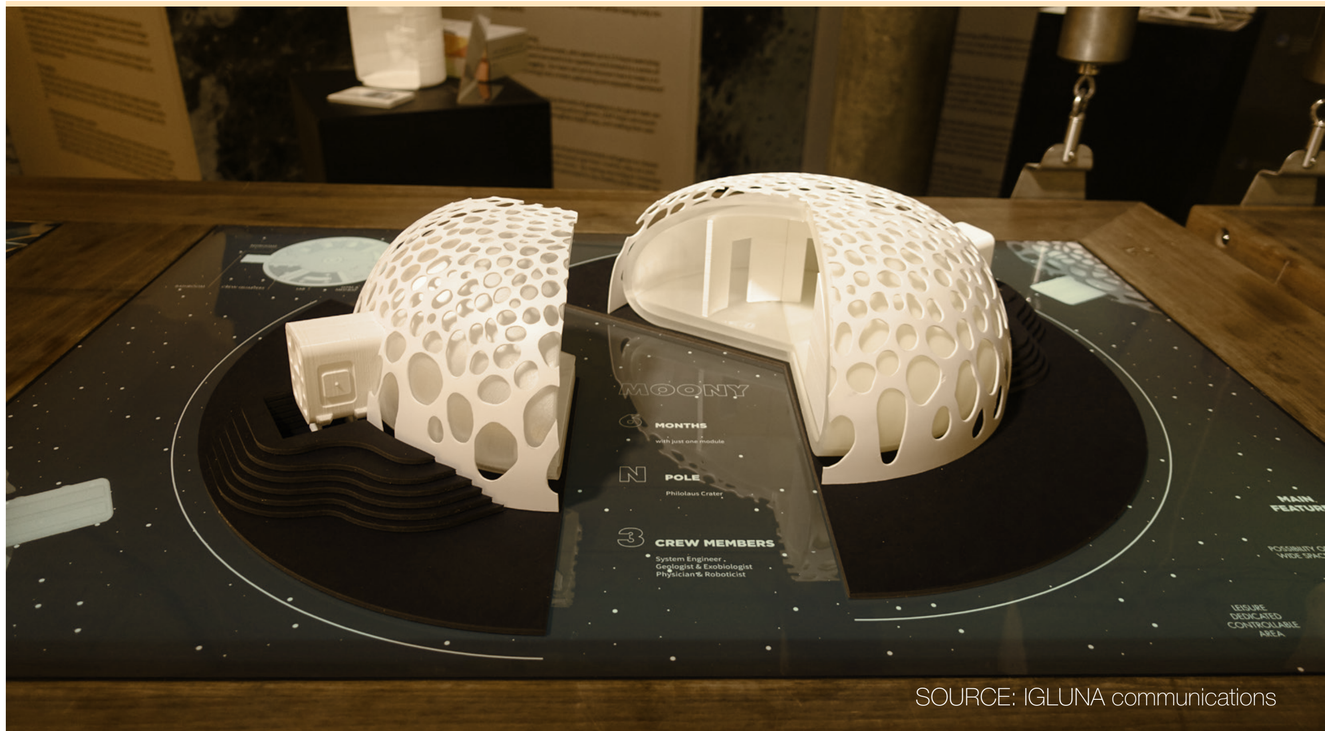
SOURCE: IGLUNA communications

building on cooperation

moony, a lunar habitat

In this context, we developed inside the Moony project, previously presented inside this same program in the past year.

Moony was thought as a modular lunar habitat to be built inside a lava tube, in such a way that it minimizes the materials needed to be brought to be constructed. The project focused on the habitat itself, and as such, we decided to populate with objects in a smaller scale.



SOURCE: IGLUNA communications

final goals of our team

what we want to achieve

Contribute to the wellbeing of astronauts. Live, instead of survive.

Enhance the food making cycle in space, from a functional, social and health point of view.

Push lateral innovation applying existing technology to different contexts.

Communicate in a clear and effective manner how envisioning can enhance technological advancements.

Nurturing new perspectives about living in extreme environments in the close future.

P10_17_focus

plan of action

where is our target?

Inside the IGLUNA2020, one of the priorities from a living perspective has been on production of food on lunar soil.

However, the produced food usually needs to be transformed, in way or another, before being eaten, leaving a gap in the proccess chain.

MELISSA IGLUNA 2020

SWAG SYSTEM

SAMPLE

IGLUNA 2020 V-GELM

food production

food consumption

plan of action

where is our target?

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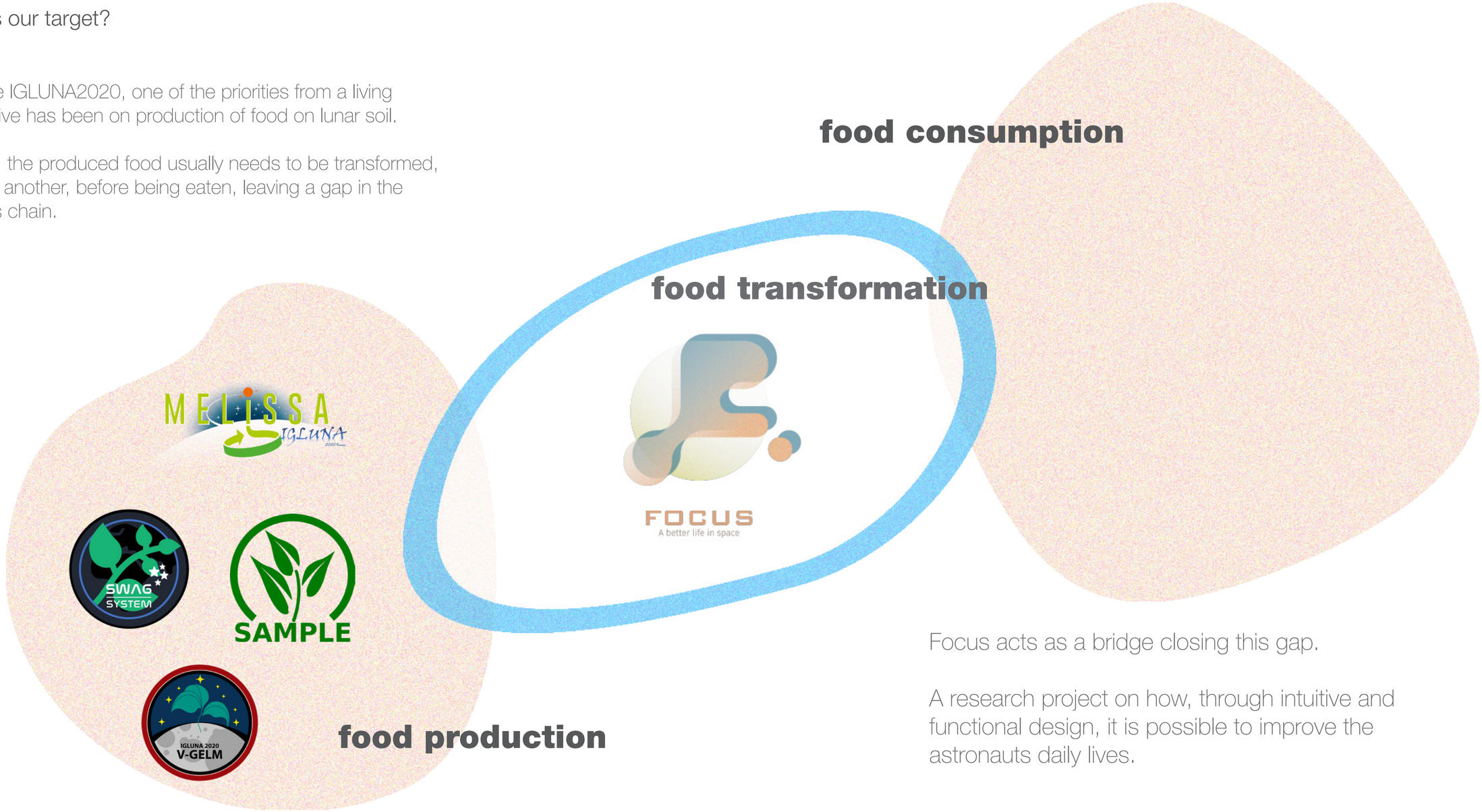
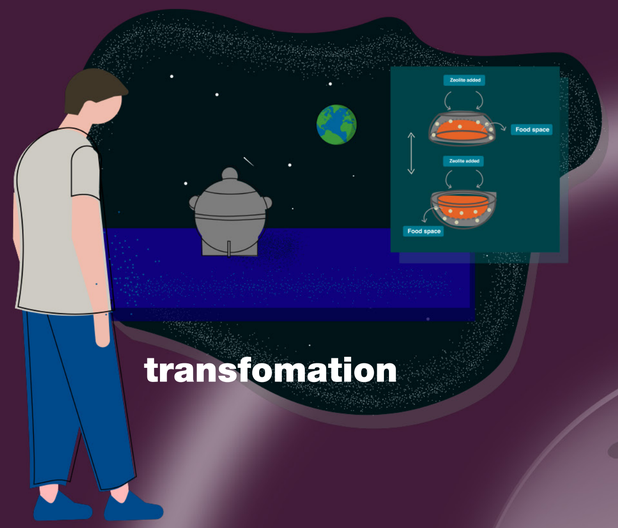


Focus acts as a bridge closing this gap.

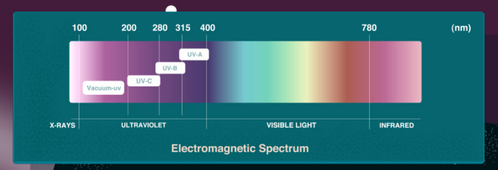
A research project on how, through intuitive and functional design, it is possible to improve the astronauts daily lives.

plan of action

where is our target?

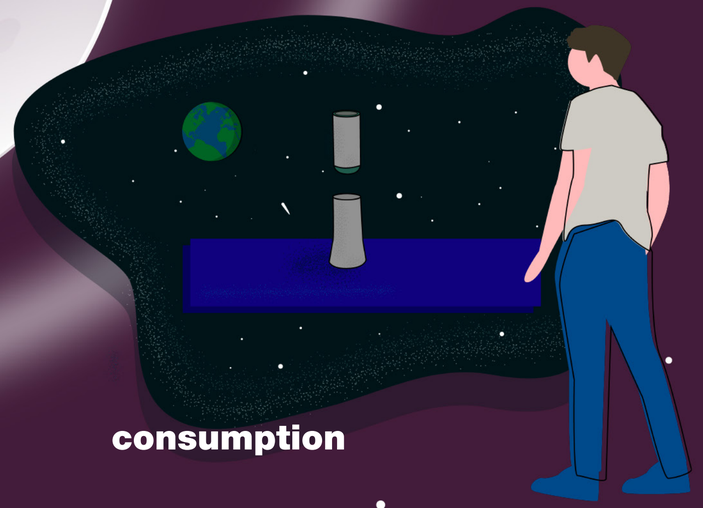


transfomation



cleaning

consumption



consumption

redefining food experience in space

Subsystems overview

cleaning

Cleaning and making sure all the produce doesn't pose a health hazard is a primary concern in a food production to consumption chain.

UV Disinfection provides a low energy consumption alternative to using valuable resources such as water and other liquids to this task.

transformation

Sugamuxi and **Ma.Co**, on the other hand, provide an alternative to cooking with no electricity through completely analog principles.

consumption

Finally, **Ma.Co** and **Archaic** cover the consumption process. Both subsystems provide an Earth-like alternative to astronauts, improving their mental wellbeing through familiarity and comfort.

3D printing in space

I.S.R.U. paradigm

To reduce the mass needed to be freighted, the natural course of action during the project was looking to addictive manufacturing, and, more specifically, to regolith 3D printing.

Focus' projects minimize components to be transported, while designing pieces that will be printed and assembled by the astronauts.

3 main alternatives

Sulfur based concrete, mainly for martian exploration

Powder based fusion through a high output laser device

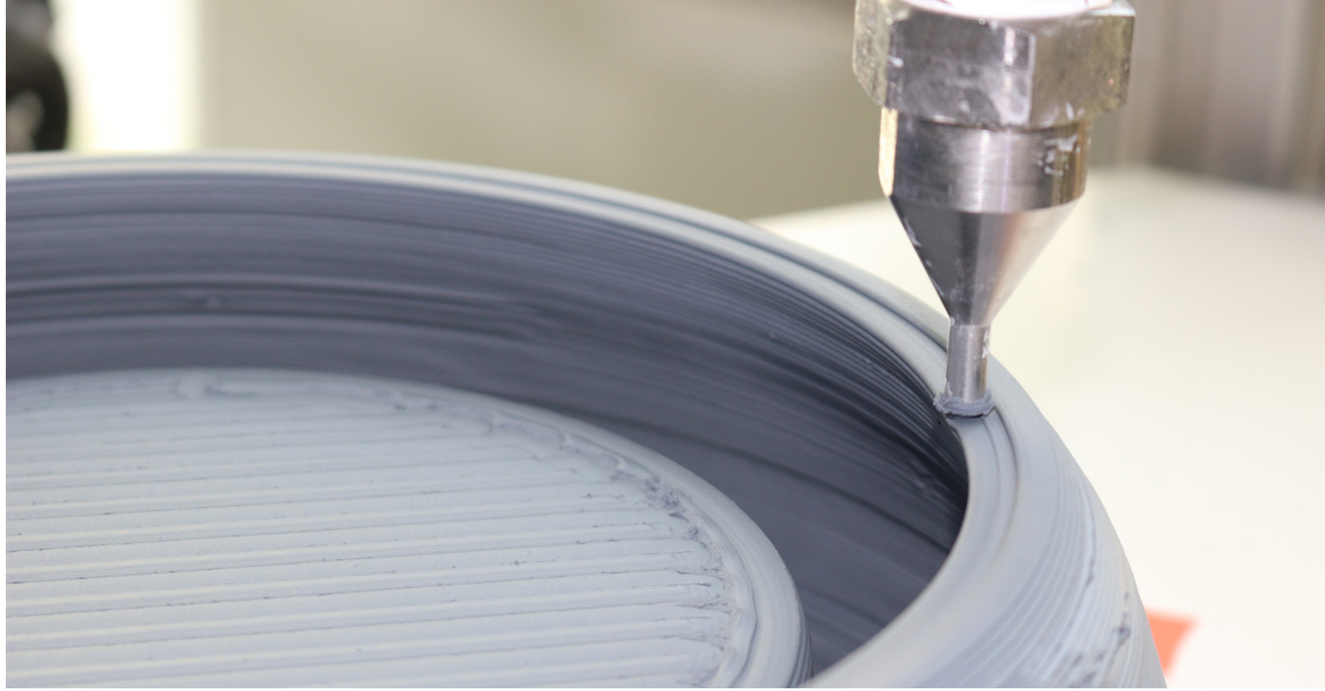
Self-propagating high temperature synthesis (SHS) processes

Local production resources

Clay 3D printing

To simulate the tridimensional aspect of the subsystems, a sponsorship was made with 3D printing lab SuperForma.

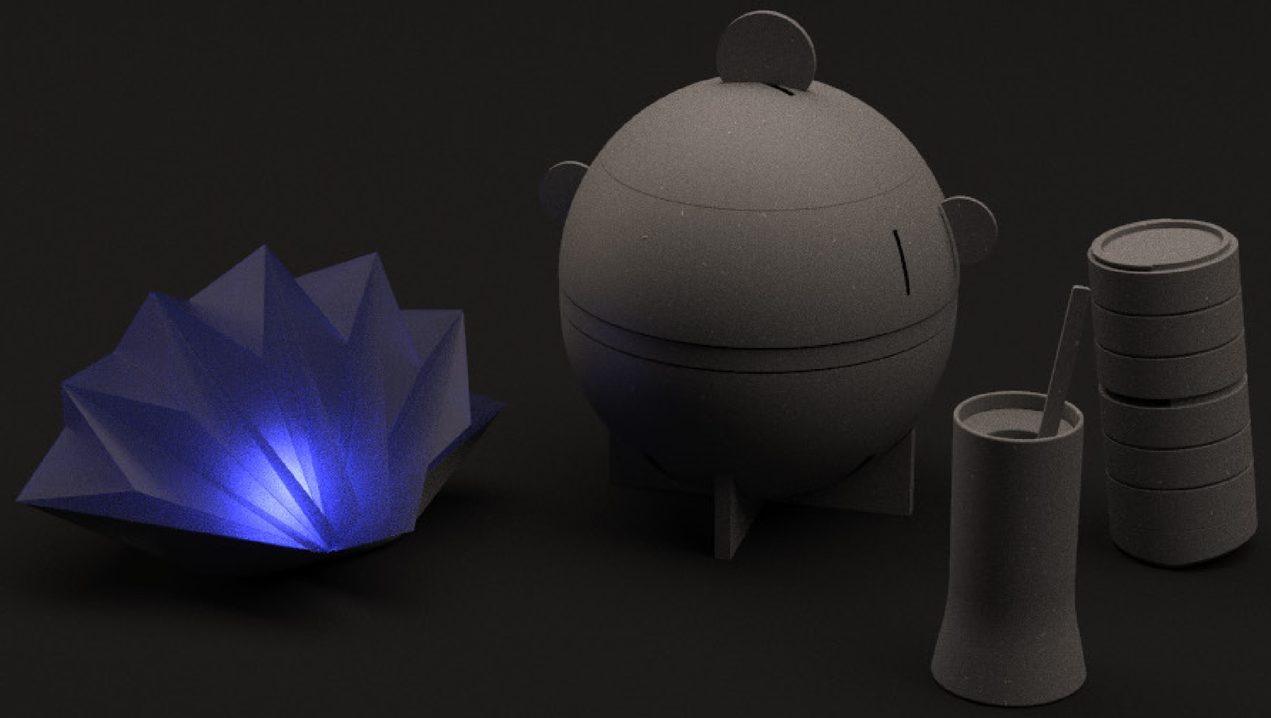
With them, the objects were refined and tested through a clay variation. While this is not the proposed solution for manufacturing the lunar system, it is useful to test and correct deviations and possible failures that were not seen before.



SOURCE: The authors

Subsystems

Overview



archaic

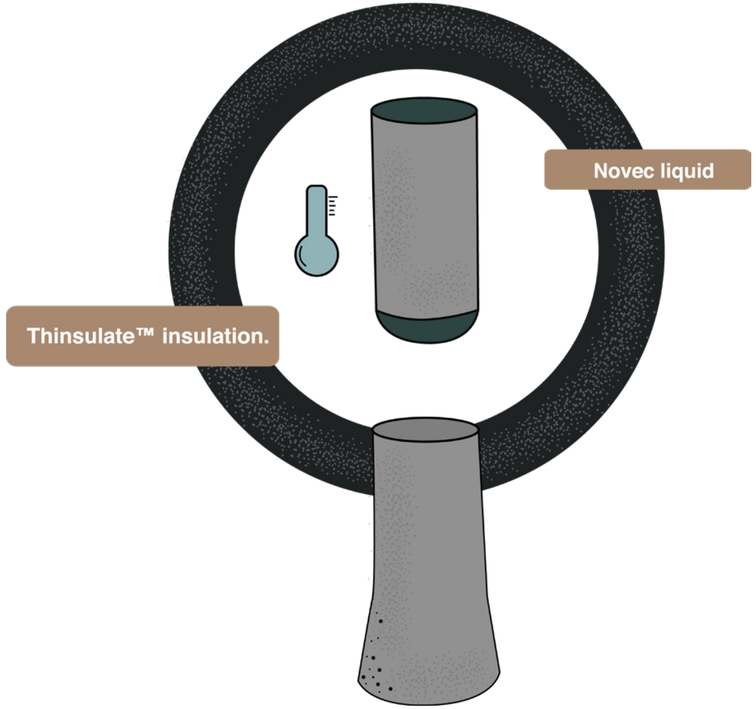
subsystem overview

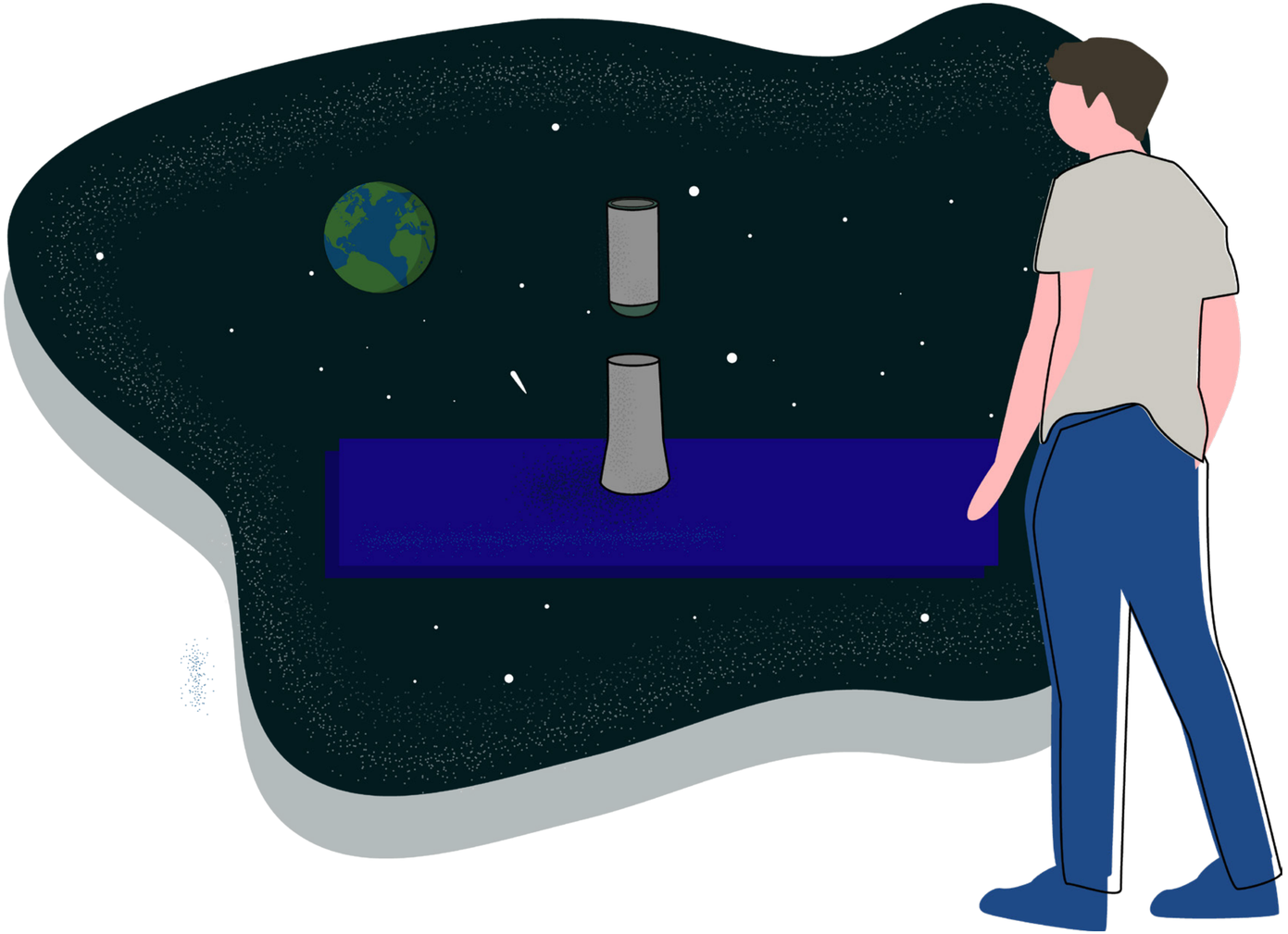
Archaic is a tool for the production of ice cream on a lunar soil

With this tool, explorers can experience a taste of home without the need of electricity or other complex technology. This is done by exploiting the resources of the moon (cold environment, regolith, plant-based diet) and a simple design with as little number of parts as possible.

archaic

technological principle





archaic

market applications

SOURCE: BOSCH home

BOSCH MUM5

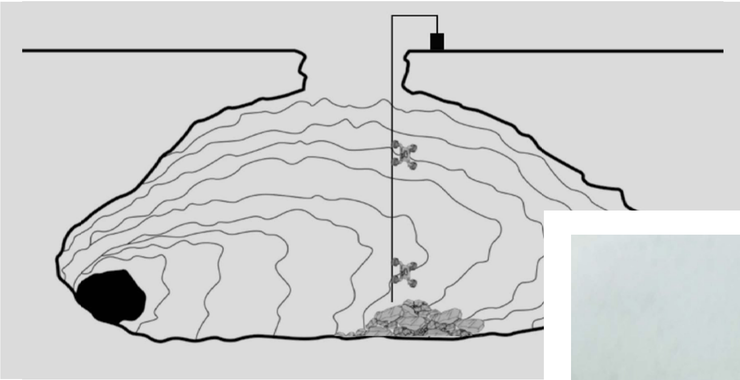
SOURCE: tatomafrio website

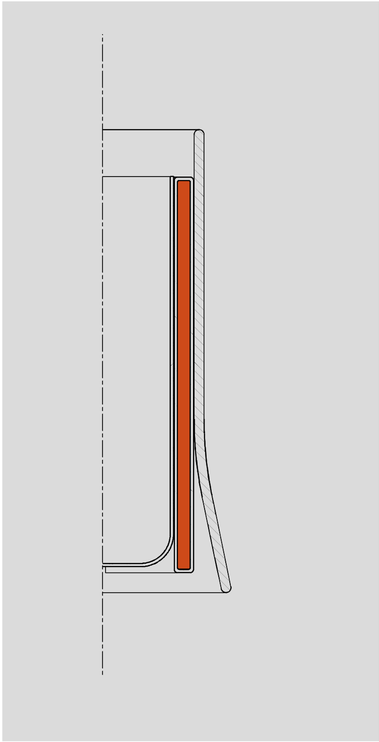
Thermal isolation block

archaic
inspirations

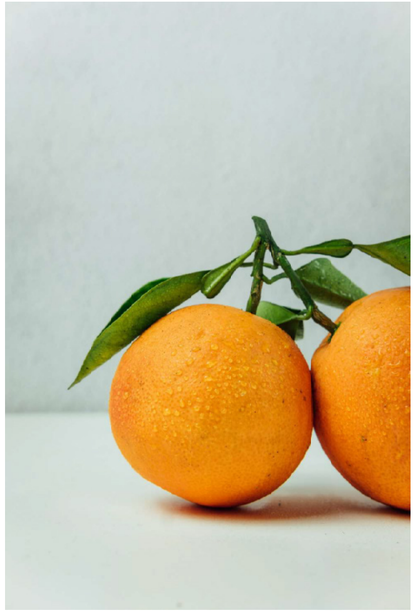
Family knowledge

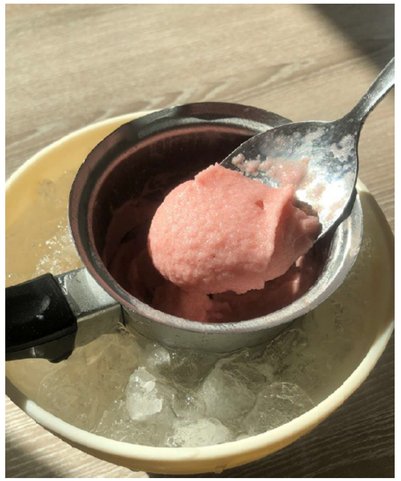
Lava tubes temperature





High feasability





Moon diet

3M Science. Applied to Life.™

Expertise

archaic

main components

Ma.Co

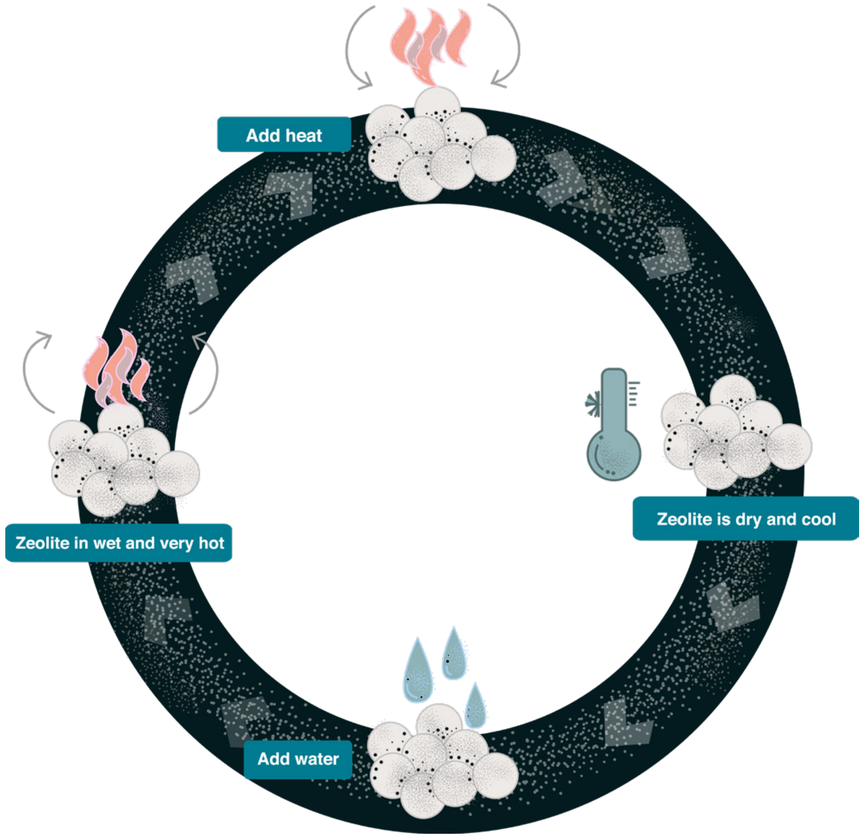
subsystem overview

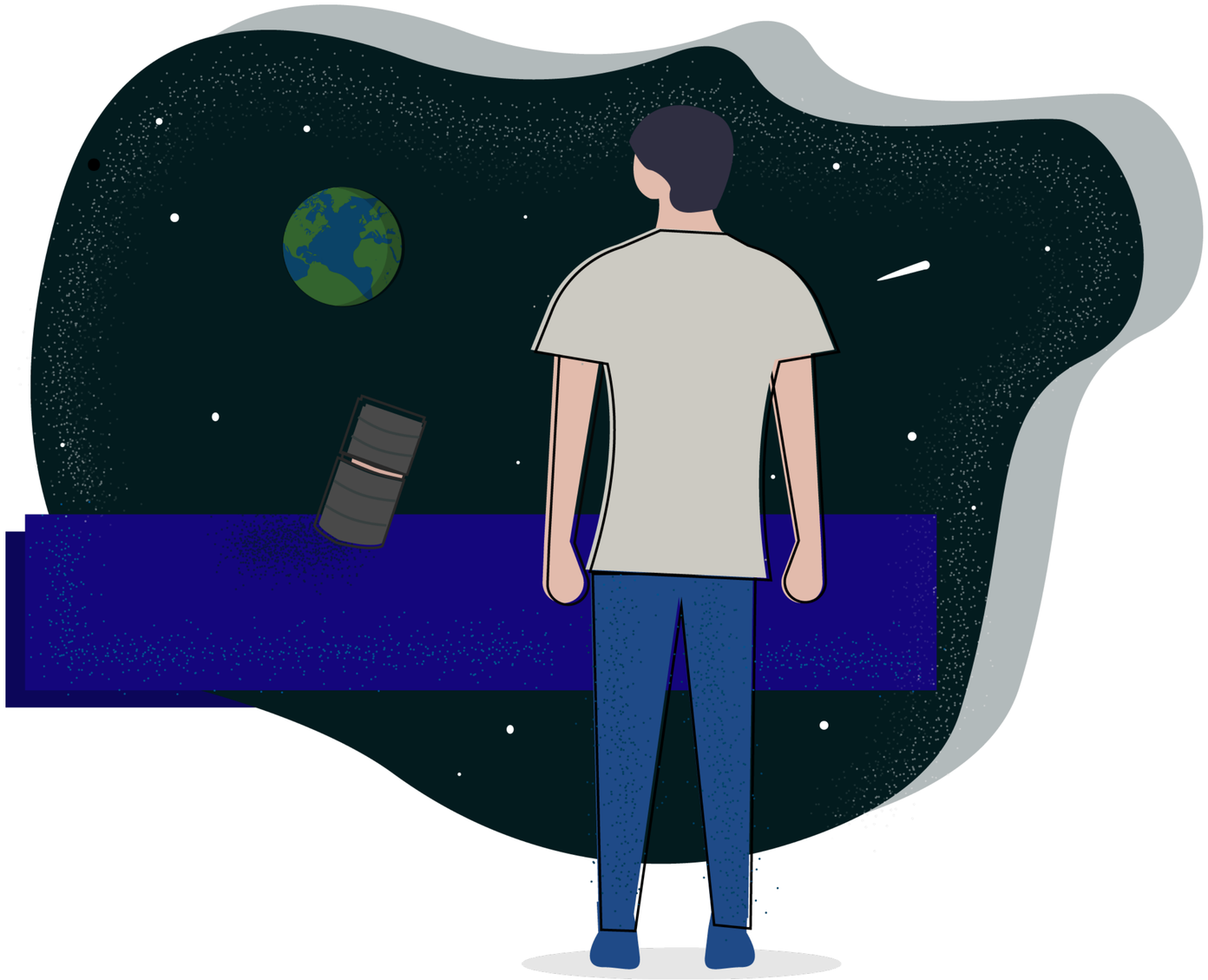
Ma.Co is a new coffee maker specifically designed to be used without any external heat sources, both on Moony and on Earth.

Ma.Co wants to establish new connections among past, future, Earth and Moon: by rediscovering ancient gestures, customs, shapes and materials - and adapting them to the new environment - it is possible to help astronauts in bringing a piece of Earth with them.

Ma.Co

technological principle





Ma.Co

market applications

SOURCE: BOSCH home

BOSCH PerfectDry

SOURCE: Newsfood website

Zeocooking

Ma.Co

inspirations








Ma.Co

main components

sugamuxi

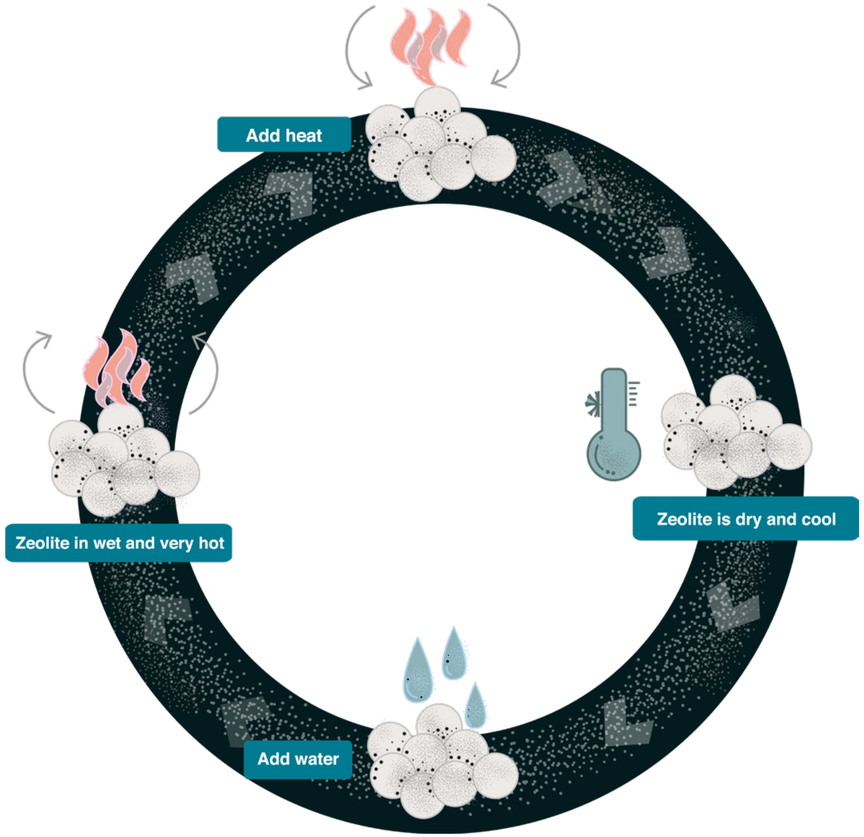
subsystem overview

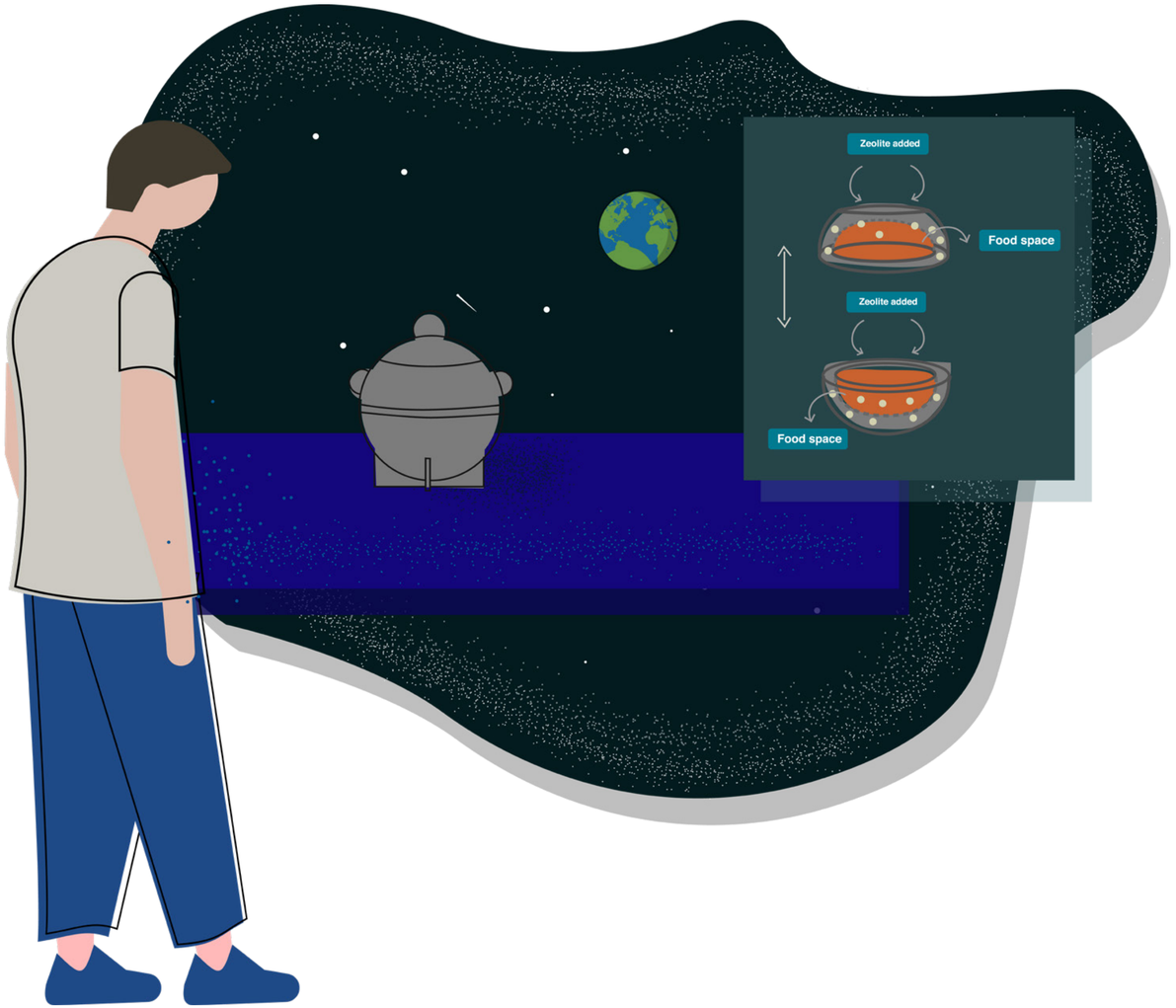
Sugamuxi is an oven that uses energy in a passive way, printed mainly in reguolith, is designed to cook food by conduction and convection allowing you to prepare different dishes in a space environment.

Sugamuxi will be 3D printed in its totality in regolith (clay on Earth), its system of channels between internal and external walls allows the position of a material from volcanic origin called zeolite which with the addition of water can reach perfect temperatures for a possible preparation of food.

sugamuxi

technological principle





system status

inspiration


La casa de terracota-Boyaca, Colombia


Pre-colombian sculture


Ryosuke Fukusada and Rui Pereira - FARO


Omid Sadri - PHO


Julie Boucherat - Mano Mani


Golden museum - Bogota'


Golden jewellery - Golden

sugamuxi

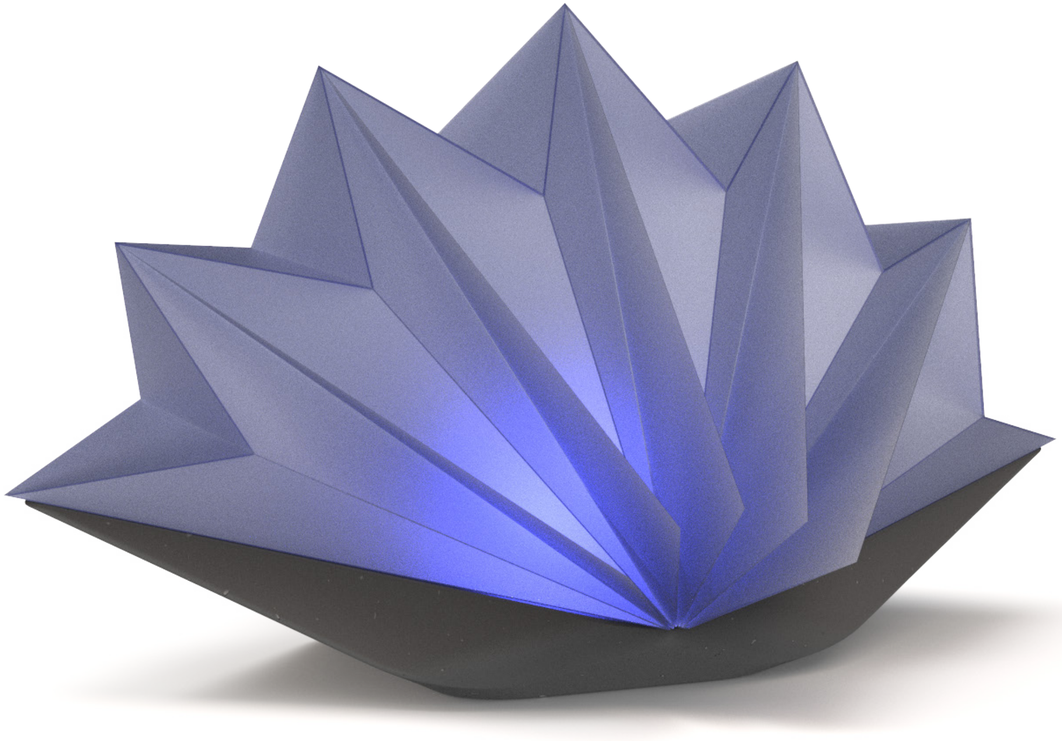
main components

uv disinfection

subsystem overview

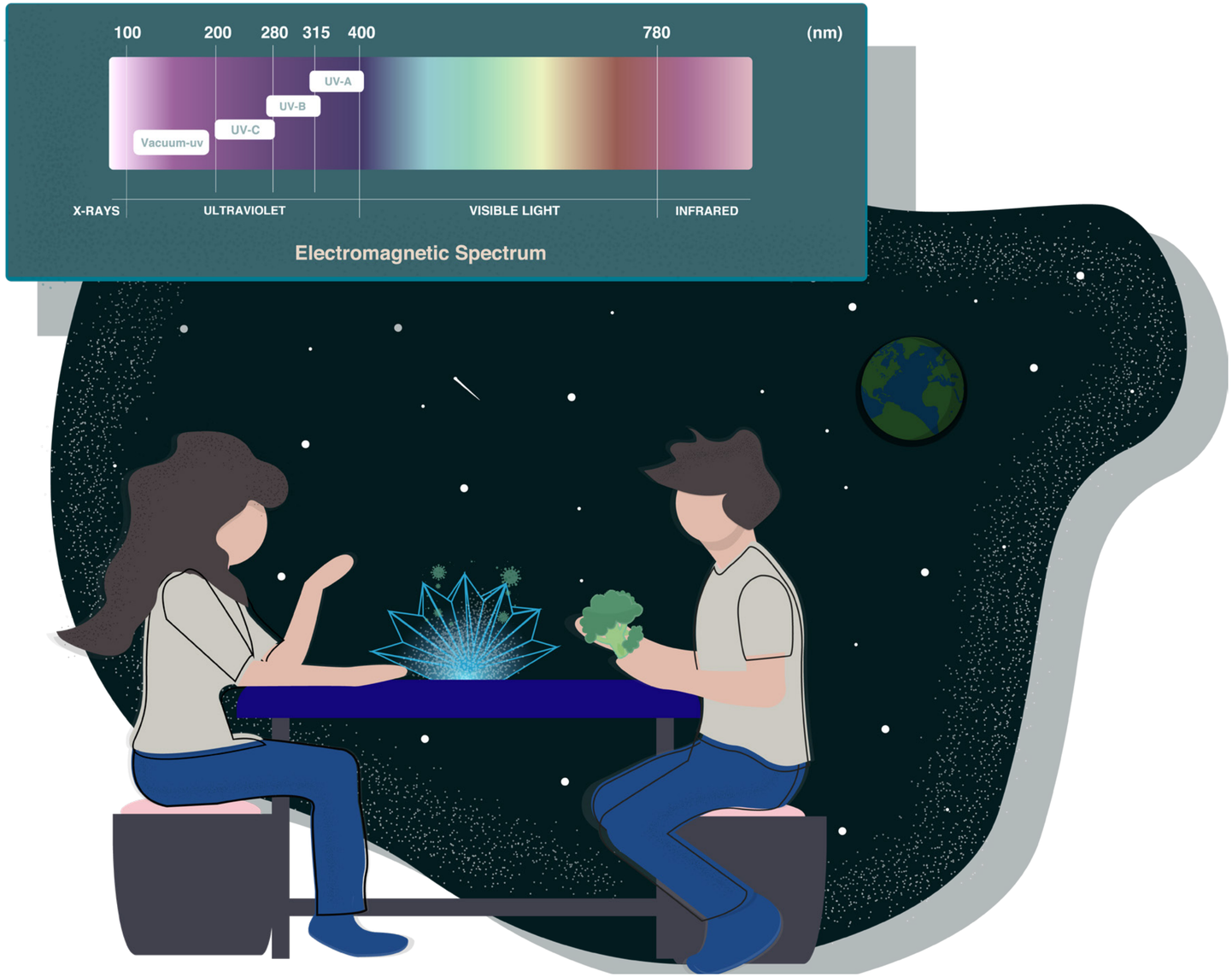
UV Disinfection is a system that focuses on disinfecting food and kitchen appliances through the use of ultraviolet type-c light.

This object packs the smallest footprint possible, aiming to reduce the most of space used during transportation. The simple electronic system and its polythene sheet, that will be folded during assembly, are the only components that are transported during spaceflight. Using UVC rays also ensures a low energy and no waste disinfection process.



uv disinfection

technological principle



uv disinfection

market applications

SOURCE: LARQ bottle

LARQ bottle

SOURCE: Dezeen

Self sanitizing doorhandle

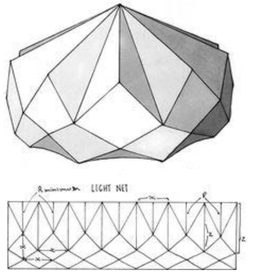
uv disinfection

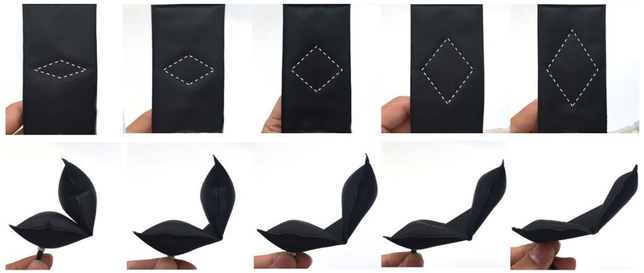
inspirations

ISSEY MIYAKE - 132 5 COLLECTION

CHIHIRO TANAKA - SAKURALIGHT

MATTHIAS LUCHE - NEO



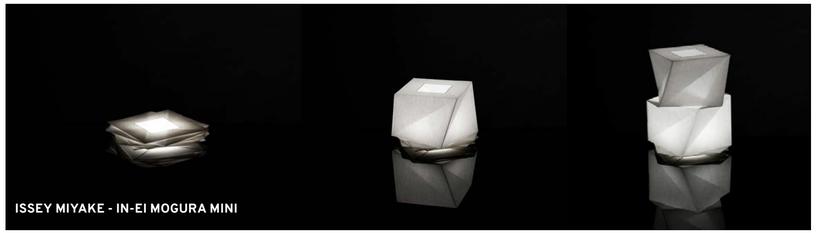


IT MEDIA LAB - AEROMORPH

JOSEF ALBERS - SCHOOL OF ULM WORKSHOP

FINELL CO. - MISFOLD

ISSEY MIYAKE - IN-MEI HOSHIGAME

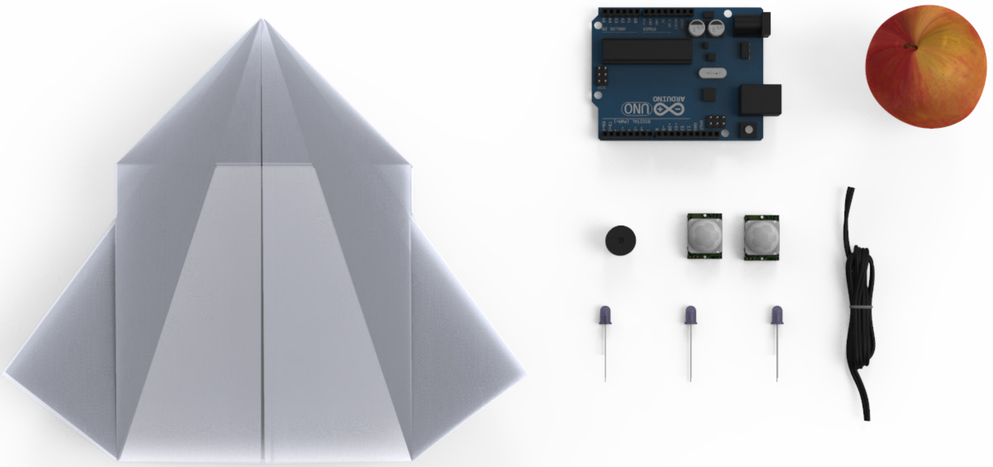


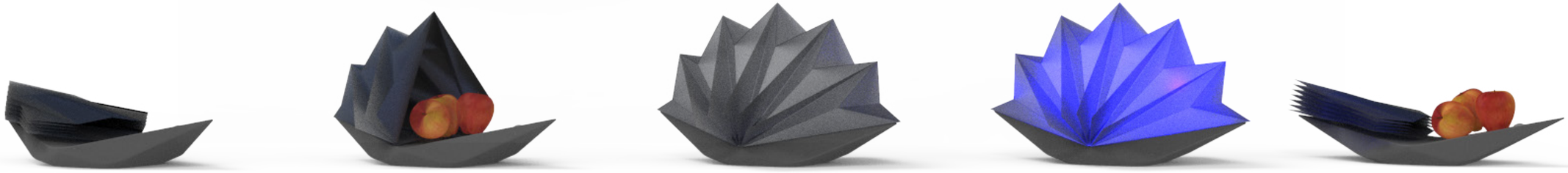
ISSEY MIYAKE - IN-EI MOGURA MINI

HANA VYORALOVÁ - ORIGAMI LAMP

uv disinfection

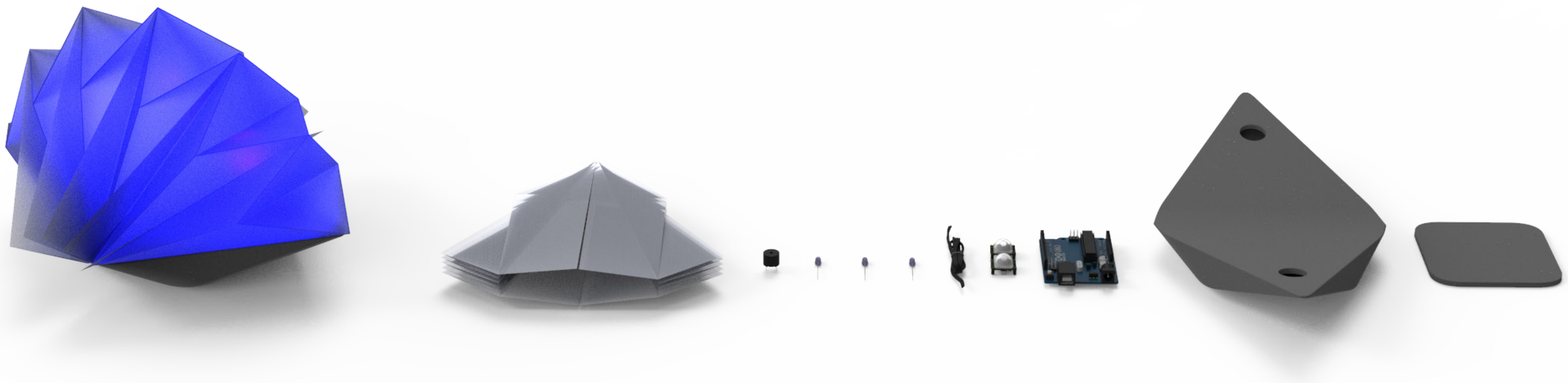
volume estimation





uv disinfection

main components



conclusion

Learnings

- Design, in the field of space exploration, can play a complementary role in instigating innovation, insightful decision making and materializing future perspectives.

- Through the use of lateral innovation - using technological advancements that are already on the market in a field where they have not been applied yet - it is possible to challenge old industry paradigms and incremental advancements to the field.

- Space exploration is a field where astronauts are subject to extreme environmental conditions, and until now, projects have prioritize functionality above all. To reach and inspire larger audiences, it may be the time to start considering comfort, familiarity and wellbeing in the same level as functionality.

SOURCE: NASA

conclusion

Earth spinoffs

SOURCE: NASA

FOCUS

A better life in space

Thank you

Professors: PhD Annalisa Dominoni, PhD Benedetto Quaquaro
Students: Dluhosch Joao, Herrera Laura, Memo Francesco, Toldo Riccardo

swiss space center

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