Clean Space Webinar

Art and Education as Inspiration for Space Debris Solutions

TODAY'S SPEAKERS

SACHA BERNA

Moderator:
MICHEL VAN PELT

MARIANNE TRICOT

ELSA MARÍA SANCHEZ

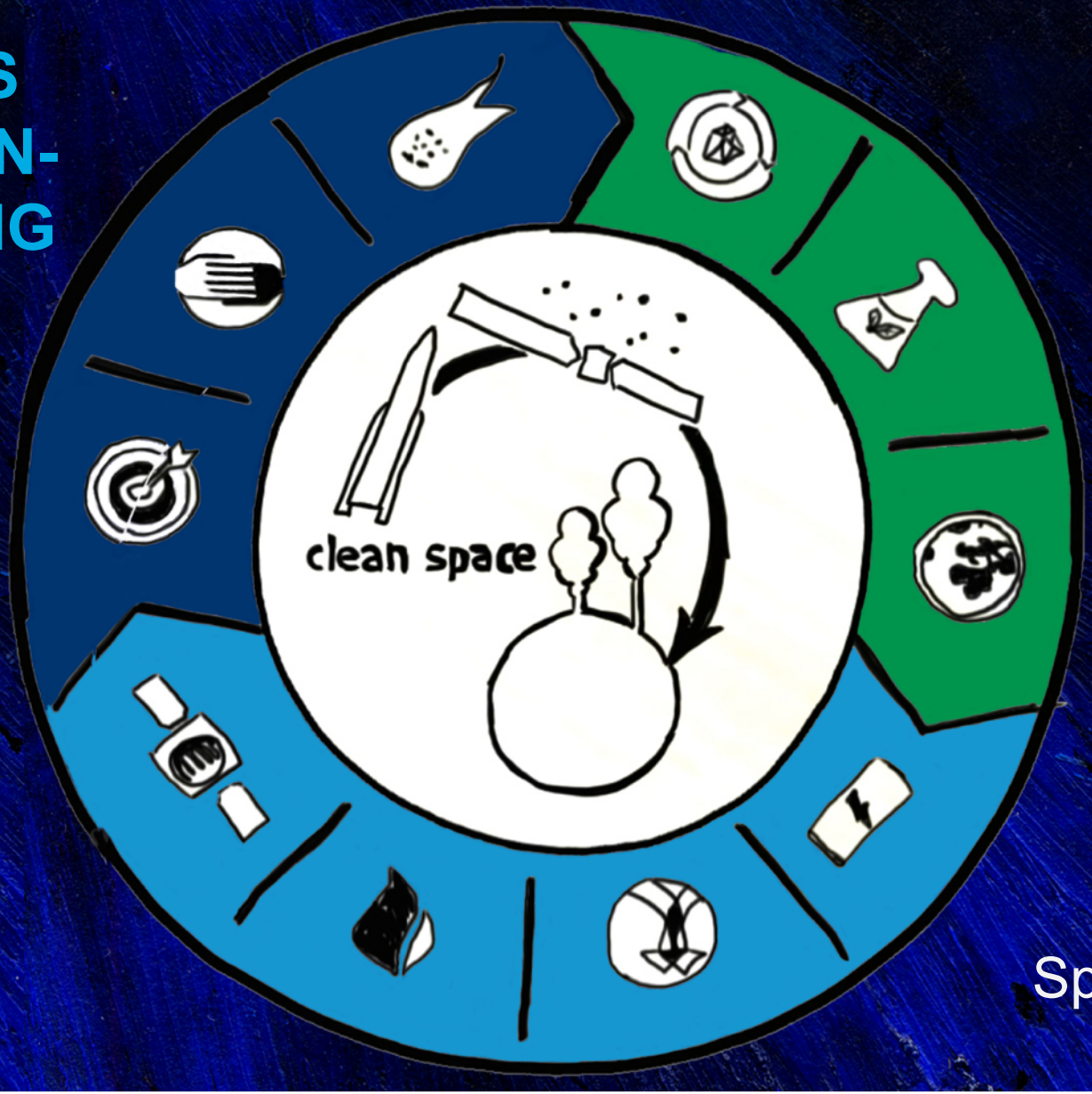
DAAN ROOSEGAARDE

AGENDA

1. Clean Space in a nutshell
2. The Space Waste Lab by Daan Roosegaarde
3. ‘For a Clean Space’ by Marianne Tricot
4. ‘The CleanSat Story’ by Sacha Berna
5. ‘Educating to clean space’ by Elsa Maria Sanchez

ACTIVE DEBRIS REMOVAL AND IN-ORBIT SERVICING

Removing space debris already in orbit



ECODESIGN

Understanding and reducing the impact of space missions on our environment

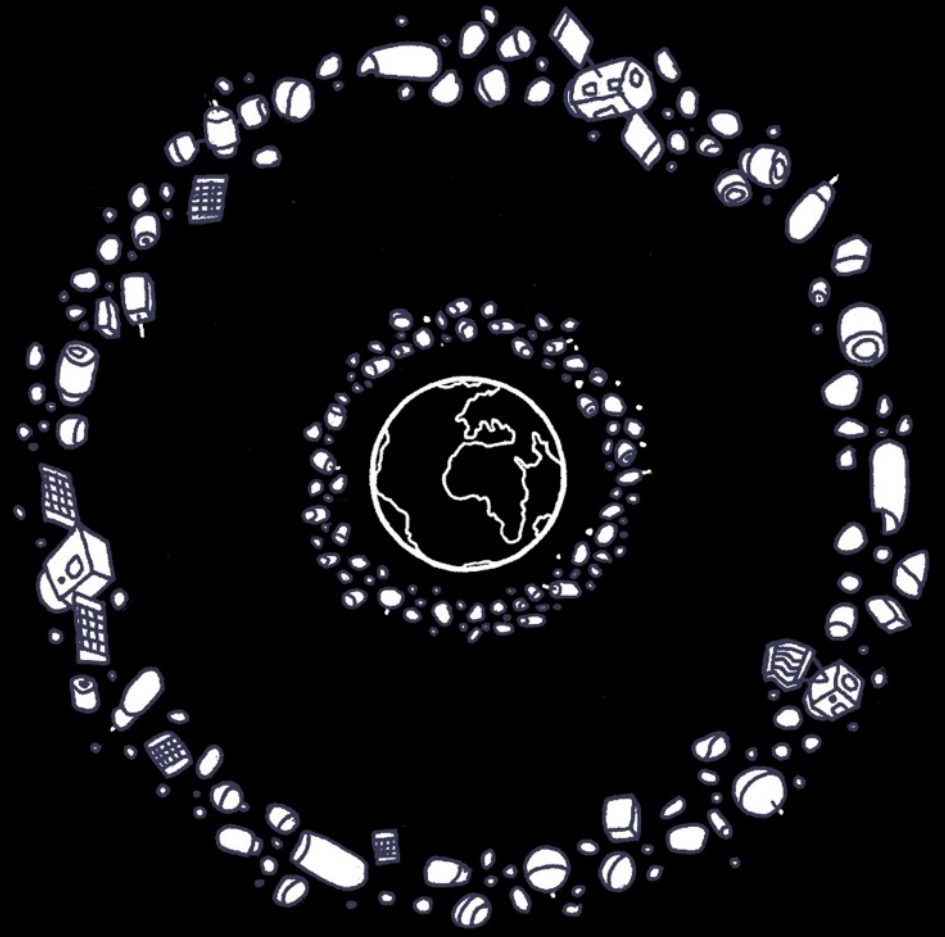
MANAGEMENT OF END OF LIFE

Space Debris mitigation

34000 objects greater than 10cm

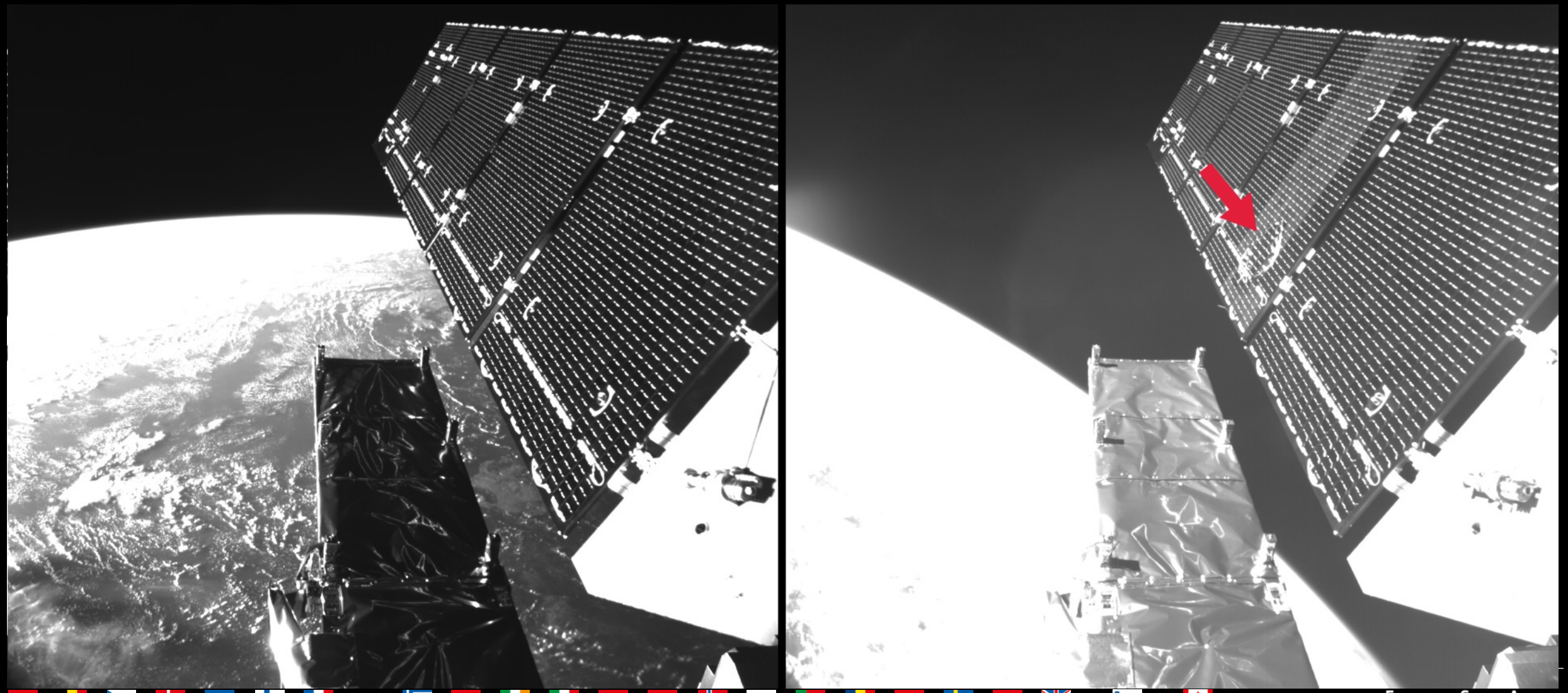
900000 objects of 1 cm to 10 cm

128 million objects of 1 mm to 1 cm

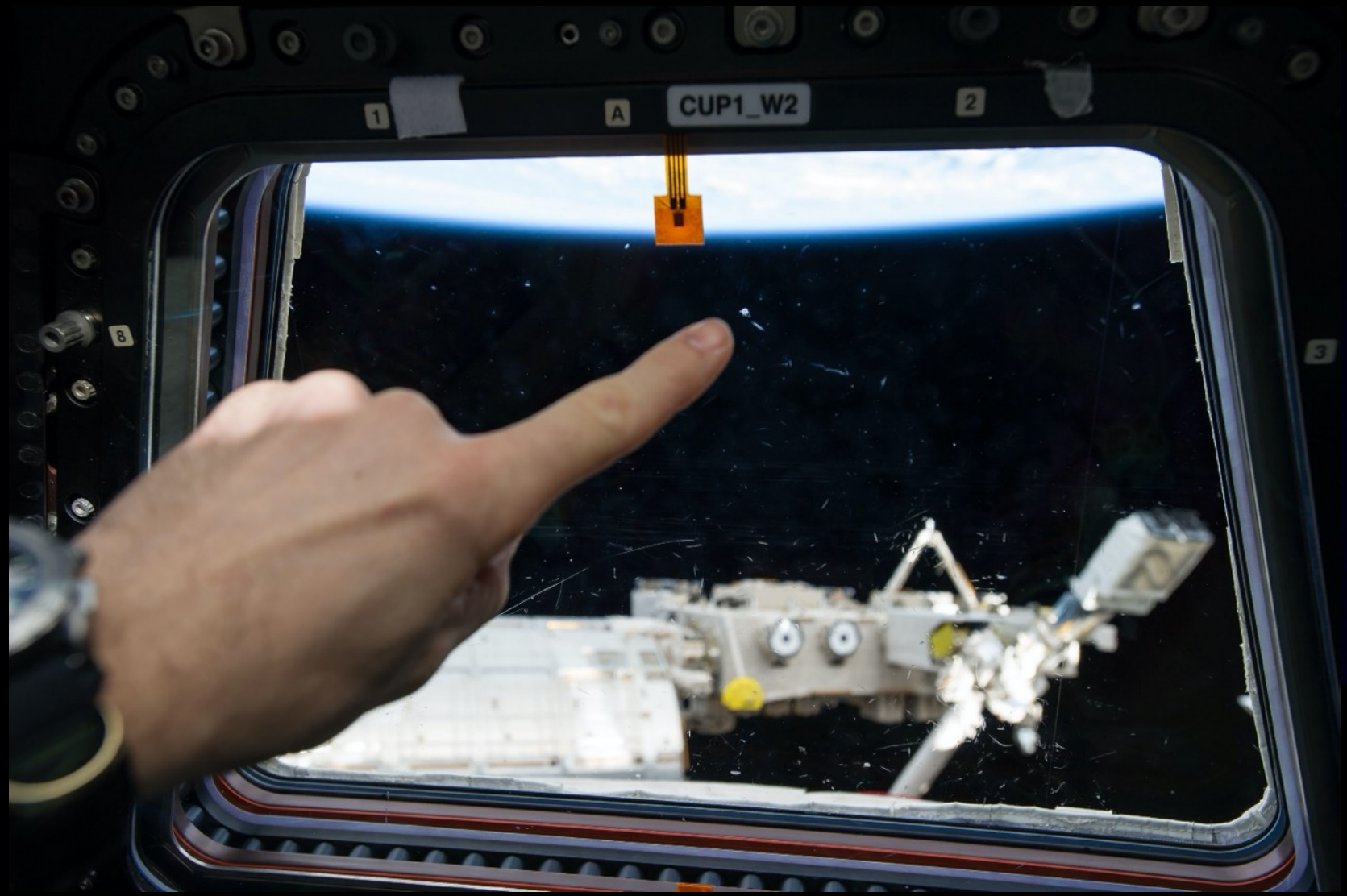


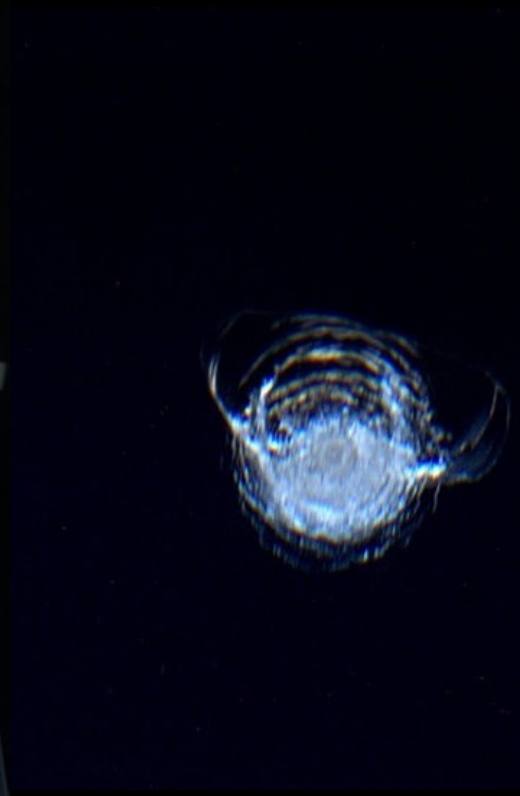
Credits: Marianne Tricot / ESA

2016: ESA Sentinel-1A solar array hit by millimeter-size debris



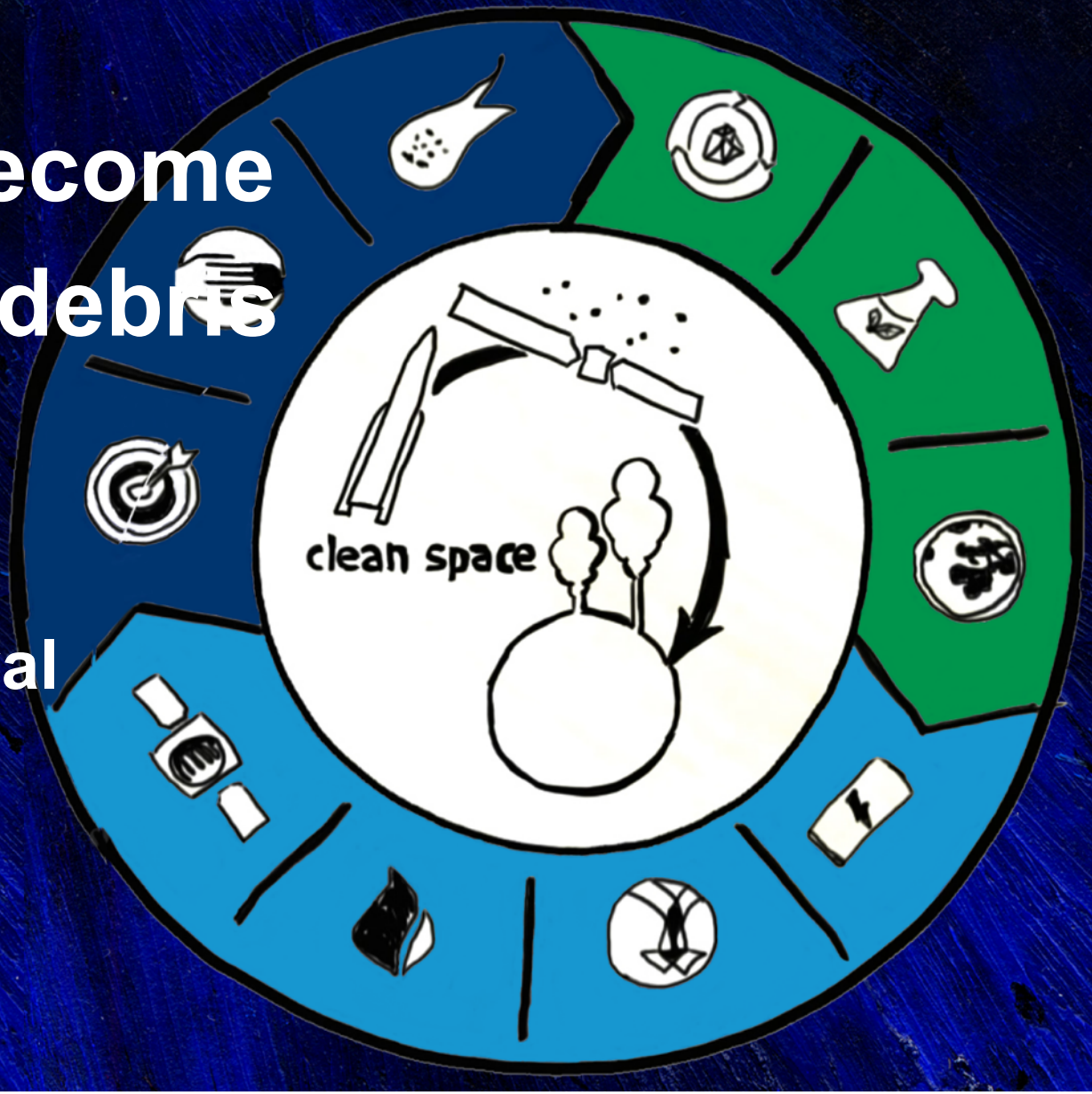
2016: tiny piece of debris hits ISS Cupola multi-layer window





Avoiding satellites become dangerous debris

- Passivation
- De-orbit
- Active removal



clearspace today

ClearSpace-1

esa

STUDIO ROOSEGAARDE

We are pioneers for the liveability of our future landscapes.
Creativity is our true capital.

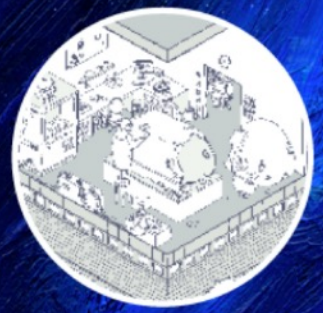
Studio Roosegaarde slides are not disclosable.
For more information about Studio Roosegaarde's collaboration with ESA Clean Space, check the
Space Waste Lab's website
https://www.studioroosegaarde.net/project/space-waste-lab
Or watch out the recording of the webinar (soon available on ESA Clean Space blog
http://blogs.esa.int/cleanspace/)

Credits: Marianne Tricot / ESA

MARIANNE TRICOT

Clean Space

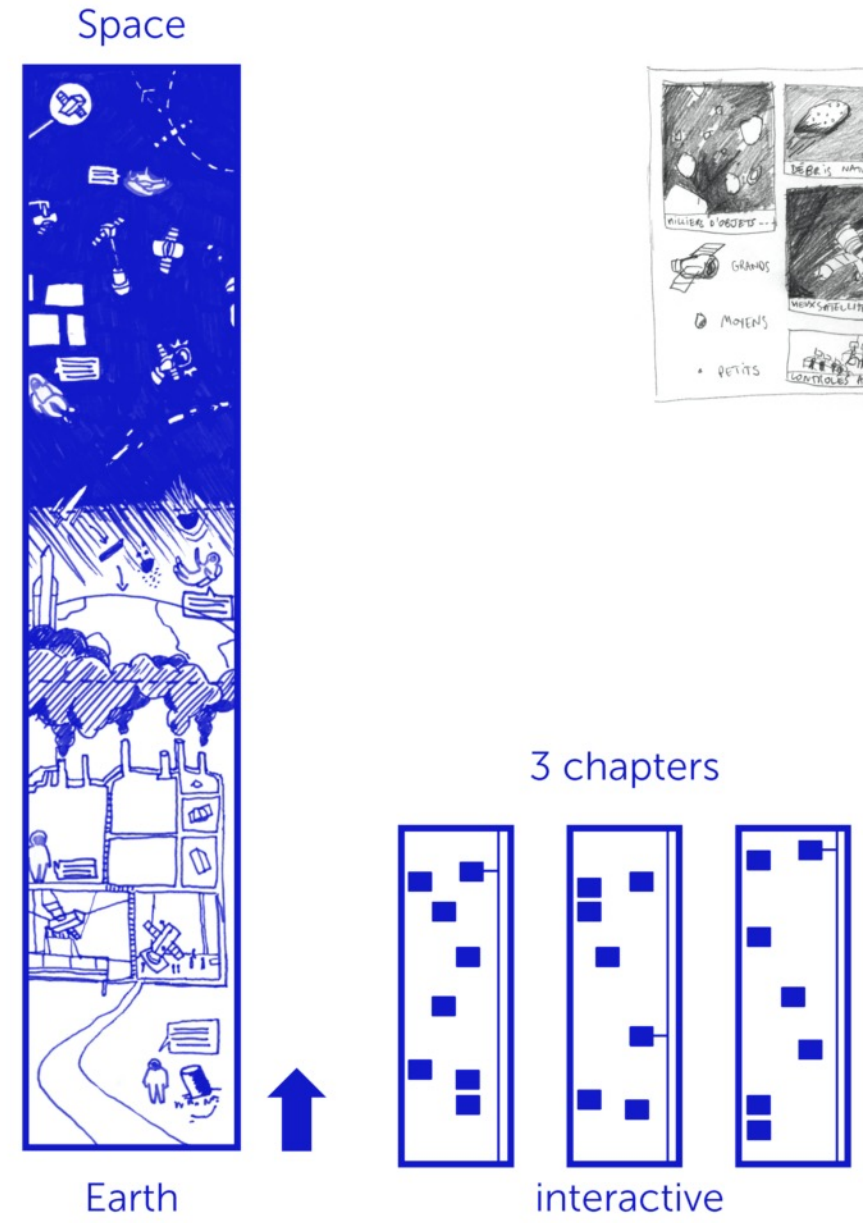
un programme spatial écologique

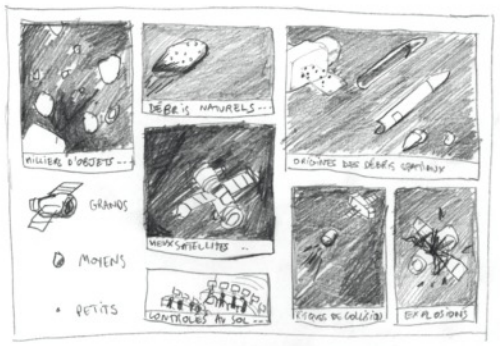


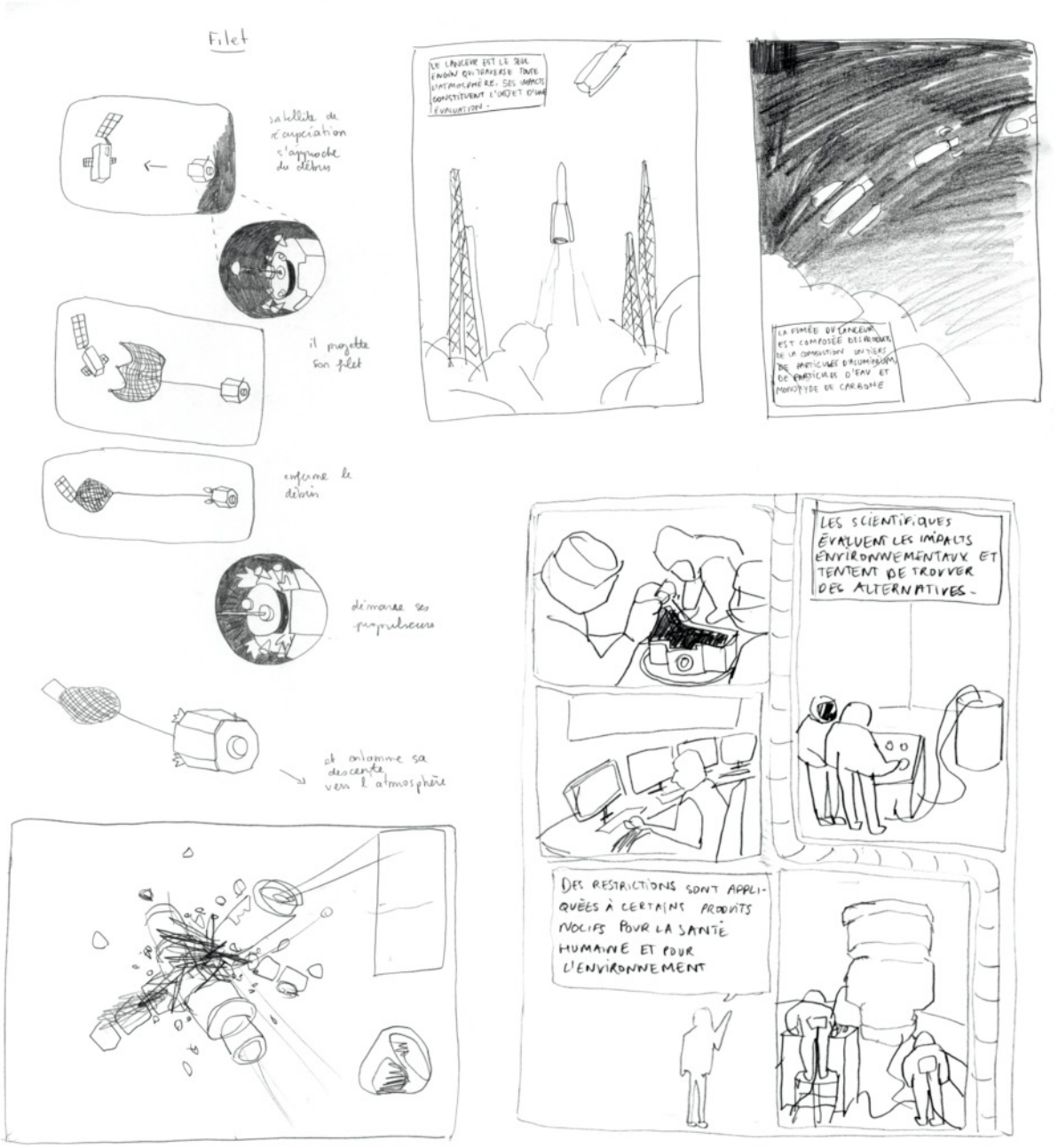
Terre

Atmosphère

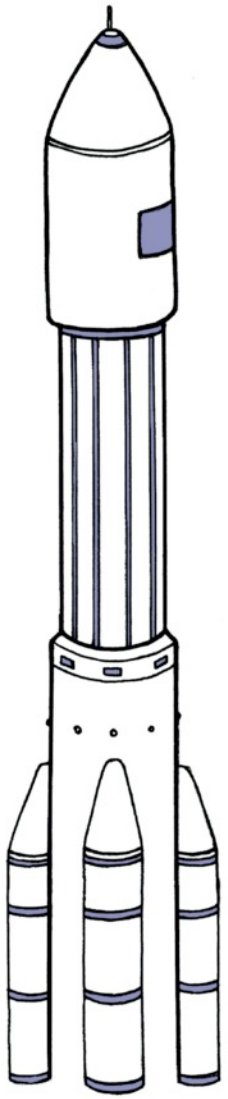
Espace

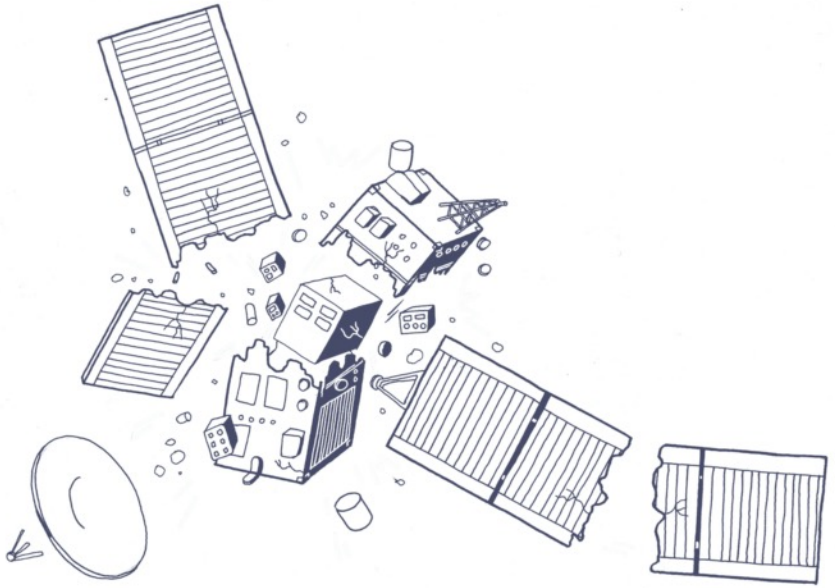


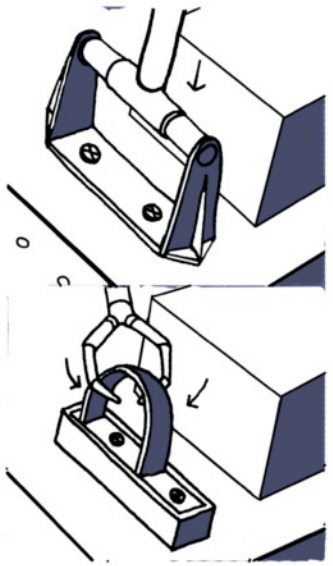


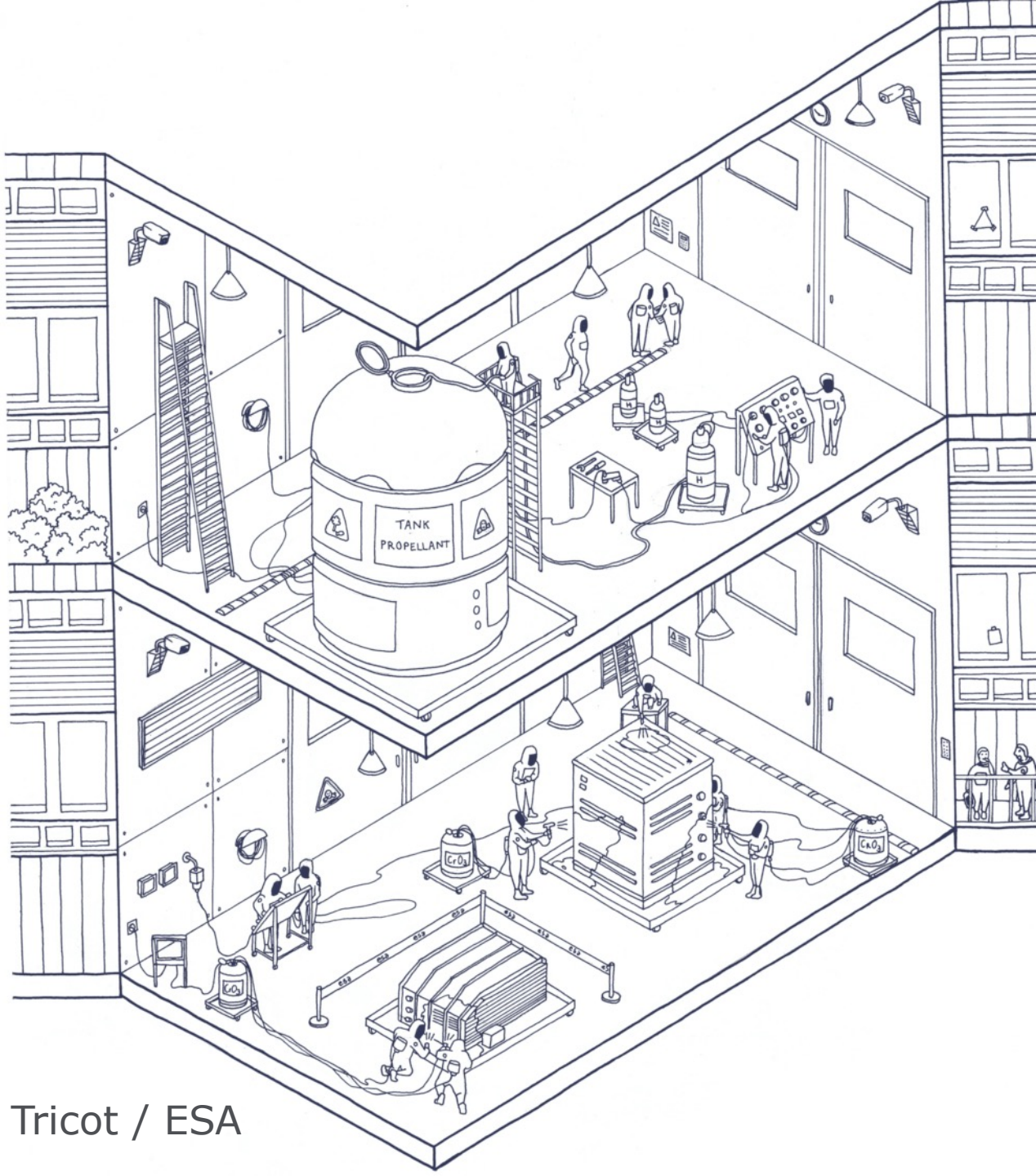


Credits: Marianne Tricot / ESA

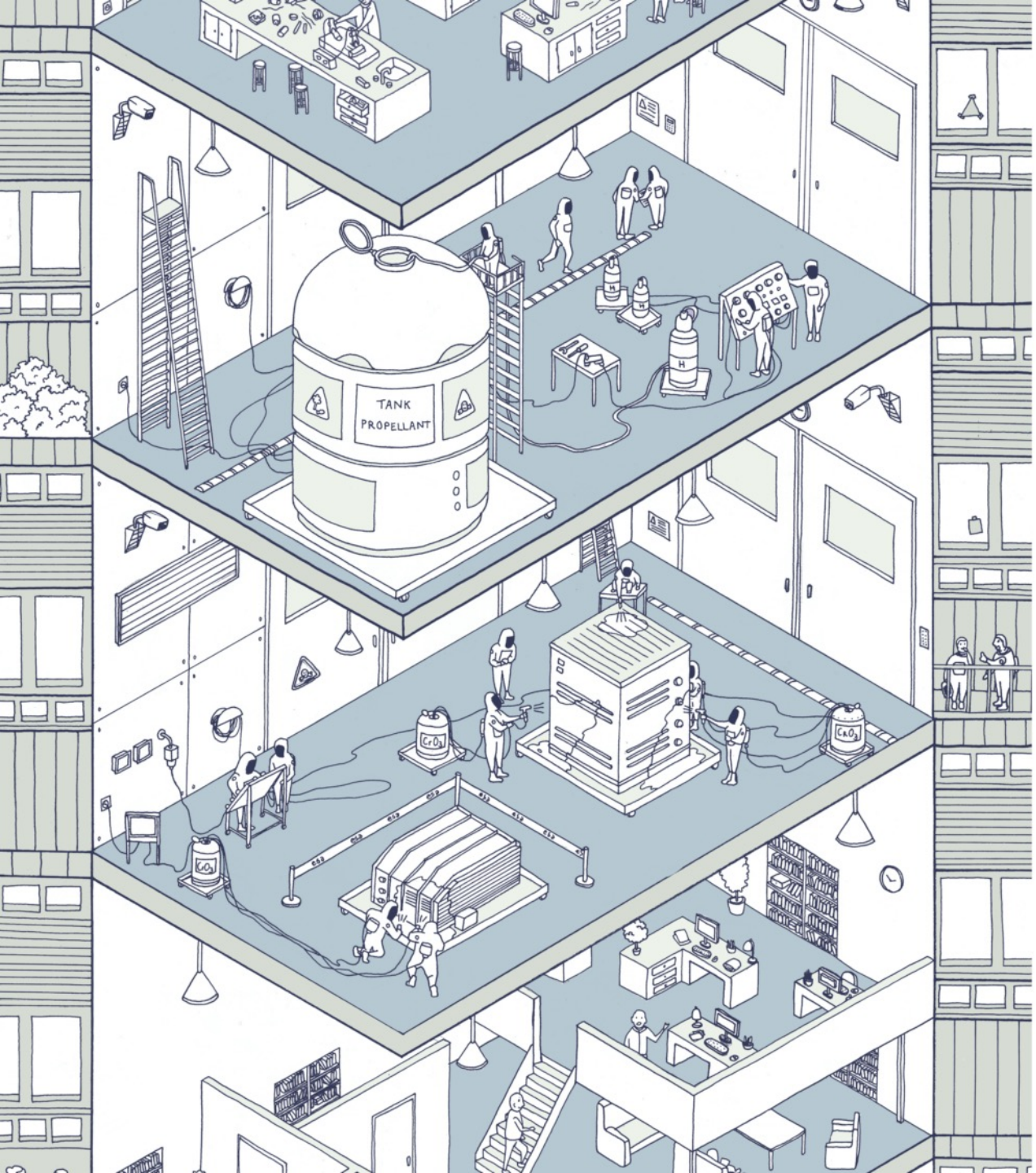




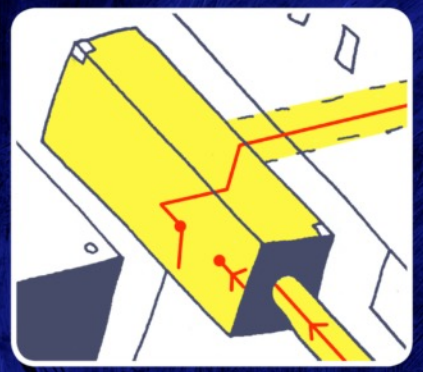


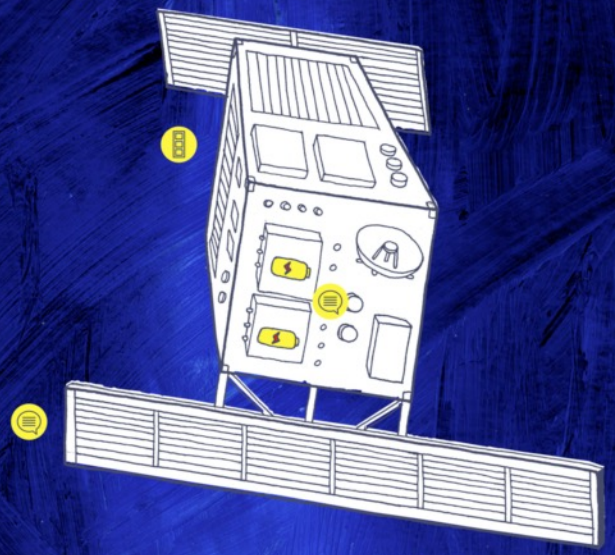


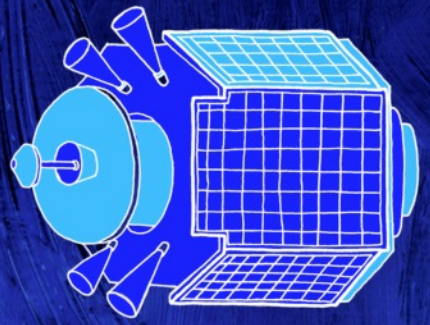
Credits: Marianne Tricot / ESA

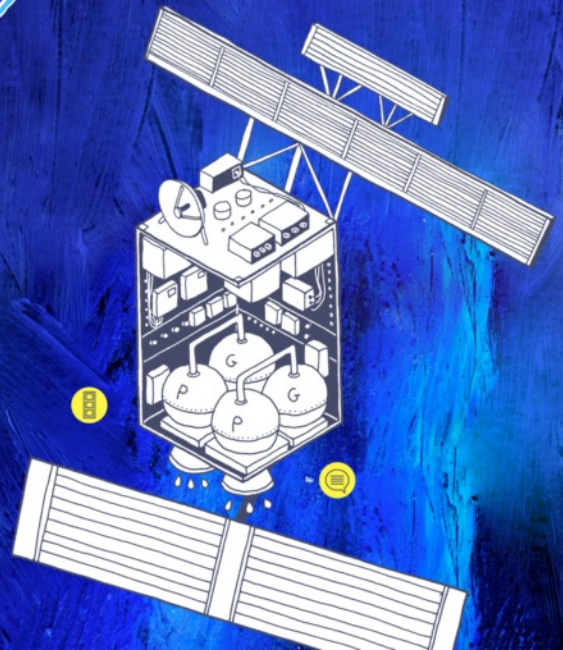


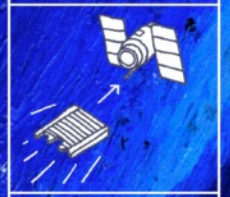
Credits: Marianne Tricot / ESA



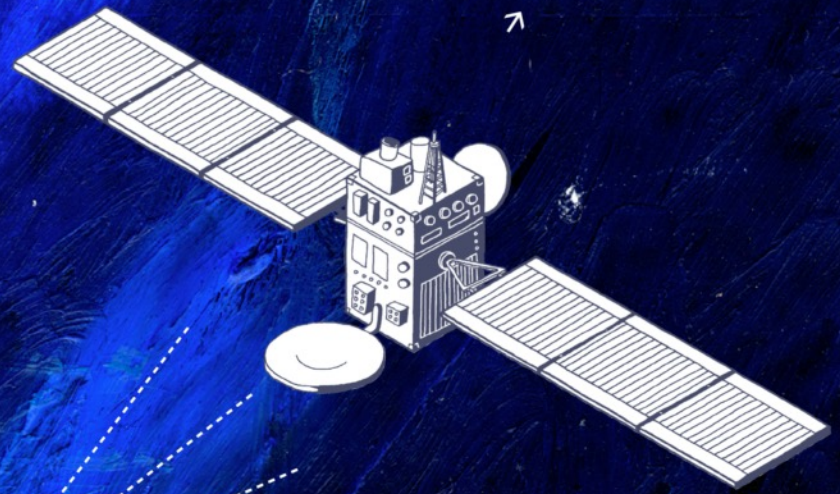








La dispersion des débris et leur déplacement à grande vitesse peuvent provoquer une réaction en chaîne : le **syndrôme Kessler**. Un débris percute un satellite, créant d'autres débris qui vont percuter d'autres engins...

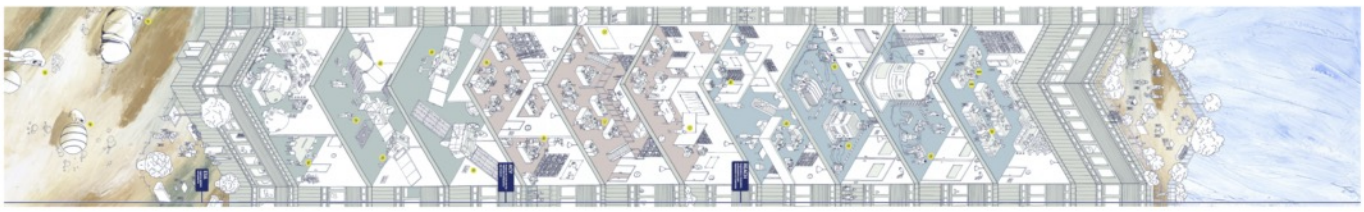


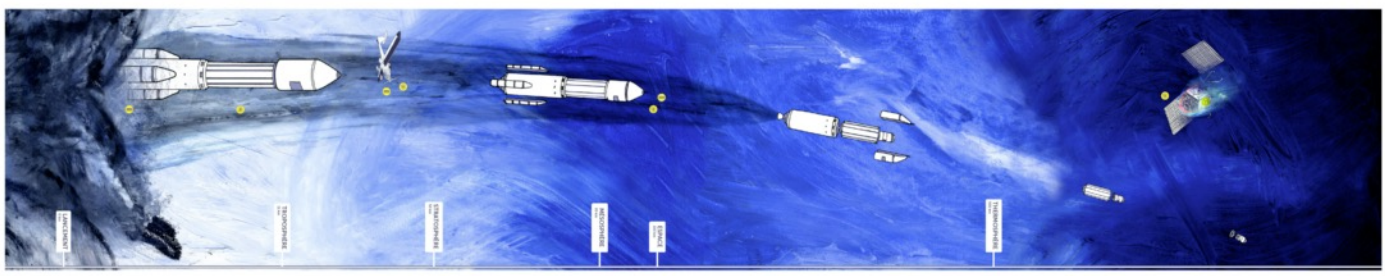
Si un satellite non fonctionnel ou un étage supérieur de fusée contient des restes de ressources énergétiques (carburant, batteries) il peut surchauffer et **exploser** avec les émissions du Soleil. Des milliers de débris supplémentaires se propagent dans l'espace.

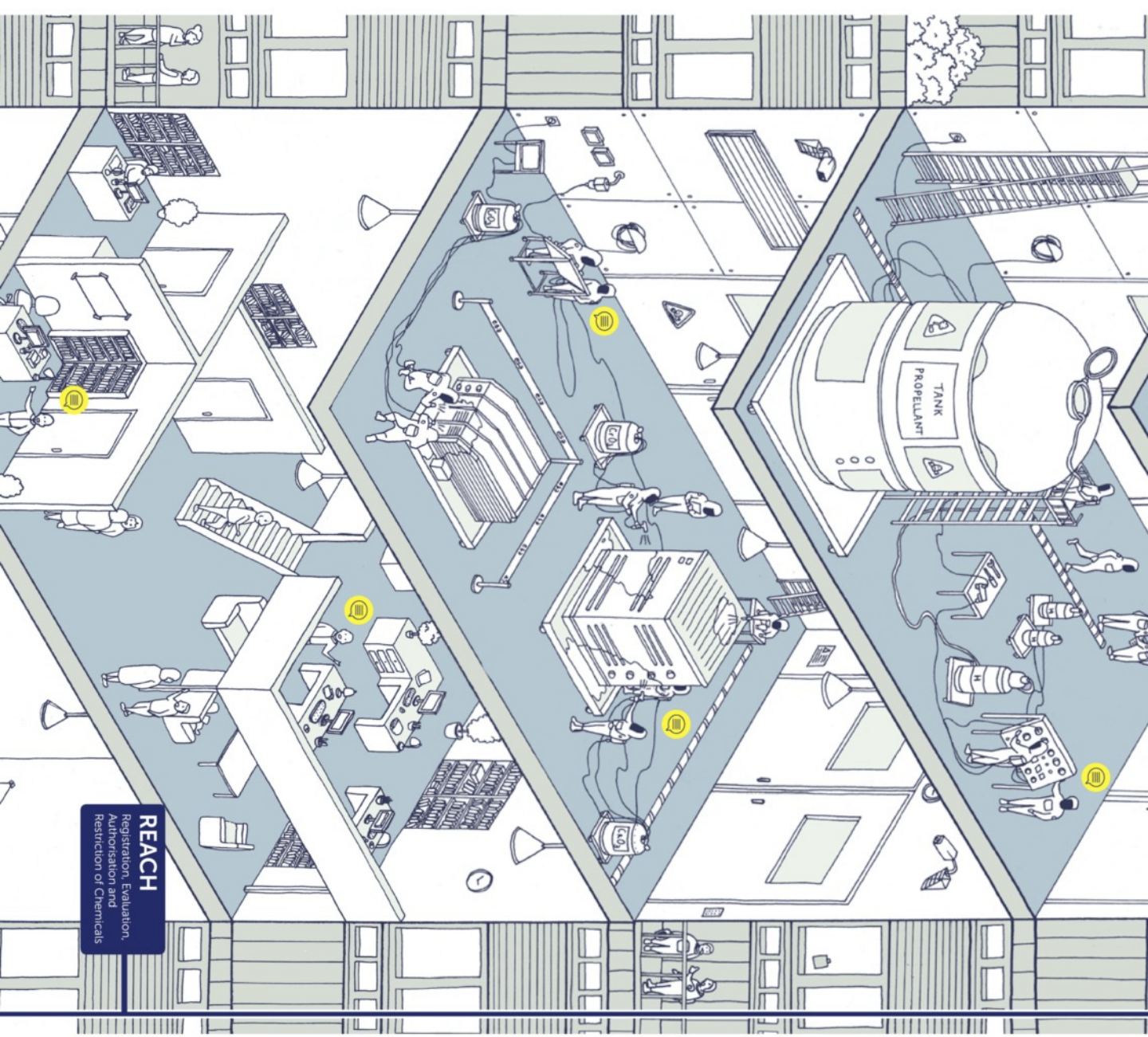
RISQUES

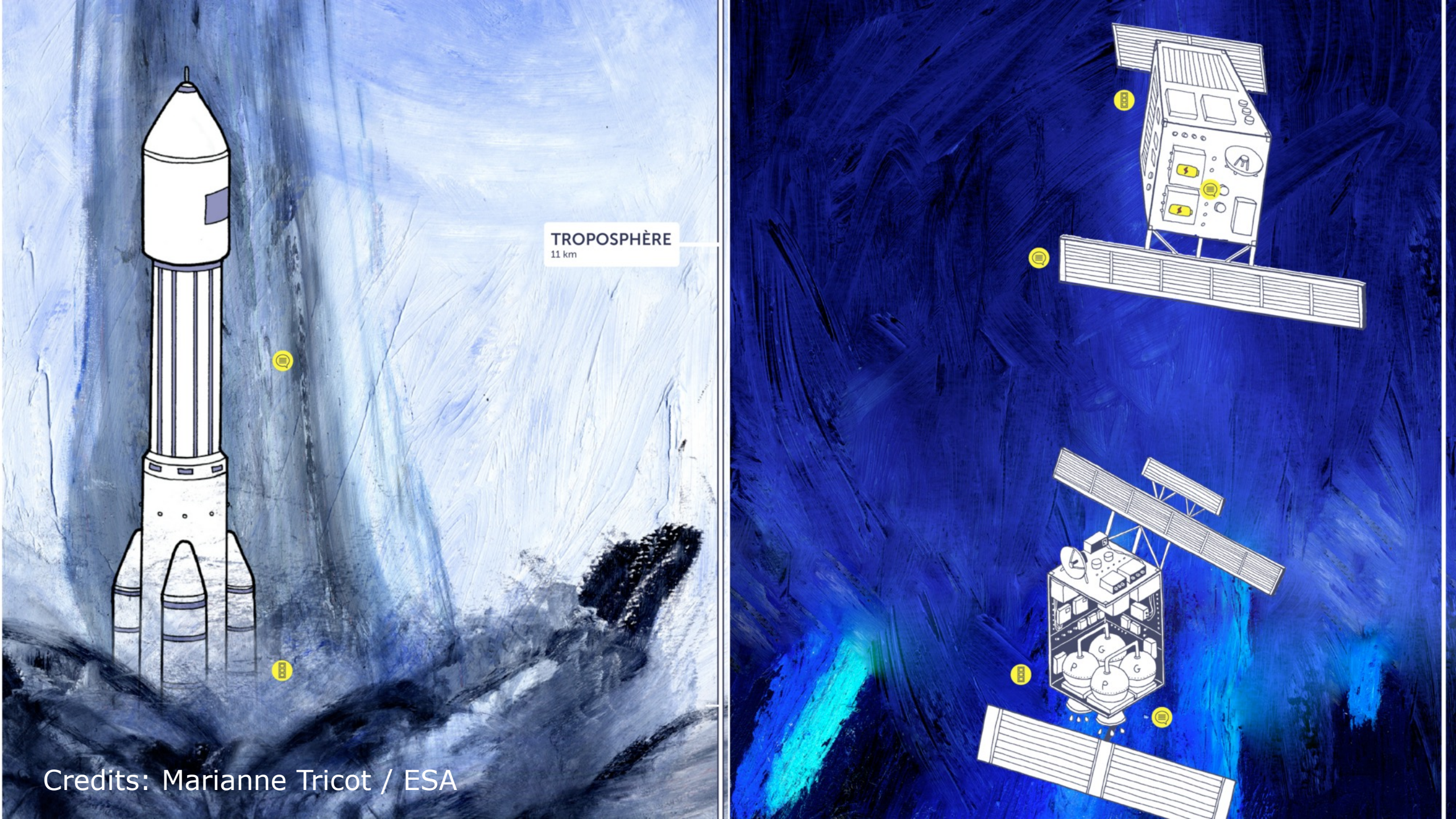
Credits: Marianne Tricot / ESA

Credits: Marianne Tricot / ESA



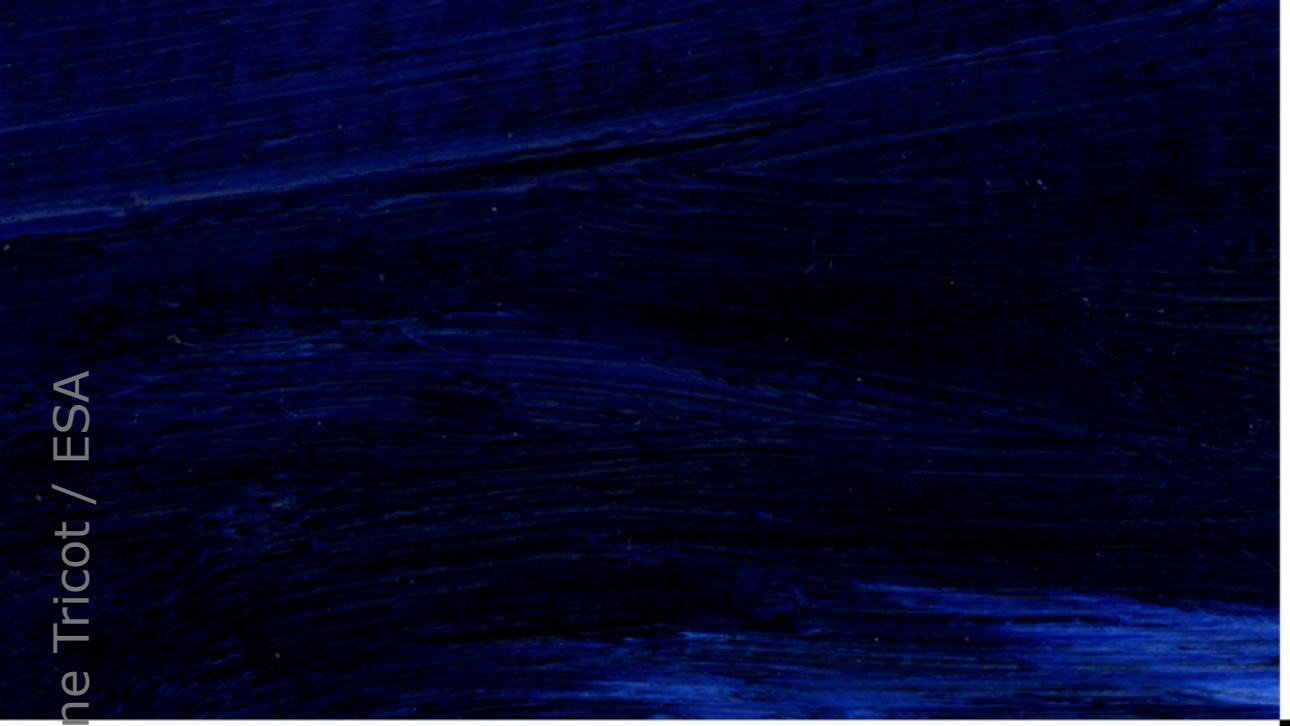


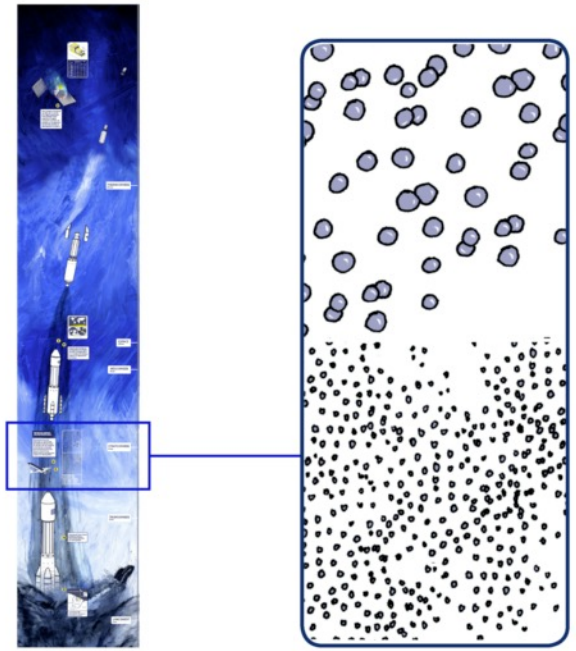


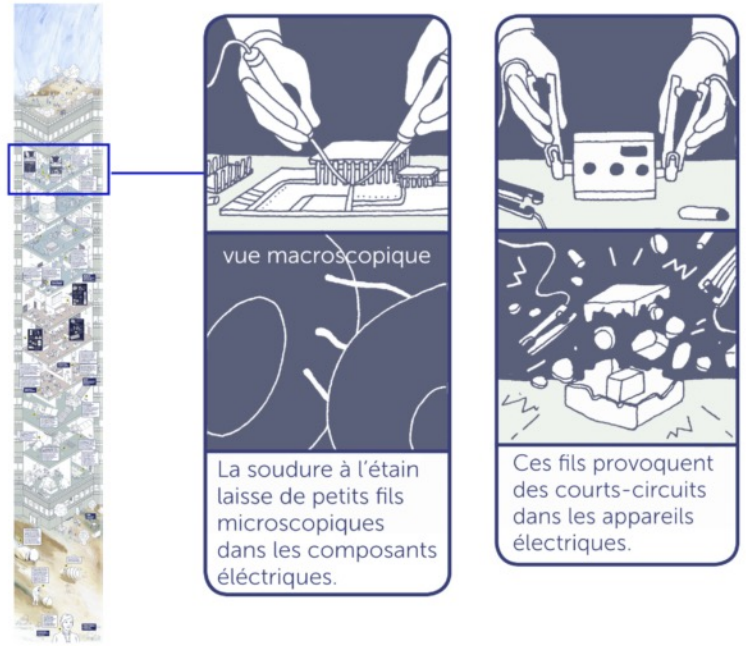


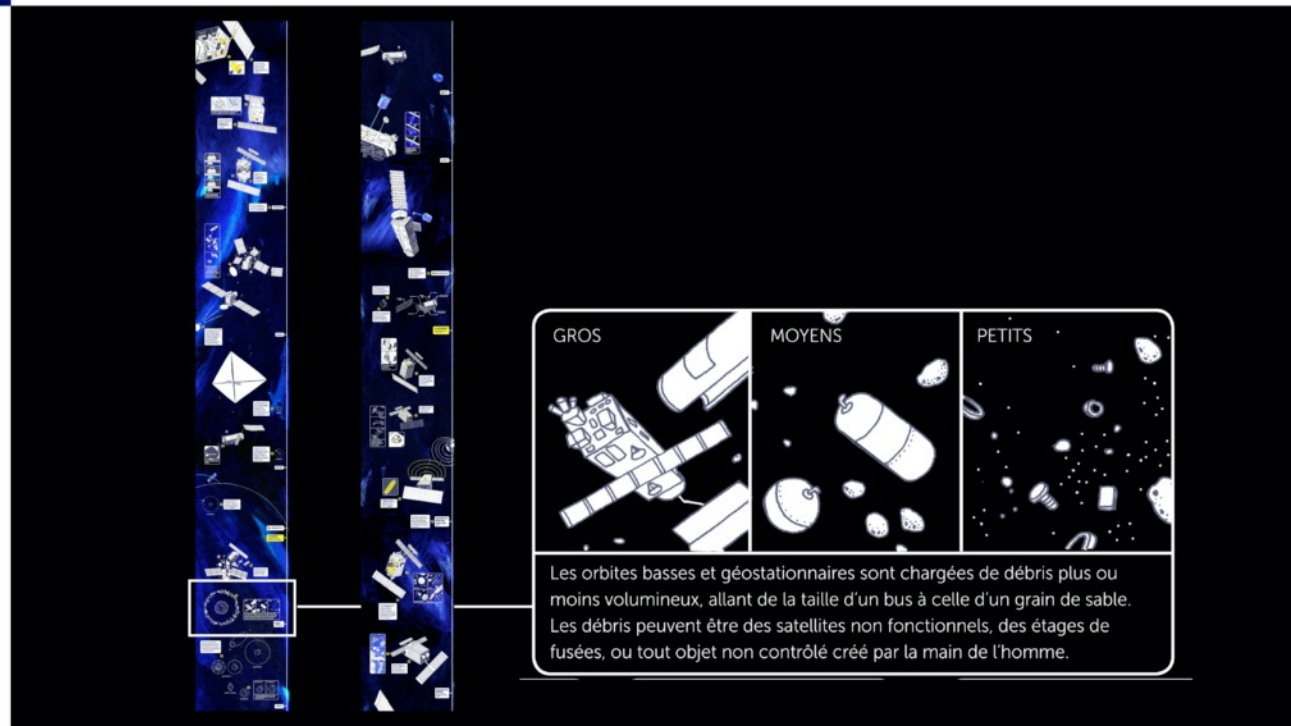
Credits: Marianne Tricot / ESA

Credits: Marianne Tricot / ESA

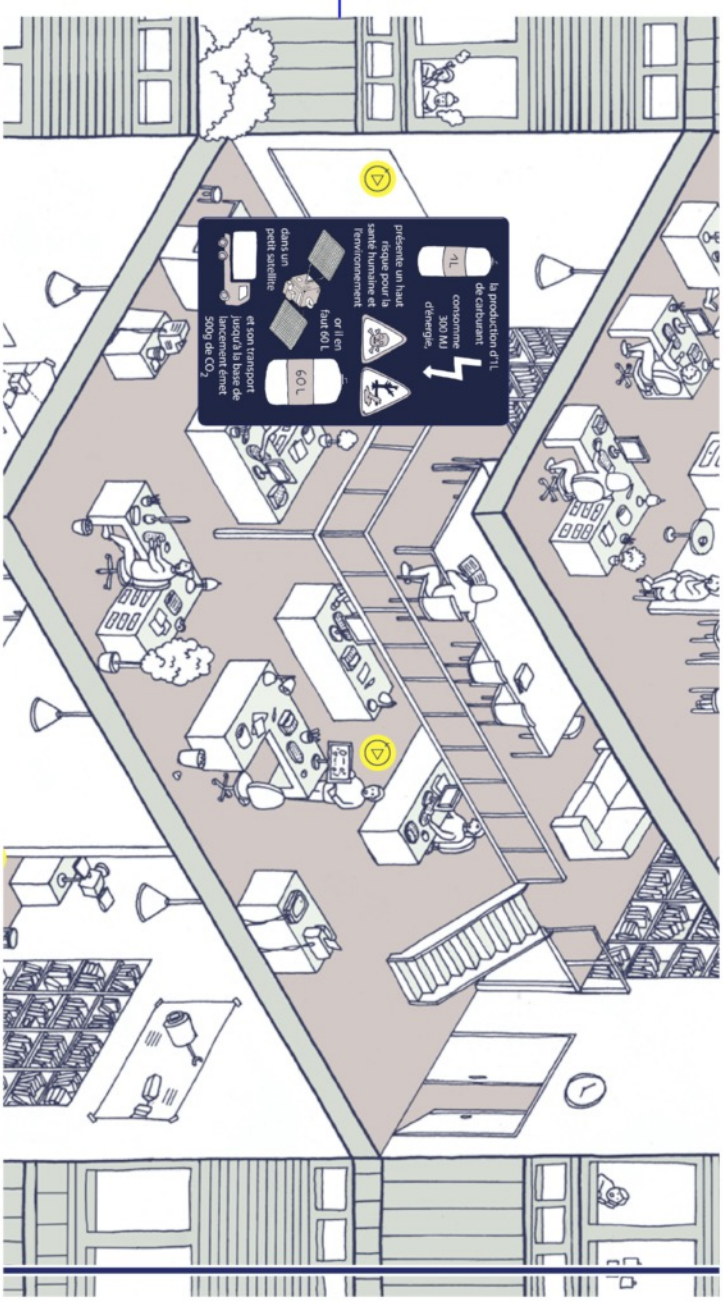


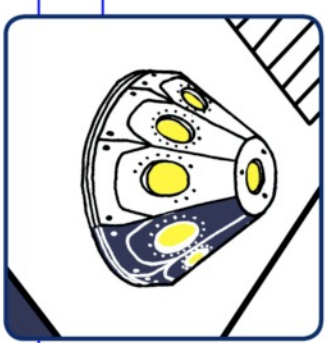


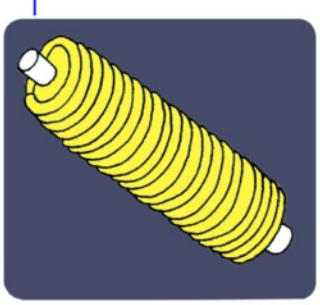


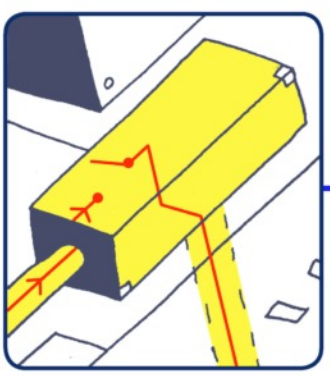


Credits: Marianne Tricot / ESA



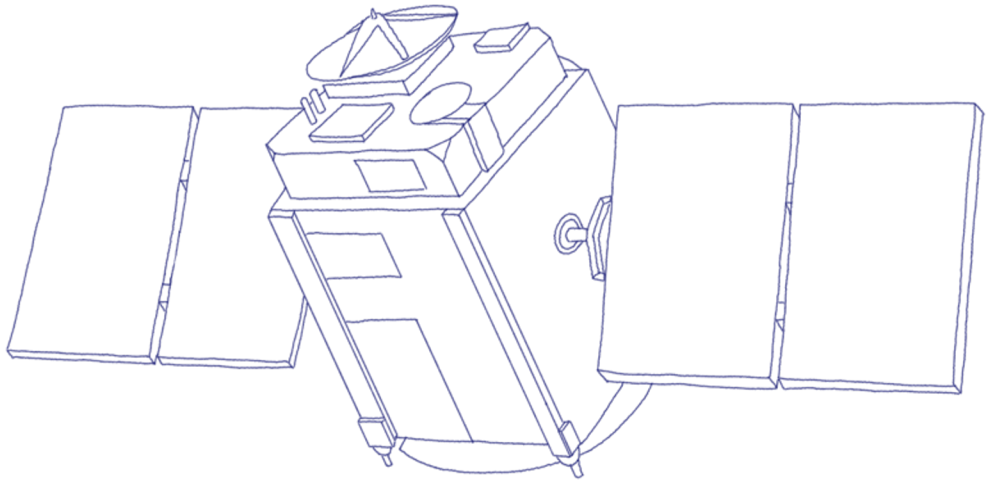






SACHA BERNA

Scientific illustration ?



Credits: Sacha Berna / ESA

- A link to the science
- Disseminate knowledge
- Arouse an interest in science
- Raise awareness

The project

The objectives of the project

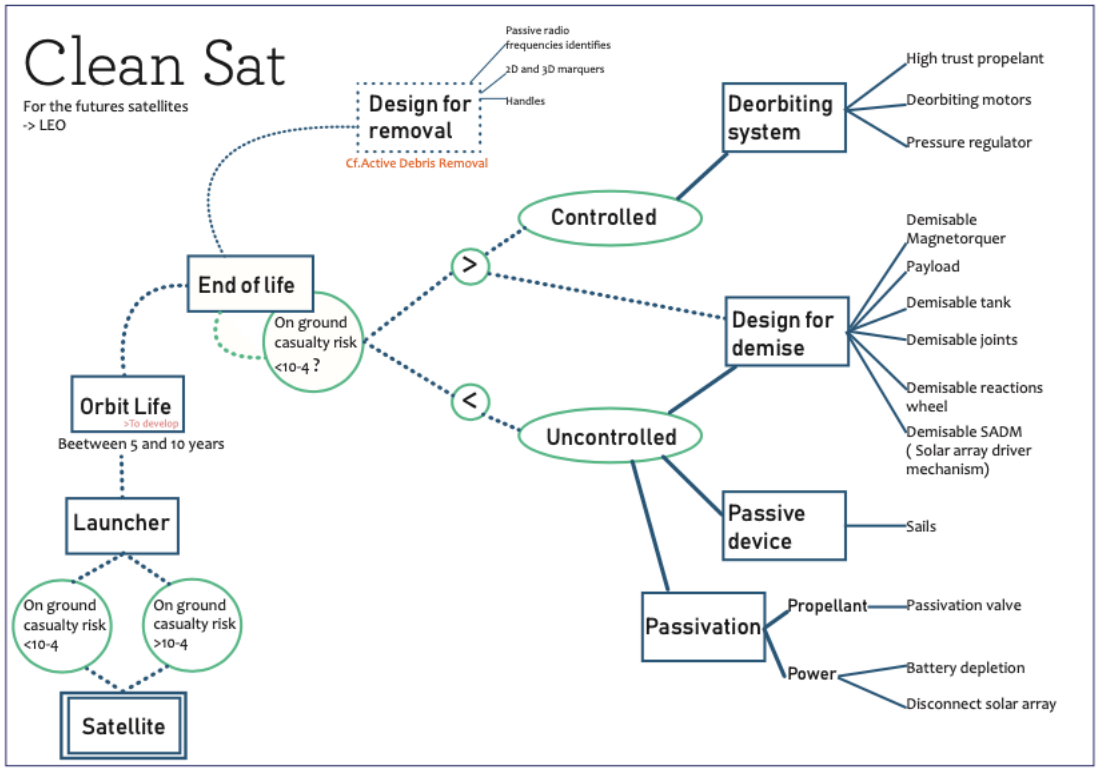
cleansat

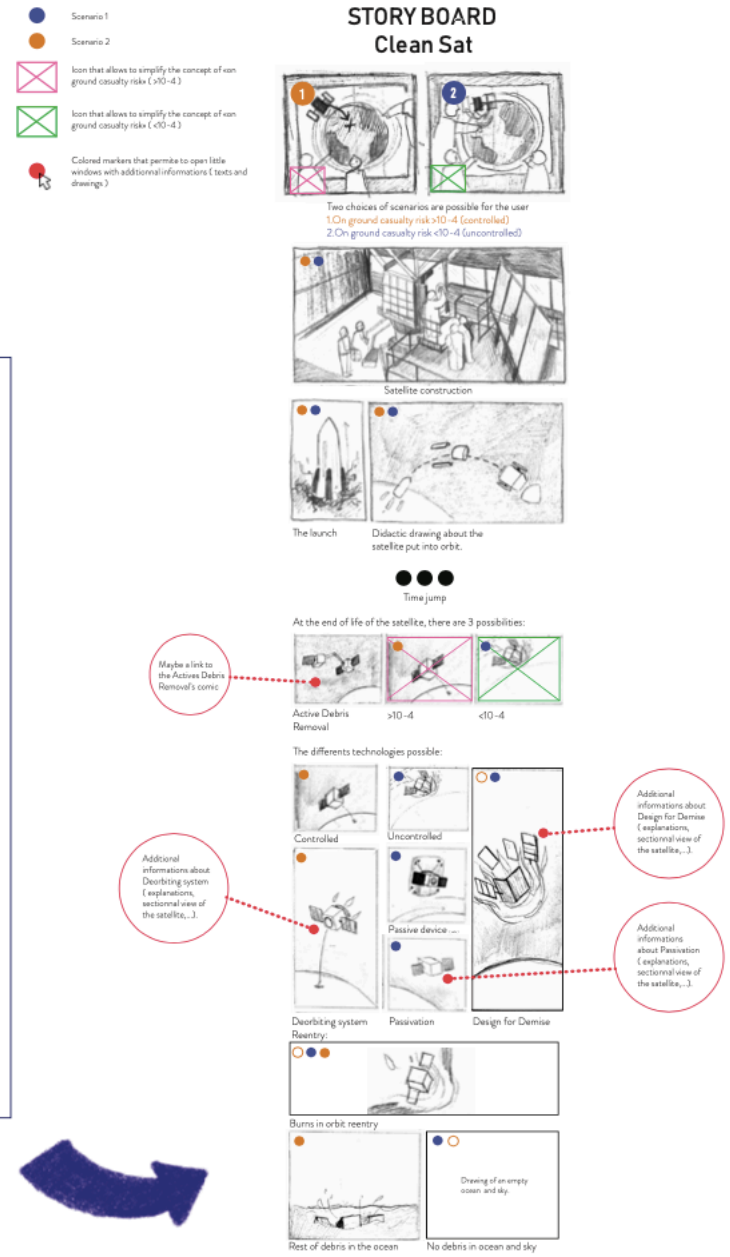
SPACE DEBRIS REDUCTION

Credits: Sacha Berna / ESA

Technical Process

The illustration at the service of understanding

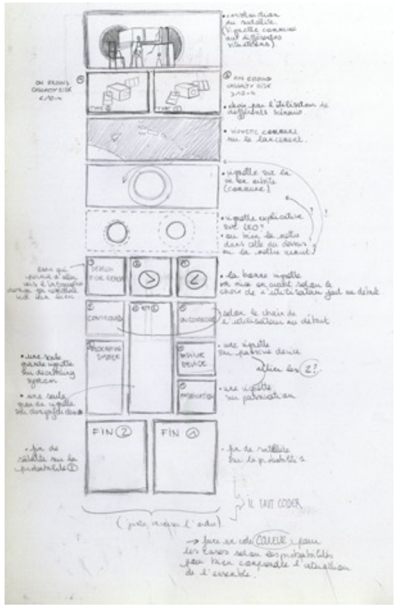


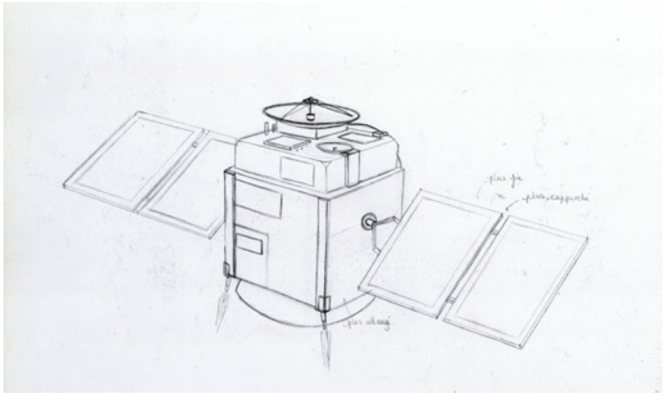


Credits: Sacha Berna / ESA

Graphic process

Adjust the drawing at the information



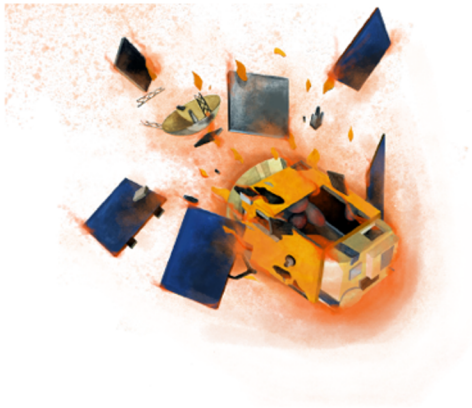


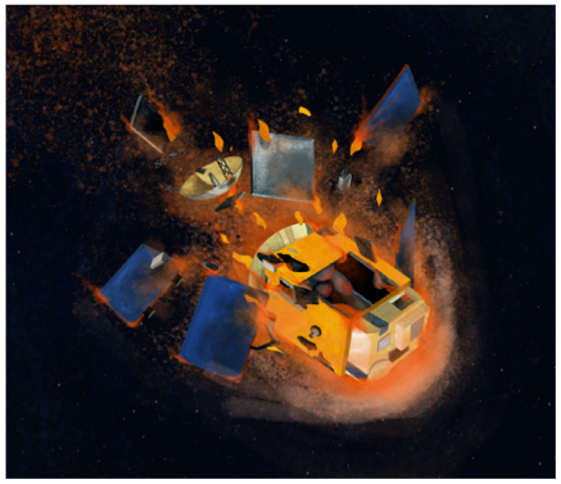
Research extracts

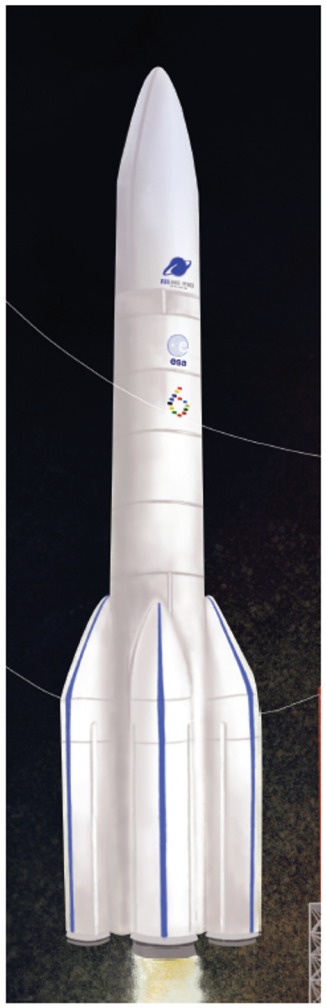
Credits: Sacha Berna / ESA

Graphic process

Step of drawing/Vary the style



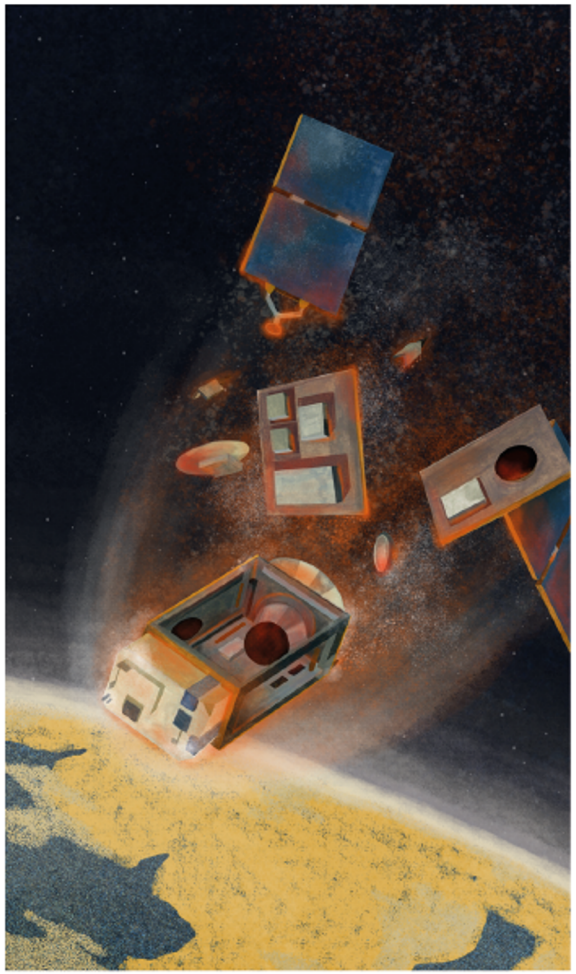


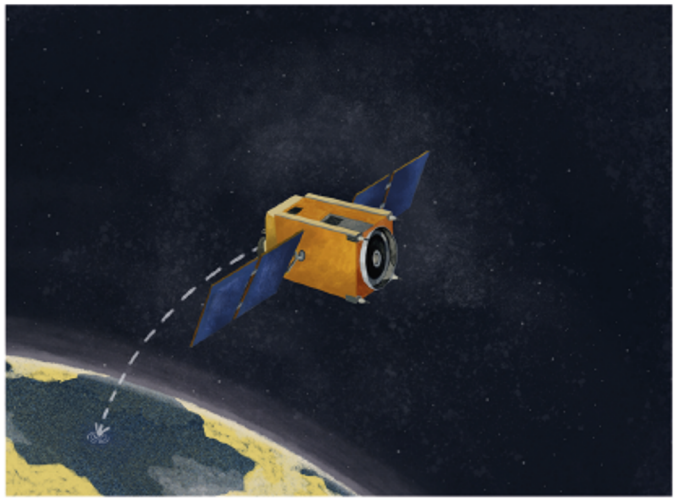


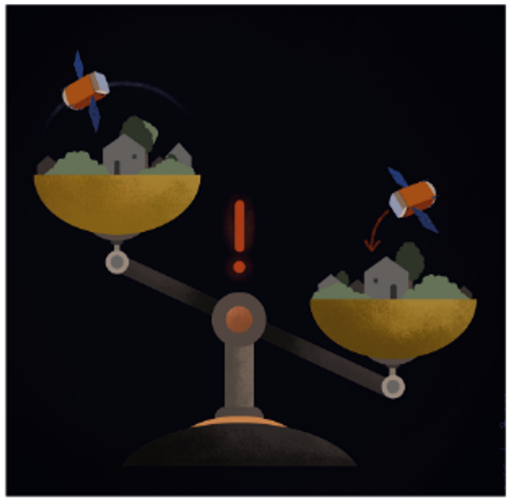
Credits: Sacha Berna / ESA

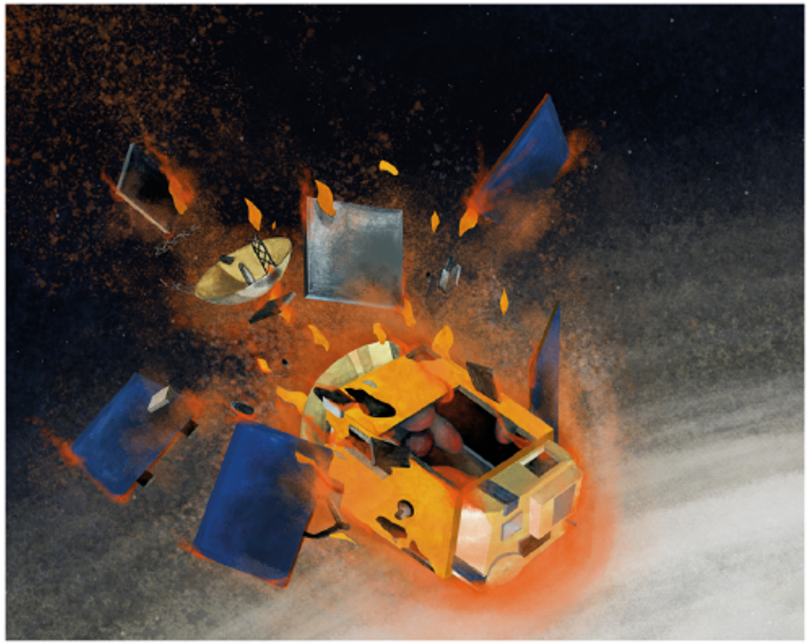
Result

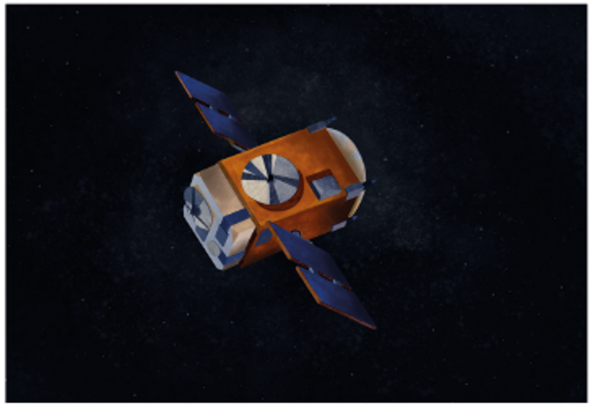
Clean Sat







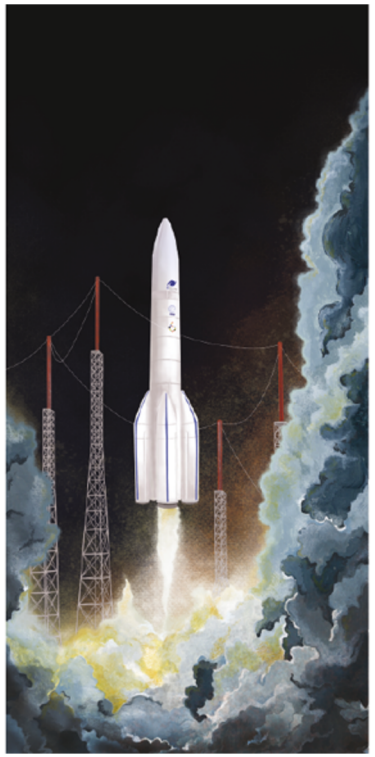




Credits: Sacha Berna / ESA

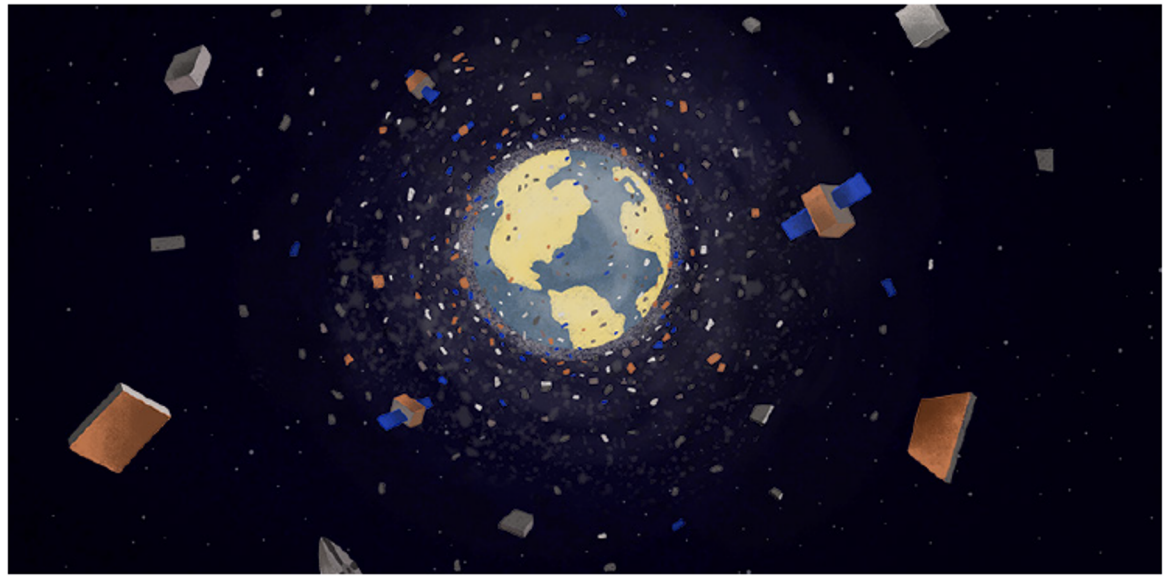
Rendering

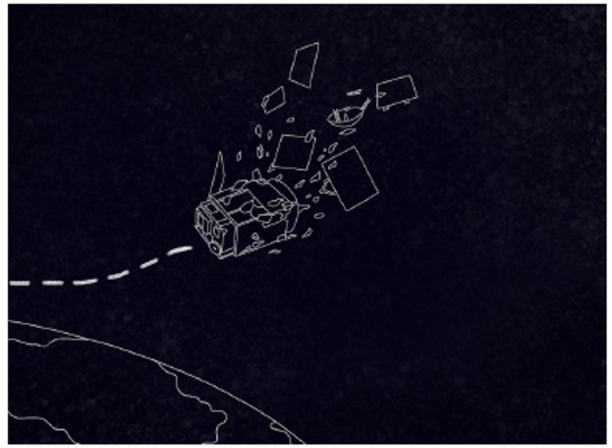
How to show the project ?

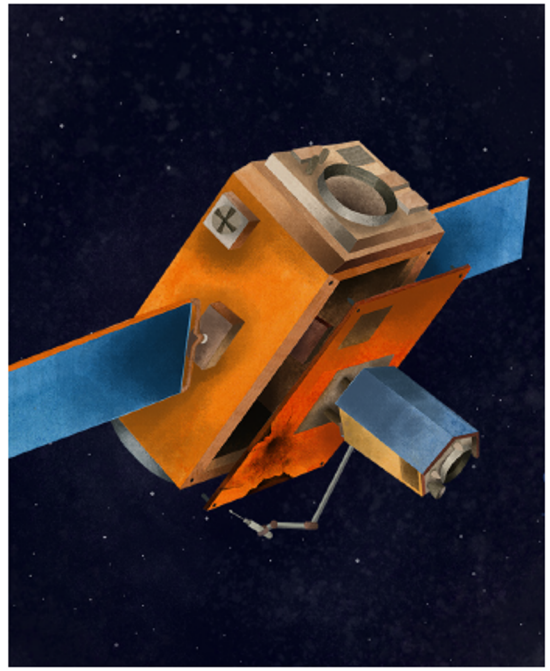


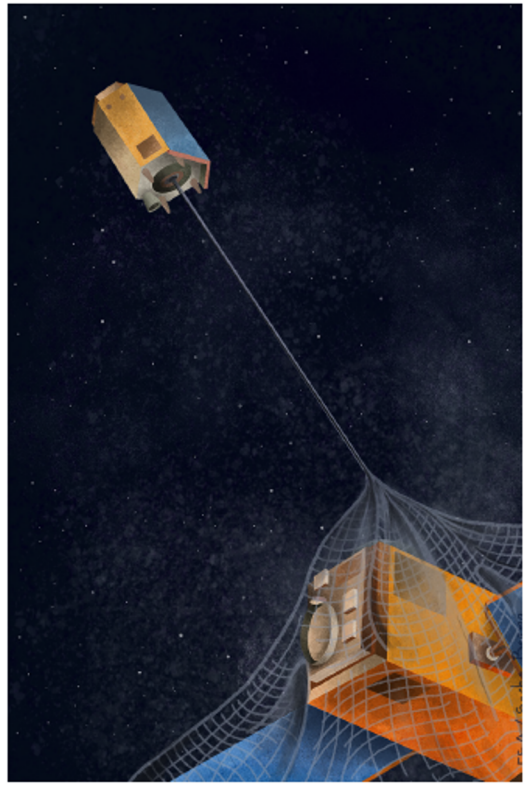
Tium etum si autatem dolor sus, omniendae ni ad modit eatenis sinc-tatem ipsae vero volorer spiderum re pra venit, sit aut et aut des sequam unt eariatet, niet la qui nulluptatus, ac-culpa rchillendam, explabo.

Credits: Sacha Berna / ESA









Credits: Sacha Berna / ESA

Educating to Clean Space

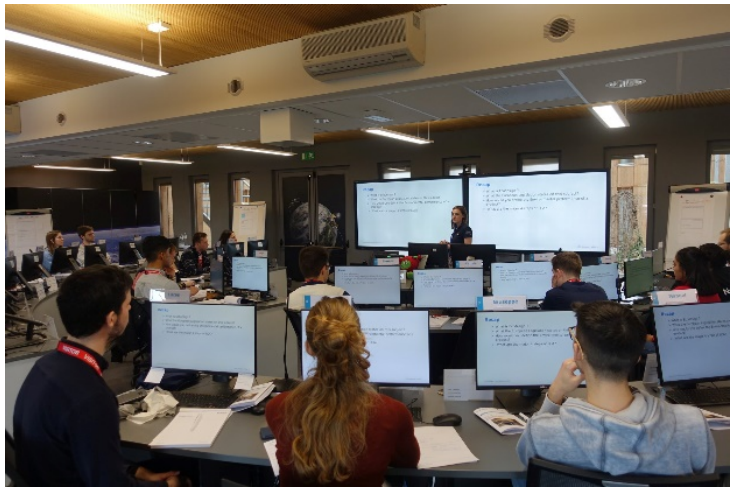
Elsa María Sanchez, **ESA's Education Office**

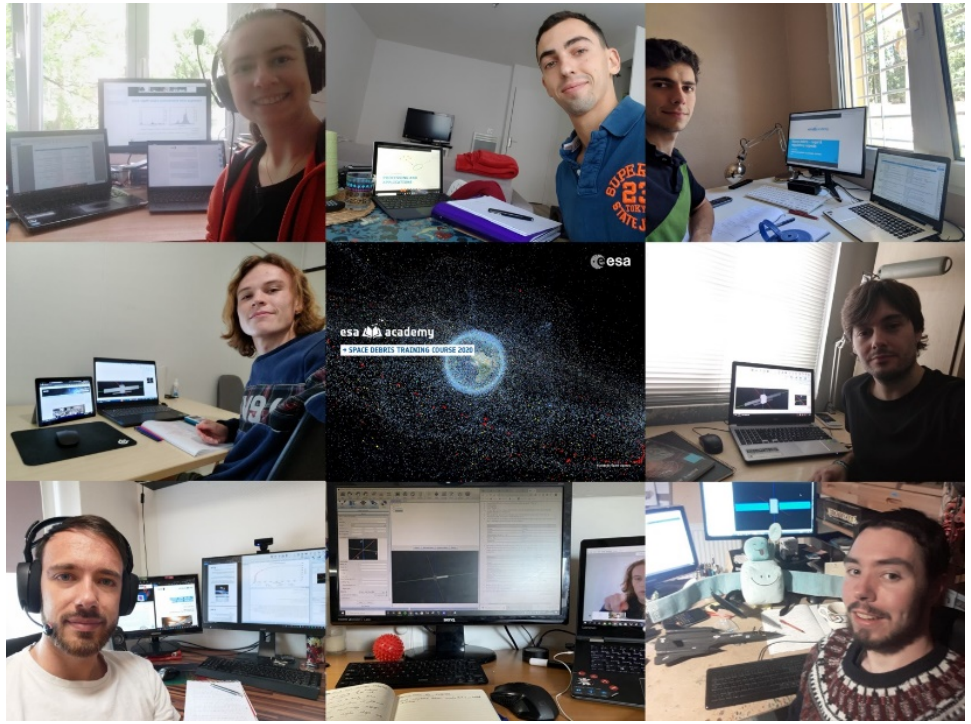
ESA Education targets & challenges

- "Prepare for jobs that have not been created, for technologies that have not yet been invented, to solve problems that have not yet been anticipated" (OECD)
- Equip the young generation with 21st Century skills
- Address changing scenarios:
  - ✓ New Space
  - ✓ Current societal challenges (climate, resources, energy, health, safety,…)
  - ✓ Growing need for a higher level of integration between knowledge fields, products, applications, services, business models

University: **ESA Academy Courses for students**

February 2020:
First edition of the **Clean Space** training course (physical event)





June 2020: First ever ESA Academy online course – 3rd edition of the **Space Debris** training course

Primary/Secondary: **What triggered our interest in developing Clean Space related activities?**

Autumn Teacher Workshop´s survey: 'What is the space topic you would like to learn about the most'

#1 answer: **Space Debris!**

Creation of the *CleanSpace Working group* with *ESA, ESERO UK, ESERO Nordic and ESERO Portugal* in order to develop educational resources

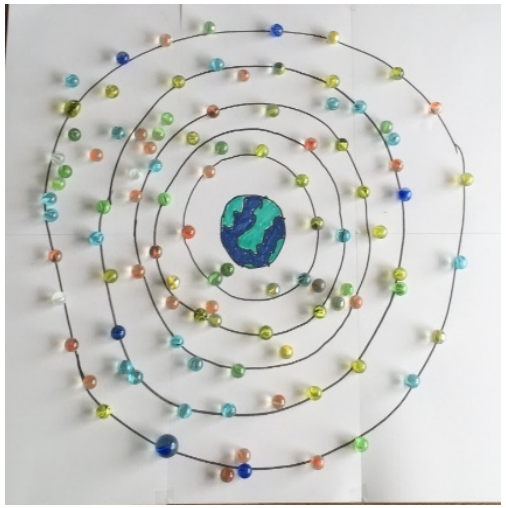
Primary Resource 1: **How do we generate Space Debris?**

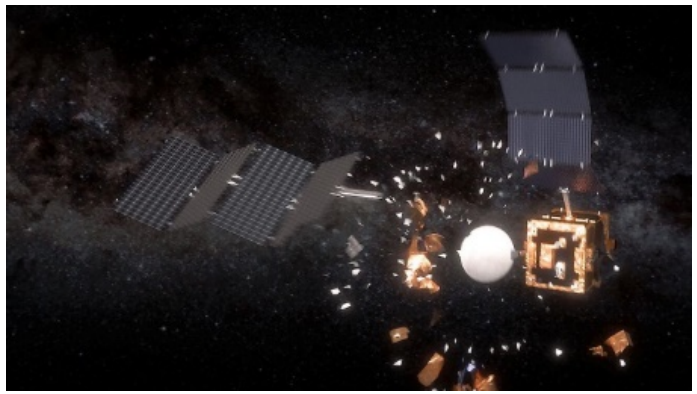
Activity 1: Collisions

Simulate the chain reaction (Kessler effect) with orbits populated with different amounts of satellites. Kids will throw marbles and analyse the reactions in each scenario.

Activity 2: Impacts

Children will simulate the creation of debris doing impact tests with crisps and analysing the size of the resulting debris (Small, medium and large)





Primary Resource 2: **The balloon rescue challenge**

Balloon rockets

Testing balloon rockets to help ‘debris’ come back to earth

Primary Resource 3: **Active debris removal tools**

Activity 1: Design and discuss your debris 'grabbing' tool

Children will creatively design a tool to grab an object

Activity 2: Reaching the debris - Unfurling tentacles

Objective: Reaching debris. Children will create their own 'unfurling' device, simulating a party blower.

Activity 3: Grabbing the debris - Sticky surfaces

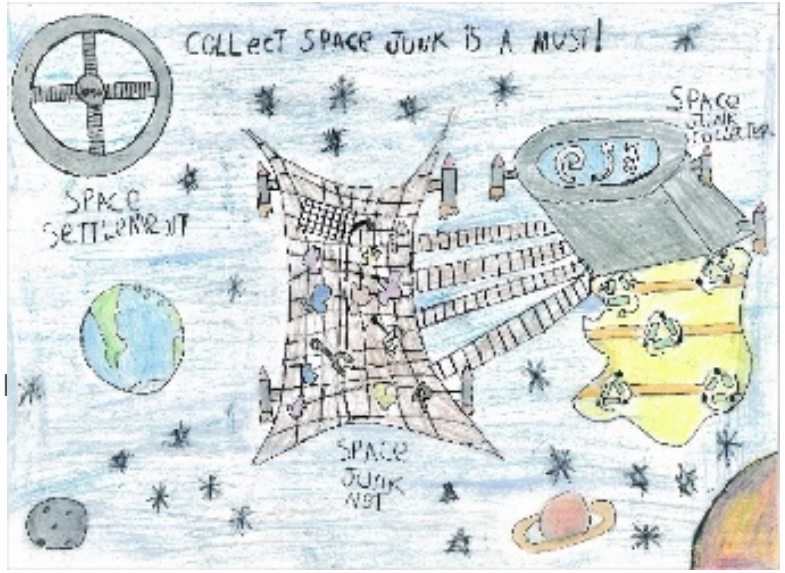
Objective: Grabbing debris.

Compare efficiency of sticky materials to attract debris

Activity 4: Design and build your own device

Objective: reach and grab the debris

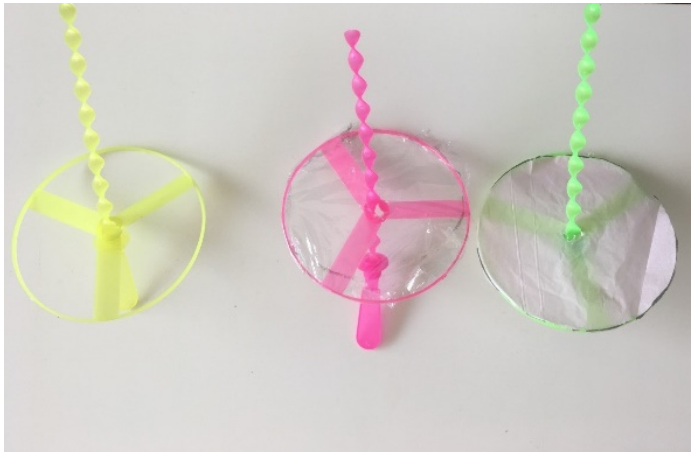
Amend, test, finalise designs and build a prototype



Primary Resource 4: **De-orbit mechanisms**

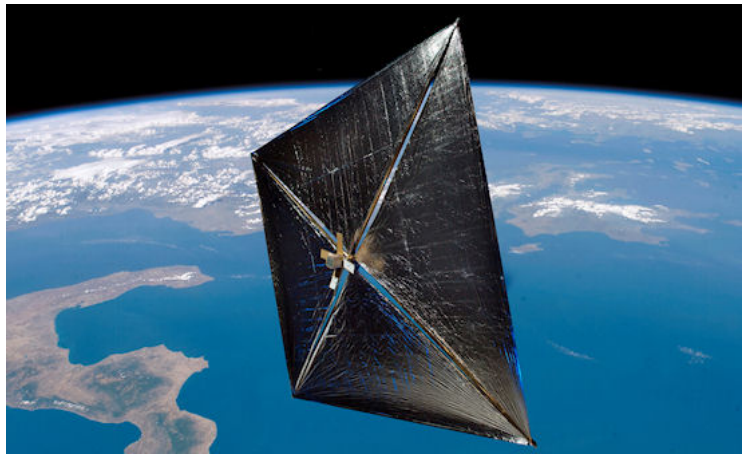
Activity 1: Satellite slowdown

Children will experience friction by moving through air, Learn that increasing surface area of object moving in air causes more drag



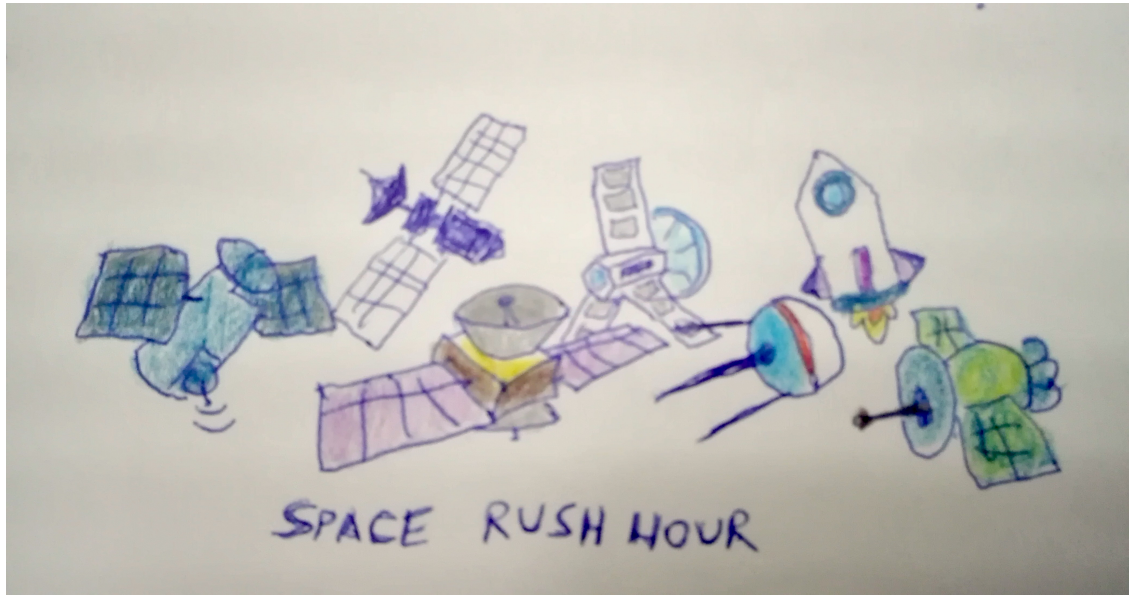
Activity 2: Satellite backpack challenge

Debris can be simulated by helicopter spinners Children will need to attach elements e.g. balloon, flat paper surface, etc to try to slow its spinning down, so that it descends faster. Launching spinners. Deciding what the satellite needs in its 'backpack'



Primary Resource 5: **Debate/art game**

Children will be presented problems



Artist: Joao Dias

Primary Resource 5: **Debate/art game**

And they will need to propose *solutions.* Children will keep creating the game as they provide their drawings

Artist: Joao Dias

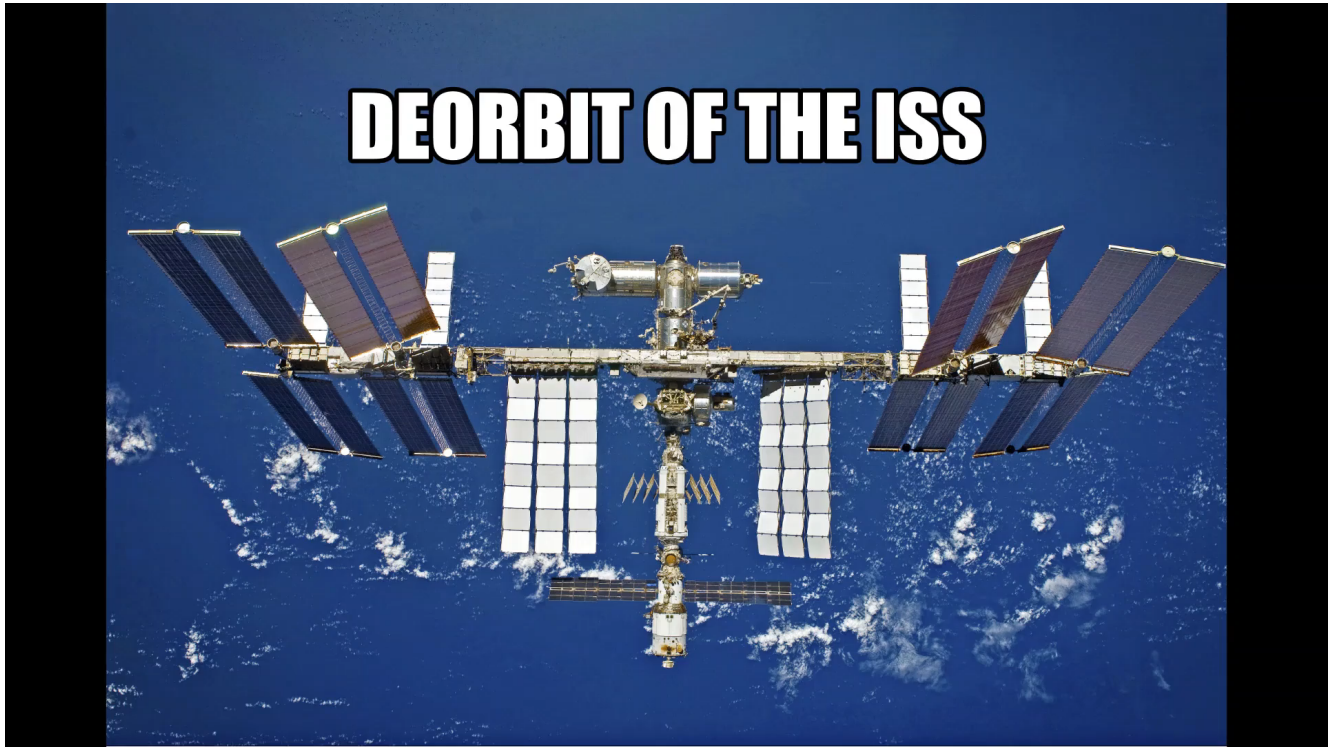
Secondary Resource 1: **Activity on orbits and simulation of re-entry**

Activity 1: Students will simulate orbits through hands-on experiments

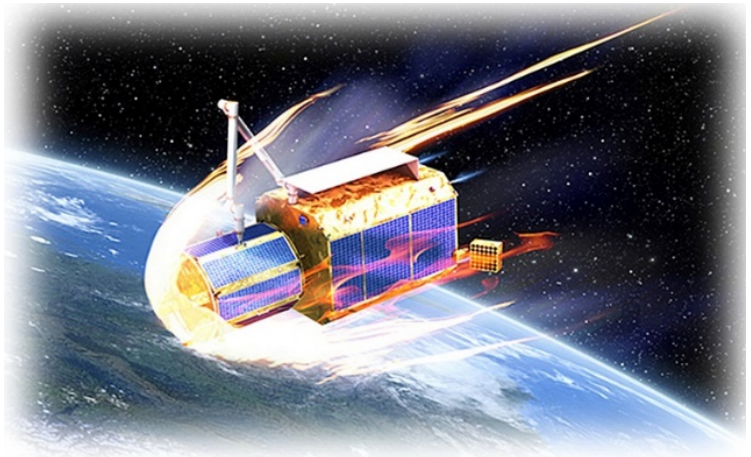
Activity 2: Students will need to change certain parameters in the code to simulate different orbits

```
# Compute the force of attraction
f = G * self.mass * other.mass / (d**2)
F = 10000

# Compute the direction of the force.
theta = math.atan2(dy, dx)
fx = math.cos(theta) * f
fy = math.sin(theta) * f
return fx, fy
```



Secondary resource 2: **The chemistry of re-entry**



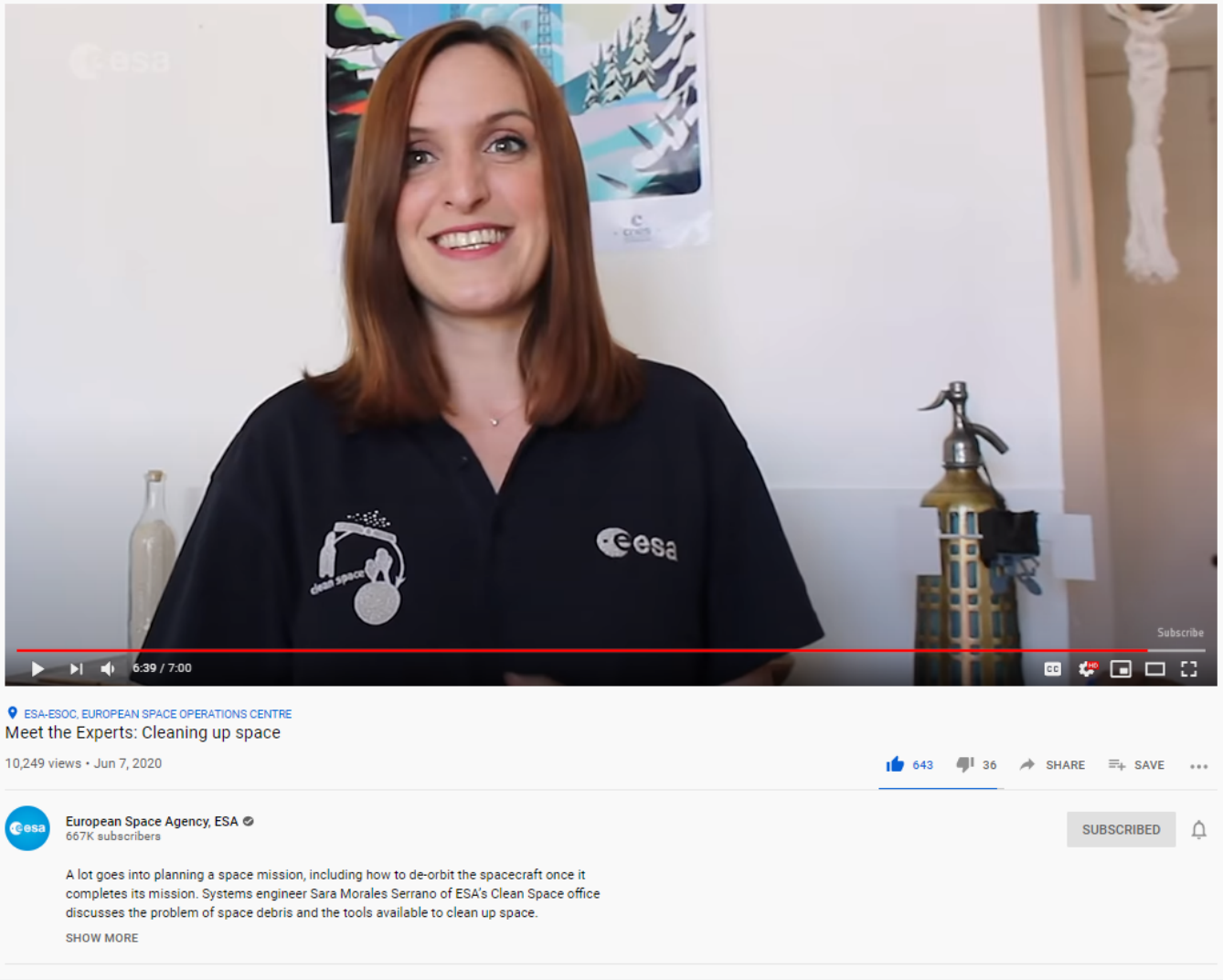
Activity 1: Plasma globe and spectra

- States of matter – plasma
- Spectra of various gases and the ‘cold plasma’

Activity 2: Resistance of materials

Students will test different materials resistance and they will explore what happens during re-entry

Educational video: **Meet the experts – Cleaning up Space,** with Sara Morales



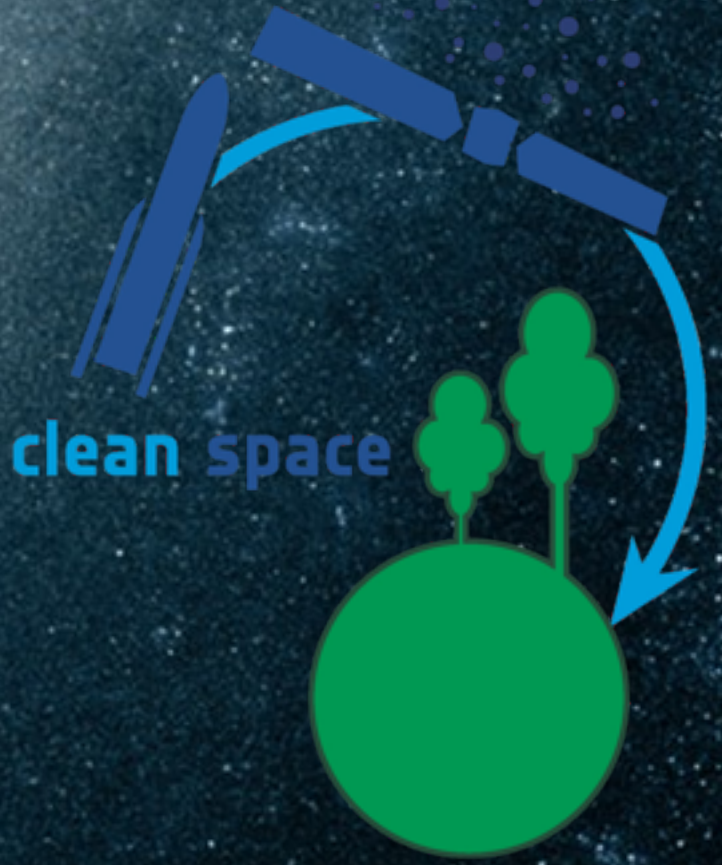
+10K views!

Educational game: **Paxi Space Cleanup**

Thank you for your participation!

Please give us your feedback by filling in our survey!

Scan the QR code ☞



Contacts and websites

Sacha Berna - sacha.berna@orange.f

Marianne Tricot - mariannetricot@gmail.com
Marianne Trico website - https://www.mariannetricot.fr

Elsa María Sanchez - Elsa.Maria.Sanchez@esa.int
ESA Education - https://www.esa.int/Education
Teach with space resources - https://www.esa.int/Education/Teachers_Corner/Teach_with_space3
Paxi game ”Space Cleanup” https://www.esa.int/kids/en/Games/Space_Cleanup

Daan Roosegaarde - https://www.studioroosegaarde.net/stories
Space Waste Lab - https://www.studioroosegaarde.net/project/space-waste-lab

Cleanspace – cleanspace@esa.int
Cleanspace blog - http://blogs.esa.int/cleanspace/
Cleanspace twitter - @ESAcleanspace