

# *Space Sciences in the classroom*

## Educational activities of the European Space Agency

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# Outline

- Education and ESA ? **WHY**
- Education and ESA - **HOW:**
  - Policy
  - Strategy
  - Expertise
  - Implementation
  - Resources
- ESA Education and Greece

# Education at ESA

“The activities of the Agency shall include mandatory activities, in which all Member States participate, and optional activities, in which all Member States participate apart from those that formally declare themselves not interested in participating therein.

- a. With respect to the mandatory activities, the Agency shall:
  - i. ensure the execution of basic activities, such as **education**, documentation, studies of future projects and technological research work...”

*ESA Convention – Article V.1.a.i*

# Educational Policy of ESA

- **Use Space as a theme, in order to:**

- (i) enhance the literacy of young people in science and technology

- (ii) motivate young Europeans to pursue a space related career

- **In line with the main trends and policies:**

- (i) increase Continuous Professional Development (CPD) for teachers

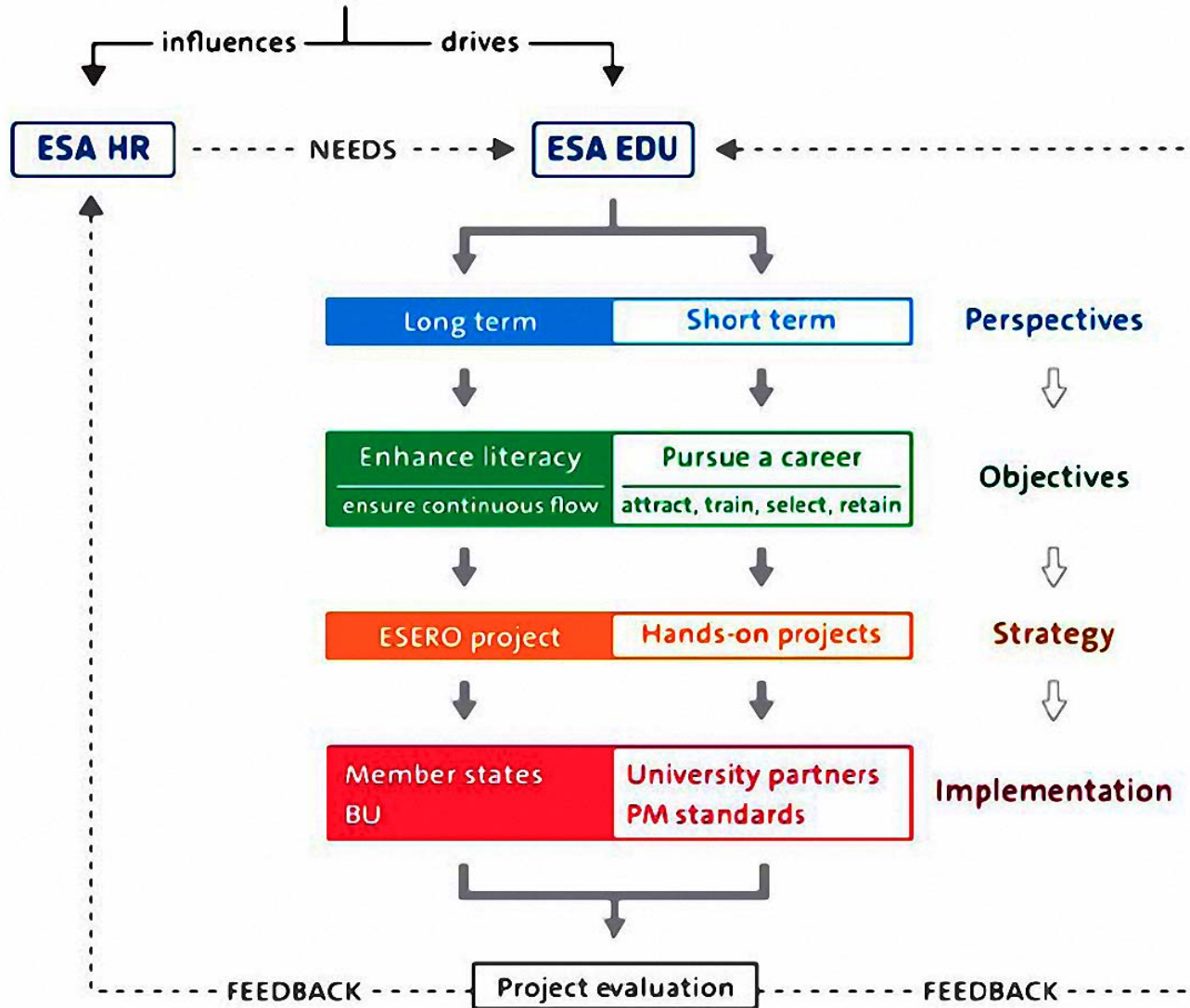
- (ii) challenge the way science is taught – ‘Inquiry Based Science Education’

- **To stimulate interest in STEM to ensure continuous stream of students in STEM studies and careers**

- **To offer a tailored and adequate response – at all level, from primary to tertiary**

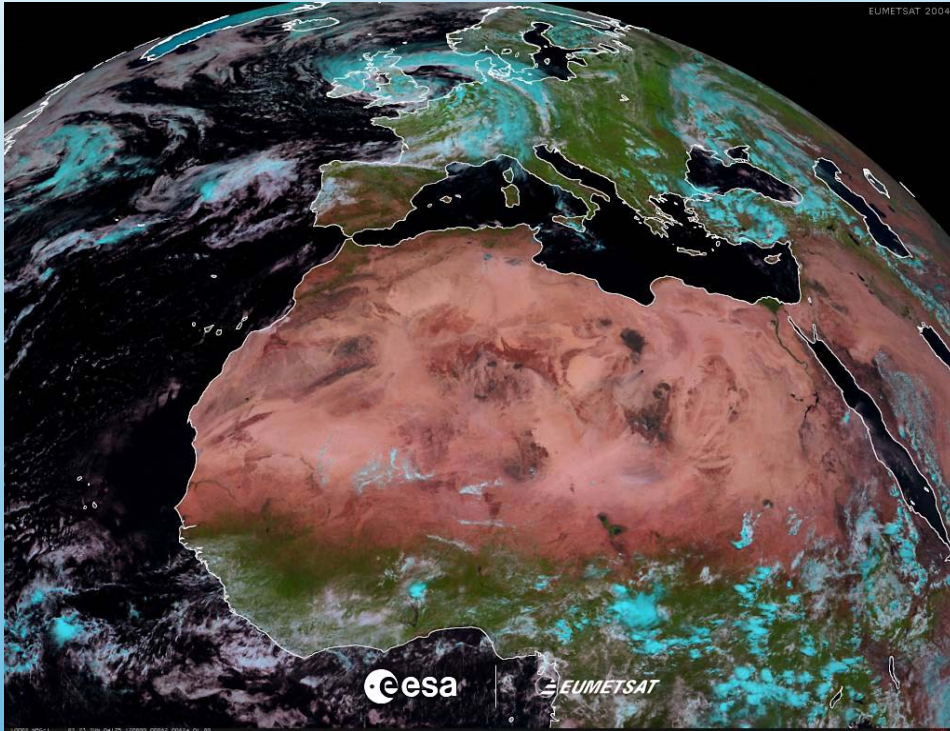


# STEM Agenda



# ESA Expertise - 1

## Earth observation

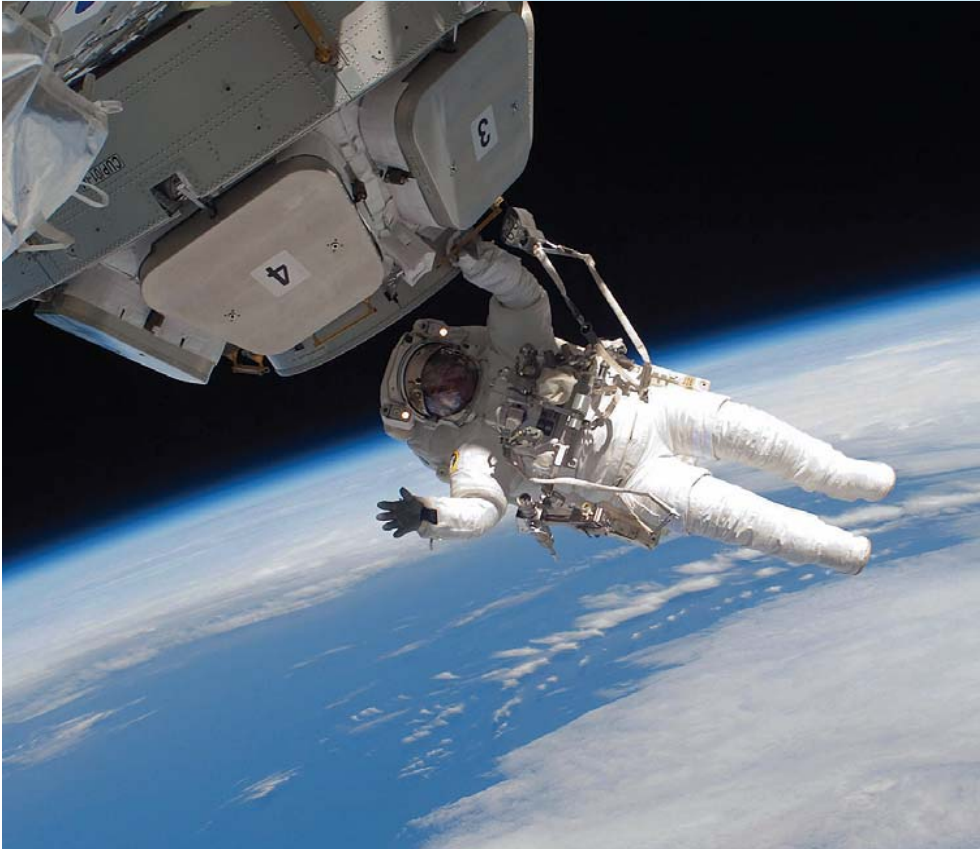


ESA's Earth observation satellites help us understand what is happening to our planet. Satellites are unique in their ability to constantly monitor the entire Earth: they can provide crucial information about our ever-changing planet. From space, they monitor many natural and man-made events, from floods and forest fires to changes in ice cover, rising sea levels and oil slicks.



# ESA Expertise - 2

## Human Spaceflight



European astronauts have been taking part in manned space missions for nearly three decades. Many have already flown on missions to the ISS, playing a vital role in the assembly and operation of key elements of the station. They also carry out research in microgravity conditions, delivering results that cannot be achieved here on Earth.

# ESA Expertise - 3

## Launchers

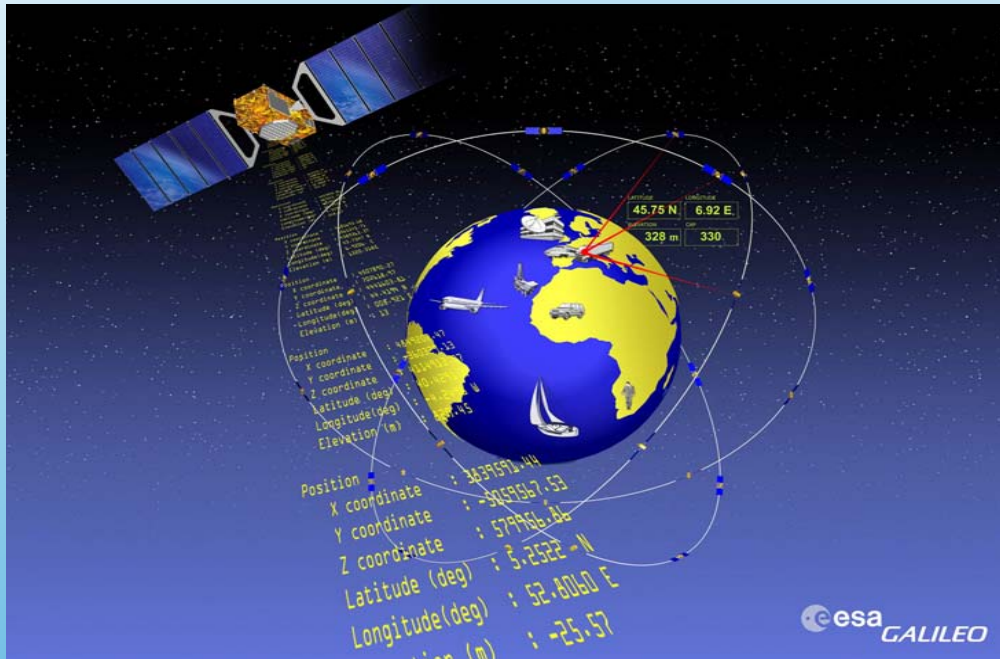


Self-sufficiency in sending satellites into orbit is vital for Europe's independence in space. Since the beginning of the Ariane programme in 1973, a highly successful series of launchers has been developed. For the future, ESA is reviewing new technologies and propulsion systems with experts from Europe's aerospace industry, to make access to space simpler and cheaper.



# ESA Expertise - 4

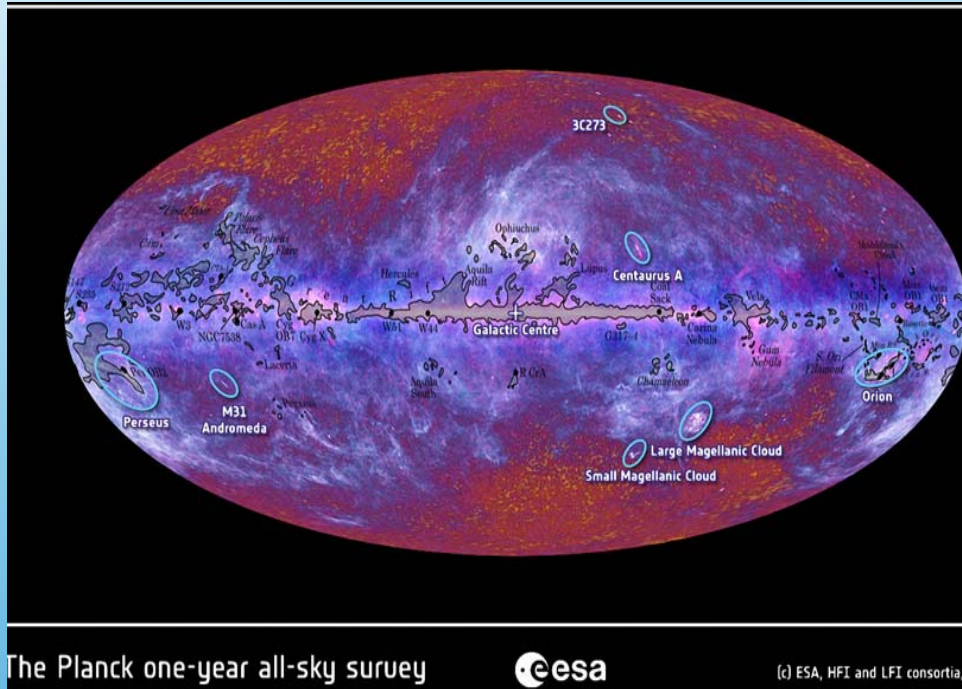
## Navigation



After mobile phones and the internet, satellite navigation is the latest high-tech addition to our everyday lives. Spacecraft orbiting Earth can tell you exactly where you are, 24 hours a day. Furthermore, air traffic control, shipping, rescue operations, crisis management and law enforcement services have all been revolutionised by more accurate and reliable positioning systems.

# ESA Expertise - 5

## Science & robotic exploration



ESA's Cosmic Vision programme is a starting point for crucial studies in space science. Several fundamental themes lie at its core:

- the conditions for planetary formation and the emergence of life
- how the Solar System works
- the fundamental physical laws of the Universe
- the origins of the Universe and what it is made of



# ESA Expertise - 6

## Technology



ESA's technology programmes cover different domains to ensure that spacecraft can operate for years in the unforgiving space environment. ESA's experts work closely with European industry in developing and testing sophisticated technologies needed to make future missions and applications possible.



# ESA Expertise - 7

## Telecommunications & integrated applications



Global communications underpin modern society and represent an important commercial sector. By promoting the research and development of a wide range of new technologies and system concepts, ESA's Telecommunications Programme aims to provide solutions to a wide range of needs and challenges faced by citizens and society at large.

# ESA Education Office

ESA's Education Office is responsible for the Agency's corporate education programme, bringing together young people from many different nations.

The aim is to help young Europeans, aged from 6 to 28, to gain and maintain an interest in science and technology, with the long-term objectives of contributing towards the creation of a knowledge-based society and ensuring the existence of a qualified workforce for the Agency that will ensure Europe's continued leadership in space activities.

<http://www.esa.int/SPECIALS/Education/index.html>



education

# Activities of Education Office

ESA's Education Office is responsible for numerous activities that can be broadly subdivided into the following categories:

- Hands-on projects
- Support to teachers
- International collaboration activities
- Opportunities for students
- Outreach initiatives

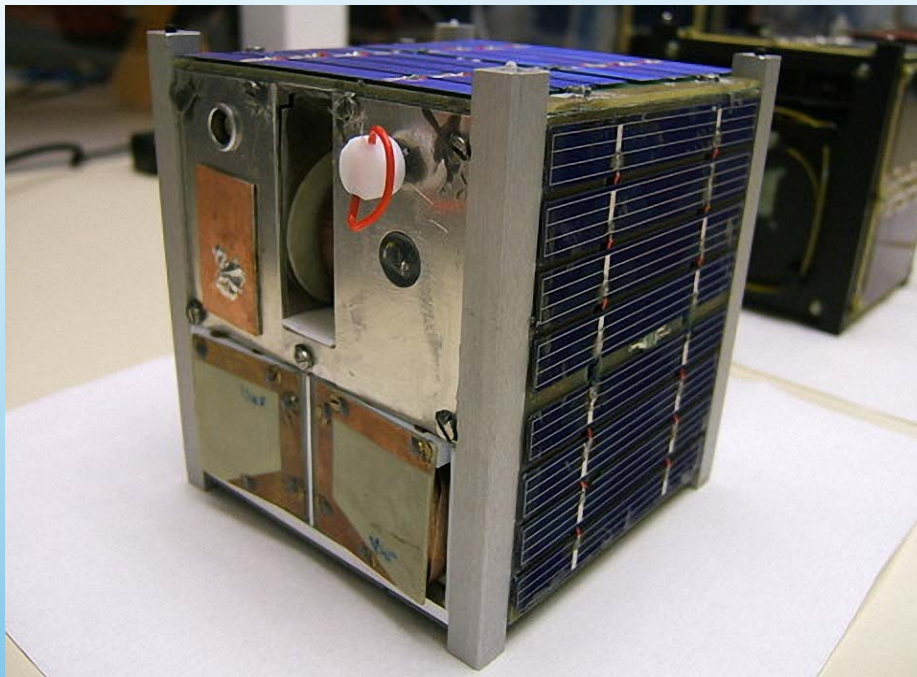


# Hands-on projects

- *CubeSats*
- *European Student Earth Orbiter*
- *European Student Moon Orbiter*
- *Global Educational Network for Satellite Operations*
- *GENSO Experimental Orbital Initial Demonstration*
- *Drop your Thesis!*
- *Fly your Thesis!*
- *Spin your Thesis!*
- *Rocket Experiments for University Students*
- *Balloon Experiments for University Students*

The Hands-on projects include the full participation of students in all aspects of designing and developing small satellites and experiments that can be flown on various microgravity platforms, such as balloons, sounding rockets, parabolic flights and CubeSats. These often include project-related workshops and training by experts.

# CubeSat



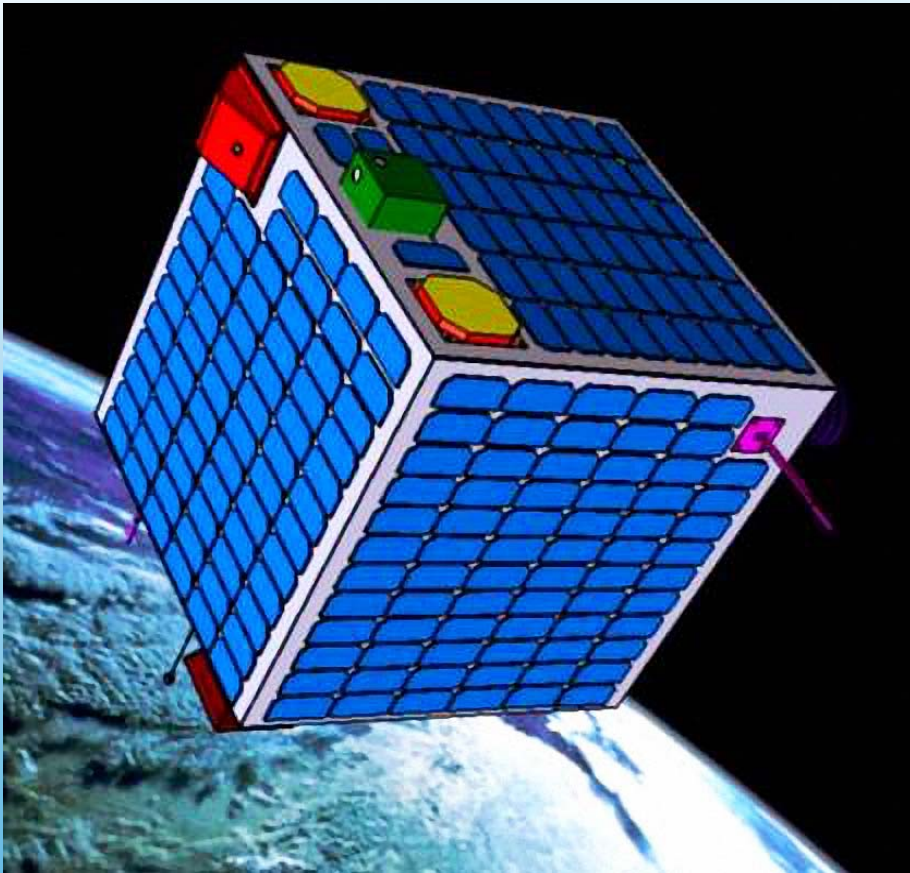
<http://cubesat.calpoly.edu/>

The CubeSat programme strives to provide practical, reliable, and cost-effective launch opportunities for universities to create small satellites and their payloads. Students, through hands on work, will develop the necessary skills and experience needed to succeed in the aerospace industry.

The CubeSat programme also benefits private firms and government by providing a low-cost way of flying payloads in space, all while creating important educational opportunities for future leaders of industry.



# ESEO



The European Student Earth Orbiter (ESEO) is a micro-satellite mission to Low Earth Orbit. It is planned to be developed, integrated, and tested by European university students and will orbit the Earth taking pictures, measuring radiation levels and testing technologies for future education satellite missions.

[http://www.esa.int/esaMI/Education/SEMA0NEMKBF\\_0.html](http://www.esa.int/esaMI/Education/SEMA0NEMKBF_0.html)

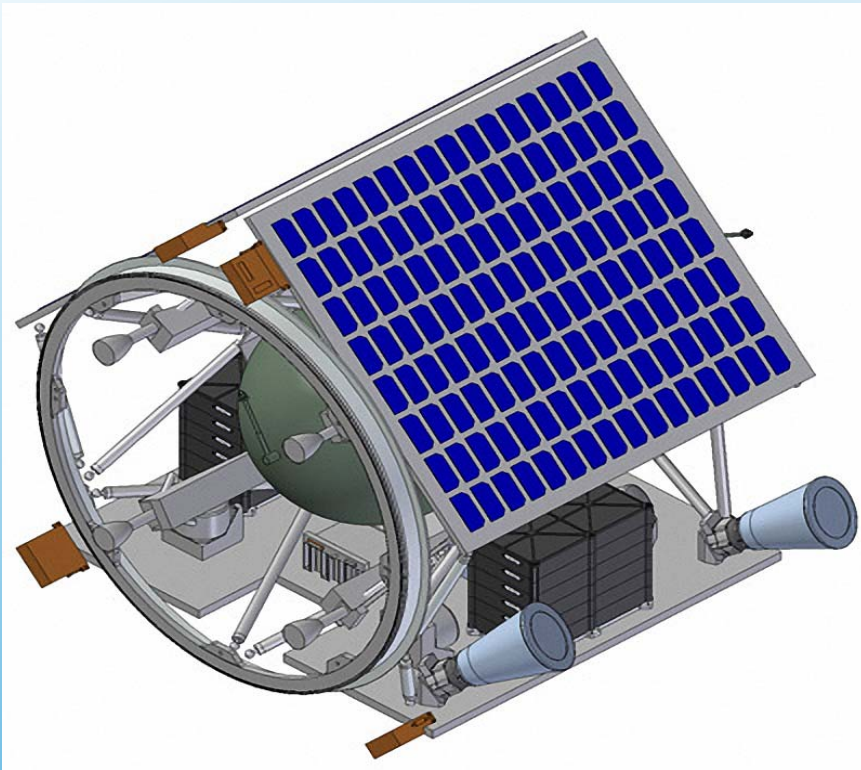


# ESMO

The European Student Moon Orbiter (ESMO) is planned to be the first European student mission to the Moon.

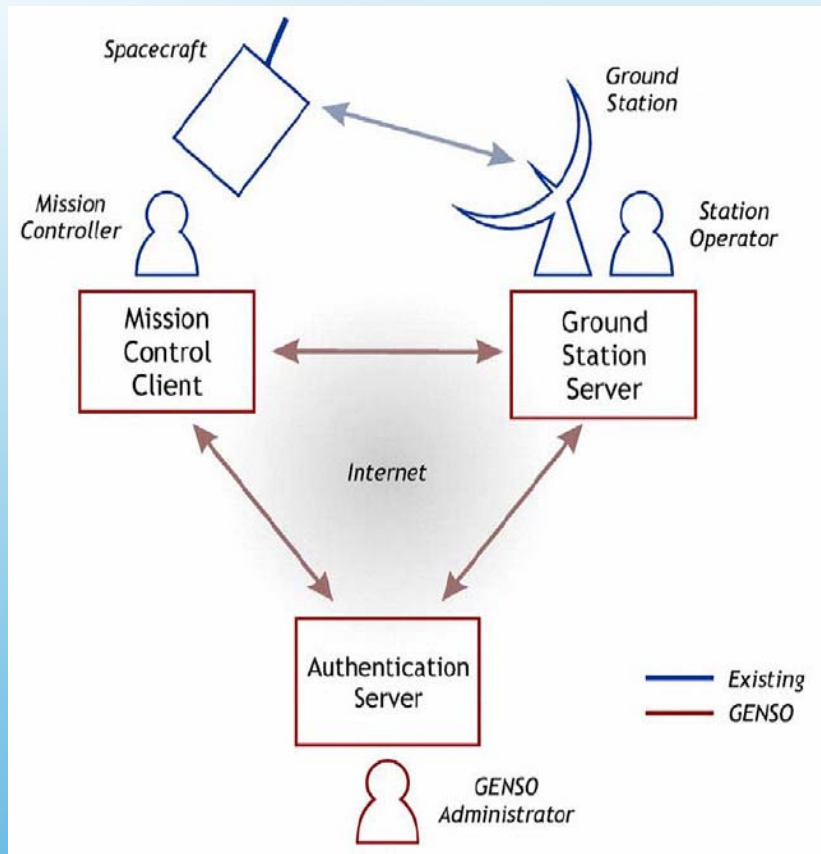
Payloads being studied include:

- 1) Narrow Angle Camera to take images of the lunar surface.
- 2) LunaNet, an internet-like network at the Moon for communication between future spacecraft in lunar orbit, landers, rovers and ground stations on the Earth.
- 3) Radiation Monitor.
- 4) Radar.
- 5) Microwave Radiometric Sounder.



[http://www.esa.int/esaMI/Education/SEML0MPR4CF\\_0.html](http://www.esa.int/esaMI/Education/SEML0MPR4CF_0.html)

# GENSO



The Global Educational Network for Satellite Operations (GENSO) aims to increase the return from educational space missions by forming a worldwide network of ground stations and spacecraft, which can interact via a software standard.

The technologies and frameworks being developed include: Authentication Servers, Ground Station Servers, Mission Control Clients etc.

GENSO is focused primarily on those sections of the VHF, UHF and S bands which are allocated for use by the radio amateur community.

[http://www.esa.int/esaMI/Education/SEMKO03MDAF\\_0.html](http://www.esa.int/esaMI/Education/SEMKO03MDAF_0.html)

# FYT



The **Fly Your Thesis!** programme gives university students the possibility to fly their scientific experiment in microgravity, as part of their Masters thesis, PhD thesis or research programme, by participating in a series of parabolic flights, which take place on the Airbus A300 Zero-G.

Each parabola includes phases with different gravity levels: 1g – 2g (while climbing), 0g (about 20 seconds per parabola), 2g (while going back to a horizontal trajectory); 1g (on a horizontal flight).

[http://www.esa.int/esaMI/Fly\\_Your\\_Thesis/index.html](http://www.esa.int/esaMI/Fly_Your_Thesis/index.html)



# DYT



The ‘**Drop Your Thesis!**’ programme gives university students the opportunity to perform their own scientific experiment in microgravity conditions, as part of their Masters thesis, PhD thesis or research programme, by participating in an ESA-sponsored campaign at the drop tower facility operated by the ZARM Centre of Applied Space Technology and Microgravity in Bremen, Germany.

Drop towers offer the best microgravity levels (as low as  $10^{-6}$  g) for a short time (up to 9 sec) and allow the experiment hardware to be changed or improved between drops.

[http://www.esa.int/esaMI/Education/SEM67TLX82G\\_0.html](http://www.esa.int/esaMI/Education/SEM67TLX82G_0.html)

# SYT



The ‘**Spin Your Thesis!**’ programme gives university students the opportunity to perform a scientific or technology experiment which is linked to their syllabus, by participating in a centrifuge campaign that provides hypergravity conditions.

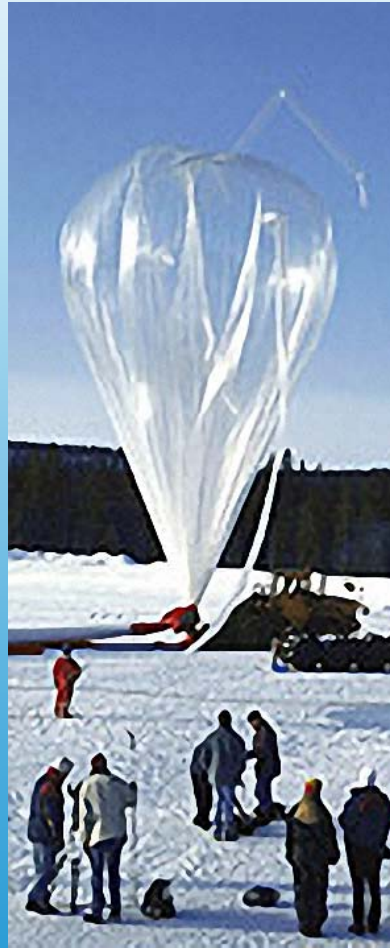
The experiments are carried out in the ESA Large Diameter Centrifuge facility at ESTEC in Noordwijk, the Netherlands.

This instrument can provide a hypergravity environment (up to 20g) for cells, plants and small animals, as well as physical science and technological experiments.

[http://www.esa.int/esaMI/Education/SEM43VZRA0G\\_0.html](http://www.esa.int/esaMI/Education/SEM43VZRA0G_0.html)



# REXUS/BEXUS



The REXUS/BEXUS programme allows students from universities across Europe to carry out scientific and technological experiments on research rockets and balloons. Each year, two rockets and two balloons are launched, carrying up to 20 experiments designed and built by student teams.

REXUS experiments are launched on an unguided, spin-stabilised rocket, capable of taking 40 kg of experiment modules to an altitude of approximately 100 km.

BEXUS experiments are lifted by a balloon to a maximum altitude of 35 km, depending on total experiment mass (40-100 kg). The flight duration is 2-5 hours.

<http://www.rexusbexus.net/>



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# CanSat

A **CanSat** is a simulation of a real satellite, integrated within the volume and shape of a regular soft drink can. The challenge for the students is to fit all the major subsystems found in a satellite, into an aluminum can of 350ml. After release from a rocket or a captive balloon, the CanSat has to perform a certain mission and land safely on the ground.



*(<http://www.cansat.eu/about.html>)*

A CanSat competition offers the opportunity to high-school and university students to have a first experience of a real space mission, including design, integration, testing, launching, data analysis and presentation of results.

# Support to teachers

In recent years, ESA has provided support to teachers mainly through the **E**uropean **S**pace **E**ducation **R**esource **O**ffice (ESERO) project.

*([http://www.esa.int/SPECIALS/ESERO\\_Project/SEM4KP4KXMF\\_0.htm](http://www.esa.int/SPECIALS/ESERO_Project/SEM4KP4KXMF_0.htm))*

The ESERO project aims at the establishment of contact / resource centres which are manned by education experts and integrated into national educational systems and networks.

The ESERO contact point implements an annual series of teacher (primary & secondary) training sessions in collaboration with national partners, already active in STEM education. They use and disseminate existing ESA/ESERO education materials and, if appropriate, develop specific resources tailored to the needs of the education community. The ESERO office also organizes national ESERO teacher conferences for secondary and primary education.

# International collaboration

Since 2005, the collaboration activities in space education are coordinated by the International Space Education Board (ISEB), with the main objective to provide opportunities to share best practices and to unite efforts to foster interest in space, science and technology among the student community worldwide.

Since ISEB's inception, a number of multinational initiatives have been developed, including:

- GENSO
- Opportunities for sponsored students to attend high-level, space related conferences and workshops around the world.
- NASA Academy internship programme
- National trainee programmes
- Postdoctoral research fellowships etc.



# Other supported activities

ESA's Education Office promotes several activities which are organized/coordinated by other institutions, like:

- The **International Space University**. These activities include the ISU Master Programs, the ISU Space Studies Program (SSP) and other educational/training activities run by ISU.
- The **Alpbach Summer School** (organized by the Aeronautics and Space Agency of the Austrian Research Promotion Agency). This School enjoys a long tradition in providing in-depth teaching on different topics of space science and technology, with the aim of advancing the training and working experience of European graduates, post-graduate students, young scientists and engineers.

# Outreach activities

The outreach activities are mostly developed and run by the Education Outreach Unit of ESA. These include, among others:

- Education portal (classical and online materials)  
[http://www.esa.int/esaMI/Education/SEMLXZF098G\\_0.html](http://www.esa.int/esaMI/Education/SEMLXZF098G_0.html)
- ESA Kids website, which includes a variety of educational resources for children (contests, animated activities etc)  
<http://www.esa.int/esaKIDSen/>
- Eduspace website (in several languages)  
[http://www.esa.int/SPECIALS/Eduspace\\_EN/](http://www.esa.int/SPECIALS/Eduspace_EN/)

The Eduspace website aims to provide secondary school students and teachers with learning and teaching tools, space image data and Earth observation applications for education and training.

- Support to outreach activities in ESA Member & Cooperating States

# Greek involvement in ESA educational activities in 2010

- CanSat: One Greek team (10 students & 2 teachers from the 3rd General Lyceum of Mytilini) were among the 11 teams in the 2010 European CanSat Competition (Norway, 13-21/08/2010).  
(<http://www.cansat.eu/teams-2010/eu2010-icaromenippus.html>)
- ESA-Kids: Several Greek pupils participated in the Space Gallery Competition. (<http://www.esa.int/esaKIDSen/art.html>)
- Teachers Workshop: Three Greek teachers participated in the ESA Summer Teachers Workshop, organized by the Directorate of Human Spaceflight (ESTEC, 26-28/06/2010).
- Alpbach Summer School: Two Greek students participated in the 2010 Summer School.



I would like to thank the ESA Education Office for providing material, pictures and, foremost, inspiration to us all!