Space Challenges
Preparing the next generation of explorers

Space Challenges is the biggest free educational program in the field of space science and high technologies in the Balkans - http://spaceedu.net

The main aim is to inspire more young people to pursue science, technical and engineering careers. The program fosters entrepreneurship in the high-tech field facilitating the development of new tech start-up projects that bring innovation to the region.

The initiative involves a range of leading experts from ESA, NASA, Caltech, MIT, Stanford University, Harvard University, University of Oxford, and many World-class organizations.

Space Challenges establishes a strong connection between education and local high-tech industry. Our efforts are aimed at helping young people to acquire knowledge and skills and to apply those at creating innovative companies and organizations.

Since 2010, hundreds of students participated the course and had the opportunity to interact with leading professionals from the high-tech sector.

The Program

The sole objective of Space Challenges Program is to attract the interest of students and young people to space exploration, science and technology. The program is designed to inspire and motivate the next generation of scientists and technologists, as well as to catalyze the development of an entrepreneurial culture among researchers in the high-technology space sector.

Space Challenges revolves around 2 major pillars:

- Spaceport Platform (MOOC platform): http://spaceport.academy
- Hands-on Educational Program: https://www.spaceedu.net/#filter=.curriculum

By organizing hands-on experience and positive, active attitude towards space science and development in students and young people, we aim to improve the development of a competitive space industry.

Space Challenges enables the participants coming from diverse background and experience, to learn together, form research collaborations, and launch space-related enterprises based on common interests and expertise, gained during the program.

The informal educational program is designed to give a broad knowledgebase of what the space scientific and industrial fabric includes. Since 2010, the annual Space Challenges program has offered its participants (Space Cadets) an exposure to the latest advances in space-related science and technology, as well as first-hand interaction with leading experts worldwide. The program has revolved around three components: Science, Technology and Entrepreneurship.

The biggest achievement of the program is that it is completely practice oriented and the participants are engaged into active participation, workshops and exercises in more than 70% of the whole duration of the programs. At the end of the program's activities, the participants have

designed, developed and built technological solutions and are ready to start new companies and continue their education in the science and technology fields.

The program completely free to all selected participants

Space Challenges consists of SIX thematic weeks, which will cover the basics of most Space-related areas including the business side. The typical workflow is shown in the following table:

Week(s)	Theme
1	**Aerospace Engineering**
2	**Robotics and A.I.**
2	**Mechanics and Electronics**
3	**Space Science and Exploration**
4	**Space Applications**
5	**Astrobiology, Biotech and Space Medicine**
6	**Entrepreneurship and Team Projects Finals**

Detailed description of the curriculum:

Weeks 1 - Aerospace Engineering

- Introduction to Aerospace Engineering
- What is a spacecraft: System level engineering and space architecture
- How does it function: Subsystems, integration and testing
- Mission Design: Concurrent Mission Design, Concurrent Mission Engineering
- Spacecraft technology: State-of-the-art projects – extremely small VS extremely large projects/CubeSat technology, swarm satellites
- Rocket science: Rocket engines and Space propulsion systems and the next- generation launch systems
- Space stations: Current technology (International Space Station)
- Space Systems Architecture

Week 2 - Robotics and A.I

- Introduction to A.I., Adaptive Algorithms and Machine learning
- Introduction to Robotics
- Robotic engineering: Subsystems and functionalities
- Computer Vision, Virtual Reality, Augmented Reality
- Human – Robot interaction, Uncanny Valley, Bionics
- Robotics for Earth-based applications: Exoskeleton structures

Week 2 – Mechanics and Electronics

- Intro to Mechanics
- Intro to Electronics
- Designing an electronic system
- Additive Manufacturing (3D Printing)
- Applications and hands-on workshop

Week 3 - Space Science and Exploration

- Relevant Topics in Modern Astrophysics
    - Exoplanets
    - Search for Extraterrestrial Intelligence (SETI)
    - Astrobiology
    - M Dwarf stars - dominant, active, harboring life?
    - Cosmology
    - Orbits, Orbital Mechanics
- Relevant Topics in Space Physics
    - Solar and Magnetospheric Physics
    - Space Weather

- ▪ Space Radiation
- ▪ Relevant topics to Space Exploration
  - ▪ Human Spaceflight
  - ▪ Robotic Space Missions: Lunar exploration, Deep space exploration, Mars exploration, Comet and asteroid exploration
  - ▪ Robotics in space exploration and extreme environments: Flyers, Divers, Landers and Orbital Probes
  - ▪ Space stations - future designs and experiments

Week 4 - Space Applications

- ▪ Connecting the planet: Communication technologies and applications
- ▪ Remote Sensing – Observing Earth from above
- ▪ Space-based Positioning, Navigation and Timing (PNT)
- ▪ Data Visualization: Extracting information from the data
- ▪ Space Mining: Asteroids and in-situ resource utilization
- ▪ Space Tourism
- ▪ Why do we explore space? – workshop activities

Week 5 - Astrobiology, Biotechnology and Space Medicine

- ▪ Intro to Space Biomedicine
- ▪ Intro to Astrobiology and latest developments
- ▪ Neuroscience - biological/computer interaction
- ▪ Life in Space: Human physiology in Space

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Week 6 - Entrepreneurship and Team Projects Finals

- Creating a space organization: Intro and Lessons
- Next steps in Space: Permanent settlement
- New Space Initiatives
- Economy vs Technology
- Team Projects Finals
- Space Challenges Expo: Space Cadets Prototypes Demonstrations

Core Lectures

The Space Challenges program includes lectures and talks by World-leading scientists, technologists, and entrepreneurs who share their success stories and their perception about the near future. Space Challenges is a multidisciplinary program and explores the links between science and technology topics.

It is open to young people with diverse background. It includes core-curriculum lectures, separated in thematic modules: *Aerospace engineering, Space systems technologies and applications, Planetary sciences, Astrophysics, Artificial Intelligence (AI) and Robotics, as well as entrepreneurship studies on how specific technologies create common wealth and disrupt whole industries.*

List of lecturers: http://www.spaceedu.net/lecturers-at-space-challenges/

Team Challenges

Space Challenges is a multidisciplinary educational program and it is completely practice oriented. The Space Cadets are working in teams of 5 to 6 participants throughout the entire duration of the program. Their goal is to design, build and test tech prototypes, solving concrete challenges.

Challenge: My Living City

My Living City Challenge. Cities are true living organisms, they breathe, change, expand... And what better way to witness this than from Space?

Discover how your city has changed over the last three years with unique multispectral space-based remote sensing data by Planet. Explore urban development as it happens, on scales of meters and days, as seen by their flock of powerful Cubesat telescopes! Join us on an exciting journey of satellite data processing, visualization, and analysis to find out how.

For this project, Space Challenges is proud to partner once more with Planet, an innovative global provider of high quality Earth observation data.

Prerequisites: prior experience in one or more of the following is recommended: Python or other high level programming language, web design, Adobe Photoshop or similar, data visualization, Geographical Information Systems

Challenge: Smarter city & Space

Smarter city & Space. Ever wondered how you could improve the life of thousands of people in your city?

The project goal is to design and develop the next generation of urban monitoring tech. Your mission will be to create a fully autonomous system for monitoring the environment of the city on hourly basis and to visualize it. The development of an outstanding app will be required. Timely information (on hourly or minute basis) such as humidity, CO_2 emissions, temperature levels, noise levels, etc. will open vast new opportunities for exponentially improving the city living conditions. Using satellite communication, supported by the world's leading provider of global mobile sat communications, combined with hourly updates on the ground (through a smart grid of sensors) and visualizing the information in an understandable manner could improve the lives of millions of people.

Experience in the following fields is a plus: C/C++ Programming basic level, network knowledge, high school chemistry level, basic electronics knowledge, Product design, 3D design and printing, technical documentation and presentation of products, real life use cases scenario

Workshops

Workshops and hands-on activities are designed to develop teamwork and leadership skills. All practices are embedded within the core curriculum. Every week of the program, workshops and presentations extend further the knowledge of the participants and help them develop successfully tech prototypes.

Workshop include

- Orbital Simulation (and some fun: Kerbal Space Program)
- Electronics and Mechanics workshop
- Launch accelerator: Part I: Launch and Part II: Mission deployed
- Presentation workshop: Selling your ideas

Resources

Spaceport: https://spaceport.academy

The Space Challenges team has developed a massive online educational platform with over 100 hours of original educational video content. It is freely available, complementing the physical program course. Our Space Cadets are expected to use the Spaceport for during the entire physical program.

Spaceport: https://spaceport.academy

Partnerships

Space Challenges Program has established close cooperation with Sofia University "St. Kliment Ohridski" and Technical University – Sofia – two of the leading universities in the Balkans.

Through close collaborations Space Challenges brings industry, education and science and technology closer to each other and acts as a bridge between those segments of the economy.

Each year Space Challenges participants get access to cutting-edge online resources, well designed office and lab space for project development and lecture auditoriums for the core presentations. The program provides all required technical resources for the development of the tech projects, as well as hands-on mentorship and custom-built workshop assignments.

Upon successful completion of the online program, the Space Cadets will receive certificates of completion for the program, introduction to leading high-tech companies and seed and venture capitals funds.