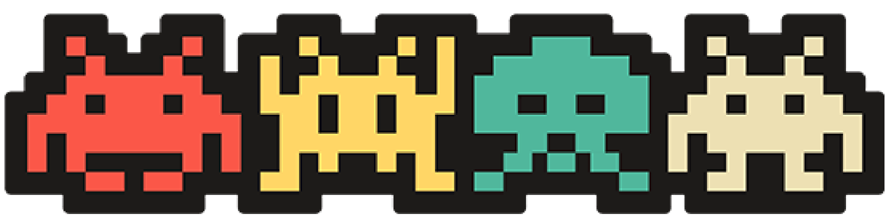
STEM education
ΟΡΓΑΝΙΣΜΟΣ ΕΚΠΑΙΔΕΥΤΙΚΗΣ ΡΟΜΠΟΤΙΚΗΣ, ΕΠΙΣΤΗΜΗΣ, ΤΕΧΝΟΛΟΓΙΑΣ & ΜΑΘΗΜΑΤΙΚΩΝ

National STEM Competition 2025

Category Regular
Beginners and Advanced

Can we survive on Mars?



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Prologue

Mars is the most popular and familiar of the planets of our Solar System, as it is the closest to Earth after Venus, but also the one that most resembles it. Since the beginning of the 20th century, the possibility of hosting intelligent life forms, as argued by the American astronomer Percival Lowell, has passed from comics and literature to television and film, with a significant part of public opinion considering this not just possible but certain. At that time, of course, our knowledge of Mars was still minimal, since our technological capabilities did not allow us to clearly distinguish details on its surface.

The systematic study of the Red Planet, and at the same time the first scientifically documented refutation of Lowell's Martians, began in 1965 when Mariner 4, with its first close-up photographs, revealed a dead and frozen world, a world without vegetation and canals, without cities and Martians, a world hostile to life with polar temperatures. arid and deserted. Six years later, Mariner 9 was also embarking on its journey to Mars. His greatest discovery, and at the same time the first serious evidence of the existence of water on Mars in his past, was a vast system of cracks, faults, ravines and drainage channels. This giant fault has obvious traces of erosion from water that has long been lost.

Viking 1 and 2 continued exploring the Red Planet in 1976. Some 21 years later, the Pathfinder mission carried Sojourner, the first robotic vehicle that could move on its surface, to the Red Planet, which chemically analyzed soil composition and collected weather data. In June 2003, The European Space Agency ESA launched the Mars Express orbiter to Mars, whose data helped astronomers explore fundamental questions about geology, atmosphere, water history and the possibility of microbial life. In March 2006, NASA launched the Mars Reconnaissance Orbiter (MRO). With the help of his data, scientists calculated that the north pole of the planet is covered by 821,000km of^3 ice, while several more minerals were discovered that can only be formed by the influence of water. Two years later, NASA's Phoenix landed on Mars, analyzing the chemical composition of soil and subsoil samples and confirming the existence of subsurface ice. digging with the help of his robotic arm his icy surface.

The Curiosity rover, which landed on Mars in August 2012, is the largest and heaviest spacecraft to date to land on Mars. Its successful landing was a "gamble" for scientists, who wanted to find out whether it is possible and what difficulties hide the mission and landing of the much bulkier payloads that will be required in the future for its manned exploration. Curiosity's most important discoveries include the confirmation of the existence of carbon, oxygen, hydrogen, phosphorus and sulfur, the building blocks of life, as well as the existence of organic molecules. However, these discoveries in no way prove the existence of simple life forms on the Red Planet, neither now nor in the past. The MAVEN orbiter entered orbit around Mars in September 2014. The main goal of MAVEN's mission is to determine exactly how the planet's atmosphere and water have been lost over time. There are several ways in which a planet can lose some of its atmosphere. In the case of Mars, however, what is thought to have happened was the continuous erosion of its atmosphere by ultraviolet radiation and solar wind. So far, MAVEN data confirm this scenario. Collecting and researching all this data, Mars looks colder than the Arctic and drier than the Sahara. However, we have discovered large amounts of ice and more recently dark lines that are likely formed by the seasonal flow of brackish water. According to all indications, billions of years ago, Mars was a much hotter and wetter planet with a dense atmosphere and water flowing into rivers and accumulating in lakes and seas.

The orbiters and robotic vehicles that landed on its surface continue to collect data, trying to find the answers, and at some point the first astronauts will walk on the surface of the Red Planet. The farther we aim into space, the greater the challenges and risks we will face. The longer a manned mission lasts, the more supplies it will have to carry, the better it will have to be shielded against harmful radiation and therefore the more weight it will have. The development and testing of the technologies necessary to build new, more powerful and efficient rockets and spacecraft has by no means been addressed, and the scientists and engineers working on these plans are not yet able to guarantee the safety of astronauts participating in long-duration missions in the future. Living astronauts in conditions of weightlessness for a long time causes muscle atrophy and osteoporosis. Their exposure to the dangerous radiation of solar flares and cosmic rays multiplies their risk of dying from cancer. This same risk will be faced by the first astronauts to set foot on Mars in the future, since this planet does not have an ozone shield and a planetary magnetic field that would protect them.

Survival on Mars requires a multifaceted approach that includes advanced technology, sustainable resource management, strong habitats, and integrated health and safety planning. Collaborative international efforts and continuous innovation will be key to making Mars a viable destination for human exploration and potential colonization.

Description

The teams' mission is to build and program autonomous robots that can navigate the surface of Mars and perform various challenges that can help humans survive on the Red Planet.

Indicatively, the following are mentioned:

- Life Support Systems
    - Oxygen Production: The Mars Oxygen In-Situ Resource Utilization Experiment (MOXIE) on NASA's Perseverance rover is a prototype system designed to produce oxygen from a CO2-rich atmosphere on Mars.
    - Water extraction: Extracting water from the soil and ice deposits of Mars.
    - Food Production: Hydroponics and aeroponics systems can be used to grow food in controlled environments.
- Habitat Construction
    - Radiation protection: Habitats must protect residents from cosmic and solar radiation. This can be achieved through underground habitats, rhegolith-based structures or inflatable units covered with Martian soil.
    - Thermal control: Insulation and heating systems are required to maintain a sustainable temperature within habitats due to Mars' cold climate.
- Energy supply
    - Solar energy: Solar panels can provide energy, although they must be designed to withstand dust storms that may reduce their performance.
    - Nuclear power: Small nuclear reactors, such as NASA's Kilopower, could provide a reliable source of energy regardless of solar conditions.
- Health and Safety
    - Medical facilities: Advanced medical facilities and telemedicine will be needed to handle emergencies and routine healthcare.
    - Psychological support: Long-term isolation can affect mental health, so strategies for psychological support, including virtual reality environments and communication with Earth, are essential.

- Scientific and Technological Research
    - Continuous Research: Ongoing research on Mars, such as geology and potential hazards, is crucial. Robotic missions can help identify and collect data before human arrival.

General Rules

The game will be played in 2 variants:

- A simpler (**Beginner**), aimed at novice learners
- Amore difficult (**Advanced**), aimed at students who want to claim their participation **in** the World Educational Robotics Olympiad WRO 2025**. This category** is divided into three age groups**,** the limits of which are listed below.

Group Definition and Age Categories:

1. A group consists of 2 or 3 students.
2. A team is led by a coach.
3. A team with one member and one coach are not considered a team and cannot participate.
4. A team can only participate in one of the beginner or advanced categories.
5. Each student can participate in only one group.
6. The minimum coaching age is 18 years old.
7. Coaches can work with more than one team.
8. The age groups **in the beginner category** are:
    1. students 8-16 years old (in season 2025: year of birth 2009-2017)
9. The age groups **in the advanced category** are:
    1. **Primary**: students 8-12 years old (in season 2025: year of birth 2013-2017)
    2. **Gymnasium**: students 11-15 years old (in season 2025: born years 2010-2014)
    3. **Lyceum**: students aged 14-19 (in season 2025: born years 2006-2011)
10. The maximum age reflects the age reached by the participant in the calendar year of the race, not his/her age on the day of the race.