

# Bridging the gap between subjects and educational levels using space educational activities

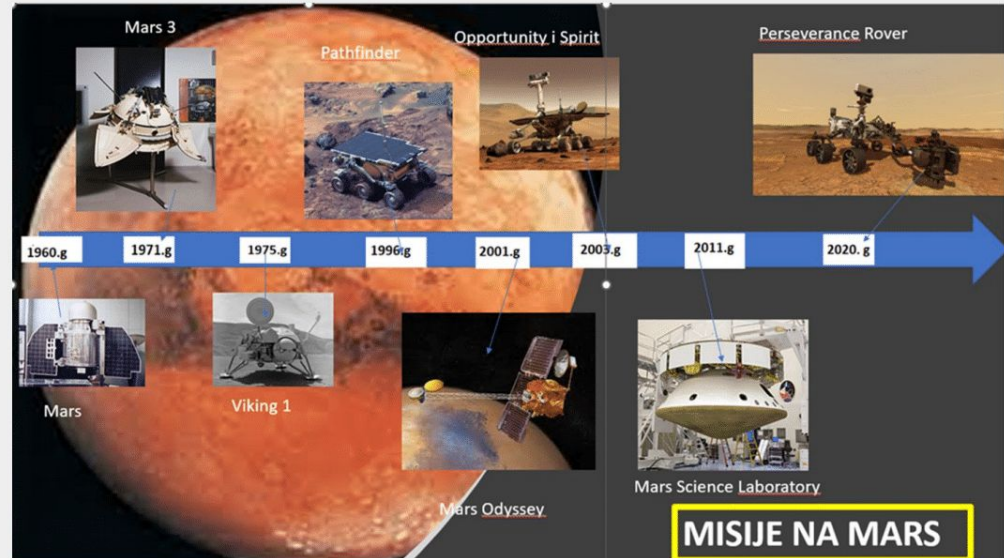
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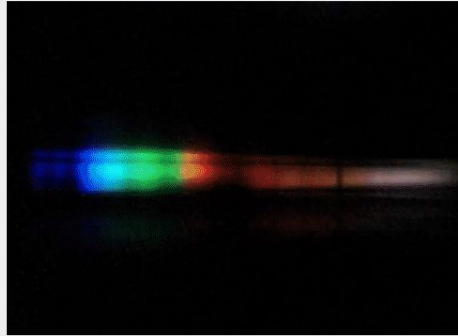
# Introduction and aims of the activities

We are trying to use astronomy to connect different subjects and bridge the gap between educational levels. In the Croatian educational system there is a big gap in science curriculum between middle school and the start of high school. This gap results in insufficient student knowledge of STEM subjects. Students that have attended astronomy as an extracurricular subject have been more successful in bridging that gap.



# Activities

In high school physics, students learn a basic concept of the electromagnetic spectrum, but without implementation and deeper analysis. Through astronomy activities, students can see the real-world implementation of this concept by observing and analyzing the electromagnetic spectrum of celestial objects.



Students measure Earth's magnetic field and gravitational acceleration and compare it with values on Mars, investigate how the gravitational and magnetic field (magnetosphere) influence the development of life and terraforming conditions on Mars.

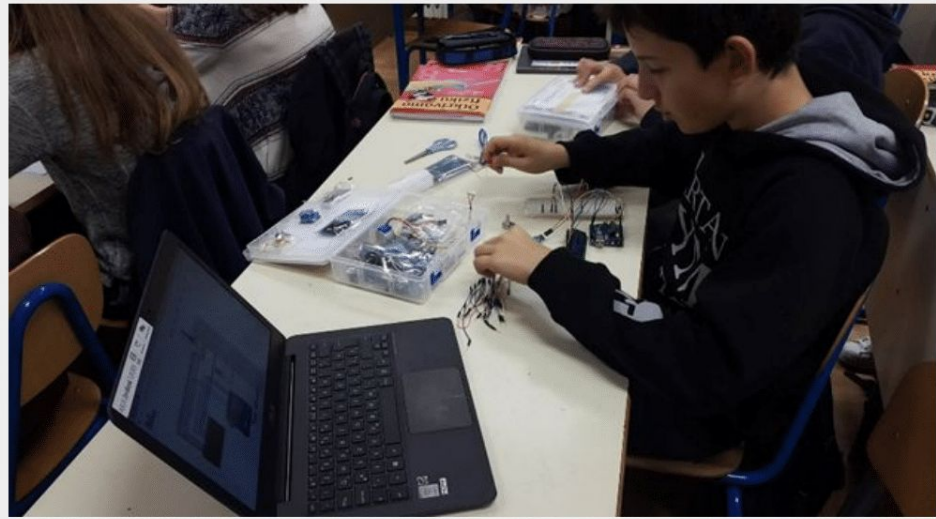


# Activities

In middle school we have integrated some engineering activities such as making and programming Arduino meteorological station and then measuring on Earth and learning the difference from Mars atmospheric conditions. So through astronomy we integrate also LEGO EV3 to build replicas of Mars rovers.

In primary classes we planted seeds and tried to mimic some of the Mars atmospheric conditions.

During PE classes students trained as astronauts, solved puzzles with gloves, played escape room – Escape from Mars.



# Conclusion



In the Croatian educational system throughout the years, in our experience, while teaching science and astronomy, we have identified a big gap in science curriculum between middle school and the start of high school, as well as the gap between high school and university. This curriculum gap results in insufficient student knowledge of STEM subjects. Students that have attended astronomy as an extracurricular subject have been more successful in bridging that gap. Throughout the years teachers who have integrated astronomy activities throughout cross-curricular science subjects such as physics, chemistry, technology and biology have increased students' interest in STEM subjects and those students tend to apply to technological universities or space-related ones.

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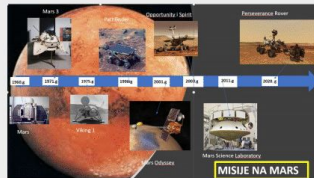


## INTRODUCTION

We are trying to use astronomy to connect different subjects and bridge the gap between educational levels. In the Croatian educational system there is a big gap in science curriculum between middle school and the start of high school. This gap results in insufficient student knowledge of STEM subjects. Students that have attended astronomy as an extracurricular subject have been more successful in bridging that gap. We will showcase educational activities that help bridge this gap by exploring astronomy using scientific concepts summarized in a project called "Exploration of Mars". Activities were cross-curricular so apart from physics, biology, chemistry, engineering they also include physical education and arts.

## AIMS OF THE ACTIVITIES

We will show activities that explore the connection between gravity, terraforming and atmospheric structure of the planet, hydroponics, assembling, programming and "driving" a rover on Mars, space tourism. These activities allow us to explore scientific concepts beyond the construct of the national curriculum.



Students explore the theme of Mars in art and science.

## ACTIVITIES IN PRIMARY AND HIGH SCHOOLS

In high school physics, students learn a basic concept of the electromagnetic spectrum, but without implementation and deeper analysis. Through astronomy activities, students can see the real-world implementation of this concept by observing and analyzing the electromagnetic spectrum of celestial objects.

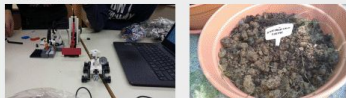


In middle school we have integrated some engineering activities such as making and programming Arduino meteorological station and then measuring and learning about the difference between the atmospheric conditions on Earth and Mars. So through astronomy we integrate also LEGO EV3 to



build replicas of Mars rovers.

In primary classes we planted seeds and tried to mimic some of atmospheric conditions like they are on Mars.

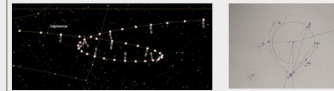


During PE classes students trained as astronauts, solved puzzles with gloves, played escape room – Escape from Mars.



Students measured Earth's magnetic field and gravitational acceleration and compare with the values on Mars. They investigate how the gravitational and magnetic field (magnetosphere) influence the development of life and terraforming conditions on Mars

Students research for the Mars Pathfinder mission and what scientific research was conducted. Getting to know the basics of nuclear physics using the example of the Alpha Proton X-ray Spectrometer. Comparing the instruments of the meteorological station at the school and the instruments used to test the atmosphere on Mars.



Students learned about the equation of an ellipse, applied the laws of geometry and trigonometry on the example of Kepler's description of the motion of Mars.

They used a sheet of paper measuring at least 18x18 cm, a protractor, triangles, rulers, calculator and tables in which the Earth's heliocentric longitude is given as a function of time, as well as measurements of the Sun-Earth-Mars angle (moments of opposition are important, when the angle is 180°).

Time	Longitude	Angle
10:00	100	180
11:00	110	180
12:00	120	180
13:00	130	180
14:00	140	180
15:00	150	180
16:00	160	180
17:00	170	180
18:00	180	180
19:00	190	180
20:00	200	180
21:00	210	180
22:00	220	180
23:00	230	180
00:00	240	180

Sometimes we even use the regular physics and chemistry experiments and give them a twist, like measuring density of materials to see which one would be most suited for building a spacecraft. We use entrepreneurship to promote tourism on Mars so students have to explore Mars in order to build a touristic programme and offer.



## CONCLUSION

In the Croatian educational system throughout the years, in our experience, while teaching science and astronomy, we have identified a big gap in science curriculum between middle school and the start of high school, as well as the gap between high school and university. This curriculum gap results in insufficient student knowledge of STEM subjects. Students that have attended astronomy as an extracurricular subject have been more successful in bridging that gap. Our research has shown that students who attend astronomy classes as early as the start of middle school are even more successful. Throughout the years teachers who have integrated astronomy activities throughout cross-curricular science subjects such as physics, chemistry, technology and biology have increased students' interest in STEM subjects and those students tend to apply to technological universities or space-related ones.