ANALOG ASTRONAUT TRAINING CENTER

JUNIOR SPACE CAMP
EDUCATION
ENVIRONMENT
FRIENDSHIP

Tutorial for students and teachers

Kraków, 2025

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PREFACE

This work is a compilation of educational activities organised by AATC Junior Space Camps (JSC) in 2021-2024. We are aware, that not everybody can attend our camps, that is why we share knowledge, practices and lessons learned in the form of this tutorial to spread good useful information across the world. JSC are unique workshops focused on future life on planet Earth and other space locations as friendly, healthy and responsible society. Our education is mounted in inspiring environment, as close to nature as possible, all in sunny friendship atmosphere bridging mentors with young generation. Educators live together with students in the habitat far from demographic areas, noisy roads and polluting industry. The landscape is agricultural, rich in geomorphological diversity, with hills, deep valleys, rivers, fields of herbs, forests with fresh and delicious raspberries, blackberries and mushrooms. The location is connected with tourist traits such as Gagarin trait, Wooden Architecture trait and surrounding Nature Parks with rocks, waterfalls and caves. Hygienic conditions in the habitat are similar to that on space stations. With limited water supplies, everybody uses wet wipes instead of shower. If weather conditions are good, everybody sleeps under the open starry sky next to the habitat. The schedule is tight like a conference, but after each 1h training there is 15 min. or 1 h break for the outdoor sport and games. During the day, activities are performed in paralel in 3 groups with 10 students divided according to their age and experience. Students have limited access to mobile devices restricted to 1 h daily. The last activity are social games, often next to bonfire integrating the JSC team. This report would not be accomplished without educators sacrificing their time during holidays in the habitat and teaching. Junior space Camps are cyclically organised every year in summer in Rzepiennik Strzyżewski, Poland, 140 km far from Kraków.

Agata Kołodziejczyk, Director of JSC at AATC

Special thanks go to our teachers:
Iwona Nowak (2024)
Cassandra Verdan (2024)
Aleksander Kopyto (2024)
Justyna Średzińska (2023)
Carolina Orozco Donneys(2023)
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Tomasz Książczyk (2022)
Anita Rzucidło (2022)
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Marcin Gazda (2021)

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Iga Kaczorowska (2024)
Alicja Kołodziejczyk (2024)
Jan Kołodziejczyk (2024)
Aleksander Franczyk (2024
Ida Tereszkiewicz (2022, 2023)
Igor Kosiński (2022, 2023)
Paweł Chruściński (2022, 2023)
Eryk Kopa (2022)

Iron rusts from disuse;
Stagnant water loses its purity and cold weather becomes frozen;
Even so does inaction sap the visor of the mind.

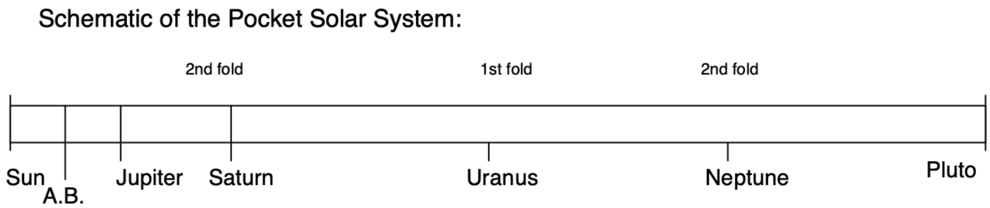
Leonardo da Vinci

1. ASTRONOMY
Teachers: Dr. Iwona Nowak, Dr. Bogdan Wszołek, Dr. Tomasz Książczyk, Dr. Agata Kołodziejczyk, Anita Rzucidło

Iwona Nowak teaching astronomy at JSC 2024. Source: Agata Kołodziejczyk

Activity 1. The Solar System

Number of students: 30
Duration: 90 min.
Location: 45 min. Classroom, 45 min. Outdoor
Materials: Projector, laptop, paper tape, pencils, leader, string
Instruction: printed version of https://nightsky.jpl.nasa.gov/media/documents/resources/SSPocketSS.pdf



Goals:
1. Learning about the planets of the Solar System,
2. Estimating the size and distance of individual planets and the Sun,
3. Explaining the motion of planets around the Sun,
4. Understanding the difference between stars and planets,
5. Making a model of the Solar System according to the instruction with added elements of creativity,
6. Presenting Nicolaus Copernicus' heliocentric theory, Keplerian and Newtonian follow-ups,
7. Learning about the concepts of stars and planets and their classification,
8. Learning about the basic principles in the Universe: gravity, nuclear fusion, radiation, astronomical unit.

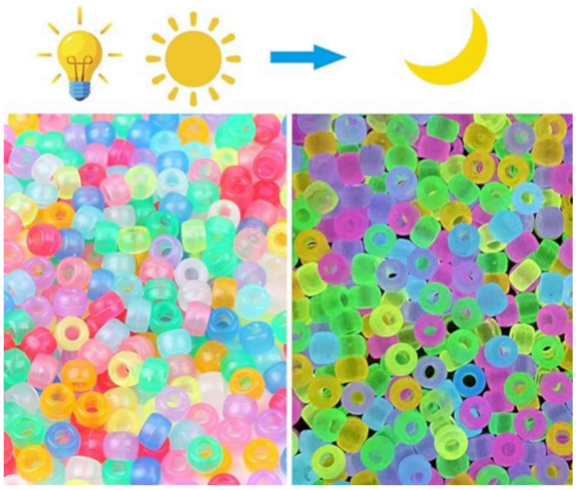
Examples of the Pocket Solar System made by the youngest participants. Source: Iwona Nowak

Activity 2. A simple light detector

Number of students: 30
Duration: 90 min.
Location: 45 min. Classroom, 45 min. Outdoor
Materials: White beads sensitive to different light wavelengths, transparent foil, string
Instruction: led by mentor

Goals:
1. Learning about the nature of light,
2. Learning about types of radiation,
3. Learning about light emitters,
4. Learning about differences between sunlight vs artificial light and its influence on environment,
5. Learning about light detectors,
6. Making a simple light detector in the form of tube or bracelet,
7. Calibration of the sensor using visible and UV light emitting diodes.

UV Detectors



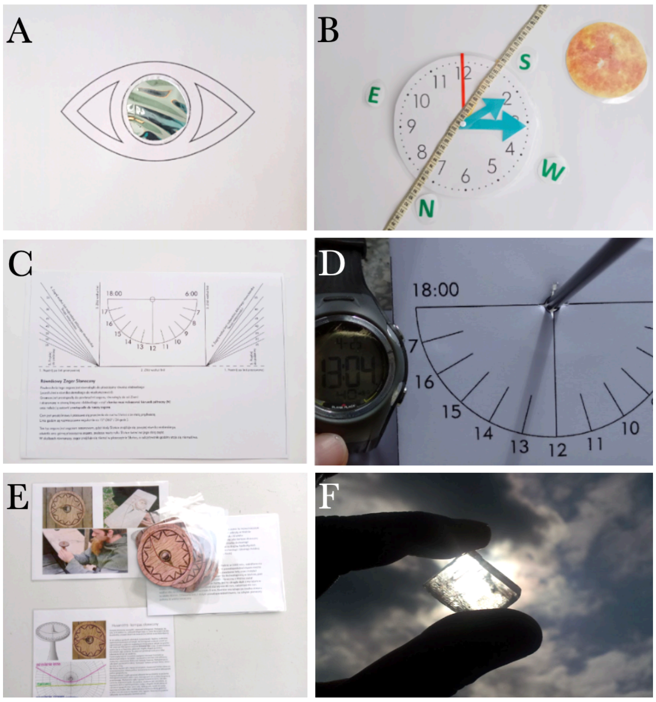
Light Intensity Detector

White beads change colour under the influence of ultraviolet radiation (300-360 nm) and intensity of solar light. This process is reversible. Source: Iwona Nowak and https://www.amazon.com/Miraclekoo-Scientific-Changing-Reactive-Bracelets/dp/B01M1A3RZ0?th=1

Activity 3: What can you learn by observing the Sun?

Number of students: 30
Duration: 90 min.
Location: 45 min. Classroom, 45 min. Outdoor
Materials: Badder foil, Viking's crystal, pendulum quadrant, sextant, Jacob's Staff - Kit, compass, digital clock, paper, leader, tailor scale
Instructions: printed: solar clocks, Husanotra compasses, quadrant, sextant and Jacob's Staff - Kit, eg. https://sklep-astromedia.pl/pl/p/Sekstant-zestaw-edukacyjny-do-samodzielnej-budowy/57, https://www.experimentis-shop.de/jakobsstab-bauen-und-verstehen-mit-bauanleitung, https://www.experimentis-shop.de/pendelquadrant-bauen-hoehnwinkel-bogenminuten, https://teleskopy.pl/filtrsloneczny.html

Goals:
1. Learning about methods and tools of Sun observation (from Stonehenge to spaceweather.com),
2. Sun observation using Badeer foil and Viking's crystal,
3. Reading the local time using solar clock,
4. Navigating with Husanotra compass,
5. Detecting polarised light - Heidinger brush.



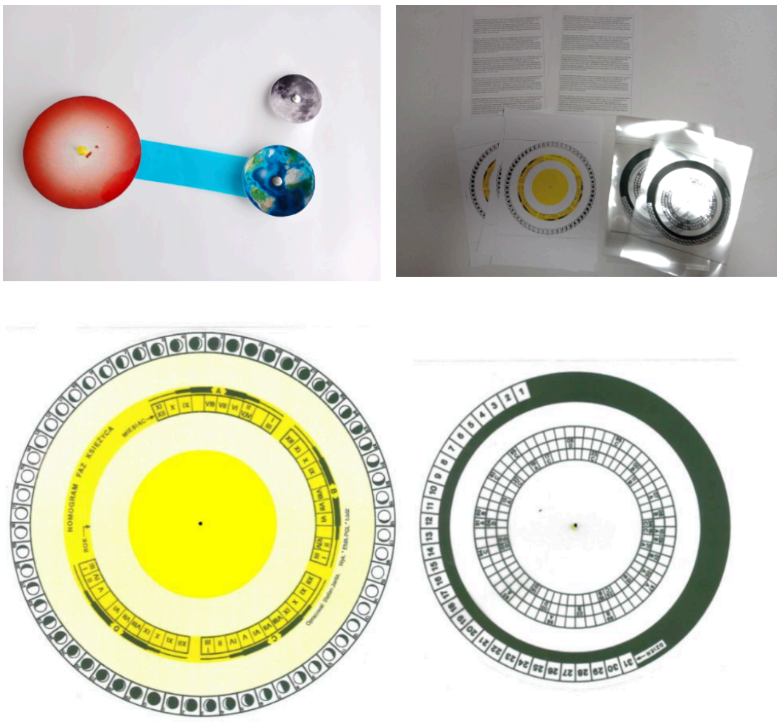
An example of using the Badeer foil to observe the Sun (A). Learning how to tell the time using a sundial model (B-D). Determination of geographical directions using the position of the Sun and a hand watch (D). In the case of cloudiness, we use a model (B). Discovering historical inventions and their uses, such as the Husanotra compass (E) and the Viking crystal (F), where the Sun played the role of a modern "road sign". Source: Iwona Nowak

Observation of the Sun consists on several topics: introducing safety procedures for direct observation of the Sun. Discussing the phenomenon of total and partial solar eclipses; learning how to determine geographical directions using the position of the Sun and an analog/digital hand watch; understanding the principle of a sundial; learning to tell time using a sundial model and presenting the history of Sun-related inventions: Husanotra, Viking's crystal, Jacob's staff, quadrant and sextant as astronomical tools used for navigation.

Learning the use of astronomical instruments such as Jacob's staff, quadrant, and sextant. Source: Iwona Nowak

Activity 4: What can be learned by looking at the Moon?

Number of students: 30
Duration: 90 min.
Location: 45 min. Classroom, 45 min. Outdoor
Materials: Nomogram
Instructions: printed: nomogram

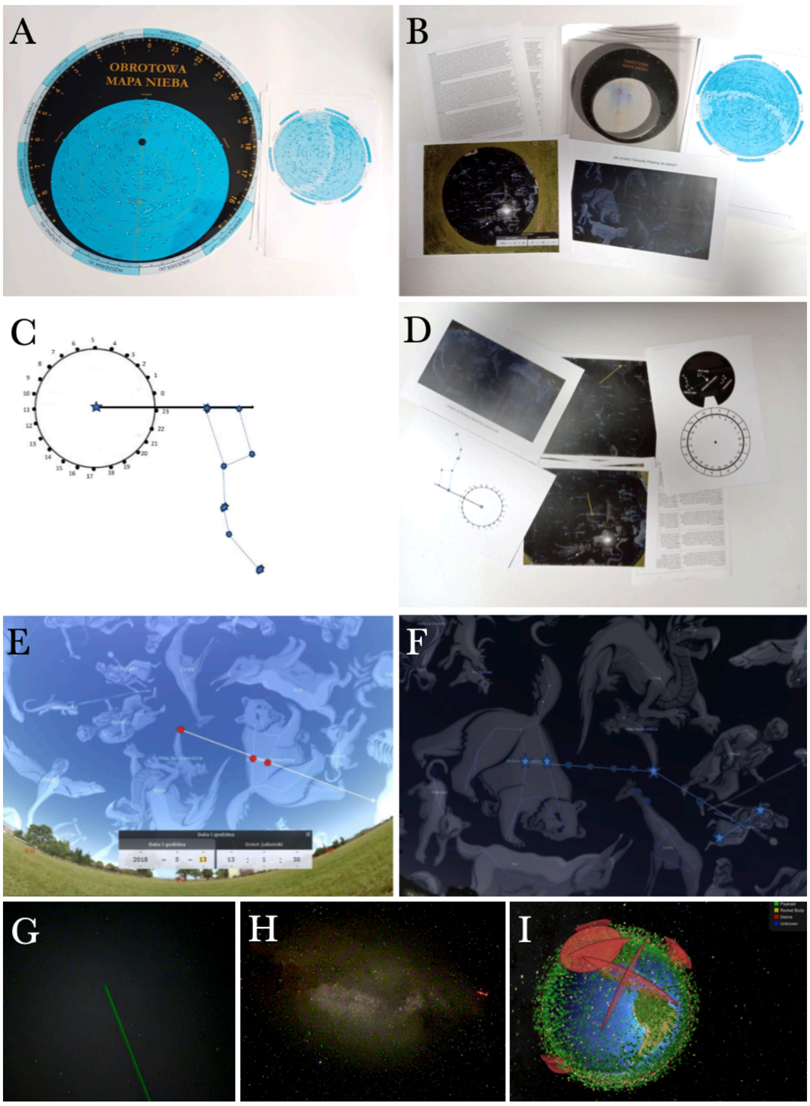


Sun-Earth-Moon model and printed nomograms. Source: Iwona Nowak

Goals:
1. Learning about methods and tools of Moon observations,
2. Learning about the Sun-Earth-Moon model,
3. Definition of lunar phases, lunar eclipses,
4. Determination of the Moon's on any given day of the year using the nomogram model.

Activity 5: What can be learned from the night sky?

Number of students: 30
Duration: 90 min.
Location: 45 min. Classroom, 45 min. Outdoor during the clear night
Materials: Nomogram, Rotating Star Map, sky laser pointer, telescope, SkyView, Stellarium, ISS Tracker, findstarlink.com, https://platform.leolabs.space/visualization
Instructions: provided by educator



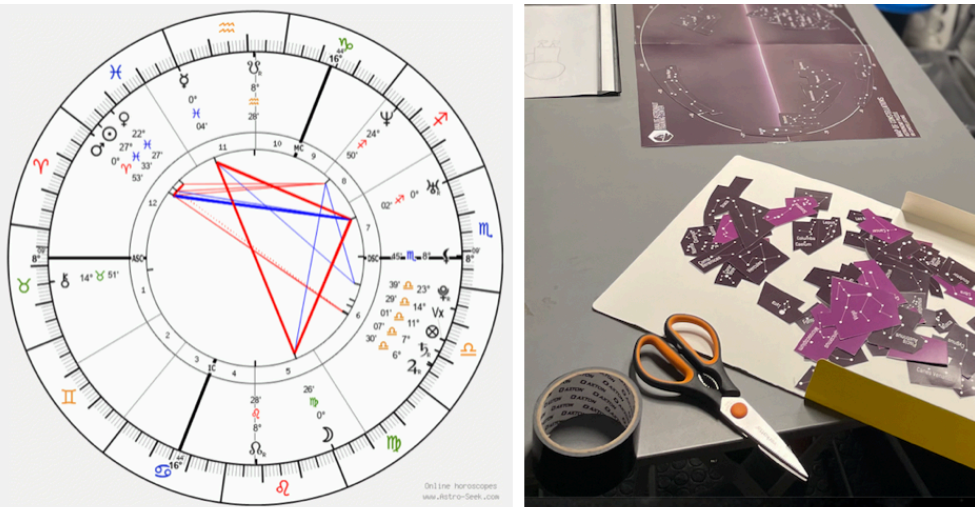
Rotating star map (A-B), nomogram (C-D) and applications available on internet: Stellarium (E-F), and Findstarlink (I). Images of sky during night observations at JSC (G-H). Source: Iwona Nowak, Agata Kołodziejczyk and internet

Goals:
1. Learning to find stars and constellations visible in different seasons using a rotating star map,
2. Learning how to use digital maps and star gazing mobile applications,
3. Locating the North Star (Polaris), Milky Way, characteristic constellations and zodiac,
4. Nocturnal: a model of a star clock for determining time based on the position of selected stars.

Activity 6. What are zodiac constellations and horoscopes?

Number of students: 30
Duration: 90 min.
Location: Classroom
Materials: Constellation puzzles, https://horoscopes.astro-seek.com/
Instructions: provided by educator

Goals:
1. Learning shapes of zodiac constellations using constellations puzzles,
2. Learning about Keplerian horoscopes,
3. Making individual Keplerian horoscope using astro-seek software.



Keplerian horoscope indicating positions of celestial bodies at the date and hour of birth (left). Constellations puzzles (right). Source: internet and Agata Kołodziejczyk

Activity 7. How to photograph the sky?

Number of students: 30
Duration: 90 min.
Location: 45 min. Classroom, 45 min. Outdoor
Materials: Mobile telephones, cameras, telescopes
Instructions: provided by educator

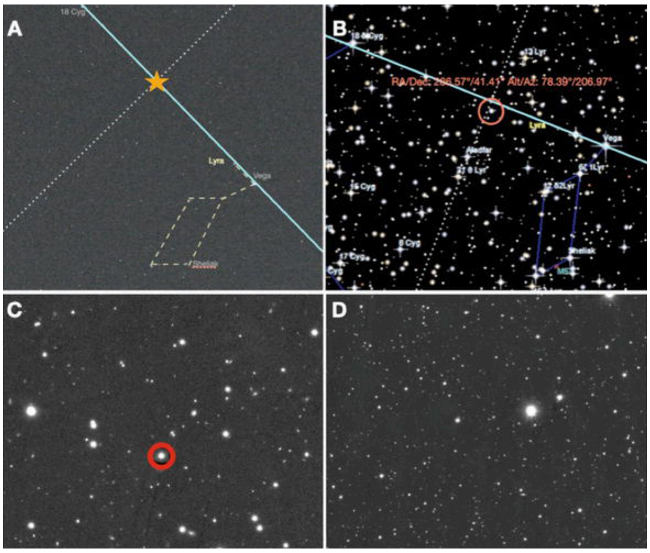
Goals:
1. Learning about sky objects which can be photographed: clouds, weather phenomena, auroras, meteors, satellites, stars, galaxies, Milky Way,
2. Learning about astrophotography equipment,
3. Learning about astrophotography techniques,
4. Sky photography contest.

Habitat photographed during aurora (13.08.2024) and noctiluscent clouds (4.07.2023). Source: Agata Kołodziejczyk

Activity 8. Space Detectives

Number of students: 30
Duration: 90 min.
Location: Classroom
Materials: Astro-puzzles, Google Earth
Instructions: provided by educator

Goals:
1. Learning how to find your house using satellite data,
2. Learning what astronomers can read from photos,
3. Astro-puzzles.



Example of astro-puzzles. A: find coordinates of yellow star. B: solution of this puzzle presented by one of our pupils. Participants are requested not only to find numbers but also to describe the method which they used. C and D: find a star labelled in the red circle on the D image. This kind of astro-puzzles is used to find constellations of points. When all points are correctly defined, they create a specific shape which is the final answer for the task.

Activity 9. Visit at Astronomical Observatory of Queen Jadwiga

Number of students: 30
Duration: 3h
Location: 15 min. Telescope Dome, 15 min. Observatory, 30 min. Outdoor: 120 min.
Materials: Newton's telescope, reflector telescope, radio telescope, educational tables
Instructions: provided by astronomer from the Observatory

Goals:
1. Learning about what can be observed in the ground astronomical observatory and what equipment is critical,
2. Presentation of 0.5 m telescope and two radiotelescopes,
3. Familiarisation with educational plates, astronauts' forest,
4. Walking a Gagarin trait (5km of walk across multiple educative stations),
5. Making a souvenir photos.

Queen Jadwiga Astronomical Observatory in Rzepiennik Biskupi offers attractive lectures about actual methods of astronomical observations. Dr. Bogdan Wszołek presents telescopes and unique knowledge with the history of observatory, his works and astronautics. Source: Agata Kołodziejczyk

Activity 10. Fluorescence and plasma

Number of students: 30
Duration: 90 min.
Location: Classroom allowing to get complete dark conditions
Materials: rhodamine, fluorescein, quinine, Pasteur pipettes, Petri dishes, glass flask, plasma lamp
Instructions: provided by educator

Goals:
1. Learning about fluorescence
2. Learning about fluorescent materials and their applications,
3. Making a fluorescent solutions and observing diffusion,
4. Microscopic observation of fluorescent objects (bacteria colonies),
5. Learning about plasma,
6. Experiments with plasma lamp.

Exercises with mixing two fluorescent chemicals: rhodamine and fluorescein. Participants observe how liquids diffuse in the flask. Plasma lamp can induce light in the fluorescent lamp. Participants try to explain the phenomenon. Source: Agata Kołodziejczyk

2. ASTROBIOLOGY

Teachers: Dr. Agata Kołodziejczyk, Dr. Carolina Orozco, Dr. José Perea, Dr. Tomasz Książczyk, Joanna Tor-Gazda, Aleksander Franczyk, Ida Tereszkiewicz

Activity 1. Searching for life in space

Number of students: 30
Duration: 90 min.
Location: 45 min. Field exploration, 45 min. Laboratory
Materials: Falcon tubes, gloves, masks, clean suits, Petri dishes, sterile agar medium, microscope
Instructions: provided by educator

Goals:
1. Learning how to collect samples from the field to prevent biocontamination,
2. Learning where to find biological material of interest (microorganisms),
3. Learning how to transfer collected biological material into growing cultivation media,
4. Observation of growing colonies of fungi and bacteria,
5. Learning about the methods of analysis.

Collecting microorganisms and extremophilic Tardigrades in several types of environment. Rocky terrain with a waterfall is located 8 km from the habitat. Pupils are asked to collect water samples from the beginning of the waterfall to 1 km distance down in the stream. After collection, water samples are analysed under the microscope and using a water strip test to determine environmental parameters such as water hardness, levels of NO2, NO3, NH3, carbohydrates, pH, potassium and sodium salts and conductivity. Participants observe differences in parameters and try to understand why this happens. Another environments for samples collection are: lake with algae and Protozoa and small natural wells with sulfur and iron bacteria located 2 km from the habitat. Source: Agata Kołodziejczyk

Activity 2. Cultivating *Pillobolus crystallinus* - the fastest propulsion system in space!

Number of students: 30
Duration: 2 h + 3 days
Location: 90 min. Field exploration, 30 min. Laboratory, 3 days: incubation in darkness
Materials: Fresh horse excrements, gloves, aluminium foil, microscope, stereoscope
Instructions: provided by educator

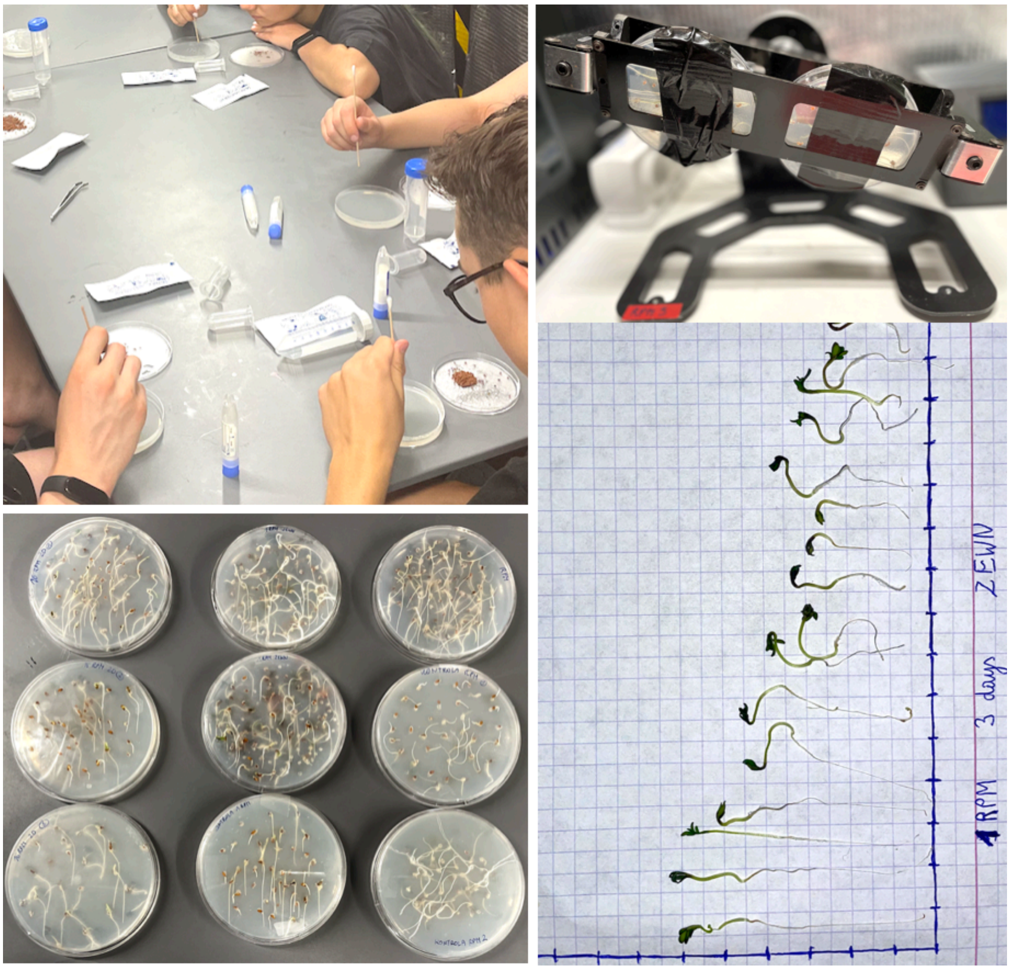
Goals:
1. Learning what is *Pillobolus crystallinus*, where it grows and why,
2. Learning about propulsion systems existing in nature and in technology,
3. Learning how to grow *Pillobolus sp.*
4. Learning how to observe this fungi after maturation.

The fastest propulsion system on the Earth. Fungi use solar rays and crystal structure to generate acceleration.

Activity 3. Effects of microgravity on plants

Number of students: 30
Duration: 120 min. + 5 days
Location: 60 min. Laboratory, 60 min. Computer room, 5 days. Rotation on RPM machine
Materials: cress seeds, Falcon tubes, wooden sticks, Petri dishes with agar, 3 x random positioning machines-RPMs (microgravity, lunar gravity, Martian gravity)
Instructions: provided by educator

Goals:
1. Learning how plants sense gravity,
2. Learning what is random positioning machine,
3. Learning how to perform scientific experiment with positive and negative controls,
4. Learning how to analyse data and run simple statistical evaluation about obtained results.



This activity should start in the beginning of the Junior Space Camp, because plants need to grow minimum 5 days in various types of altered gravity conditions on Petri dishes. On the fifth day plants are gently removed from agar plates and measured (length of roots, stems and leaves) using ImageJ software. Source: Agata Kołodziejczyk

Activity 4. Kombucha microbial consortium for bacterial cellulose production

Number of students: 30
Duration: 90 min.
Location: 30 min. Classroom, 120 min. Laboratory
Materials: Fresh hydrogel kombucha derived bacterial cellulose (30xA4 format hydrogels), plastic boxes, sewing machine, cotton filling, felt, decorations
Instructions: provided by educator

Goals:
1. Learning what is kombucha and its bio product - bacterial cellulose,
2. Learning how bacterial cellulose grows on the Earth and in space,
3. Processing bacterial cellulose hydrogels to the elastic biomaterial form,
4. Creative designs using bacterial cellulose,
5. Learning how to use sewing machine,
6. Learning how to make decorations, earrings, jewellery and other gadgets.

Kombucha is a symbiotic microbial consortium which was tested 18 months on the external panel KIBO of the International Space Station. It is considered to be the most promising consortium to be sent to space for future production of biomaterials in situ. Source: Agata Kołodziejczyk

Activity 5. Kombucha derived composite materials

Number of students: 30
Duration: 90 min.
Location: 45 min. Classroom, 45 min. Workshop
Materials: bacterial cellulose from the kombucha consortium, blender, flour, plant seeds, sugar, salt, linseed, lunar and martian regolith simulants, pure cellulose, masks, gloves, protective clothes, balance,
Instructions: provided by educator

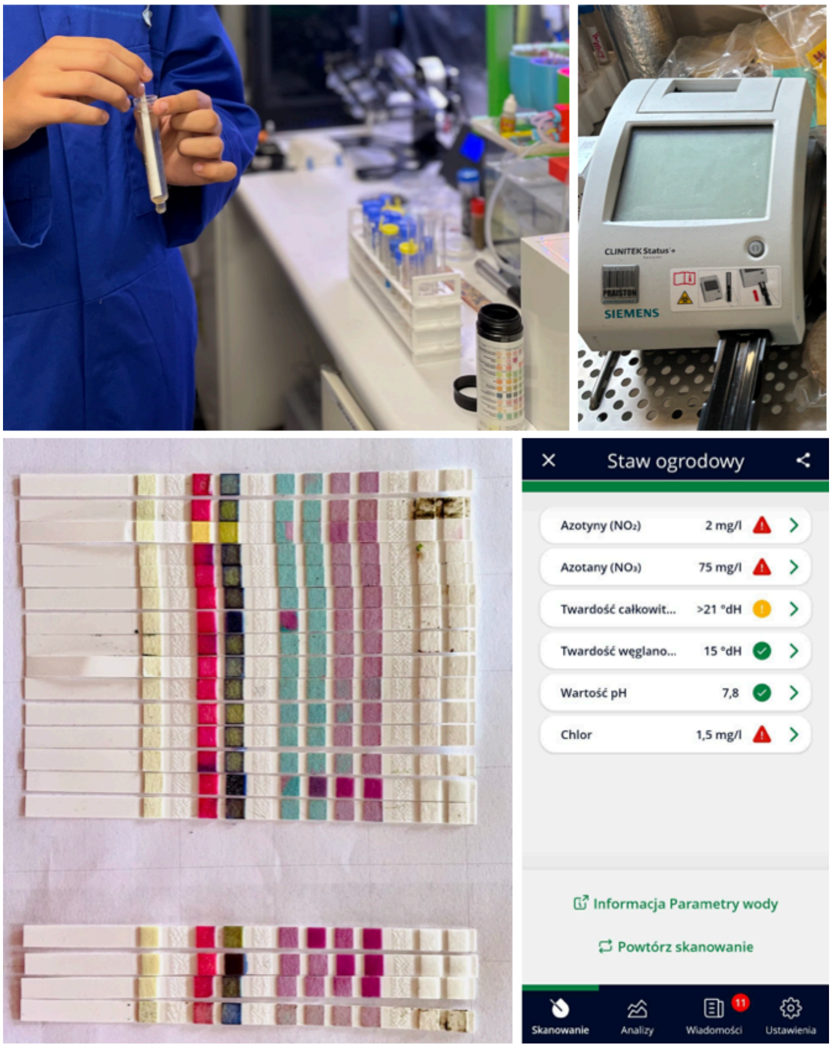
Goals:
1. Learning what is a bio composite,
2. Learning about using biocomposites in daily life,
3. Making a biocomposites from kombucha and regolith simulants,
4. Measuring physical and chemical properties of obtained biomaterials,
5. Competition for the best industrial design.

Participants learn how to use ecological materials to produce biocomposites with different physicochemical properties. Additionally participants learn how to use biocomposites in daily life. Source: Agata Kołodziejczyk

Activity 6. Urine filter, urine analysis

Number of students: 30
Duration: 90 min.
Location: 45 min. Classroom, 45 min. Laboratory
Materials: Falcon tubes, measuring stripes, Siemens urine analyser, JBL water analysis stripes, JBL water analysis mobile application, urine filters: active carbon, granite stones, sand, cellulose
Instructions: provided by educator

Goals:
1. Learning how to measure urine correctly,
2. Learning how to use urine analyser and water analysis mobile application via strip tests,
3. Learning about the meaning of obtained parameters,
4. Learning about urine filtration methods in space and in extreme environments,
5. Competition build the Mose effective urine filter.



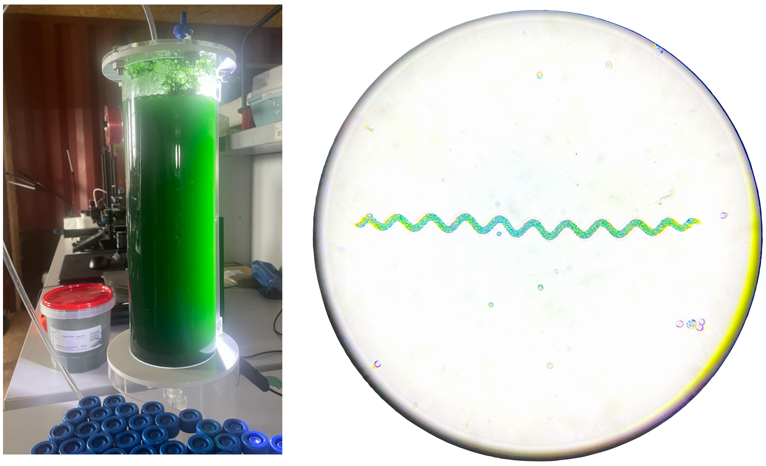
Each participant of the camp is making urine analysis using professional equipment. Results are then discussed individually. The second part of this activity is building urine filter and analysis of its efficiency. After filtration the solution is analysed using another strip test for water analysis. The winner gets award. Source: Agata Kołodziejczyk

Activity 7. Algae bioreactors

Number of students: 30
Duration: 90 min.
Location: 45 min. Laboratory, 45 min. Outdoor
Materials: Falcon tubes, microscope, microscope slides and cover slips, algae cultivation media (depending on algae species different cultivation medium), algae bioreactors LED lamps, air pumps. pH meter, thermometer, balance, magnetic stirrer, glass flasks, algae cultures from https://algaeresearchsupply.com/
Instructions: provided by educator

Goals:

1. Learning how to cultivate algae,
2. Learning what are profits from algae cultivation,
3. Searching for algae in local water,
4. Building algae bioreactor,
5. Learning how to measure the biomass production and how to control the system.

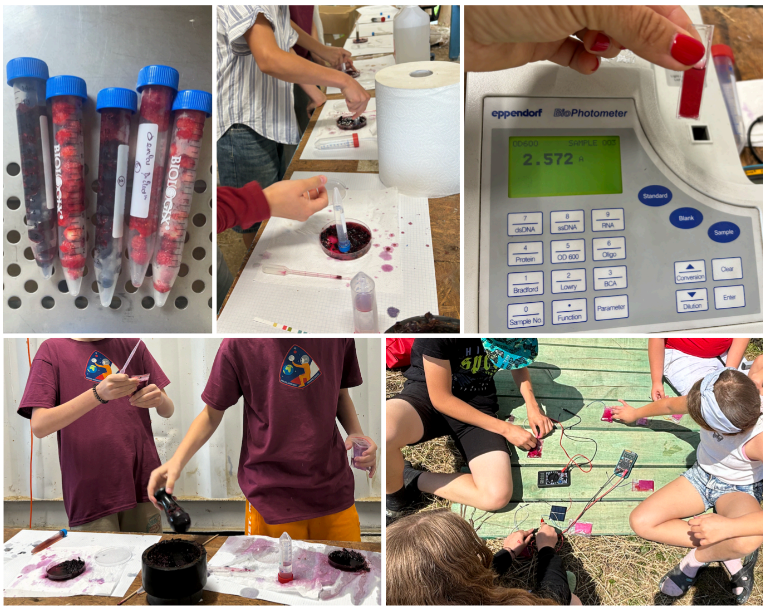


Spirulina sp. bioreactor in the habitat is one of the most exciting to observe under the microscope. Source: Agata Kołodziejczyk

Activity 8. *In situ* resource utilisation

Number of students: 30
Duration: 90 min.
Location: 45 min. Workshop, 45 min. Outdoor
Materials: Falcon tubes, forest fruits, mortar, cotton pads, string bags, copper cables, insulating tape, multimeter, light source (eg. Sun, UV lamp, etc.), photometer
Instructions: provided by educator

Goals:
1. Learning what is *in situ* resource utilisation, what are limited and unlimited resources,
2. Learning what is a principle of solar panels,
3. Building a solar panel using in situ resources,
4. Measuring the efficiency of created solar panel,
5. Organising a competition for the best solar panel design.



This activity should be performed during a sunny day. Participants go to the forest to collect forest fruits: black berries, blue berries, strawberries, raspberries and black elderberry. After fruit collection, pupils prepare extracts of photosensitive components, measure the absorbance and protein content in the obtained solutions using a photometer. Extracts are distributed in cotton pads packed in a small string bags equipped with cables. Voltage is measured using a multimeter in dark and sunny areas. Source: Agata Kołodziejczyk

Activity 9. Planetary protection

Number of students: 30
Duration: 3h + 5 days
Location: 120 min. Outdoor, 60 min. Laboratory, 5 days incubation of samples
Materials: Mobile phones with geo-localisation system, notebooks, projector, screen, computers, Petri dishes with agar, incubator
Instructions: provided by educator

Goals:
1. Learning what is planetary protection,
2. Learning methods and standards for planetary protection for missions to orbit, Moon and Mars,
3. Field exploration to detect invasive species,
4. Learning how to make a map with specific locations of invasive species,
5. Learning about human microbiomes
6. Mapping individual microbiomes on agar media

Pupils prepare agar medium on Petri dishes, then collect individual microbiomes from fingers, tongue and under the armpits. 5 days after inoculation, pupils analyse grown cultures of microorganisms under the microscopes. Source: Agata Kołodziejczyk

Cloudy day is a good time to explore local environment. In the proximity of the habitat there are farmer's fields, forests, valleys, rivers and waterfalls. Pupils search for invasive species. Each location should be noted and photographed. After classes participants present results and the map of invasive species is created in each team. Source: Agata Kołodziejczyk

Activity 10. Biodiversity as key to survival

Number of students: 30
Duration: 90 min.
Location: 45 min. Classroom, 45 min. Outdoor
Materials: collective bags, dryer, string bags, labels
Instructions: provided by educator

Goals:
1. Learning about biodiversity, why it is so important for protection of life,
2. Learning about local herbs and their applications,
3. Collecting herbs of specific species: lucern, cornflower, chamomile, geranium, mint, St. John's wort, comfrey, calamus, common yarrow, dandelion, clover, horsetail, chicory, ribwort plantain,
4. Learning how to dry herbs and make a tasty herbal tea,
5. Making a Junior Space Camp Tea for each participant.

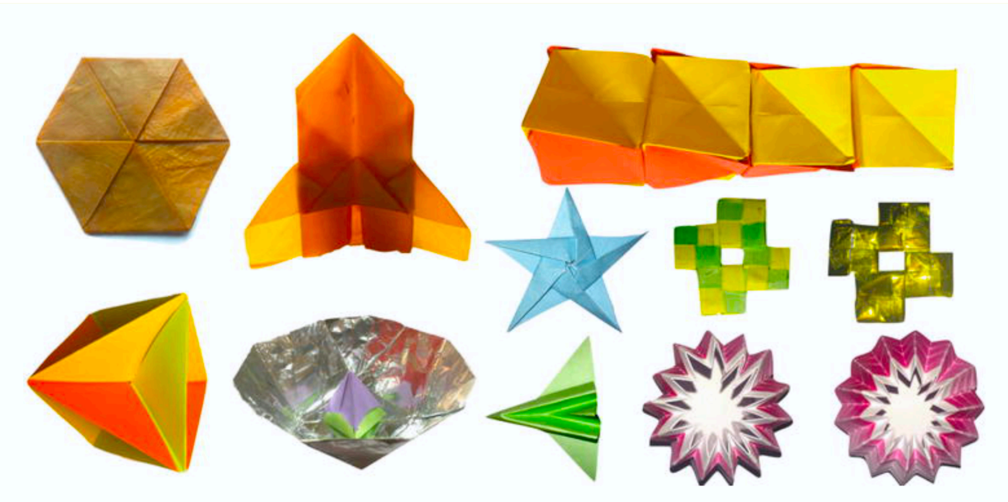
Collection of herbs reveals plant biodiversity in various environments. Participants learn, which regions are diverse, which are not and why. Pupils learn useful herbs, how to collect them and how to protect their chemical properties in the drying process. At the end of classes pupils learn how to mix various species of herbs to create tasty and healthy summer tea - a souvenir from the camp. Source: Agata Kołodziejczyk

3. SPACE ARTS
Teachers: Alicja Kołodziejczyk, Jan Kołodziejczyk, Dr. Agata Kołodziejczyk

Activity 1. Space Origami

Number of students: 30
Duration: 60 min.
Location: 60 min. Classroom
Materials: origami paper, projector, camera, laptop, screen,
Instructions: book "Space Origami": https://www.astronaut.center/pdf/book-space-origami.pdf

Goals:
1. Learning about origami techniques,
2. Learning about applications of origami structures in space,
3. Learning how to fold paper according to origami instructions,
5. Competition for origami shapes.



Origami models are selected from the easiest to the hardest one. Each participant needs to make at least one origami model. Source: Agata Kołodziejczyk

Activity 2. Painting

Number of students: 30
Duration: 60 min.
Location: 60 min. Classroom or Outdoors depending on weather
Materials: paper, watercolour paints, acrylic paints, oil paints, poster paints, pastels, crayons, pencils, markers, fluorescent paints
Instructions: examples of space art from internet

Goals:
1. Learning about why art is important for humans, especially in space,
2. Learning about painting techniques used for space arts,
3. Painting in 3 categories: life in space, space technologies, aliens,
4. Awarding the best works.

Examples of art work during the Junior Space Camp in various age groups. Source: Agata Kołodziejczyk

Activity 3. Space communication

Number of students: 30 divided in 5 teams
Duration: 4 h
Location: 120 min. Classroom, 120 min. Outdoors
Materials: mobile phones with good cameras, laptops, make-up accessories, elements of scenography (backgrounds with space landscapes), costumes, iMovie software
Instructions: provided by educator

Goals:
1. Learning how to communicate space,
2. Learning how to prepare a professional video, movie, document or podcast,
3. Learning how to prepare a professional scenario,
4. Learning how to professionally record sound and sound effects,
5. Learning how to professionally act in front of cameras,
6. Learning how to post process the video.

This part of training is very interactive and joyful. Participants like it very much and are very creative. The final effects are watched at the end of the Junior Space Camp during the last evening before the departure.

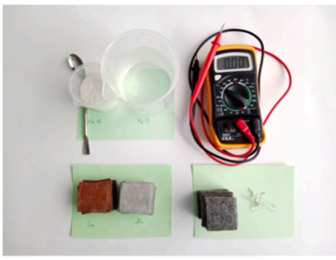
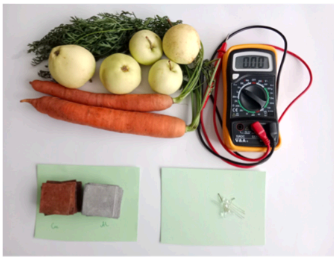
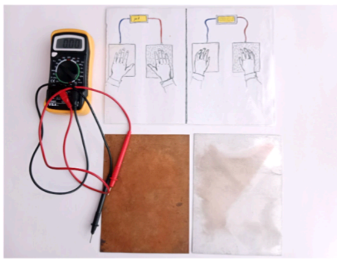
4. ELECTRONICS

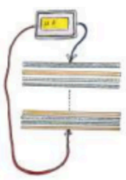
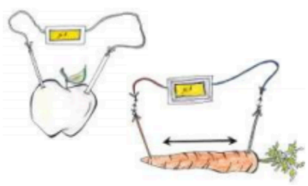
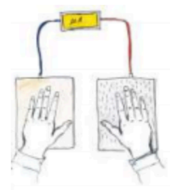
Teachers: Dr. Iwona Nowak, Daniel Maciejewski, Paweł Chruściński

Activity 1. Building a Voltaic cell - the precursor to modern battery

Number of students: 30 divided in 5 teams
Duration: 60 min.
Location: Classroom
Materials: multimeter, metal plates, fruits, rulers, led diodes
Instructions: provided by educator

Goals:
1. Learning what electrical current is,
2. Learning how to build a Voltaic cell,
3. Learning how to protect the environment by disposing of used batteries in dedicated containers,
4. Learning the source of electric charge in a cell,
5. Learning what serves as the electrolyte in the constructed cells,
6. Learning that the human body is a conductor of electricity, so it is important to protect the body from contact with the grid electricity, which is dangerous to health and life. In the conducted experiments we are dealing with an electric charge with low voltage values, which is harmless to the human body,
7. Learning about the impact of distance between electrodes on the cell voltage; the further apart the electrodes, the lower the voltage value,
8. Learning how the contact surface with metal plates, which are the source of electric charge, affects the voltage value of the obtained current,
9. Learning what influences the electric charge value of the cell and how to build a cell to achieve the highest electric charge values.

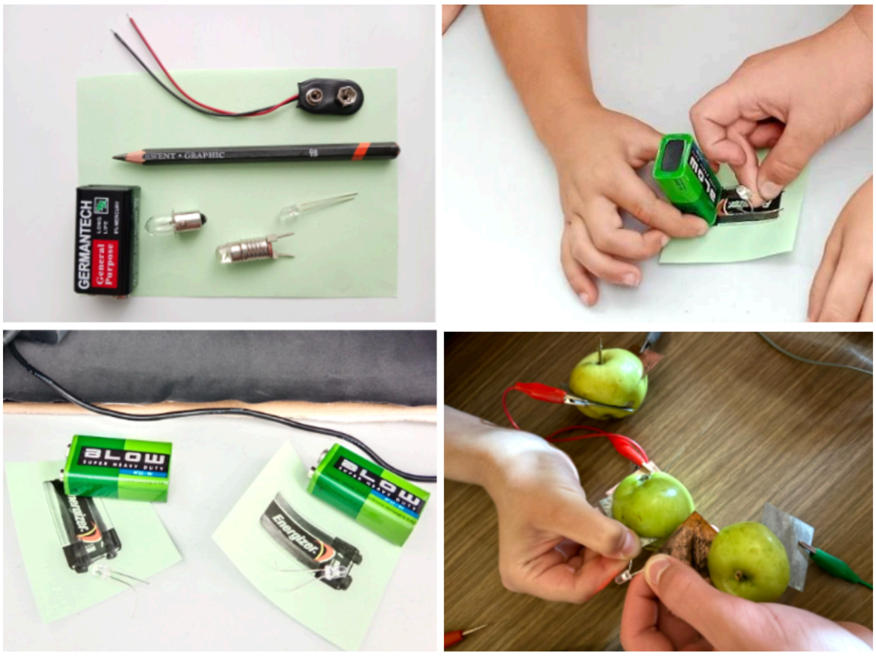




Electronics are a part of our lives. We use them all the time, and they are everywhere, but most people don't really know how they work. Students independently build cells from various materials and measure voltage. Participants build a cell using a carrot and observe how the voltage changes with the distance between the electrodes. All group members hold hands to close the circuit and compare the meter readings when holding with whole palms versus just elbows. Source: Iwona Nowak

Activity 2. Building simple electrical circuits

Number of students: 30 divided in 5 teams
Duration: 60 min.
Location: Classroom
Materials: 9V batteries, LED diodes, pencil, paper, fruits, cables
Instructions: provided by educator

Goals:
1. Learning how to build electrical circuits to light up a connected diode,
2. Learning how to increase the voltage in the circuit powering the diode by using a series connection,
3. Learning what electrical circuits are, how they work, and their basic components (power source, conductors, receivers, switches,
4. Understanding conductivity principles: Participants will discover which materials are conductors and which are insulators, and how this affects current flow in a circuit,
5. Applying Ohm's Law and series circuit principles: Participants will learn how to increase the circuit voltage using series connections and how this affects the operation of a diode.

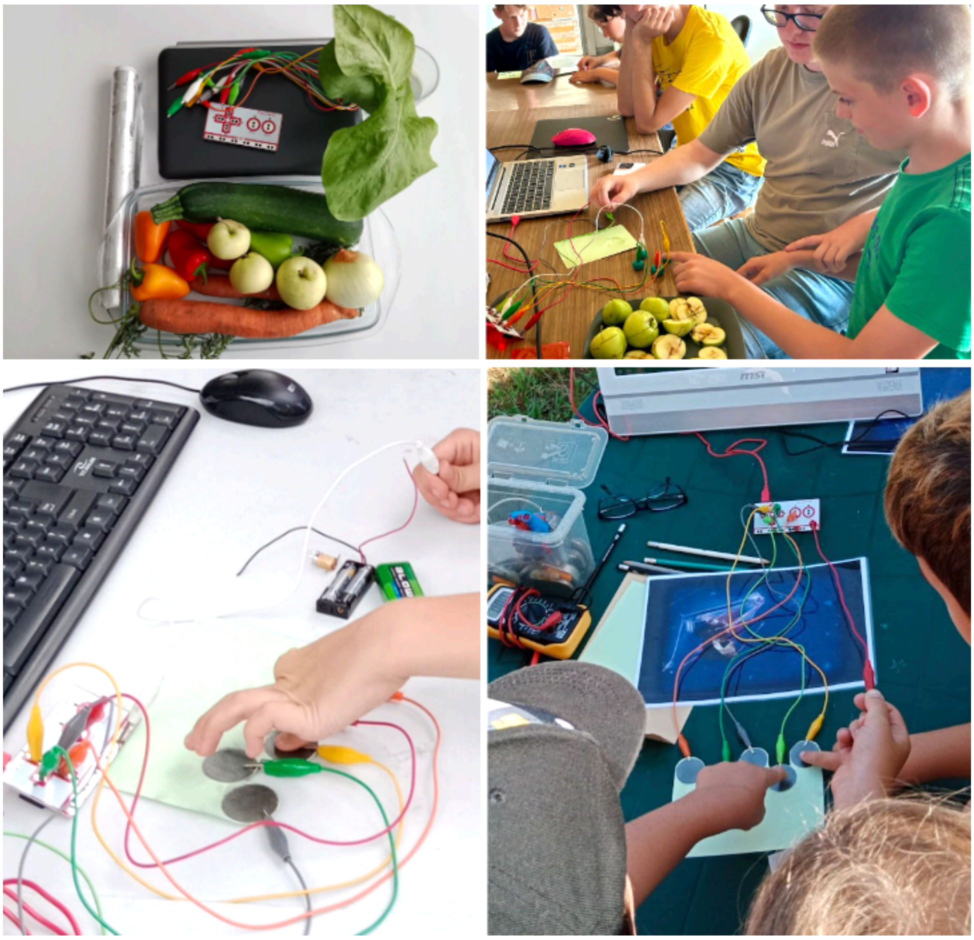


Participants enhance their analytical and logical skills by identifying and solving problems related to circuit construction and operation. Practices for working with electrical circuits are crucial for safety and effective learning. Source: Iwona Nowak

Activity 3. Building a keyboard

Number of students: 30 divided in 5 teams
Duration: 60 min.
Location: Classroom
Materials: 9V batteries, AA batteries, Makey Makey kit (www.makeymakey.com), fruits, vegetables, play dough, salt, graphite pencil, paper, Scratch program, computers, cables,
Instructions: provided by educator

Goals:
1. Learning which materials are conductors and how to use them to create electrical circuits,
2. Creative approach to technology: By using unconventional materials such as fruits, vegetables, play dough, or drawings, participants will learn to think outside the box in a technological context,
3. Practical application of Makey Makey technology: Participants will gain the skills to use the Makey Makey kit, which turns any conductive objects into interactive buttons,
4. Interdisciplinary knowledge connection: The workshop combines elements of physics (conductivity), art (creating keyboards from various materials) and computer science (programming in Scratch).



After a brief introduction to the Makey Makey kit and its capabilities, participants are divided into groups to build a keyboard (fruits, vegetables, play dough, drawing with a graphite pencil on paper). Groups design their keyboards, deciding what the keys will look like, then connect their keyboard to the Makey Makey kit and test its functionality with simple programs in Scratch. Pupils have opportunity to write their own code. Source: Iwona Nowak

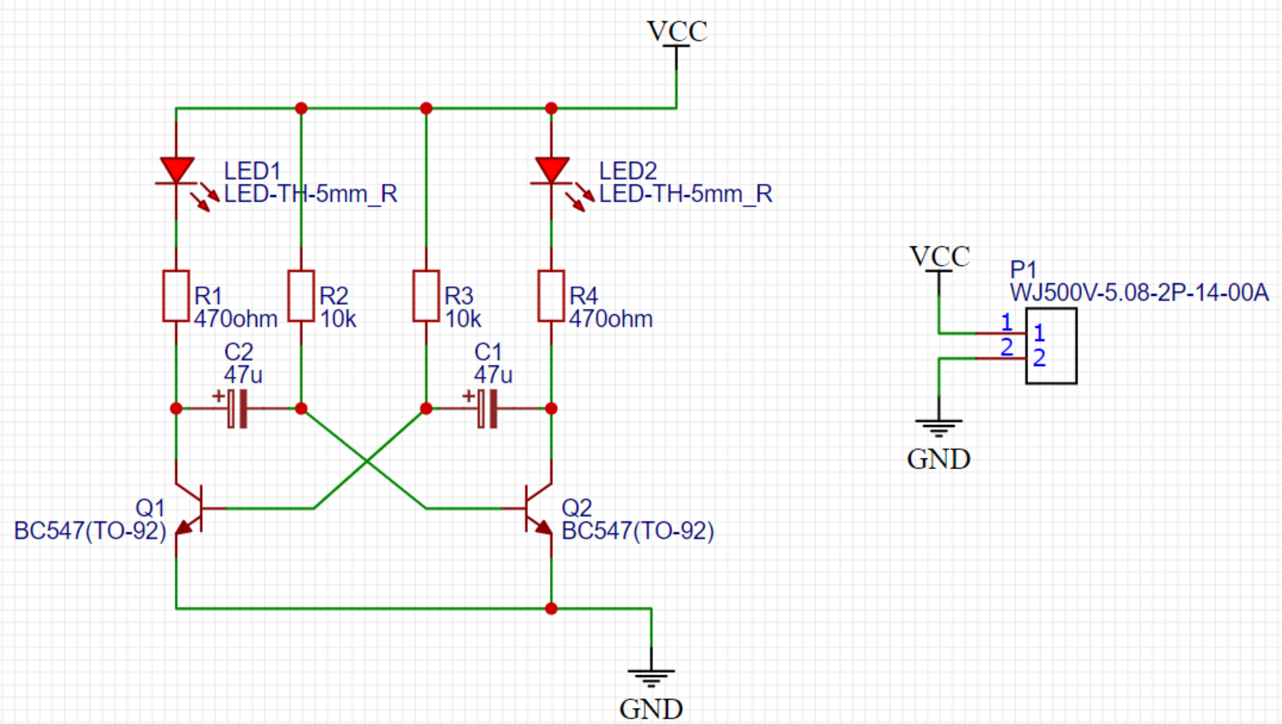
Activity 4. Soldering
Daniel Maciejewski

Number of students: 30 divided in 5 teams
Duration: 60 min.
Location: Electronic laboratory
Materials: soldering stations with adjustable temperature and interchangeable tips, high-temperature resistant ESD protective mats for the workstation, electronic multimeter with resistance and DC voltage measurement, solder binder - 1mm and 0.5 mm diameter solder wire, Flux - to wet the connection and

facilitate soldering, diagonal cutters, IPA-Isopropyl alcohol with a brush for cleaning flux, electronic microscope (for advanced groups), PCB for multivibrator project designed by Daniel Maciejewski: Education Kit #001 and Education Kit #001_SMD (for advanced groups), set of resistors with 10 kOhm resistance, resistors with 470 Ohm resistance, set of capacitors with 47uF capacitance for 16V or higher voltage, set of transistors with a minimum beta of 100 and a minimum collector current of 50mA, LED diodes with a minimum operating current of 20mA, connectors (2-pin screw terminal ARK112 with 5.08 mm pitch), wiring (two insulated cable with a minimum diameter of 2x0.15mm2 and about 20cm length to connect the board to a battery
Instructions: provided by educator

Goals:
1. Learning basic principles of electronics: supply voltage, ground, current,
2. Learning to identify and describe basic discrete components used in electronics: resistor, capacitor, transistor, LED diodes,
3. Understand safety and hygiene practices and recognition of potential hazards associated with hazardous materials such as solder (tin), flux, Isopropyl alcohol (IPA),
4. Learning how to red schematics of circuits,
4. Independently solder a functioning electronic circuit.

For the workshops a simple and straightforward astable multivibrator circuit was prepared. It includes nearly all basic electronic components and the number of components required for the correct operation of the circuit.



Printed Circuit Boards (PCBs) for the astable multivibrator project, for both the basic and advanced groups, were designed by Daniel Maciejewski and manufactured in a factory. This allowed for the provision of high-quality base material for soldering training and the avoidance of potential issues with mismatched sizes of electronic component enclosures and the designated spaces on the PCB. Mastering advanced SMD soldering techniques requires precision and patience. Every step, from applying solder paste to positioning components to the soldering process itself, is crucial for achieving a reliable connection. Source: Daniel Maciejewski

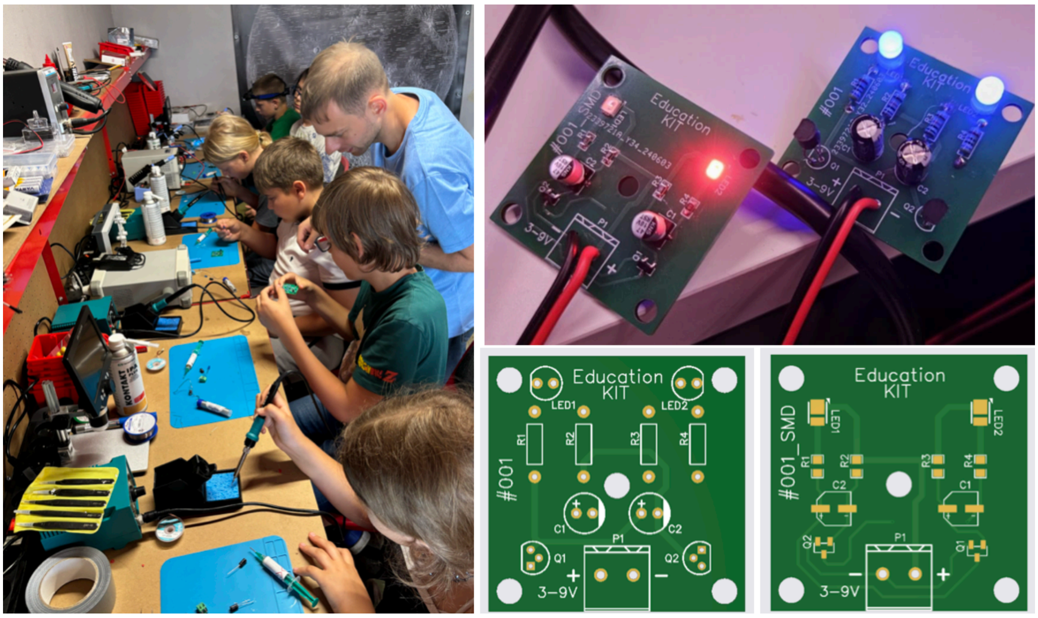
Component Assembly

The first step in assembling electronic boards is inserting through-hole components, starting with the lowest ones, usually resistors. The process involves threading the metal leads of the component through the holes in the PCB. For some components, like electrolytic capacitors or LEDs, attention must be paid to polarity. These components have clearly marked positive and negative leads. Incorrectly installing the component can cause the circuit to malfunction or even damage. For through-hole components, the longer lead always indicates the positive side. Additionally, on the capacitor body, the negative lead is marked next to one of the terminals. Similarly, for LEDs, besides the different lead lengths, the 5mm LED casing has a distinct flat side indicating the cathode. Next, the board is turned over, taking care not to let the inserted components fall out. A small amount of flux is applied to the solder pad with the inserted metal lead of the component. The soldering iron tip heats both the metal lead and the solder pad. Without removing the soldering iron the solder wire melts, joining the two elements. Then, soldering iron is removed allowing the joint to cool. Once the cooled solder immobilizes the component in the PCB, the excess of metal lead is removed. Diagonal cutters are used to trim the remaining part of the lead just above the solder joint. To build a fully functional circuit, this entire process must be repeated for each electronic component on the multivibrator board, finishing with the tallest components.

Advanced Level Soldering

In advanced soldering techniques, one method of applying solder alloy to solder pads is using a metal stencil for solder paste, which allows simultaneous application of paste to all solder pads. However, to develop manual dexterity, the advanced group uses standard solder in the form of thin wire with a diameter of 0.5 mm and a standard soldering station with a thin tip. The first step, although not necessary, but facilitating manual soldering of SMD components, is to apply a small amount of flux to the PCB pads where the components will be soldered. Due to the small size of the components, a minimal amount of substance is sufficient. A crucial stage in the process of manual soldering of SMD components is their precise positioning. The component must be accurately placed in the designated spot on the PCB, without misalignment. All metal leads on the electronic component's casing must contact the pads on the PCB, without causing short circuits between them. The process of soldering SMD components is similar to assembling through-hole components. First, touch the soldering iron tip to the solder pad on the board to heat it. Then, while continuously heating the pad, add a small amount of solder. After the solder connects with the component and the pad, remove the soldering iron tip and allow the joint to cool. If the component is correctly soldered, repeat this process for the remaining leads of the component. The use of surface mount technology eliminates the need for mechanical processing. There are no metal leads on components that need to be shortened, significantly speeding up the assembly process, especially on a production line where this process is performed by pick-and-place machines. To build a fully functional circuit, the entire soldering process must be repeated for each electronic component on the multivibrator board. After soldering, it is necessary to remove flux residues from the PCB. This process is performed using a specialized ESD brush and isopropyl alcohol. Isopropyl alcohol effectively dissolves flux residues and degreases the PCB surface. Due to its properties, it quickly evaporates from the laminate, leaving a clean surface. The penultimate step before connecting the board to power and starting it is an optical inspection. This involves thoroughly visually inspecting the solder joints to detect potential shorts between pads. This inspection ensures that all connections are properly made and there is no risk of short circuits that could damage the circuit. If all connections are correctly made, the circuit should work immediately after connecting to power. Regardless of the power source, whether it is a 9V battery or a regulated workshop power supply, the circuit does not require any calibration or configuration.

A properly functioning circuit is characterised by alternating flashing of two LEDs. Cleaning, optical inspection, and startup are key final steps in the PCB assembly process. Each of these steps ensures that the assembled circuit is not only clean and free of contaminants but also fully functional and ready for operation. By carefully conducting these procedures, one can be confident that the final product meets high standards of quality and reliability.



Soldering is a key technology in electronics. It involves joining two metal parts without melting them. Unlike welding, where the material melts, in soldering, the parts being joined do not change their state. Only the solder, which is usually a tin-lead alloy or other special alloys, melts. The solder must thoroughly wet the surfaces of the metals being joined to ensure a strong and effective connection. Soldering is really important in making and fixing electronic devices because it allows us to connect small parts, like integrated circuits, resistors, or capacitors, to make complex electronic circuits. We need precise and long-lasting connections so that our gadgets can work properly. Source: Daniel Maciejewski and Agata Kołodziejczyk

5. 3D PRINTING

Teachers: Daniel Maciejewski, Marcin Gazda, Igor Kosiński, Agata Kołodziejczyk

Activity 1. Design a habitat in Tinkercad software

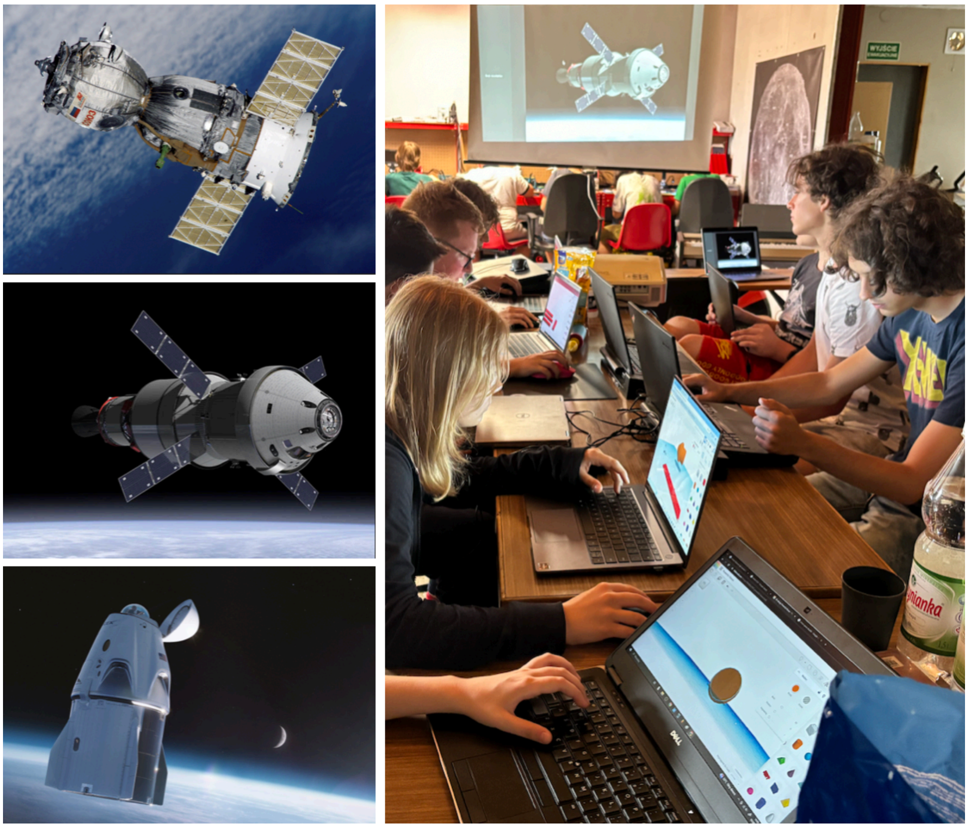
Number of students: 30
Duration: 60 min.
Location: Classroom, 3D printers, SD cards, connectors, filaments
Materials: laptops, projector
Instructions: Tinkercad software downloaded for free from internet

Goals:
1. Learning how to operate Tinkercad,
2. Building a simple and complex geometrical figures,
3. Learning how to to design a house and habitat,
4. Learning what are differences between house and habitat,
5. Learning how to prepare file for 3D printing,
6. Learning how to calibrate and operate 3D printer.

Activity 2. Design a spaceship which you like: Soyuz, Orion, or Dragon

Number of students: 30
Duration: 60 min.
Location: Classroom
Materials: laptops, projector, screen, 3D printers, filament
Instructions: Tinkercad software downloaded for free from internet

Goals:
1. Learning what are human space flight vehicles operating in space transport,
2. Learning how space ships are built and what are critical subsystems enabling life in space,
3. Discussion about shapes of spaceships, propulsion systems, thermal shields, telemetry and navigation systems,
4. Learning about life support systems,
5. Building selected spaceship in Tinkercad.

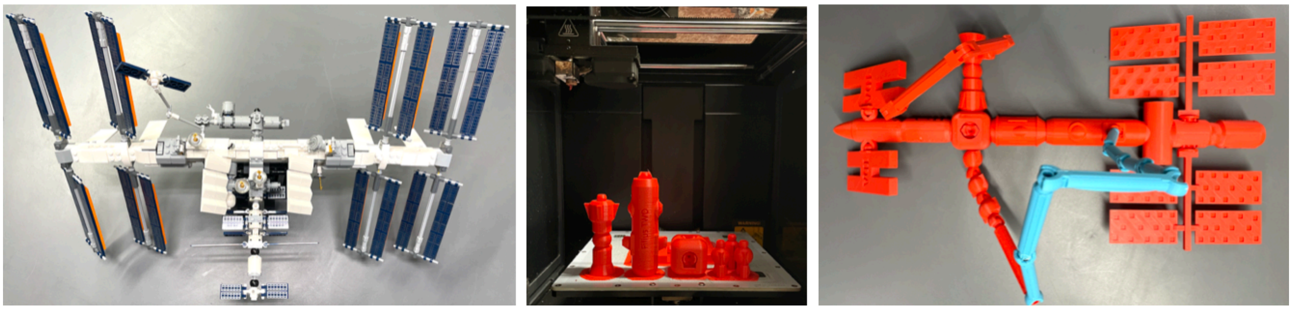


Participants are using laptops to prototype their designs. This activity learns how to keep proportions and memorise geometry. It learns spatial memory and improving 3D printing skills. Source: Agata Kołodziejczyk

Activity 3. Design a space station

Number of students: 30
Duration: 60 min.
Location: Classroom
Materials: laptops, projector, screen, 3D printers, filament
Instructions: Tinkercad software downloaded for free from internet

Goals:
1. Learning what is the space station,
2. Learning how space station is built and what are critical subsystems enabling life in space,
3. Discussion about shapes of space stations, propulsion systems, thermal shields, telemetry and navigation systems, rack system, experiments, which are performed during the missions,
4. Learning about existing space stations.



Like many countries collaborating in design of the final shape of the International Space Station, each participant is designing one module of the station compatible with the rest of subsystems. Such activity learns how to cooperate with others. Source: Agata Kołodziejczyk

6. ROBOTICS
Teacher: Cassandra Verdan

Activity 1. Introduction to Martian rovers - the journey to explore Mars

This class aims to provide students with an understanding of humanity's exploration of Mars, focusing specifically on the role and evolution of Martian rovers. Through this course, students will learn about the scientific, technological, and exploratory steps that have led to the development of sophisticated rovers capable of studying the Martian surface. The goal is to enhance students' appreciation for space exploration and to deepen their understanding of how these robotic missions contribute to our knowledge of Mars, potentially answering fundamental questions about the existence of life on other planets.

Number of students: 30
Duration: 60 min.
Location: 60 min.: Classroom
Materials: laptop, projector, screen
Instructions: provided by educator

Goals:
1. Identification of the historical milestones in Martian exploration and the role of rovers,
2. LEarning of the technological components and instruments equipped on various rovers,
3. Understanding the scientific goals of rover missions, such as searching for signs of past life and assessing the planet's habitability,
4. Discussing the implications of rover findings for future missions and potential human exploration.

In this session, participants explore the evolution of rovers, starting from the early fascination with Mars in the 19th century to the rover missions of today like Spirit, Opportunity, Curiosity, and Perseverance. Through a presentation, students learn about the technological advancements, mission challenges, and significant discoveries of each rover. The class covers: the historical context that spurred the exploration of Mars, key milestones in Martian rover missions and their technological innovations, the scientific objectives and findings of various missions, finally, a detailed overview of how rovers are designed to navigate and analyse the Martian surface. This comprehensive introduction sets the stage for students to understand how rovers operate in harsh environments and contribute to our understanding of Mars as a potential future habitat.

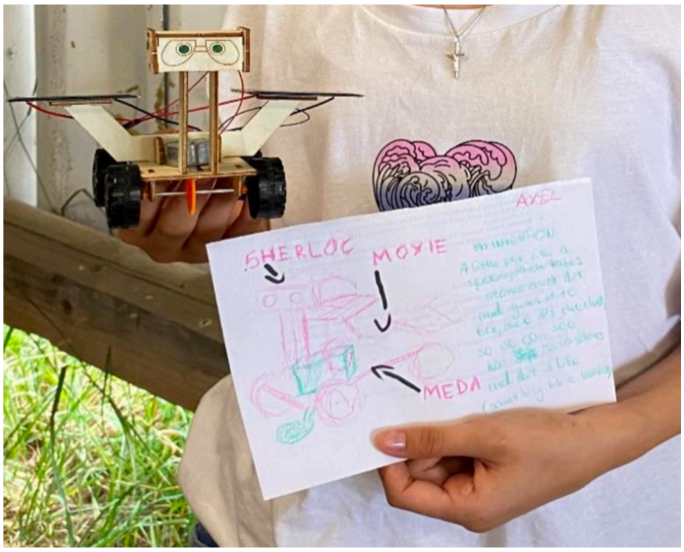
Excerpt from the course's presentation. Source: Cassandra Verdan

Activity 2. Design and build a rover

Number of students: 30
Duration: 120 min.
Location: 60 min.: Classroom, 60 min.: Workshop
Materials: laptop, projector, screen, pencils, pens, coloured markers, sheets of paper for drawing, DEUXPER Science Solar Mars Rover Model DIY Kit
Instructions: provided by educator

Goals:
1. Learning the practical aspects of assembling and troubleshooting a miniature rover,
2. Understanding the key technologies used in real Martian rovers and how they can be adapted to their miniature versions,
3. Exercising creativity in designing a unique instrument that could theoretically enhance the capabilities of their rover on a Martian mission.

This class is an engaging, hands-on activity where participants build miniature rovers using provided kits. The session aims to construct miniature rovers and incorporate Perseverance Rover Technologies: participants integrate at least three main technologies used in the Perseverance rover, for example: autonomy in navigation, advanced imaging capabilities, sample collection and caching mechanisms. Encouraging innovation, pupils design and conceptualise their own scientific instrument or technology that could enhance the rover's mission capabilities. This could involve creating new sensors, devising methods for improved data transmission, or developing better ways to analyze environmental samples. After building their rovers, students will draw and outline their own imaginative rover missions. They will map out a "Martian" landscape on paper, where they will plan and execute a mission using their rover models. This activity will not only reinforce students' understanding of rover functionality and mission goals but also enhance their creativity and promote engineering skills.



Participants first brainstorm the key features and capabilities they believe are essential for a "perfect" Martian rover. This might include considerations like mobility, power source, scientific instruments, communication methods, and survivability in harsh environments. Using the sheets of paper, pupils draw their rover designs, label important components and provide a brief description of the function of each system. They integrate at least three advanced technologies currently used in real Martian rovers, such as autonomous systems, advanced power generation methods (like RTGs or solar panels), or sophisticated scientific instruments for geology and climatology studies. In addition to using existing technologies, students invent at least one unique instrument or feature for their rover. This could address a specific scientific goal, improve the rover's operational efficiency, or enhance its ability to explore new types of Martian terrain. Participants describe how this new feature would work and justify its inclusion based on its potential benefits for Mars exploration. Upon completion of their drawings, each pupil or group (depending on class size and structure) will present their rover design to the class. Participants explain their design choices, focusing on the integration of existing technologies and their innovative features. Additionally, they discuss how their rover would contribute to the exploration of Mars and potentially answer unresolved scientific questions. Source: Cassandra Verdan

Assessment Criteria :

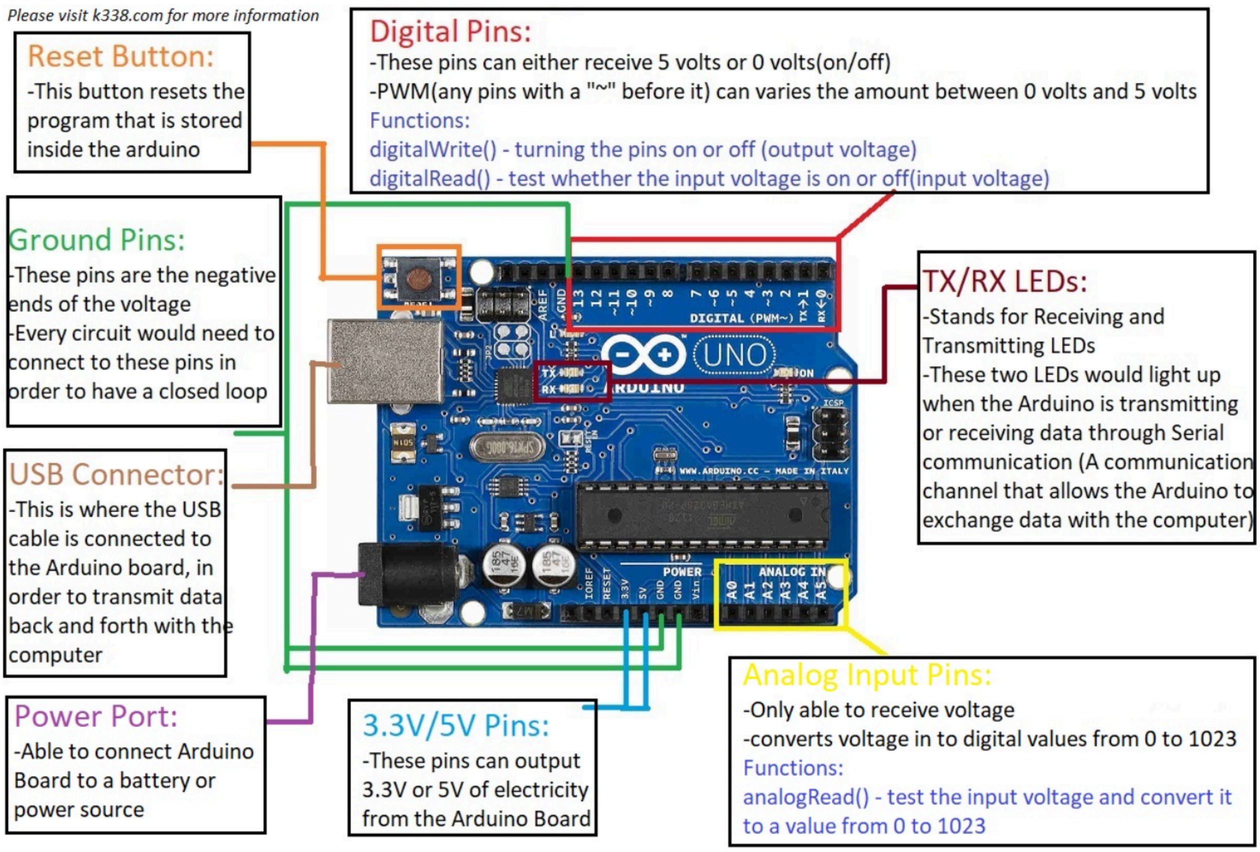
Creativity and innovation in rover design
Practical integration of existing technologies
Feasibility and effectiveness of the newly invented feature

Activity 3. Introduction to Arduino Programming Language

Number of students: 30
Duration: 120 min.
Location: 60 min.: Classroom, 60 min.: Workshop
Materials: laptop, projector, screen, Arduino Uno plates, batteries, wiring (connectors to laptops)
Instructions: https://www.arduino.cc/en/Guide

Goals:
1. Understanding the fundamental concepts of Arduino and its components,
2. Learning to write and upload code to the Arduino board,
3. Exploring the use of inputs and outputs in electronic projects,
4. Understanding basic programming concepts and structures used in Arduino sketches.

The course aims to provide basic understanding of Arduino programming, preparing to engage in future electronics projects. The goal is to construct and program a remote-controlled robot. Participants learn about the key components of Arduino projects, including inputs, outputs, and basic programming structures through a masterclass given by the teacher on screen. Pupils go through setting up their development environment, writing first programs, and understanding how Arduino interacts with electronic components.

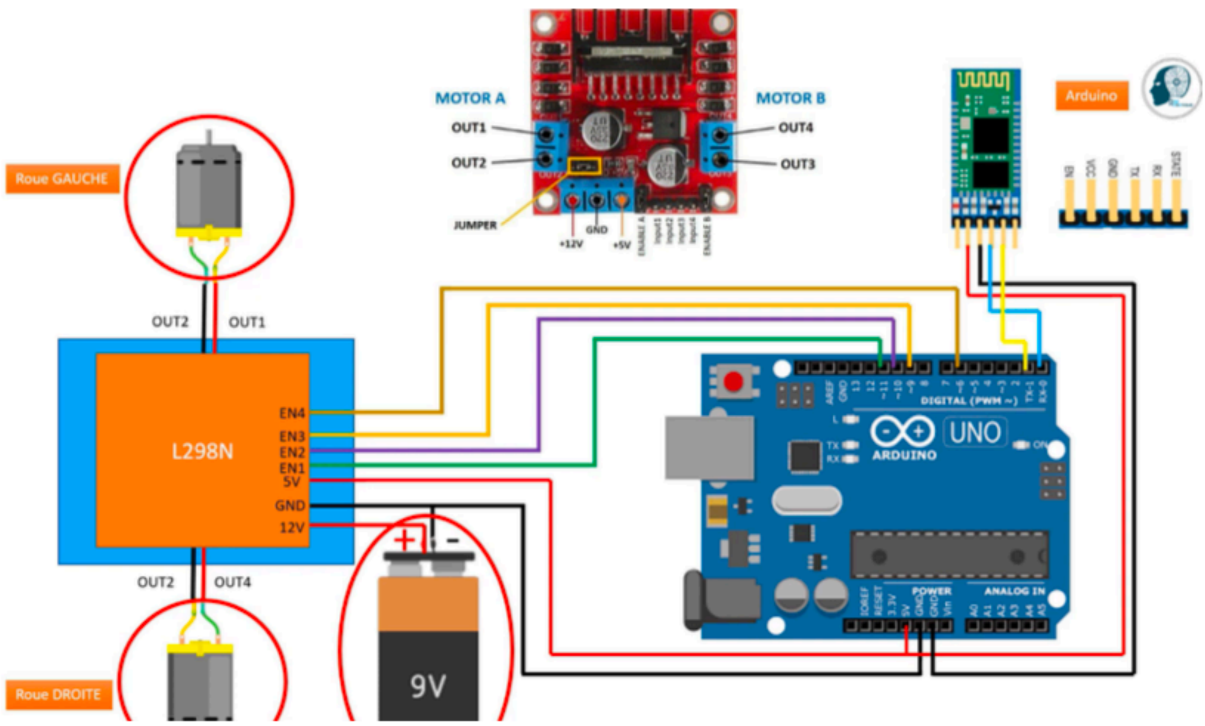


Scheme of Arduino components. Source: https://k338.com/2020/05/22/

Activity 4. Construction of electrical system for remote-controlled rover

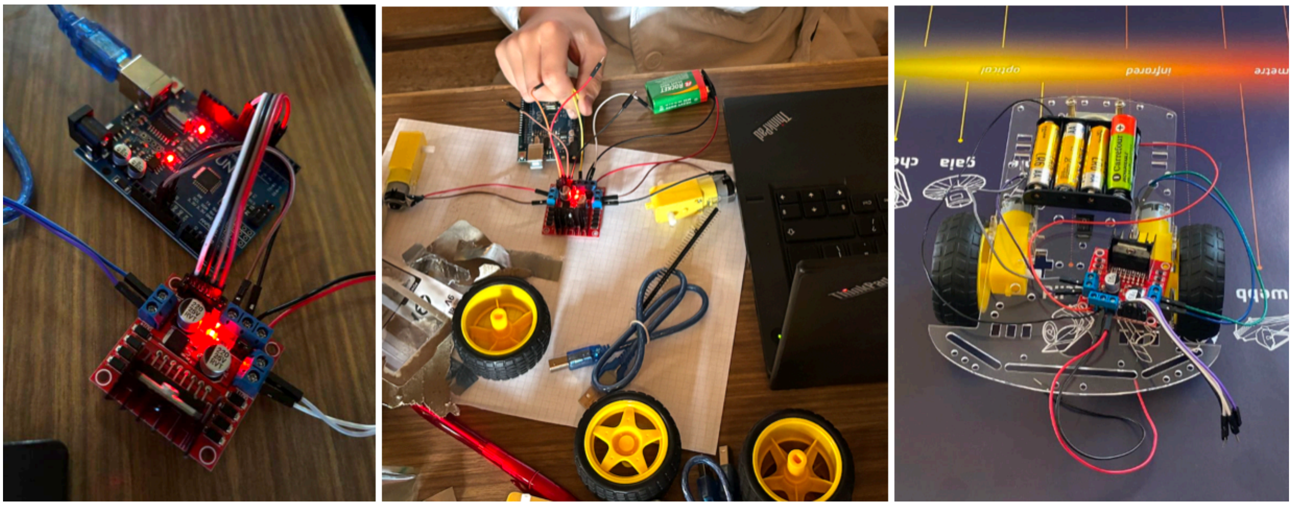
Number of students: 30
Duration: 120 min.
Location: Classroom
Materials: Forbot Kit with the motors, wheels and plate for assembling, Bluetooth Model, Module L298N, Arduino Uno, Breadboard, Connecting wires, screwdriver and glue gun
Instructions: provided by educator

Goals:
1. Learning and understanding the role of each component, including the power source, L298 motor driver, Bluetooth module, DC motors, and Arduino board,
2. Learning how to connect and utilise various electronic components such as the power source, L298 motor driver module, Bluetooth module, DC motors, Arduino board, and wiring,
3. Learning to assemble the electrical system on the breadboard, allowing the remote-controlled rover to be powered and controlled via Bluetooth,
4. Hands-on experience with wiring and component integration, including the use of a motor driver module, Bluetooth communication, and power management,
5. Understanding the basic programming concepts and structures used in Arduino sketches.



Electrical Circuit to be Reproduced.

Participants construct the electrical system required for the remote-controlled robot. This involves connecting motors, sensors, and other components to the Arduino board, ensuring everything functions correctly and is properly controlled. The final activity culminates in programming the robot to perform tasks remotely. Pupils apply their acquired knowledge of the Arduino language to write code enabling the robot to move, sense its environment, and respond to commands. Advanced participants build the program from the ground up using basic commands and tasks. Those who find programming more challenging either copy the code or arrange it in the correct order, while the teacher explains each part of the code in detail. Participants download and install the Arduino IDE and connect the board to the computers. Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs and turn it into an output via Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing. Source: Video from Crunchlabs: "Arduino Crash Course with Mark Rober".



Part of the electrical system assembled. Participants reconstruct the electrical system, providing step-by-step assistance throughout the process. After completing the electrical system, participants test the EN1, EN2, EN3, and EN4 pins by connecting the positive wire of the power source to each pin individually. This helps to understand which pins correspond to which wheel and the direction each wheel turns. Understanding this mapping is critical to avoid operational issues when running the program. Source: Cassandra Verdan

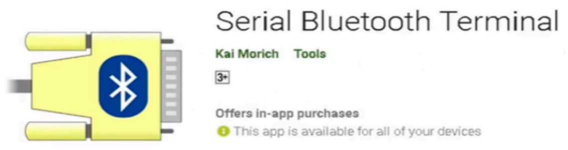
Activity 5. Programming the remote-control rover

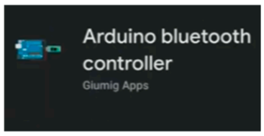
Number of students: 30
Duration: 120 min.
Location: Classroom
Materials: Forbot Kit with the motors, wheels and plate for assembling, HC-05 Bluetooth Model, Module L298N, Arduino Uno, Breadboard, Connecting wires, screwdriver and glue gun
Instructions: HC-05 Bluetooth Module User's Manual v1.0.pdf

Goals:
1. Learning the fundamental concepts of coding on Arduino,
2. Learning how to write and upload a program to the Arduino that controls the remote - controlled rover, allowing it to move forward, backward, turn left, and turn right based on commands received,
3. Learning how to connect Arduino to a Bluetooth device to enable remote control of the rover,
4. Testing the program to ensure the rover responds correctly to commands and make necessary adjustments for proper functionality,
5. Understanding serial communication between the Arduino and a Bluetooth device,
6. Learning how to use PWM (Pulse Width Modulation) to control motor speed and direction.

The modules are activated using the code provided in the bluetooth manual. Participants download the "Arduino Bluetooth Controller" application onto their phones. These modules are designed to work with Android devices; other mobile devices might not be compatible.

Bluetooth Module
HC-05 or HC-06





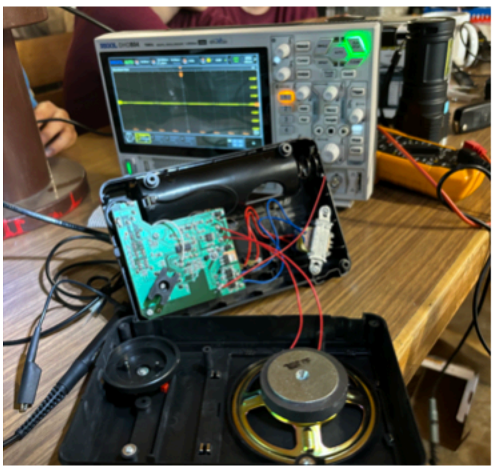
Android

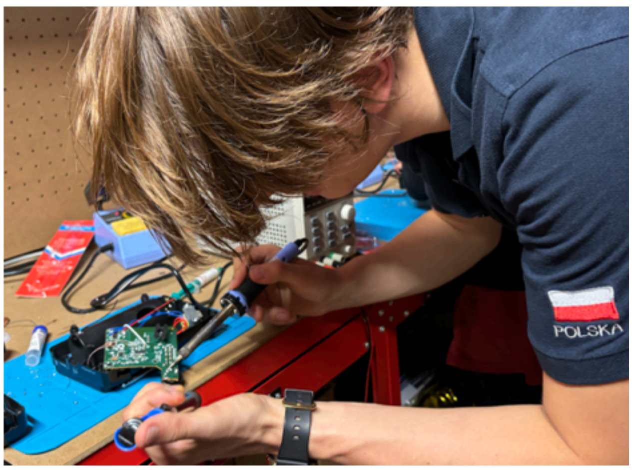
The Bluetooth devices should appear under the name "HC-05" or "HC-06" in the Bluetooth connection list. The robot should now be remotely operable through the phones by sending in the commands for it to move forward, backward, left, right, speed up, or slow down. Enjoy! Source: Cassandra Verdan

Activity 6. Building a radio
Teacher: Aleksander Kopyto

Number of students: 30
Duration: 120 min.
Location: Classroom
Materials: Radios, projector, laptop, camera, oscilloscope, multimeter, soldering materials
Instructions: provided by educator

Goals:
1. Learning the fundamental information about radio waves,
2. Learning how radio is built,
3. Disassembling the radio and identification of each element,
4. Learning how to use oscilloscope to measure radio frequency,
5. Building a radio,
6. Improving soldering technique.



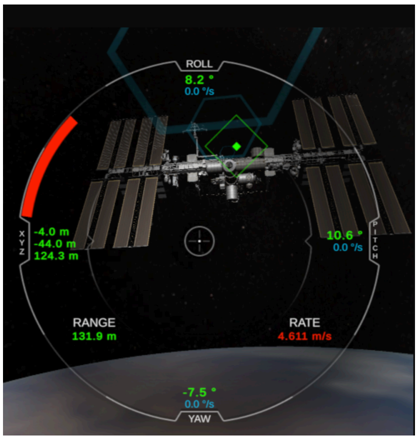


Aleksander showing the elements of the regular radio. Source: Agata Kołodziejczyk

7. AERODYNAMICS

Teachers: Dr. Agata Kołodziejczyk, Krystian Komenda, Asit Rahman

Activity 1. Docking to ISS on simulator



Number of students: 30
Duration: 30 min.
Location: Classroom
Materials: laptops, online simulator
Instructions: https://iss-sim.spacex.com/

Goals:
1. Learning what is simulator and simulated missions ,
2. Learning how to dock to the International Space Station,
3. Learning cognitive skills.

Activity 2. Operating drones

Number of students: up till 30
Duration: 180 min.
Location: 90 min. Outdoor, 90 min. Classroom
Materials: Drones, controllers, landing sites, laptops
Instructions: https://drony.gov.pl/e-learning

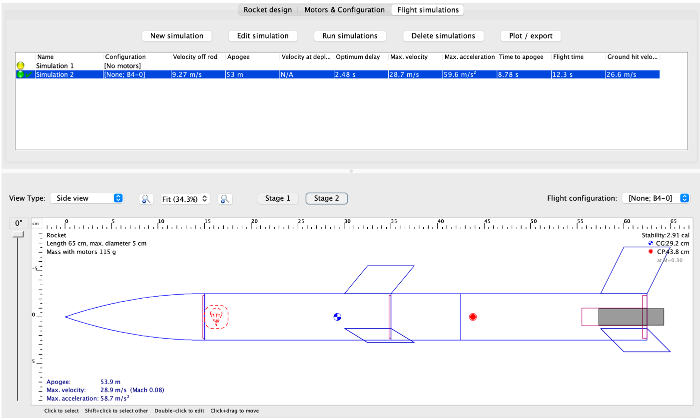
Goals:
1. Learning how the drone is built,
2. Learning how to operate the drone,
3. Learning how to get a drone certificate,
4. Passing the first flight exam on line: Pilot Competencies A1A3 Exam.

Participants learn about meteorological conditions for the drone flights as well as they learn how to navigate and land with resolution to 20cm. Source: Agata Kołodziejczyk

Activity 3. Construction a rocket model

Number of students: 30
Duration: 90 min.
Location: 45 min. Classroom, 45 min. Outdoor
Materials: Rocket models, rocket engines, material for parachutes, tape, OpenRocket software
Instructions: provided by educator

Goals:
1. Learning why rockets fly and how fast they can fly,
2. Learning how to design a rocket in the OpenRocket software,
3. Hands-on experience - building a model of a rocket,
4. Learning safety procedures,
5. Launching the rocket models.



After simulations in the OpenRocket software, participants build their own rocket models and fly them up.
Source: Agata Kołodziejczyk

8. BIOASTRONAUTICS

Teachers: Dr. Agata Kołodziejczyk, Matt Harasymczuk, Justyna Średzińska, Iga Kaczorowska, Asit Rahman, Daniel Maciejewski, Eryk Kopa

Activity 1. Egg-naut competition

Number of students: 30
Duration: 4 hours
Location: 120 min. Classroom, 120 min. Outdoor
Materials: eggs, laptops, balloons, bubble foil, styrodur, bandages, duct tape, umbrellas, scissors, threads, needles, paper, plastic bottles, etc.
Instructions: provided by educator

Goals:
1. Learning how to manage limited budgets,
2. Learning how to collaborate with partners,
3. Learning about limitations in space projects,
4. Designing of a lander with egg-naut,
5. Participation in the competition.

The competition is designed in a way, that each participant is owner of the space company and gets contract with the national agency to build a lander capsule with egg-naut on board, which will be tested in crash tests on the observation tower on 3 levels: 10m, 20m and 30m altitude. Pupils get initial budget and plan the mission to buy appropriate materials and build the payload.

Materials and prices to be used in building the egg-naut capsule:

1. Parachute - umbrella - 200 000 000 EUR
2. Bottle 1.5 l - 300 000 000 EUR
3. Cartoon - 300 000 000 EUR
4. 1 m of string - 100 000 000 EUR
5. 1 m of ribbon. - 100 000 000 EUR
6. 1 m of elastic - 150 000 000 EUR
7. 1 m of duct tape - 150 000 000 EUR
8. 1 A4 paper sheet - 10 000 000 EUR
9. Bubble foil 10cm x 10 cm - 50 000 000 EUR
10. 10 cm of elastic bandage - 50 000 000 EUR
11. 2 pieces of gauze - 20 000 000 EUR
12. 10 foams - 10 000 000 EUR
13. 2 balloons - 50 000 000 EUR
14. 2 latex gloves - 30 000 000 EUR
15. 15 drawing pins - 50 000 000 EUR
16. Renting scissors and other accessories for 30 min. - 50 000 000 EUR

Initial budget given for each competitor:
300 000 000 EUR from National Space Agency
Competition criteria:

1. Survival of egg-naut
2. Total cost of the payload
3. Total mass of the payload

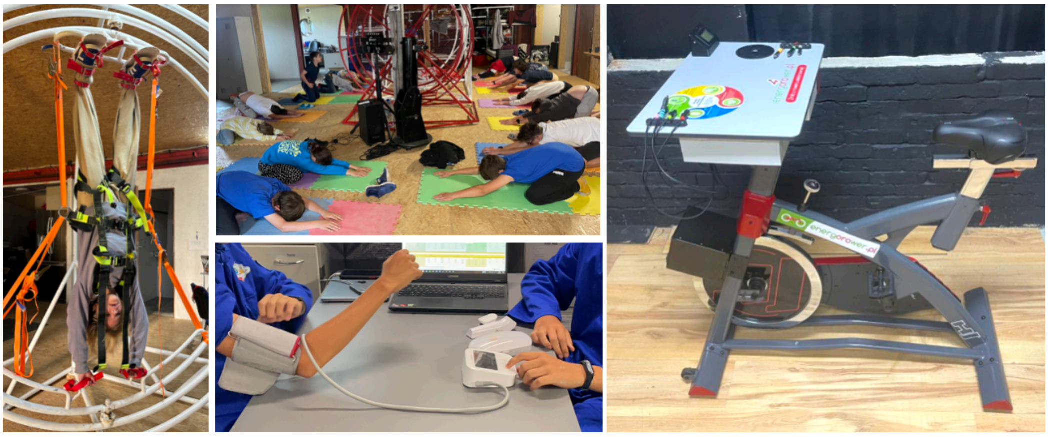
All designed capsules with egg-nauts ready for tests are transferred to the observation tower at Brzanka national park located 10 km from the habitat.

Participants struggle with the budget and the payload design, but the crash test is very emotional. The competition is organised in the national park in a beautiful landscape. Source: Agata Kołodziejczyk

Activity 2. Analog astronaut training

Number of students: 30
Duration: 90 min.
Location: 45 min. Classroom, 45 min. Outdoor
Materials: Walkie-talkie, 3D gyroscope, yoga mats, bioimpedance balance, blood pressure measuring device, energy-bike, smart-watches, subjective time perception test
Instructions: made by mentor

Goals:
1. Learning how to train like an astronaut,
2. Learning discipline, regular physical activity, healthy sleep and healthy diet,
3. Learning how to improve performance in cognitive tests, memory and reflex,
4. Testing subjective time perception and endurance.

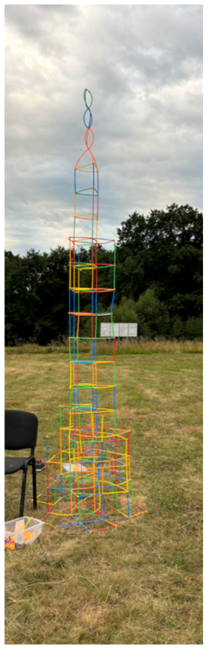


Astronaut training is one of the most joyful activity. Participants are very engaged and inspired to be better versions of themselves. Source: Agata Kołodziejczyk

Activity 3. Navigation runmageddon

Number of students: 30 divided in 3 groups
Duration: 90 min.
Location: Outdoor
Materials: Walkie-talkie, night vision, GPS, face paintings, coloured sticks
Instructions: provided by mentor

Goals:
1. Learning how to navigate in terrain during the day and night,
2. Learning how to make a cryptic outfit,
3. Learning how to collaborate in the team,
4. Learning healthy competition.

Participants enjoy this game, especially during the night. 3 groups are first preparing their cryptic outfit, then the first group goes and prepares navigation points, second group is following the first group and needs to find all hidden elements. The last group is following group A and B but they are supposed to be completely unseen by others. There is a time regime for this task, communicates are send via radio to the team leader. The leader is selected by each group. Source: Agata Kołodziejczyk

9. FOOD IN SPACE
Teachers: Dr. Agata Kołodziejczyk, Daniel Maciejewski

Activity 1. Aquaponic and hydroponic systems for food production in space

Number of students: 30
Duration: 90 min.
Location: 45 min. Classroom, 45 min. Greenhouse
Materials: Elements for aquaponic and hydroponic systems, pipes, pumps, sensors, filters, 3D printer, expanded clay, aquarium, plastic boxes, led lamps, CO2 sensor, light intensity sensor, temperature and humidity sensor, turbidity sensor, seeds, plants, fishes, cameras
Instructions: provided by educator

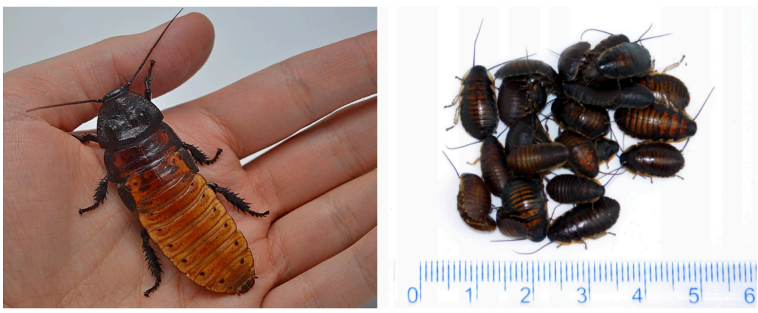
Goals:
1. Learning about growing food in hydroponic and aquaponic systems,
2. Building hydroponic and aquaponic systems,
3. Measuring environmental parameters of the systems,
4. Observation of the plant growth.

Aquaponic (top left) and hydroponic (top right) systems at the AATC habitat can be expanded in the dedicated greenhouse module. Pupils build their own systems and compare which system is more efficient considering the biomass production. Because of short time of the camp, the optimal plant to cultivate is cress, which after experiment is measured and eaten. The total biomass production is computed in relation to monitored parameters from water analysis and environmental sensors. Source: Agata Kołodziejczyk

Activity 2. Cockroach bioreactor

Number of students: 30
Duration: 60 min. + 5 days
Location: 30 min. Classroom, 30 min. Workshop
Materials: Cockroaches *Gromphadorhina portentosa*, plastic containers (made from PET bottles after drinking water), scissors, in situ resources
Instructions: provided by educator

Goals:
1. Learning about food in space,
2. Understanding how to take care of insects,
3. Learning about cockroach life and unique features of this animals,
4. Learning how to distinguish cockroach gender,
5. Building a house for cockroaches female and male,
6. Having a cockroach as pet for 5 days, comparison of body weight before and after the cultivation process,
7. Learning creativity.



At the beginning participants are suspicious regarding cockroaches as pets, but this attitude is changing fast. Source: internet

Activity 3. Making jelly candies and mochi

Number of students: 30
Duration: 60 min.
Location: Classroom
Materials: powder sugar, gelatine, orange juice concentrate, raspberry juice concentrate, pots, spoons,
Instructions: provided by educator

Goals:
1. Team building and integration,
2. Learning how to make a jelly candies and mochi,
3. Celebrating produced sweets.

Participants prepare sweets and try to obtain the best final shapes. Source: Agata Kołodziejczyk

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Design of the logo of the camp: Krystian Komenda

SUMMARY

This work is a compilation of the main classes during the Junior Space Camps organised in subcarpathian village Rzepiennik Strzyżewski. Education, environment and friendship are the main components of this one week joint meetings of talented pupils and passionated experts. Presented classes maintain a focused and productive learning environment, allowing for individual attention and support when needed. Manual and technical skills were the main goals to be achieved. Participants mounted in brief theoretical background moved directly to the practical application in soldering, programming, 3D printing and cultivating of plants and other organisms in bioreactors. Pupils enhanced collaboration and communication skills encouraged by creativity. Procedures introduced in the beginning of each space camp proved safety and responsibility despite work with dangerous tools. The mixture of multidisciplinary tasks increased interest in science and technology in a holistic way, which is a new approach in education systems. Teamwork and collaboration was promoted in joint problem-solving and idea-sharing tasks during integrated knowledge from physics, computer science, biology, astronomy, chemistry and psychology. This allowed to understand how different fields of science can work together to create innovative solutions. Practical challenges and engaging tasks aimed at fostering greater interest in electronics, programming and technology. Success in completing projects strengthen participants' confidence.