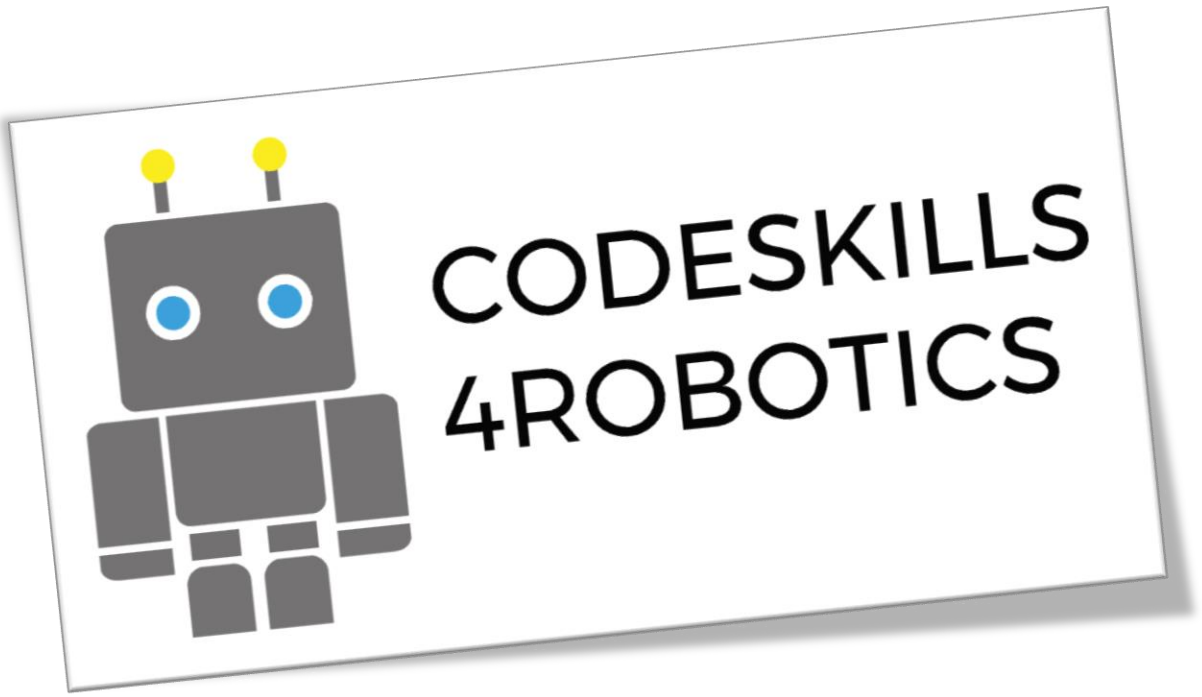

COMPETENCE FRAMEWORK

CODESKILLS4ROBOTICS: Promoting Coding & STEM Skills through Robotics: Supporting Primary Schools to Develop Inclusive Digital Strategies for All

IO1: Building the CODESKILLS4ROBOTICS Competence Framework: From Theory to Practice

Partners: Hellenic Mediterranean University, Emphasys Centre, N.C.S.R. "Demokritos"

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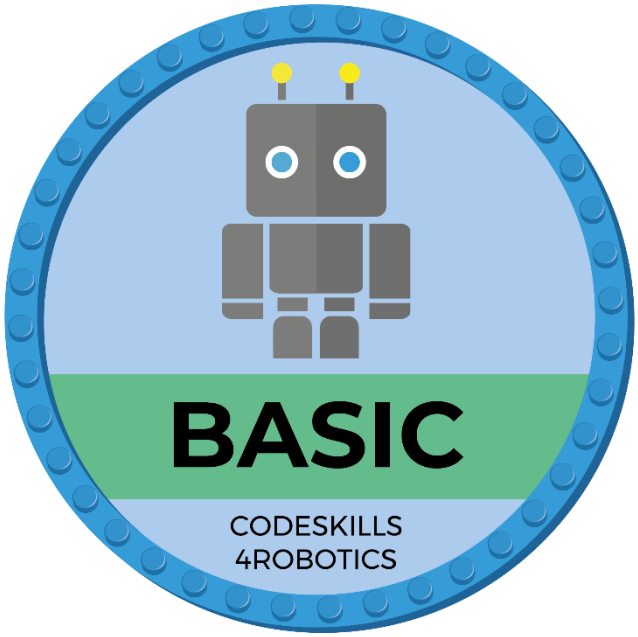
ΙΔΡΥΜΑ ΚΡΑΤΙΚΩΝ ΥΠΟΤΡΟΦΙΩΝ ΙΚΥ

This project has been funded with support from the European Commission. This publication [communication] reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein." "Funded by the Erasmus+ Programme of the European Union"

CODESKILLS4ROBOTICS
Competence Framework

MODULE 1: DEVELOP BASIC STEM SKILLS AND PROGRAMMING

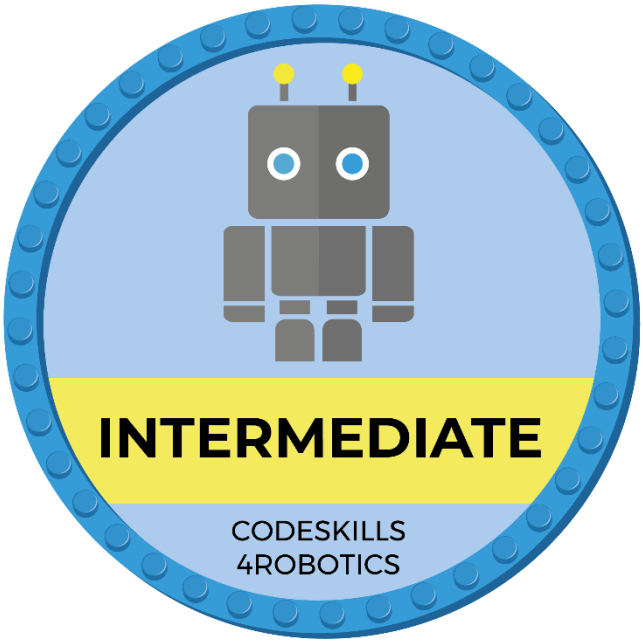
Section A:	Basic Robotics Movements
The aim of the section is to introduce students to the basic movements of robots. Students will build the robot REA and learn to program it to perform basic movements. They will also learn how to use loops to program it to make repetitive movements.	
Associated Badge:	

Chapter:	**1.1 Let's Build REA**
Level:	Beginner (Basic)
Pre-requisites:	There are no cognitive pre-requisites
Equipment:	A Lego Boost Kit
Main Objective:	Construct the base model robot - REA
Duration:	1 classroom period - 45' minutes
General Learning Outcomes:	Learn how to follow basic assembly instructions and construct a mechanical device
Robotics Learning Outcomes:	Learn how to construct a basic robotic structure with wheels for movement
Knowledge:	Students should be able to follow instructions given in a visual form and reproduce a replica of the end result
Skills:	Students should be able to: - Use and connect different Lego pieces

	- Identify ways to assemble technic and electronic parts using Technic pins and connectors - Build the recommended robot (REA) using different Lego pieces by following the step by step instructions
Soft Skills:	- Team work - Collaboration skills - Communication skills - Coordination - Problem Solving - Decision making - Experimenting - Focus - Goal setting - Creativity

Chapter:	**1.2 Moving Instructions of REA**
Level:	Beginner (Basic)
Pre-requisites:	Basic understanding of what the speed of an object is. Understanding of how an Angle is measured in Degrees and of how Time is measured in seconds
Equipment:	A constructed model of the REA Robot
Main Objective:	Program REA to perform basic movements
Duration:	2 class periods - 90' minutes
General Learning Outcomes:	Learn how to create an algorithm to solve a problem by writing sequential coding instructions
Robotics Learning Outcomes:	Learn how to write coding instructions to move the motors of a robotic device
Knowledge:	Students should be able to create and follow an algorithm to solve a problem
Skills:	Students should be able to: - Use a combination of blocks in order to move REA forward/backward in straight line - Use a combination of blocks in order to make REA turn to the left/right by setting the desired number of degrees
Soft Skills:	- Team work - Collaboration skills - Communication skills - Coordination - Problem Solving - Decision making - Experimenting - Focus - Goal setting - Creativity

Chapter:	**1.3 Using Loop Commands with REA**
Level:	Beginner (Basic)
Pre-requisites:	A basic understanding of the coding blocks used for movement
Equipment:	A constructed model of the REA Robot
Main Objective:	Program REA to repeat a set of commands by using iteration
Duration:	2 class periods - 90' minutes
General Learning Outcomes:	Learn how to create an algorithm to solve a problem by writing iteration (repeating) coding instructions
Robotics Learning Outcomes:	Understand the three types of loop blocks - For Loops which repeats code for a specific number of times - While Loops which requires a condition to be true in order to repeat a piece of code - Forever Loops which repeat a piece of code forever
Knowledge:	Students should be able to create and follow a repeating algorithm to solve a problem
Skills:	Students should be able to: - Use the different blocks for Looping commands (yellow blocks) - Use a combination of blocks in order to move REA forward/backward in straight line - Use a combination of blocks in order to make REA turn to the left/right by setting the desired number of degrees
Soft Skills:	- Team work - Collaboration skills - Communication skills - Coordination - Problem Solving - Decision making - Experimenting - Focus - Goal setting - Creativity

Section B:	Robotics Sensors
In this section, students will learn how to use environmental data (via sensors) to program the robot. They will learn how the sensors that the robot is equipped with work, while they will program it to perform tasks using the sensors.	
Associated Badge:	
Chapter:	1.4 Using Sensors with REA
Level:	Intermediate
Pre-requisites:	A basic understanding of the coding blocks used for iteration - loops
Equipment:	A constructed model of the REA Robot and the Lego Boost Color and Distance Sensor
Main Objective:	Program REA to interact with its environment with the help of the sensor and how selection coding works
Duration:	2 class periods - 90' minutes
General Learning Outcomes:	Learn how sensors are used by robots and to create an algorithm to solve a problem by receiving input from the environment
Robotics Learning Outcomes:	- Learn how to use sensors (color, sound, distance) - Learn how to program the robot to identify objects - Learn how to program the robot to recognize colors from a given range - Learn how to measure the amount of light reflection - Learn how to code using selection coding (if/else)
Knowledge:	Students should be able to understand - How a sensor works - How the received input can be used to solve a problem - How a selection algorithm works
Skills:	Students should be able to use the detect objects block (orange blocks) o Use a combination of blocks in order to make REA detect objects and colors

	○ Use a combination of blocks in order to allow REA to make decisions based on the sensor's input
Soft Skills:	- Team work - Collaboration skills - Communication skills - Coordination - Problem Solving - Decision making - Experimenting - Focus - Goal setting - Creativity

Chapter:	**1.5 Following Walls with REA**
Level:	Intermediate
Pre-requisites:	A basic understanding of the coding blocks used for recording the reflected light intensity as well as selection - if/else and iteration - loop blocks
Equipment:	A constructed model of the REA Robot and the Lego Boost Color and Distance Sensor
Main Objective:	Program REA to travel in an area by following one side of a wall or one side of an object
Duration:	2 class periods - 90' minutes
General Learning Outcomes:	Learn how sensors are used by robots in order to navigate autonomously and to create an algorithm to solve a problem by receiving input from the environment
Robotics Learning Outcomes:	- Learn how to use sensors to record the distance from an object - Learn how to program the robot to identify and avoid objects - Learn how to measure the amount of light reflection
Knowledge:	Students should be able to understand how a sensor works and how the received input can be used to solve a problem
Skills:	Students should be able to use the detect objects block (orange blocks) ○ Use a combination of blocks in order to make REA detect the distance from objects ○ Use a combination of blocks in order to allow REA to make decisions based on the sensor's input
Soft Skills:	- Team work - Collaboration skills - Communication skills - Coordination - Problem Solving - Decision making - Experimenting - Focus - Goal setting

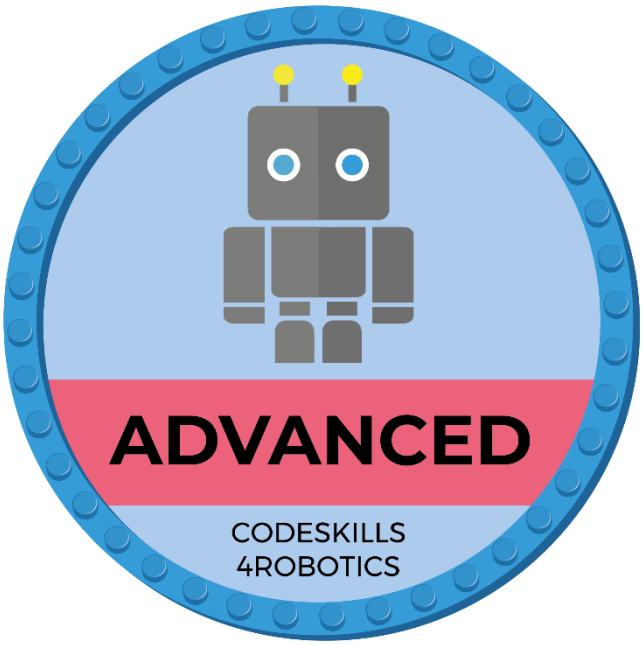
	- Creativity

Chapter:	**1.6 Following Lines with REA**
Level:	Intermediate
Pre-requisites:	A basic understanding of the coding blocks used for recording the reflected light intensity as well as selection - if/else and iteration - loop blocks
Equipment:	A constructed model of the REA Robot and the Lego Boost Color and Distance Sensor
Main Objective:	Program REA to travel in a predefined path marked with a black line on a white background
Duration:	2 class periods - 90' minutes
General Learning Outcomes:	Learn how sensors are used by robots in order to navigate in a predefined path and to create an algorithm to solve a problem by receiving input from the environment
Robotics Learning Outcomes:	- Learn how to use sensors to measure the amount of light reflection - Learn how to program the robot to adjust its path and follow a black line
Knowledge:	Students should be able to understand how a sensor works and how the received input can be used to solve a problem
Skills:	Students should be able to use the light sensor in order to measure the reflected light intensity and make REA move on a predefined path-line
Soft Skills:	- Team work - Collaboration skills - Communication skills - Coordination - Problem Solving - Decision making - Experimenting - Focus - Goal setting - Creativity

Chapter:	**1.7 Detecting Sound with REA**
Level:	Intermediate
Pre-requisites:	A basic understanding of the coding blocks used for selection - if/else and iteration - loop.
Equipment:	A constructed model of the REA Robot
Main Objective:	Program REA to react in a different way depending on the sound intensity which it receives
Duration:	1 class period - 45' minutes
General Learning Outcomes:	Learn how sound sensors are used by robots and create an algorithm to solve a problem by receiving input from the environment

Robotics Learning Outcomes:	- Learn how to use sound sensors to measure the intensity of sound - Learn how to program the robot to react based on sound intensity
Knowledge:	Students should be able to understand how a sound sensor works and how the received sound intensity can be used to solve a problem
Skills:	Students should be able to use the sound sensor in order to measure the sound intensity and program REA to perform accordingly based on the level of sound
Soft Skills:	- Team work - Collaboration skills - Communication skills - Coordination - Problem Solving - Decision making - Experimenting - Focus - Goal setting - Creativity

Chapter:	**1.8 Navigating REA with a Remote Controller**
Level:	Intermediate
Pre-requisites:	A basic understanding of the coding blocks used for iteration - loop and basic mathematical calculations (division)
Equipment:	A constructed model of the REA Robot
Main Objective:	Program REA to move with the use of a remote control device
Duration:	1 class period - 45' minutes
General Learning Outcomes:	Learn how remote-controlled robots can have various scientific uses
Robotics Learning Outcomes:	- Learn how to manually control a robot by using a remote-control device - Learn how to program the robot to move in higher precision
Knowledge:	Students should be able to understand how a robot can be manually controlled and how the input can be tweaked for precise movement
Skills:	Students should be able to learn how to use the remote control to trigger movements
Soft Skills:	- Team work - Collaboration skills - Communication skills - Coordination - Problem Solving - Decision making - Experimenting - Focus - Goal setting - Creativity

Section C:	Advanced Robotics
In this section, students will learn about specific and specialized aspects of robots and programming such as the use of gears and the concept of variables.	
Associated Badge:	
Chapter:	1.9 Using Gears with REA
Level:	Advanced
Pre-requisites:	A basic understanding of the coding blocks used for movement, basic mathematical calculations and how gears work
Equipment:	A modified model of the REA Robot which includes gears for gearing up and gearing down
Main Objective:	Use gears in order to change the speed and torque of REA
Duration:	2 class periods - 90' minutes
General Learning Outcomes:	Learn how gears can be used in order to change the speed and torque of a moving object
Robotics Learning Outcomes:	- Learn how to increase the maximum speed of a robot with wheels - Learn how to increase the maximum torque of a robot with wheels
Knowledge:	Students should be able to understand how gears are used in situations where more speed or torque is needed
Skills:	Students should be able to learn how to use gears for increased speed and torque
Soft Skills:	- Team work - Collaboration skills - Communication skills - Coordination - Problem Solving - Decision making - Experimenting - Focus

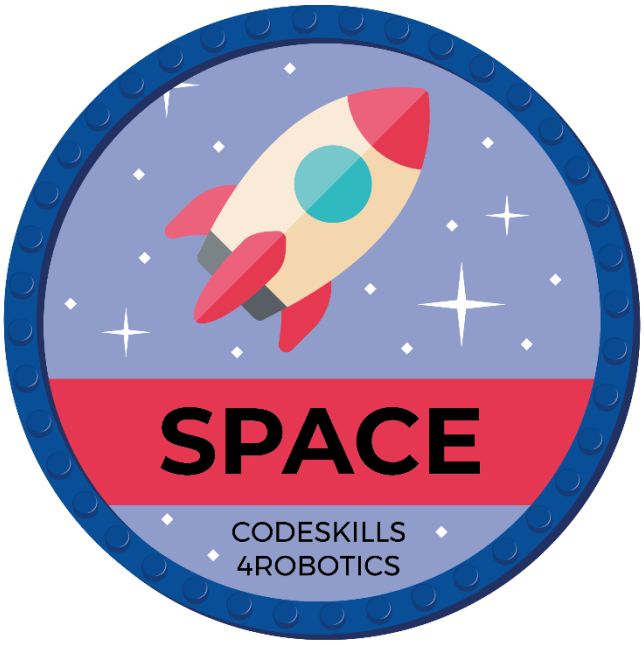
	- Goal setting - Creativity

Chapter:	**1.10 Using Variables with REA**
Level:	Advanced
Pre-requisites:	A basic understanding of the coding blocks used for selection - if/else and iteration - loop blocks as well as basic mathematical calculations
Equipment:	A constructed model of the REA Robot and the Lego Boost Color and Distance Sensor
Main Objective:	Learn how to use variables to store information
Duration:	2 class periods - 90' minutes
General Learning Outcomes:	Learn how computers and robots make calculations as well as how data are stored and used by a computer program
Robotics Learning Outcomes:	- Learn how to use operators for calculations - Learn how to store data in variables - Learn how to use the content of a variable
Knowledge:	Students should be able to understand how variables and operators are used in coding
Skills:	Students should be able to: - Use variables to program REA - Use operators and make calculations - Use the result of the calculation as input for programing REA
Soft Skills:	- Team work - Collaboration skills - Communication skills - Coordination - Problem Solving - Decision making - Experimenting - Focus - Goal setting - Creativity

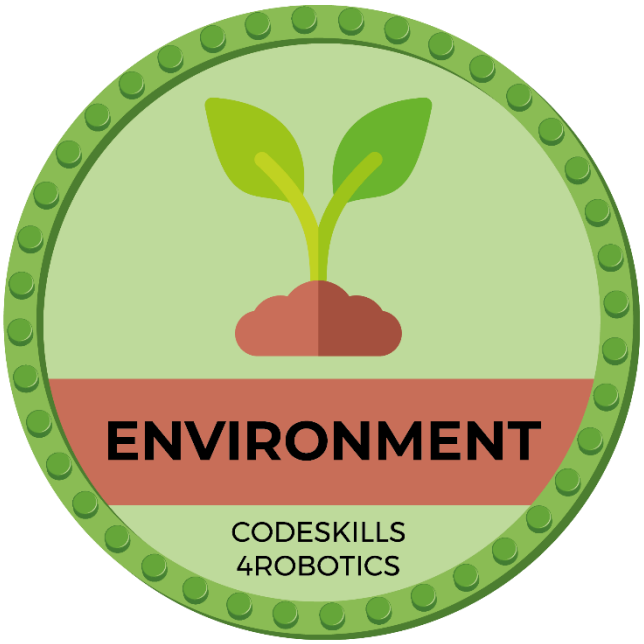
MODULE 2: THE CREATIVE SCENARIOS	
2.1 BUILDING AND PROGRAMMING SMALL ROBOTS	
Pre-requisites:	There are no cognitive pre-requisites.
Equipment:	For this scenario, you will need Lego Boost kits and tablets that are compatible with them. Pupils will be divided into groups and instructions will be given to them.
Main Objective:	Overview of the standard models in the Toolbox: Vernie the Robot, M.T.R.4, Frankie the Cat, Guitar 4000 and the AutoBuilder.
Duration:	Approximately 2,5 hours per construction
Learning Outcomes:	- Learn how to build and program Vernie the Robot - Learn how to build and program M.T.R.4 - Learn how to build and program Frankie the Cat - Learn how to build and program Guitar 4000 - Learn how to build and program the AutoBuilder - Learn how to use the standard models as a reference guide, to expand on further ideas and create programs
Skills:	Students should be able to: - Identify the available tasks and programs recommended by Lego - Use the standard models as a reference guide, to expand on further ideas and create programs - Add own techniques and imagination to extend programming options beyond the original suggestions - Customize own ideas and program them, using a combination of movements and sensor abilities
Soft Skills:	- Team work - Collaboration skills - Communication skills - Creativity - Coordination - Focus - Goal setting

2.2 THE FOUR (4) CREATIVE SCENARIOS	
2.2.1 HISTORY SCENARIO - Talos: From the Legend to Modern Robots	
Associated Badge:	
Pre-requisites:	Students should be familiar with the educational material of Module 1 and more specifically with the chapters, which are related to the basic movements of robots, loop commands, the use of sensors, following the line programs, detecting sounds and the use of remote control. (Chapters 1.2, 1.3, 1.4, 1.6, 1.7 and 1.8).
Equipment:	For this scenario, you will need Lego Boost kits and tablets that are compatible with them. Pupils will be divided into groups and instructions will be given to them.
Main Objective:	In this scenario, students will be introduced to the legend of Talos. They will construct and program a Robot just like the mythical guardian of Crete. Finally, they will discuss issues related to the protection and preservation of important cultural sites.
Duration:	Estimated Time: 8 Teaching hours - 2 hours for starting point (introduction), questions, drawing - 3 hours for the construction of Vernie - 2 hours for programming the robot and the carrying out of the assignments

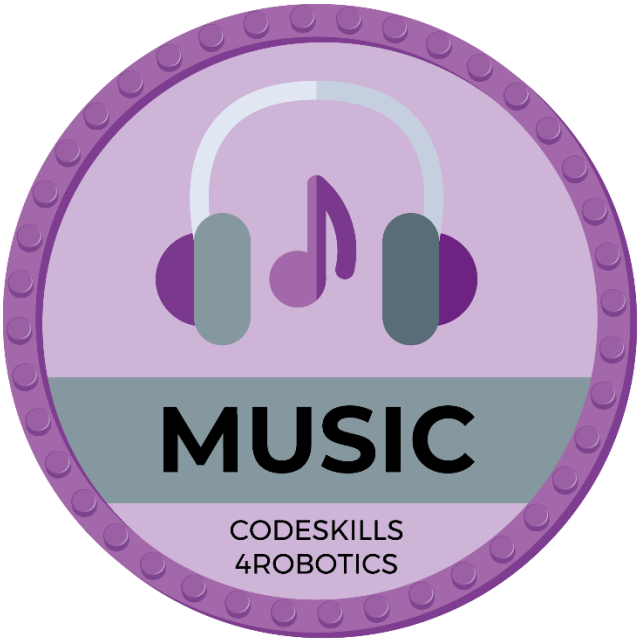
	- 1 hour for the completion of the assignments, video recording of the proceedings, discussion, analysis of the project and suggestions for new assignments/activities
General Learning Outcomes:	- Calculate the perimeter of the island of Crete - Calculate the speed of Talos
Robotics Learning Outcomes:	- Construct the robot - Get familiar with the sensors of the robot and how to use them - Get familiar with the loops coding concept - Get familiar with the if - else coding concepts
Knowledge:	- Learn simple movement commands - Be introduced to the legend of Talos and the geomorphology of Crete
Relevant Subject:	History
Soft Skills:	- Develop imagination and creativity through the construction of the robot - Develop team working skills - Coordination - Problem solving - Decision making - Experimenting - Focus - Goal setting - Creativity

2.2.2 SPACE SCENARIO - Robot from Earth to Space	
Associated Badge:	
Pre-requisites:	Students should be familiar with the educational material of Module 1 and more specifically with the chapters, which are related to the basic movements of robots, the use of sensors, detecting sounds and the use of the remote control. (Chapters 1.2, 1.4, 1.6, 1.7 and 1.8).
Equipment:	For this scenario, you will need Lego Boost kits and tablets that are compatible with them. Pupils will be divided into groups and instructions will be given to them.
Main Objective:	In this scenario, pupils will get to know the planets of our Solar System and program the robot in order to explore them. Finally, they will discuss issues related to space exploration, the difficulties, the changes that such an action will bring about and its impact on humanity.
Duration:	Estimated Time: 5-6 Teaching hours - 1 teaching hour, starting point (introduction), presentation of planets, discussion. - 2-3 teaching hours, construction of the robot. - 2 teaching hours, programming, project analysis.
General Learning Outcomes:	- Get to know the planets of the Solar System

	- Calculate the distances between them and the difficulties of traveling to another planet.
Robotics Learning Outcomes:	- Construct the robot - Get familiar with the sensors of the robot and how to use them - Get familiar with the loops coding concept - Get familiar with the if - else coding concepts
Knowledge:	- Learn simple movement commands - Learn to use the if-else coding concept
Relevant Subject:	Astronomy
Soft Skills:	- Develop imagination and creativity through the construction of the robot - Develop team working skills - Coordination - Problem solving - Decision making - Experimenting - Focus - Goal setting - Creativity

2.2.3 ENVIROMENTAL SCENARIO - The Environmental Facility	
Associated Badge:	
Pre-requisites:	Students should be familiar with the educational material of Module 1 and more specifically with the chapters, which are related to the basic movements of robots, loop commands, the use of sensors, detecting sounds and the use of the remote control. (Chapters 1.2, 1.3, 1.4, 1.6, 1.7 and 1.8). There are also general education pre-requisites: Students should be able to understand what recycling means, how people recycle and what is the expected impact. Students may make a study visit to the local recycling station.
Equipment:	For this scenario, you will need Lego Boost kits and compatible tablets, depending on the number of students in the class. You will need an extra for the teacher. Pupils will be divided into groups and instructions will be given to them. Preferably gender mixed groups.
Main Objective:	Students learn about the environment and the importance of sorting the waste that humans create. The students will build the robots Vernie and M.T.R.4 for inspiration and use them in different activities concerning the scenario environment.

Duration:	Estimated time for the scenario will be 540´ - Student´s study visit to the local environmental station, 120´ - Two groups building Vernie, 120´ - Simultaneously two groups building M.T.R.4, 180´ - Programming the robots, 120´ - Activities such as sorting waste products, 60´ - Finalizing the scenario 60´
General Learning Outcomes:	Be introduced to the recycling concept and its importance to the environment.
Robotics Learning Outcomes:	- Construct the robot - Get familiar with the sensors of the robot and how to use them - Get familiar with the loops coding concept - Get familiar with the if - else coding concepts
Knowledge:	- Learn simple movement commands - Learn to use the if-else coding method
Relevant Subject:	Biology, Social Sciences
Soft Skills:	- Develop imagination and creativity through the construction of the robot - Develop team working skills - Coordination - Problem solving - Decision making - Experimenting - Focus - Goal setting - Creativity

2.2.4 CULTURE SCENARIO - Form Your Own Robot Guitar Band!	
Associated Badge:	
Pre-requisites:	Students should be familiar with the educational material of Module 1 and more specifically with the chapters, which are related to the use of sensors and detecting sounds. (Chapters 1.4 and 1.7) Students should have basic knowledge of note learning. What does the C major scale look like? Students should also know about the regional folk music in their area and traditions connected to the music.
Equipment:	For this scenario, you will need Lego Boost kits and compatible tablets, depending on the number of students in the class plus an extra for the teacher. Pupils will be divided into groups and instructions will be given to them. Preferably, gender mixed groups.
Main Objective:	We want our students to make a simple melody by building the robot Guitar. We intend to find out what the possibilities of the Robot Guitar are. Can the students create and play a simple tune with the help of the Robot Guitar? Can we add rhythm instruments to support the melody loop? Can we find chords that fit the melody loop? Is it possible, with the help of the guitar, to arouse interest in the origin of music and how people created simple instruments that then evolved into what we today recognize as modern musical instruments? Can the

	Robot Guitar stimulate students' curiosity for increased knowledge of today's synthetic music?
Duration:	Estimated Time: 480 minutes - Building the Robot Guitar, 180 minutes - Programming the Robot Guitar, 120 minutes - Music history, Folk music 180 minutes
General Learning Outcomes:	- Learn about the history of musical instruments. - See the connection between The Robot Guitar and modern synthetic music - Learn about folk music in different countries
Robotics Learning Outcomes:	- Construct the robot - Get familiar with the sensors of the robot and how to use them - Get familiar with the loops coding concept
Knowledge:	- Learn to use the if-else coding concept - Learn to use the loop coding concept - Learn about folk music in different countries
Relevant Subject:	Music, Music History
Soft Skills:	- Develop imagination and creativity through the construction of the robot - Develop team working skills - Coordination - Problem solving - Decision making - Experimenting - Focus - Goal setting - Creativity