



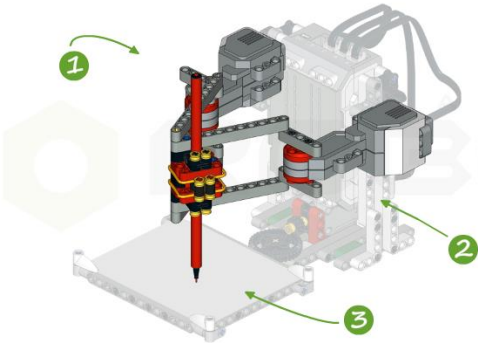

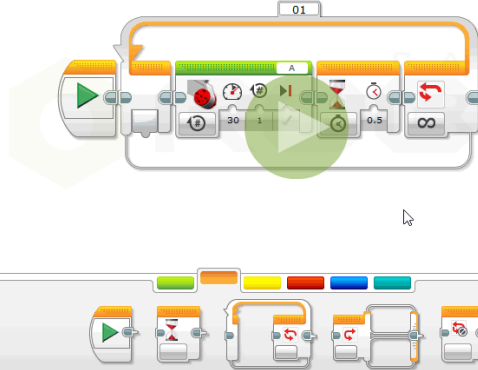

Erasmus+ KA2 Strategic partnerships for school education project  
“How to Raise an Inventor. Technology and engineering learning material for schools”

Project no.: 2017-1-LT01-KA201-035284

**MODULE DESCRIPTION AND  
RECOMMENDATIONS FOR TEACHERS**

Name of the module	The Art of Making								
Creators	Fundacja Edukacyjne Centrum Doskonalenia (Poland)								
Main topics	Building and programming robots using LEGO Education Mindstorms EV3 robotics kits								
Available in these languages	English, Dutch, Polish, Lithuanian, Latvian								
Recommended age group	9 - 13								
Length of the course	The course is intended for twelve 45-minute lessons when working with students aged 9-13 with a bit of prior LEGO Mindstorms experience. If kids don't have previous experience, the lessons may require more time to finish. You can also shorten the time needed for each lesson with good classroom organization.								
Duration of each lesson or project	Spirograf - 2 x 45 min (programs 2 and 3 can be omitted, may require longer time when working with inexperienced students); Line follower - 2 x 45 min (program 2 can be omitted); Plotter - 3 x 45 min (the last lesson can be omitted), Drawer - 2 x 45 min (may require longer time when working with inexperienced students); Robotic arm - 3 x 45 min (may require more time when working with inexperienced students)								
Required hardware Tips for hardware	LEGO Education Mindstorms EV3 sets (#45544) - one for every pair of students; computers. LEGO Education sets can be purchased via local LEGO Education distributors.								
Required software	LEGO MINDSTORMS Education EV3 Lab software, available for Windows & Mac*. The software can be downloaded here: <a href="https://education.lego.com/en-us/downloads/mindstorms-ev3/software">https://education.lego.com/en-us/downloads/mindstorms-ev3/software</a> *EV3 Programming app available for iOS, Android, Chromebook & Windows 10 touch devices is not compatible with the materials.								
Required skill level (pupils)	Basic motor skills								
Required skill level (teachers)	Familiarity with computers and other electronic devices.								
Skills developed in the module	<table> <tr> <td>Creativity</td> <td>***</td> </tr> <tr> <td>Technological and engineering</td> <td>*****</td> </tr> <tr> <td>Critical thinking and problem solving</td> <td>****</td> </tr> <tr> <td>Communication</td> <td>*****</td> </tr> </table>	Creativity	***	Technological and engineering	*****	Critical thinking and problem solving	****	Communication	*****
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Communication	*****								
What pupils will learn?	Students will learn how to design, build and program LEGO robots to make them perform specific tasks, focused mainly around art. During the lessons students will familiarize themselves with various STEM related topics, such as: sensors, gear transmission, belt transmission, worm drive, differential drive, counterweight, center of gravity, sequence, algorithm, loop, conditional statement, variable, etc.								
The structure of the course	The course consists of 4 guided projects (Spirograph, Line follower, Drawer, Plotter) with detailed, step-by-step building and programming instructions and 1 open project (Robotic arm) where students design, build and program a robot themselves and test its operation in a classroom competition. Each project is planned for 2 to 3 lessons.								



<p>What is different about this teaching material comparing to others for the same topic?</p>	<p>Robot models are fairly simple and instructions are easy to follow, which allows teachers to use the materials during 45-minute lessons. As an added bonus, most projects combine engineering skills with art, giving the opportunity to further develop students' creative skills.</p>
<p>What teaching materials do pupils get?</p>	<p>Graphics, animations and texts on how to build and/or program a robot available online via e-learning platform.</p>
<p>What teaching materials do teachers get?</p>	<p>Comprehensive lesson materials in form of graphics, animations and texts that can be used in every part of the lesson: introduction, robot building, exploring the construction, robot testing and programming. All the materials are available online via e-learning platform and can be presented to the students using a projector, or shared with them using a lesson sharing tool within the platform. Additional materials include printable teacher guides for each project and EV3 program files.</p>
<p>How to reach the material?</p>	<p>Create an account at: <a href="https://www.robocamp.eu/en/the-art-of-making/">https://www.robocamp.eu/en/the-art-of-making/</a> and then login: <a href="https://elearning.robocamp.eu/">https://elearning.robocamp.eu/</a></p>
<p>Examples of the material</p>	<div style="border: 1px solid #ccc; padding: 10px;"> <div style="background-color: #76b82a; color: white; padding: 5px; text-align: center; font-weight: bold;">Spirograph - lesson 2: Explore</div> <div style="display: flex; justify-content: space-between; align-items: center; margin-top: 10px;"> <div style="text-align: center;">  </div> <div style="border: 1px solid #ccc; padding: 5px; width: 200px;"> <ol style="list-style-type: none"> <li>1. The pen gripper is placed on the conjunction of two arms propelled by two large motors.</li> <li>2. The motors are attached to a stable and heavy stand.</li> <li>3. Being able to control the pen with two arms allows you to create multiple interesting patterns.</li> </ol> </div> </div> <div style="text-align: right; margin-top: 10px;">  </div> <hr style="border-top: 1px dashed #000; margin: 10px 0;"/> <div style="background-color: #76b82a; color: white; padding: 5px; text-align: center; font-weight: bold;">Spirograph - lesson 2: Code</div> <div style="display: flex; justify-content: space-between; align-items: center; margin-top: 10px;"> <div style="text-align: center;">  </div> <div style="border: 1px solid #ccc; padding: 5px; width: 200px;"> <p>In this step, you will activate the rotating base with the sheet of paper.</p> <p>To do this, go to the Action tab and select the "Medium Motor" block. Place it under the script created up until now.</p> <p>Next, drag the sequence wire of the Start block to the newly added block. From now on, both code chunks will be executed simultaneously.</p> </div> </div> <div style="text-align: right; margin-top: 10px;">  </div> </div>



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Recommended projects	Spirograph - program 1; Line follower - program 1, Plotter - program 1 (with elder and/or experienced students, try to include a second program for the plotter too (lesson 3) - it's fun!)
Organization of the course	It's best to do each project in one run and not divide it between lessons as not to block the equipment.
For teachers with no prior experience in the topic	Before you start, sign up for a RoboCAMP webinar <a href="#">here</a> or take a look at 'Getting started with LEGO robotics' guide.
Additional material for teachers	For tips on running a robotics class watch our tutorials <a href="#">here</a> and <a href="#">here</a> , or read an <a href="#">article</a> on 5 tips on how to launch a robotics course at your school.
Suggested next topics for pupils to get into after this course	We suggest doing some more LEGO Mindstorms robotics, both guided and open projects. Then you can move to text-based programming, such as ROBOTC or take part in robotics competitions (First LEGO League, World Robot Olympiad)
Support	If you have any problems or questions you can live chat with us at <a href="http://www.robocamp.eu">www.robocamp.eu</a> or email us at <a href="mailto:support@robocamp.eu">support@robocamp.eu</a>

