

EARLY Teaching Scenario

Topic: Weightlifting with Marty

Aim(s): Students learn how to:

- Assemble robot Marty
- Use Scratch for basic programming
- Programme simple movements of Marty
- Consolidate weight measurement

Skills pupils develop during the scenario: connect to curriculum →

The National Curriculum for Polish primary schools (IT and physics) states that by the end of class 8, students should be able to:

- Design, create and test programs in the process of solving problems
- Use in these programs (i.a.): input / output instructions, arithmetic and logical expressions, conditional instructions, functions
- Design, create and test software controlling a robot or other object on the screen or in reality
- Extract phenomena from the context, name them, and indicate factors relevant and irrelevant to their occurrence
- Carry out selected observations, measurements and experiments using their descriptions
- Use physical concepts and quantities to describe phenomena and indicate their examples in the surrounding reality



The course components that are trained in this learning scenario are as follows:

- Creating a robot from provided components
- Programming the robot with a blocks-based graphical programming language
- Problem solving
- Collaboration

Target group: pupils in primary school (grades 5 - 6)

Age of students: 11 - 12 years old

Number of pupils: maximum of 10 in a subgroup

Duration (estimated time/number of lessons): 3 sessions x 45 - 90 minutes each

Prerequisites (necessary materials and online resources):

- Robot Marty (preferably more than 1 to engage the whole class)
- Computers or mobile devices with sufficient parameters to programme in Scratch
- Small objects for Marty to grab and lift
- Scales
- Online support materials available at <https://robotical.io/>

Introduction to the scenario (*incl. possible applications, alternatives and risks*)

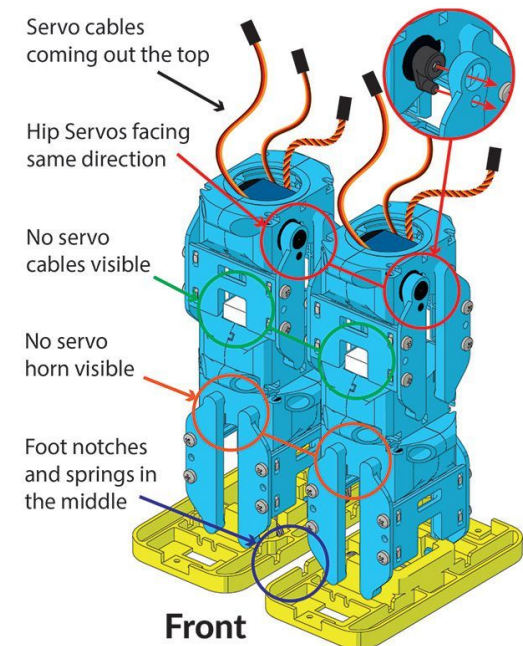
Marty is a fully programmable, WiFi-enabled walking robot. It's a great object for kids to play with but also a powerful tool to learn basic programming, electronics, and mechanical engineering through a fun and engaging process. Marty is customisable with 3D printed parts and its basic construction and functions can be upgraded with a Raspberry Pi computer and a camera. In this scenario the students will learn how to assemble Marty and programme it to execute a range of movements. In particular, they will make Marty lift small objects of different weight to find out his gripping arm's capability. Thus this problem-based learning scenario relates not only to their IT programme but also includes some elements of engineering and physics.

Before the program begins (preparatory work for teacher)

- Prepare a computer lab with enough work stations for the students; they can also use mobile devices
- Students can get started programming Marty using the block-based language Scratch (more advanced students can use Python). Ensure that all the devices have a stable Internet connection and can run Scratch.
- The number of robots available will impact the size of groups to be involved in the workshops. The components are numerous, so not more than 2 - 3 students should work on one robot's assembly. Most of the parts can be 3D printed to reduce the cost of building the robots - print the sufficient number of these components and purchase only the required electronic and mechanical devices.
- First go through the whole process of constructing and programming the robot yourself to be well prepared to assist your students in this process.

Main part of the scenario (3 lessons)

Each of the following lessons is a distinct unit of learning that can be delivered on its own. Ideally, all the students progress through all the steps but this depends on their level and the number of computers/mobile devices and robots available for the workshops. Perhaps the best idea is to run the first lesson devoted to assembling the robot with a small group of dedicated students constructing 1 - 3 robots and then the following lessons with the whole class.



Lesson one: Building Marty the robot

Working with Marty can be a great adventure. It starts very easily, even if you buy the kit for assembling or if you decide to print some parts on your own. There's a very [clear and helpful guide](#), how to assemble Marty.

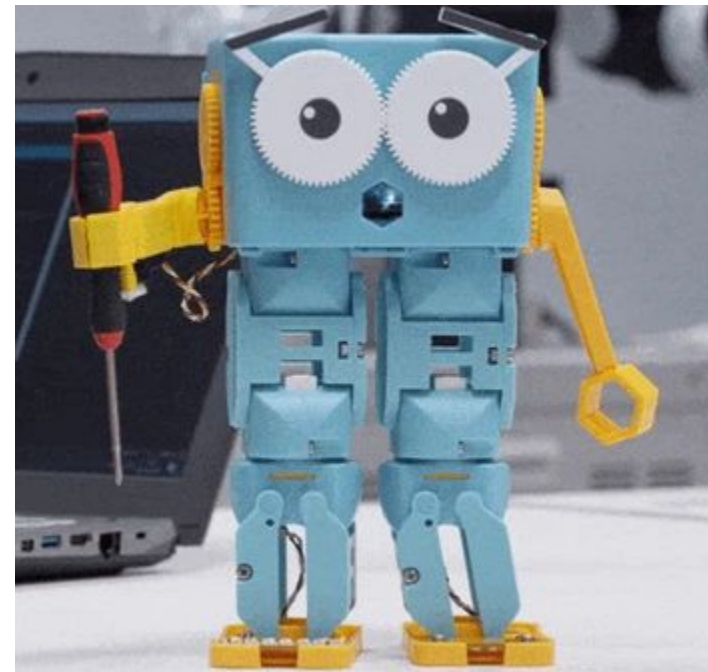
However, the next steps: connecting to WiFi, calibrating and connecting to Scratch platform, can be more challenging in some cases. Even if there is still a quite clear tutorial online, Marty does not always respond as he is supposed to.

For this reason we decided to record [this tutorial](#) and to show you the whole process with some difficulties to overcome.

Lesson two: Scratch programming

Scratch is the simplest way to program Marty and thus an ideal tool for beginners. It has a simple graphical interface and blocks you can combine to build up a program. Marty's website includes a number of [tutorials](#) that can help students learn its basics through coding the robot to perform various actions. In this lesson the students practise by clicking and dragging blocks to be able:

- to turn on Marty's motors and then return Marty to a normal standing position
- make him walk and then wiggle
- make a more challenging walks to avoid obstacles or coming close to the edge



Lesson three: How much weight can Marty lift

Marty has hands with grippers so it can be programmed to grab and lift an object. Although it's quite easy to estimate the size of such an object just looking at the item and the robot's arm, the weight it can lift is much more difficult to guess. This challenge provides a background for a problem-based learning scenario with the following steps:

- First students choose a number of objects of different weight which the robot can grab with its hand. The teacher should make a preselection, e.g. bringing various small manual tools like screwdrivers, wrenches of different size, etc.
- The next task is to create a Scratch script to make Marty grab one of these items and raise it above his head.
- The robot is given heavier and heavier loads and he comes to a halt. At this stage the students have to measure his capacity weighing the heaviest object lifted.
- Each group writes down their results and then compares with each other.
- At this stage the IT class (Scratch programming) merges with a physics class on weight measuring. This can be a way to revise material introduced previously or an idea on how to present a new topic in a funny and interactive way.

Learning outcomes

Students will be able to:

- Assemble a small robotic arm with provided components
- Use a block-based programming language to make the robot execute movements
- Collaborate with peers in on the workshop tasks

Sources

This scenario is based on the materials available at <https://robotical.io/>