



MARTY
THE ROBOT

Educator's Guide

Everything you need to get started

Contents page

| | |
|--|-----------|
| Introducing Marty the Robot..... | 3 |
| Getting to Know Marty..... | 4 |
| Marty in the Classroom..... | 6 |
| Fitting in with the Curriculum..... | 9 |
| The Marty Learning Process..... | 10 |
| Programming with Marty..... | 12 |
| Further Learning..... | 14 |
| Get in Touch..... | 14 |
| Educator's FAQ..... | 15 |

Introducing Marty the Robot

Meet Marty - our fully programmable and customisable robot. Designed by roboticists in Scotland, Marty helps you to teach STEAM (Science, Technology, Engineering, Art & Maths) subjects in a fun and interactive way. By promoting creativity and learning by doing, Marty acts as an entryway into computer science but is also adaptable enough to be used up to university level.

You don't need to be a roboticist or programming expert to use Marty in a classroom. The Marty Edu and Classroom packs both come with initial setup support with plenty of online tools and resources to help you get up and running in no time.

Pupils lead their own development as they progress through a Build-Play-Learn ideology. When used in kit-form, Marty offers a systematic and logical build process with simple guided tasks. For more advanced mechanical designs, you can 3D print new parts for Marty, either through our online library or by creating your own bespoke designs.

Marty can be programmed in languages including Scratch, Python and JavaScript. Using any of these programming environments, you are able to control whole movements or individual motors, read sensors, and make up your own tasks for Marty to follow. If you're looking for more advanced programming and robotics, you can upgrade Marty with a Raspberry Pi computer and run ROS, the Robot Operating System, as used frequently in academia and industry.

Marty helps your students develop STEAM skills such as,



By exposing young people to real world problems, Marty encourages them to think and act like budding engineers, scientists and designers.

Getting to know your marty

Real robots are packed with highly advanced technology, and Marty is no different. However, although the technology may be complex, that doesn't mean it has to be scary. Marty offers advanced computing and engineering that is approachable for people of all ages. With big eyes, moving eyebrows, and a funky way of walking, Marty is designed to add character, personality, and fun to the process of learning. Let's explain a bit about how Marty works,

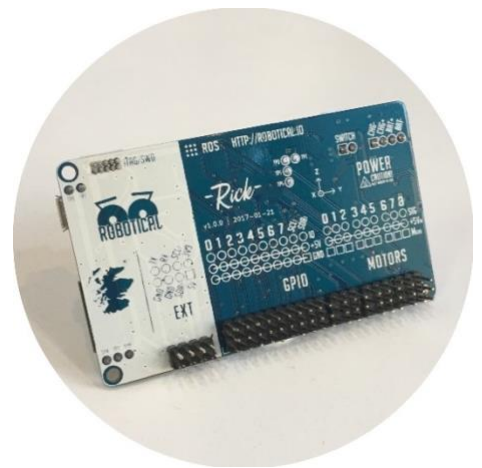
Control Board ("Brain")

The Control PCB (Printed Circuit Board) is where all the complex triggers and reactions happen once you program Marty. Think of the PCB as Marty's brain. It's the central system for all the things Marty does and feels.

On the control board there is a network of components helping Marty to move and sense. For example, the control board has an accelerometer to tell how Marty is standing and moving. It's like our own human balance systems, which tells us which way is up and can make us feel dizzy.

The control board also speaks to Marty's motors and sensors to find out what they are reading. Again, this is similar to our own nervous system, which receives signals from our senses. For example, when we bump into something, our system tells us how to react - in this case to say "ouch". You can use Marty's brain to send signals to the servo motors and read the sensors (like the tilt sensors, or the bump switches you can attach to the feet) to allow Marty to physically react when sensing something – like shaking hands if there is a force on the arm.

The more sensors you add, the more Marty will be able to interact with the world, all of which is possible due to the control board brain. The control board acts as the portal through which we communicate with Marty, and Marty can communicate with the world.



Servo Motors ("Muscles")

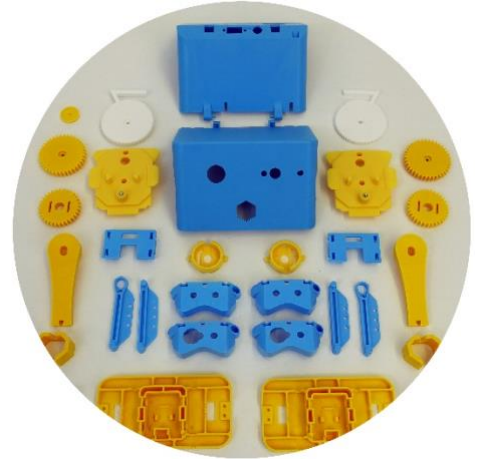
Marty has nine servo motors that allow movement – three in each leg, one for each arm, and one to move the eyebrows. The servos have position sensors in them, allowing them to move to specific positions – so if you program Marty to move motors through a series of poses, they know what to do.

One of the unique things about Marty is the walking mechanism, which uses fewer motors than a traditional biped. That makes Marty easier to use, and more energy efficient.



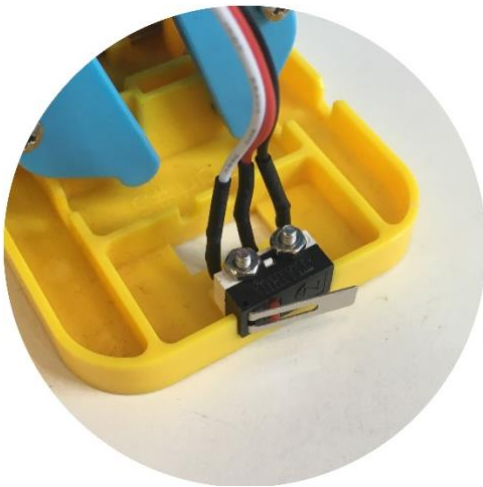
Plastic Components (“Body”)

Marty has 55 plastic parts that make up most of the body. These parts form the skeleton of Marty, as well as a protective shell around Marty’s vital components. The body parts fit together using stainless steel nuts and bolts, making it possible to assemble and disassemble Marty many times. As well as mechanics, linkages, and physics, the components lay a foundation for lessons surrounding material science and manufacturing processes.



Sensors

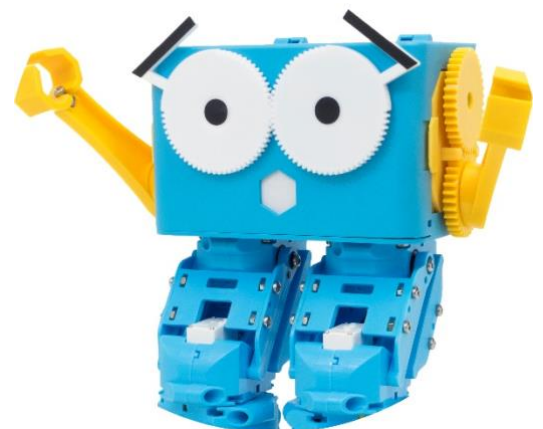
Any real robot needs to interact with the world around it. Industrial robots are used to just perform the same movement again and again, but these days we expect robots to be able to react to real life situations. Built in sensors for Marty include force sensing on all the joints, tilt and acceleration sensing, and the kit comes with two bump switches you can attach to the feet. They can be used to detect collisions or facing down to detect ledges and keep Marty from falling off things!



You can also add extra sensors, for example, distance sensors which you could use to help Marty solve a maze or react when somebody sits down in front of Marty. For more advanced users it’s possible to add a Raspberry Pi computer on Marty, and then give Marty a microphone, or a camera to detect faces and play football autonomously!

Gears & Independently Controlled Motors (“Personality”)

Another special trait of Marty is the unique personality and expressiveness. Rather than having a screen for a face, Marty has big eyes with moving eyebrows. Emotion by motion is possible because each of Marty’s limbs are controlled by their own separate motors. Marty’s personality helps young people engage with the activity and reduces barriers for those who may not be as comfortable when engaging with technology. Personality is the key to helping a wide range of individuals to be comfortable when engaging with technology and taking that first step to a potential future career. Through this Marty offers an approachable entry into STEAM engagement.



Marty in the classroom

Marty is an adaptable tool that can be used across primary, secondary and even tertiary education. By sparking the excitement of young people and harnessing their infectious enthusiasm, Marty can rapidly promote STEAM learning and engagement. In some schools, computer science is in danger of becoming a mundane functional experience. Marty brings back the excitement of learning about technology by offering a tangible interactive experience whilst promoting a learning through play ethos.



Primary School

The primary stage development with Marty introduces foundation concepts such as sequencing, storytelling and the relationship between instructions and operations. It supports the ability to:

- Identify patterns in everyday tasks
- Understand and structure information
- Understand, predict and problem solve block-based programming languages
- Understand and communicate using technical languages
- Develop a sequence of instructions to align to a design brief

- Relate programming concepts to everyday tasks and activities

Secondary School

The secondary stage development with Marty explores more advanced concepts such as analysis and problem-solving using text-based programming. It supports the ability to:

- Analyse algorithms for correctness and identify faults
- Understand the world through computational thinking
- Design, test and build computing solutions
- Introduce object-oriented programming concepts

- Understand data structures and process real world data from sensors

Marty: Student Ratio

Typically, we recommend no more than three to four students per Marty. However, there are opportunities for students to work on a one-to-one basis with Marty for personal projects, or larger collaborative groups for class projects.



Building your Marty

The recommended format for building your Marty is illustrated in the Marty build instructions. It is recommended that you assemble all the separate component parts and then assemble them together to finish the build, starting with the **Legs**, progressing to the **Arms** and then onto the **Head**. Once all these components are assembled, you can attach them together and add the electronics.

It is possible to build Marty in groups as the Arms, Legs and Head can all be constructed in parallel, with the final assembly and installation of the electronic components being completed as a group activity. We recommend the following groupings:

| Assembly Step | Build Steps | Individual | Group of 2 | | Group of 3 | | |
|----------------|-------------|------------|------------|-----------|------------|-----------|-----------|
| | | Student 1 | Student 1 | Student 2 | Student 1 | Student 2 | Student 3 |
| Leg 1 | 1-11 | X | X | | | X | |
| Leg 2 | 1-11 | X | | X | | | X |
| Arm 1 | 12-14 | X | X | | X | | |
| Arm 2 | 12-14 | X | | X | X | | |
| Head Base | 15-17 | X | | X | X | | |
| Head Face | 18-19 | X | X | | X | | |
| Final Assembly | 20,24,25 | X | X | X | X | X | X |
| Electronics | 21-23 | X | X | X | X | X | X |

Groups of 4+: Building in groups of 4+ is not recommended as it often leads to a lack of ownership which results in an increase of mistakes during the build. However, given adequate supervision and direction, larger groups can be successful and should be left to the individual educator's discretion.

Storing your Marty Set

Worried about how and where to store your Marty's? When you purchase Marty as part of a Marty Edu Pack or Marty Classroom Pack, you get plastic storage tubs that are specially designed to hold your Marty.

Each tub can hold 2 Marty's comfortably and also comes with a tray to put on top that can be used to hold spare components,



Health & Safety

We have put Marty through rigorous safety testing. Please read the following points to help you use Marty safely in the classroom environment,

- Marty is not a toy – adult supervision is required
- Marty contains small parts which may present a choking hazard
- Do not expose Marty to extreme heat or a naked flame
- Avoid excessive physical shock or vibration
- Do not immerse Marty or any of Marty's components in water and do not use in an environment where there is a possibility of Marty getting wet
- Never leave Marty charging unattended - Marty should not be charged for more than 24 hours
- Only use Marty with the supplied rechargeable battery
- Do not disassemble, deform, puncture, short circuit, modify in any way or heat the battery as improper use can result in fire
- Stop using and disconnect the battery immediately if the battery begins to bulge or becomes too hot
- Batteries must be charged with the supplied charger only – never use a modified or damaged charger
- The charging cable is not a toy
- Connect charging cables to a USB 5v 1.5 A DC supply

- If connecting to a transformer, only use with a transformer for toys – the transformer is not a toy
- Do not clean Marty with liquid

Fitting in with the curriculum

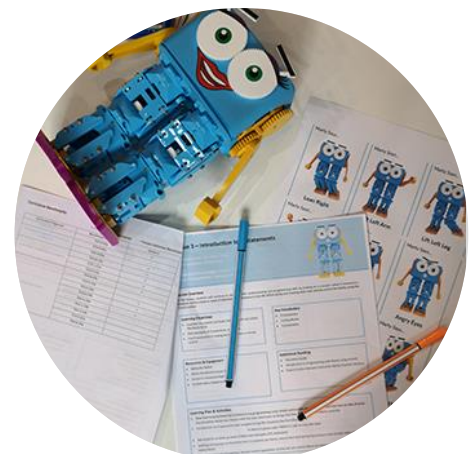
Marty acts as a valuable tool to engage young people in education, particularly for STEAM subjects, regardless of the regional curriculum that you use. Some core technology learning skills are listed below,

| Curriculum for Excellence (Scotland) Technologies Experiences & Outcomes | National Curriculum (England, Wales, N.I) The National Curriculum in England Framework |
|--|---|
| <ul style="list-style-type: none">• Knowledge and understanding of key concepts in technologies• Curiosity, exploration and problem-solving skills• Planning and organisational skills• Creativity and innovation• Skills in collaborating, leading and interacting with others• Critical thinking through exploration and discovery• Making connections between specialist skills developed within learning and skills for work | <ul style="list-style-type: none">• Understand and apply fundamental principles and concepts of computer science, including abstraction, logic, algorithms and data representation• Analyse problem in computational terms and have repeated practical experience of writing computer programs in order to solve such problems• Evaluate and apply information technology, including new or unfamiliar technologies, analytically to solve problems |

Marty has the capacity to complement a young person's learning by hitting each of these outcomes with an engaging and adaptable approach. We offer [lesson plans and resources](https://martytherobot.com/users/education/resources/)¹ that have been crafted to accommodate a wide-range of curriculums and include subject crossover content that expands the learning possibilities across disciplines.

All of our lesson plans detail the benchmarks and outcomes that are being addressed in both the Curriculum for Excellence for Scotland and the National Curriculum for England. If you are unsure how our materials map to your region's curriculum, [get in touch](https://robotical.io/support/)² and we would be happy to help out where we can!

We also include everything you need to carry out a lesson including teacher guides, presentation slides, sample solutions, student workbooks and worksheets.



[1] <https://martytherobot.com/users/education/resources/>

[2] <https://robotical.io/support/>

The marty learning process

Marty the Robot has been developed to aid learner progression. Beginners can program Marty to carry out simple sequences of instructions and react to simple inputs. Intermediate learners can start to use real text-based programming languages and implement complex algorithms on Marty. Finally, advanced learners can use real world robotics tools like ROS to explore subjects such as kinematics and signal processing.



Learning with Marty

To get started with Marty, we recommend that you and your pupils just get stuck in and start to experiment with what Marty can do! Recipe-based learning is a thing of the past and instead learning through playing has presented itself as a style that can empower each pupil to direct their own learning journey. If you are unsure where to start, we have lots of [flexible lesson plans](#)¹ to get you started!

The value of learning through play is evidenced by the freedom the students have to create things that are meaningful to them. These situations allow students to approach the task with a sense of interest and care that can be missed in other learning styles. The result being that the student gains a deeper connection with the task and field of study, encouraging them to pursue their interests further in the subject.

Once you have started to get to grips with Marty, you might want to ask the following set of questions to help you use Marty in the classroom,

- What problems did you encounter and how did you solve them?
- Will your students be able to overcome these problems?
- How much of an introduction will Marty need to your students?
- What areas of using Marty will need the most encouragement?
- How much time will you allocate for each lesson?

[1] <https://martytherobot.com/users/education/resources/lesson-packs/>

Learning Progression

| Hardware Skills | Software Skills | Software Progression | Age |
|--|--|---|-------------|
| <ul style="list-style-type: none"> Explore mechanisms | <ul style="list-style-type: none"> Use logical reasoning to predict program behaviours Explore and comment on logical processes using computational thinking | <ul style="list-style-type: none"> Marty the Robot app controller Scratch | 4-8 years |
| <ul style="list-style-type: none"> Recognise materials Discuss and create engineering design solutions Explore electronic systems | <ul style="list-style-type: none"> Explain programming language concepts using technical terms Create computing solutions in response to a design brief Identify errors and debug | | 8-11 years |
| <ul style="list-style-type: none"> Design and construct assemblies Explore and explain engineering design solutions Product technology analysis Understand and suggest sustainability improvements | <ul style="list-style-type: none"> Select appropriate tools to fulfil a selected design solution Understand the fundamentals of hardware and software communication | <ul style="list-style-type: none"> Python JavaScript | 11-14 years |
| <ul style="list-style-type: none"> Discuss engineering principles and their impact Analyse material performance Explore sensors Understand and create electronic circuits | <ul style="list-style-type: none"> Compare algorithms for correctness and efficiency Select the appropriate tool to fulfil a high-level computing solution with reasoning justified | <ul style="list-style-type: none"> C++ ROS (Robotic Operating System) V-Rep Simulation | 14-18 years |
| <ul style="list-style-type: none"> Explore mechatronics Understand robotic principles and standards Kinematics | <ul style="list-style-type: none"> Use ROS and other advanced tools Advanced algorithms and data processing – image processing, speech, filtering, etc. | | 18+ |

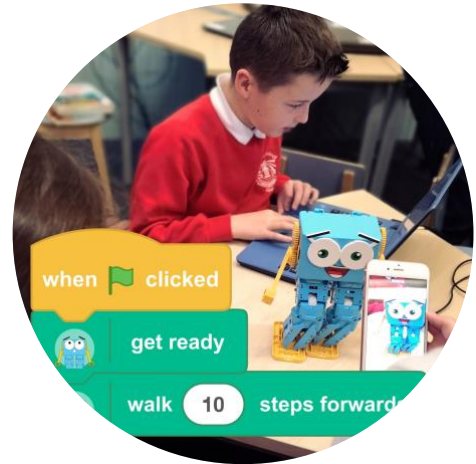
Programming with Marty

Get Started with Scratch

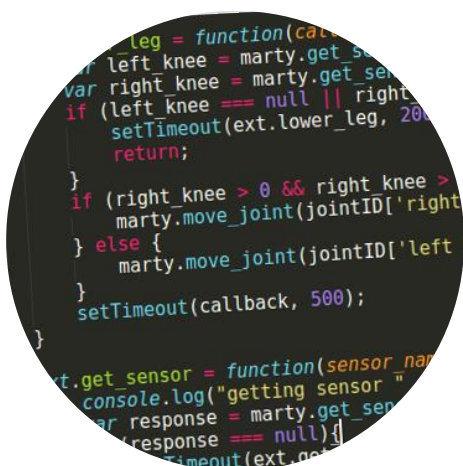
Scratch is the best place to start if you're new to programming, it focuses on blocks of code that you drag, drop and click together to build a program. Combining these blocks, students can build basic to complex programs to bring their Marty to life. Scratch has been designed to help people take those first steps into programming by teaching basic sequencing and thinking of programming as a list of basic instructions.

We have developed a Scratch extension in the form of a number of Scratch blocks that can be used specifically for Marty. You can access this in two different ways,

1. If you have access to a Robotical Command Hub, you can simply connect to the WiFi hotspot (*RoboticalHubPlus-2G*) and go to `192.168.8.1` in a web browser. This will bring up a menu allowing you to select Scratch
2. With access to the internet, go to martytherobot.com/users/using-marty/program/ and select *Scratch*. You can then follow our guides to familiarise yourself with the program



Developing with Python



Python makes for a great first step away from block-based programming into textual programming. You can program Marty in Python using the library that we have developed called *MartyPy*. Libraries are collections of code that we've written to get the complicated things out of the way, making it easier to use and work with.

For example, *MartyPy* contains definitions for the *walk* function, which can be used to make Marty walk. Using our *MartyPy* library, you can gently introduce students to programming with Python without having to start with the more complicated stuff, building up their knowledge of both programming and robotics.

For more information on how to get started with Python and MartyPy, go to martytherobot.com/users/using-marty/program/ and select *Python* to view our tutorial and documentation.

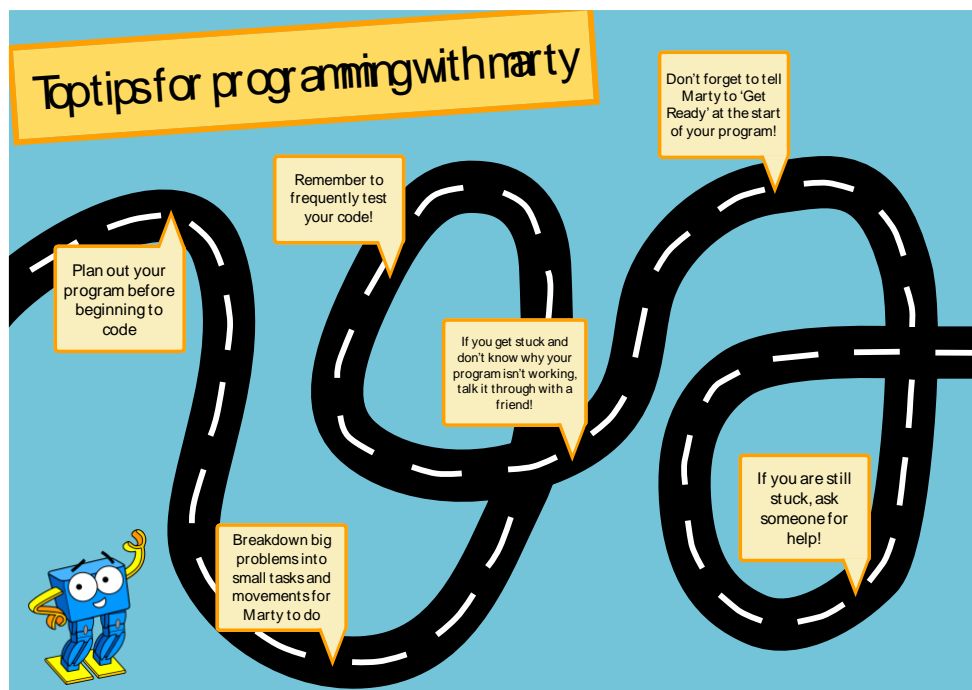
Advanced Progression & Further Learning

Marty comes with built-in sensors and bump switches but if you want Marty to be able to respond and interact even more with the environment then you can add additional sensors. We have lots of [articles and posts](#)¹ that we add to frequently covering how you could use and program different sensors with Marty.

Although Marty is injection-moulded, it is possible to 3D print all of the plastic body parts. We have made all of this [available to download](#)² along with some other accessories that could be printed for your Marty. Using the original designs for Marty, you don't have to start from scratch when customising body parts.



The Raspberry Pi is a small in-expensive computer that can be paired with Marty to allow for the addition of further sensors and functionality. Robotical have a pre-built image for a Raspberry Pi that is available with ROS (Robotic Operating System – a set of advanced robotic tools widely used within academia and industry) and other programming tools that can be used with Marty. With ROS, you can program Marty to become functionally autonomous and perform tasks without user intervention. All of the resources and support you need to get started with adding a Raspberry Pi and using ROS can be found with our [learn articles](#) ³.



[1] <https://martytherobot.com/users/using-marty/activities/>

[2] <https://robotical.io/downloads/1.0/>

[3] <https://robotical.io/learn/>

further Learning

Growing Outside of the Classroom

If you or your pupils would like to learn more about programming, we recommend the following sites to find specialist tutorials. Each of these sites offers open-source learning for whoever requires them – no matter the age or development stage.

Scratch

<https://scratch.mit.edu/>

Python

<https://wiki.python.org/moin/>

<https://trinket.io/>

<https://www.codecademy.com/>

ROS

<http://wiki.ros.org/>

JavaScript

<http://javascript.info/>

<https://www.codecademy.com/>

Raspberry Pi

<https://www.raspberrypi.org/>

C++

<http://www.cplusplus.com/>

Connecting Education to Community

As an open-source tech tool, Marty has gathered a [community following](#). This community consists of makers that are actively contributing additional content whenever they can. The result is a wide network of challenges and activities that can be shaped for the classroom.

Get in touch

Education

Tanya Howden
tanya@robotical.io

Distribution & Partnerships

Myles Bax
myles@robotical.io

School Sales

Ben Henderson-Palmer
ben@robotical.io

Support

<https://robotical.io/support>

- [1] <https://martytherobot.com/users/using-marty/activities/>
- [2] <https://robotical.io/downloads/1.0/>
- [3] <https://robotical.io/learn/>

Marty Educator FAQ

Which of my classes can I use Marty with?

Marty can be used from early primary school up to university level. Because you can program Marty with so many different programming languages, you can start off with something simple like Scratch but at the other end of the spectrum, you could be using systems like ROS that roboticists around the world use!

Where can I find lesson plans and materials to help me get started with Marty in the classroom?

We have loads of resources to help make your life that bit easier with introducing Marty to the classroom. From lesson packs with plans, guides and student workbooks to classroom printouts to spread the word of STEM in your department - we got you covered! If you find that there is a specific topic or theme missing from our collection, let us know and we'll see what we can do!

What devices can I use with Marty at school?

When using Marty at school, we recommend connecting to our Command Hubs so that you don't need to mess around with getting Marty onto the school network. Devices such as desktops, laptops and tablets/iPads are possible.

What programming languages can Marty be used with?

There are lots of different approaches you can take to programming with Marty. Starting off simple we have Scratch, a block-based editor that is perfect for introducing students to the wonderful world of programming. Moving on from that, students can start to use Python - a very popular language that is great for introducing text based programming languages. JavaScript can also be used on a webpage to communicate with Marty over a websocket. On the advanced side of our programming scale, you can use C and ROS to explore and code with Marty.

How can I buy a Marty for my school?

Marty the Robot can be bought directly from us through <https://robotical.io/shop> or you can buy our little robot friend through XMA.

What teacher support is available?

If you have any problems or queries about anything Marty related then we are always available to help out the best that we can. Simply drop us a message from our website or straight to hello@robotical.io and someone from the team will be with you ASAP. If you're looking for additional support with using Marty in the classroom then we are happy to talk to you about organising classroom workshops or teacher training tailored to your school.

How many students per Marty should I have?

We recommend having around 2-4 students per Marty although this will depend on the activity that you are doing with your class. For example, with an activity such as making a dance video where Marty dances along to a song, each student can be given a different role such as choreographers, directors and producers.