micro:bit Project

### Educator Delivery Pack 2

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| Introduction |

ENGINmakers started in 2022 as a project to support the Civic Mission of Cardiff University, and initially received funding to engage two students to create two ‘activities’ that support teachers and primary / secondary pupils in their learning of coding concepts, and the relevance of coding to applications such as those found in Engineering.

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| New Curriculum for Wales |

This resource pack has been specially designed to support the delivery of the Science and Technology AOLE. This means through the delivery of the materials contained within this pack, learners will:

* Increase their breadth and depth of knowledge and their effectiveness as a learner
* Deepen their understanding of the ideas and disciplines within this area of learning
* Refine and develop their sophistication in the use and application of skills
* Make connections and transferring their learning into new contexts

To fulfil these principles of progression, this pack will focus upon the following description of learning:

* Computation is the foundation for our digital world

To fulfil this description of learning this pack will focus on the following elements of progression step 3:

* I can use conditional statements to add control and decision making to algorithms
* I can identify repeating patterns and use loops to make my algorithms more concise
* I can use sensors and actuators in systems that gather and process data about the systems’ environment

To cover each of these elements, this resource pack contains a set of 3 lessons each of which have been designed to be delivered within a 50-minute school lesson. Each lesson in this pack comes with a lesson plan, presentation, and worksheets where necessary, all of which can be modified and adapted as necessary to support the needs of learners in your school.

Please note this resource pack does build upon the content, which was provided in the resource pack 1, which was released as part of this project. Although there is no formal requirement for that resource pack to be used before the lessons in this pack are delivered it would be advantageous to learners to at least explore some of the content the pack contains.

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| Disclaimer |

The University is not responsible in any way for examination results or the impact this delivery pack may have on learner performance. This delivery pack has been designed to provide learners with additional and complementary knowledge to support the delivery of the new curriculum in Wales. All materials within this resource pack may be edited and reused by educators for non-commercial purposes in the schools they represent.

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| Equipment |

To fulfil each of the lessons which are contained within this resource pack 2x BBC micro:bit V1s and 1x Robo:Bit M1 buggy are both required per student group. Please note, if a V2 micro:bit is available then it should be used as it will enable learners to make use of the additional features it contains such as the built-in speaker.

The MakeCode can easily be adapted for use with a robot other than the Robo:Bit M1 – please contact [gallichand@cardiff.ac.uk](mailto:gallichand@cardiff.ac.uk) if you are interested in having the code modified for your particular robot.

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| Lesson 1 |

**Synopsis**

This lesson provides learners with a quick introduction as to what the Robo:Bit is and requires learners to create a piece of code which can be used to help the Robo:Bit navigate through an obstacle course.

Big Question

How can we use the BBC micro:bit to drive a Robo:Bit through an obstacle course?

* Learning Stop 1 – Identify what the Robo:Bit is
* Learning Stop 2 – Produce a piece of code which can control the Robo:Bit
* Learning Stop 3 – Create an obstacle course for the Robo:Bit to navigate through

Lesson Plan

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| **Estimated Timings** | **Learning Stop** | **Suggested Delivery Outline** | **Resources** |
| 5 mins | Learning Stop 1 -  Identify what the Robo:Bit is | Once the register has been taken  introduce learners to the big question, which is on slide 2 and inform learners, they are firstly going to explore the big question by looking at learning stop 1.  To do this, display slide 3 in slideshow mode and reveal the picture piece-by-piece. As each piece is revealed use some of the following questions to get learners to analyse the picture in greater detail:   * What do you notice in the picture? * What does that make you think? * What do you think will be in the rest of the picture? * What do you think it does?   Once all the pieces have been revealed inform learners the picture is of a Robo:Bit which is a robot which can be controlled through the use of a micro:bit. The robot contains controlling motors and an accelerometer which can be used to aid navigation and collision detection. | Slides   * 1-3 |
| 25 mins | Learning Stop 2 – Produce a piece of code which can control the Robo:Bit | Display slide 4 and explain to learners to achieve learning stop 2 they are now going to be split into groups, [determine group size based on the number of micro:bits and Robo:Bits available] one half of the group will be the Robo:Bit ‘brain’ and the other half will be the Robo:Bit ‘controller’.  Display slide 5 and inform the learners who are in the brain group they need to download the code from the website address shown on the board onto their BBC micro:bit.  Inform the learners who are in the controller group they need to write the code for how the Robo:Bit will work, the slide contains an example of how they might get started. Inform learners to succeed with this task they need to:   * Workout what valueto send to the “Rotate” command to make the Robo:Bit rotate 90 degrees * Choose different button presses on the micro:bit ‘controller’ to drive forwards and to rotate left and right by 90 degrees   Once the brain group have downloaded the code they need onto their micro:bit they should work with the controller group to help them finish writing the code. If learners struggle to write the required code, display slide 6 on the board to help them.  Once learners are certain their code works allow them to try it out and see if their Robo:Bit works. | Hardware   * BBC micro:bit * Battery charger * USB cable * Robo:Bit   Slides   * 5-6   Code   * [Brain Code](http://bit.ly/microbitBrain) |
| 15 mins | **Learning Stop 3 – Create an obstacle course for the Robo:Bit to navigate through** | Display slide 7 and inform learners to achieve this learning stop they are now going to have some free time in which they need to create an obstacle course and see if they can get the Robo:Bit to navigate around it without any collisions taking place. Learners are to design the obstacle course using any objects which you feel are appropriate for them to use e.g. books, pens, rulers etc.  During this time regulate learning and encourage learners to refine and extend their code where necessary e.g. they could create a button press or ‘on shake’ to activate a series of commands. | Hardware   * BBC micro:bit * Battery charger * USB cable * Robo:Bit   Slide   * 7 |
| 5 mins | **Big Question –**  **How can we use the BBC micro:bit to drive a Robo:Bit through an obstacle course?** | Display slide 8 and select different groups to showcase to the rest of the class how their Robo:Bit navigates the obstacle course they have designed.  Follow up with a final class discussion as to what worked well, what was difficult? And how learners feel their code could be improved in relation to the big question. | Hardware   * BBC micro:bit * Battery charger * USB cable * Robo:Bit   Slide  8 |

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| Lesson 2 |

**Synopsis**

In this lesson learners are required to create an analog controller which makes use of the pitch and roll sensors the BBC micro:bit contains in order to control the Robo:Bit.

Big Question

How can we use sensors to gain greater control of the Robo:Bit?

* Learning Stop 1 – Identify what a sensor is
* Learning Stop 2 – Analyse how the BBC micro:bit pitch and roll sensors work
* Learning Stop 3 – Use the pitch and roll sensors of the BBC micro:bit to create an analog controller for the Robo:Bit

Lesson Plan

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| **Estimated Timings** | **Learning Stop** | **Suggested Delivery Outline** | **Resources** |
| 10 mins | Learning Stop 1 – Identify what a sensor is | Once the register has been taken, display slide 2 and pose the big question to the class. Inform learners to answer this question they are firstly going to look at learning stop 1 and consider what a sensor is. Play the video which slide 3 contains.  Once the video has finished playing have a class discussion about how the robots in Amazon’s factory work, link the conversation back to the work which was carried out in the previous lesson and consider why sensors are so important in terms of ensuring the robots work correctly and efficiently.  Conclude the discussion by ensuring learners are clear a sensor is a device which detects or measures a physical property and responds to it where necessary. | Slides   * 1-3   Links   * [Amazon](https://www.youtube.com/watch?v=TUx-ljgB-5Q) Factory Robots |
| 5 mins | Learning Stop 2 – Analyse how the BBC micro:bit pitch and roll sensors work | Display slide 4 and inform learners the BBC micro:bit’s accelerometer uses sensors to measure angles of tilt in two directions, one is known as pitch and the other is known as roll. Inform learners they are now going to undertake two quick activities to learn the difference between them. Firstly, ask learners to stand up, put their arms out and pretend they are flying from side-to-side. Inform learners this is known as a roll and reveal the animation on slide 5 to help them visualise the action they just performed.  Next ask learners to sit on the floor and to rock back and fore with their feet and arms up in the air. Inform learners this set of action is known as pitch and reveal the animation on slide 6 to help them visualise the action they have again just performed. | Slides   * 5-6 |
| 30 mins | Learning Stop 3 – Use the pitch and roll sensors of the BBC micro:bit to create an analog controller for the Robo:Bit | Display slide 7 and inform learners it is now time to see this theory in practice and as such they are going to use the pitch and roll sensors to drive the Robo:Bit at different speeds.  To do this, arrange pupils into the same groups they were in during the previous lesson. Inform learners the brain code they previously used is to stay the same for this lesson but this time as a group they need to develop the code required for the controller. Display slide 8 to help them get started.  As learners start to implement the required code regulate learning and if learners struggle to implement the code display slide 9 to help them. Please note not all of the code on slide 9 is needed, get learners to try and identify which pieces of the code will help them and what can be ignored. | Hardware   * BBC micro:bit * Battery charger * USB cable * Robo:Bit   Code   * [Brain Code](http://bit.ly/microbitBrain)   Slides   * 8-9 |
| 5 mins | Big Question - How can we use sensors to gain greater control of the Robo:Bit? | To conclude the lesson display slide 10 and firstly discuss learning stop 3. Ask learners to firstly identify how the controller in this lesson was different from the previous lesson. Inform learners the controller in this lesson was an analog controller whereas in the previous lesson the controller was digital and as such it had been pre-programmed to perform a specific task.  Then conclude the lesson by getting learners to discuss the big question in relation to the advantages and disadvantages of using sensors to control robots, link the discussion back to the video shown at the start of the lesson. | Slide   * 10 |

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| Lesson 3 |

**Synopsis**

This lesson require learners to build upon the knowledge gained in the previous two lessons in this pack and consider how they can refine their code to improve the performance of the Robo:Bit.

Big Question

How can we further improve the performance of the Robo:Bit?

* Learning Stop 1 – Identify ways in which the tasks carried out in previous lessons could have been improved
* Learning Stop 2 – Develop a plan of how the code used in previous lessons can be further refined and developed
* Learning Stop 3 – Produce a piece of code which follows an algorithm

Lesson Plan

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| **Estimated Timings** | **Learning Stop** | **Suggested Delivery Outline** | **Resources** |
| 5 mins | Learning Stop 1 – Identify ways in which the tasks carried out in previous lessons could have been improved | Whilst the register is being taken display slide 2 and get learners to discuss with the person sat next to them what they think all three images have in common with each other.  Once the register has been taken have a class discussion as to what learners think the answer is. Inform learners the answer is all three technologies (artificial limbs, self-driving cars, and drones) all require sensors to make them work.  Next display slide three and reveal the big question to the class and inform the class that to answer this question we are firstly going to look at learning stop 1 by having a class discussion.  As a class discuss the tasks which were carried out in the previous two lessons and ask learners to suggest ways in which the tasks could have been improved e.g. what other tasks could we have got the Robo:Bit to perform?  At the end of the discussion display slide four and see if any of the ideas discussed match the ideas the slide contains. | Slides   * 1-4 |
| 10 mins | Learning Stop 2 – Develop a plan of how the code used in previous lessons can be further refined and developed | Display slide five on the board and inform learners they must now decide as a group which of the ideas they would like to try and implement in this lesson by refining the code they have previously put together.  Once each group has decided what they would like to do they need to use a planning sheet to develop an algorithm for how their idea is going to work. Learners should be free to produce their algorithm as either a flowchart or pseudocode. The algorithm needs to just focus on the additional piece of code they intend to implement. | Resource  Worksheet 1  Slide   * 5 |
| 30 mins | Learning Stop 3 – Produce a piece of code which follows an algorithm | Display slide 6 and inform the class that as soon as they have completed their planning sheet, they are to work on implementing their algorithm by refining and further developing the code they have previously created.  As learners work on their code, regulate learning, and use further questioning techniques to further assess their attainment of the work at hand. | Hardware   * BBC micro:bit * Battery charger * USB cable * Robo:Bit   Slide   * 6 |
| 5 mins | Big Question - How can we further improve the performance of the Robo:Bit? | To conclude the lesson display slide 7 on the board and get learners to undertake a walking carousel. This means learners should display their work and be able to articulate and demonstrate to each other as they walk around the room how they have further improved the performance of the Robo:Bit. | Slide   * 7 |