

STRAND		Knowledge and understanding				Processes and production skills																		
		Digital Systems		Representation of data		Collecting, managing and analysing data				Creating Digital Solutions by:														
										Investigating and defining		Generating and designing		Producing and implementing		Evaluating		Collaborating and managing						
Content Description		Investigate the role of hardware and software in managing, controlling and securing the movement of and access to data in networked digital systems (ACTDIK034)		Analyse simple compression of data and how content data are separated from presentation (ACTDIK035)		Develop techniques for acquiring, storing and validating quantitative and qualitative data from a range of sources, considering privacy and security requirements (ACTDIP036)		Analyse and visualise data to create information and address complex problems, and model processes, entities and their relationships using structured data (ACTDIP037)		Define and decompose real-world problems precisely, taking into account functional and non-functional requirements and including interviewing stakeholders to identify needs (ACTDIP038)		Design the user experience of a digital system by evaluating alternative designs against criteria including functionality, accessibility, usability, and aesthetics (ACTDIP039)		Design algorithms represented diagrammatically and in structured English and validate algorithms and programs through tracing and test cases (ACTDIP040)		Implement modular programs, applying selected algorithms and data structures including using an object-oriented programming language (ACTDIP041)		Evaluate critically how student solutions and existing information systems and policies, take account of future risks and sustainability and provide opportunities for innovation and enterprise (ACTDIP042)		Create interactive solutions for sharing ideas and information online, taking into account social contexts and legal responsibilities (ACTDIP043)		Plan and manage projects using an iterative and collaborative approach, identifying risks and considering safety and sustainability (ACTDIP044)		
Sequence of Lessons / Unit	Approx. time req'd	Year A or B	CD	Achievement standard #	CD	Achievement standard #	CD	Achievement standard #	CD	Achievement standard #	CD	Achievement standard #	CD	Achievement standard #	CD	Achievement standard #	CD	Achievement standard #	CD	Achievement standard #	CD	Achievement standard #	CD	Achievement standard #
Robotics and embedded systems		10	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input checked="" type="checkbox"/>	4	<input checked="" type="checkbox"/>	5	<input checked="" type="checkbox"/>	5	<input checked="" type="checkbox"/>	8	<input checked="" type="checkbox"/>	9	<input type="checkbox"/>		<input type="checkbox"/>	

Years 7 and 8 Achievement Standard	Years 9 and 10 Achievement Standard
<p>By the end of Year 8</p> <ul style="list-style-type: none"> Students distinguish between different types of networks and defined purposes. (1) They explain how text, image and audio data can be represented, secured and presented in digital systems. (2) Students plan and manage digital projects to create interactive information. (3) They define and decompose problems in terms of functional requirements and constraints. (4) Students design user experiences and algorithms incorporating branching and iterations, and test, modify and implement digital solutions. (5) They evaluate information systems and their solutions in terms of meeting needs, innovation and sustainability. (6) They analyse and evaluate data from a range of sources to model and create solutions. (7) They use appropriate protocols when communicating and collaborating online. (8) 	<p>By the end of Year 10</p> <ol style="list-style-type: none"> Students explain the control and management of networked digital systems and the security implications of the interaction between hardware, software and users. They explain simple data compression, and why content data are separated from presentation. Students plan and manage digital projects using an iterative approach. They define and decompose complex problems in terms of functional and non-functional requirements. Students design and evaluate user experiences and algorithms. They design and implement modular programs, including an object-oriented program, using algorithms and data structures involving modular functions that reflect the relationships of real-world data and data entities. They take account of privacy and security requirements when selecting and validating data. Students test and predict results and implement digital solutions. They evaluate information systems and their solutions in terms of risk, sustainability and potential for innovation and enterprise. They share and collaborate online, establishing protocols for the use, transmission and maintenance of data and projects.

Robotics and embedded systems

A selection of four projects are presented to accommodate a range of student skill levels and interest, teacher background and school resources. Select the relevant project for your students or allow them to choose a project that appeals to them

Project 1: Intro to robotics

As an introduction to robotics it may be useful to brainstorm ideas as to what a robot is and what it is not. Discuss intelligence and list things according to their level of intelligence. Students can investigate a line-following robot or an obstacle-avoiding robot.

Project 2: Robotic hand

A project that incorporates a social aspect as well as innovation and sustainability is to design and fabricate an assistive device such as a robotic hand. Once the function requirements are defined a prototype is design and created that involves some level of programming.

Project 3: Electronics

Students with experience in robotics can explore the role of sensors and use this to design their own robotic device using a robotics kit or using electronic components and a development board. Evaluate the robot based on the intended functionality.

Project 4: Sewable electronics

As alternative to robotics investigate sewable electronics which are a form of wearable electronics that enable students to demonstrate their creativity incorporating the use of electronics with textiles. Evaluate the solution using sustainability, innovation and/or enterprise as criteria.

Projects				
	Project 1: Intro to robotics	Project 2: Robotic hand	Project 3: Electronics	Project 4: Sewable electronics
Questions to guide exploration	<i>What is a robot and how does a robot safely move within its surroundings?</i>	<i>How can robotics emulate a human hand?</i>	<i>Which sensors does my robot need?</i>	<i>What can I create using sewable electronics?</i>
AC Alignment	<i>Investigating and defining (ACTDIP038) Generating and designing (ACTDIP039)/ (ACTDIP040) Producing and implementing (ACTDIP041) Evaluate (ACTDIP042)</i>	<i>Investigating and defining (ACTDIP038) Generating and designing (ACTDIP039)/ (ACTDIP040) Producing and implementing (ACTDIP041) Evaluate (ACTDIP042)</i>	<i>Investigating and defining (ACTDIP038) Generating and designing (ACTDIP039)/ (ACTDIP040) Producing and implementing (ACTDIP041) Evaluate (ACTDIP042)</i>	<i>Investigating and defining (ACTDIP038) Generating and designing (ACTDIP039)/ (ACTDIP040) Producing and implementing (ACTDIP041) Evaluate (ACTDIP042)</i>
What's this about?	<p>Interestingly there is not widespread agreement on what a robot is. There are varying definitions of what constitutes a robot. Most roboticists however agree a robot has a physical form, senses its surroundings, undertakes some form of automated action and is able to make decisions requiring a level of intelligence.</p> <p>A theme worth exploring in robotics is risk vs innovation. The risks may include:</p> <ul style="list-style-type: none"> choosing the wrong system to automate when something goes wrong what happens? system being hacked; inaccurate programming out of control Artificial Intelligence (AI) . <p>Material handling is one application of robotics. A simple solution to automate the process of material handling is to paint colour strips on the floor for the robot to follow. This form of robot can be investigated using line tracking robots. These robots, sometimes referred to as automated guided vehicle (AGV) are portable robots that follow markers or wires in the floor, use vision, magnets, or lasers for navigation.</p> <p>A line following robot uses the behaviour of light and the way light behaves when it hits surfaces of different</p>	<p>Projects that incorporate a social aspect quite often provide a high level of engagement particularly for female students.</p> <p>Designing and fabricating assistive devices for a person in need, can include a social aspect and a focus on innovation which can result in a more meaningful robotics project.</p> <p>There are a range of projects where students can design and fabricate an assistive device such as a robotic glove for someone who has limited hand use.</p> <p>For each person the particular needs (functional requirements) are defined which feeds into the requirements for the assistive device. An example of this might be that the person has a functional wrist however might be missing fingers or have fingers that lack mobility.</p> <p>These projects incorporate the use of a 3D printer. A focus here could include sustainability of materials used or processes. Schools may not necessarily need a 3D printer onsite as there are</p>	<p>When investigating embedded systems using a context such as robotics, students will use a development board and a range of electronic components connected in a circuit to complete a design challenge.</p> <p>An Arduino development board is a single circuit board that contains a built in microcontroller. It can be connected to a range of electrical components and be programmed using a general purpose programming language. Like other development boards that contain a microcontroller, Arduino can sense the environment by receiving input from a variety of sensors and can affect its surroundings (output) by controlling lights, motors, and other actuators.</p> <p>There are a range of sensors that enable a robot to gather data about its environment. These include:</p> <ol style="list-style-type: none"> 1. Light sensor (measure light intensity) 2. Proximity sensor (detects the presence of an object) 3. Ultrasonic sensor (measure distance) 4. Infrared Sensor (detects the intensity of received light that reflects off an object or surface) 5. Sound sensor (detects ambient noise) 6. Thermal sensors (measure temperature) 7. Magnetometers (detect magnetic fields) 	<p>Instead of a robotics context you may find some students are more likely to engage with an Arts or Design and Technologies type focus that integrates electronics.</p> <p>Sewable electronics such as the Arduino LilyPad are a form of wearable electronics that enable students to demonstrate their creativity incorporating the use of electronics with textiles. These pieces of tech are highly compatible with costume design or an interactive arts project.</p> <p>Sewable electronics are made up of a central board that contains the microprocessor; this is what stores the Arduino sketch (the computer program). Depending on the central board it may also contain an RGB LED, On/OFF switch, push button, power supply socket and a number of pins. The kits come with conductive thread that act as a wire to join components via an electric circuit. A range of common sensors enable data inputs such as:</p> <ul style="list-style-type: none"> light sensors (detect light) and can be used to program connected LEDs to illuminate accelerometer use this sensor for basic motion sensing, program an output such

	<p>colour. Infrared sensors mounted at the front of the robot for example, can detect light reflected from a white surface which it reads as a value of 1 or high. Conversely light from a black surface is absorbed and therefore detected by the sensor as low or zero. These values can be used in the creating a program for a development board such as an Arduino. If the value is high then the robot moves in a specified direction, if low it moves in a different direction.</p> <p>Ultrasonic sensors emit sound waves and use the reflected sound wave from an object to measure distance. Distance is then estimated by the time interval between sensor and object. A program is written to command the robot to change direction to avoid an obstacle. This can be investigated by designing a robot that move autonomously within its surroundings.</p>	<p>now options to send designs off-site to be printed and collected.</p> <p>To create a robotic hand these types of projects typically incorporate the use of a microcontroller which are 'embedded' within the robotic hand control system. Examples of common microcontrollers include Arduino, Hummingbird and Raspberry Pi.</p> <p>Robotic hands and arms also have a place in space exploration. This may prove to be a useful alternative context in which students have an interest and be used to engage students in designing their robotic device.</p>	<ol style="list-style-type: none"> 8. A barometric sensor (measures atmospheric pressure). 9. A contact switch can be used to detect a collision. 10. Accelerometers measure the linear acceleration. 11. Gyroscopes measure the angle of tilt. 12. GPS use the signals from several satellites orbiting the planet to help determine its geographic coordinates. They are only accurate to within 5m. <p>When connecting these sensors and other electrical components such as LEDs in an electrical circuit often a resistor is used in conjunction with the component to protect the it from overload. When creating electrical circuits be mindful about the use of resistors which are often identified in the tutorials.</p>	<p>as blinking LEDs or making sound produced by a LilyPad buzzer.</p> <ul style="list-style-type: none"> • GPS to log your position. • Temperature Sensor receives temperature from a physical touch, based on body heat and ambient conditions. • Pulse Sensor is a heart-rate sensor for Arduino. It can be used to easily incorporate live heart-rate data into a project. <p>Outputs typically include the LilyPad buzzer or LEDs.</p>				
<p>The focus of the learning (in simple terms)</p>	<p>As an introduction to robotics it may be useful to brainstorm ideas as to what a robot is and what it is not. There is not a widely accepted definition, therefore it's a useful activity to undertake.</p> <p>Provide a graphic organiser that supports students to describe what they think is a robot, list its characteristics and provide examples and non-examples.</p> <table border="1" data-bbox="281 1024 715 1270"> <tr> <td>A robot is ...</td> <td>An example of a robot is ...</td> </tr> <tr> <td>Characteristics of a robot are ...</td> <td>This is not a robot ...</td> </tr> </table> <p>Through discussion distill the main characteristics which may include:</p> <ul style="list-style-type: none"> • It's a physical thing: it's not a computer program such as a bot • Sensing: a way to sense its surroundings • Some form of automation: works without human intervention • Performing a task: robots are designed to do something useful to help humans • Movement: ability to move within its surroundings • Energy: some form of power source • Level of Intelligence: programmed to know what to do; does it use user input or data to make decisions? Can it learn from its previous experiences? <p>Students may raise the question about bots and if they are robots. According to most roboticists a bot is not actually a robot.</p> <p>If possible, bring in a floor cleaning robot. Is it intelligent? Intelligence is a concept worth exploring when learning about</p>	A robot is ...	An example of a robot is ...	Characteristics of a robot are ...	This is not a robot ...	<p>Use relevant stories about people who need a prosthetic to improve their quality of life. Connect these stories to the design and fabrication of a robotic hand.</p> <p>Build a robotic hand Decide on a relevant project, based on the resources available for example what programming boards does the school have, what electronics components and equipment is available and access to a 3D printer. Select relevant online resources to provide guidance for students as needed.</p> <p>Integrating data, programming and materials Organise students in groups to investigate a robotic hand and create a working model that is controlled by a sensorised glove. Build the sensorised glove that incorporates the use of sensors connected via an Arduino board to visualise real time data in an Excel spreadsheet. Use this data to make adjustments to the operation of the robotic hand and run a series of trials to investigate its dexterity.</p> <p>Social aspect Students may want to take the project to the next level and create a 'robotic hand' for a particular person. This can be accomplished by accessing the e-NABLE community website. Alternatively, students can use the downloadable website resources of existing designs to create the parts using a 3D printer. These parts can then be put together to build the working robotic assistive device.</p> <p>Discuss how to evaluate the solution, discussing criteria related to a focus on sustainability, innovation and/or enterprise.</p>	<p>When designing their own robotic devices its useful to know what sensors would be of use considering particular functions and ways they want the robot to operate. Predicting what sensors a robot might have, helps students think about the role of sensors. Provide a list of some basic robotic design challenges that may include:</p> <ol style="list-style-type: none"> 1. A robot that tracks movement 2. A robot that operates within a set boundary 3. A robot that is able to pick up and move different sized small objects 4. A robot this is able to transport a payload from one set of coordinates to another 5. A robot that is able to climb stairs 6. A robot that is able to recognise and identify familiar objects; for example, knowing the difference between a dog and a cat. 7. A robot controlled by voice. <p>Students choose one of the challenges and identify the types of sensors that may be required and how a system might be used to carry out the task. Create design drawings to explain their ideas.</p> <p>Students negotiate their own project to create a robot to complete a specific task. The previous robot challenges can be used as inspiration or a starting point.</p> <p>Before creating the robotic device consider using the following process:</p> <ol style="list-style-type: none"> 1. Group selection (consider skills and assign roles) 2. Define and research the project then create a materials list 3. Check the materials are available (Refine the project based on available materials as required) 4. Generate design options in drawings or flow charts. Raise challenges, main points or questions that require answering prior to building. 5. Build the prototype, test, redesign and debug as you go. 6. Complete the prototype. 	<p>Whatever the development board used, students will need assistance to learn how to program using the relevant programming language.</p> <p>If using the Arduino LilyPad, students will use the Arduino (Integrated Development Environment) IDE to create a sketch (computer program). Students unfamiliar with this software will require an introduction as to how to use it and the steps to write a program.</p> <p>A suggested first step is to follow along and create a blinking LED.</p> <p>Once familiar with the way a sketch is written students can investigate using values to trigger behaviours. For example, make some decisions based on the light sensor's readings. If the light value is low, turn on LED, else turn off LED. Refer to a relevant tutorial to assist students to create the code and debug as they go. Have a number of lengths of wire with an alligator clip at each end to easily build the test circuits.</p> <p>Once students have had success in programming an output based on data from a sensor, they can design their own sewable electronics project. Instead of alligator clips students can use conductive thread. Refer to a relevant tutorial to get handy tips on how best to carry out this part of the project.</p> <p>Discuss how to evaluate the solution, discussing criteria related to a focus on sustainability, innovation and/or enterprise.</p>
A robot is ...	An example of a robot is ...							
Characteristics of a robot are ...	This is not a robot ...							

	<p>robotics. Are robots intelligent? How would you rate and order the intelligence of certain things? Provide a list of 6-10 things for students to order from lowest to highest intelligence, for example, a virus, a human, a floor cleaning robot, a heater with thermostat, a dolphin, a dog, a chess playing robot, a social robot such as Kismet, a chimpanzee and a fly. To undertake this task, students need to agree on characteristics or functions that can be performed or not able to be performed and use this to differentiate levels of intelligence. This task will provide an opportunity to discuss Artificial Intelligence (AI).</p> <p>Students could debate risk vs innovation or social impacts. Prompts might include:</p> <ol style="list-style-type: none"> 1. How far would you trust a robot? 2. What is already automated? What shouldn't be automated? Why? 3. The Driverless car: Who is at fault if a driverless car is involved in an accident? Can we guarantee the systems won't be hacked? <p>Line-tracking robot Investigate: How can we build a robot that moves a small payload? Use commercially available robotic kits to build a robot that uses Infrared (IR) sensors to detect and follow a line to move along a predetermined path. Alternatively, for a more challenging electronics-based project, have the students design and create their own robot using robotic kit materials and electronics components such as a breadboard, development board such as an Arduino, Raspberry Pi or Hummingbird and relevant sensors, servos (motors), resistors etc.</p> <p>Collision detection Investigate how to build a robot that avoids collisions. Use commercially available robotic kits to build a robot that uses ultrasonic sensors. As a further challenge have students design and build their own robot (instead of the kit robot) that detects obstacles and avoids collisions.</p> <p>Build a robot with AI functionality Use a robotics kit such as Lego Mindstorms or Edison and incorporate some form of AI where the robot uses data to improve performance such as a robot that rolls 'lawn bowls' or takes in data to make decisions.</p>		<p>7. Evaluate the prototype based on the intended functionality.</p>	
<p>Supporting resources and tools and purpose/ context for use.</p>	<p>Define a robot What Is a Robot? Watch this video that discusses different definitions of a robot.</p> <p>How Robots Work This brief article introduces the idea of AI in relation to robots.</p> <p>Kismet: the Social Robot</p>	<p>Learning hook e-NABLING Aden – Yemen Use this video to introduce the design and fabrication of 'prosthetics' to enable people to use assistive devices such as robotic hands.</p> <p>7 Ways to Engineer your Health Use this poster as a discussion started about engineering body parts.</p> <p>Video: Building machines that emulate humans</p>	<p>Challenge robots Use this interactive to solve real world problems that need a robotic solution. This is a good warm up to get students thinking about the types of sensors that a robot uses to gather data about its surroundings and make decisions.</p> <p>How to Make a Robot – Lesson 7: Using Sensors Use this site to find out the multitude of sensors and electronic components that can be used in the design of a robot. It will help students answer the question: Which sensors do my robots need?</p>	<p>Planning a Wearable Electronics Project Here's a guide to planning a project with LilyPad or other wearables products.</p> <p>Getting Started with LilyPad The LilyPad system is a set of sewable electronic pieces designed to help you build soft, sewable, interactive e-textile (electronic textile) projects.</p> <p>ProtoSnap LilyPad Development Simple Hookup Guide</p>

<p>Researchers in the Artificial Intelligence Laboratory working to engineer smarter robots are now building a machine that interacts socially with people in this video segment adapted from the Massachusetts Institute of Technology.</p> <p>Robotics applications Automated guided vehicle View this commercial solution that uses automated guided vehicles in materials handling and transport without human intervention.</p> <p>Making your own robot Line follower Use this video or one similar showing a line tracking robot in action to discuss how it might work.</p> <p>Mindstorms NXT Line follower Building and programming instructions for LEGO® MINDSTORMS® NXT.</p> <p>Mblock Simple line following program</p> <p>Forward until Dark - Robotics Academy In this lesson, you will use a VEX Line Tracking Sensor and the Threshold you calculated to cause the robot to move forward until it detects a dark surface, and then stop.</p> <p>How To Build A Robot - Lesson 3: Build A Line Tracking Robot This tutorial shows the electronics parts including sensors and Arduino programming board that can be used to create and program a line tracking robot.</p> <p>Tracking a Line This tutorial will explain how to use a Hummingbird LED and light sensor to make a mobile robot follow a line.</p> <p>AI classroom activity: Machine learning In this article Dr Joshua Ho discusses how to build an Artificial Intelligence (AI) system that can exhibit another behaviour that is often associated with human intelligence: learning.</p> <p>Edison: Lesson 7: Detect obstacles Introduction to the concept of obstacle detection and artificial intelligence – Students program the robot to make decisions (artificial intelligence) in response to obstacles in the robot’s environment.</p>	<p>This video describes the sequence of ideas as students investigate the human hand and how this can be used to influence the building of a robotic hand.</p> <p>Lesson ideas</p> <p>Building Machines That Emulate Humans Students build robotic models from cardboard and straws to understand the anatomy and biomechanics of the human hand. Then, they conduct trials visualizing data in Excel to generate new ideas for improving it’s performance.</p> <p>BUILD A HAND The e-NABLE community has developed a collection of different 3D-printable assistive devices that are free for download and fabrication by anybody who would like to learn more about the designs or fabricate a device for somebody in need.</p> <p>Arduino: Making a robotic hand (low cost) In this tutorial, learn how to make a robotic hand and how to controlled it.</p> <p>Robotic Arm and 3D Modeling A 3D printed robotic arm, controlled through an arduino, also being 3D rendered in Python OpenGL, using the Ci20 board.</p> <p>Robotic hand wireless control In this project; 3D robot hand assembly, servo control, flex sensor control, wireless control with nRF24L01 are available.</p> <p>Creating a Robotic Hand with the Raspberry Pi This project will provide you with the knowledge to begin to build your own robotic hand using Raspberry Pi and Linux programming code.</p> <p>Making a Robot Hand with Hummingbird This simple project will provide you with the knowledge to begin to build your own robotic hand using Hummingbird programming board and easy visual programming.</p>	<p>Different Types of Sensors A basic list of common sensors and their uses.</p> <p>149 robot projects These are Arduino -based projects that may be used to provide a starting point for students to design their own robots to complete a task.</p> <p>Prototyping with microcontrollers and sensors Use this lab is to better understand the basics of electronics, the Arduino board, and the Arduino IDE (Integrated Development Environment).</p> <p>You can learn Arduino in 15 minutes. This YouTube video is a great intro to Arduino. Learn how to choose an Arduino, dim LEDs, build a motor speed controller and more.</p>	<p>The ProtoSnap series is a way to prototype your project without a breadboard. Everything is wired together on a single board, which makes it easy to explore the possibilities of the components before snapping them apart and building them into your project.</p> <p>LilyPad Light Sensor Hookup Guide This tutorial takes you through how to hook up a light sensor and read values and incorporate into a computer program to create a sketch.</p> <p>Sound page guide Use this tutorial to make some interactive art. Use conductive paint, conductive thread or alligator clips.</p> <p>FLORA - Wearable electronic platform: Arduino-compatible - v3 Flora is a wearable electronics platform. It's a round, sewable, Arduino-compatible microcontroller designed to be used to create wearables projects.</p> <p>Flora sensors This video describes high tech sewable sensors available for use with Adafruit Flora.</p> <p>Circuit Playground Express An alternative to LilyPad and Flora is Circuit Playground Express which can be programmed using visual block code for students that need a simpler programming environment but still able to design a wearable tech project, musical instrument or other creation.</p> <p>The Tilt Trumpet Create an instrument which enables you to change the pitch and volume by tilting the Circuit Playground Express in various directions.</p>	<p>Suggested approaches may include: Description of problem and solution. List of functional and non-functional requirements. Presentation and</p>
<p>Assessment</p>	<p>Suggested approaches may include:</p>	<p>Suggested approaches may include:</p>	<p>Suggested approaches may include:</p>	<p>Suggested approaches may include: Description of problem and solution. List of functional and non-functional requirements. Presentation and</p>

<p>Teacher checklist recording level of engagement in discussion about what a robot is and what it is not. List of functional and non-functional requirements for robotic design. Presentation and explanation of their robot.</p> <p>Achievement standard Define and decompose complex problems in terms of functional and non-functional requirements.</p> <p>Test and predict results and implement digital solutions.</p>	<p>Description of problem and solution. List of functional and non-functional requirements. Presentation and explanation of their robotic hand.</p> <p>Achievement standard Define and decompose complex problems in terms of functional and non-functional requirements.</p> <p>Test and predict results and implement digital solutions.</p>	<p>Description of problem and solution. List of functional and non-functional requirements. Presentation and explanation of their robot.</p> <p>Achievement standard Define and decompose complex problems in terms of functional and non-functional requirements.</p> <p>Test and predict results and implement digital solutions.</p>	<p>explanation of their design incorporating sewable electronics.</p> <p>Achievement standard Define and decompose complex problems in terms of functional and non-functional requirements.</p> <p>Test and predict results and implement digital solutions.</p>
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We are ...				
SOLO LEVEL	One	Many	Relate	Extend
SOLO VERB	<i>Identify & Define</i>	<i>Combine & Perform Serial Skills</i>	<i>Apply</i> <i>Integrate</i>	<i>Create & Evaluate</i>
Success Criteria	<p>I can define a robot</p> <p>I can identify situations where automation would be useful</p> <p>I can identify parts of an electrical circuit such as sensors, actuators and development board</p>	<p>I can combine components in an electrical circuit including a development board</p> <p>I can program a development board following a tutorial and using existing code for example a sketch for Arduino</p>	<p>I can program a development board that uses data to trigger a certain behaviour</p> <p>I can use a robotic kit to build a robot to carry out a specific task</p>	<p>I can design and create my own robotic device using electronic components and other materials (recycled or commercially available)</p> <p>I can evaluate the digital solution I created based on criteria such as sustainability, innovation and/or enterprise.</p>
Digital Technologies Way Of Thinking	Computational thinking		Computational thinking	Design thinking