Educator Guide

MagneBot

Send it Project •

Project Overview

Background

Recycling facilities are designed to process many different types of materials. The rubbish that arrives at each facility contains all of these recyclable materials piled together. Because each of these materials has a different recycling method, they must be sorted and separated from each other. This sorting and separation can either be performed manually by humans or can be automated using machines.

Synopsis

In this project, learners will learn how to create a program to control a robotic arm and clean up magnetic recyclable waste that has been spilt onto the facility floor! Along the way, they will learn how rubbish is recycled, why recycling is important, some of the advantages and disadvantages of automation, and different methods of sorting items.

This project is divided into five lesson plans

01. Let learners **Imagine** the situation by playing and discussing a situation video. Learners will work in groups to explore the Project theme to accurately **Define** the situation.

02. Facilitate a class discussion around the topics and questions that your learners previously covered in **Define**. This lesson will end with an explicit definition of the problem and the tools available to solve it.

03. Learners will get a chance to **Research** the tools available on our platform that they will use to construct their solution. This lesson will end with a session where learners will **Plan** how they will build their solutions.

04. Learners will use our platform to **Create** and test their solutions to the problem inside our simulated environment.

05. Learners will use our platform to **Improve** upon their previous solutions, applying the skills they have learnt and the knowledge they have gained to solve more advanced problems. They will then take the time to **Review** their entire work on the Project.

Project Overview

Subject Areas

- Technology
- Engineering
- Computer Science
- Automation
- Social Science
- Maths

Learning Outcomes

In this Project, **learners** will:

- Understand the basics of programming a robotic system.
- Practice converting human decisions into an instruction set for a robot.
- Understand examples of how robots can help humans perform everyday tasks.
- Learn how to use action blocks in the Flow editor.
- Learn about the purpose of recycling facilities and what we can do to improve their efficiency.
- Understand why it is important to only put the correct items in recycling bins.

Equipment List

Learners require:

- Access to our digital platform through a laptop, PC or tablet (no account needed at this stage)
- Learning journal (included in lesson plan)

Educators require:

- Situation video (link included in lesson plan)
- Access to the Lesson Plan (either printed or digital)
- Easy access to help sheets, either printed or digitally (files included in lesson plan)

Curriculum Standards

Curriculum standards that this Project aligns with.

Covered   Moderately covered

Achievement objectives (tasks)					
Technological practice	Level 1	Level 2	Level 3	Level 4	Level 5
Planning for practice	Outline a general plan to support the development of an outcome, identifying appropriate steps and resources.	Develop a plan that identifies the key stages and the resources required to complete an outcome.	Undertake planning to identify the key stages and resources required to develop an outcome. Revisit planning to include reviews of progress and identify implications for subsequent decision making.	Undertake planning that includes reviewing the effectiveness of past actions and resourcing, exploring implications for future actions and accessing of resources, and consideration of stakeholder feedback, to enable the development of an outcome.	Analyse their own and others' planning practices to inform the selection and use of planning tools. Use these to support and justify planning decisions (including those relating to the management of resources) that will see the development of an outcome through to completion.
Brief development	Describe the outcome they are developing and identify the attributes it should have, taking account of the need or opportunity and the resources available.	Explain the outcome they are developing and describe the attributes it should have, taking account of the need or opportunity and the resources available.	Describe the nature of an intended outcome, explaining how it addresses the need or opportunity. Describe the key attributes that enable development and evaluation of an outcome.	Justify the nature of an intended outcome in relation to the need or opportunity. Describe the key attributes identified in stakeholder feedback, which will inform the development of an outcome and its evaluation.	Justify the nature of an intended outcome in relation to the need or opportunity. Describe specifications that reflect key stakeholder feedback and that will inform the development of an outcome and its evaluation.
Outcome development and evaluation	Investigate a context to communicate potential outcomes. Evaluate these against attributes; select and develop an outcome in keeping with the identified attributes.	Investigate a context to develop ideas for potential outcomes. Evaluate these against the identified attributes, select, and develop an outcome. Evaluate the outcome in terms of the need or opportunity.	Investigate a context to develop ideas for potential outcomes. Trial and evaluate these against key attributes to select and develop an outcome to address the need or opportunity. Evaluate this outcome against the key attributes and how it addresses the need or opportunity.	Investigate a context to develop ideas for feasible outcomes. Undertake functional modelling that takes account of stakeholder feedback in order to select and develop the outcome that best addresses the key attributes. Incorporating stakeholder feedback, evaluate the outcome's fitness for purpose in terms of how well it addresses the need or opportunity	Analyse their own and others' outcomes to inform the development of ideas for feasible outcomes. Undertake ongoing functional modelling and evaluation that takes account of key stakeholder feedback and trialling in the physical and social environments. Use the information gained to select and develop the outcome that best addresses the specifications. Evaluate the final outcome's fitness for purpose against the brief.

Covered Moderately covered

Achievement objectives (tasks)					
Technological knowledge	Level 1	Level 2	Level 3	Level 4	Level 5
Technological modelling	Understand that functional models are used to represent reality and test design concepts and that prototypes are used to test technological outcomes.	Understand that functional models are used to explore, test, and evaluate design concepts for potential outcomes and that prototyping is used to test a technological outcome for fitness of purpose.	Understand that different forms of functional modelling are used to inform decision making in the development of technological possibilities and that prototypes can be used to evaluate the fitness of technological outcomes for further development.	Understand how different forms of functional modelling are used to explore possibilities and to justify decision making and how prototyping can be used to justify refinement of technological outcomes.	Understand how evidence, reasoning, and decision making in functional modelling contribute to the development of design concepts and how prototyping can be used to justify ongoing refinement of outcomes.
Technological products	Understand that technological products are made from materials that have performance properties.	Understand that there is a relationship between a material used and its performance properties in a technological product.	Understand the relationship between the materials used and their performance properties in technological products.	Understand that materials can be formed, manipulated, and/or transformed to enhance the fitness for the purpose of a technological product.	Understand how materials are selected, based on desired performance criteria.
Technological systems	Understand that technological systems have inputs, controlled transformations, and outputs.	Understand that there are relationships between the inputs, controlled transformations, and outputs occurring within simple technological systems.	Understand that technological systems are represented by symbolic language tools and understand the role played by the "black box" in technological systems.	Understand how technological systems employ control to allow for the transformation of inputs to outputs.	Understand the properties of subsystems within technological systems.
Nature of technology					
Characteristics of technology	Understand that technology is purposeful intervention through design.	Understand that technology both reflects and changes society and the environment and increases people's capability.	Understand how society and environments impact on and are influenced by technology in historical and contemporary contexts and that technological knowledge is validated by successful function.	Understand how technological development expands human possibilities and how technology draws on knowledge from a wide range of disciplines.	Understand how people's perceptions and acceptance of technology impact on technological developments and how and why technological knowledge becomes codified.
Characteristics of technological outcomes	Understand that technological outcomes are products or systems developed by people and have a physical nature and a functional nature.	Understand that technological outcomes are developed through technological practice and have related physical and functional natures.	Understand that technological outcomes are recognisable as fit for purpose by the relationship between their physical and functional natures.	Understand that technological outcomes can be interpreted in terms of how they might be used and by whom and that each has a proper function as well as possible alternative functions.	Understand that technological outcomes are fit for purpose in terms of time and context. Understand the concept of malfunction and how "failure" can inform future outcomes.

Adapting the lessons

The times given for each step of the Creation Process are just for guidance. Depending on how much time you have available and how in-depth you want to discuss each topic, you could spend up to twice as long on each step of the creation process.

We recommend using the times as a minimum estimate to help you with your own planning. You are free and encouraged to adjust, skip and/or repeat steps depending on the engagement and aptitude of your class and your desired goals for the lesson.

Online learning

These lesson plans can be used for online learning.

If your school runs structured lessons through video meeting platforms, we recommend using breakout rooms for class discussions. All other tasks can be completed in the lesson as per the lesson plan or as homework activities.

If an individual learner needs additional help or guidance, you can ask them to temporarily share their screen (potentially in a breakout room) so that you can see what they are doing and guide them more closely.

Suppose your school is not running regular lessons or has poor turnout. In that case, you can instead skip over the class discussion parts of the lesson plans and assign learners individual tasks (e.g. complete the Research step by DD/MM/YYYY).

We recommend you use the learning journal to set completion targets for your class and have them share with you their progress by making their learning journals available to you through email or google classroom.

Curriculum Standards

Curriculum standards that this Project aligns with.

Covered | Moderately covered

<table>
<tr><th colspan="7">Progress outcomes (assessment)</th></tr>
<tr><th></th><th>Level 1</th><th>Level 2</th><th>Level 3</th><th>Level 4</th><th colspan="2">Level 5</th></tr>
<tr><td>Computational thinking for digital technologies</td><td>In authentic contexts and taking account of end users, learners use their decomposition skills to break down simple non-computerised tasks into precise, unambiguous, step-by-step instructions (algorithmic thinking). They give these instructions, identify any errors in them as they are followed, and correct them (simple debugging).</td><td colspan="2">In authentic contexts and taking account of end users, learners give, follow and debug simple algorithms in computerised and non-computerised contexts. They use these algorithms to create simple programs involving outputs and sequencing (putting instructions one after the other) in age-appropriate programming environments.</td><td>In authentic contexts and taking account of end-users, learners decompose problems into step-by-step instructions to create algorithms for computer programs. They use logical thinking to predict the behaviour of the programs, and they understand that there can be more than one algorithm for the same problem. They develop and debug simple programs that use inputs, outputs, sequence and iteration (repeating part of the algorithm with a loop). They understand that digital devices store data using just two states represented by binary digits (bits).</td><td>In authentic contexts and taking account of end-users, learners decompose problems to create simple algorithms using the three building blocks of programing: sequence, selection, and iteration. They implement these algorithms by creating programs that use inputs, outputs, sequence, basic selection using comparative operators, and iteration. They debug simple algorithms and programs by identifying when things go wrong with their instructions and correcting them, and they are able to explain why things went wrong and how they fixed them.</td><td>In authentic contexts and taking account of end users, learners independently decompose problems into algorithms. They use these algorithms to create programs with inputs, outputs, sequence, selection using comparative and logical operators and variables of different data types, and iteration. They determine when to use different types of control structures. Learners document their programs, using an organised approach for testing and debugging. They understand how computers store more complex types of data using binary digits, and they develop programs considering human-computer interaction (HCI) heuristics.</td></tr>
<tr><td>Designing and developing digital technologies</td><td colspan="2">In authentic contexts and taking account of end users, learners participate in teacher-led activities to develop, manipulate, store, retrieve and share digital content in order to meet technological challenges. In doing so, they identify digital devices and their purposes and understand that humans make them. They know how to use some applications, they can identify the inputs and outputs of a system, and they understand that digital devices store content, which can be retrieved later.</td><td colspan="2">In authentic contexts and taking account of end-users, learners make decisions about creating, manipulating, storing, retrieving, sharing and testing digital content for a specific purpose, given particular parameters, tools, and techniques. They understand that digital devices impact on humans and society and that both the devices and their impact change over time.

Learners identify the specific role of components in a simple input-process-output system and how they work together, and they recognise the "control role" that humans have in the system. They can select from an increasing range of applications and file types to develop outcomes for particular purposes.</td><td colspan="2">In authentic contexts, learners follow a defined process to design, develop, store, test and evaluate digital content to address given contexts or issues, taking into account immediate social, ethical and end-user considerations. They identify the key features of selected software and choose the most appropriate software and file types to develop and combine digital content.

Learners understand the role of operating systems in managing digital devices, security, and application software and are able to apply file management conventions using a range of storage devices. They understand that with storing data comes responsibility for ensuring security and privacy.</td></tr>
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Overview

Imagine (15 mins)

Introduce and discuss the Project with your learners with a video that showcases the situation.

Define Part I (30 mins)

Let your learners work in groups to explore the Project theme and define the situation accurately.

Lesson Resources

Situation cutscene

Presentation slides for Define

Glossary

1. **Automation:**
Automation is all about using technology to carry out tasks that a human would have traditionally carried out. Examples include robots in car manufacturing assembly lines and self-driving trains. Humans are good at critical thinking, whereas most technology is great at repeatedly performing the exact same action. This is why routine tasks (tasks that involve performing the same action repeatedly) are usually the first to be automated as little or no critical thinking is needed.

   E.g. robots in car manufacturing assembly lines and self-driving trains.

2. **Autonomous:**
A device or vehicle that is autonomous is able to operate without any direct human control. A device or vehicle is normally made autonomous by writing code that is able to take in information, use that information to make a decision, and then automatically perform a designated action for the outcome of that decision.

   E.g. traffic light that only turns green when there are cars waiting in that lane. A "dumb" autonomous vehicle or device would skip the information processing and decision-making steps and simply perform a repetitive task. For example, a traffic light that changes colours on a timer.

Imagine 15 mins

Follow these steps

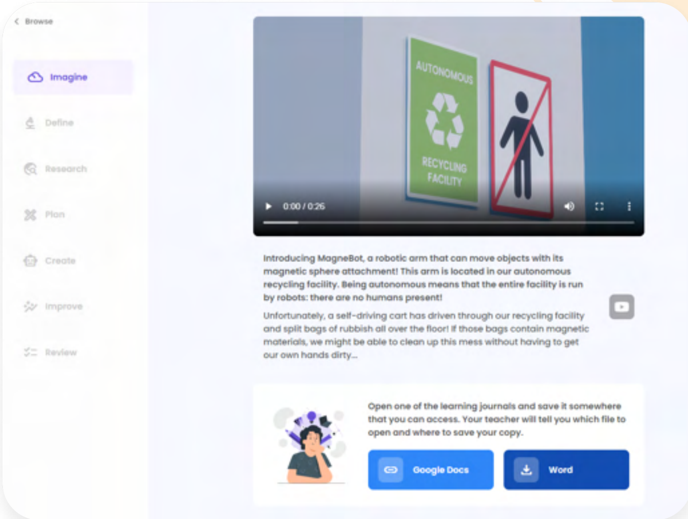
1. Bring all of your learners to the front of the class if possible.

2. Welcome the class and tell them that they will be completing a **Project** over the following five lessons where they will get to plan, build, test, and improve a solution to a problem.

3. Tell the class that we will begin by playing a cutscene of the situation to set the scene, then play the following video:

4. Discuss with the class what happened in the video.

   Discussion points could be based on what the robot in the centre of the room is, the accident that occurs and what we are going to have to do to clean up the accident.



https://app.createbase.co.nz/magnebot

If they understand the problem, you might want to ask learners what they would do in the same situation.

Tips for Educators

For your reference, here is a quick explanation of what is happening in the video:

- In one section of a recycling facility, a robotic arm is currently idle.
- This robot is called MagneBot.
- A self-driving cart passes through the room and spills bags of rubbish all over the floor!
- The robotic arm detects this mess and activates itself, ready to receive instructions.

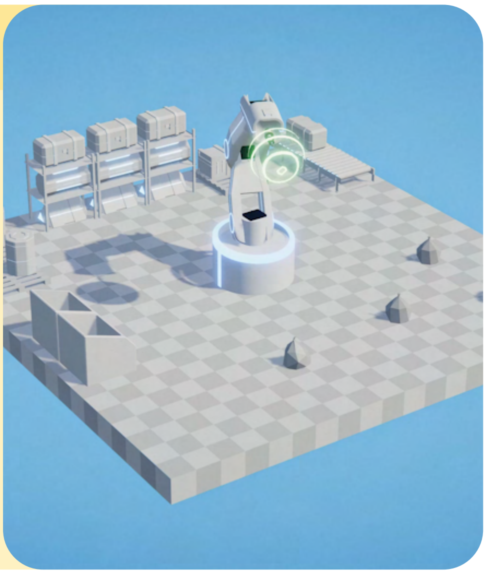
Helpful Examples

0:16–0:18 seconds

Q “What happens to the robot?”

A MagneBot detects the accident and wakes up.

0:19–0:26 seconds



Q “What is it doing now?”

A MagneBot is ready to receive instructions.

Q “Why does MagneBot not just start picking up the rubbish?”

A Robots only do exactly what they are programmed to do.

Tips for Educators

Feel free to move on to Define once you are satisfied that your class understands this project’s background.

Helpful Examples

If you are finding it difficult to get the kids to talk about it, replay the video to the class with pauses and ask questions about what is happening in specific scenes.

Here are some example discussion points to get you started:

0:00-0:04 seconds

Q “Where are we?”

A an autonomous recycling facility. In this scenario, autonomous means that it is operated entirely by robots (there are no humans present).

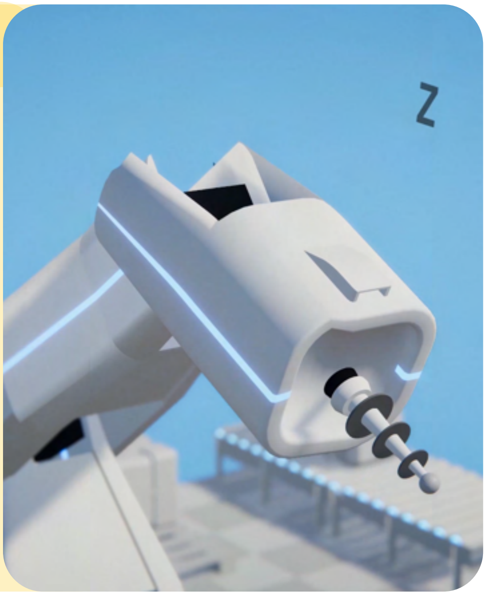
0:05-0:12 seconds

Q “What do you think is happening here?”

A MagneBot is idle/sleeping.

Q “If the arm is idle, is bobbing up and down a good idea?”

A No, because it consumes electricity, effectively takes up more space when unused, and could potentially hit something.



0:13-0:15 seconds

Q “What is happening here?”

A A self driving cart passes by and spills rubbish all over the floor.

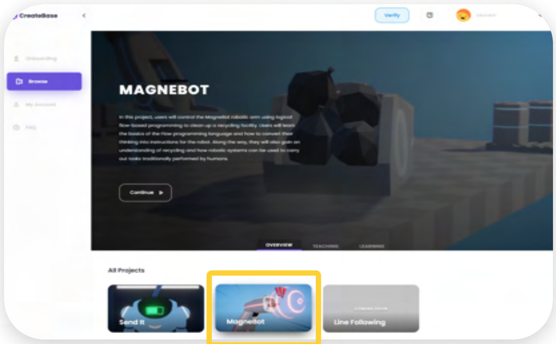
Q “How could this have been avoided?”

A Larger cart, have a gate on the back, fill the cart with less items.

Define Part I 30 mins

Now that you have watched the video with your class and are happy that they understand what has happened, your learners will have an opportunity to explore some of the broader topics that could stem from an autonomous recycling facility.

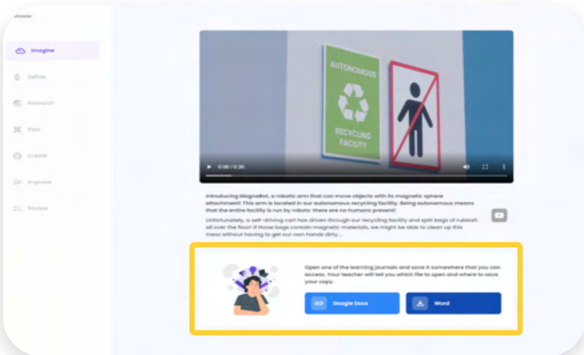
1. To get started, create small groups of 3-4 learners. And send them to their computers. Learners should be seated next to their group members.

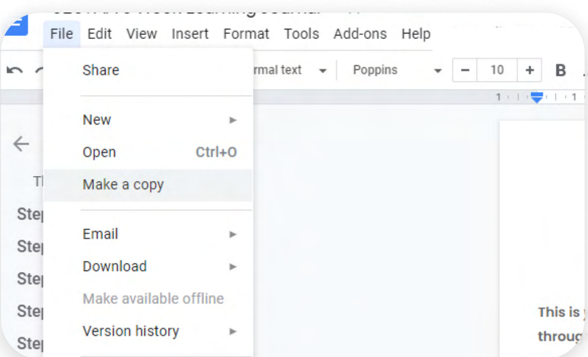


2. Tell your learners to go to https://app.createbase.co.nz/magnebot

3. Ask them to rewatch the Situation video and tell them to download either the Google Docs **or** Microsoft Word **learning journal**.

   If you want your learners to work from Google Docs, they must choose the Google Docs option and then click ***File*** -> ***Make a copy*** and save it somewhere that they can access.





4. Once downloaded, the learners should fill out their names and then move to the Define section on the website platform.

Tips for Educators

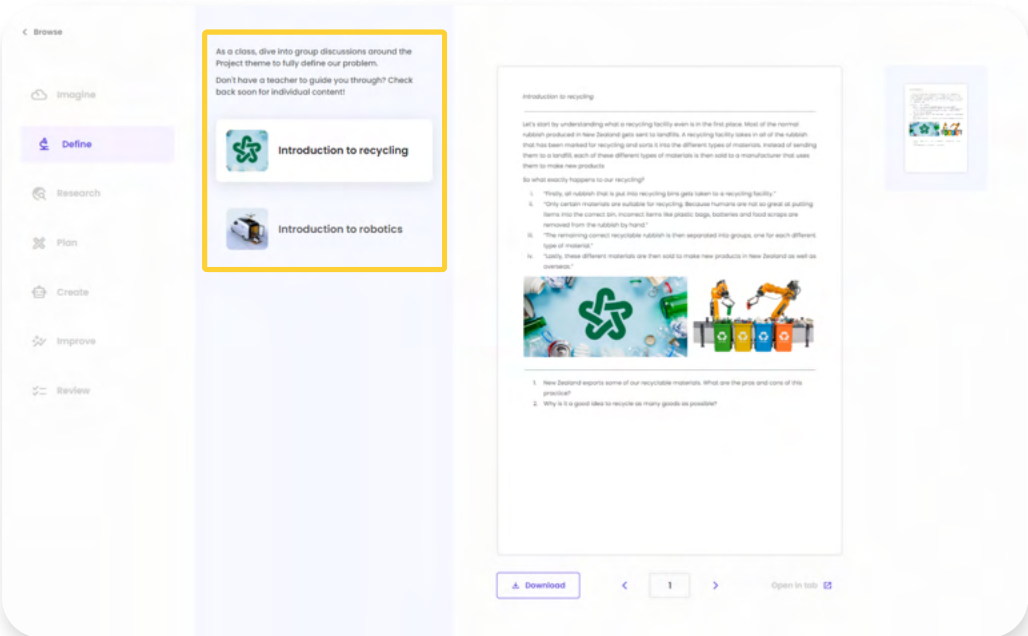
To reduce confusion, it is recommended that you tell your learners exactly where to save their files. If you want to access these files later to check on their progress, ask them to save them in a location that you can also access.

Lesson 1 •

Define Part I 30 mins

5. Once in the Define section, **as a group**, tell them to select any one of the sections and discuss the questions. For each question, each learner needs to write an answer in their learning journal. Wander the room while this is happening and ask learners questions to help them start thinking.

   If a group finishes early, let them answer a second section.



6. With 5-10 minutes to go, remind the class that they must have answers for every question in at least one card in their individual learning journals by the end of the lesson.

7. At the end of the lesson, make sure that each learner has their copy of the **learning journal** saved somewhere that they can easily access at the start of the next class.

Homework

For homework, inform each learner that if they haven't already done so, they must have answers for every question in at least one of the Define cards written out in their individual learning journals by the start of the next lesson.

Overview

Define Part II (45 mins)

Facilitate a class discussion around the topics and questions that your learners covered as groups in Define Part I. learners will get a chance to share their opinions about the topics that they covered and also hear the views of others. End the lesson by explicitly stating the problem and the tools that learners can use to solve it.

Lesson Resources

Presentation slides for Define

Glossary

1. **Automation:**
   Automation is all about using technology to carry out tasks that a human would have traditionally carried out. Examples include robots in car manufacturing assembly lines and self-driving trains. Humans are good at critical thinking, whereas most technology is great at repeatedly performing the exact same action. This is why routine tasks (tasks that involve performing the same action repeatedly) are usually the first to be automated as little or no critical thinking is needed.

   E.g. robots in car manufacturing assembly lines and self-driving trains.

2. **Autonomous:**
   A device or vehicle that is autonomous is able to operate without any direct human control. A device or vehicle is normally made autonomous by writing code that is able to take in information, use that information to make a decision, and then automatically perform a designated action for the outcome of that decision.

   E.g. traffic light that only turns green when there are cars waiting in that lane. A "dumb" autonomous vehicle or device would skip the information processing and decision-making steps and simply perform a repetitive task. For example, a traffic light that changes colours on a timer.

Lesson 2 •

Define Part II 45 mins

2

Now that your learners have had a chance to discuss some of the broader topics that could stem from an autonomous recycling facility in groups, discuss the same or similar topics as a class.

If each group in **Define Part I** chose different topics, you should now have a range of "experts" in each topic that you can call upon for their opinions.

The direction of this discussion should be dynamic and driven by learners' curiosity. Make sure to ask follow up questions, and if the learners lead you away from the prompts below, then **don't be afraid to go off-script!**

1. Introduce your class to today's lesson, saying that now we have a bunch of subject matter experts, we will be having a class discussion on the Define themes. It is important that everyone shares their knowledge and opinions to fully understand our problem from different perspectives.

"Now we have a bunch of subject matter experts, we will be having a class discussion on the Define themes."

2. You may wish to have each learner open their **learning journals** for reference or instead stay off their device for the entire lesson, depending on how easily you think they will be distracted.

3. You now want to discuss as a whole class the themes raised in some of the Define cards. Try and get every learner thinking and participating, even if they were not in a group that discussed the particular topic you are currently on.

Tips for Educators

To get started, try using this premade structure (with examples) for the discussion over the next five pages. You can also find a slideshow attached as a lesson resource.

Intro to Recycling

"Let's start by understanding what a recycling facility even is in the first place. Most of the normal rubbish produced in New Zealand gets sent to landfills. A recycling facility takes in all of the rubbish that has been marked for recycling and sorts it into the different types of materials. Instead of sending them to a landfill, each of these different types of materials is then sold to a manufacturer that uses them to make new products."

"So what exactly happens to our recycling?

1. Firstly, all rubbish that is put into recycling bins gets taken to a recycling facility.
2. Only certain materials are suitable for recycling. Because humans are not so great at putting items into the correct bin, incorrect items like plastic bags, batteries and food scraps are removed from the rubbish by hand.
3. The remaining correct recyclable rubbish is then separated into groups, one for each different type of material.
4. Lastly, these different materials are then sold to make new products in New Zealand as well as overseas."

a. "New Zealand exports some of our recyclable materials. What are the pros and cons of this practice?"

+ We don't need to pay upfront for recycling processing facilities.

– Exporting overseas means that they are transported further, costing money and increasing the amount of negative environmental impact.

+ It is often still better for the environment than using new raw materials.

b. "Why is it a good idea to recycle as many goods as possible?"

i. It helps reduce the amount of waste that goes into landfills which:

- Cuts down on **greenhouse gases.**
- Reduces the amount of **space taken up by landfills**
  - (**Fun fact**: Aucklanders produce enough waste to fill up Eden Park every week!)
- Makes it less likely for rubbish to **contaminate the environment.**

ii. Reusing materials can save costs and increase the supply of rare materials.

Intro to Robotics

"Let's flick back to the end of the situation video. Why didn't the robotic arm just automatically pick up the rubbish bags for us?"

"If I told you to run in front of a car, would you do it? No, you would decide that my instruction was bad and ignore it. What would happen if I programmed a robot to do the same thing?"

"A big difference between a robot and a human is that a human can reject instructions and make its own decisions. A robot only does exactly what it is told to do, every time. This can be good (e.g. quality control in a manufacturing line) and bad (if something goes wrong, the robot can't change its action unless it has been programmed to)."

"MagneBot did not automatically pick up the rubbish from the floor because it had not been programmed to do so!"

a. Explain to your class what automation is, using the glossary as assistance.

The dictionary defines automation as: "the technique of making an apparatus, a process, or a system operate automatically."

b. Ask your class to give you examples of automated processes. Examples might include traffic lights, robotic assembly lines and computer macros.

c. What are the **pros** and **cons** of sorting rubbish using robotics compared to humans? Things to consider include:

Cost (humans have to be paid, robots need to be bought and maintained: more upfront cost but less cost over time)

Size (robots and humans take up different sizes, depending on the job, robots might take up more or less space than a comparable human)

Risk (the cost of a human life is much more than a robot, so robots might be better for high-risk scenarios)

Accuracy & precision (would a robot or a human be more accurate? why?)

Consistency (get a learner to draw five circles. Drawing five consistent circles is a difficult task for humans but trivial for robots)

Willingness to do repetitive tasks (robots will do whatever you tell them, no questions asked, compared to humans who get bored)

How can robots help us recycle?

a. Ask your class for ideas about how robots could help us recycle.

Here are a few examples:

Sorting rubbish and separating materials in a recycling facility.

- Most of New Zealand's recycling is already sorted at an automated facility. Paper and cardboard is separated with a vibrating machine while metal items are removed using magnets or an eddy current. Optical scanners identify different types of plastic. All that's left is the glass, which is sorted by colour.
- Source: https://www.makethemostofwaste.co.nz/recycling/what-happens-to-your-recycling/

Sorting rubbish before they get to the recycling facility.

- Case study: https://venturebeat.com/2019/11/21/alphabets-trash-sorting-robots-have-reduced-office-waste-contamination-to-less-than-5/

Telling humans which rubbish bin to put their rubbish into.

- Case study: https://venturebeat.com/2019/01/28/oscar-the-ai-trash-sorter-can-be-a-real-grouch/

How can robots help us recycle?

a. Ask your class for ideas about how a robotic arm could pick up a piece of rubbish. Here are a few realistic and unrealistic examples:

Claw

- Often the easiest answer to think of but can be quite difficult in practice. There are so many different shapes, sizes and weights of rubbish that having a single claw that is appropriate for all of them can be difficult. Claws also have to be positioned and oriented correctly when grabbing an item which requires fine motor controls. Can also be tedious when trying to sort through piles of rubbish.

Magnets

- Amazing for picking up magnetic objects from a pile of rubbish. The downside is that it is not very helpful for picking up non-magnetic items like plastic as they will not be attracted to the magnet.

Suction

- We can also use suction cups to pick up items. A downside to this approach is that items without flat surfaces are likely to be more difficult to pick up, and items of different sizes and weights will require different sizes or numbers of suction cups.
- We could also take the "vacuum cleaner" approach, sucking in air to attach a probe to and pick up items of rubbish.

There are many other methods as well so see what ideas your kids can come up with and have a discussion about them to work out their feasibility.

4. Bring the discussion to a close by linking it back to the situation video.

5. State the problem that the learners will be solving for the remainder of the Project:

"Luckily, each of the rubbish bags in our problem contains magnetic items, meaning that we can pick them up using our magnetic sphere."

"In this Project, your task is to write a program to control MagneBot in order to pick up each rubbish bag and deposit them in one of the two recycling bins."

6. State the functionalities of the robotic system:

"Your robot has a sensor that detects how far away the nearest object is in front of it. You can also give the robot commands to both jump and slide."

Homework

Homework is optional for this lesson, but it may include the learners drafting their algorithms at home. If you want to make sure this is completed, tell the learners to write down or draw their thinking process for controlling the robot, ready to present during the next lesson.

Overview

Research (30 mins)

Learners will get a chance to research the tools available on our platform that they will need to use to construct their solution.

Plan (15 mins)

This lesson will end with a session where learners will plan how to construct their solutions, either as a class, in groups or as individuals.

Lesson Resources

[Presentation slides for Define](#)

Glossary

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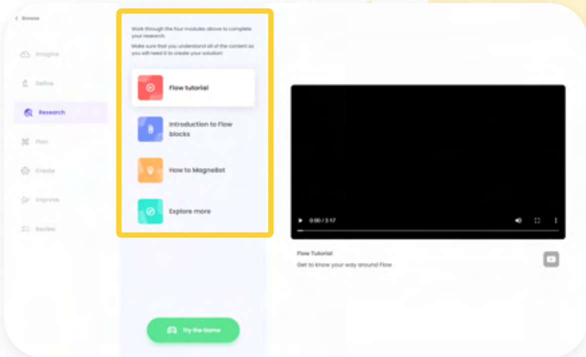
Lesson 3 •

Research 25 mins

3

1. Tell the learners to return to their computers and read all of the content under the **Research** section of the platform.

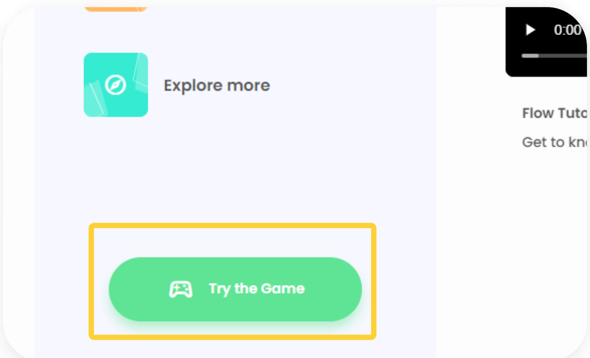


Tips for Educators

The first card in the Research step is a video with sound. Suppose you want to avoid all of your learners playing this video simultaneously (with all of the sounds overlapping). In that case, you might want to start by navigating to the Research section of the platform yourself (http://app.createbase.co.nz/project/magnebot/research) and playing the “Flow tutorial” video on a projector screen for the class.

2. Make sure that each of your learners reads and tries to understand every card. Learners should be returning to the Research step later in the Project if they get stuck, but it is still important that they try to understand the content the first time, or at least know what is there, so they know where to go to find the information when they need it.

3. If a learner finishes early, tell them to try and complete the “game” manually. Tell them to think about what information they are processing when playing the game and how they are using this information to make decisions.



4. Once you are confident that every learner has read all of the Research content and has had a chance to play the “game”, ask them to move to the **Plan** section on the platform.

Plan 20 mins

1. Tell your learners to read through the Plan step on the platform and then answer the **Plan** questions in their **learning journals**.

2. Bring the learners away from their computers back to the front of the class when they have all finished.

3. Tell the class:

> "Now that we know all of the tools at our disposal and the basics of operating the robotic system, we will now plan how we will utilise these tools to solve the problem."

4. Start by asking learners to talk about how they played the game.
Example questions that you might ask include:

   1. "Did the rubbish bags have to be in the centre of the magnetic sphere to pick them up? "
      a. *No, the centre of the rubbish bag could have been anywhere inside the magnetic sphere.*
   2. "What would cause the arm to break? "
      a. *Hitting the ground.*
      b. *Hitting the side of the bins.*
      c. *Hitting its own base*
   3. If we tried to move the arm through its own base, it would collide and break. If we encounter a situation where we can't move directly from point a to point b in one movement (for example, because there is an obstacle in the way), what should we do?
      a. *Break that one movement into multiple smaller movements in order to move around the obstacle. For example, if there is another item on the ground that we are going to hit if we try and move directly to the bins, we might have to first lift the gravity sphere up above the height of that obstacle.*

4. Talk through each action that you will need to perform to move deposit one rubbish bag into a bin:

1. Move gravity sphere to within range of a bag.
2. Enable the magnet to grab the rubbish.
3. Lift the rubbish above the ground.
4. Move the gravity sphere above one of the two bins (might require multiple movements).
5. Disable the magnet to drop the rubbish into the bin.

5. Conclude the lesson by telling the class to plan out each action they will need to perform using a code bock to deposit a rubbish bag into a bin, as starting from the next lesson, they will be coding and testing their solutions!

Homework

Homework is optional for this lesson, but it may include the learners drafting their algorithms at home. If you want to make sure this is completed, tell the learners to write down or draw their thinking process for controlling the robot, ready to present during the next lesson.

Educator Preparation •
Lesson 4 45 mins

4

Overview

Create (45 mins)

Your learners will use our platform to create and test their solutions in our simulation. Your role as an educator will be to guide struggling learners while prompting excelling learners with questions to help them identify areas of improvement.

Glossary

1. **Automation:**
Automation is all about using technology to carry out tasks that a human would have traditionally carried out. Examples include robots in car manufacturing assembly lines and self-driving trains. Humans are good at critical thinking, whereas most technology is great at repeatedly performing the exact same action. This is why routine tasks (tasks that involve performing the same action repeatedly) are usually the first to be automated as little or no critical thinking is needed.

   E.g. robots in car manufacturing assembly lines and self-driving trains.

2. **Autonomous:**
A device or vehicle that is autonomous is able to operate without any direct human control. A device or vehicle is normally made autonomous by writing code that is able to take in information, use that information to make a decision, and then automatically perform a designated action for the outcome of that decision.

   E.g. traffic light that only turns green when there are cars waiting in that lane. A "dumb" autonomous vehicle or device would skip the information processing and decision-making steps and simply perform a repetitive task. For example, a traffic light that changes colours on a timer.

Create 45 mins

1. Welcome the class back to the MagneBot Project. If there has been a significant delay between the current and previous lesson, then you might want to give a quick recap to your learners of what you covered in your class in the last lesson.

2. Tell the class that today they will be building and testing their solutions. If you requested your learners to create a plan for their algorithm between lessons as homework, then perhaps ask a few learners to share with the rest of the class.

3. Briefly explain to the class how the **Create** step will work:

Build
Learners will implement their solution by starting with individual elements and building up to the final solution.

Test
Learners should constantly be testing their code to see how well their individual components or final solution solves the problem.

Iterate
Learners will continue building and testing until the problem has been completely solved.

Share
When learners think that they finished, encourage them to share their solution with other classmates who have finished and/or an educator to get their feedback. Make sure that the learners explain how they arrived at their solution. If necessary, they might need to start iterating again, either because a problem was identified or an educator/classmate gave them an idea for how to improve their solution.

4. Tell your learners to return to https://app.createbase.co.nz/ and start the **Create** step.

Tips for Educators

- If your arm is breaking, it is most likely because you are hitting an obstacle along the way, or contorting the arm into a non-conformable position. To solve this problem, try to identify which movement is causing the break, then split that movement into multiple smaller movements, avoiding the location that is causing the break.
- You do not need to move the magnetic sphere to the exact coordinates of each rubbish bag and bin. In particular, try moving above those coordinates.
- When moving a rubbish bag above one of the bins, you normally want to start by lifting the bag straight up.

5. If any learners finish early and you do not see any more ways for them to work on their solution in the **Create** step, then either ask them to help the other classmates or let them move onto the Improve step early.

6. At the end of the lesson, tell the class to wrap up their work by taking a screenshot of their final code and inserting it into their **learning journal** under the **Create** step. They should do this regardless of if they have a working solution or not.

7. Ask any learners who have yet to finish the **Create** step to visit the platform from home and try to get a working solution before the next class.

Overview

Improve (30 mins)

Your learners will get a chance to apply the skills they have learnt and the knowledge they have gained to solve more advanced problems. We might adjust the problem parameters or solution constraints to enable new solutions.

Review (15 mins)

Learners will then review their work. Options for review include having members of the class share their unique solutions and the decision-making that got them there and/or conducting self-assessments using their learning journal.

Glossary

1. **Automation:**
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Lesson 5 •

Improve

30 mins

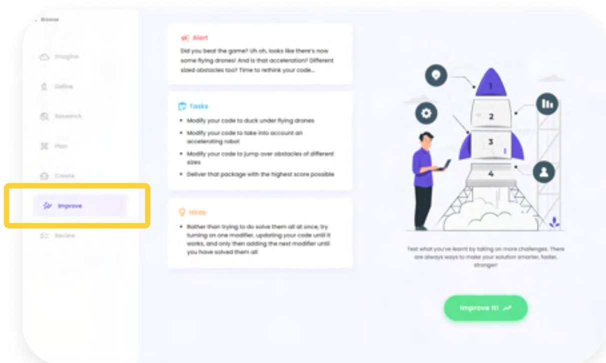
5

1. To start the lesson, confirm the number of learners who have completed the **Create** step. Tell all of the learners who have a working solution that their next task is to move on to the **Improve** step.

2. If any learners have yet to complete the **Create** step, make sure they complete the **Create** step first and post a screenshot of their now working solution in their **learning journal**.

   Every learner working on **Improve** should be able to show and explain to you a working solution for **Create** (as long as their answer works, it is okay, and even encouraged, if it is different from their peers). You should prioritise spending your time to help these learners complete the Create step so that they also can move on to Improve.

3. Let the kids who have finished the **Create** step try to complete the **Improve** step with minimal assistance. The **Improve** step helps reinforce the learners' learning but, in this Project, there is no set objective to complete. Instead, learners are given an opportunity to experiment with a more complicated environment.



   If you want to give your learners a more concrete goal, ask them to see who can stack the most items on top of each other using Flow code.

5. At the end of the **Improve** step (when you feel like the learners have progressed far enough), tell the class to wrap up their work by taking a screenshot of their final code and inserting it into their learning journal. They should do this regardless of if they have a working solution or not.

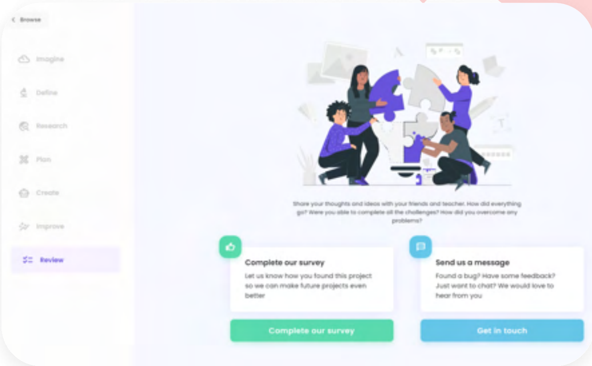
Lesson 5 •

Review 15 mins

5

The final part of this Project is the **Review** step.

As part of the Review process, we provide two suggested options:



Share and **Reflect**. Feel free to do one or the other or both, depending on the time that you have available.

Share

1. Encourage your learners to talk to the person next to them about their final solutions and their decisions at each step to their classmates.

   This helps learners remember what they have done and get new ideas by listening to how others solved the problem differently, which may help with learner reflection in the next task.

2. During this process, walk around the classroom and ask learners who do not have much to say prompts to get them talking.

Reflect

1. Ask your learners to complete the Reflection section of the learning journal.

2. When every learner has completed their learning journal, you could ask some learners to share its contents and ask them questions as they do so.

3. **Optional**: At the end of the lesson, ask each learner to submit their completed learning journals somewhere where you have access in case you want to review them.