CreateBase

SAMPLE

Demo Educator Guide

Heat Seeker

Project Overview

Background

An overloaded electrical circuit has resulted in a fire inside a warehouse! The warehouse stores badly protected explosive hydrogen fuel cells. If we don't put out the fire quickly, the resulting heat from the fires will cause the hydrogen fuel cells to explode! The overloaded circuit and resulting fire have fried most of the factories wiring, so the power is out. Without lights, we have limited visibility. Sending human firefighters into the warehouse would be extremely dangerous with the risk that an explosion could occur at any time. Luckily, this warehouse utilises line-following robots to move its items around.

Synopsis

In this Project, learners will create an algorithm to guide a line-following robot to a series of fires within a warehouse, putting them out safely before they spread to the nearby hydrogen fuel cells! Learners will not only create their own control algorithm, but they will also learn about some of the basics of fire safety, warehouse automation, and the advantage that robots have over humans when operating in hazardous situations.

This Project is divided into nine lesson plans

01. **Define** the situation by playing and discussing a video with your class. You will then help them to accurately **Define** the problem that they will be solving in the Project.

02. Learners will **Imagine** their own solutions to the problem before being introduced to the solution that they will be implementing. You will also describe the approach to implementing this solution that students will be taking in this Project (solving five seperate sub-problems).

03. Learners will now use the platform to start to **Create** their solutions. They will begin by researching and then planning their solution to the first sub-problem.

04. Learners will continue to **Create**, coding their solution to the first sub-problem before researching the second.

05. Learners will continue to **Create**, planning and then coding their solution to the second sub-problem.

06. Learners will continue to **Create**, planning and then coding their solution to the third sub-problem.

07. Learners will continue to **Create**, researching, planning and then coding their solution to the fourth sub-problem.

08. Learners will **Create** their solution to the complete problem. They will plan how they will combine their solutions to each of the sub-problems together before writing and testing their code.

09. Learners will be given an opportunity to **Improve** their solution, before concluding the Project by spending time to **Review** their journey.

Project Overview

Subject Areas

- Technology
- Engineering
- Computer Science
- Line Following
- Fire Safety

Learning Outcomes

By the end of this Project, **learners** will be able to:

- Explain how and why line-following is used for navigation.
- Understand why we decompose problems.
- Understand the fundamentals of flow-based coding and write code using the Flow editor.
- Describe DC motors and outline how they work (optional).
- Describe IR sensors and outline how they work.
- Define comparators and conditionals.
- Write programs that use sensor data to control an output.
- Use logical reasoning to derive simple and more complex algorithms.
- Write programs that use conditional statements to control an output.
- Differentiate between different types of fires and how to deal with them.
- Define while loops and use them to solve problems.
- Combine the solutions to different sub-problems to solve a larger problem.
- Explore ways a solution can be optimised.

Equipment List

Learners require:

- Access to our digital platform through a laptop, PC or tablet (no account needed at this stage)
- Access to our learning journal through either Google docs or Microsoft Word

Educators require:

- The 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)

Table of Contents

Table of Contents

Project Overview

Adapting the lessons

The times given for each step of the Creation Process are only there to give you an estimate for how long they could take. You have the final say on how long to spend on each activity, depending on how much time you have available and how in-depth you want to discuss each topic. 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.

The content included in each lesson plan serves as an example of how you could deliver the Project contents to your learners. It is your choice whether you want to follow it to the letter, use it as a rough guide or do your own thing. You may also want to allow excelling learners to move fowards at a faster pace and start working on the (nearly endless) Improve step before the other learners.

Online learning

These lesson plans can be used for online learning.

If your school runs 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 under special circumstances, such as during a lockdown, it becomes difficult for students to have regular attendance. In that case, you can skip over the class discussion parts of the lesson plans and assign learners individual tasks (e.g. complete the first sub-problem in the Create step individually by DD/MM/YYYY).

We recommend that you use the learning journal with checkpoints to set completion targets for your class. Have them share their progress with you by making their learning journals available through email or Google Classroom.

Overview 1

Define (45 mins)

Introduce and discuss the Project with your learners with a video that showcases the situation. The goal is to have learners identify what has happened then work as a class to define the problem that they will be solving in this Project through the development of a Project brief.

Learning Outcomes

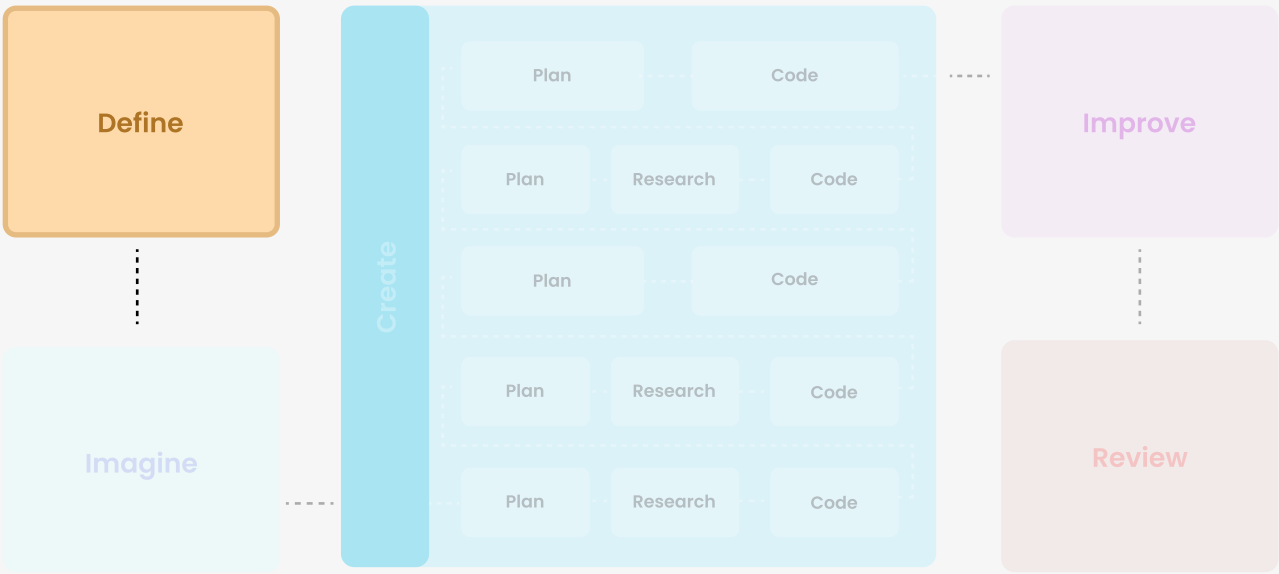
By the end of this lesson, learners will:

- Understand the situation.
- Understand the purpose of using line-following in warehouses.
- Be able to define the problem that they need to solve.

Lesson Resources

Situation cutscene

Project Progress



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, self-driving trains and self check-in machines at airports.

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.

3. **Line-following:**
   Line following refers to the process of directing a robot by making it follow a line (usually a black line on the floor). Line following requires the use of a series of sensors (normally infrared) to detect when the robot has strayed off the line and an algorithm that uses this sensor data to determine how to control the robot to keep it on the line. A lot of autonomous robots that always follow the same set of paths use line following to navigate as it is relatively cheap and easy to set up. The downside of using line following for navigation is that you are restricted to the predetermined paths set out with the physical lines.

Define Part I 10 mins

Use these steps for guidance

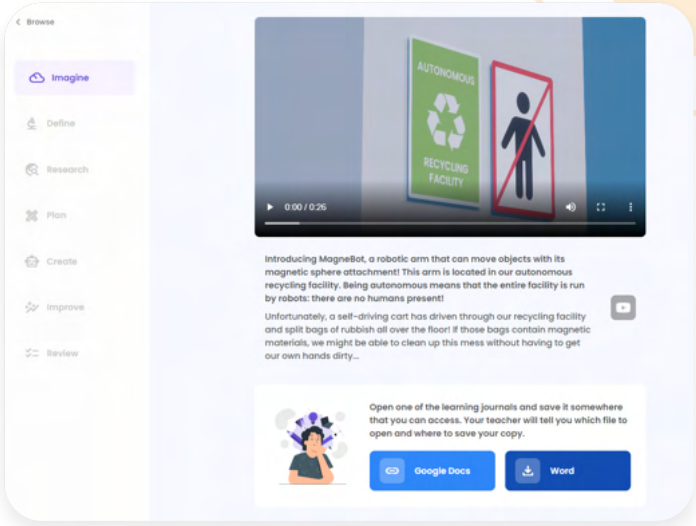
1. Bring all of your learners to the front of the class if possible.

2. Welcome the class, for example, by telling them that they will be completing a **Project** over the following nine 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 video of the situation to set the scene. You can then play the 68-second video on a projector for the class to watch. Access the video through the link on the right or the lesson resource.

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

   Discussion points could be based on the setting, the first problem that occurs, and then how this results in a chain of events leading up to the final (dangerous) situation.



https://app.createbase.co.nz/project/heat-seeker/0/define

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:

- An electrical fire starts in a warehouse. This warehouse uses line following robots to move items around.
- Firefighters arrive at the warehouse to put out the fire.
- A dangerous explosion occurs as the fire spreads to nearby hydrogen fuel cells, almost injuring the firefighters.

Helpful Examples

If you are finding it difficult to get your class 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:

0:06-0:10 seconds

Q "Where are we?"

A Inside a building/warehouse.

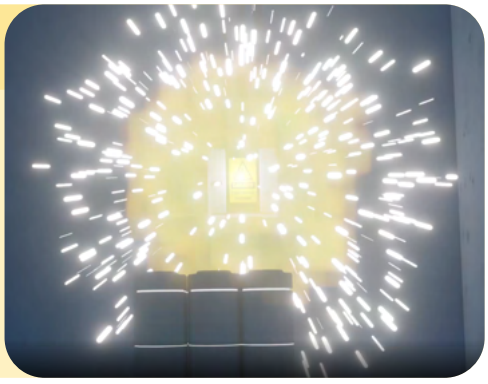
Q "What can we see inside the warehouse? What stands out as being unique?"

A There are white lines on the floor and a pair of robots that appear to be following the lines, each carrying an item.

0:11-0:27 seconds

Q "What has happened here?"

A A lightning strike has overloaded an electric circuit, resulting in a fire breaking out.



0:30-0:36 seconds

Q "What will happen next if we don't put out the fire?"

A The fire might spread to the other items in the warehouse (hydrogen fuel cells)."

Helpful Examples

0:37-0:50 seconds

Q "What happened?"

A Firefighters arrived to put out the fire, but an explosion occurred when they tried to enter.

Q "Why was there an explosion? "

A The heat from the fire caused the hydrogen fuel cells to explode.

Q "Why is this a problem?"

A If the firefighters had entered the building slightly earlier, they would have been caught in the explosion!

Summary

Q "What has happened?"

A A lightning strike resulted in a fire starting inside a warehouse that utilises line-following robots. When firefighters arrived to try and put out the fire, explosive hydrogen fuel cells stored within the warehouse ignited, almost injuring the firefighters.

Define Part II 10 mins

Now that you have watched the video with your class and you are happy that they understand what has happened, have an **in-depth discussion** about the exact problem that has occurred. 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!

Here are some examples of questions that you could ask to start discussions:

1. We know from the situation that a fire is spreading throughout the warehouse!
    a. **What do you think could have been done to avoid the fire?** - don't place any flammable/explosive items near open flames or sources of electricity.
    b. **What do most buildings have to detect a fire?** - smoke alarms.
    c. **What do most buildings have to automatically put out a fire?** - sprinklers.

2. We saw that there was an explosion when the firefighters tried to enter the warehouse.
    a. **Why did this occur?** - the heat from the fires increased the temperature and pressure of the hydrogen fuel cells until they exploded.
    b. **How could this situation have been avoided?** - safety/warning signs outside the warehouse that indicated the presence of dangerous/explosive items inside the building to stop the firefighters from entering. Use an automatic or human-free system for putting out the fire.

2. We don't want to purposefully send human firefighters into highly dangerous situations (at least, more dangerous than normal fires).
    a. Should we just leave the fire alone? Why or why not?
        i. **Why:** won't risk any more human lives.
        ii. **Why not:** the fire could spread to nearby buildings and if we manage to put out the fire early, we may save some of the equipment inside the warehouse.
    b. **If we can't send a human into the warehouse to put out the fire, what could we send instead?** - a robot.

Define Part II 10 mins

3. In order for a robot to replace one of our firefighters, what is it going to need to be able to do?

1. **Detect each fire**
2. **Move to the location of each fire inside the warehouse**
3. **Put each fire out**

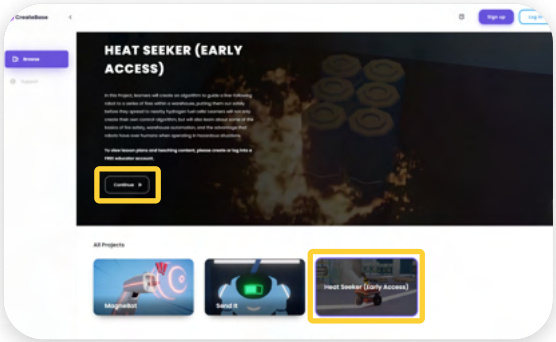
4. Bring the discussion to a close by linking it back to the situation video and clearly stating the problem and the brief:

> **"In this Project, we have a fire inside a warehouse that we need to put out. Because the warehouse contains items that are at risk of exploding due to the fire, is too dangerous to send human firefighters inside. We are going to have to come up with another method of finding and putting out the fires that does not require human presence."**

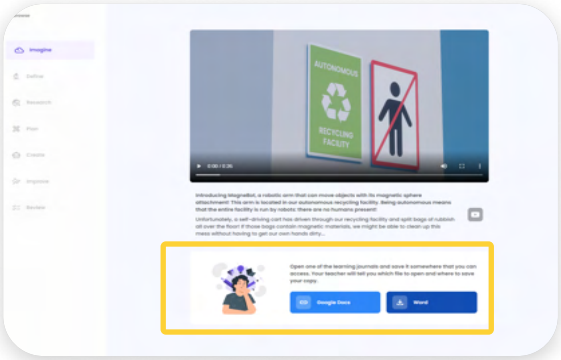
Define Part III 15 mins

If your learners aren't already on the platform, then now is the time to get them to log in to their accounts and access the Heat Seeker Project.

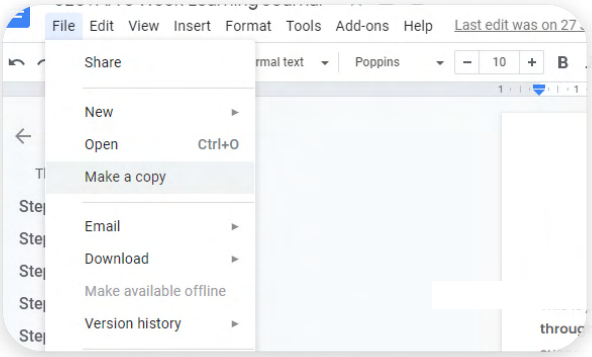
1. Tell your learners to visit https://alpha.createbase.co.nz/browse/heat-seeker and click continue.



2. Ask them to rewatch the situation video if they need a refresher and tell them to download either the Google Docs **or** Microsoft Word **learning journal** using either of the buttons underneath the video.



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.



3. Once downloaded, the learners should spend the remainder of the lesson answering all of the questions inside **Step 1: Define**.

3. If any students finish early you can ask them to move on to the Define step on the platform (the entire class will be going through this during the next lesson).

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.

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.

Overview 2

Imagine (45 mins)

Learners get the chance to brainstorm their own solutions before being introduced to the solution they will be building and the approach they will be taking to implement it.

Learning Outcomes

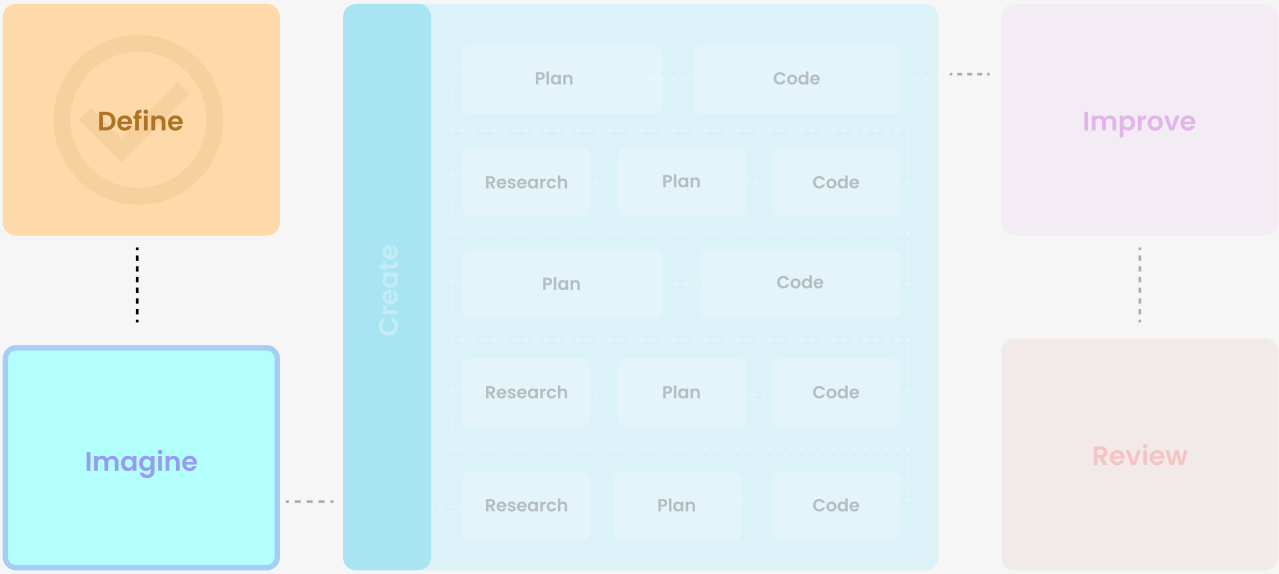
By the end of this lesson, learners will:

- Describe their own solution to the problem.
- Understand the approach that they will be undertaking to solve the problem.
- Understand why we decompose problems.

Lesson Resources

- Line Following
- DC Motors

Project Progress



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2. **Flow control/branching:**
   In programming, the flow of code refers to the order in which code is run, and actions are performed. Think about it like walking down a tile path, where each tile represents a line of code. When you stand on a tile, that line of code is run. By looking ahead at the upcoming tiles, you can see the order that each line of code will be run. If your path splits into two, you can no longer tell exactly which code will be run in advance until you decide which path to walk down. Flow control is all about how we write our code to make these decisions. Branching is the simplest form of flow control, where the code "path" splits into multiple paths.

3. **Algorithm:**
   An algorithm is a sequence of rules or instructions. Computers usually follow algorithms to perform a calculation or make a decision. Good algorithms are well-defined, meaning that they have a rule or an instruction for every relevant possibility.

4. **Loops:**
   In programming, a loop refers to a piece of code that is run multiple times. The number of times that the code repeats itself depends on how the loop is written.

Imagine Part I 20 mins

If some time has passed since the previous lesson, then go through the following questions with your class:

1. **What is the problem?** - There is a fire in a warehouse with explosive items.
2. **What needs to be done?** - We need to find and put out the fire without using any humans.

Now that you have defined the problem with your class and you are happy they understand the problem, we could move on to the Imagine step. The Imagine step is divided into 3 stages as below:

1. Imagine a solution:

Within this stage, your students should work in groups or individually to come up with their own potential solutions. They should be using the problems that they outlined in the Define step to determine if their solution would be fit-for-purpose. Their learning journals contain questions that help them to start thinking about potential solutions. You may ask your learners to simply complete the Imagine questions in their learning journals or you might want to carry out your own activity. Once the students have a solution in mind, try and get them to present their solution to the class explaining how it solves the problem. Ask your learners follow-up questions according to their answers to test their understanding of the problem.

2. **Explore our solution:**

   In this stage, you have the option to either explain to the student or let the students read the information within our platform regarding the solution that we are going to go through. The students should also try out the manual game and try to solve the problem using keyboard controls. At the end, try and have a discussion about what they observed within the environment and walk through their thinking process as they were playing the game: what decisions were they making, and what information were they using to make those decisions?

Main Highlights

The solution: A fire extinguisher is attached to a robot. The robot is programmed to follow a line, navigating between and putting out each fire.

- **Observations:** There are a few observations to look at:
  - It is challenging to navigate through the smoke with limited visibility. This may make a solution that involves navigating using cameras very difficult.
  - There is a possibility of human error occurring during manual control.

- **Process of thinking:** The learner should be able to identify how they reacted differently to each section of the track. Example sections include:
  - Straight lines
  - Slight curves
  - Sharp turns
  - FIre being close

Imagine Part III 10 mins

3. Divide the problem:

This stage aims to introduce your learners to the approach that they will be taking to solve the problem.

We are breaking our main problem down into a series of sub-problems that we can build individual solutions for, and then combine them at the end to solve the complete problem. This makes our problem more approachable by breaking it down into bite-sized chunks that we can focus on one at a time.

Students can read through this process using the third page of the Imagine pdf on the platform (https://app.createbase.co.nz/project/heat-seeker/0/imagine) and/or you could explain it to them briefly.

Main Highlights

The reason behind dividing of the problem

- Start implementing and testing at an earlier stage
- Easier to identify and fix any issues that occur along the way

- **The different subproblems**
  a. We need to program our robot to move.
  b. We need to program our robot to detect small curves in the line and adjust its movement accordingly.
  c. We need to program our robot to detect significant turns in the line and adjust its movement accordingly.
  d. We need to program our robot to detect the presence of a fire and automatically put it out.
  e. We will then combine each of these smaller programs to solve the complete problem.

After explaining the approach, you can conclude the lesson by letting your learners know that they will be able to start creating their solutions to the first sub-problem during the next lesson.

Sign up to continue

That is it for this demo!

If you would like to view the rest of this lesson plan, or the full lesson plans for any of our other Projects, please sign up to our platform using the following link:

https://app.createbase.co.nz/auth/signup

You will then be able to register your school to gain access to teaching content like lesson plans, learning outcomes and curriclum alignment.