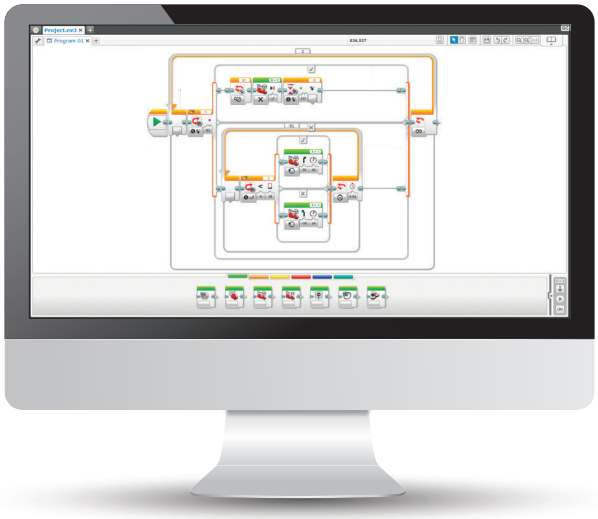
Activity 5

Traffic Lights and Automated Rail Systems

During this activity, the students will extend their understanding of the Colour Sensor and draw on their experiences of using the Loop Block by creating a program that simulates a 'stop – go' traffic light system.

In addition to this they will program their wheeled robot to follow a pre-determined path (or line) and they will be introduced to the Switch Block.



Activity 5
Lesson Plan

OUTCOMES

Students will be able to:

- understand that algorithms are capable of carrying out a series of instructions in order
- extend their understanding of Boolean logic and its uses
- use the Wait Block in relation to the Colour Sensor
- understand that the Colour Sensor has several functions and that it can measure a range of parameters
- extend the use of the Colour Sensor to recognise LEGO® system colours and reflected light intensity
- extend their understanding of the Loop Block
- understand the concept of a switch and how to use it for 'true' and 'false' commands

VOCABULARY

input, output, algorithm, wait, Colour Sensor, debug, ambient light, reflected light, loop, Boolean logic, switch

INTRODUCTION

- Explain to the students that they will once again be using the Colour Sensor. This time, though, they will be exploring its capacity to recognise and react to LEGO® system colours. They will also extend their understanding of how this sensor reacts to light. This time they will use reflected light intensity in order to create a program that will drive their wheeled robot along a given track. This will occur over the course of three challenges.
- Tell them that they will use the Colour Sensor to make their wheeled robot more autonomous and to simulate how a 'robot car' might respond to traffic lights, and that they will create a program that will make their wheeled robot drive around a given course or track.
- Ask them to think of real-life situations in which autonomous vehicles might operate, e.g. the Docklands Light Railway, etc.
- Explain that they will be exploring how switches and loops work, and how they could incorporate these into their programs.

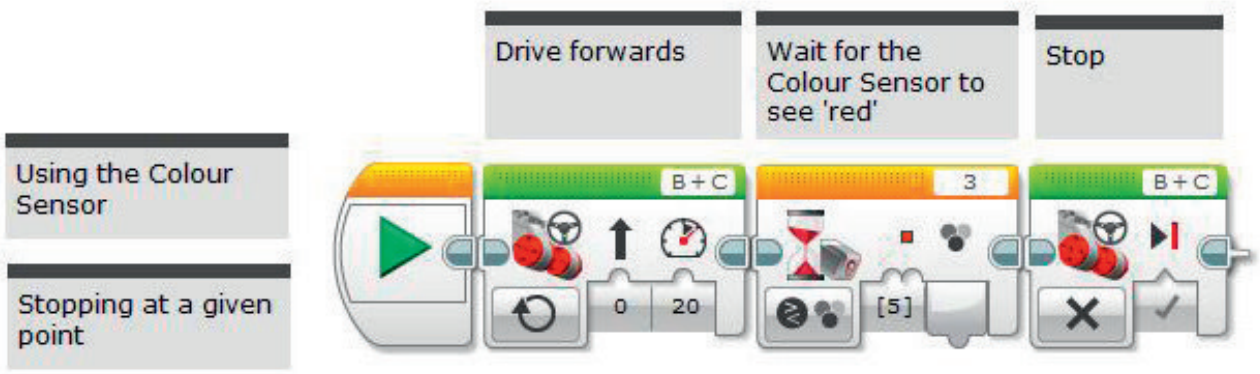
Activity 5
Lesson Plan

MAIN CHALLENGE 1

- The students will begin exploring the function of the Colour Sensor that recognises LEGO® system colours by programming their wheeled robot to drive along the table and stop at a red 'traffic light'.
- They will need to use the Wait Block in order to do this. Point out that the robot can eliminate colours or ignore them if they are detected.
- The students will create a program that uses the Colour Sensor to stop the motors when the sensor sees red.
- They will need to 'tell' the Colour Sensor to recognise the colour red.
- You may wish for the students to further explore this concept and to ensure that their programs work as required by experimenting using a range of colours.

Activity 5
Lesson Plan

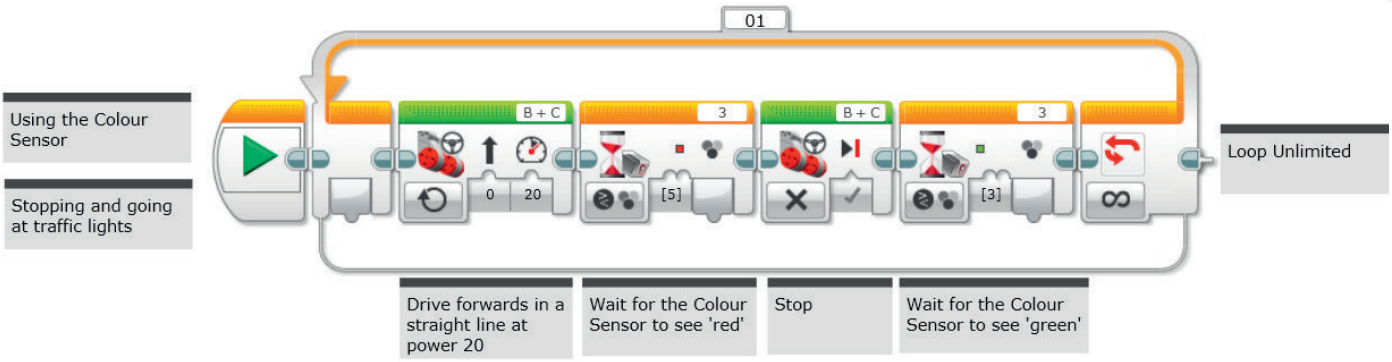
POSSIBLE SOLUTION
FILENAME: CS ACTIVITY 5
TAB: MAIN 1



MAIN CHALLENGE 2

- This challenge will require the students to simulate traffic lights more closely, by having their wheeled robot respond to a series of green and red signals.
- Re-introduce the Loop Block and reiterate the concept of a loop and its ability to make a program run indefinitely until it is manually stopped.
- Putting this inside a loop allows for the possibility of multiple 'traffic lights' along a track.
- Point out to the students that they will need to make sure that all other colours are deselected in order for the Colour Sensor to respond most effectively to the colours they choose (red and green).

POSSIBLE SOLUTION
FILENAME: CS ACTIVITY 5
TAB: MAIN 2



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MAIN CHALLENGE 3

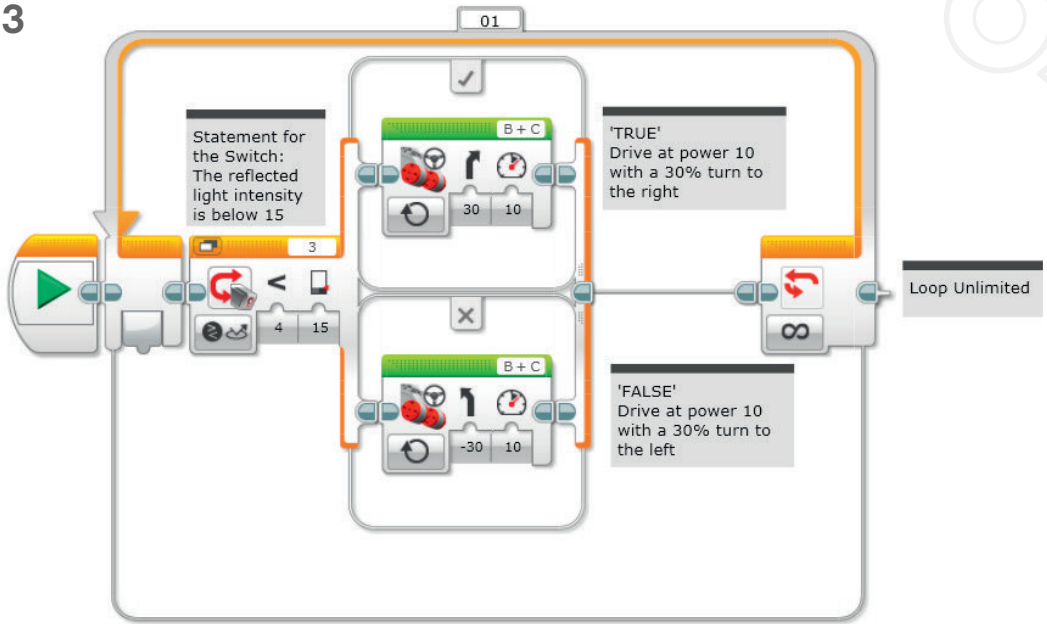
- In this activity, the students will contemplate how an automated vehicle might be guided along a road or track. How can they produce a line-following wheeled robot by using reflected light?
- The students will need to be introduced to the Switch Block, which will operate inside of a loop. Explain that a Switch Block can be used to automate a program that allows the wheeled robot to operate autonomously.
- Explain that the Switch Block is used to control the flow of a program and that the default Switch Block, using the Touch Sensor, is a classic example of Boolean logic. Demonstrate to the students how to change the block to the Colour Sensor and explain the trigger point. The trigger point is used to create the true / false statement (i.e. above the trigger point do one thing, below it do another).
- Point out that in order to create the line-following program, they will need to 'wiggle' the wheeled robot along the line. In other words, the wheeled robot will turn left and then right depending on whether the trigger has been crossed. Point out that the Move Steering Blocks that are used in the program will need to be set to 'On'.
- Once the wheeled robot is following the line, can it be improved so that it behaves more like a car, i.e. a straighter line rather than a wiggle?
- You will need to spend some time explaining the concept of a switch and how it is an example of Boolean logic.
- The students will once again use the Colour Sensor, but this time they will need to program it so that it responds to reflected light intensity.
- Tip: They will need to take reflected light intensity readings from the Port View in order to gauge which value to input into the Wait Block.
- Tip: This will work best using black tape on a very light (or white) surface.
- A possible extension from here would be to add a second Colour Sensor and to combine the line-follow and traffic light programs in order to simulate automated passenger services, such as the Docklands Light Railway.

Activity 5
Lesson Plan

POSSIBLE SOLUTION
FILENAME: CS ACTIVITY 5
TAB: MAIN 3

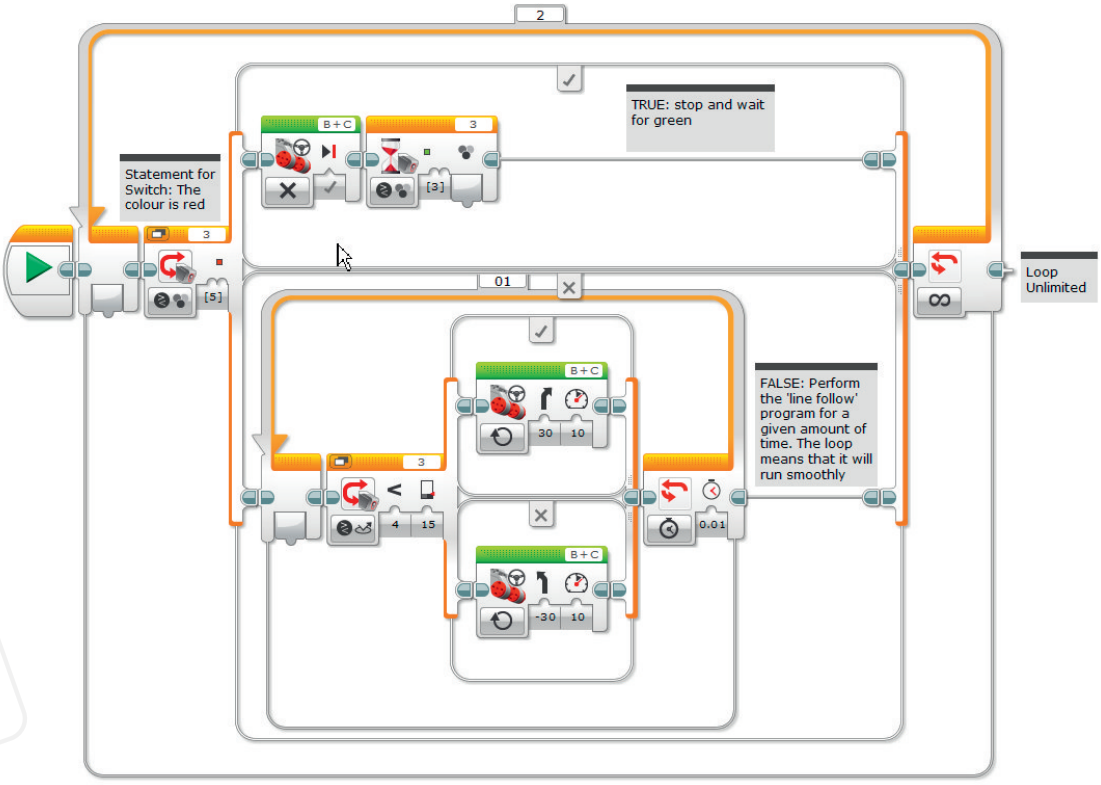
Using the Colour Sensor

Building on understanding of ambient light, using reflected light intensity to follow a line



POSSIBLE SOLUTION FOR EXTENSION ACTIVITY (SIMULATING THE DLR)
FILENAME: CS ACTIVITY 5
TAB: EXTENSION

Combine the concepts from the previous challenges to make the car travel along a black line, while stopping at traffic lights along the way



Activity 5
Student Worksheets

CHALLENGES FOR TODAY

Today you are going to use the Colour Sensor and the Switch Block in order to make decisions using Boolean logic. These two blocks will allow the wheeled robot to make choices based on the colours that it sees.

CHALLENGE 1

When driving a car, it is important to recognise and abide by the rules of the road.

What should a motorist do when they are approaching traffic lights?

If cars were automated, they would need to use some sort of sensor in order to recognise and respond to traffic lights automatically.

For this challenge, you will need to program your wheeled robot so that it responds to a 'stop' command. Which colour should you use in your program?

Use the Wait Block to program the Colour Sensor so that it recognises red and stops the wheeled robot.

Refine your program by making your wheeled robot stop at an appropriate distance from the 'traffic lights'.

Make sure that the wheeled robot is only responding to red by eliminating the other colours.

Blocks to Consider

Plan your program first. Write it in pseudo-code below:

Activity 5
Student Worksheets

CHALLENGE 2

Now that you have programmed your wheeled robot to stop at traffic lights, you need to make sure it goes again!

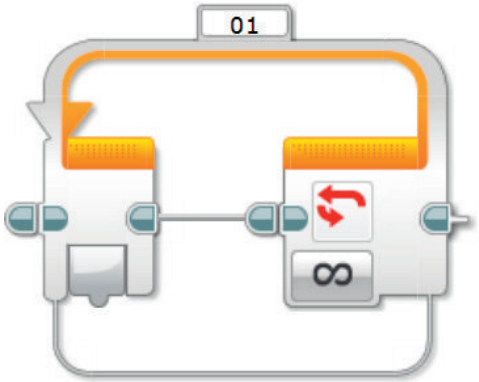
Create a program that uses the Colour Sensor to recognise and respond to both 'stop' and 'go' commands.

Which colours will you use?

What if there were multiple sets of traffic lights along the street? Can you change your program so that the 'stop – go' algorithm is repeatable?

Blocks to Consider

Use the same blocks that you used in programming task 1, but also consider using the following:



Plan your program first. Write it in pseudo-code below:

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Student Worksheets

CHALLENGE 3

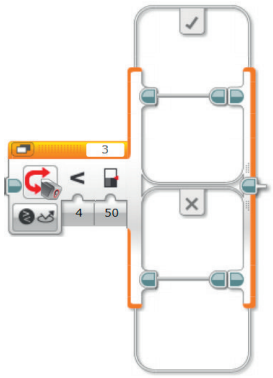
For this challenge, you will begin to make your wheeled robot even more autonomous. You will need to alter your model slightly so that the Colour Sensor is pointing downwards. Imagine that cars can drive on 'autopilot' along a given route, a little bit like driverless trains such as the Docklands Light Railway.

Your challenge is to program your wheeled robot to do just that. You will need to create a program that recognises and responds to the black line that has been laid out for you. Your wheeled robot will need to travel along that line without losing contact with it. You will need to constantly debug your program in order to make your wheeled robot travel as smoothly as possible along the line.

Tip: In the Port View, you will need to change the Colour Sensor settings so that it measures reflected light intensity.

Blocks to Consider

Use the same blocks that you used in programming tasks 1 and 2, but also consider using the following:



Plan your program first. Write it in pseudo-code below:

Activity 5
Student Worksheets

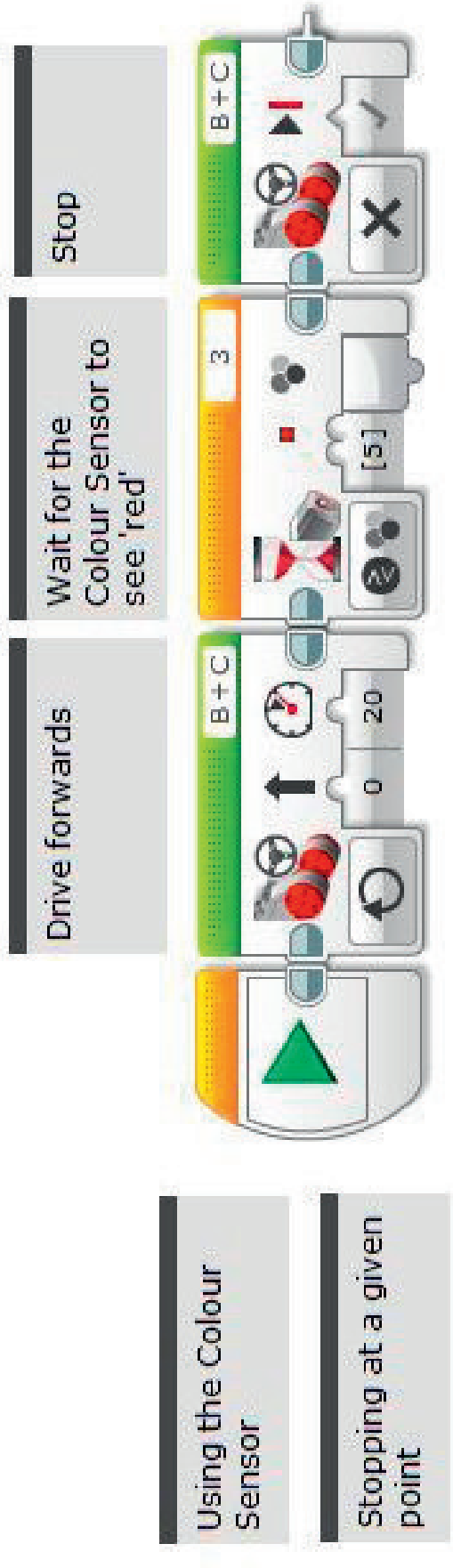
After a programming activity, it is important to note down your thoughts and observations. Consider the following points and then in the box below record how the activity went.

- How could you improve your program?
- Could your program have been more streamlined? Have you used too many blocks? Is there a more efficient way of building your program?
- What examples of real-world applications could you see your program being used in?

Thoughts and Observations

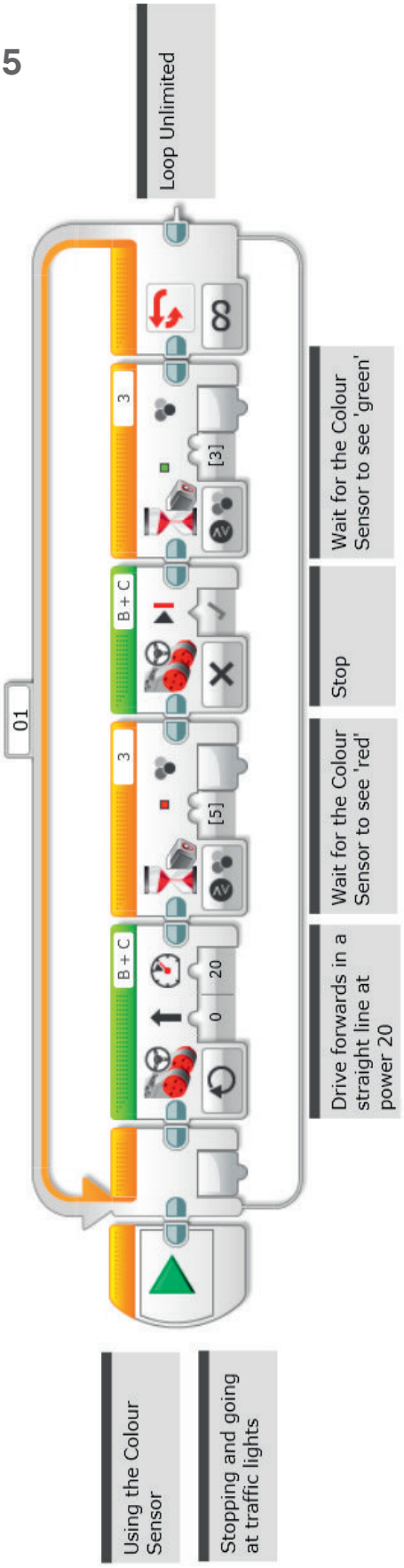
Activity 5
Appendix

POSSIBLE SOLUTION
FILENAME: CS ACTIVITY 5
TAB: MAIN 1



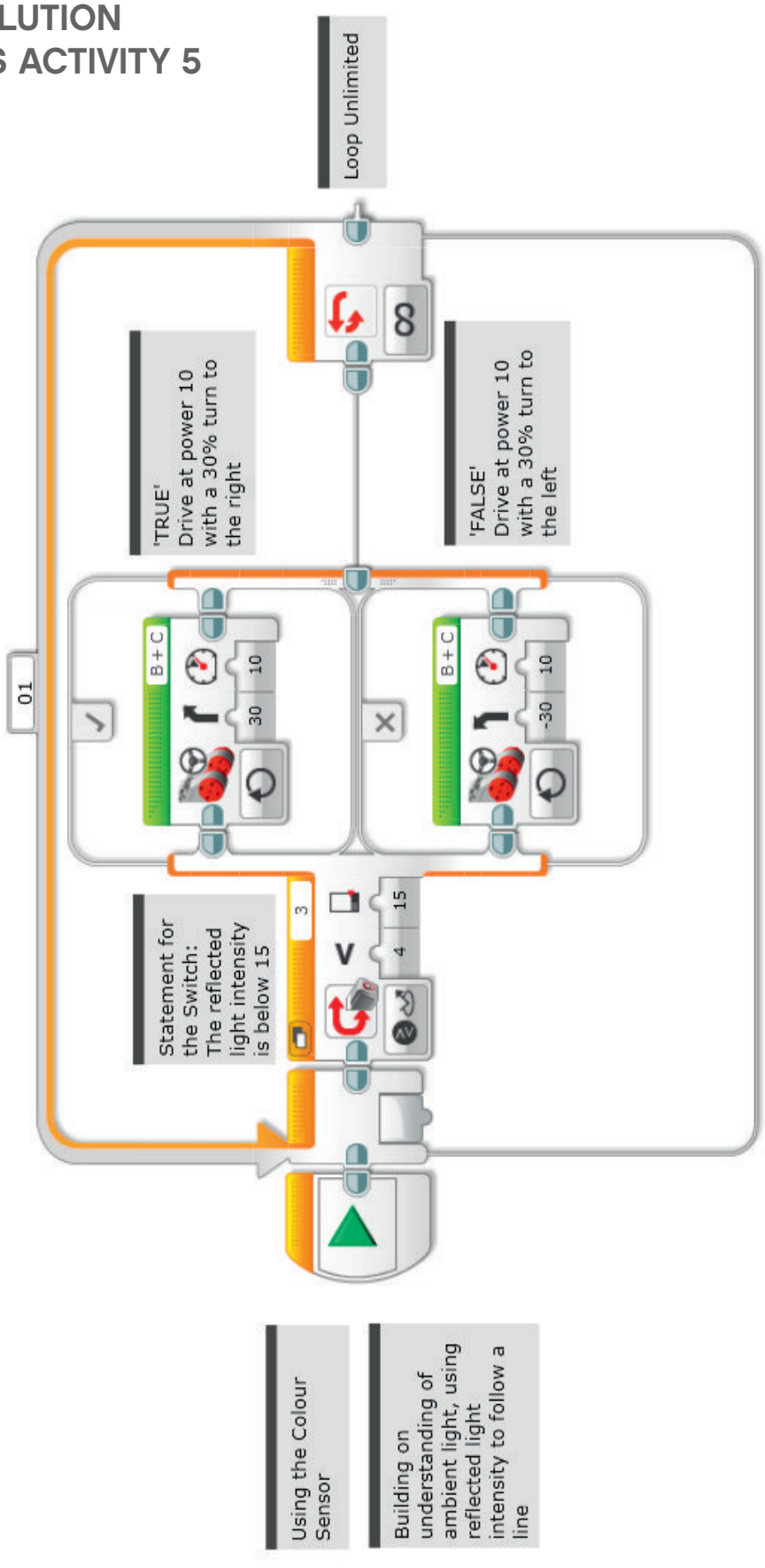
Activity 5
Appendix

POSSIBLE SOLUTION
FILENAME: CS ACTIVITY 5
TAB: MAIN 2



Activity 5
Appendix

POSSIBLE SOLUTION
FILENAME: CS ACTIVITY 5
TAB: MAIN 3



Activity 5
Appendix

POSSIBLE SOLUTION
FILENAME: CS ACTIVITY 5
TAB: EXTENSION