

LESSON 3(b): Search and Rescue

LESSON AIM:

Be able to program a sensor to allow our improved robot rescue vehicle to make decisions

Success Criteria:

Be able to program hardware (the colour sensor) to control the robot vehicle

Be able to control the large motor through accurate positioning

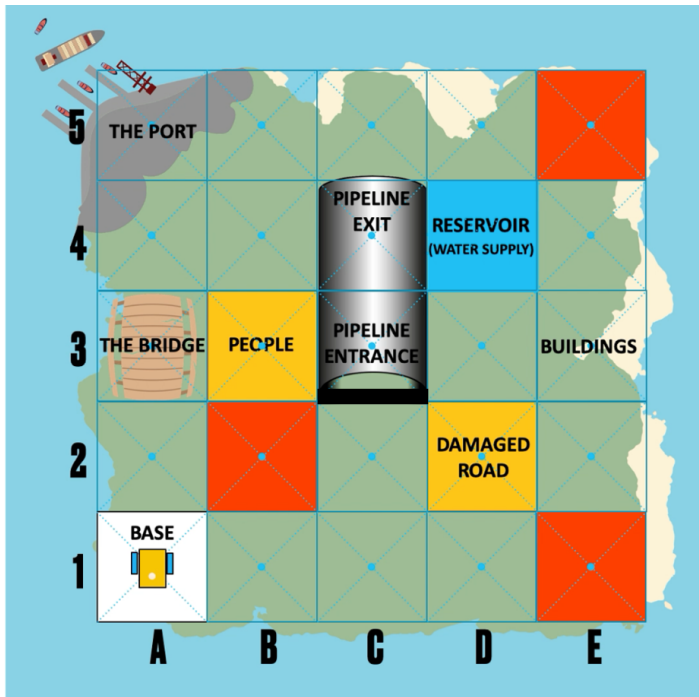
Create a program that makes decisions using variables (colour sensor value) and Boolean expressions

COVID-19

Schools should use and adapt these resources in line with their own school's policies in relation to COVID-19.

LEGO® Education have provided some support documentation and tips to make hands-on learning with LEGO Education fun, engaging and hygienic!

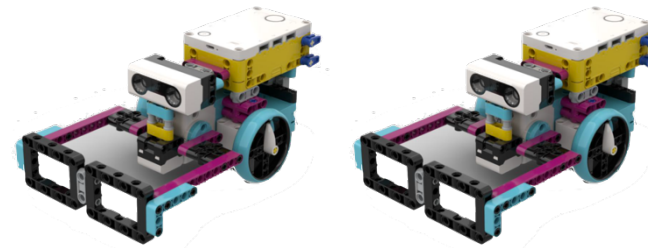
<https://education.lego.com/en-gb/support/in-person-steam-resources>



BEFORE THIS LESSON

Build (or have students build) TWO SPIKE Prime robot rescue vehicles using the instruction guide (L3_RescueRobotV2)

THEY WILL LOOK LIKE THIS...



Set up the island map in 3D in your classroom – using the guide (L2_MapGuide)

Print the 'Search' worksheet as required (L3_Search)

Print the 'Rescue' worksheet as required (L3_Rescue)

Download Lesson 2 Learning Presentation (L3b_LearningPresentation)

Check install of SPIKE Prime Software: <https://education.lego.com/en-gb/downloads/spike-prime/software>

Suggested Learning Sequence:			
Teachers could...	Students could...	Key Questions	Support or Challenge (Elaborate)
ENGAGE: 5 mins <i>approx.</i> - Teacher introduces students to the lesson by showing SLIDES 1-5 of the Learning Presentation (L3b_LearningPresentation). - Establish the success criteria and context of the lesson. - Reveal the new build model of robot vehicle including the colour sensor, distance sensor and large motor controlled grabber (SLIDE 4) and explore prior learning. - Explore context of lesson with students.	Students answer the questions in class discussion lead by teacher and share their prior learning and experiences, drawing on their knowledge of robot rescue vehicle v1.	“How has the robot vehicle been improved?” “Can you think how it might perform better?” “What sort of things do you think it could now be capable of doing?”	Support: Differentiated questions and close-up use of the robot vehicle build to support evaluation of the design, or annotate an image of build on the w/board.
EXPLAIN AND EXPLORE: 5 mins <i>approx.</i> Show SLIDES 6-7 - Explain what the key features of the colour sensor are and the LEGO colours it can detect. - Teacher can refer to resource sheet (L3_ColourSensor_Spec) for support if needed.	- Students watch and listen. - Students ask and answer questions about the colour sensor.	“What are 3 key features of a colour sensor? <i>See slide 6</i> <i>Prompt: the built-in light helps the sensor ‘see’ colour more accurately.</i> “Which colours on the mat will our robot vehicle be able to sense?” “What do you think we could program the robot to do when it senses those colours?”	Support: Live demonstration of the colour sensor at work with teacher explanation and Q&A. Challenge: Teacher might explain how the colour sensor works (use Slide 19-20 in the ‘Extras’ at the end of the presentation) .

EXPLAIN and EXPLORE: 10 mins <i>approx.</i> ▪ Show SLIDE 8 ▪ Teacher to explain what a Boolean block is. ▪ These can be easily identified in the App by their shape – they are hexagons! ▪ Show SLIDE 9 ▪ Teacher explains worked example using blue colour sensor block. ▪ Play SLIDE 10 ▪ John explains how to code the colour sensor, using it to make the robot vehicle stop when it senses (TRUE) a particular colour.	▪ Students listen and answer questions. ▪ Students will listen and watch.	“Look at the green Boolean blocks, if we wanted this block to be True, what value would I input?”	Support: Some students might not grasp the concept quickly; they will develop their understanding once undertaking hands-on learning when coding and any misconceptions can be addressed at that stage. Use this part of the lesson to ‘sew the seed’.
EXPLORE: 15mins <i>approx.</i> ▪ Play SLIDE 11 to remind students of the ‘Driver’ ‘Navigator’ roles. ▪ Show SLIDE 12 ▪ Teacher issues and explains the worksheet ‘Search!’ (L3_Search). ▪ Although the locations are at different distances, both the programs are identical because the robot decides when to stop. A big advantage of using sensors! EXPLAIN: 5 mins ▪ Show SLIDE 13 Coding the grabber! Teacher refers back to the use of the large motor in the earthquake simulator where it moved the tectonic plate forwards and backwards. Now they will use the motor to make the ‘grabber’ move up	▪ Students complete worksheet ‘Search!’ (L3_Search) using Word Blocks, creating the code for using the Colour Sensor to search out the damaged road (yellow zone) and then to search for the people (yellow zone). Students listen and answer questions.	“What would you predict this program will do?”	Support: Students might be directed to complete one rather than both search activities. Challenge: As the robot passes over red zones on the way to yellow zones, students could program their robot vehicle to respond when it senses red.

and down. This element of the build will be used to ‘grab’ people or (in a downward position) used as a ‘plough’ to push. EXPLORE: 15 mins ▪ Show SLIDE 14 Rescue! ▪ Teacher explains worksheet ‘Rescue!’ ▪ Resource: (L3_Rescue) ▪ Teacher to mediate to check accuracy of code and support with debugging. • At appropriate time intervals, the teacher invites student pairs up to the island map, to trial their programs on the physical map in a rotating carousel – taking it in turns when their programs are complete and they feel ready. Celebrate coding success & mission success! Additional Extension activities are on SLIDE 15 if required	Students use the programs they created when completing worksheet (L3_Search) – ADDING to their programs to incorporate both the colour sensor and the ‘grabber’ to solve the 2 challenges (clearing the damaged road and rescuing the people)	(see slide 15) <i>Prompt: grabber moves to down position, waits 2 seconds, moves to the upright position, waits 2 seconds, moves to the down position</i> “Does your robot perform as you expected? Do you need to debug any part of the sequence?” “Are your lines of code in the right sequence?” “How could you make your algorithm more accurate?” “Are all of the values correct?” “What is the advantage of using the colour sensor?”	Support: Teacher might provide a partly completed program to support students in completing the ‘Rescue 1 - Clear the Damaged Road’ challenge on the worksheet. Challenge: Students could develop their program so that their robot vehicle starts at BASE rather than in the grid references stated on the worksheet and return to BASE at the end of the program
EVALUATE (range of possible activities): 5 mins <i>approx.</i> Show SLIDE 16	• If time, students visit the mat to run their program and showcase their robot	Self-assessment statements: (Bricks or thumbs!)	•

Showcase students' coding success on the mat with robot vehicles completing the two challenges using the colour sensor and 'grabber'. Self-review: Students to self-assess their confidence with the key skills of the lesson using coloured LEGO bricks (if available) or thumbs (see self-assessment statements below). Play SLIDE 17: ● Watch the Careers links video (3 mins) – discuss the ideas presented and how it links to what they have been doing today.	vehicle completing a mission successfully! ● Students select either a green, blue or purple brick from the SPIKE Prime box which best represents their level of confidence in achieving the key aims of the lesson (see self-assessment statements below). ● Students hold up the selected brick for the teacher to review, celebrate and reward. ● Students share reflections on the careers video.	Green brick: I can program hardware (the colour sensor) to control the robot vehicle. Blue brick: I can control the large motor through accurate positioning. Purple brick: I can create a program that makes decisions using variables (colour sensor value) and Boolean expressions.	
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Key words and definitions:

Coding/Programming: *Writing a series of instructions to tell a computing device exactly what to do and how to do it can be changed*

Hardware: *The physical parts of a computer system*

Selection: *When a program has to make a choice*

Variable: *A value that is stored in a program but can be changed*

Boolean: *A variable where the value is either true or false*

Computing/Computer Science Links



Key Stage 2

- Design programs that accomplish specific goals
- Debug programs that accomplish specific goals
- Control or simulate physical systems
- Use logical reasoning to detect and correct errors in programs
- Work with various forms of input
- Work with various forms of output

	● Use sequence in programs ● Use logical reasoning to explain how some simple algorithms work ● Solve problems by decomposing them into smaller parts Key Stage 3 ● design, use and evaluate computational abstractions that model the state and behaviour of real-world problems and physical systems ● use logical reasoning to compare the utility of alternative algorithms for the same problem ● understand simple Boolean logic and some of its uses in circuits and programming
	Second Experience & Outcome (to end of P7) ● TCH 2-13a: I understand the operation of a process and its outcome. I can structure related items of information. ● TCH 2-14a: I can explain core programming language concepts in appropriate technical language. ● TCH 2-15a: I can create, develop and evaluate computing solutions in response to a design challenge. Third & Fourth Experiences & Outcomes (S1 – S2) ● TCH 3-13a: I can describe different fundamental information processes and how they communicate and can identify their use in solving different problems. ● TCH 3-13b: I am developing my understanding of information and can use an information model to describe particular aspects of a real world system. ● TCH 3-14b: I can describe the structure and operation of computing systems which have multiple software and hardware levels that interact with each other. ● TCH 3-15a: I can select appropriate development tools to design, build, evaluate and refine computing solutions based on requirements. ● TCH 4-13a: I can describe in detail the processes used in real world solutions, compare these processes against alternative solutions and justify which is the most appropriate. ● TCH 4-13b: I can informally compare algorithms for correctness and efficiency. ● TCH 4-15a: I can select appropriate development tools to design, build, evaluate and refine computing solutions to process and present information whilst making reasoned arguments to justify my decisions
	Progression Step 3 ● I can use sensors and actuators in systems that gather and process data about the systems' environment. ● I can explain and debug algorithms. Progression Step 4 ● I can select and use data structures that efficiently manage data in algorithms. ● I can plan and implement test strategies to identify errors in programs. ● I can select and use multiple sensors and actuators that allow computer systems to interact with the world around them.

- I can apply design principles in order to design a range of efficient user interactions.

Skills Builder – Universal Framework



During each lesson, you might wish to highlight one or more of the essential skills that students build over their lifetime. You might give students the opportunity to reflect on how successful they have been in developing these skills.

You can download resource L1_SkillsBuilder for further details of how the 'Universal Skills Builder Framework' links to the [Coding Success](#) project. Further details of the Skills Builder Framework and assessment opportunities can be found at www.skillsbuilder.org