

**STEM – Robot basics**

**Incorporating Digital Technologies and Mathematics**

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| **Unit name:** sTeM – Robot basics | **BAND:** Foundation to Level 2  This learning sequence focuses on Level 1. | **Approximate Time:** 3 x 1 hour sessions approximately |
| **Unit OVERVIEW:**  The problem is the bee needs to get to the flower. Create an algorithm to program a simple robot (such as a Bee-Bot or Blue-Bot) to follow your instructions using simple commands to solve the problem.  **What makes this unit have a STEM focus?**  Digital Technologies  - Creating Digital Solutions  Mathematics  - Number and Algebra: Patterns and algebra  - Measurement and Geometry: Location and transformation  Note: Teacher may also consider including discussion of bees pollinating flowers (Science: Science Understanding/Biological Science) in this learning sequence. | | |

# Curriculum being taught

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| **Technologies** | **Mathematics** | |
| **Digital Technologies** |
| ***Creating Digital Solutions*** | ***Number and Algebra***  *Patterns and algebra* | |
| ***Levels Foundation-2*** | ***Foundation*** | ***Level 1*** |
| F-2: Follow, describe and represent a sequence of steps and decisions (algorithms) needed to solve simple problems  [(VCDTCD017)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCDTCD017) | Follow a short sequence of instructions  [(VCMNA077)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA077) | Recognise the importance of repetition of a process in solving problems  [(VCMNA094)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMNA094) |
| ***Measurement and Geometry***  *Location and transformation* | |
| Describe position and movement [(VCMMG082)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMMG082) | Give and follow directions to familiar locations [(VCMMG099)](http://victoriancurriculum.vcaa.vic.edu.au/Curriculum/ContentDescription/VCMMG099) |

# Achievement Standards

***The highlighted sections identify the parts of the Achievement Standards addressed in this learning sequence***

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| **Digital Technologies** | **Mathematics** |
| **By the end of Level 2**, students design solutions to simple problems using a sequence of steps and decisions. | **Number and Algebra – Foundation**  Students…represent, continue and create simple patterns  **Number and Algebra Level 1**  Students…continue simple patterns involving numbers and objects with and without the use of digital technology.  **Measurement and Geometry - Foundation**  Students…use simple statements and gestures to describe location.  **Measurement and Geometry – Level 1**  Students … use the language of distance and direction to move from place to place. |

# Learning activities Equipment/resources

* Simple robots; examples suitable for young children include [Bee-Bots](https://www.bee-bot.us/) or [Blue-Bots](https://www.bee-bot.us/bluebot.html)
* [Programming command cards](http://barefootcas.org.uk/wp-content/uploads/2014/09/Bee-Bot-Resources-Barefoot-Computing-Programming-Command-Cards.pdf) – available free online from Barefoot Computing (small cards with symbols to show left and right turn, forwards, backwards, stop)
* [Bee-Bot fake bot cards](https://www.barefootcas.org.uk/wp-content/uploads/2014/09/Bee-Bot-Resources-Barefoot-Computing-Fakebots.pdf) – available free online from Barefoot Computing (small card versions of the Bee-Bot robot for practising)
* Masking tape for grid map on floor or grid map chart (grid consists four by five squares, with each square measuring 15 cm x 15 cm)
* Scissors
* Glue
* *Bee to flower* student worksheet (A3 grid map) – Refer to Appendix 1
* Learning intentions and success indicators for Robot basics handout – Refer to Appendix 2
* *Peer review on directional language* handout – Refer to Appendix 3
* Rubric for teacher: *Robot basics* learning sequence– Refer to Appendix 4

**OH&S**

Teachers should be familiar with the Victorian Department of Education and Training Risk management policy and references that provide tools and links to resources that assist in identifying and mitigating against risk in schools. <http://www.education.vic.gov.au/school/principals/spag/governance/pages/risk.aspx>

In this particular activity, consideration should be given to the following:

* Students may need to be supervised with scissors

**Key concepts and vocabulary**

* algorithm - a description of the sequence of steps required to solve a problem
* a simple robot –a machine that can be programmed to carry out task
* commands – instructions provided to the robot
* direction – left, right, forwards, backwards, turn and go
* location – particular place or position
* testing to debug – establishing why an algorithm isn’t working correctly

**Teacher instructions**

* Before the session, prepare the following resources:
  + Print the *Bee to flower* student worksheet (A3 grid template) (Appendix 1)
  + Print and laminate one set of *Programming command cards* for teacher use
  + Print *Programming command cards* for your students to cut up and paste on the *Bee to flower* worksheet. Please note, the term ‘pause’ will not be used in this learning sequence
  + Print and laminate the *Bee-Bot fake bot cards* – ensure there is at least one set of cards between two or three students
  + Display each of the learning intentions and success indicators around the classroom so students can see them (Appendix 2)
  + Print off *Peer review on directional language* handout(Appendix 3)
  + Print off *Teacher rubric for Robot basics* (Appendix 4)

***Session 1***

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| ***Learning intention and success indicator for students*** |
| * *I can correctly identify and use the language of forward, backward, left, right and go.* |

***Activity***

* Display the ‘I can’ statements around the classroom and make students aware of them (refer to Appendix 2).
* Begin with explicit instruction of directional language and have students physically move themselves left, right, forwards and backwards, in preparation for programming the robot.
* Have students provide directional instructions to their peers and practise the following movements: forwards, backwards, turn left, turn right, and go.
* Introduce the term ‘algorithm’ and explain the concept as a sequence of steps of decisions required to solve a problem. Explore different uses for algorithms in real life, such as operating a computer to write an email, or following a series of steps in the method of a recipe.
* Provide explicit teaching of how to give directional instructions, by using the laminated *Programming command cards* to show the command/s to students and giving verbal instructions at the same time. This will assist students with connecting the physical movement with the action of the card. For example, ask students to:
  + Take one step forward, turn right (using one Forward command card and one Turn right command card)
  + Turn left and go two steps forward (using one Turn left command card and two Forward command cards)
* Following guided instruction from the teacher, pair students together and ask students to select a series of commands, and give the instructions/commands to their partner to complete the physical movements.

***Session 2***

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| ***Learning intention and success indicator for students*** |
| * *I can design a simple sequence of steps (algorithm) to solve the problem of getting the bee to the flower.* |

* After students have experimented with creating different commands, introduce the problem to be solved – ‘How can you get the bee to the flower?’ Refer to *Bee to flower* student worksheet (Appendix 1).
* Ask students to cut out the Programming command cards and place relevant Programming command cards on the *Bee to flower* student worksheet to design a solution of commands to program the robot to travel from the start to the end point so the bee can get to the flower. Discuss the importance of using patterns to create an algorithm with the students. Do not get the students to stick the Programming command cards on the worksheet at this stage.
* Use the masking tape to create a grid map (15 cm x 15 cm squares) on the classroom floor or create a grid map chart. Get students to use the Bee-Bot fake bot cards to trial and debug their sequence of steps (algorithm) according to their *Bee to flower* student worksheet. If the sequence of steps does not work, have students repeat the process and manipulate the Programming command cards on the worksheet and then try again with the Bee-Bot fake bot and the grid map.
* After students have successfully trialled their sequence of steps, ask them to stick their selected Programming command cards onto the *Bee to flower* student worksheet.
* Ask the students to use the grid (either on the classroom floor or on their worksheet) to identify patterns in their algorithms.
* Get students to complete a peer review on directional language (refer to Appendix 3).
* Teacher could also ask students to reflect on testing to debug by asking the following questions:
  + What errors did you have to fix?
  + How did you fix the errors?
  + Who was responsible for fixing the errors? You or your partner?

***Session 3***

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| ***Learning intention and success indicators for students*** |
| * *I can test and debug program a robot to successfully travel from the bee to the flower*. |

* Ask students to use the robot and the grid map on the classroom floor to test and evaluate their chosen programming commands to determine if they have solved the problem of getting the bee to the flower.
* If students encounter errors, direct them back to checking their sequence of steps (algorithms) according to their *Bee to flower* student worksheet.
* Compare the different algorithms created by students, discussing the different ways students solved the problem. Discuss ways that the problem was solved using the:
  + least amount of commands
  + most amount of commands
  + shortest path
  + longest path
* Ask students to write up a self-reflection which will give evidence for assessment. Guiding question could include:
  + How many steps did it take to move the bee to the flower? Could you have done this differently?
  + Did you use a pattern when the robot travelled from the bee to the flower?
  + Did you use all the directional language? i.e. left, right, forward, backward and go?
  + Can you think when you might need to move ‘backwards’?
  + Why did you have to use the instruction ‘go’ when programming the robot?
  + Why was instruction ‘stop’ not used when programming the robot?

# Additional resources / references

Bee-Bot website - <https://www.bee-bot.us/>

*This website (American based) provides basic information about the Bee-Bot and accessories you can purchase. It also includes some basic information on how Bee-Bots have been used*.

Barefoot Computing teacher resources (Bee-Bot fake bot template) - <http://barefootcas.org.uk/wp-content/uploads/2014/09/Bee-Bot-Resources-Barefoot-Computing-Fakebots.pdf>

*This website provides a free download of the Bee-Bot fake bot template that you can print and use before using the Bee-Bot.*

Barefoot Computing teacher resources (command cards) - <http://barefootcas.org.uk/wp-content/uploads/2014/09/Bee-Bot-Resources-Barefoot-Computing-Programming-Command-Cards.pdf>

*This website provides a free download of command cards that you can print and use to support this activity. The commands included are: turn right, turn left, forwards, backwards, pause, and go. [Please note, that pause is not used in this learning sequence].*

Direct the robot to the flower **Appendix 1**

Name: \_\_\_\_\_\_\_\_\_\_\_

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|  |  |  | C:\Users\08796503\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\284X64FR\flower-outline-coloring-page[1].jpg |
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| Start |  |  |  |

**Appendix 2**

*‘I can’ statements to display around classroom*

* I can correctly identify and use the language of forward, backward, left, and right.
* I can design a simple sequence of steps (algorithm) to solve the problem of getting the bee to the flower.
* I can test to debug a program so the robot can successfully travel from the bee to the flower

# Appendix 3

# Peer review: Directional language

How well could your partner do the following tasks?

Complete the table below by ticking the number of smiley faces that you think best describes how your partner did each task.

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| **Tasks** | **☺** | **☺☺** | **☺☺☺** |
| Move forwards and backwards |  |  |  |
| Move left and right |  |  |  |
| Provide good instructions when testing the algorithm |  |  |  |
| Debug a program so the Bee-Bot fake bot could travel from the bee to the flower |  |  |  |
| Identify a pattern in their algorithm |  |  |  |

# Appendix 4

# Rubric for teacher: *Robot basics* learning sequence

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| **Elements from achievement standards** | **Indicators** |  | **☺** | **☺☺** | **☺☺☺** | **☺☺☺☺** |
| Demonstrates skill in investigating a problem/challenge to move the bee to the flower | Uses an algorithm to program a robot to move the bee to the flower | Insufficient evidence | identifies directional language of left and right | demonstrates the directional language of left, right, forward and backward to create an algorithm to program a robot | experiments with the use the language of left, right, forward and backward to create an algorithm to move the bee to the flower | applies the use the language of left, right, forward and backward to create an algorithm to move the bee to the flower |
| Insufficient evidence | identifies directional language of, forward and backward |
| Tests to debug an algorithm for a robot to travel from the bee to the flower | Insufficient evidence | tests to identify a way to debug an algorithm | tests to illustrate a way to debug an algorithm | experiments with testing to debug an algorithm for a robot to travel from the bee to the flower | demonstrates how to test to debug an algorithm for a robot to travel from the bee to the flower |
| Uses a pattern when creating an algorithm to follow directions | Insufficient evidence | identifies a pattern when creating an algorithm to follow directions | illustrates a pattern when creating an algorithm to follow directions | experiments with using a pattern when creating an algorithm to follow directions | applies a pattern when creating an algorithm to follow directions |