

Product Code: EL00535 / IT00143



Pro-Bot

Teacher Guide

Pro-Bot

Use the screen on the device to write programs, draw shapes and respond to inputs.

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Previous Experiences

Prior to using Pro-Bot children may have worked with Bee-Bot and Blue-Bot. Bee-Bot and Blue-Bot provide a good route into learning the basic concepts of programming.

Progression

The activities listed below are in a suggested order of progression. There is no specific amount of time to be spent on each as this will vary from one situation to another. It may also be necessary to break some of the activities down further to suit children's needs.

National Curriculum

The National Curriculum for Computing references below are indicative of some aspects of the curriculum the activities cover. They are not an exhaustive list nor do they indicate that one activity fully covers that curriculum area. The activities support children in learning computing skills and applying computational thinking.

National Curriculum for Computing

Key Stage 1

- Understand what algorithms are; how they are implemented as programs on digital devices; and that programs execute by following precise and unambiguous instructions
- Create and debug simple programs

Key Stage 2

- Design, write and debug programs that accomplish specific goals, including controlling or simulating physical systems; solve problems by decomposing them into smaller parts
- Use sequence, selection, and repetition in programs; work with variables and various forms of input and output
- Use logical reasoning to explain how some simple algorithms work and to detect and correct errors in algorithms and programs

Additional Support

A separate user guide is supplied with Pro-Bot.

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Key Focus 1 - Create a simple program using basic commands

Preparation

This activity may be done with or without a mat. Check Pro-Bot powers-up when switched on.

Activity

Some of Pro-Bot's control buttons mirror those of Bee-Bot and Blue-Bot, i.e. Forward, Backward, Left, Right and Go. Using these buttons allows Pro-Bot to be operated in an identical manner to Bee-Bot/Blue-Bot and enables progression to be made in small steps. As with Bee-Bot, mats and grids are available to support children's understanding of basic movement. Children should be given time to use these basic commands to make Pro-Bot move. This activity may effectively be a re-cap of Bee-Bot/Blue-Bot or a first introduction to Pro-Bot.



Key Focus 2 - Create a program using commands and parameters

Preparation

Check Pro-Bot powers-up when switched on. Identify a suitable surface to run Pro-Bot on. Smooth surfaces will allow Pro-Bot to move more accurately.

Activity

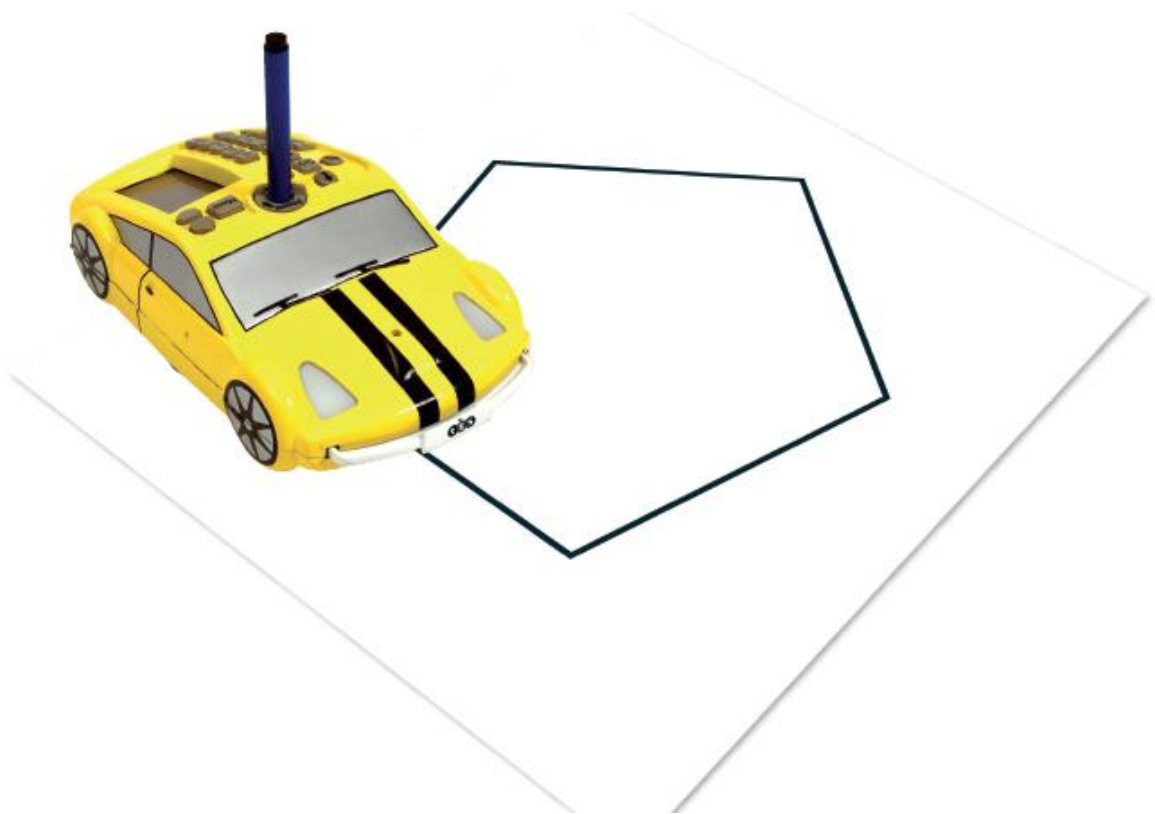
Once confident with the basic movements, children should begin adding parameters to commands, e.g. "Forward 10". 'Forward' is the command and '10' is the parameter. The parameter tells Pro-Bot how far to move forward. Angles of turn are also parameters that can be added to Left or Right, e.g. "Right Turn 45". Children should spend some time experimenting with parameters and noticing how these affect Pro-Bot's movement. They might work on creating regular polygons. A square is a good place to start.



Key Focus 3 - Use repetition in programming

Preparation

Check Pro-Bot powers-up when switched on. Identify a suitable surface to run Pro-Bot on. Smooth surfaces will allow Pro-Bot to move more accurately. Ensure large sheets of paper and felt tips are available.



Activity

After spending time experimenting with Pro-Bot and drawing simple regular polygons, pupils can begin to look at ways to become more efficient in their programming.

Pro-Bot has a 'Repeat' command. This can be used to repeat one or several commands. In the previous activity children might have used commands (such as the ones shown here) to draw a square.

Ask the children to look carefully at the commands. Can they see which instructions repeat and how many times they repeat?

The commands 'Fd 10' and 'Rt 90' are repeated four times. To draw the same square as the example above, enter the commands as shown.

Use a pen in Pro-Bot's pen holder to draw shapes. Which other regular polygons can be created? Try using Pro-Bot to draw an equilateral triangle. This is quite challenging and can provoke useful discussions about internal and external angles.

You might also talk about the relationship between the number of sides and the angles, e.g.

A square - 4 sides, external angle 90°

A pentagon - 5 sides, external angle 72°

An octagon - 8 sides, external angle 45°

Tip: For each of the above multiply the number of sides by the angle.

```
Main
Fd 10
Rt 90
Fd 10
Rt 90
Fd 10
Rt 90
Fd 10
Rt 90
```

```
Main
Rpt 4 [
Fd 10
Rt 90
]
```



Key Focus 4 – Using Procedures

(A set of instructions to complete a specific task)

Preparation

Check Pro-Bot powers up when switched on. Identify a suitable surface to run Pro-Bot on. Smooth surfaces will allow Pro-Bot to move more accurately. Ensure large sheets of paper and felt tips are available.

Activity

Procedures are a great way for pupils to solve problems by decomposing them into smaller parts.

In LOGO, the programmer can 'teach' a new command, for example to 'Square'. Every time the command 'Square' is typed, LOGO will carry out that procedure. Pro-Bot can be 'taught' new actions using its procedure functionality. For example pupils could use 'Proc1' to store instructions to draw the first initial of their name and 'Proc2' to store instructions for the second initial. By using 'Proc1' and 'Proc2' from the main program, Pro-Bot will then draw the children's initials.

Main
Proc40

NB Pro-Bot has a hidden 'Proc39' which draws a diamond and a hidden 'Proc40' which draws 8 diamonds as a star.

Key Focus 5 - Create a simple program one step at a time.

Preparation

Check Pro-Bot powers-up when switched on. Identify a suitable surface to run Pro-Bot on. Smooth surfaces will allow Pro-Bot to move more accurately. Find suitable objects to use as obstacles and resources to build a tunnel for Pro-Bot to drive through.

Activity

The curriculum for Computing 2014: 'Work with variables and various forms of input and output'.

Children's understanding of inputs and outputs may be supported using Pro-Bot. In previous activities, pupils have programmed **outputs** from Pro-Bot, i.e. wheels moving and lights switching on and off. Pro-Bot will also produce different sounds. These are all forms of **output**.

Pro-Bot may also help children understand **inputs**. It has front and back bumpers, a light sensor and a sound sensor - these are all **input** devices. Pro-Bot can be programmed to switch its lights on if the room goes dark or to back away and turn from an obstacle should it bump into one.

Try the following challenges:

Get Pro-Bot to switch on its lights as it drives through a tunnel, then switch them off as it leaves.

(This simulates the automatic headlights function on a real car.)

Get Pro-Bot to navigate around an obstacle using the front bumper.

Get Pro-Bot to work its way past several obstacles using front and back bumpers.

Program Pro-Bot so that it will not move until it 'hears' a noise.

All these challenges are fantastic for developing children's computing and problem solving skills, as well as their ability to work in a team!

Getting Started with Pro-Bot

Pro-Bot Basics – A Program



In a programming language, such as Logo, a program is a sequence of commands that are executed in the order specified. With the Pro-Bot, like the multi-award winning Bee-Bot®, a simple program can be developed using only the four arrow keys. Surprisingly complex and extended sequences can be created without requiring any other keys.

By default, pressing a or moves the Pro-Bot 25cm and pressing the or rotates 90°. Pro-Bot's memory can hold over 200 steps, making it possible to create longer and more complex program sequences.

Here's a sample program to get you started. After entering the following commands four time press and the Pro-Bot will trace out a square with 25cm sides. When writing programs on the Pro-Bot, the short form of the program commands is displayed on the LCD screen of the Pro-Bot:

	Forward	Fd		Back	Bk
	Right turn	Rt		Left turn	Lt
	Repeat	Rpt		Pause	Ps

TIP: If you want to stop the Pro-Bot when it is going, press the key again.

Editing Your Program

One of the great strengths of the Pro-Bot is its ability to edit the programs using the built-in LCD. Use the scroll keys above the display to move the cursor up and down the list of commands.

To insert a command in between two commands, move the cursor onto the command you want to insert after, then type the new command.

TIP: To insert in front of the first command of a program, move the cursor to the very top of the display (above the first command).

To delete a command, press the key.

Pressing will only delete the last key pressed on each line.

TIP: To delete the whole program or individual procedures, hold the key down for 3 seconds and select the required option using the scroll keys and key to confirm.

Repeat Loops

Clearly, typing those 8 commands in to draw a square is a very inefficient use of time and can be confusing to students. What we actually want the Pro-Bot to do is draw one side of the square, then turn 90° , and do that four times.

Of course, Pro-Bot can do that for you. Just tell it to repeat the two commands four times. Use the **Rpt** key to start this, then a number specifying how many repeats are required, then your command list, and finally the **]** key to finish the sequence. Pro-Bot will repeat all commands between these two keys as many times as you specify. For instance, to draw a 25cm square, press the following keys:

Rpt **4** **↑** **↻** **]**

Notice that Pro-Bot changes the order slightly on the display. This is to conform better to the Logo language specification whilst minimising the number of keys that need to be pressed. With only five key presses, we have made a much simpler program that can easily be modified to create other regular shapes.

TIP: If the number after the **Rpt** key is omitted, the loop will be executed 255 times.

Different Step Lengths and Angles

Pro-Bot is not limited to 25cm steps and 90° turns. To go different distances and angles, simply use the same commands you are used to but add the number of cm or degrees afterwards. For instance, to move 37cm forward, press: **↑** **3** **7**

To turn Pro-Bot left by 30° , press: **↶** **3** **0**

Using the number keys and the repeat loops, we can make Pro-Bot trace out more complex regular polygons, using the same program structure as before, but with changed numbers and 5cm sides. For instance:

Triangle:	Rpt 3 ↑ 5 ↻ 1 2 0]
Pentagon:	Rpt 5 ↑ 5 ↻ 7 2]
Hexagon:	Rpt 6 ↑ 5 ↻ 6 0]
Octagon:	Rpt 8 ↑ 5 ↻ 4 5]
Circle (approx):	Rpt 2 0 ↑ 1 ↻ 1 8]

TIP: To work out how many degrees to turn, divide 360 by the number of sides in the polygon. So a nine sided nonagon would need to turn by $360/9 = 40^\circ$ at each step.

Using the Pen Mechanism

With the pen mechanism, you can bring these shapes to life. Insert a standard (TTS / Berol) felt tip into the pen holder, then twist the levers clockwise to place the pen under slight pressure onto the writing surface. Ensure the surface below is capable of taking a dry wipe pen without damage.

When you have finished drawing, twist the levers anti-clockwise to lift the pen off the surface. There is no need to take the pen out every time.

TIP: It is easiest to fit the pen in correctly when the mechanism is in the “Up” position. Twist the levers anti-clockwise and ensure that the top of the mechanism is proud of Pro-Bot’s top surface.

TIP: Don’t put the pen in with the lid still attached or the lid will stay in! To remove the pen lid from the Pro-Bot, put the pen back in so that it fits back into the lid then push the pen up from the underneath using a ball-pen or similar.

K’Nex Compatibility

The Pro-Bot has been designed to be compatible with K’Nex. It has 4 K’Nex shaped mounting holes one in each corner to allow K’Nex pieces to be inserted.

Procedures – What is a Procedure?

Logo is a “procedural language”. This means that the main program can call other “secondary programs” (procedures) that each perform a specific function. For instance, one procedure could trace out a leaf, another could trace out a petal and a third could draw a stem.

The main program could use all these three procedures to draw a complete flower. Pro-Bot, of course, can do exactly this. In fact different groups of students could write the different procedures and the main program, then put them all together and see how well it works!

Pro-Bot has several different types of procedure. They are numbered from 1 to 39. Procedure numbers 1 to 32 are fully definable by you, numbers 33 to 37 are for sensors and 38 to 40 are the built-in, invisible, demo sequences. The other special procedures are also shown differently in the display and are:

- 33 FRONT: Run when the front touch sensor is triggered
- 34 REAR: Run when the rear touch sensor is triggered
- 35 DARK: Run when the light sensor goes from light to dark
- 36 LIGHT: Run when the light sensor goes from dark to light
- 37 SOUND: Run when the sound sensor is triggered
- 38 HEXGN: Draws a hexagon (not visible)

- 39 DIAMND: Draws a diamond (not visible)
- 40 FLOWER: Draws eight diamonds using proc39 (not visible)

Procedures – Using Procedures

To use an existing procedure in your program, press the **Proc** key followed by the number of the procedure you want to run. For example, to run the built-in hexagon procedure, you would use: **Proc 3 8**

The following example draws a simple flower, with each petal being drawn using a Procedure 1 (petal), which itself uses Procedure 2 (half petal).

```

Main          Proc 1      Proc 2
Rpt 6 [      Proc 2      Rpt 10 [
Proc 1       Lt 120      Fd 1
]           Proc 2      Lt 6
           Lt 60       ]
  
```




TIP: On complex programs it is best not to use 'Pause after command', so switch it off in the Config menu.

Procedures – Defining and Editing

To create a new procedure, press the **Menu** key then scroll down to the <New Proc> menu entry and press **Menu** again. You are then presented with a list of procedures from Proc1 to Proc32 and the sensor procedures. You can use any of the first 32 procedures for what you want, but the sensor ones are fixed and can only be used for their allocated sensor. Scroll down to the number you want to use then press **Menu** again to select it.

The top line of the display changes to the number of the procedure chosen, for example 'Proc 3'. You can then enter commands as you would normally. When you have finished entering commands for the procedure, press the **Menu** key again. To edit a procedure you have already written, press and scroll down to the <Edt Proc> menu entry and press **Menu** again. Scroll down to the number of the procedure you want to edit, then press **Menu**. Edit the commands in the list as normal and press **Menu** once more to complete the procedure editing.



Pro-Bot allows you to run any procedure from within any other procedure, even ones that haven't any commands in yet. If you run procedures that call each other, you may

get into an endless loop. Don't worry; just press the  key to stop the program running.

TIP: To completely redefine a procedure that you have already written, simply use 'New Proc' instead of 'Edit proc' and Pro-Bot will clear the procedure for you.

Menu System

Using the menu key gives you access to a number of other functions within Pro-Bot. Special commands can be added to your program, different configuration options can be selected and procedures can be managed.



The Menu system is entered by pressing the  key above the display. You are then given a list of menu selections. The first in the list is always <Back>, which allows you to go back one level of the menu. Use the up and down scroll keys to move the highlight to the menu item you want to select, then press  again to select that item.

The Menu system is structured as follows:

- Back Goes back one level
- New Proc
 - o <Select> Edit procedure with empty program
- Edt Proc
 - o <Select> Edit procedure with existing program
- Config
 - o Units
 - Cm Units are in Cm
 - Pro-Bot Units are in Pro-Bot lengths
 - o End of Cmd
- Beep on/off Enable beep after commands
- Pause on/off Enable pause after commands

- Sensors (NB. in version 1 all sensors are enabled together)
 - o Touch on/off Enable both touch sensors
 - o Sound on/off Enable sound sensor
 - o Light on/off Enable light sensor
- Clear
 - o Clr Main Clears Main procedure only
 - o Clr Proc Clears specified procedure
 - o Clr All Clears the whole program

Special Commands Menu

Press and hold  for 1½ seconds and a list of special commands will appear. Use the scroll keys to select the desired command, then select it with the  key. The special commands available are:

Light On:	Switches the Pro-Bot's headlights on whilst running
Light Off:	Switches Pro-Bot's headlights off
Sound 1:	Plays sound "witch on"
Sound 2:	Plays sound "button click"
Sound 3:	Plays sound "car horn"
Sound 4:	Plays sound "data transfer"
Sound 5:	Plays sound "transfer complete"
Sound 6:	Plays sound "error"
Sound 7:	Plays sound "go to standby"
Pen Up:	Has no effect but provides compatibility with Probotix
Pen Down:	Has no effect but provides compatibility with Probotix

Using Sensors


The most exciting thing about learning to program with the Pro-Bot is the four built-in sensors that can be used to control your program. Before you can use sensors in your program, you must enable them by selecting sensors from the Menu system and checking that they say "On".

You don't need to call the procedures for the sensors; they will be run automatically whenever the relevant sensor is activated. In fact, you would be very unlikely to ever use the command "Proc 33" in a program, although it is not forbidden.

Touch Sensors

When the front touch sensor hits an obstacle, procedure 33 FRONT will run. Similarly when you activate the rear touch sensor, procedure 34 REAR will be run. You can get Pro-Bot to do whatever you like when these are activated.

TIP: Why not beep the horn, reverse and turn slightly to avoid an obstacle? Put the following commands into procedure 33 FRONT:

Sound 3 (remember to press and hold  to access the special commands)
Bd 10
Rt 45

Then watch what happens when your main program causes it to run into an obstacle.

Light Sensor

The light sensor, mounted on the front of Pro-Bot, is sensitive to changes in the light level in the room. When the room lights go dark (below about 50 lux), procedure 35 DARK will be run. Similarly, when the room lights come back on (more than about 350 lux), procedure 36 LIGHT will be run.

TIP: Why not switch Pro-Bot's headlights on when the room goes dark, and switch them off again when it gets light?:

In procedure 35 DARK: "Light On"


In procedure 36 LIGHT: "Light Off"

Then watch the headlights go on and off when the room lights are switched off while running your main program. Perhaps your main program is drawing a square?

Sound Sensor


The sound sensor, mounted underneath, is sensitive to short sharp sounds such as a hand clap or a shout. It is only enabled during pauses so that the sounds of the motors do not accidentally trigger the sensor. You may want to insert a brief pause after every command – go to the Configuration menu and check that it says "Pause On" in the "End of Command" menu entry. If you do that, there will be a brief period after every command when the Pro-Bot will listen for your instruction.

Alternatively, you could insert a pause for a fixed length of time at the beginning of the program, or at specific points where you want the Pro-Bot to wait for you.


TIP: Insert a Pause 499 at the start of your program. When you press  Pro-Bot will do nothing until you clap, or shout at it, then the program will start running. You don't even have to put anything into the Procedure 37 SOUND for this to work!

Examples Using Sensors

Example 1: Turning lights on when going through a tunnel

Press  followed by New Procedure

Select Procedure 35 'Light to Dark' [35 DARK] using scroll keys

Press and hold the  button to access the special commands menu.

Select 'Light On'

Press  again

Select procedure 36 'Dark to Light' [36 LIGHT]

Press and hold the  button to access the special commands

Select 'Light Off'

Press  to return to the main screen

At the main screen, program Pro-Bot to move forward by pressing the forward arrow


 several times

Press  to start Pro-Bot


The program will look as follows in the following three procedures

Main	35 DARK	36 LIGHT
Fd 100	Light On	Light Off

Example 2: Reversing when front touch sensor is pressed


Press  followed by New Procedure


Select Procedure 33 'Front touch sensor' [33 FRONT]


Press and hold the  button to access the special commands menu.

Select 'Sound 3' to make Pro-Bot beep its horn

Press the back arrow key  to program Pro-Bot to reverse

Press the left arrow key  to insert a turn (by doing this Pro-Bot will continue reversing and turning until there are no obstacles in front of it)

Press  to return to the main screen

Press the forward key  and enter a large number such as 300 (This will ensure that Pro-Bot hits an object in the room before the program ends)

Press  to start Pro-Bot

The program will look as follows in the two procedures

Main	33 FRONT
Fd 300	Sound 3
	Bd
	Lt

Connecting to a PC

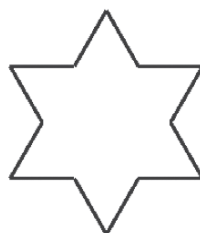
Only use the special USB cable provided with your copy of Probotix software (TTS Code – EL00477) (available separately) to connect Pro-Bot to the PC. Follow the instructions with Probotix to install the PC software.

The upload/download process is managed completely from the PC and all that needs to be done on the Pro-Bot is to ensure that it is switched on.

More Example Programs

6-Pointed Star

Rpt 6
[Fd 10
Rt 120
Fd 10
Lt 60]



5-Pointed Star

Rpt 5
[Fd 10
Rt 132
Fd 10
Lt 60]



Complex Flower

Main	Proc 1	Proc 2
Rpt 12	Rpt 30	Rpt 15[
[Proc 1	[Fd 1	[Fd 1
Lt 30]	Lt 3]]	Lt 6]
Rpt 24[Lt	Lt
Proc 2	Rpt 30[Rpt 15[
Lt 15]	[Fd 1	Fd 1
	Lt 3]	Lt 6]
	Lt	Lt



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