**Electrical conductors**

**Lesson 4: Making a conductivity tester**

**Introduction**

In this lesson, pupils build on their understanding of inputs by learning how to use the BBC micro:bit’s pins as inputs. They plan, write, test and debug MakeCode programs to use their micro:bits to test the electrical conductivity of materials before comparing this to the previous method they used. This lesson requires physical micro:bits.

**Time:** @60 minutes

**Learning objectives**

* To plan, write, test and debug programs
* To write programs that use selection
* To write programs that use inputs and output

**Materials needed:** computers/laptops with access to the MakeCode editor, micro:bits and associated hardware, crocodile clip leads, selection of materials used in lesson one when testing electrical conductivity, printouts of micro:bit testing sheet, printouts of slides 12 and 13, pin-support hex file.

**Lesson summary**

1. Introduction: Recapping inputs (10 minutes)
2. Using pins (15 minutes)
3. Creating electrical conductivity testers (25 minutes)
4. Comparing conductivity tests (10 minutes)

**Introduction: Recapping inputs (10 minutes)**

* Display **slide 3** showing the phrase ‘the BBC micro:bit inputs’. Invite pupils to recap their understanding of inputs from the previous lesson.
* Use the [link on **slide 4**](https://makecode.microbit.org/#pub:_2htEdAXKe7zD) to open the ‘How do I show the output?’ program in the MakeCode editor and give pupils a copy of slide 4 and a copy of the LED planner (**slide 13**). Explain that they are going to predict the output micro:bit will show when certain inputs are used by representing the LEDs that will be turned on using the planner.
* Ask questions such as, ‘*what will the micro:bit’s output be when I press button B*?’ In response, pupils can use the program to identify the output, in this case a serious face, and represent it by selecting the LEDs that will be lit on the planner.
* Use the simulator to test pupils’ predictions. Repeat several times using a different input each time. It is suggested that a maximum of five questions should be asked as this will leave enough space to use the LED planner for another activity in this lesson.

**Using pins (15 minutes)**

* Use **slide 5** to explain to pupils that the micro:bit has 3 large pins number 0, 1 and 2 which can be used as inputs by connecting crocodile clips to one of them and the another crocodile clip to ground pin (GND).
* Display the program [Pin-Inputs](https://makecode.microbit.org/#pub:_WKpHpv0mo8e5) in the MakeCode editor (**slide 6**) and ask pupils to state what condition needs to be met and what output will be displayed when the condition is/isn’t met. Test pupils’ ideas using the simulator.
* Ask pupils to demonstrate how to download the program and transfer it to a micro:bit. Then, connect crocodile clips to pins 0 and GND and explain to pupils that this creates an electrical circuit. Demonstrate this by touching the crocodile clips together and observing the change in the output (the sad face should change to a happy face because pin 0 has been pressed).
* Remind pupils that to use the input again the restart button has to be pressed and locate this on the back of the micro:bit.
* Ask pupils to suggest another material that could be used to complete the circuit and change the input (an electrical conductor).
* Select a material that pupils identify as an electrical conductor and invite a pupil(s) to complete the circuit by attaching it between the crocodile clips. Again, highlight the change in output (it should be the same as above).

**Creating electrical conductivity testers (25 minutes)**

* Use **slide 7** to ask pupils to think/pair/share how the micro:bit can be used to test the electrical conductivity of materials.
* Discuss the program that pupils will need to write to achieve this. Identify that micro:bit will need to display one image if pin 0 is pressed (the material is an electrical conductor) and another image when it isn’t pressed (the material isn’t an electrical conductor).
* Give pairs of pupils a copy of the LED planner and the decision box recording sheet (**slides 13 and 14**) and ask them to plan their program by identifying the condition that needs to be met (which pin needs to be pressed) and the outputs (images) to be displayed when the input is/isn’t pressed (slide 8).
* Give out copies of the **micro:bit testing sheet** and time to plan, program and carry out their electrical conductivity test using their micro:bits. After using the same materials as in lesson one, encourage pupils to identify objects in the classroom that they can take the micro:bit to and test.

**Comparing conductivity tests (10 minutes)**

* Ask pupils to identify the two ways they have tested the electrical conductivity of materials in this unit - using an electrical circuit and using the micro:bit (**slide 9**).
* Display **slide 10** and invite pupils to explain what the terms *pros and cons* means. Ask pupils to discuss in their pairs the pros and cons of both ways of testing the electrical conductivity of materials (examples are included in the slide speaker notes).
* Discuss as a class and use the learning objectives on **slide 11** to review pupils’ learning.

**Extension ideas**

Pupils could use the pros and cons identified for each way of testing the electrical conductivity of materials as the basis for producing a comparative text on the two methods.

**Differentiation**

**Support:** Import file [**pin-support hex file**](https://makecode.microbit.org/#pub:_EMUbdzTjsMcY)into the MakeCode editor to provide pupils with the structure of the program in which they create the images to be shown when the pin is/isn’t pressed.

**Stretch & challenge:** Pupils could be challenged to write a program that uses a different pin from pin 0 which is used in the lesson examples.

**Opportunities for assessment**

* Informal assessment of pupils’ understanding of selection, inputs and outputs through class and group discussion.
* More formal assessment of pupils’ plans and programs.