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**Energy awareness
Lesson 2: Energy data planning**

Students program a BBC micro:bit to measure light readings and plan where reliable energy usage data can be gathered.

**Learning objectives**

* Understand the importance of planning when collecting data to ensure it is reliable
* Program a micro:bit to take measurements of environmental data (a light meter to measure light levels)
* Understand the importance of baseline measurements and calibration when collecting data

**You will need**

Downloadable resources:

* Student handouts
* Lesson slides
* Lesson plan
* HEX files

Other resources:

micro:bits, micro:bit battery packs, student work from previous lesson, paper - writing (optional), pens (optional), spreadsheet (optional)

**Review and introduction**

Invite students to share their best ideas from the previous activity to recap how they can monitor electric light usage around our school or homes.

Discuss practical considerations and reach consensus about the best places to place a light data logger.

Explain that in the next lesson they will be making a timer to measure how long lighting is switched on for.

Discuss that firstly, they will need to make a light meter to take readings of the light level to find out how much light is measured when the lights are on or off. They will then use this to decide which locations allow reliable collection of data and calibrate the timer (which will be made next lesson). Highlight the need to take accurate baseline light readings when the lights are on and off in order to calibrate the timer (slide 3).

**Make a light meter**

Ask students to make predictions about what the program below does (MakeCode blocks or Python text code). If you open the code in the MakeCode editor, you can use the simulator and ask a student to demonstrate changing light levels and what happens when you press the buttons. (Slide 4)

Downloaded program files:

* energy-awareness-2-makecode.hex
* energy-awareness-2-python.hex

The key concepts (slide 5) are:

* it uses a variable called reading to store the light level recorded by the micro:bit's built-in light sensor input, which is in the LED display
* it takes a new light level reading when you press button A and stores it in the reading variable
* the light level reading is shown on the micro:bit's LED display output when you press button B

You can optionally show the video from the Energy light meter Make it: code it project to help explain the program and how to use it: <https://youtu.be/1UJXPZrxPh0> (Slide 6)

**Test the light meter**

Invite students to test out the light meter by flashing the code on to micro:bits. Use either the downloaded HEX file or flash it from the MakeCode or Python editors.

Using the instructions below (slide 7), ask students to take test readings at their desks with the micro:bit uncovered then covered with paper or a book to simulate lights being turned on and off.

Remind them the light sensor is built into the LED display, so you need the micro:bit's front to be pointing towards the light source.

* Place your micro:bit where you want to take the light reading, cover it over or turn the lights off and press button A.
* Uncover it and button B to see the light reading. This will be a number between 0 and 255.
* You can press B again if you're not sure of the reading.
* To record another reading with the lights on (or with it uncovered) press button A again and then press button B to see the number.
* You should see a consistent difference between the values - lower numbers when the lights are off or micro:bit is covered and higher values when the lights are on and the micro:bit is uncovered.

**Use the light meter**

Recap with students the different areas chosen to take light readings.

Ask students to attach battery packs to their micro:bits and use the light meter take at least 3 readings in these areas. Highlight that for the readings to be useful, they need the difference between when the lights are on and off to be as large as possible.

If possible, you, or your students could also gather information about the wattage and type of lighting used in each location, which will be useful in lesson 5 on measuring energy usage.

Encourage as many readings as possible in each area. Students could collate and calculate averages from their own or class results using paper or the sample spreadsheet provided. (Slide 8)

**Review**

If you wish, recap the learning objectives. (Slide 9)

Invite students to share and explain:

* their views on the best locations for recording light usage data and why their choices will allow the most reliable collection of data.
* Whether they encountered any problems and how they approached and overcame them
* What they would change were they to do this again (slide 10)

**Differentiation**

Support

* Students could work in pairs or small groups to record and collate data together.
* Students could use the spreadsheet on a laptop or tablet to record their data, or use a voice recorder.

Stretch & challenge

* Students could use Python instead of MakeCode blocks
* They could collect more data in more locations, justifying their decisions.
* Students could make improvements to the light meter code, for example calculating the average of multiple readings on the micro:bit itself

**Opportunities for assessment**

Informal assessment of students' approach and data collection. E.g.:

* Did the students record more than one reading in each location?
* Were the values consistent?
* Did they correctly calculate average readings for a given location? If not, did they take steps to account for this or fix it?
* Have students collectively found at least one good location to record light usage data next time?