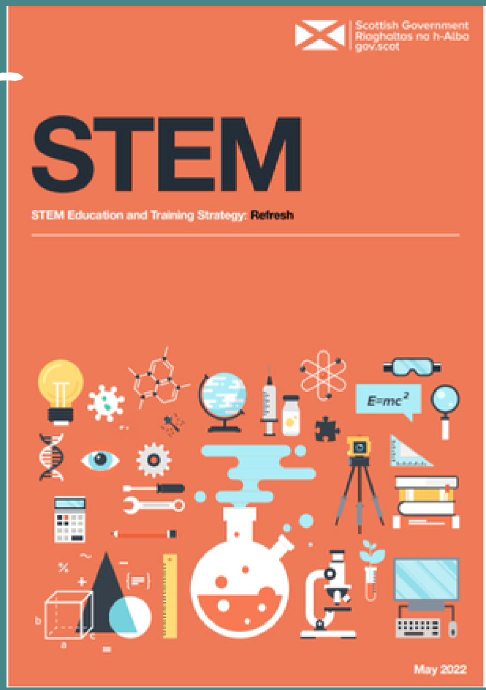
AIR QUALITY

INTERDISCIPLINARY PROJECT:
ENVIRONMENTAL SCIENCE, TECHNOLOGY AND BIOLOGY

sserc

STEM education and training seeks not only to develop expertise and capability in each individual field but also to develop the ability and skills to work across disciplines through interdisciplinary learning.



GROUNDED IN THE SCIENCE CURRICULUM

Biodiversity and interdependence	I have collaborated on investigations into the process of photosynthesis and I can demonstrate my understanding of why plants are vital to sustaining life on Earth.	SCN 3-02a
Processes of the planet	I can explain some of the processes which contribute to climate change and discuss the possible impact of atmospheric change on the survival of living things.	SCN 3-05b

N5

National 5 Environmental Science
Sustainability, Key Area 4: Energy
c - The "enhanced" greenhouse effect.

Materials required for this project

- BBC Micro:bit
- Monk Makes Air Quality Kit for Micro:bit (available from Kitronix)
- Device

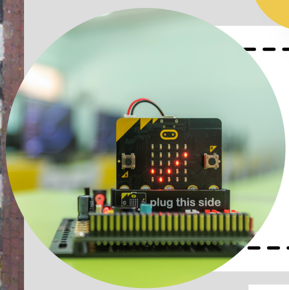
The two investigations in this project pack require two chunks of code, available to download in this resource. One will support outdoor measurements, while the other turns the Micro:bit into a data logger and should be carried out indoors.

Your Project

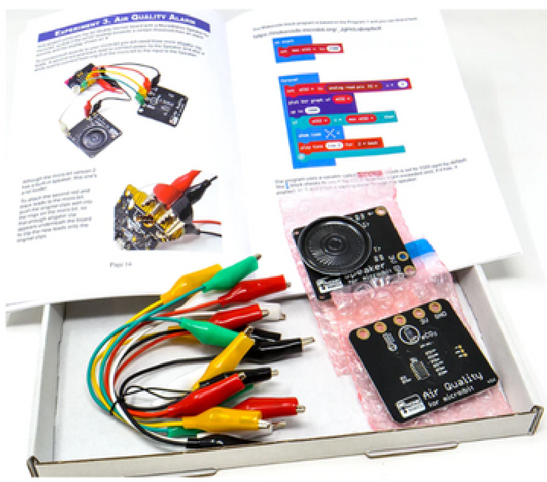
Introduction & Aim

As the human population continues to grow, our activities accelerate the enhanced greenhouse effect. Increasing levels of road traffic affects air quality, which is correlated with health conditions such as asthma. Various counter-measures have been put in place across the country, from promoting the use of public transport, limiting the use of transport around city centres and planting more trees.
In this project, you will measure the impact of road traffic and green plants on air quality.

The BBC Micro:bit



You will need a device, BBC Micro:bit and a Monk Makes Air Quality accessory kit (available from Kitronix).



Part 1: Road traffic

Aim: To investigate the effect of proximity to a busy road on air quality, using a BBC Micro:bit.

1

Code the micro:bit as an Air Quality Meter using the Monk Makes accessory. Click the blue button below to access the code, press **edit** on the screen that appears and then **download.**

Download the Air Quality Meter code

This short video will take you through the steps.

A note about the BBC Micro:bit Monk Makes Air Quality accessory: This air quality sensor board measures the level of volatile organic compounds (VOCs) - not carbon dioxide concentration. This is why it is more affordable. Accurate measurement of carbon dioxide levels requires more sophisticated technology.

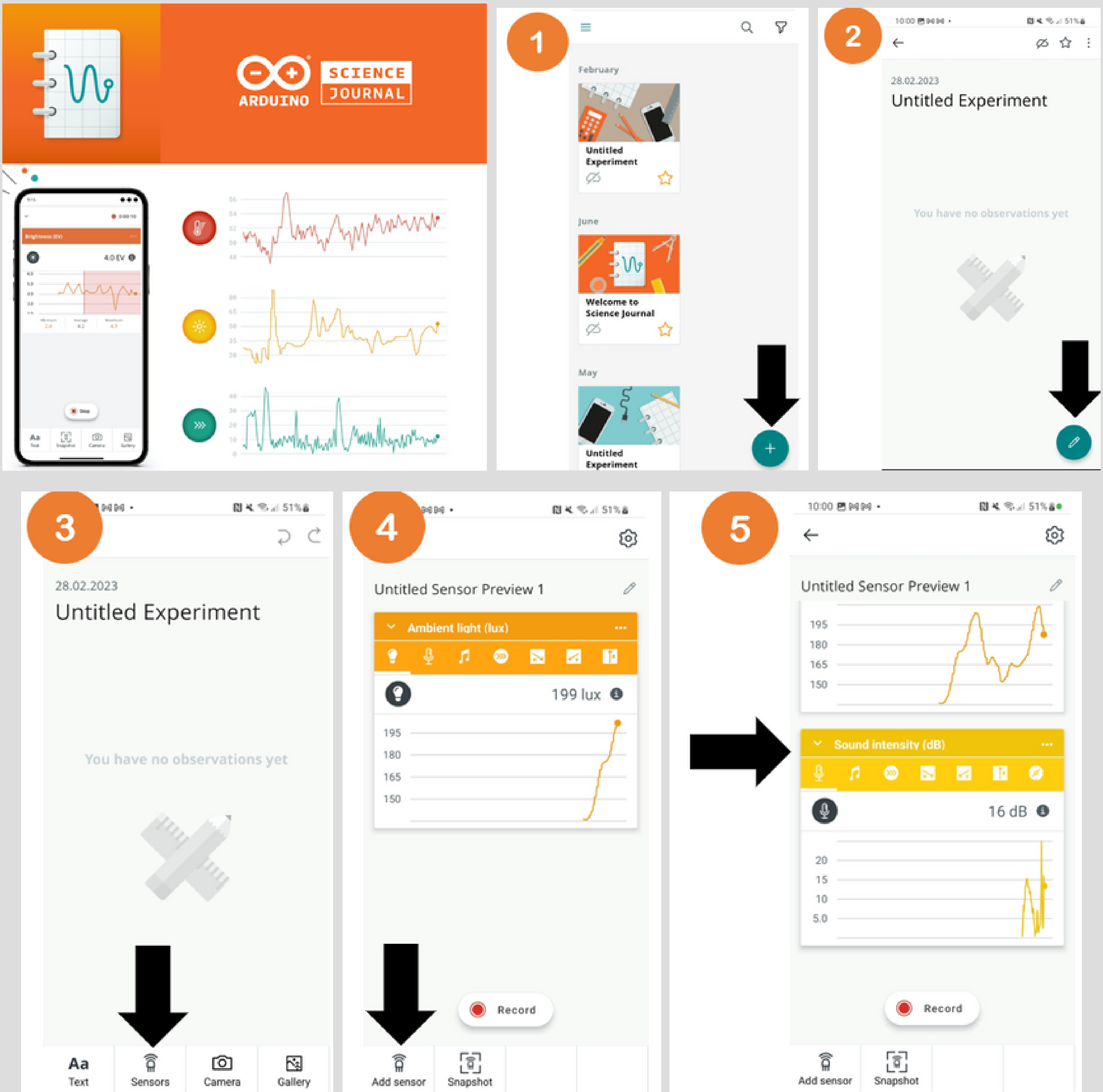
However, the level of VOCs rises at a fairly similar rate to the concentration of carbon dioxide, providing an indirect estimation of the relative carbon dioxide levels in the air.

Carbon dioxide concentration (ppm)	Notes
250 - 400	Average concentration in ambient air
400 - 1000	Concentrations typical of indoor spaces with reasonable air exchange
1000 - 5000	Recent research suggests that levels as low as 1000 ppm are likely to impact human health, e.g. loss of concentration, kidney problems, increased heart rate
5000	Long-term workplace exposure limit in most countries

2

Download the Arduino Science Journal app to a smartphone.

Start a new experiment and add the **sound** sensor. The screenshots below provide a step-by-step guide on how to access the sensor.



3

With your coded micro:bit, identify a suitable outdoor location close to a road with a reasonable level of traffic. Ensure you have listened carefully to your teacher's risk assessment.

Starting approximately 1 metre from the road, record the noise level using the Arduino Science Journal app and then record the VOC levels using the micro:bit. Input the data into the table.

4

Using a trundle wheel (or suitable alternative), move to a position approximately 10 metres from the road. Repeat the two measurements: sound level and VOC level.

Repeat these measurements at 30 m and 40 m from the road.

distance from road (m)	sound level (dB)	VOC level (ppm)
1		
10		
20		
30		
40		

5

Plot your data as a scatter graph and draw your line of best fit. Reflect back to your aim: **To investigate the effect of proximity to a busy road on air quality**. What is your conclusion?

6

Taking it further:

- Think about the impact of what you have found out. If the concentration of VOCs is correlated with carbon dioxide concentration, what consequences could you predict for increasing road use as the human population continues to rise?
- What can individuals and wider society do to deal with this problem?
- Could you design a further investigation to estimate the impact that heavy road use has on other organisms?

Part 2: The impact of plants

Aim: To investigate the effect of plants on air quality, using a BBC Micro:bit.

1

Code the micro:bit as a data logger, capable of measuring temperature and VOC concentration continuously. Click the blue button below to access the code, press **edit** on the screen that appears and then **download.**

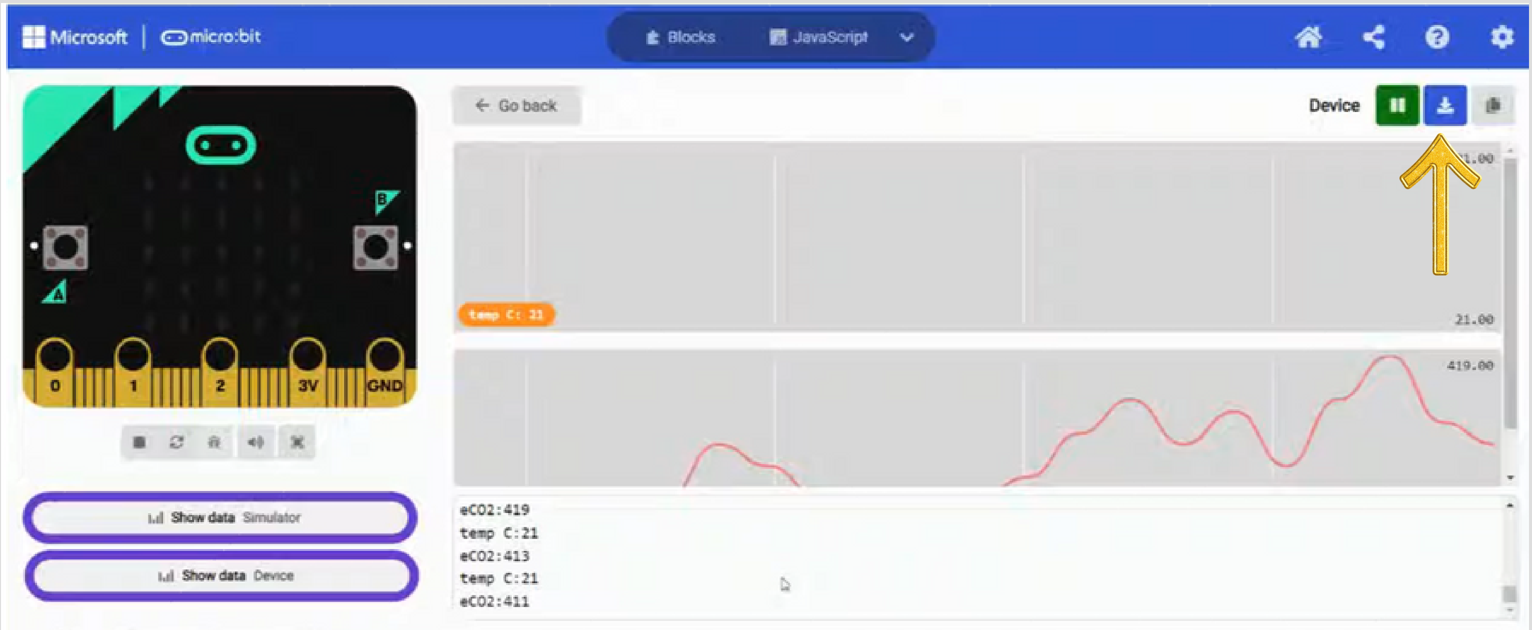
Download the data logger code

You then need to pair your Micro:bit to a device using the USB cable. On the MakeCode website (accessible using the blue button above), you need to **pair/connect** the devices. This short video will show you how.

2

In a room, set up the Micro:bit with the air quality monitoring accessory, as carried out in Part 1. With the Micro:bit paired to your device, allow it to start recording the VOC levels and temperature continuously. You will see the chart appear on your device screen (see image below). Try gently blowing air in the direction of the air quality monitor – you should see a real-time change in your VOC measurements on screen.

Leave the monitor to record data for one period. This will give a background reading to the air quality in your classroom over a defined time period. Click on the blue **export data** button (see gold arrow in image below) to download the data as a .csv file.



3

For this next stage, introduce plants around the air quality monitor and around the classroom. Set up the Micro:bit to continuously monitor the VOC levels in the classroom again, being mindful to keep all other variables as comparable as possible to when background levels were monitored in step 2.

Export your data.

4

With the two sets of exported data, summarise the data to produce a table similar to the one below. Now, present the data as a graph that shows the VOC levels over the same time period: in the **absence** and **presence** of plants.

Were there any differences in your plots? What conclusions can you draw from the data about the impact of plants on VOC (and therefore carbon dioxide) levels?

Time (min)	VOC concentration (ppm) in the absence of plants	VOC concentration (ppm) in the presence of plants
0		
10		
20		
30		
40		
50		

Taking it further

Remember the control measures in school during the COVID pandemic? Use the air quality monitor to investigate the impact of:

- keeping the windows and doors open versus closed during a period
- wearing a face covering – does this effect the VOC levels in the classroom over 1 period?

Do you have a classroom pet? What difference does this have on classroom VOC levels compared to another classroom?

How do VOC levels in the classroom vary during a period during a practical activity?

Do you have a school greenhouse with growing plants? How do the VOC levels vary during the day or across different seasons?