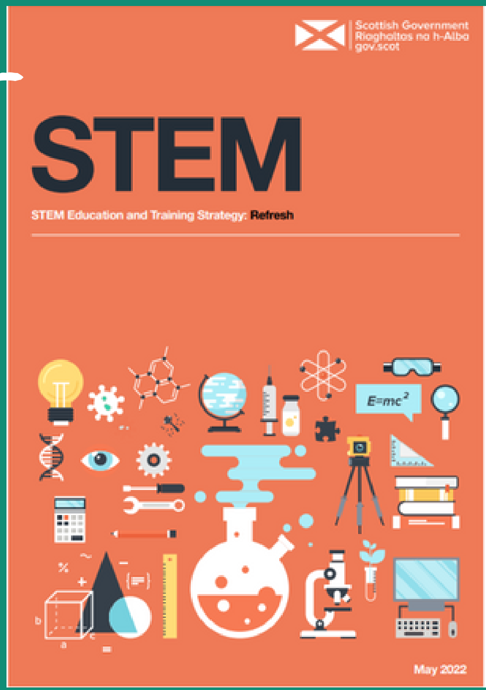
GROWING FOOD

INTERDISCIPLINARY PROJECT: ENVIRONMENTAL SCIENCE, BIOLOGY, TECHNOLOGY AND SUSTAINABILITY

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.



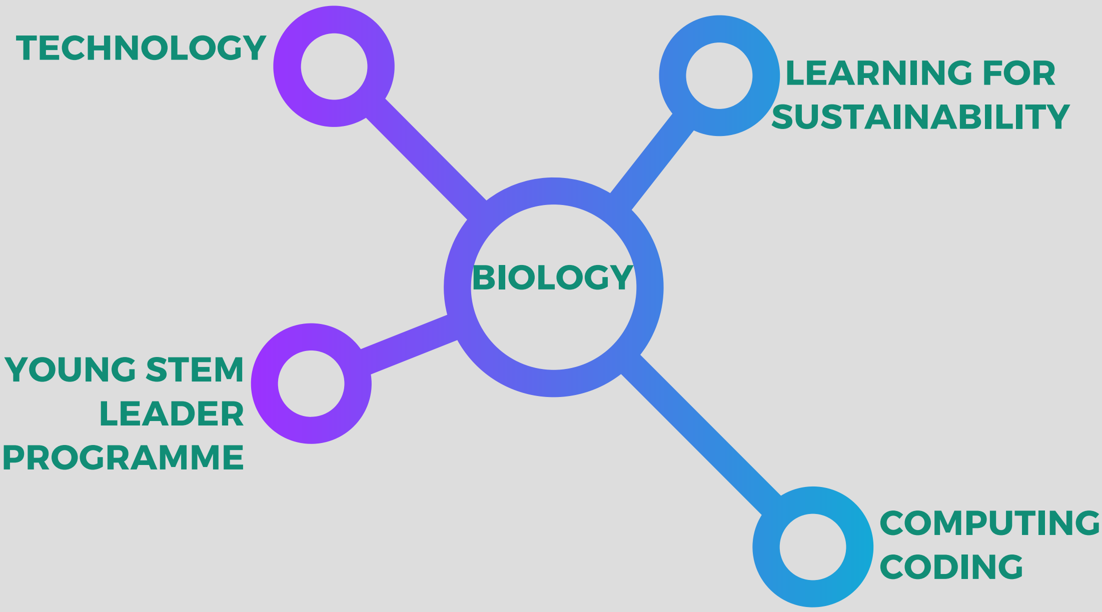
GROUNDED IN THE SCIENCE CURRICULUM

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

N5

Biology - Life on Earth, Key Area 5: Food production.

Environmental Science - Sustainability, Key Area 2: Food.



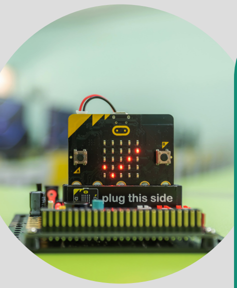
Your Project

Introduction & Aim

As the global human population continues to increase, society faces a huge challenge: how do we feed the world? At a local and national level, there is increasing media coverage of people relying on support from food banks and the rising cost of food.

In this project, you will investigate how some food can be grown at home and different factors that can affect crop growth allowing food producers to optimise yields.

What does the project involve?



This project includes three parts:

1. Making sustainable pots to grow your plants.
2. Coding a Micro:bit to function as a soil moisture meter. This will sound an alarm when your crop plants become too dry.
3. Investigating how wavelength of light can affect crop growth.

Part 1: Making seed pots

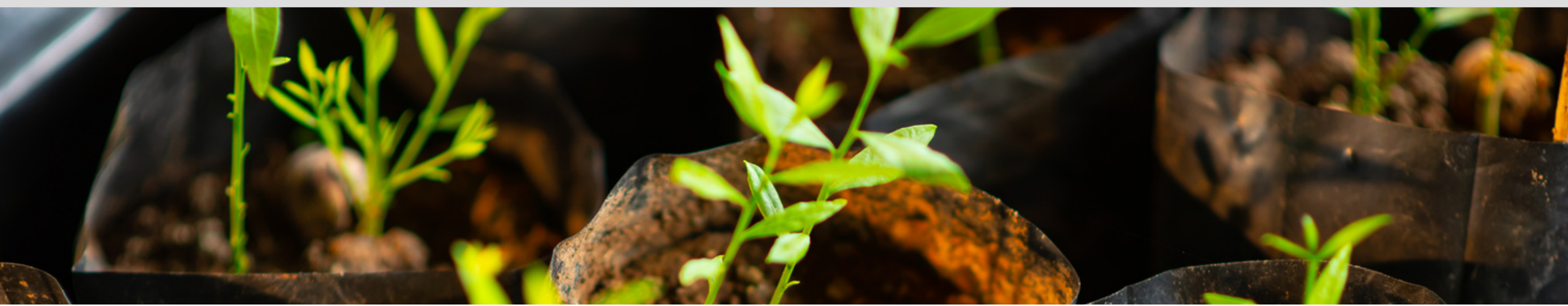
Aim: To make sustainable seed pots to support seedling development.

Materials required:

- Narrow, tall glass
- Newspaper
- Tray to contain seed pots
- Growing medium, e.g. compost, perlite.
- Selection of seeds, e.g. radish, cress, lettuce, kale, broad beans (all straight-forward to germinate and grow)

Health & Safety

Hazard	Control measure
Legionella bacterium in compost	• There has been some concern over *Legionella* in old compost over recent years. In light of this, use current year compost that has been stored in a cool place, away from the sun. Open bags carefully in a well-ventilated area using sharp scissors/knife. • Pot up seeds/plants in a well-ventilated area. Avoid making dust. • Hand washing to be carried out after activities, avoiding hand-to-mouth operations throughout the activity.
Allergic reactions	Commercial seeds can be treated with a fungicide or pesticide. Avoid purchasing these if the end plant is to be taken home by learners. Consult learner records to see if any have an allergic reaction to any of the seeds/plants. It so, these learners should not handle the material. Avoid touching eyes when handling plants.



Method

1. Fold a newspaper page in half, length-wise, and place the glass (open end facing inwards) on the paper.

2. Roll the newspaper around the glass.

3. Fold the end of the newspaper into the open end of the glass.

4. Remove the glass from the newspaper assembly. Then REPEAT!

5. Repeat until you have at least one pot per person.

6

Fill your plant pots with a suitable growing medium. You could use a seed compost or perlite (*refer to health and safety risk assessment*).

As part of your growing project, you could move onto Part 3 of this project guide and investigate the effect of wavelength of light on the growth of your seeds.

Alternative aims might include:

- To investigate the effect of **soil moisture** on the growth of seedlings.
- To investigate the effect of **light intensity** on the growth of seedlings.
- To investigate the effect of **growth medium** on the growth of seedlings.
- To investigate the effect of **planting density** on the growth of seedlings.

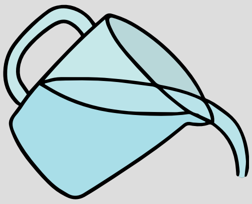
The **growth of your seedlings** can be determined by taking daily or weekly measurements of the height of the seedling stem. It could also involve recording physical properties of the seedlings, e.g. any yellowing or wilting of leaves.

Part 2: Using a Micro:bit as a soil moisture meter

Aim: To code a BBC Micro:bit to function as a soil moisture meter, raising an alarm if compost becomes too dry.

This protocol involves two steps:

1. **Calibration** of the micro:bit to obtain readings for dry, moist and wet compost.
2. **Coding** of the micro:bit to function as a soil moisture meter.



Materials for Step 1:

- Micro:bit
- Device
- MakeCode website
- 3x soil samples (one dry, one **just right**, one water-saturated)
- 2x nails
- 4x wires
- 8x crocodile clips

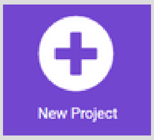
Materials for Step 2:

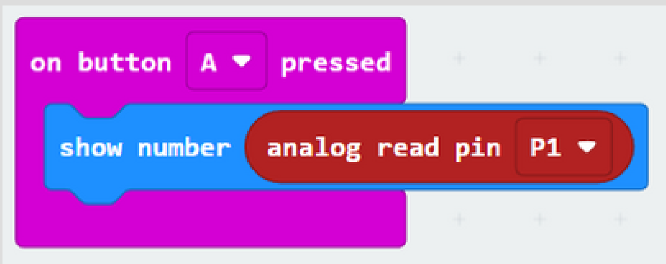
- Micro:bit
- Device
- MakeCode website
- 2x nails
- 4x wires
- 8x crocodile clips
- Plants to measure soil moisture

Method for Step 1 - **Calibration**

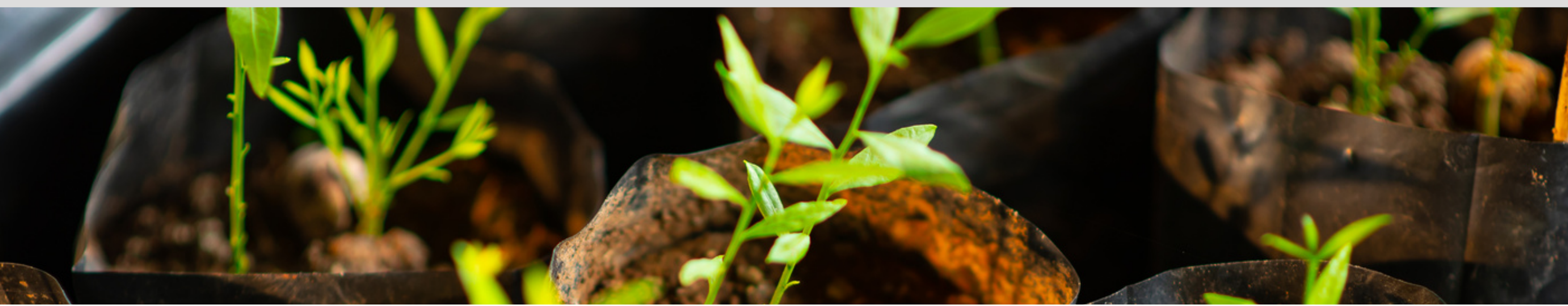
1

Go to the MakeCode website and click **New project**. Input the code (**shown right**). Click the download button on the MakeCode website and this will generate a **hex** file. Alternatively download the **hex** file here. Attach the micro:bit to your device and drag the hex file onto the micro:bit.



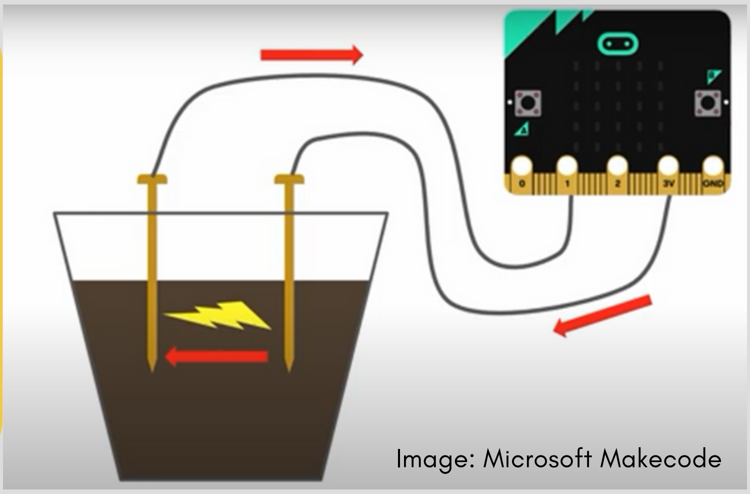


This code instructs the micro:bit to display the value from P1 when button A is pressed. The value from P1 will be the soil moisture level.



2

Now the micro:bit is correctly coded, set up the micro:bit as shown **opposite**. Connect one wire, using two crocodile clips, from the 3V pin on the micro:bit to a nail. Connect a second wire from pin 1 to a nail. Put both nails into a sample of dry soil. Note the value displayed on the micro:bit when button A is pressed.



3

Repeat this process for a sample of **just right** soil - not too dry, not too wet.

Repeat this process again for soil that is **water-saturated**.

Soil moisture	Reading from P1
Dry	
Just right	
Water-saturated	

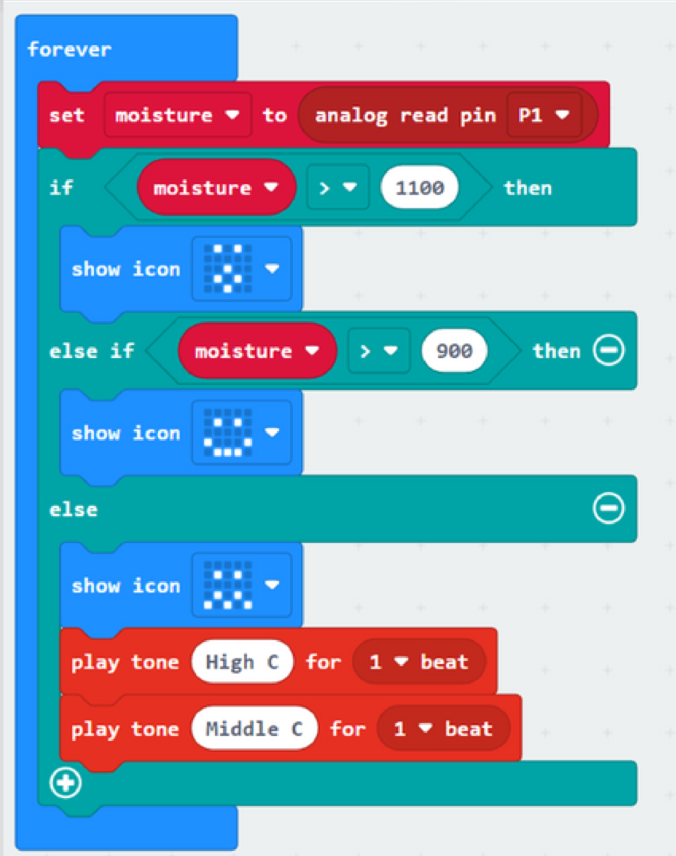
Click on the YouTube video above for a full tutorial for this part of the project.

The values you have collected in this part of the project will be used in the next step. You need to tell the micro:bit how to recognise if soil in your plant pots is **dry**, **just right** or **saturated with water.** The micro:bit will sound an alarm if the soil has become **too dry** to indicate that watering must take place to protect the health of your seedling. Consider the economic benefits of having a system such as this, e.g. on a farm producing crops.

Method for Step 2 - Measuring soil moisture levels in seedling pots

1

Go to the MakeCode website and click **New project**. Input the code (**shown right**). Where the numerical values are displayed, change these to your readings from water-saturated, just right, and dry (in that order) from Step 1.
Click the download button on the MakeCode website and this will generate a **hex** file.
Alternatively download the **hex** file here. Attach the micro:bit to your device and drag the hex file onto the micro:bit.



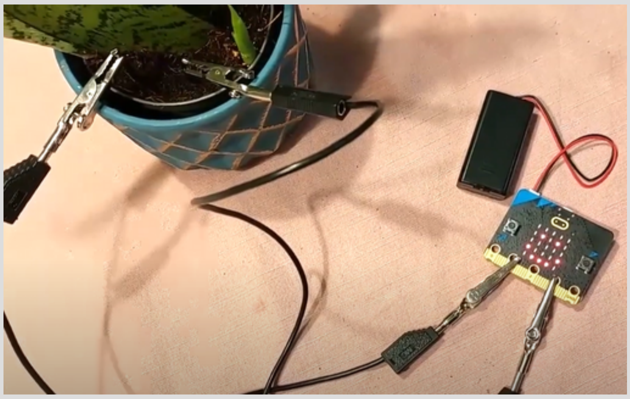
What does this code do?

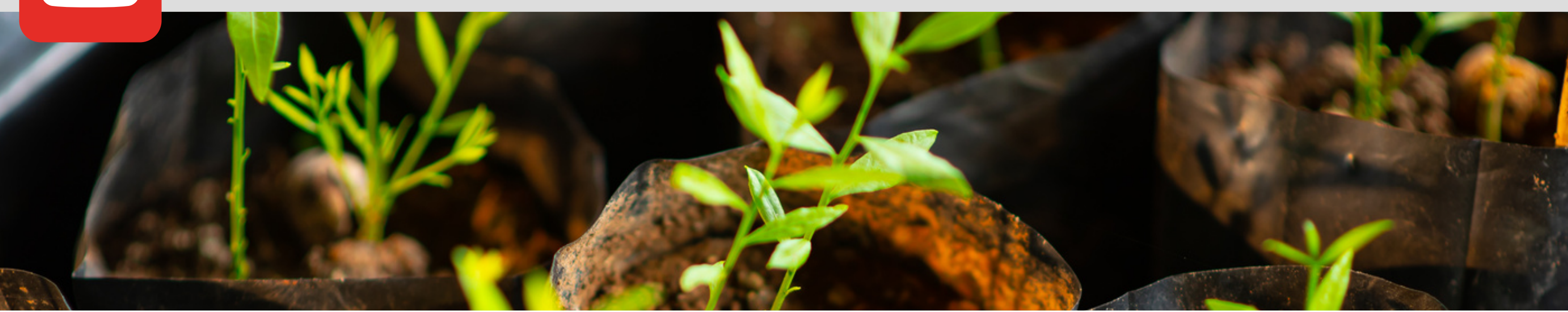
This code instructs the micro:bit to read the moisture level from pin 1. If the moisture level is greater than **1100**, display a shocked face (compost is **water-saturated**). If the value is between **900 & 1100**, display a happy face (compost is **just-right**). If the value is less than **900**, display a sad face and an alarm tone (compost is too **dry**).

You need to adapt this code for your own readings, collected in step 1. For example, if your water-saturated soil provided a moisture reading of 1223, change 1100 in the code above to 1223.

2

Use your coded micro:bit to test the compost with your growing seedlings. Embed the nails into the compost and check moisture levels. If the **alarm sounds**, it is time to water those plants!



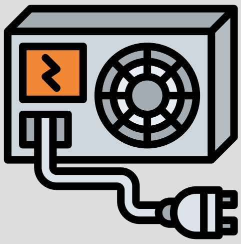


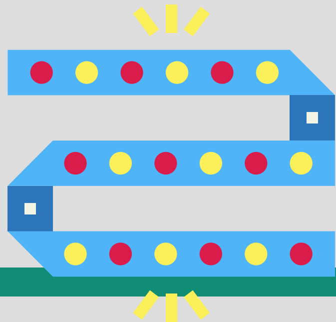
Part 3: Wavelength of light and plant growth

Aim: To investigate if wavelength of light affects plant growth.

Materials required:

- Seeds in compost
- LED lighting
- Dark boxes to contain plants
- Power supply

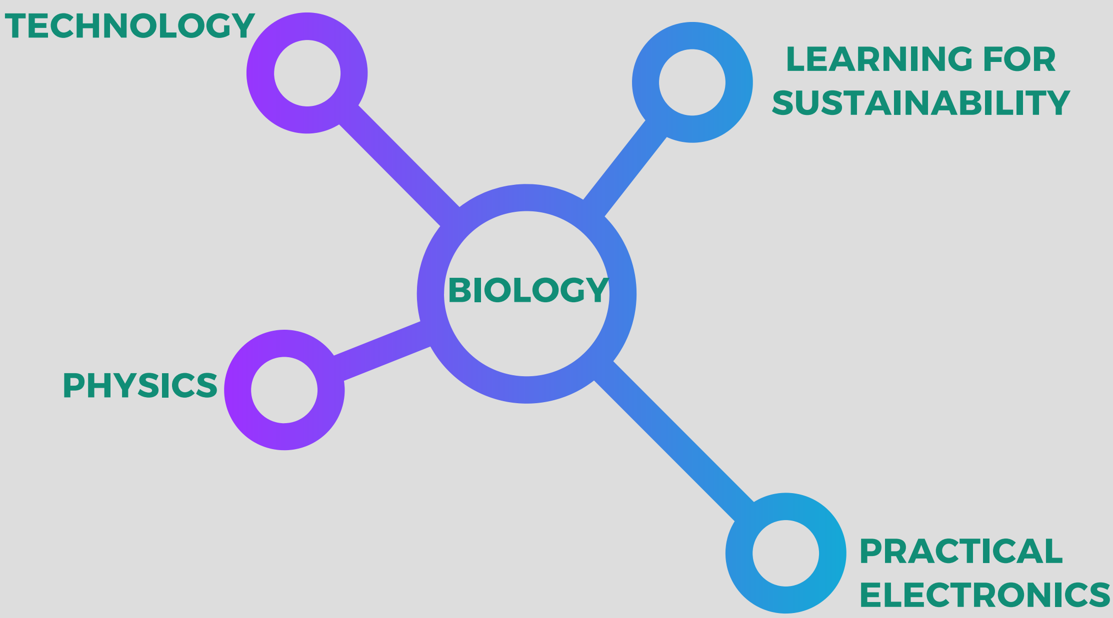




Introduction

When considering the commercial growth of food crops, it is important to understand the variety of factors that can influence growth and, ultimately, yield. The absorption spectra of photosynthetic pigments in different plants means that the full range of visible light is not used equally in converting light energy to chemical energy. The role of the spectrum of LED lighting in plant development is investigated in this part of the project.

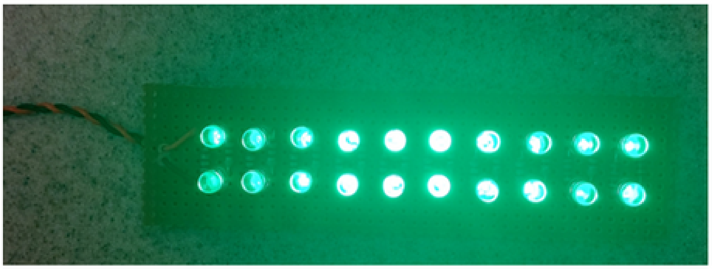
A range of LED lighting can be used from purpose built LED boards to LED strip lights used in our homes (**see image above**). Click here to access further background reading on this topic. This activity may also incorporate National 5 Practical Electronics outcomes, with learners constructing electronic circuits using permanent soldering.



Link to National 5 Practical Electronics

N5 National 5 Course Specification

SQA



Skills, knowledge and understanding for the course

The following provides a broad overview of the subject skills, knowledge and understanding developed in the course:

- awareness of safe working practices in electronics
- analysing electronic problems and designing solutions to these problems
- simulating, testing and evaluating solutions to electronic problems
- skills in using a range of test equipment
- constructing electronic circuits using permanent (soldering) and non-permanent methods

Method

1 Place seed pots with newly germinated seeds into a dark box equipped with LED lighting (**see images below**). In our image, we have recycled boxes used for timers. Iluminate continuously, taking measurments of stem growth over the course of several weeks.
Compare the growth of these plants to plants from Part 1 of this project, with access to the full spectrum of visible light.

The Benefits of Outdoor Learning

STEM bulletin

Supporting STEM for all Local Authorities through advice, ideas and inspiration

Read our latest Bulletin article, featuring Laura Campbell, on the benefits of outdoor learning. Laura completed her probationer year as a Biology/Science teacher at Braes High School and has since taken up a post at Rossie School in Montrose delivering the Forest School Programme.

Activities & professional learning

Embracing outdoor learning

Scotland's "rich urban and rural environments" present enormous potential for delivering the Curriculum for Excellence in a meaningful way to engage young people in their learning, as outlined in Education Scotland's key document "Curriculum for excellence through outdoor learning" [1].

A wealth of research highlights the benefits of outdoor learning, from supporting young people's attainment, health and wellbeing, wider achievements and personal development [2]. Education Scotland's 2022 evaluation of "Structural barriers to STEM engagement" [3], carried out by Ekosgen, reports that learners "want their learning experience rooted in the real world" with an emphasis on Learning for Sustainability, climate education and outdoor learning. Meanwhile, the 2022 OECD PISA report "Are students ready to take on environmental challenges?" [4] states that while approximately half of students are "environmentally enthusiastic", there is a curriculum-agency gap where being aware of the issues does not necessarily translate into meaningful action. The opening line of this report states, "Never before have the stakes been so high for the role of science education in shaping how people interact with the environment". Embracing the outdoors as part of our learning and teaching practice is a fantastic way to respond to these findings and embed Learning for Sustainability, an entitlement for all learners and recognised within the GTCS Professional Standards and HGIOS.

Teacher Insight – Laura Campbell

Laura Campbell, a Teacher of Biology/Science, completed her probation year at Brae's High School in Falkirk and, during this time attended SSERC's Science Probationer Residential course as a delegate. Throughout the course, Laura spoke passionately about outdoor learning:

"We talk so much about Play Pedagogy in Primary and Early Years. But it stops in S1. Why? Learners behave differently outdoors – they play again and there is more freedom."

Laura Campbell, Biology teacher.

As a Biology/Science teacher, Laura had delivered many of her own lessons outdoors and shared some of her favourite outdoor learning activities in Biology (Figure 1).

When learning outdoors, Laura noted changes in behaviour and attitudes among learners; they relaxed and those who were often unmotivated and disengaged started to participate more and enjoy the lesson. Learner voice (Figure 2) reinforced the positive correlation between outdoor learning and a sense of wellbeing [2].

Laura conducted a practitioner enquiry, during her probation year, on outdoor learning. She planned and delivered a whole-school outdoor learning day for the S1 cohort, with subject-specialists across the school adapting a "indoor" lesson for the outdoors. Measures were put in place to ensure the event was inclusive and could continue regardless of the weather on the day. Figure 3 summarises the variety of outdoor learning activities offered.

Figure 1 - Laura Campbell shares some of her favourite outdoor learning activities.

>>