# EXPLORE OUR WORLD

## SSERC BIOLOGY

Fieldwork is a valuable part of the biology and environmental science curriculum. Its inherent interest for many young people can make it a powerful motivating influence. It can encourage an appreciation of living things and help develop an understanding of the relationships between living things and their environment. It can illustrate the practical need for conservation and thus contribute to their development as responsible citizens and effective contributors to environmental concerns.

(SSERC, *Materials of Living Origin*)

# PLANTS FOR LIFE BIODIVERSITY CHALLENGE

sserc

## Challenge 2

Plantlife

Human activities can have a positive or negative effect on ecosystems, resulting in an increase or decrease in species density or diversity. In this challenge, you are going to investigate the **effect of a human activity on biodiversity** in a particular area. This will involve a comparison between two contrasting sites within the same ecosystem.

Plantlife, a British conservation charity, launched the "no mow May" campaign in 2019 to encourage the growth of wild flowers that support a complex community of pollinators and claim that "80% of lawns support the equivalent of 400 bees a day from the nectar sugar produced by [wild] flowers". They report an optimal mowing frequency of once every four weeks.

In this challenge, you will test this idea: can we promote biodiversity by not cutting the grass?

This task involves:

- Interpretation of Ordnance Survey map content.
- Random sampling strategy.
- Techniques to measure abiotic factors (temperature, light intensity, soil moisture, soil pH).
- Identification of sampled organisms.
- Consideration of biodiversity in the context of a terrestrial ecosystem.
- Use of a quadrat for quantitative sampling of plants.

# MATERIALS

For this Challenge, you will carry out a range of procedures. The materials you will need for each section are outlined below.

## 1 MAPPING YOUR LOCATION

- Ordnance Survey map for your area
- Random number generator
- Smartphone with Google Maps installed

## 2 MEASURING ABIOTIC FACTORS

- Thermometer
- Light meter
- Soil moisture meter
- Soil pH meter
- Paper towels
- Pencil and paperwork to record data

## 3 QUADRAT SAMPLING

- Tape measure
- Rope and canes
- Quadrat
- Plant identification guide, e.g. from the Field Studies Council
- PlantNet app on a smartphone device (Android or Apple)
- Laminated white paper + clipboard + paperclip
- Pencil and paperwork to record data

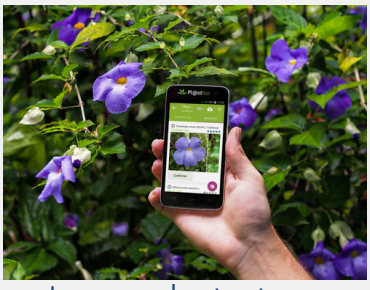
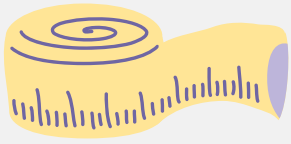
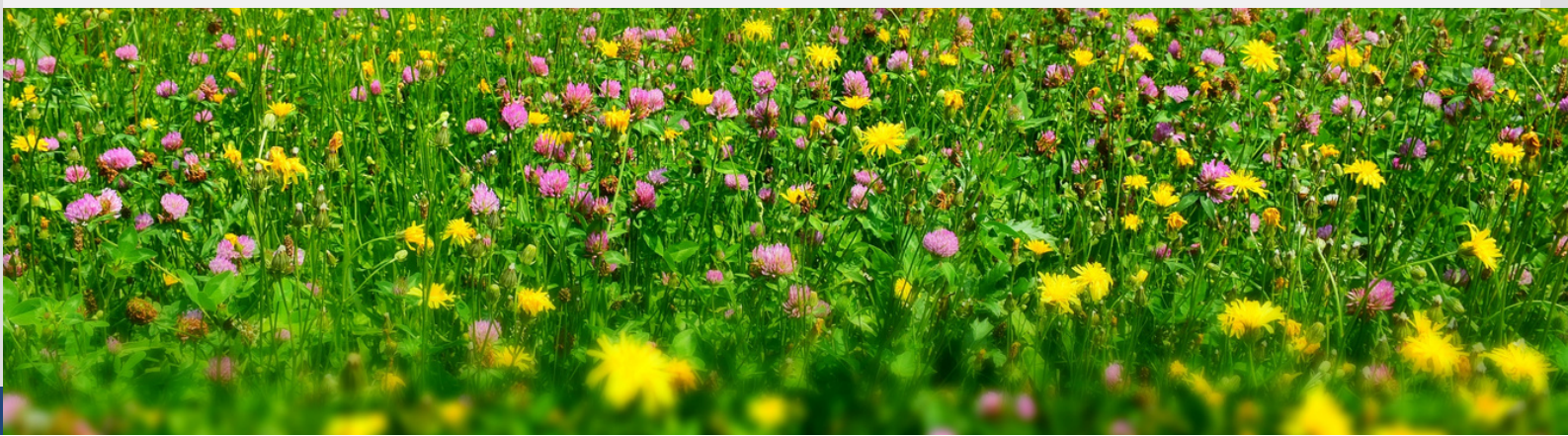


Image: plantnet.org



# METHOD

## Section 1: Mapping your location

To perform a diversity study between two contrasting sites, a **random sampling strategy** in each of the sites is the most appropriate. This is based on the assumption that the abiotic factors in each site will be largely similar, but they must be monitored. In this section, you will use an OS map for your location and use a random number generator to determine sampling points for the quadrat. Random sampling means that every individual in the population has an equal chance of being selected. This removes bias from the sampling procedure. Random sampling *does not* mean standing in a fixed position and throwing the quadrat into a "*random*" position. At this stage, it is important to choose a suitable "**sample size**", i.e. how many quadrat measurements will be made within the site to ensure the sample provides a representative measure of the diversity within the whole site.

## BEFORE LEAVING THE CLASSROOM

### STEP 1 - USING THE ORDNANCE SURVEY MAP

Find an ordnance survey map of your chosen area. This resource provides a great overview of what you can learn from the map. An OS map shows a birds-eye view of your location, highlighting roads, rivers, buildings, trees and lakes.


Check your OS map for the following information:

1. Determine the grid reference for your location and note this down. See page 8-9 of the OS guide.
2. Check that the footpaths are **not** shown in black -if black, they are not necessarily public rights of way.
3. Identify any rivers or streams running through the area - this might give you an indication of footwear to bring.
4. Look at the contour lines - these are shown as thin orange/brown lines and indicate the height/shape of the land. The numbers refer to the height above sea level and can be used to infer how wet the ground might be. See page 11 of the OS guide.

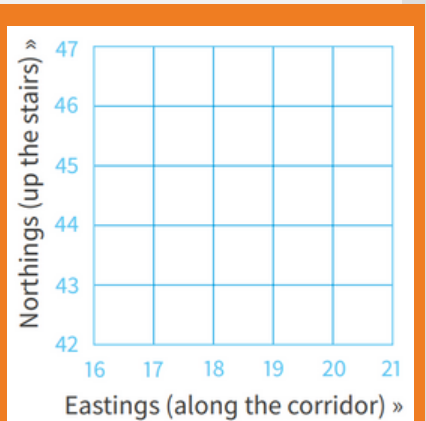



Image from ordnancesurvey.co.uk

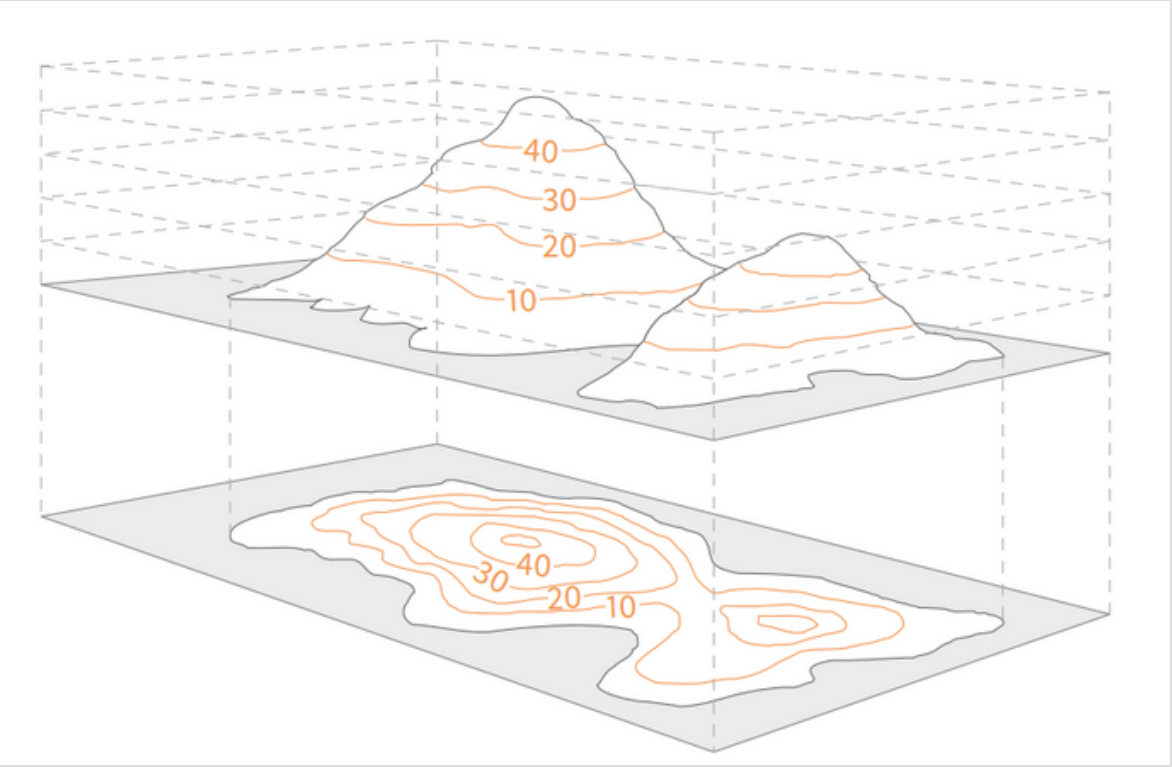



Image from ordnancesurvey.co.uk. Contour lines on OS maps are shown in orange and refer to the height of sea level for areas of land. This is important when planning a fieldwork excursion so you can plan your route and safe sampling spot.

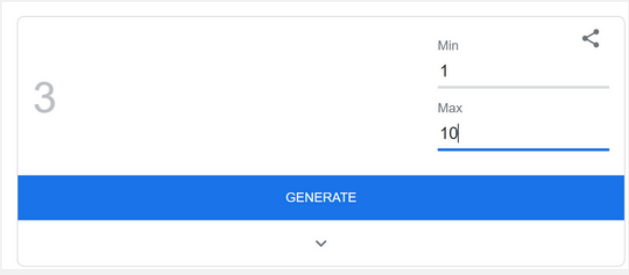
5. Finally, have a closer look at the contour lines. The closer together the lines appear, the steeper the land. For this activity, the steepness of the area does not matter - but the contrasting areas you choose should be very similar.



Images from ordnancesurvey.co.uk

## STEP 2 - CHOOSING SAMPLING POINTS

Choose your sampling coordinates using the "random number generator". Set your Min and Max values to 1 and 10, respectively, and then select 10 "coordinates". Learners can make their own copy of a suitable Google Sheet for this, if appropriate.




| Sample site | X | Y |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | | |
| 7 | | |
| 8 | | |
| 9 | | |
| 10 | | |

## AT THE SAMPLING LOCATION

### STEP 3 - IDENTIFING 2 CONTRASTING SAMPLE SITES

Visit the site to be sampled. Identify 2 contrasting sites and cordon off a 10m x 10m zone in each, using ropes and canes.
The first site should have evidence of being mown recently; the second site should have evidence of being unmown. See images on the next page.


grass cutting boundary can be seen

A 10m x 10m zone provides a 100m$^2$ sampling area. Using a quadrat, with dimensions 0.5m x 0.5m, each quadrat provides a measure of the diversity and density of plant life within a 0.25m$^2$ area.


Mown area - Site 1


Unmown area - Site 2

## STEP 4 - TAKING ABIOTIC FACTOR MEASUREMENTS

Start in Site 1 (Mown area). Use the tape measure to determine the location of the first sample coordinate. The X,Y values generated by the random number generator correspond to the metre interval markings on the tape measure and should line up with the lower-left corner of the quadrat.

At this site, collect your abiotic factor measurements:

- Light intensity
- Soil moisture
- Soil pH
- Soil temperature

Each of these measurements should be made from the middle of the quadrat.

Use the soil moisture meter to determine the moisture reading. Ensure the probe is dry, using the paper towels to remove any moisture, and insert into the ground about 3cm. Record the reading in your table - an example is shown below and a copy of this can be made by clicking here. Dry the probe when measurements are complete.

The same procedure should be used to measure soil pH. If you are using a 3-in-1 meter (soil moisture, pH and light intensity), the measurements can be made at the same time!

The measure soil temperature, dry a thermometer and insert into the hole made by the soil moisture probe. Leave to equilibrate for 2 minutes. Record the temperature.

The light intensity measurement can be made by holding the meter away from the body, with the sensor facing upwards. Record the reading in your table.

| Sample Site | Light meter reading | Soil moisture reading | Soil pH reading | Soil temperature |
|---|---|---|---|---|
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |
| 6 | | | | |
| 7 | | | | |
| 8 | | | | |
| 9 | | | | |
| 10 | | | | |

## STEP 5 - TAKING DENSITY AND DIVERSITY RECORDINGS

At each of the coordinates, position the quadrat as outlined in Step 4. Use the identification guide to identify plant species within the quadrat.

Alternatively, use the PlantNet app to take a photo of the species to obtain an ID. It might be helpful to extract a sample of the leaf, place it on the laminated white paper and take the photo from there - a paper clip can be used to hold the leaf in place (the wind can easily catch it resulting in a blurry photo!).

For each quadrat, record the number of squares in which each plant species is observed. Repeat these steps for each of your (X,Y) coordinates.

A sample table is included below for how you might record the data. In this example, some suggested plants that are likely to be observed in a typical "playing field" have been included. Make your own copy here.

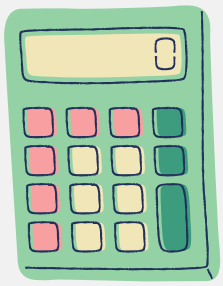
| Plant species | Abundance / 0.25m^2 | | | | | | | | | | Average abundance / 0.25m^2 | Estimated abundance / 100m^2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | | |
| Daisy | | | | | | | | | | | | |
| Dandelion | | | | | | | | | | | | |
| Common mouse-ear | | | | | | | | | | | | |
| Ribwort plantain | | | | | | | | | | | | |
| Greater plantain | | | | | | | | | | | | |
| White clover | | | | | | | | | | | | |
| Red clover | | | | | | | | | | | | |
| Bulbous buttercup | | | | | | | | | | | | |
| Creeping buttercup | | | | | | | | | | | | |
| Meadow buttercup | | | | | | | | | | | | |
| Slender speedwell | | | | | | | | | | | | |
| Germander speedwell | | | | | | | | | | | | |
| Broad leaved grasses | | | | | | | | | | | | |
| Fine leaved grasses | | | | | | | | | | | | |
| Yarrow | | | | | | | | | | | | |
| Silverweed | | | | | | | | | | | | |
| Hogweed | | | | | | | | | | | | |
| Black medick | | | | | | | | | | | | |
| Selfheal | | | | | | | | | | | | |
| Common chickweed | | | | | | | | | | | | |
| Broad-leaved dock | | | | | | | | | | | | |
| Common knapweed | | | | | | | | | | | | |
| Sheep's sorrel | | | | | | | | | | | | |
| Rough hawkbit | | | | | | | | | | | | |
| Mosses | | | | | | | | | | | | |
| Thistles | | | | | | | | | | | | |
| Ragwort | | | | | | | | | | | | |
| Stinging nettle | | | | | | | | | | | | |
| Fat hen | | | | | | | | | | | | |
| Groundsel | | | | | | | | | | | | |
| Charlock | | | | | | | | | | | | |
| Shepherd's purse | | | | | | | | | | | | |
| Pineapple mayweed | | | | | | | | | | | | |
| Knotgrass | | | | | | | | | | | | |
| **Number of different species found / 100m^2** | | | | | | | | | | | | |

## STEP 6 - SITE 2 (UNMOWN AREA)

Repeat Steps 4 and 5 in Site 2.

## RETURN TO THE CLASSROOM

## STEP 7 - DATA ANALYSIS



**Determine species density**

1. Calculate the mean number of each species found across your 10 quadrats.
2. Use this mean value to estimate the number of each species present in the full 10m x 10m area.

**Example**

You could do this for one species, e.g. white clover. If the mean number of white cover in 0.25m$^2$ was 6, it can be estimated that there would be 2400 white clover across the full sampling area since 100m$^2$ is 400x greater than 0.25m$^2$(6 x 400 = 2400).

This highlights why sampling is required - it would take a long time to count 2400 white clover! However, it also highlights the need to ensure your sample size was appropriate and that your sampling strategy provided a representative view of the overall population, i.e. if you did count every single white clover in the sampling area, would you still have got 2400?

**Comparing species density between the two areas**

Compare the estimate mean number of white clover (or alternative species) between the two sites. Was there a correlation between grass cutting and ***species density***?

| Comparing Species Density | |
|---|---|
| **Site** | **Abundance of white clover / 100m^2** |
| Mown | |
| Unmown | |

**Comparing species diversity between the two areas**

Count the number of **different** plant species observed between the two sampled sites. Did grass cutting have an impact on **species diversity**?

| Comparing species diversity | |
|---|---|
| **Site** | **Number of different plant species / 100m^2** |
| Mown | |
| Unmown | |

## STEP 8 - FORMING CONCLUSIONS

Consider the following questions:

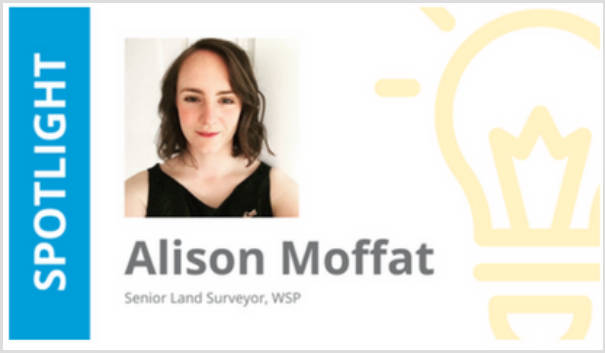
1. Why was random sampling the most appropriate sampling strategy for this investigation?
2. Was the sampling size (i.e. 10 quadrats per site) adequate? How do you know? How could you test this? (*hint: learn about cumulative means on The Biology Coach website* within the AH Biology pages).
3. What conclusions can you draw from the data?
    a. Does grass cutting affect species density?
    b. Does grass cutting affect species diversity?
    c. Do you agree with PlantLife and their "no mow" initative? Explain.

STEM AMBASSADOR HUB

STEM AMBASSADORS IN SCOTLAND

Next steps - Check out the STEM Ambassador in Scotland (SAiS) website to explore their Spotlight section for more information on ecology-related careers.

Alison (right) is a Senior Land Surveyor, a career path driven by her love of the outdoors and learning about geography in school. Click on her Spotlight to learn more about her job.




Visit the STEM Learning website to advertise for a STEM ambassador for a more custom opportunity within your Faculty.


# YOUNG STEM leader

led by sserc

Citizen Science is a fantastic way to become involved in meaningful ecology work, collecting data and logging your findings. Watch this video about citizen science from the British Ecological Society to learn more about the importance of this work. Choose a project and get involved!

| | |
|---|---|
| **DISCOVER** | Discover the importance of citizen science in collecting ecological data, from using camera traps to learn about mammal distribution (MammalWeb) to performing a point count for Garden Birdwatch. |
| **CREATE** | Create an activity or resource about the findings you have collected in your local area. Could you convince others to get involved, perhaps covering different seasons or even years? |
| **INSPIRE** | Presenting your work to others is an important way to inspire others to care for their local environment and realise the impact of human activities on biodiversity. |
| **LEAD** | The YSL4 Award allows you to lead an activity or event you have designed, either yourself or as part of a team. Think about the skills, qualities and behaviours to build and develop to deliver your inspirational STEM activity. |

If the YSLP is for your class, sign up for Tutor Assessor Training on the Young STEM leader programme website. You will gain access to a full range of resources to support your learners through the award.

# REFERENCES

The list of plant species that are likely to be found in playing field was supported by The Field Studies Council "Playing Field plants guide".

The PlantLife website was used for background information.

A guide for reading Ordnance Survey maps was found here.

Young STEM Leader Programme at SSERC

STEM Ambassadors in Scotland at SSERC

Data processing file presented throughout this resource is available for you to make your own copy here.