Cyfoeth Naturiol Cymru
Natural Resources Wales

Activity plan

Assessing peatland condition, depth, age and carbon content

Suggested time needed for activity	**Half day to full day depending on size of group and number of assessments made**
Location	**Outdoors on an area of peatland**

Context

This activity plan suggests how to get your learners to carry out a simple hands-on investigation to assess the condition, depth, age and carbon content of an area of peatland.

Natural Resources Wales' purpose is to pursue sustainable management of natural resources in all of its work. This means looking after air, land, water, wildlife, plants and soil to improve Wales' well-being, and provide a better future for everyone.

Curriculum for Wales

Humanities

- **What matters**
  Our natural world is diverse and dynamic, influenced by processes and human actions.

- **What matters**
  Informed, self-aware citizens engage with the challenges and opportunities that face humanity and are able to take considered and ethical action.

Science and Technology

- **What matters**
  Being curious and searching for answers is essential to understanding and predicting phenomena.

Mathematics and Numeracy

- **What matters**
  Geometry focuses on relationships involving shape, space and position, and measurement focuses on quantifying phenomena in the physical world.

Objectives

Whilst on a site visit, learners will be able to:

- Complete an on-site visual peatland condition assessment, recognising when a peatland is in good, average or poor condition.
- Investigate how deep the accumulation of peat is.
- Estimate how long peat has been accumulating for.
- Make an estimation of the volume of carbon stored within the peatland.
- Make an assessment as to whether the peatland they are visiting is absorbing or emitting carbon.

Before you visit

Peatlands are protected habitats. They are characterised by open water and saturated soils and are potentially hazardous environments. To ensure you and your learners have a safe and enjoyable time, we suggest you get in touch with us **before you visit** an NRW peatland to get permission for your planned activities.

As group leader, you have overall responsibility for the discipline, safety and overall control of your group. To ensure a safe and enjoyable time for everyone we suggest the following:

- Ensure your learners wear suitable footwear and ask them to keep to boardwalks and paths.
- If you see an adder, advise your learners not to approach it.
- Livestock may be found grazing on some sites. Please do not approach them or try to feed them.
- Follow any on site signage and guidance.

Background and additional information

To ensure your learners have a basic understanding and the relevant vocabulary, we suggest checking out the following activities and resources either in the classroom before your visit, or on site before completing this activity:

- Information note – Peatland - How carbon sinks can turn into carbon emitters
- Information note - A guide to peatlands
- Activity plan & resource cards – How does peat form?
- Activity plan & resource cards – Sustainability glossary game

Suggested equipment and resources

- Worksheet - Assessing peatland condition, depth, age and carbon content
- Extendable or threaded probing rods – It's a good idea to check before you visit roughly what the likely depth of peat is on site. You don't want to risk not having enough length of rod or having to carry too many. If you mention this when you apply for permission, we can let you know or alternatively, you can access this information from the Welsh Peatlands Data Portal, which has a data layer with information on the thickness of peatlands in Wales.
- Measuring tapes
- Peatland plant ID books or apps
- 1m^2 quadrats
- Clipboards
- Pencils/pens
- Wet wipes or hand sanitiser for handwashing

Suggestions to complete this activity

Setting the scene

We suggest that you explain to your learners that peatlands are natural carbon stores and globally store approximately double the amount of carbon stored in all the world's forests, making them a vital tool in helping to regulate the climate. Their storage of huge stocks of carbon in the soil prevents it from being emitted to the air as carbon dioxide (CO_2). However, our historical and sometimes current, management techniques threaten this vital carbon store. Drainage, burning, cultivation and extraction has left peatlands in a wide range of conditions ranging from actively growing to actively eroding.

Healthy peatlands in good condition have lower greenhouse gas emissions and absorb carbon at a higher rate than peatlands in poor condition. Damaged peatlands can emit CO_2 and contribute to climate change.

Explain to your learners that they will be completing several tasks at a minimum of five sample locations. As Group Leader, you can choose to assign all or just some of these tasks.

To minimise the impact on the peatland these activities should be completed in groups using sample areas that are easily accessible from the main footpaths and that are typical of the proximate area. Make sure you have liaised with the site owner and sought permission before your visit.

Advise your learners to select a probing location that is typical of that proximate area and that is easily accessible. Take into consideration that the peat surface near ditches is often lower due to erosion and degradation, whereas hummocks will raise the ground surface level above the actual peat level.

Task 1 - Location

Ask your learners to find out and note the location of each of their sampling points. This will allow them to plot the data gathered on a map later if required. Learners could be asked to provide a grid reference for each location.

Task 2a and 2b – Site observations

Explain to your learners that they can assess the condition of the peatland in their sample area by identifying the plants on the surface such as sphagnum cover and by assessing the land condition. For example, if there any visible erosion evidence characterised by areas of bare peat.

Classifying the condition of different areas of a peatland allows land managers to identify the most appropriate management approach for a particular area. For example, actively growing areas to be safeguarded and degraded areas to be dammed to encourage re-wetting. We suggest that you discuss the 'Visual assessment of peatland condition guide' (available on the Worksheet that accompanies this Activity Plan), with your learners. Using a quadrat, you could complete a demonstration assessment. You could discuss with your learners that within a peatland, it is likely that there will be areas in good condition and others in not such good condition. It is therefore important to survey several different areas in order to assess the overall peatland condition.

Representation of a m^3 column

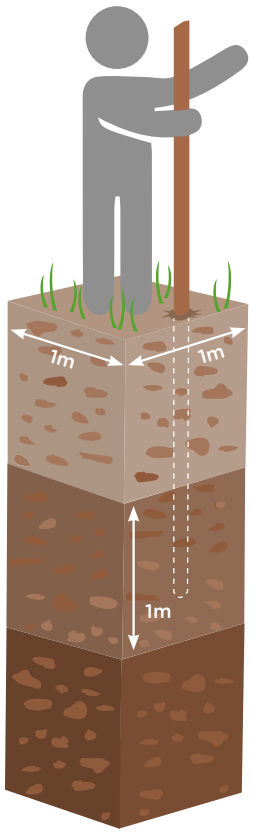


Figure 1

Task 3 – Site assessment

You could ask your learners to make an assessment using all the information they have gathered. Is the peat in each of their sample areas actively growing? Has it been degraded? Is it actively eroding?

Task 4 – Peat depth

Explain to your learners that as a group they are going to find out how deep the accumulation of peat is. On average, healthy peat has a growth rate of 1mm of peat per year, so 1 metre of peat can take a thousand years to form. Explain that peat accumulations are rarely uniform, therefore, to get an average measurement for the site, the depth of the peat must be measured at each sample location.

Task 4a - Estimate

Before they begin this task, you could ask your learners to guess how long they think peat has been accumulating at the site and note their estimates on the Peatland Assessment Form (part of the worksheet).

Task 4b – Actual

We suggest you show your learners the extendable probing rods and explain that peat depth can be measured by pushing these narrow rods into the peat until they can be pushed no deeper. Refer your learners to Figure 1 on their worksheets.

Depending on what the area was like before it began to infill with peat, peat deposits will sit upon a substrate of clay, gravel or silt. When the probing rods reach the substrate, it will not be possible to push them down any further.

The depth to which the rod sinks indicates the peat depth. If the peat depth appears unexpectedly shallow it's possible that your probing rods have hit a tree root or an obstruction which has been buried by the peat. We suggest moving your probe away from the area and trying again.

When the probing rods can't be pushed any deeper, they should be carefully removed. Ask your learners to check the tip of the probing rod for evidence of clay or sand. This will confirm that the probing rod has reached the substrate below. Your learners can then lay out and measure the combined length of the rods used – this will be an indication of the peat depth.

Top tip! You could ask your learners to measure the length of one individual probing rod before commencing this activity. This will speed up the measuring process and as the rods are submerged, it will give your learners a live indication of the peat depth.

Ask your learners to record their results for each sample location in the table on their worksheet.

Task 4c – Average site depth

Once your learners have measured the peat depth at a minimum of five different locations, it's possible to work out an average peat depth for the site.

$$\frac{\text{Peat depth (m) at each location (L1 + L2 + L3 + L4 + L5)}}{\text{Number of locations sampled (5)}} = \text{Average peat depth (m) for the site}$$

How long has peat been accumulating for?

Task 5a – Accumulation time at each location

Once your learners have measured the peat depth at each location it is possible to work out the length of time, in years, that peat has been accumulating by using the average peat growth rate of 1mm a year.

$$\frac{\text{Depth of peat (m) at sample location}}{\text{Growth rate 0.001m/yr}} = \text{Number of years peat has been accumulating}$$

For example: The example location in the table has a peat depth recorded of 6.23 metres.

$$\frac{\text{6.23 metres}}{\text{0.001m}} = \text{6,230 years of peat accumulation}$$

Task 5b – Average site accumulation time

Once your learners have worked out the length of time peat has been accumulating at a number of locations, it is possible to attain an indication of how long peat has been accumulating across the site.

$$\frac{\text{Number of years at each location (L1 + L2 + etc.)}}{\text{Number of locations sampled}} = \text{Average number of years peat has been accumulating across the site}$$

We suggest you review your learners' earlier guesses – how close were they to the more accurate measurement of how long peat has been accumulating at the site?

Task 5c – When did the peat begin to accumulate?

Using their calculation of the average length of time peat has been accumulating at the site, you could ask your learners to work backwards. In what year did the peat present on site begin to accumulate?

Amount of carbon stored in the peat

Task 6a – Carbon stored at each location

Explain to your learners that once they have investigated the depth of peat accumulation in a location, they will be able to calculate an indication of the amount of carbon stored in kilograms, within a metre cubed column at that location (see Figure 1).

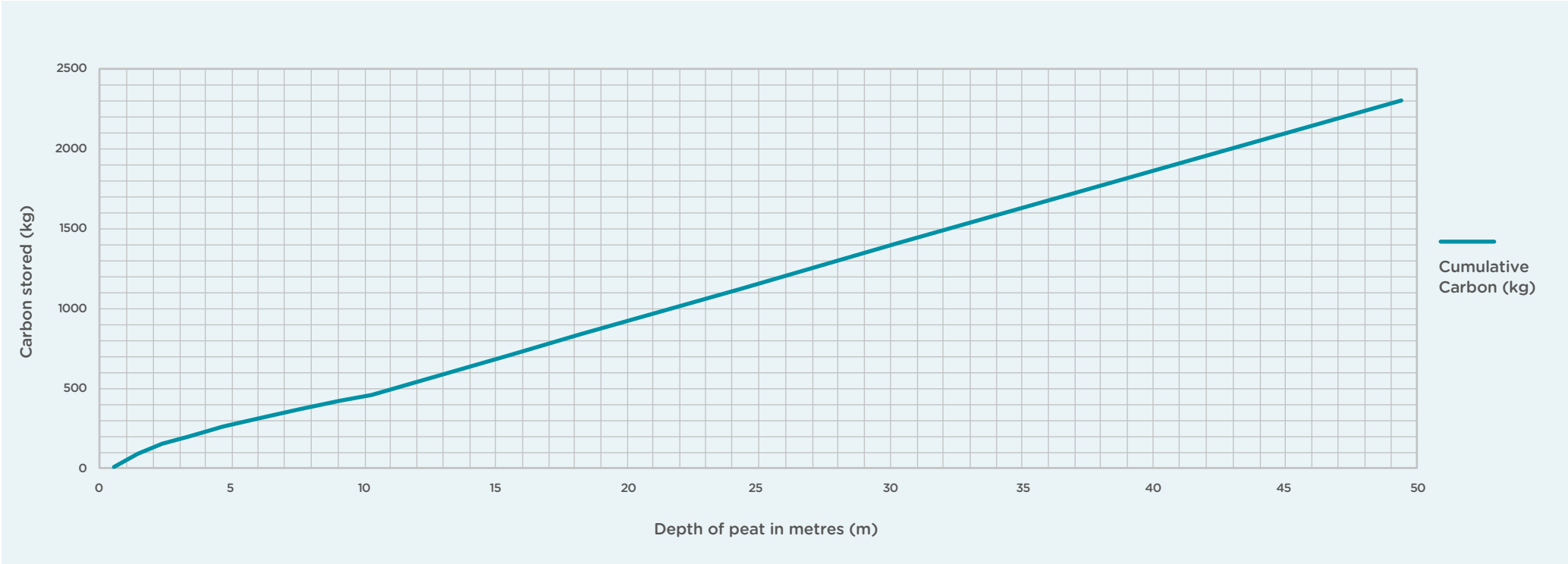
Using our 'Carbon storing capacity of peat' graph (available on the Worksheet that accompanies this Activity Plan), learners can find the peat depth for each sample location along the 'x' axis. By drawing a straight line up to the line on the graph and reading across to the y axis, they can note the total amount of carbon stored at the sample location in kilograms.

Task 6b – Average amount of carbon stored across the sample locations

Once your learners have calculated the carbon stored at each sample location, they could calculate the average amount of carbon stored across the sampled locations.

$$\frac{\text{Carbon in kilograms at each location (L1 + L2 + etc.)}}{\text{Number of locations sampled}} = \text{Average amount of carbon stored across sample locations in kilograms}$$

Carbon storing capacity of peat



Please Note: The amount of carbon stored in peat is related to peat composition, which has many variables such as its bulk density (the amount of peat dry matter per unit volume). To generate this graph, we have based the calculations on a scientific formula to 10m and then from 10m and deeper an average carbon storage figure has been used. Therefore, this graph isn't meant to be used as a scientific tool for mega depths of peat greater than 10m, but more as an educational tool to relate a carbon footprint to a volume of peat.

For more information see: Information note - Peatland: How carbon sinks can turn into carbon emitters.

Carbon content graph

Based on the equations above and because bulk density varies with depth, we have calculated the carbon stored in peat every 5cms to a depth of 10m.

Using these results, we calculated an average carbon content for each m^3 of peat between 0 and 10m. For depths greater than 10m we have used the average carbon stored per meter between the 0-10m range (45.96401kg per m^3).

The graph is then generated from a cumulative sum of each meter of carbon stored e.g. at 1m its 96.21kg, at two meters its 59.27kg so the cumulative figure for those $2m^3$ is 155.48kg and so on.

Due to the averages used and the variables in peat composition and growth rate, this graph isn't meant to be used as a scientific tool for mega depths of peat greater than 10m, but more as an educational tool to relate a carbon footprint to a volume of peat.

For more accurate figures you may be able to obtain the bulk density figures of your local peatland or with permission undertake a study of the peatland to generate your own results.

For more information see: Information note - Peatland: How carbon sinks can turn into carbon emitters.

Offsetting your carbon footprint

Task 7 – Carbon footprint

If prior to your visit your learners have calculated their annual carbon footprint using our Worksheet - How to calculate your carbon footprint, you could ask them to calculate what area of peat on the site would be needed to offset their carbon footprint.

If the average peat depth (based on a surface area of $1m^2$) of the overall site (Task 4c) isn't deep enough to offset their carbon footprint, ask your learners to use the table on the bottom of their worksheet to calculate how many m^2 of land at the site would be required to absorb their annual carbon emissions.

If, for example, their annual carbon footprint is 1432.4kg reading from the graph they would need a m^3 column of peat that is 31.1m deep to offset their carbon emissions! Taking thousands of years to develop, most peatlands are nowhere near that deep. If the peatland at our imaginary site is only 4.8m deep they would actually need a $6.48m^2$ area of peat to offset their annual carbon footprint – see Figure 2.

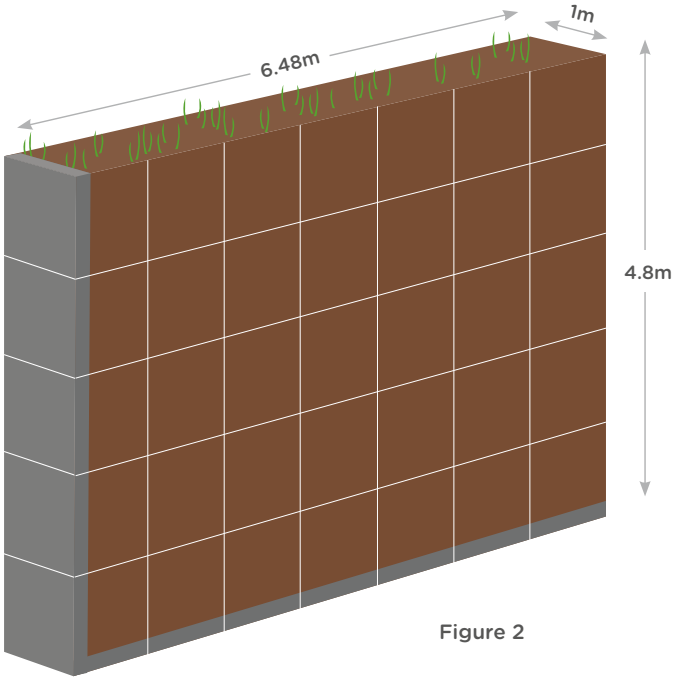


Figure 2

Marking these areas out with string may help visualise the scale of the amount required.

Even if the peat on site is adequate to offset their annual carbon footprint for this exercise, ask your learners to imagine how many m^2 and depth of peat would be needed to absorb their carbon emissions over their lifetime.

Everyone needs to consider their carbon emissions as part of an overall global issue and make every effort to reduce them.

Learners can use the box at the end of the worksheet to record their commitment.

Suggested key questions

- Peat depths within a site can vary – ask your learners if their results concur with this statement.
- What factors may cause peat depth to vary on a site?
- What are the advantages and disadvantages of investigating peat depth with a probing rod? Is it a reliable method of obtaining peat depth data? What other methods could be used?

Optional - If Task 6 has been completed:

- Is the area of peat of a sufficient size to offset the annual carbon footprint of the entire class? Land surface area can easily be measured using the tools available on the Welsh Government's DataMapWales.

Adapting for different needs/abilities

- Learners could work through the tasks independently.
- Learners could complete the worksheet without calculators.
- Learners could complete the worksheet as a group.
- Break down each stage of the worksheet and check results and understanding before moving onto the next stage.

Suggestions for follow up activity/extension

- You could measure and compare how much carbon is stored in trees compared to peat. Which is the most efficient natural carbon store? Check out our Activity plan - Calculating the amount of carbon stored in a tree.
- Try our Activity plan – Shrinking peatland.

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