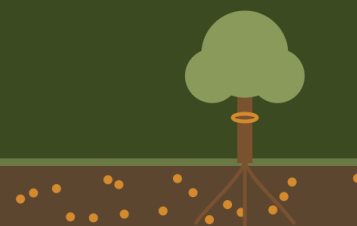


The Grounds Audit

How much carbon do our grounds really store?

KS2 (Years 3 to 6) and KS3 · About 75 minutes, or two shorter lessons · Mostly outdoors



Facilitator notes

In Session 1 pupils predicted where their grounds store the most carbon. Now they find out. Working in teams, they measure trees, map every surface and habitat, and test the soil. By the end the class has its own carbon map of the school grounds, plus two numbers they will need in Session 3: the total carbon stored in the school's trees, and roughly how much of the site is covered by each habitat.

At a glance

Big question	How much carbon do our grounds really store, and where?
Learning outcomes	All pupils: measure a tree's girth accurately and use a table to estimate its carbon. Most pupils: map habitats on the school site and score each for carbon and for wildlife, using evidence. KS3 and some upper KS2: estimate areas in square metres, convert carbon to carbon dioxide, and explain why bigger trees store so much more.
Curriculum links	KS2 Science: living things and their habitats (Y4, Y6), working scientifically. KS2 Maths: measurement, data handling. KS2 Geography: fieldwork, maps and keys. KS3 Biology: ecosystems, the carbon cycle. KS3 Geography: fieldwork, data collection. KS3 Maths: area, unit conversion.
Time	About 75 minutes: 10 briefing, 40 outdoors, 20 pulling it together, 5 to check predictions. Splits easily into two lessons.
You will need	Session 1 pupil sheets, team sheets (A, B and C), the tree carbon reference page, tape measures or string, a 1.3 m stick per tree team, clipboards, coloured pencils, a printed plan or aerial view of the site, trowels or spoons, small pots or paper plates, gloves.

National Education Nature Park link

If your school has a Nature Park habitat map, print it out and give it to the map team. Their job becomes checking the map, adding anything missing, and giving each area a carbon score and a wildlife score. Use the habitat types on your Nature Park map wherever they differ from the simple list in this pack. If you have not mapped your site yet, today's map team is doing the groundwork for it, and you can enter it on the Nature Park website afterwards. Registration is free for schools in England at educationnaturepark.org.uk.

Background for you

Foresters estimate how much wood is in a tree from the girth of its trunk, measured at 1.3 metres off the ground. The tree carbon table in this pack does the same thing. It uses a standard size-to-weight formula for broadleaf trees, includes the roots, and assumes that about half of the dry wood is carbon.

Conifers store a little less for the same girth. The figures are rough, but they are plenty good enough for comparing one tree with another.

The striking pattern: carbon grows much faster than girth. Double a tree's girth and it holds more than five times as much carbon. That is why one big old tree can outweigh a whole row of saplings, and why looking after the trees you already have matters so much. A newly planted tree will take decades to catch up.

Soil carbon is much harder to measure, so the soil team looks for clues instead. Darker, crumbly soil full of roots and creatures usually has more organic matter, and so more carbon, than pale, hard-packed soil. This is a comparison, not a measurement.

Session plan

Part 1. Briefing (10 minutes)

Hand back the Session 1 pupil sheets. Ask pupils to remind each other of their predictions: which place did they think stored the most carbon?

Say: *Last time we made guesses. Today we are going to collect evidence, the way real scientists survey a site. By the end of the lesson we will know whether our guesses were right.*

Split the class into three teams and give out the team sheets. Demonstrate measuring a tree's girth using the How to measure a tree diagram. Show pupils how to read the tree carbon table.

Part 2. The audit (40 minutes)

Team A, the tree measurers, measure every tree they can safely reach, or a sample of up to eight. They record where each tree is, its type if they know it, and its girth, then look up the carbon in the table.

Team B, the map makers, draw or check a bird's-eye map of the grounds. They divide it into areas by habitat type, estimate the size of each area by pacing, and give each area a carbon score and a wildlife score.

Team C, the soil detectives, collect a spoonful of soil from three places: under a tree or hedge, from mown grass, and from somewhere bare or trampled. They compare colour, smell, texture, roots and creatures.

Smaller classes, or classes with more adult help, can rotate through all three tasks in pairs, spending about 12 minutes on each.

Safety: agree boundaries first. Wear gloves for soil and wash hands afterwards. Put soil back where it came from. Do not reach round prickly or poisonous trees such as holly or yew, and stay away from steep banks, ponds and roads.

Part 3. Pulling it together (20 minutes)

Back inside, each team reports. Build a class carbon map on a large printed plan of the site, colouring each area by its carbon score. Add up the carbon in all the trees measured and write the total in big numbers on the board.

Ask the soil detectives which sample they think holds the most carbon and why. Does it match the carbon scores on the map?

Part 4. Were we right? (5 minutes)

Pupils compare their findings with their Session 1 predictions and complete the summary on Sheet D.

Say: *Keep that tree total safe. Next session we will compare it with something surprising: how much carbon our school gives out every year.*

Common misconceptions

- **A tree twice as wide stores twice as much carbon.** It stores far more, because the trunk is wider, taller and has bigger branches and roots.
- **Planting lots of saplings will quickly make up for losing a big tree.** Saplings are worth planting, but it will be many decades before they hold what a mature tree holds.
- **Grass has no carbon in it.** The grass blades hold very little, but the soil underneath can hold a lot.

Adapting the session

- **Lower KS2:** measure girth with string and compare string lengths before looking anything up. Use the As heavy as column of the table rather than the numbers. Score wildlife as none, some or lots.
- **Upper KS2:** use the full table and both scores, and total the tree carbon for the class.
- **KS3:** work out each pupil's stride length (pace out 10 metres and divide) to turn paces into metres, then calculate areas in square metres. Convert carbon to carbon dioxide by multiplying by 3.7, and explain why that number is bigger.

Coming next: Session 3, Carbon vs Nature

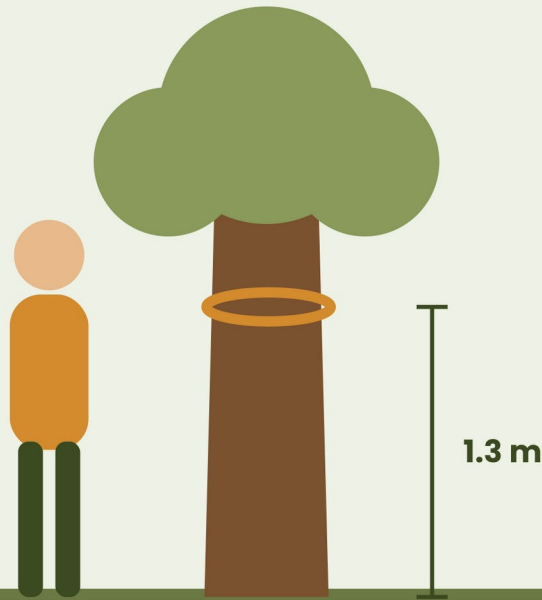
Pupils look at where carbon and wildlife agree and where they clash, using today's scores. They also compare the class tree total with the school's yearly carbon footprint. If you can, find your school's annual gas and electricity use before Session 3. The school business manager or site manager will usually have it.

Tree carbon reference page

Print one per tree team, or display it.

How to measure a tree

Measure round the trunk at 1.3 metres off the ground, about an adult's chest height.



- 1 Mark 1.3 m on a stick**
or a piece of string.
- 2 Wrap a tape measure**
round the trunk at that height.
- 3 Write the girth in cm.**
No tape? Use string.
- 4 Look it up in the**
tree carbon table.

Tip: a tree that splits into several trunks below 1.3 m? Measure each trunk and add up the carbon.

Tip: no reaching round prickly or poisonous trees, and stay off steep banks.

Girth (cm)	Carbon stored (about)	As heavy as...	KS3: CO ₂ taken from the air
Under 40	10 kg	a car tyre	40 kg
40 to 75	70 kg	an adult	250 kg
75 to 125	300 kg	a motorbike	1 tonne
125 to 175	800 kg	a small car	3 tonnes
175 to 225	1.5 tonnes	a family car	5.5 tonnes
225 to 275	2.5 tonnes	a hippo	9 tonnes
Over 275	4 tonnes or more	an elephant	15 tonnes or more

Rough estimates for broadleaf trees, including roots. Conifers store a little less. Good for comparing trees, not for exact accounting.

Sheet A: Tree measurers

Find out how much carbon your school's trees are storing.

Names: _____

Measure each tree's girth at 1.3 m off the ground. Then use the tree carbon table to find how much carbon it stores.

Tree	Where is it?	Type of tree (if you know)	Girth (cm)	Carbon stored
1				
2				
3				
4				
5				
6				
7				
8				

Total carbon in our trees: _____ kg

The tree storing the most carbon is tree number _____. It is about as heavy as _____.

KS3 challenge

Doubling a tree's girth more than multiplies its carbon by five. Use two of your trees to test this. Why do you think carbon grows so much faster than girth?

Sheet B: Map makers

Map the habitats in your grounds and score each one.

Names: _____

Draw a bird's-eye map of your school grounds, or check the Nature Park map you have been given. Split it into areas and number them.

Our map



For each area, record its habitat type, its size, and a score for carbon and for wildlife. Use the score guides on the next page.

Area	Habitat type	Size (paces or m ²)	Carbon score (0 to 5)	Wildlife score (0 to 3)	What we saw
1					
2					
3					
4					
5					
6					
7					
8					

Score guides for map makers

Carbon score

Habitat type	Carbon score	Why
Hard surface (tarmac, paving) or building	0	Soil sealed over, nothing growing
Bare soil	1	Some carbon in the soil, nothing adding to it
Short mown grass	2	Little above ground, but the soil holds carbon
Flower beds and planted areas	2	Depends how often the soil is dug
Pond or wet area	2	Mud at the bottom can store carbon
Long grass or wildflower meadow	3	Deeper roots, soil left undisturbed
Shrubs and scrub	3	Woody stems and leaf litter
Hedge	4	Woody stems and a deep root mat
Trees and woodland	5	Big stores in wood, roots and soil

Wildlife score

Wildlife score	What you saw
0	Nothing living, or almost nothing
1	One or two kinds of plant, very little else
2	Several kinds of plant, or some minibeasts
3	Lots of different plants plus minibeasts, birds or places to shelter

KS3: pace out 10 metres and count your paces. $10 \div \text{your number of paces} = \text{your stride length in metres}$. Area = length $\times$ width.

Sheet C: Soil detectives

Which soil is hiding the most carbon?

Names: _____

Collect a spoonful of soil from three different places. Wear gloves. Put the soil back afterwards.

Soil from	Colour	Smell	Roots?	Creatures?	Crumbly or hard?
Under a tree or hedge					
Mown grass					
Bare or trampled ground					

Clue: dark, crumbly soil full of roots and creatures usually holds more carbon than pale, hard, lifeless soil.

I think the soil holding the most carbon came from

My evidence is

Sheet D: What did we find?

Everyone completes this at the end of the session.

Name: _____ Class: _____

The biggest carbon store in our grounds is

Our trees store about _____ kg of carbon altogether.

In Session 1 I predicted that the most carbon would be stored in

Was I right? What surprised me?

One place in our grounds that is high for carbon but low for wildlife, or the other way round:

KS3 challenge

Turn your class's tree carbon total into carbon dioxide by multiplying by 3.7. Why is the carbon dioxide figure bigger than the carbon figure?
