Creating Natural Connections
Mathematics & Numeracy

CUMBERNAULD LIVING LANDSCAPE

Cumbernauld is incredibly green - over 50% of the town is open space, which includes parks, nature reserves and much more.

The Cumbernauld Living Landscape team are improving these outdoor spaces for people and wildlife and helping everyone in the community connect with nature on their doorstep.

Cumbernauld Living Landscape is a partnership between the Scottish Wildlife Trust, North Lanarkshire Council, The Conservation Volunteers and Sanctuary Scotland, James Hutton Institute.

In January 2019, we were awarded a £1.37 million National Lottery Heritage Fund grant, along with generous support from North Lanarkshire Council and other donors, amounting to a £2.1 million investment in a four-year programme putting wildlife and people at the heart of Cumbernauld's future.

This funding allows the Cumbernauld Living Landscape team to deliver transformational improvements to Cumbernauld's environment with a long-term change in the way the town's people connect with nature. Our collaboration with the community and local schools, countryside rangers, landscape architects, and landowners is key to our success.

We have a long history of working closely with the local community. Since 2013, we've been working together to improve Cumbernauld's outdoor spaces including improving accessibility to parks, restoring peat bogs to reduce flooding, creating wildflower meadows to support insects, connecting young people to nature through outdoor education sessions, improving woodlands by planting native tree species, and supporting health and wellbeing through our Wild Ways Well programme.

We continue to seek funding to enable us to work in partnership ensuring our activities remain responsive to the needs of the community and instil long-term community ownership.

PROJECT PARTNERS — Scottish Wildlife Trust — NORTH LANARKSHIRE COUNCIL — Sanctuary Scotland — The James Hutton Institute — TCV The Conservation Volunteers

FUNDERS — HERITAGE FUND — Scottish Natural Heritage Dualchas Nàdair na h-Alba nature.scot

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"The book of nature is written in the language of mathematics."

Galileo Galilei

Introduction

Welcome to the Curriculum for Excellence outdoor learning methods for mathematics. The following activities can be used by education practitioners as a tool to integrate and explore outdoor learning with mathematics.

As an educator you know your children, where they are and the learning path they are on. You also know the Curriculum for Excellence, how best to deliver that. These are simple exercises that can be adapted for all ages and school years as you see fit. It will still have the same impact across all ages.

Learning levels for tasks have been marked like so (Early years to second level).

What drives our desire to provide CPD for educators?

Children are aware of the hierarchy in lessons. Peter is the best at Maths or Amy at English but that boils down to the children thinking that they are not good at this subject, they feel silly or fear that they may be ridiculed if they ask a question, it is simply not the case, they just earn differently. These invisible children are all around us. When you put them into the outdoor learning environment, that hierarchy is gone, they all have equity and have the opportunity to become excellent.

As a conservation charity you may wonder why we care about outdoor learning? The simple fact of the matter is that when people, regardless of age, are healthy, enjoy the outdoors and understand the benefits that nature and the environment give to them, they appreciate their experiences, nature, and the environment more. We believe that this appreciation builds to respect for that environment and a level of stewardship, enabling the individual to care more, take action and promote our valuable greenspaces. Together people and nature can thrive and learn.

Thank you.

Continuing Professional Development

Measuring trees

Session in depth:

This activity looks at the four different ways to measure a tree's height. A class experiment may be to try all the methods and see how accurate they are when compared to each other! There are many others to explore, and you can find them online. The four sampled here will demonstrate the practical application of outdoor learning for numeracy.

Materials required: Location:

Measuring tape   local greenspace (somewhere with trees to measure)

Paper and pencil

Instructions:

Trees grow almost everywhere on the planet. They require light for energy, space to grow, nutrients (minerals in the soil and organic matter) and water to survive. In many ways they are like us. Trees have two growth spurts each year and if you were to fell a tree and cut cross sections you would see those rings that everyone knows tells you the age. However, you need to be careful counting as each light and dark ring is equal to 1 year's growth the light wider ring is growth occurring through summer and the darker narrow ring, winter.

The Pencil method (2nd to 4th Level)

Split the group/class into pairs. One student stands far enough from the tree so they can see the top (ground level with tree base) and their partner stands by the tree at the centre of the trunk line. Make sure there is enough safe space around the tree as the partner will have to walk away from the tree for a distance.

Holding a pencil at arm's length, the student holds the pencil with the tip of the pencil at the top of the tree and their thumb holding the pencil were the tree meets the ground. The student then rotates their wrist 90 degrees. The pencil is now horizontal to the ground.

The student instructs their partner to sidestep until they until they are aligned with the top of the pencil – if they are standing far away you may need to use hand signals. The height of the tree is the measurement from the partner's feet to the centre of the tree.

The upside-down method (Early years to 4th level)

The student walks away from the tree guessing how big it is, keeping their back to the tree, then bending upside down from the waist looking through their legs to see if they can see the **full tree**. A little bit of back and forth will enable the student to see the whole of the tree while looking at it upside-down. Measure the distance from the student to the tree. This is the height of the tree.

The Twin method (Early years to 4th level)

Split the class into groups of students who are the same height as each other, guess how tall the tree is and walk to that distance from the tree. One student lies down feet towards the tree (may need a yoga mat or at the least check the ground is clear of debris or fouling!) A partner then stands at the feet of the student lying down.

The student lying down should then be able to position their partner to move back and forth until their top of their headlines up with the top of the tree remembering that their feet should be together (there is going to be a lot of wiggling around to accomplish this task). Once the person lying down can see the tip of the tree at their partner's head have another student measure from the eyes of the person lying down to the tree. This is the height of the tree.

The Ratio method (2nd to 4th level)

Take a sheet of A4 paper, Measure from the bottom corners on the long edge to 21cm and mark 2.1cm from the bottom of the paper.

Fold along 21cm markings (dotted line in diagram)
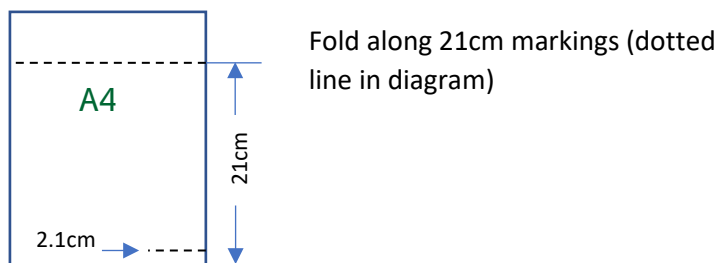
Using the 21cm sheet of paper, have one student stay at the tree and the other student, holding the sheet of paper, walk away until the treetop is in line with the top of the paper and the tree base (ground level) is in line with the bottom of the paper. The student with the paper then asks their partner to wave their hand until it is level with the 2.1cm mark on the paper and hold it in place. A measurement from the arm to the ground is taken and multiplied by 10.

The hand was 1/10th of the way up the sheet of paper (2.1cm = 1/10th of the 21cm page). The tree height must then be 10 times the height of the arm between the ground and the 2.1cm on the sheet.

Questions:

Can the students think of any other methods of measuring a tree's height? What can they find online to expand their learning? Are there any online apps (Google Play or Apple store).

Reflections:

Adding the outdoors to lessons helps make them all the more exciting, and numeracy is an exciting subject if you understand it from early years. Stimulating learning through these tasks can create a learning environment where children thrive. Ask the students how this compared to classroom tasks.

Continuing Professional Development

Calculating a tree's age (1st to 4th Level – Early Years can have fun too)

Session in depth:

The previous activity helped us examine the height of a tree, however that does not tell us how old it is. This activity looks at the **estimation** of a tree's age (trees grow at different rates each year with two rings of growth for summer and winter shown on a cut section). Encourage your students to add, divide and measure.

Materials required: Location:

Measuring tape   local greenspace (somewhere with trees to measure)

Paper

Pencils

Instructions:

The height of a tree does not tell us how old that tree is, it only tells us that it had access to light, space, nutrients (minerals in the soil and organic matter) and water. The table below tells you how old specific tree species can grow to. So how do we measure it?

Table 1. Tree species and associated life span

Tree Species	Life Span
Ash	200
Beech (non-native but common)	350
Birch	100
Cherry	50
Elm	100
Hawthorn	300
Hazel	70
Holly	300
Maple	120
Oak	800
Rowan	120
Scots Pine	500
Willow	400
Yew	5000

1. Guesstimate

Guess the age of the tree first. How old does everyone think it is? Have a discussion as to their thinking behind the guess.

2. Estimate

The average person's hug is 130cm, but you can also find the average arm span of the group through measuring from longest fingertip on right hand to longest fingertip on left hand. Add everyone's span sizes up and then divide by the number in class. You now know the average arm span for the class. The next step is to hug the tree and see how many spans are required to measure the tree's circumference. Always measure the circumference of the tree at chest height of an adult (shoulder height of smaller children).

3. Accurate

Take a measuring tape and measure the circumference of the tree at chest height. Record the measurement.

Using the table below divide the circumference in centimetres by the number given for the associated tree.

Table 2. Tree species and associated value to divide measurement.

Tree Species	Divide circumference in cm by:
Oak	2
Hazel, Elm, Ash, Beech	2.5
Holly, Yew	1.25
Scots Pine	3.25

How old are your trees?

Questions:

You will notice that there are a few trees missing from Table 2. Can your students explain why this is? The answer lies in the growth speed of different trees, the density of the wood when growing and the habitat they are in, e.g., hawthorn trees will take hundreds of years to get to the girth of a 40-year-old ash tree.

Hawthorn is a slow growing; dense wood and its habitat is usually hedgerows. Hawthorn and other tree species are packed together in a hedge where they must compete for water, nutrients, space and light. Those variables change girth growth rate immeasurably. A core sample might be the only way to determine the age of a living tree under these conditions.

Reflections:

Do your students understand what they were trying to achieve? How can it be different next time? Do they understand the concept of decades and centuries in a tree's life in comparison to ours?

Continuing Professional Development

Managing a meadow (2nd to 4th Level)

Session in depth:

This activity measures perimeter to define area, calculating the volume of seed needed and the associated cost of that seed for the area chosen. This activity also covers World at Work.

Materials required: Location:

Measuring tape   local greenspace/park (large grassland area is better)

Pen/pencil/paper/clip board

Instructions:

Your students have been commissioned to manage an area of land for a nectar network, creating a sustainable wildflower meadow for pollinators. The students should discuss the benefits of assorted sizes of meadows for pollinators and people (to allow for access e.g., a path network or car park) against a meadow that would cover the whole site (management costs, sustainability, angering people who like to picnic are a few examples). Set the group off to explore a greenspace and locate a suitable area that has access to sunshine, drainage, and access for maintenance.

They are to suggest a discrete meadow within the park area, measure out a perimeter and work out the area of their chosen site. From that work out the cost of seed for the area using the following table. You have a budget of £2000. What is the best value mix for your project?

Table 3. Scotia Seeds wildflower mixes

Mix	Sowing rate g/m^2	Cost of 100g (£)	Cost of 500g (£)	Cost of 1KG (£)
Urban Pollinator	4	13.62	56.70	86.94
Dry Meadow mix	3	12.36	51.36	76.68
Mavisbank	3	11.46	47.82	71.40
MG5 Meadow	3	14.70	61.20	91.38
Bird, bee and butterfly	2	30.42	133.68	200.52
Pond edge mix	2	37.56	156.60	237.30

 All prices are correct as of 18/05/2020 and include VAT @ 20%

Questions:

Is the area in m^2 all you need to know to deliver the job? – What about biodiversity or habitat type? Would this change the price? Has anyone considered the added cost of labour or machinery to create the meadow? This is a real scenario and one we work out each time we create a meadow.

Reflections:

Did the students think that the price of seed was more or less than they expected it to be? Do the students think conservation is expensive?

Continuing Professional Development

Numeracy scavenger hunt (Early to 3rd level)

Session in depth:

This is a fun activity to introduce everyday items in the context of numeracy. We are surrounded by shapes, angles, and patterns that we probably take for granted. Add the fun scavenger hunt to find some of those more difficult ones too! This can be easily adapted for your students' level.

Materials required: Location:

Paper, pencil and clipboard   School ground or local greenspace

Instructions:

Split the class into smaller groups and using the template on the next page, set them off within the school grounds or in the local greenspace (reinforce boundaries) to hunt and record the scavenger hunt items. Get each group to show off where they found each item and to discuss the final selection (DAFOR).

Questions:

Do the students think DAFOR is a suitable method to record plants or do they think there is a more robust way of completing the task? Can the students come up with a numeracy scavenger hunt suitable for younger years or even early years?

Reflections:

How have the students performed with this task and any of the others?

Have you found using outdoor spaces has an impact on your students' learning?

Does this encourage you to utilise outdoor learning for the teaching of numeracy?

Are you interested in learning more?

DAFOR

The scientific measure of estimate usually for plant life within a quadrat etc. DAFOR stands for:

Dominant   50-100 % of the area within the quadrat likely to be grass
Abundant   31 – 50% coverage – such as buttercups
Frequent   16-30% coverage – Clover
Occasional   6-15% coverage - lesser trefoil
Rare   1-5% coverage - eyebright
Not present   0%

Numeracy scavenger hunt

What can you find in nature?

You will find three items at the bottom of the page which ask you to fill in items in the DAFOR scale. Conservationists use this to survey plants. Can you find suitable plants?

Numeracy in nature	What did you find?	Where did you find it?
Angles		
Acute angle		
Right angle		
Obtuse angle		
Reflex angle		
Shapes		
Circle		
A straight line		
Square		
Cube		
Rectangle		
Hexagon		
3 different types of triangles		
EQ _ _ _ _ _ _ _ _ _ _		
SC _ _ _ _ _		
IS _ _ _ _ _ _ _		
Sphere		
Cylinder		
Heart		
Symmetry (hint – plants)		
Radial		
1 line of symmetry (mirror image)		
2 lines of symmetry		
Patterns (some urban influences)		
Criss cross		
Doted lines		
Fibonacci pattern		
Honeycomb		
Dominant (50-100%)		
Abundant (31-50%)		
Frequent (16-30%)		
Occasional (6-15%)		
Rare (1-5%)		
Not present	N/A	N/A

Curriculum links for all activities

Activity	Equipment required	Key links to curriculum
Measuring the height of a tree		
The pencil method	Pencil Paper Measuring tape	MNU 2 – 01a, 3 – 01a, 4 - 01a MNU 2 – 03a, 3 – 03a, 4 - 03a MNU 2 – 11a, 2 – 11b, 2 – 11c MTH 3 – 11a, 3 – 11b MTH 4 – 11a, 4 – 11b
The upside-down method	Measuring tape	MNU 2 – 01a, 3 – 01a, 4 - 01a MNU 2 – 03a, 3 – 03a, 4 - 03a MNU 2 – 11a, 2 – 11b, 2 – 11c MTH 3 – 11a, 3 – 11b MTH 4 – 11a, 4 – 11b
The twin method	Sheet of A4 paper for each young person Pencil Measuring tape	MNU 2 – 01a, 3 – 01a, 4 - 01a MNU 2 – 03a, 3 – 03a, 4 - 03a MNU 2 – 11a, 2 – 11b, 2 – 11c MTH 3 – 11a, 3 – 11b MTH 4 – 11a, 4 – 11b
The ratio method	Sheet of A4 paper for each young person Pencil Measuring tape	MNU 4 – 03a MNU 3 – 07a, 4 – 07a
Calculating a tree's age		
Guestimate	N/A	MTH 4 – 12a MTH 4 – 16b
Estimate	Paper – pencil Measuring tape	
Accurate		
Managing a meadow		
Working out area	Measuring tape pencil - paper	MNU 2 – 11c MNU 2 – 12a MTH 4 – 17a MTH 2 – 21a, 3 – 21a,
Working out costing		
Numeracy Scavenger Hunt		
Scavenger hunt	Pencil Paper	MNU 3 – 11 b MNU 0 – 13a, 1 – 13a/b, 2 – 13a MTH 1 – 16a, 1 – 16a, 4– 16a MNU 1 – 17a, 2 – 17a, 3 – 17a MTH 1 – 19a, 2 -19a, 3 – 19a

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Partners

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