KS3 Outdoor Maths Opportunities

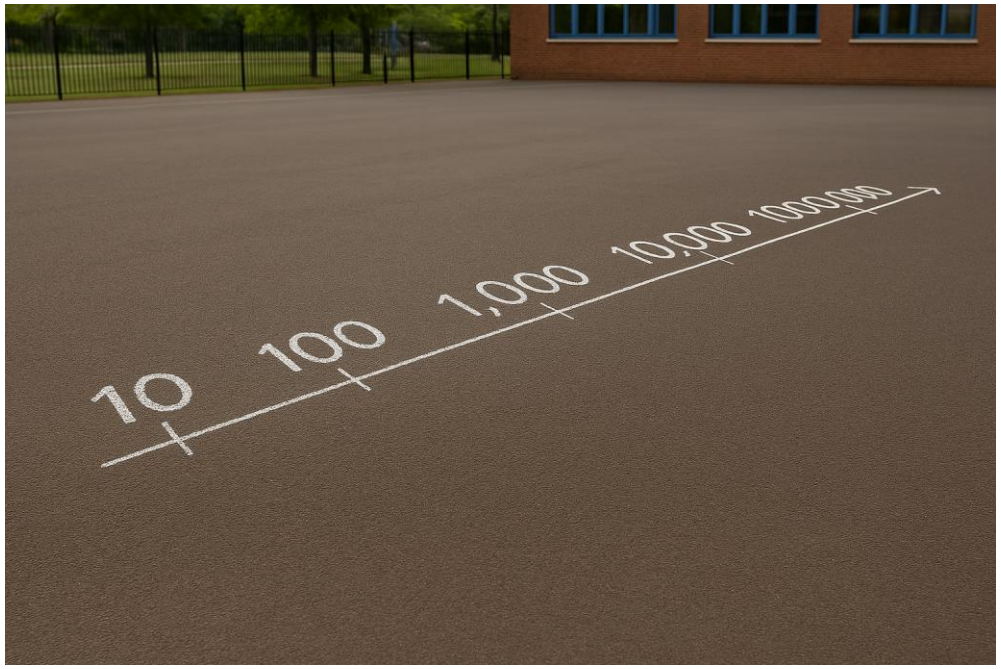
The structure of the number system

Outdoor number line

Create a large number line outside using chalk or cones to mark out powers of 10.

Pupils must place number cards correctly on the line – these could be pre-made or written on whiteboards.

Pupils could also be required to order decimals on a number line, either blank or with marked integers.



Place value revision

Assign different natural objects a place value (e.g. stones = ones, sticks = tens, leaves = hundreds, acorns = thousands, etc.) and task pupils with a range of activities that make use of these:

- Build the largest and smallest possible numbers with the resources you can find using the digits 4, 7, 3 and 6.
- Build a number that rounds to 5,000.
- Use sticks to represent what 30 x 10 would look like.

Change the objects to represent decimal place values:

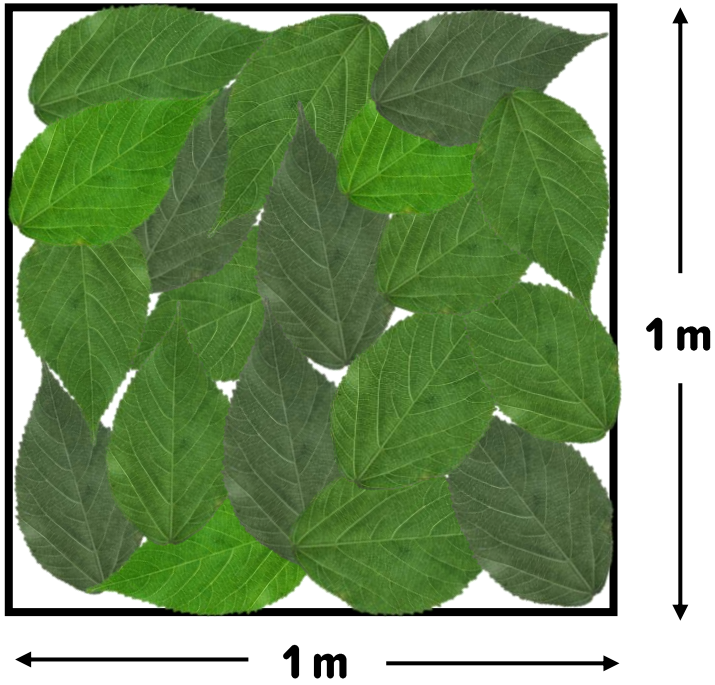
- Build a number between 0.5 and 0.7 to at least three decimal places.
- Build a number equivalent to $\frac{3}{5}$
- Build the value equal to 0.00195 x 10

Estimating place value

Allow pupils the opportunity to feel place value by estimating and measuring various distances.

For example:

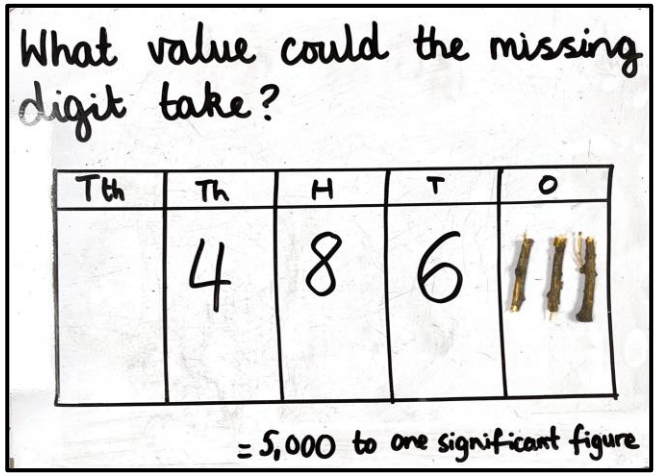
- How far is 1000 steps?
- Mark out 100 metres. How many of these are there in 10,000 metres?
- Estimate how many leaves fit into 1 square metre. Scale this up by 1,000,000.

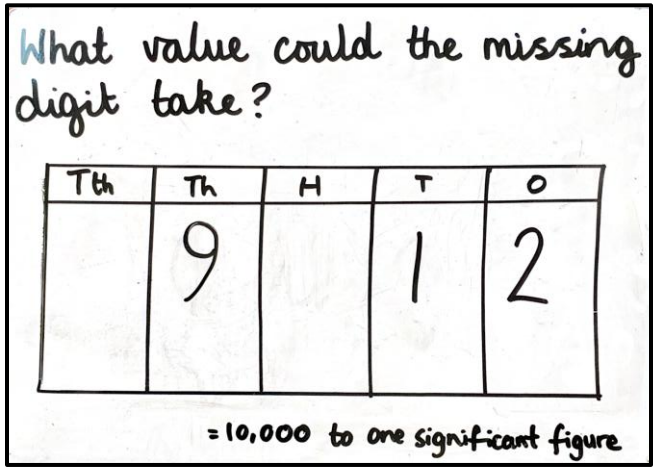


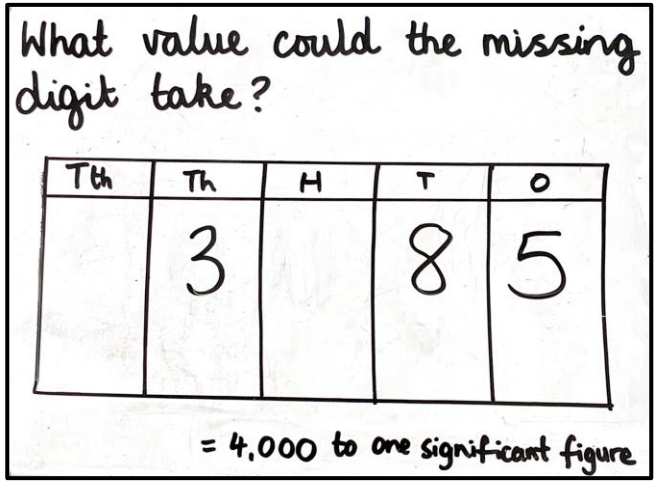
Missing values

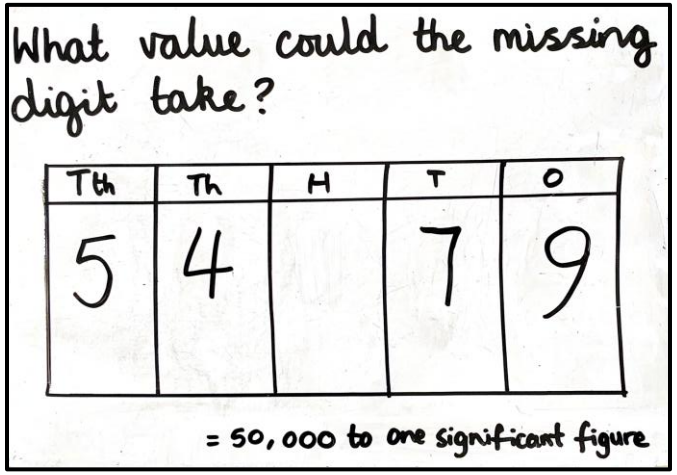
Provide pupils with missing digit values that must round to a power of 10.

Pupils place the correct number of sticks in the empty column to make the statement correct. How many possibilities can they find for each example?









Multiplication and division with negative factors

Natural arrays can also be used to explore what happens when one of the factors is negative.

Ask pupils to create arrays and tell them that each natural object is worth -1. Encourage them to describe their arrays in full sentences and with corresponding equations:

- **Where in the array are 3 groups of -6?**
- **Where could you see 6 groups of -3?**
- **What is the same/different about these interpretations?**
- **What are the equations that could be written for this array?**

3 x -6 = -18

6 x -3 = -18

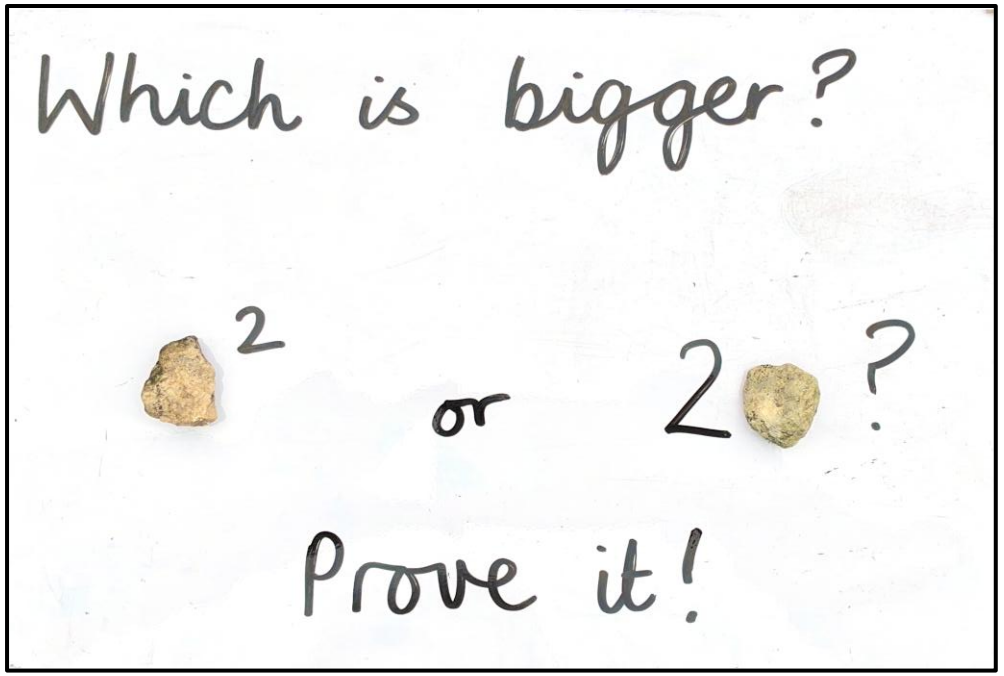
Algebra

Algebraic notation with natural resources

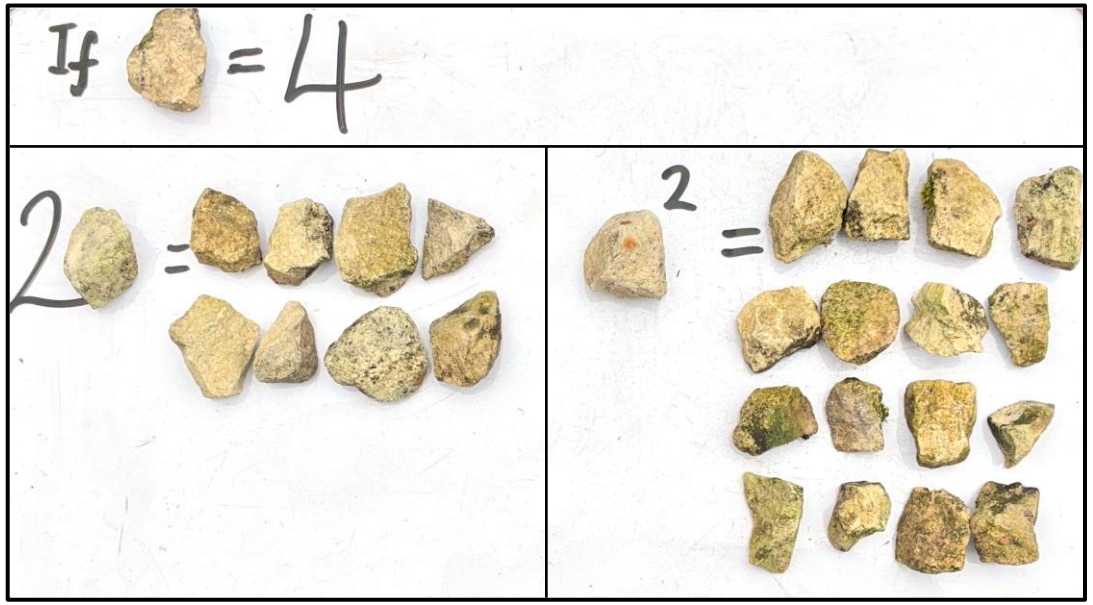
As well as using letters to represent numbers, use natural resources as an opportunity to prove why different expressions represent different values.

This will allow pupils to explore certain concepts in a concrete way.

For example:



Algebraic notation with natural resources



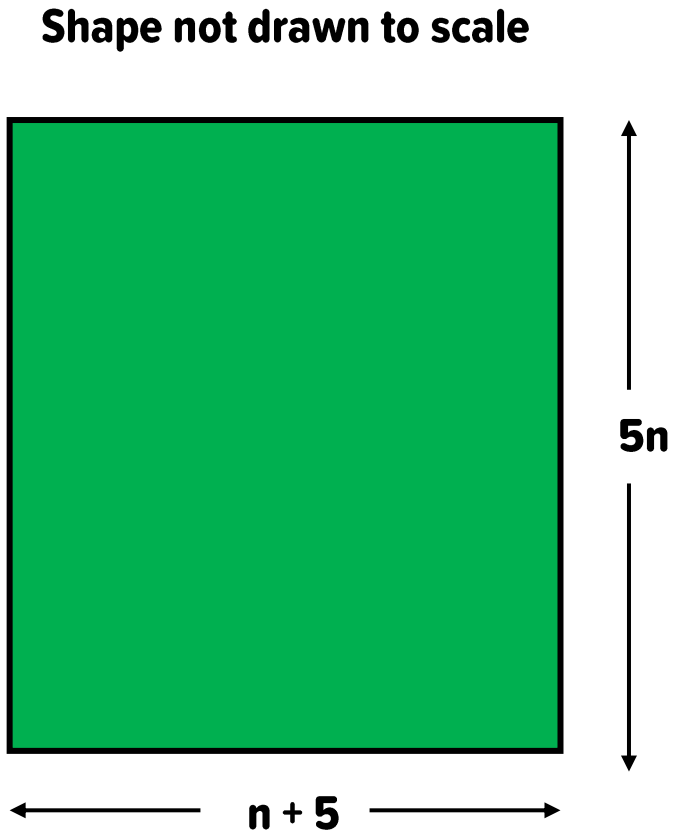
and so on...

Exploring algebra in measure

Similarly to the activity **‘Algebraic notation with natural devices’,** allow pupils to prove their responses to these questions about a rectangle, which has measurements given as algebraic formulae:

- If the shape was drawn accurately, what would the proportions of the rectangle’s sides look like? Would it be wider or taller?
- Could the rectangle ever become a square?

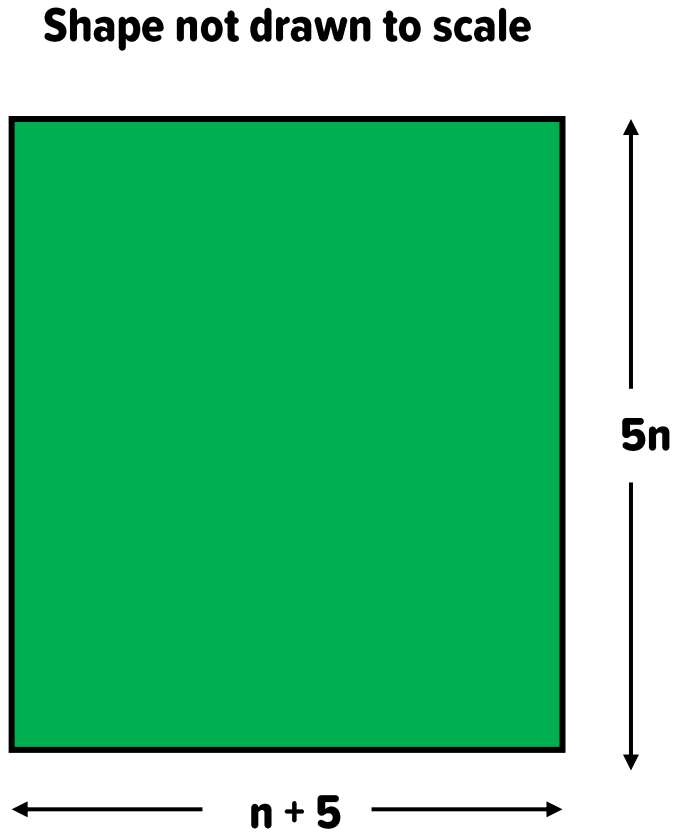
Allow pupils to build different possibilities using sticks of roughly the same length to help them reason about and justify their responses.



Exploring algebra in measure

You can continue to explore the previous activity by setting pupils specifications for their models, for example:

- What would the value of **n** have to be so that the height is double the width?
- What would the value of **n** have to be for the width to be one stick longer than the height?

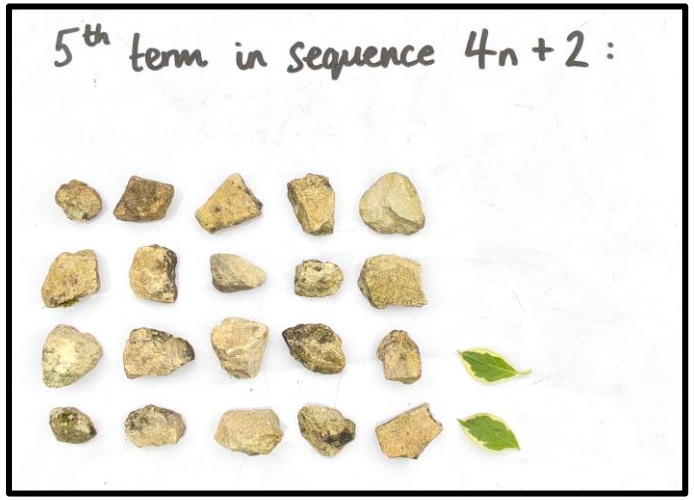


Algebraic sequences

Challenge pupils to use natural resources to build a given term in an algebraic sequence.

For example:

- “Show the 5th term in the sequence 4n + 2”
- “Show the 4th term in the sequence 6n + 3”
- “Show the 6th term in the sequence 3n – 1”



Then ask pupils to explain where in their picture the term is represented; where the algebraic rule can be seen; where the addition or subtraction part of the sequence is apparent.

n^{th} term in an arithmetic sequence

Ask pupils to create a square out of sticks:

Then create an adjoining square using 3 more sticks:

Continue this pattern until there is a row of four squares:

Ask pupils:

- What is the sequence of numbers? (i.e. the number of sticks)
- What would the number of sticks be in the 15^{th} diagram? Can you think of a calculation you could perform to establish this?

If time, pupils could then prove their reasoning by building the 15^{th} diagram.

Ratio, proportion and rates of change

Simple ratio tasks

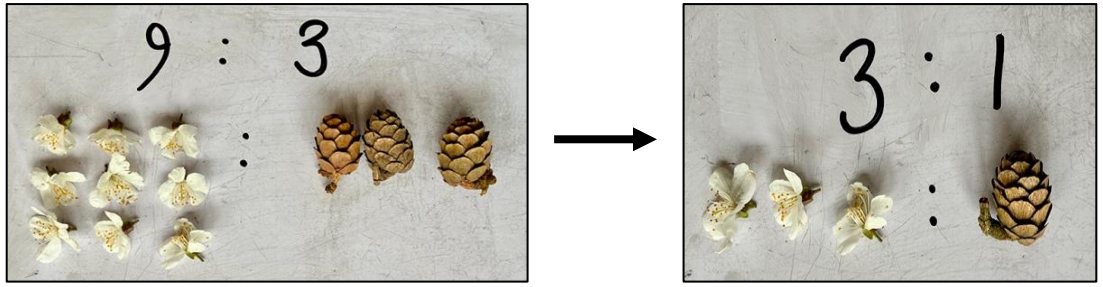
Allow pupils to find ratios in your outdoor area. You may wish to provide a worksheet based on the objects (both manmade and natural) available on site.

E.g.

Objects	Ratio	Simplest form
trees to shrubs		
flower beds to paved areas		
doors to windows		

Have pupils collect a range of natural items, then provide them with a range of ratio cards (e.g. 5:4, 3:10, 7:1, etc). Pupils represent the ratios with their collected resources.

As a challenge, you could provide pupils with a ratio card that they have to make then simply, e.g. 12:4.

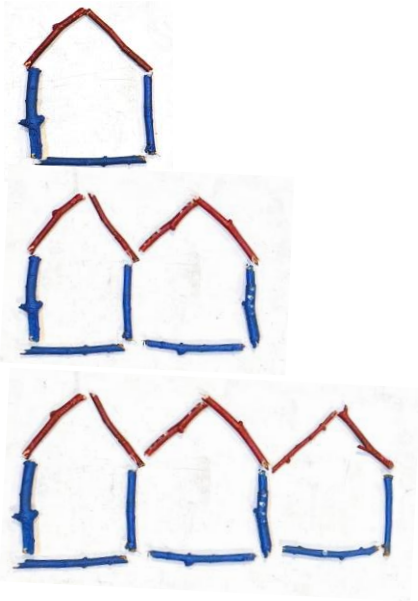


Understanding sequences

This task involves pre-painting sticks two colours of your choice. (Alternatively, you could dip just the ends in paint or put a blob of nail varnish somewhere noticeable.)

Ask pupils to create a pentagon out of the sticks, using one colour for the ‘roof’ and the other colour for the lower part of the shape:

Ask them to repeat the pattern, creating an adjoining pentagon following the same pattern:



Points for discussion:

- What is changing?
- What is staying the same?
- What is the ratio of (e.g. red) to (e.g. blue) sticks each time?
- How many (e.g. red) sticks will the next shape in the sequence require?
- How many (of a particular colour) sticks will there be in the Xth number of the sequence?

Calculating percentage increase or decrease

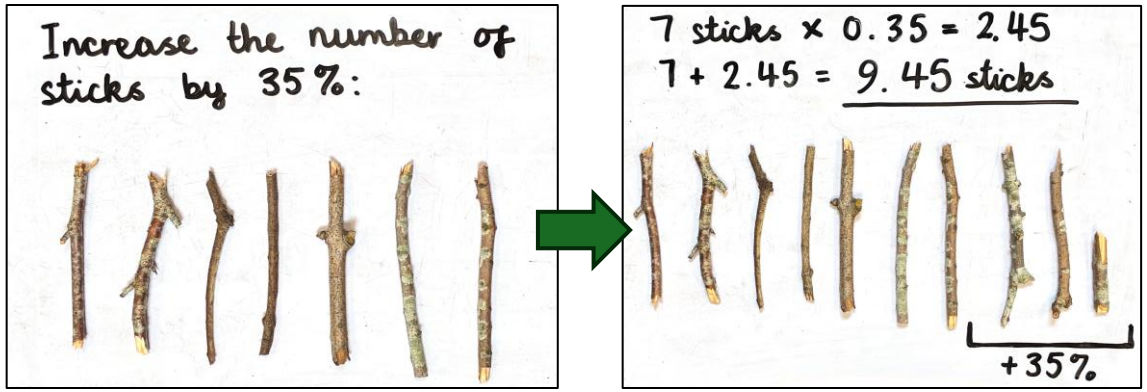
Provide or ask pupils to gather a number of sticks of a similar size (these can be broken to make a more uniform). Each stick is worth 1.

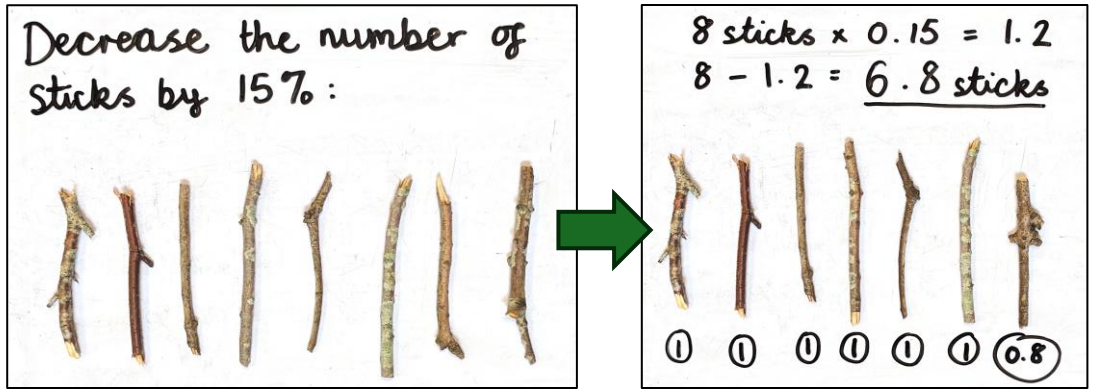
Give pupils instructions to increase or decrease a given number of sticks by a given percentage, e.g.:

‘Increase **X** sticks by 35%’

‘Decrease **X** sticks by 15%’

Encourage pupils to record their calculations on whiteboards. For decimal values, they will have to break their stick as accurately as possible to represent a fraction of 1 whole.





Wildflower seed packets

Wildflower seed packets provide information about sowing rates, usually in grams per square metre. This information could be used to create ratio problems for pupils to solve before planting:

These seeds have a sowing ratio of 3 g:1 m^2
How many square metres could be covered with this 1 kg packet?

An area for planting has a length of 17 metres and a width of 9 metres.
How many grams of wildflower seeds are needed to cover the area?
How many grams would be left over?

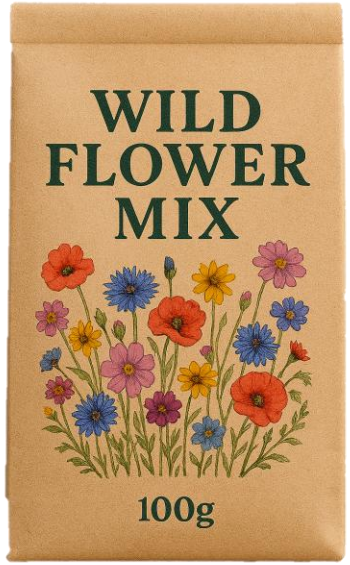
Wildflower seed packets

Wildflower seed packets could also be used for ratio and percentage problems regarding the seed mix:

A 100 g bag of wildflower seeds contains approximately 2,000 seeds.

In this bag, the ratio of poppy to chamomile to celandine to cornflower seeds is 4:5:3:4.

- How many seeds of each flower type are there in this pack?
- How many more chamomile seeds are there than poppy seeds?
- What is the percentage of each seed type in the bag?

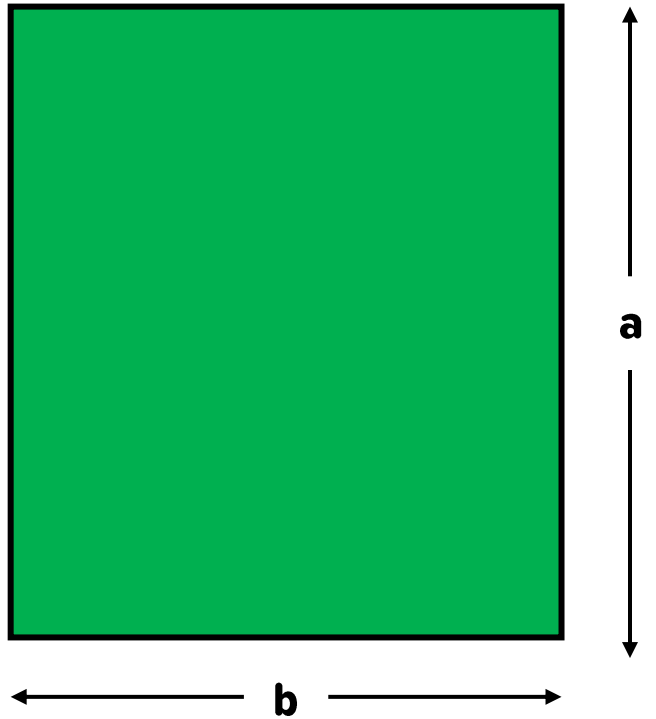


Geometry and measures

Perimeter

Task pupils with finding the perimeter of an outdoor area – large or small.

They then write expressions for the perimeter of the area in as many different ways as they can.



Understanding/revising metric units

After revising different units of metric measurement, challenge pupils to find examples in the outdoor area that represent measures of **length, mass** and **capacity**.

Ask them to consider what would be the most appropriate metric unit to measure their findings.

Converting metric units

This task also supports securing understanding of place value and powers of 10.

If you have the equipment available, task pupils with measuring and recording some of the examples they found to represent length, mass and capacity in the outdoor area. They can then convert their measurements into various equivalent measures in different metric units:

The conker weighs 14 grams.
What is this in milligrams? How about kilograms?

10^4	10^3	10^2	10^1	10^0	$\frac{1}{10}$	$\frac{1}{10^2}$	$\frac{1}{10^3}$	
			1	4				g
1	4	0	0	0				mg
				0	0	1	4	kg

Triangles

Provide pupils with sets of measurements given in different units.

Can pupils predict whether they are the lengths of an equilateral, scalene or isosceles triangle?

Using chalk, allow pupils the opportunity to prove their answers.

★ 154.8 cm / 1.548 m / 1548 mm

★ 60 100 mm / 0.061 km / 6100 cm

★ 0.000074 km / 70.4 mm / 7.2 cm

Probability

Probability in seed mixes

Wildflower seed packets can also be used for probability questions, e.g.:

A 100g packet of wildflower seed mix contains seeds from four types of flowers in the following proportions:

Flower type	Percentage of mix	Weight in 100g
Blue violet	30%	30g
Poppy	25%	25g
Daisy	20%	20g
Marigold	25%	25g

If we plant the entire 100g mix and one seedling emerges at random, what is the probability that the seedling is:

1) A blue violet
2) A daisy
3) Not a poppy
4) Either a poppy or a marigold

This could then be put to the test by planting such a mix!

Exploring different likelihoods

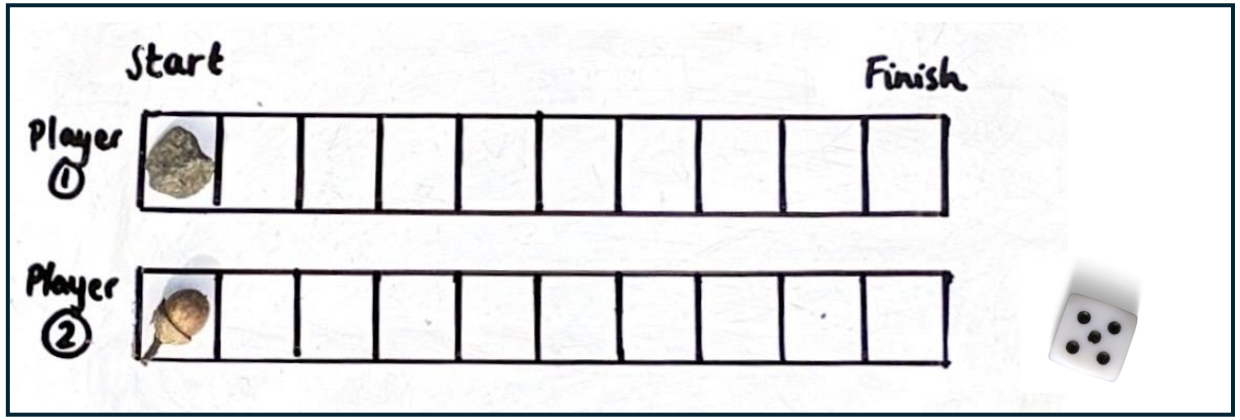
Play a game of probability in partners using natural materials.

Using mini whiteboards or chalk on paved areas, get pupils to draw a two-sided track with 10 spaces. Each player can choose a natural object to use as a counter, then take it in turns to roll a 6-sided dice.

- **Player 1** can move their counter one space along the track **if a number greater than 4** is rolled.
- **Player 2** can move their counter one space **if a number less than 4** is rolled.
- If the dice lands on a 4, roll again.

The first player to reach the end of the track is the winner.

After playing a few times, ask pupils to explain if the game they have played is fair or not and why.



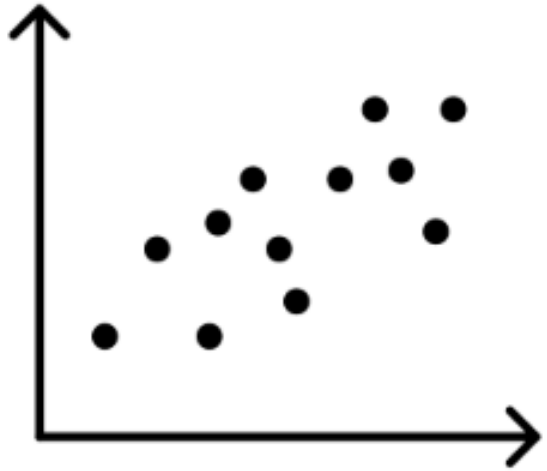
Statistics

Outdoor pattern seeking

Provide pupils with hypotheses to investigate or allow them to create their own, using the outdoor area as inspiration.

For example:

- ‘The tallest trees have the widest trunks.’
- ‘Trees that receive more sunlight have larger average leaf sizes.’
- ‘Areas with more biodiversity have larger average insect counts.’
- ‘There is more lichen presence in shaded areas.’



Pupils can then create graphs with their findings and comment on what they have found, and whether they are able to answer the hypothesis. Do their graphs raise further questions?

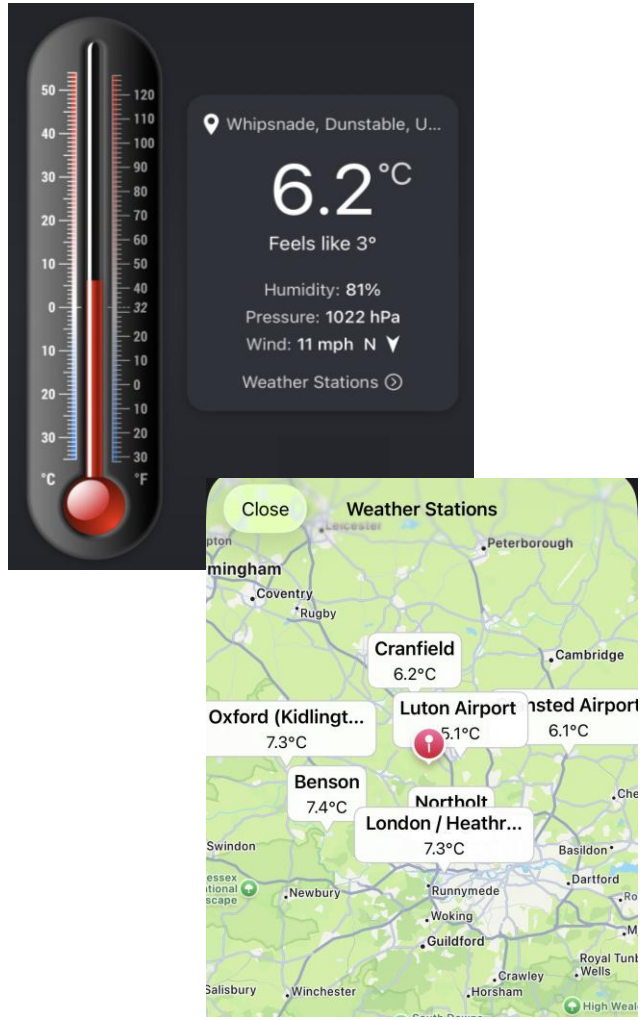
Weather forecasting

Using an outdoor thermometer or an app (e.g. Thermometer++ on the App Store), head outside to record the temperature each day for 5 days.

[On the Thermometer++ app, you can get a reading to 1 decimal point. You can also look at nearby weather stations and may want to record the variance around your local area.]

Ask pupils to create graphs from the 5 days of recorded data, and use this to answer questions related to their results, e.g.:

- ★ For what fraction of the days was the maximum temperature below X°C?
- ★ What was the mean maximum temperature, to one decimal place?



Litter picking pie charts

As a class, complete a litter picking task to clean up your outdoor area.
Once you have collected the litter, you can create a results table in a variety of ways:

- Type of litter (e.g. plastic packaging; fruit peels; sweet wrappers; paper, etc.)
- The weight of the litter collected from different areas (you will have to ensure the litter collection bags are clearly labelled and kept separate during the initial task)
- Amount of litter found in different areas
- Recyclable products vs. non-recyclable products (broken down into categories relating to the type of material)

Type of litter	Amount
Food waste	27
Food packaging	59
Paper	43
Broken glass	8
Plastic bottles	17

Pupils then use these results to create pie charts, working out the degree of the angle for each category:

Amount of litter	154	27	59	43	8	17
Angle size (°)	360°					