KS2 Outdoor Maths Opportunities

Number and place value

How much is 100?

3NPV-1 Teaching guidance:

Pupils need to experience:

- what 100 items looks like
- making a unit of 1 hundred out of 10 units of 10

Using a range of natural objects (this could be anything – sticks, leaves, blades of grass, stones, etc), ask pupils to collect 100 of each item and lay them out in sets.

Then ask pupils to compare the different sets of 100:

- **What is the same?** (All sets have 100 items)
- **What is different?** (The size/space taken up by the different objects)

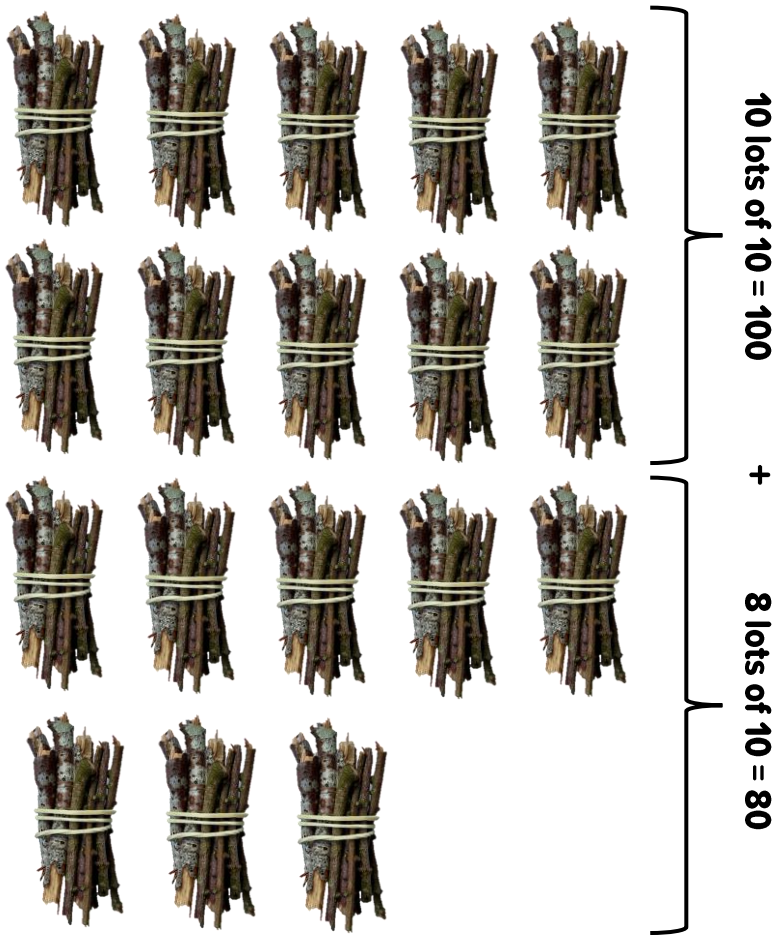
Tens in 3-digit numbers

Pupils can combine their groups from the previous activity to work out how many tens there are in other 3-digit multiples of ten.

For example, if we combine 10 groups of ten and 8 more, how many groups of ten is this altogether? What are 18 tens equal to?

This could then be linked to corresponding multiplication equations: 18 x 10 = 180 or 180 = 10 x 18

Pupils could also use these groupings to work in reverse: for example, how many groups of ten can 210 be divided/split into?



Tenths and hundredths

Following a similar principle to the previous activity:

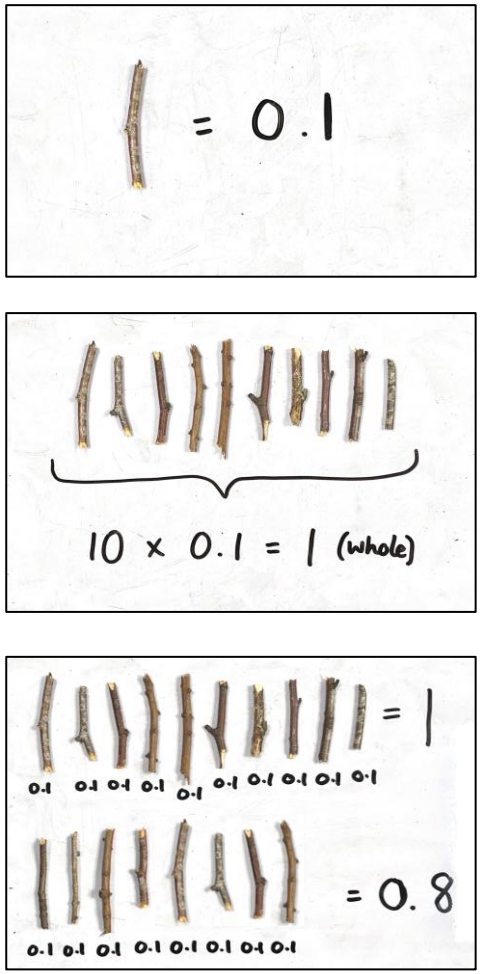
If a stick is equal to one-tenth (0.1), how many lots of one-tenth would we have to bundle together to make 1 one?

Once pupils are confident with values that only involve the tenths place, they can then start to reason with numbers that have ones and tenths:

E.g. if we have a group of ten-tenths, and another group of eight-tenths, how many tenths is this altogether?

“18 tenths is equal to 1 one and 8 tenths, and is written as 1.8”

This activity can be adapted to incorporate/focus on hundredths in a similar way.



10 tenths is equal to 1 one

18 tenths = 1.8

0.1 x 18 = 1.8

Roman numerals

Create Roman numerals using sticks. Pupils could either be tasked with making given numbers or identifying values made by a teacher or partner.

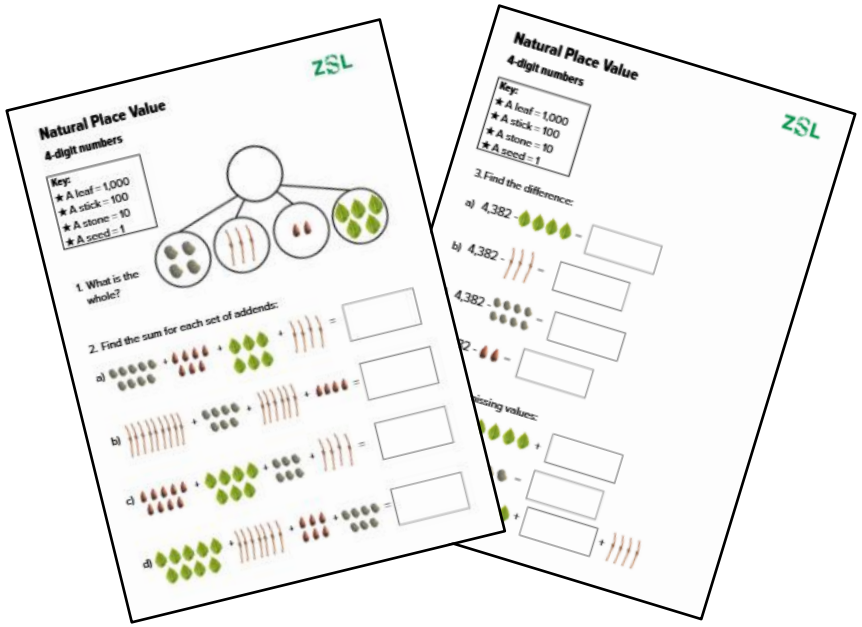
Those confident identifying different values could solve equations using sticks to represent the answer.

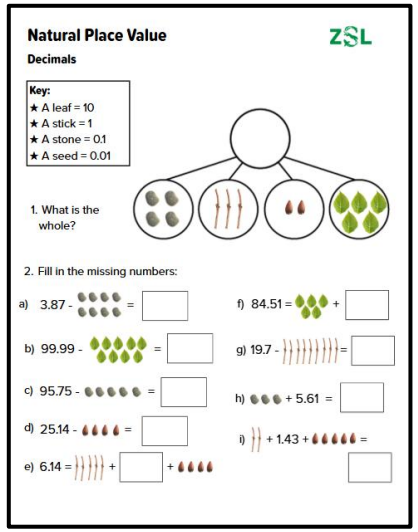
Another engaging activity is to challenge pupils to create their birth year or full birth date in Roman numerals.

Place value and partitioning

Assign different natural materials a place value and challenge pupils to combine partitioned amounts.

Pupils can explore this physically outdoors using natural objects, and there is also the option of using our worksheets for LKS2 (4-digit values) and UKS2 (decimal values).





Worksheets available on site

Decimal numbers/place value

As in the previous activity, assign different natural materials a place value and ask pupils to create given values, ensuring they have used the correct number of materials in the correct place value columns.

Values could be self-generated by pupils by rolling dice or using packs of playing cards.

Language focus: “There are four hundreds, two tens, three ones and three tenths. The number is four-hundred and thirteen point three.”

Finding Fibonacci

The Fibonacci Sequence is a sequence in which each number is the sum of the two preceding numbers: 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55 and so on.

This pattern and its numbers are found a lot in nature. For example, many flowers have 3, 5, 8, 13, 21 or more petals.

Can pupils find any examples that demonstrate this?

Other examples of the Fibonacci numbers or curve in nature include snail shells, sunflowers heads, pinecones, the furled fronds of young ferns, and some aloe plants.

Are there any other places you can find Fibonacci around the site?

1 berry

The branch splits into 3 other branches

This leaf has 3 points

Each blossom flower has 5 petals

8 petals

34 petals

Addition & subtraction

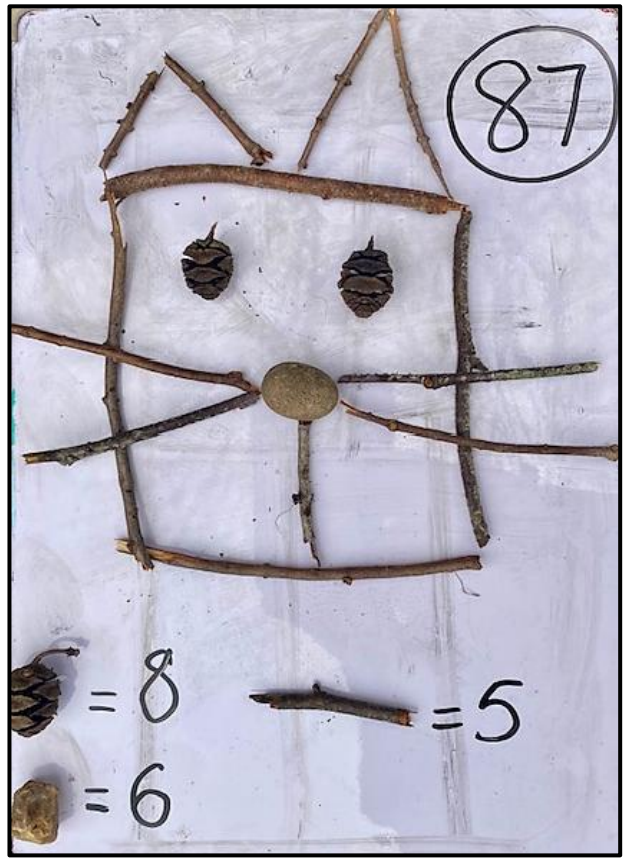
What is your picture worth?

In small groups, get pupils to create a picture using natural objects found in your outdoor area.

After this, gather as a class to collectively assign values to each object.

The groups then return to their pictures and calculate the value of the whole based on the assigned values.

Values could be assigned based on your current focus in class, such as times tables or using decimal numbers.



Magic number square

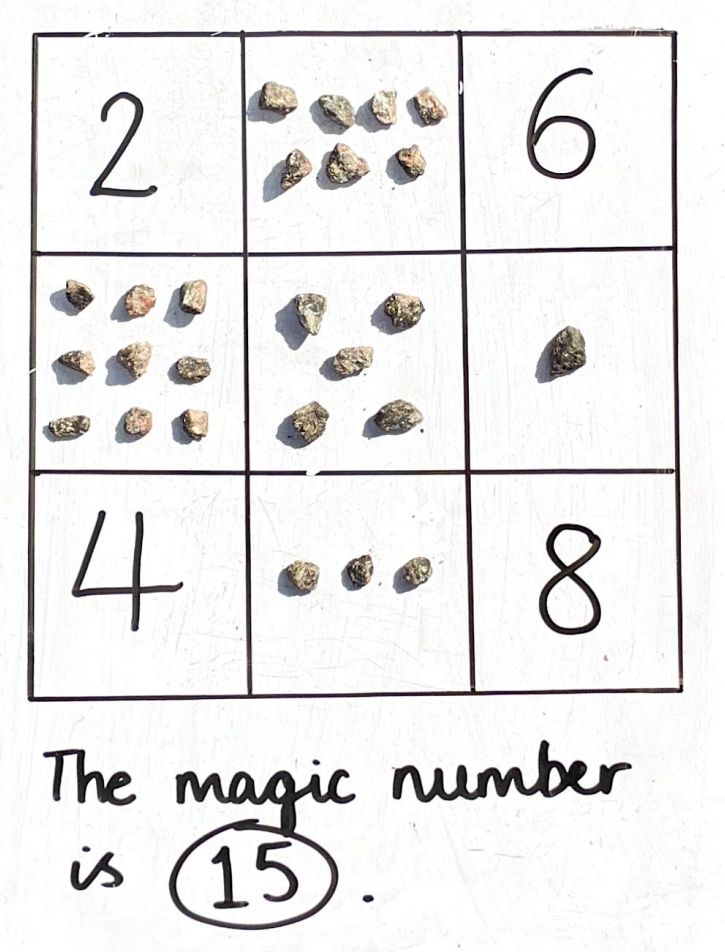
A magic square is a grid in which every row, column and diagonal adds up to the same number. It is a fun way for pupils to problem solve through trial and error. It can also be used to strengthen number bonds recall.

Tell pupils to draw 3 x 3 grids on their whiteboards or use sticks or chalk to create versions directly onto the playground.

You will also need a range of small tokens (e.g. pebbles, fir cones, acorns, conkers).

Tell pupils the ‘magic number’ which is to be the sum of each row, column and diagonal of their grid.

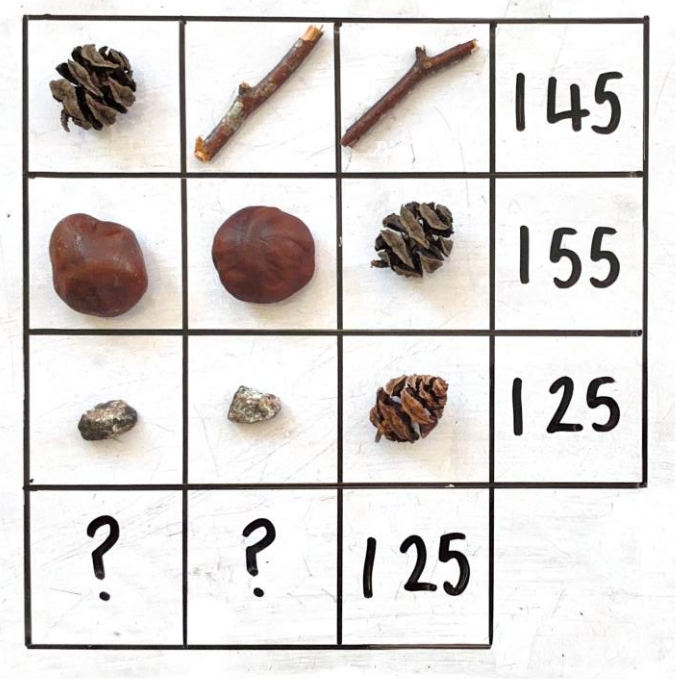
You can vary the level of challenge by telling them the range of values that appear in their grid (e.g. in the one opposite, all the digits from 1 to 9 are used), or you could provide some of the values before beginning and telling pupils where to place these on their grids.

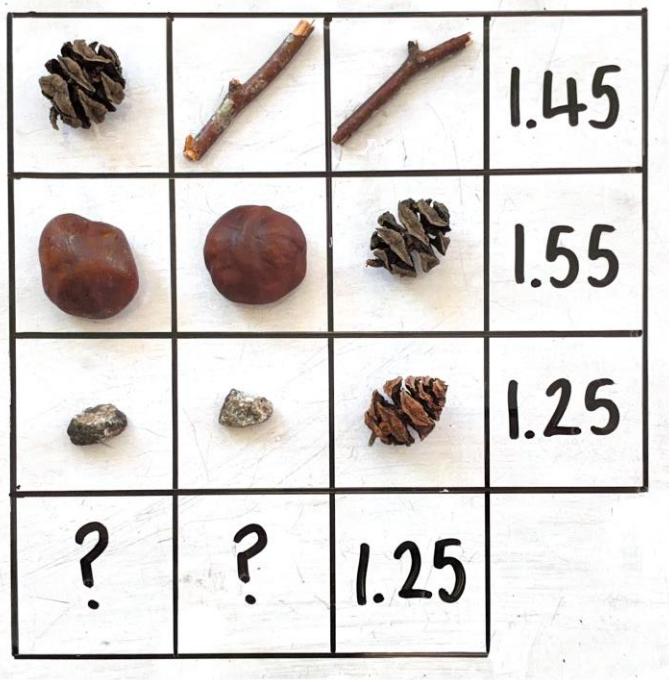


Solve problems with 2 unknowns

Place natural objects in a grid with a given value for each row and column. Can pupils work out the unknown amounts?

Once pupils are confident with this, they could be tasked with creating their own examples for their classmates to solve.





Choose values based on your current focus, i.e. positive or negative integers; decimals; fractions, etc.

Multiplication & division

Create natural arrays

Allow pupils the opportunity to use natural objects to create arrays for different times tables facts.

Encourage pupils to explore which is the most efficient way to arrange their materials to make them easier to count.

Explore the principle of commutativity: how does changing the factors around affect the groups and the multiple?

Pupils should also use these multiplication facts to derive linked division facts.

Language focus: “3 times 6 is 18, so 18 divided by 6 is 3.”

Counting stones

Collect stones so that you have enough for multiple of each value between 2 and 12 (or just focus on the table(s) your class is working on). Write the numerical values on one side and a corresponding pictorial representation on the other.

Pupils can use these to create both multiplication and division equations, with the stones providing opportunities for the total number of items to be both seen (pictorial representations) and not seen (numerical values).

There are four groups of 4:
4 x 4 = 16
16 ÷ 4 = 4

Minibeast multiples

After completing a minibeast hunt, challenge pupils to work out the total number of legs for each species using their multiplication knowledge.

Insect	Tally	Number	Number of legs
ant	𝍸 𝍸 III	13	13 x 6 = 78*
woodlouse	𝍸 II	7	14 x 7 = 98**
snail	I	1	1 x 0 = 0
slug		0	–
bee		0	–
ladybird	𝍸	5	5 x 6 = 30
butterfly	I	1	1 x 6 = 6
spider	II	2	2 x 8 = 16

* Encourage use of known facts: if 12 x 6 = 72, then 13 x 6 is one more group of 6.

** If 7 x 7 = 49, then 14 x 7 will be double the product.

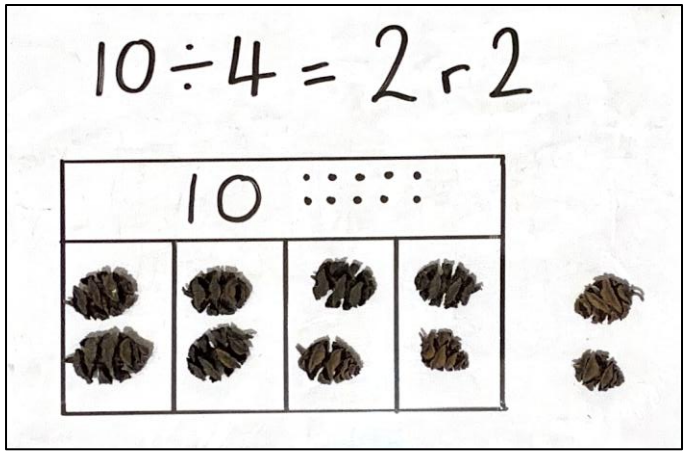
Extension: If I had seen 7 spiders, how many legs would this be altogether?

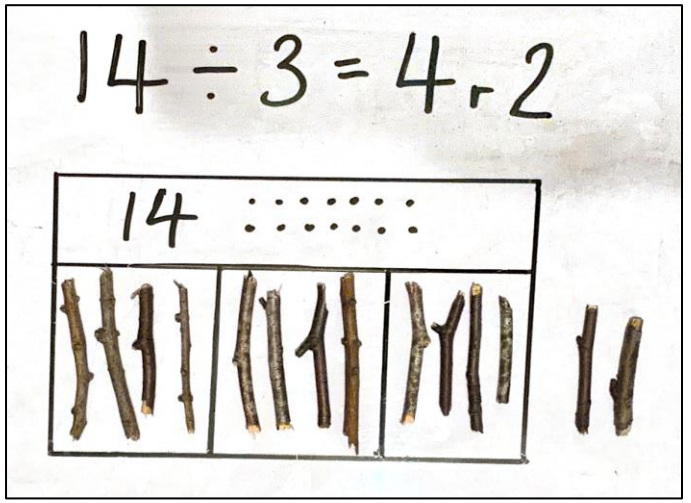
Dividing with remainders

Encourage pupils to consider real-life contexts when things cannot be divided easily and there is something ‘left over’ to pre-empt this learning.

Provide pupils with random amounts of objects to sort into containers/chalked division mats/into groups on a whiteboard. Demonstrate how to record the matching equations.

Support pupils to use their multiplication knowledge to understand why remainders only occur when the dividend is not a multiple of the divisor.



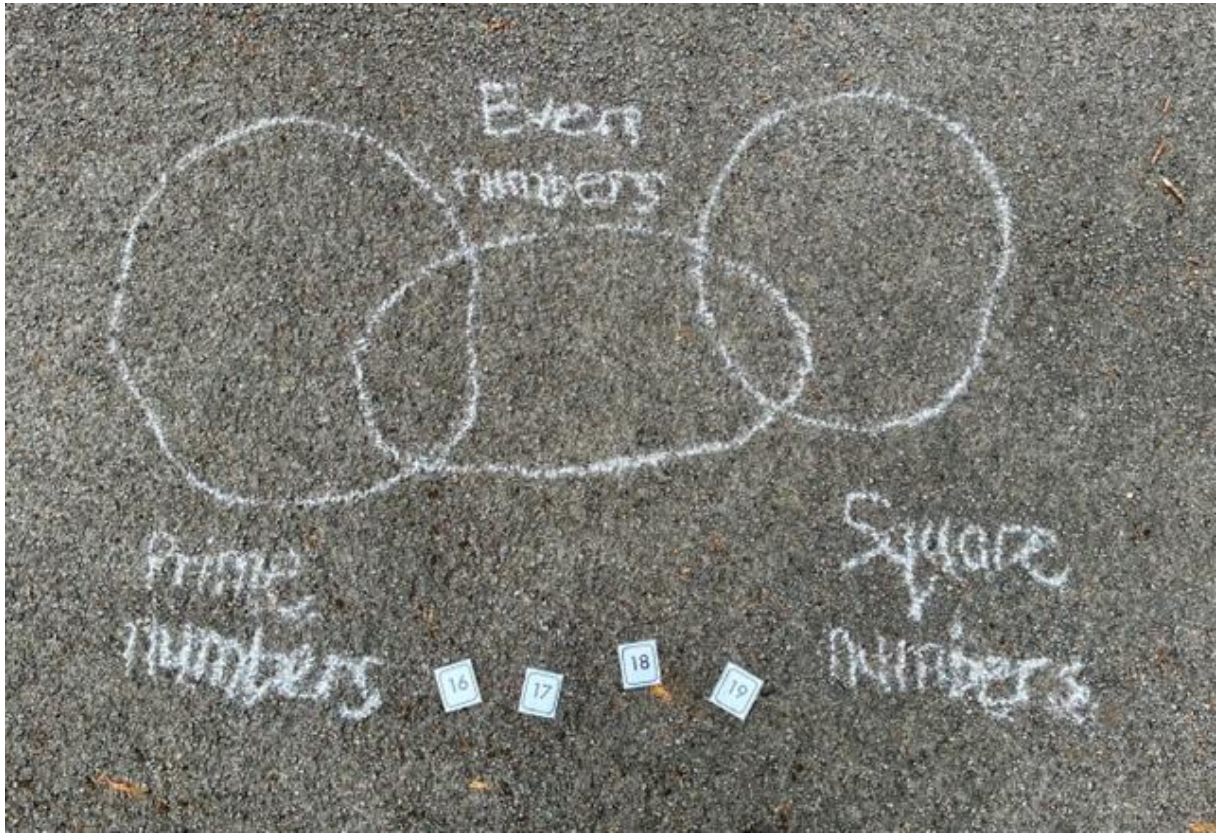


Common multiples, factors and prime numbers

Create Venn diagrams in chalk outside to check pupils' understanding of concepts involving common multiples, common factors and prime numbers. Give pupils number cards or whiteboards with chosen values to sort into the diagram. Working in groups or partnerships will hopefully encourage pupils to verbalise their reasoning and unpick any possible misconceptions around these topics.

Example taken from 2016 Key Stage 2 Mathematics Paper 2: reasoning, Q5

'Place each number in its correct place on the diagram.'



Fractions

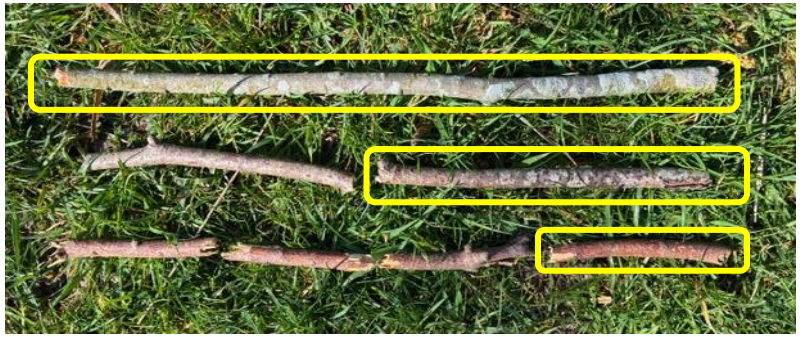
(including decimals - Y4)
(including decimals and percentages - Y5+6)

Fraction walls

Create fraction walls using sticks and use these to compare the size of the fractions, relative to one another.

- Which is larger – ⅓ or ½? Can you show me?
- How many quarters make one half?

This activity could also be completed using different sized sticks to represent 1 whole to demonstrate that the size of each part is relevant to the whole (i.e. half of 1 stick is not half of a different stick).



$$\frac{1}{3} < \frac{1}{4}$$

Unit and non-unit fractions of sets

Natural objects can be used to allow pupils the opportunity to explore and describe fractions of sets.

Once they have gained a clear understanding of unit fractions, they can apply this to learning that a non-unit fraction is made up of a quantity of unit fractions.

Language focus: "The whole has been divided into 3 equal parts. Each part is one-third of the whole."

Language focus: "The whole is divided into 8 parts.

$\frac{5}{8}$ of the leaves are brown. $\frac{3}{8}$ of the leaves are green.

$\frac{5}{8}$ is 5 one-eighths. $\frac{3}{8}$ is 3 one-eighths."

Exploring mixed numbers and improper fractions

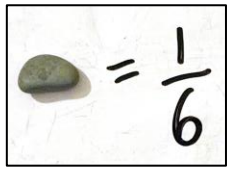
Get pupils to gather as many of the same natural object as they can (this could be done in groups).

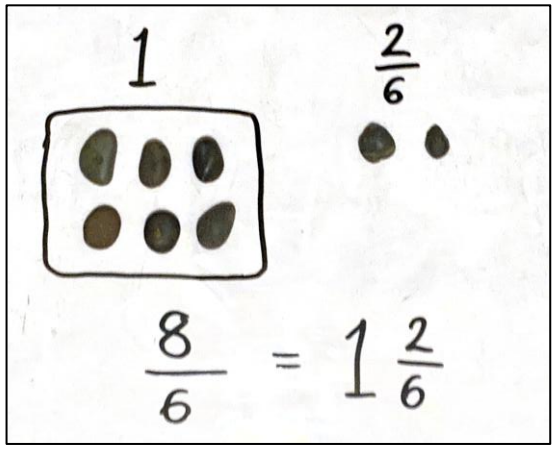
Give pupils a number to set out – this will be the numerator of the improper fraction.

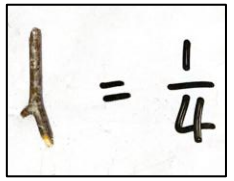
Then tell them the number of objects to put in each group – this is the denominator.

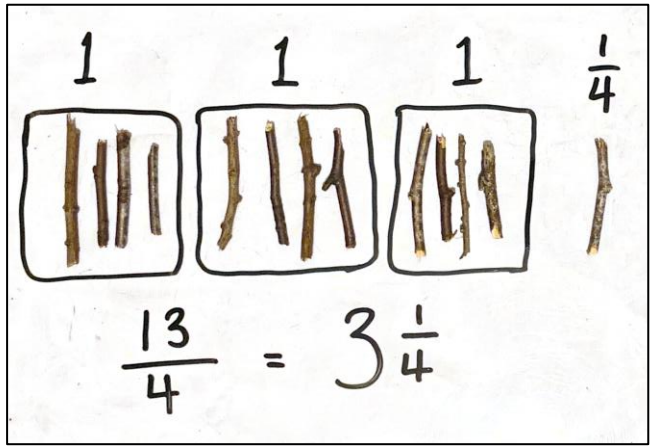
Ask pupils to identify how many ‘whole’ groups they have. How many unit fractions are left over?

Demonstrate how to represent the value as both a mixed number and an improper fraction.





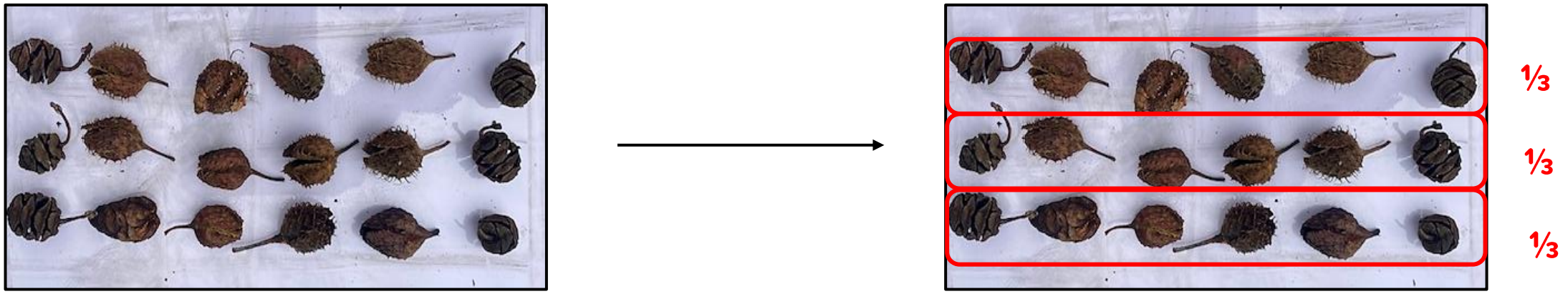




Fractions of quantities

Using natural concrete resources will allow pupils to connect their learning of unit fractions to known division facts.

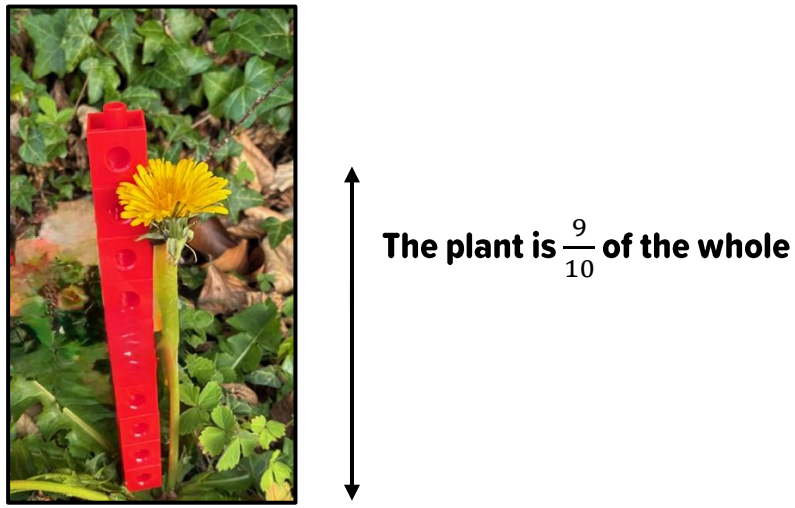
Provide pupils with a set from which they have to identify the whole, the number of equal parts, and the size of each part written as a unit fraction.

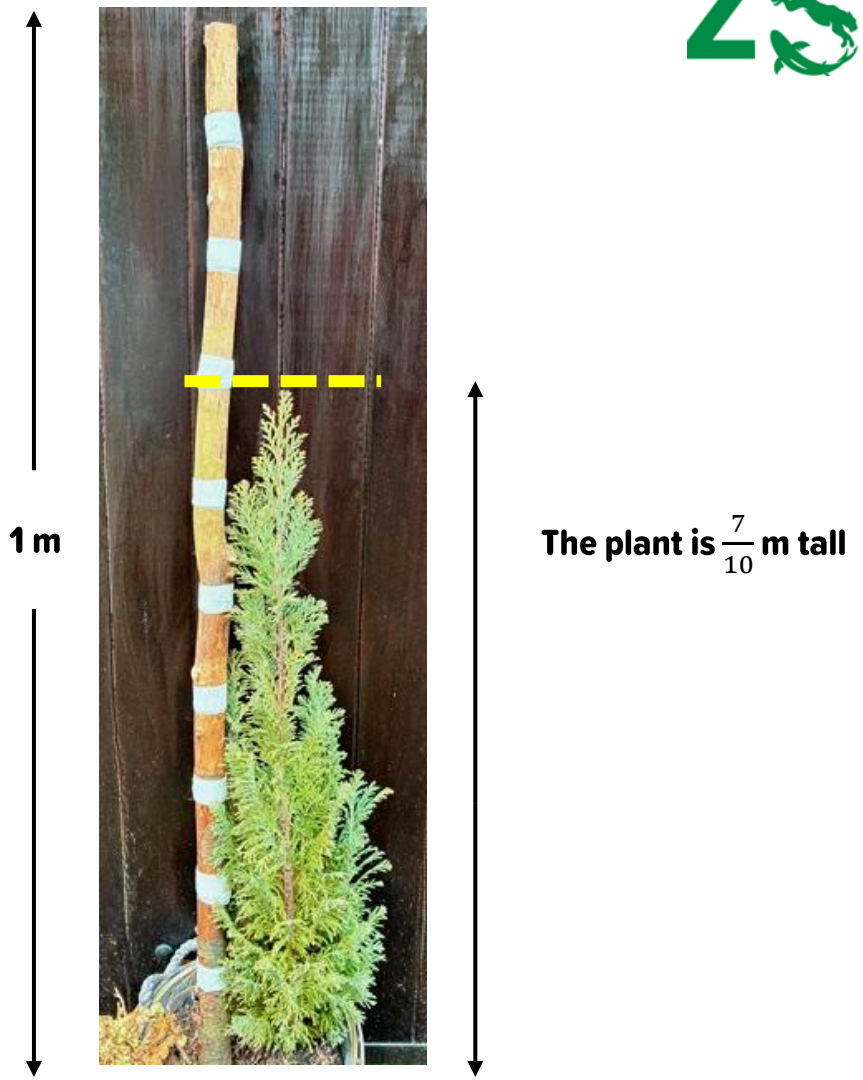


Language focus: "The whole is 18 acorns. The whole is divided into 3 equal parts. Each part is ⅓ of the whole. ⅓ of 18 acorns is 6 acorns."

Fractions of measure

Depending on the height of different plants on your school site, pupils could measure using cubes or metre sticks. They then give their answer as a fraction of the cubes or of a metre.



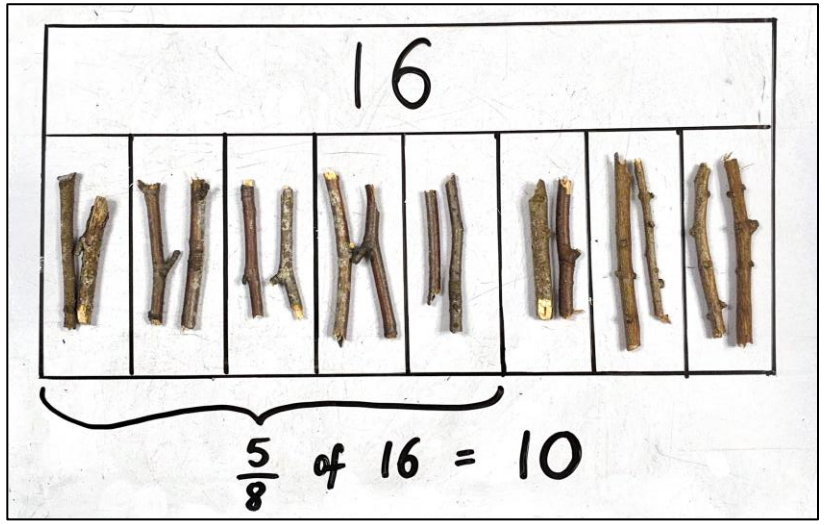


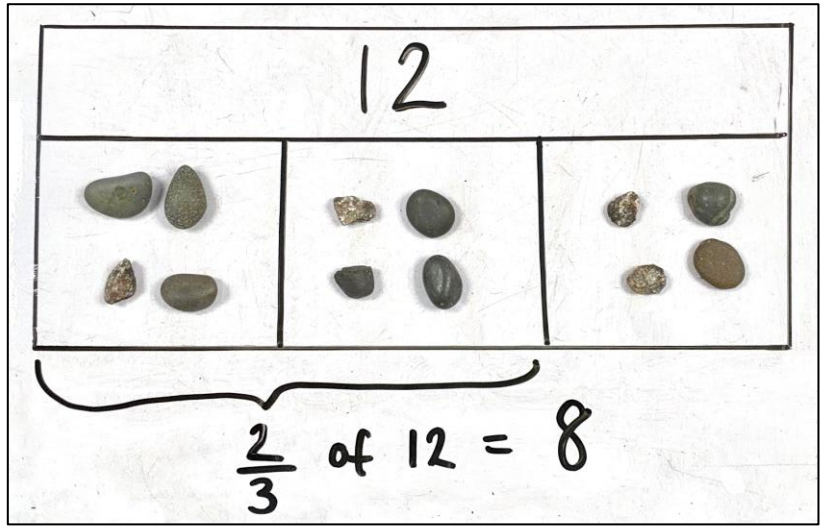
Outdoor measuring stick credit: Creative Star Learning

Calculating fractions of amounts

Provide pupils with questions relating to finding fractions of amounts and allow them to use natural tools to work out the answers.

Equipment from the PE cupboard, such as hoops, or chalk could be used to create fraction/grouping mats. If pupils are working individually, whiteboards are suitable.





Calculating fractions of measure

Ask pupils to collect items such as those suggested opposite. They measure the length and width of these objects (values could be rounded up or down to allow for easier calculating).

Pupils then apply their times tables knowledge to calculate fractions of each measurement.

Simplify: Find ½ of each measurement.

Extend: Find a non-unit fraction for each amount.

Find a stick

Length: _____ Width: _____

⅓ of its length: _____ ½ of its width: _____
¼ of its length: _____ ⅙ of its width: _____

Find a leaf

Length: _____ Width: _____

⅓ of its length: _____ ½ of its width: _____
¼ of its length: _____ ⅙ of its width: _____

Find a stone

Length: _____ Width: _____

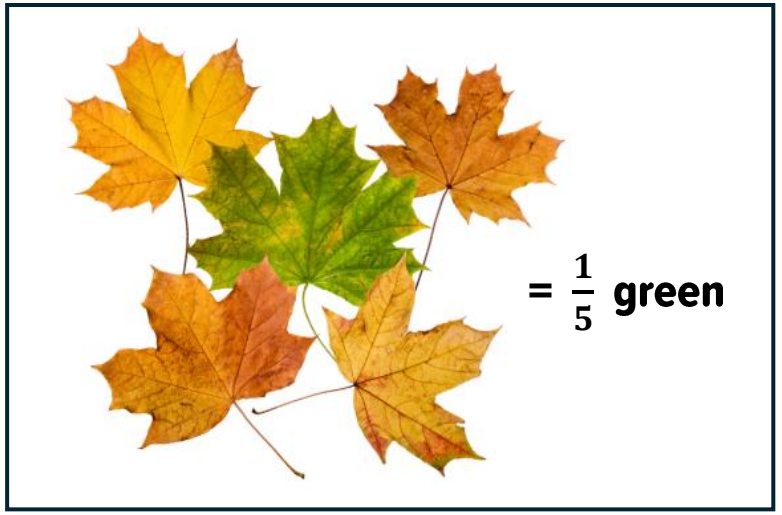
¼ of its length: _____ ½ of its width: _____
1/10 of its length: _____ ⅕ of its width: _____

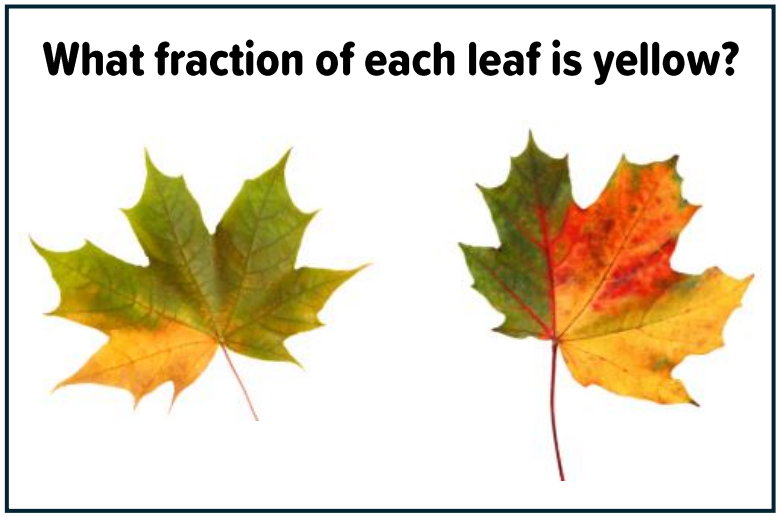
Worksheets available on site

Fraction challenges

Provide pupils with a range of fractional challenges that could also incorporate other areas of maths such as weight and measure, e.g.:

- Collect 10 leaves.
  What fraction of these are green?
- Collect a bundle of sticks.
  What fraction of the sticks are less than 10cm?
- Collect some rocks/stones.
  Estimate: what fraction are heavier than 10 grams?
- Collect some rocks/stones.
  What fraction are larger than your palm?
- Investigate some flowers.
  What fraction have more than 10 petals?





Finding fractions, percentages and decimals

A similar table to the one opposite could be completed for a range of outdoor objects:

Simplify: Just find fractions of the amount (converting to simplest form if applicable)

Extend: Add extra challenge questions for pupils to solve, e.g.

- Collect 8 acorns, with 25% still in their acorn cups. How many acorns cups is this?
- Collect 15 rocks, with 60% having a sharp edge. How many sharp-edged rocks have you collected?
- Collect 9 sticks. This is 30% of the total number of sticks you need. How many more do you need to collect?

Collect 20 leaves and complete the table:			
Leaf types:	**Fraction**	**Percentage**	**Decimal**
Green			
Brown			
Red			
Yellow			
More than 1 point			

Worksheets available on site

Measurement

Estimating measure

In groups or individually, ask pupils to represent how long they think different measures are, such as 1 metre/10 cm/half a metre, etc.

Pupils use natural objects to estimate a length, then use rulers/measuring sticks/tape measures to check their work.

How close were their estimations? Were there any surprises?

Outdoor measuring challenges

Challenge pupils to use their rulers to find, for example:

- Something smaller than 1cm/something bigger than 10cm
- The measurements of natural objects such as a blade of grass, a flower stem, the length and width of a leaf

Ask pupils to record their findings and compare who has the biggest/smallest or longest/widest.

Estimation and measure

Estimate: How many blades of grass are there in one square metre?

- Ask pupils to find and mark out small areas of grass (1cm x 1cm) and count the number of blades in this area.
- Then multiply this by 100 to find the average number there would be in $1m^2$.

See this blog post for a similar idea – you could cut out a footprint and discover how many daisies or other signs of biodiversity it covers. (For example, no daisies under my footprint, but several clovers!)

Daisy Footprints

via creativestarlearning.co.uk

Area/perimeter

Allow pupils to measure different areas and objects around the school site, then calculate the perimeter and/or area for these.

Use context questions, such as: ‘How many metres of fencing would we need to go around the perimeter of the playground?’

Measure and decimals

Have all pupils take part in a long jump challenge. Their jumps are to be recorded in metres (the more accurate the better – you may want them to measure in centimetres initially then convert).

Name	Distance jumped (m)
Jenny	2.85
Mike	3.09
Finn	3.14
Ciara	2.7
Laura	3.02

Provide pupils with questions to answer about their results such as:

- Who jumped the furthest?
- What was the difference between 3rd and 4th place?
- How much further did _____ jump than ____ ?
- Using greater and less than symbols, put ____ , ____ , ____ , ____ and ____'s jumps in order of least to most distance travelled.

Comparing decimals and fractions

Using containers to water flowers around the outdoor area can be used as an opportunity to compare fractional and decimal values.

For example, ask pupils to compare the amount of water given to different plants if they fill up $\frac{1}{10}$ of a 1 litre container and 0.75 litre of a different container.

How about $\frac{4}{10}$ of a litre compared to $\frac{1}{4}$ l?

Which is greater: 0.8 l or $\frac{4}{5}$ l? Can you prove it?

Geometry

Recognising quarter turns

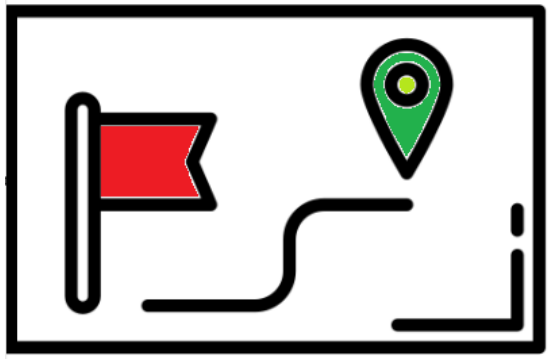
Take pupils outside to practice making quarter turns with their bodies. Practice from standing: “Make a quarter turn clockwise,” and including movement: “Walk in a straight line. Make a quarter turn anticlockwise.”

As a group, read instructions for pupils to follow. They should all end up in the same place facing the same direction!

E.g. “Take 5 steps forward. Make a quarter turn clockwise.

Take 3 steps forward. Makea three-quarter turn anticlockwise.

Take 2 steps forward. Make a half turn clockwise.”



Pupils could then splinter into pairs or groups to follow written instructions starting from different positions around the playground and record where they end up.

Angle hunt

Provide pupils with a square piece of card/paper or a post-it note with one corner marked 90°.

Alternatively, pupils could create their own right angle measurers using strips of card and butterfly pins.

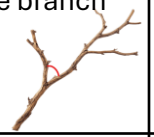
This is their ‘angle hunter’.

They can then use this to identify objects that have right angles, obtuse angles and acute angles.

Pupils could investigate…

- the angles of tree branches
- the offshoots of plants
- manmade objects such as benches or plant boxes

What is the smallest angle they could find?
What is the largest?
Why do you find so many right angles in buildings?

Object	Right angle? (90°)	Acute angle? (<90°)	Obtuse angle? (>90°)
Tree branch 		✓	

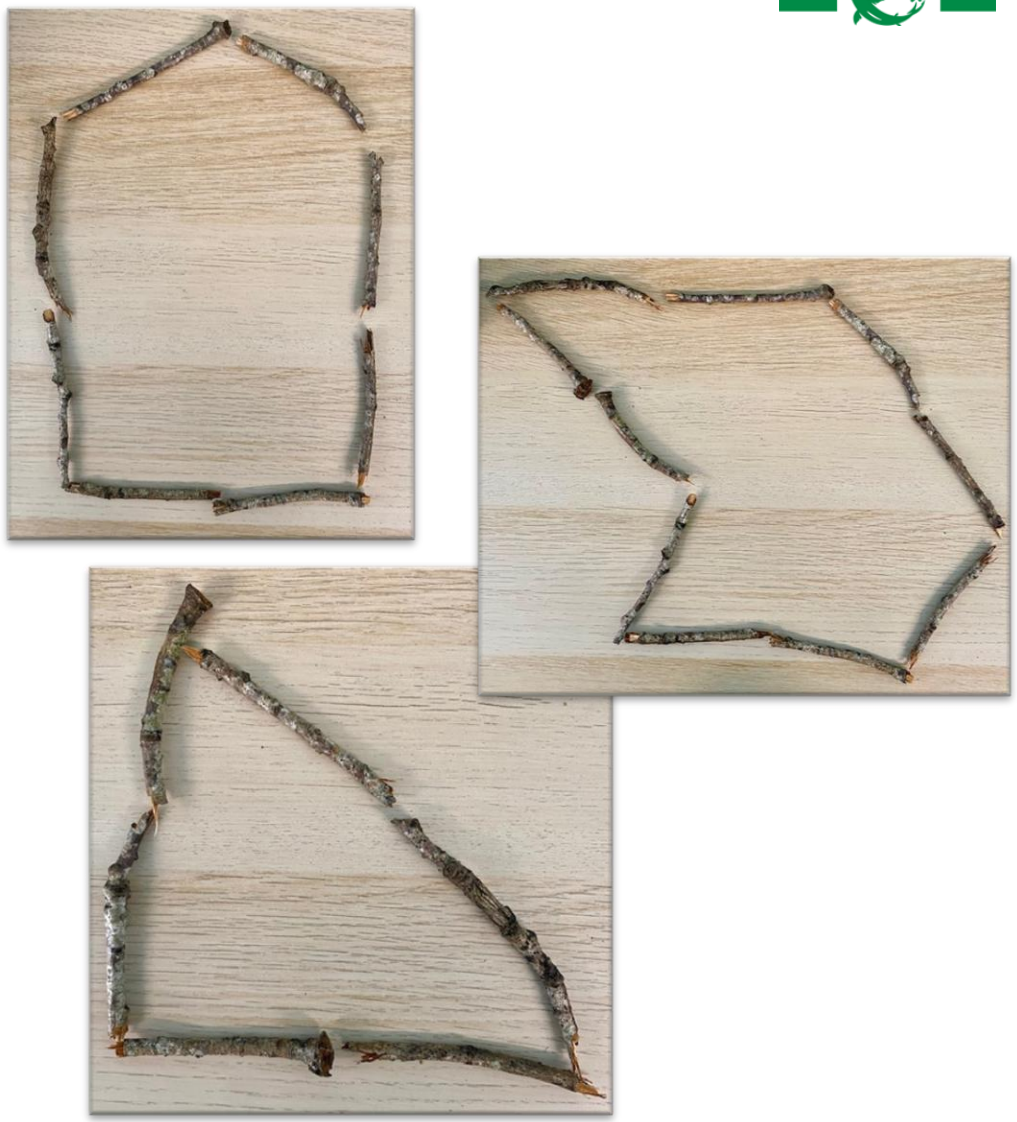
Worksheet available on site

Shapes, lines and angles

Provide pupils with a range of shape-related challenges to complete using sticks, e.g.:

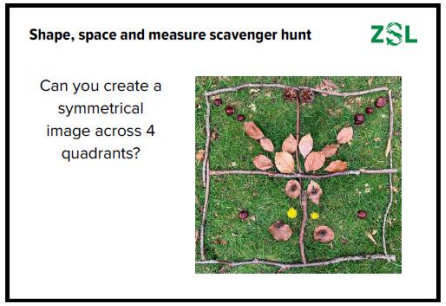
- Use 6 sticks to create a triangle that has 1 right angle
- Use 10 sticks to create an irregular hexagon that has 2 acute angles
- Use 8 sticks to create a pentagon that has 2 perpendicular sides

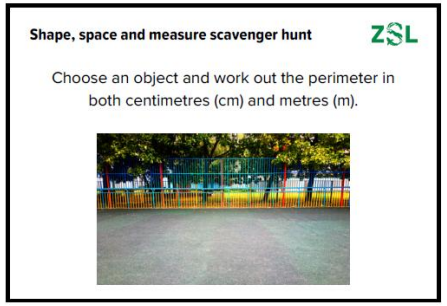
The level of challenge can be adapted to suit the needs of learners.

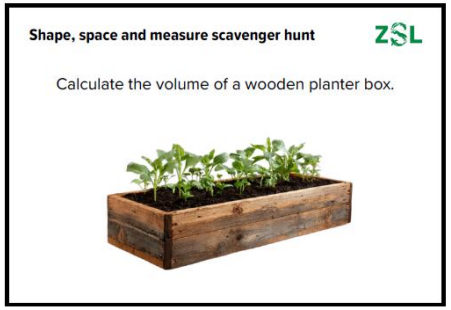


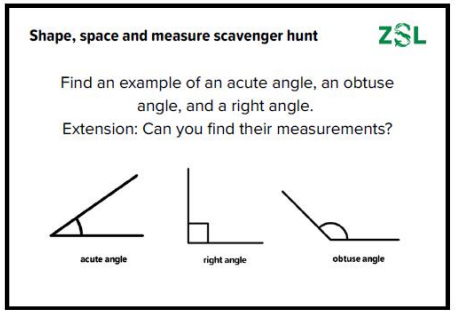
Shape, space and measure scavenger hunt

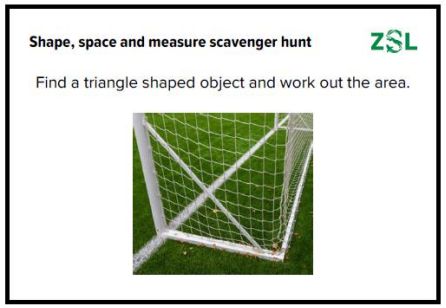
Provide pupils with task cards for a range of shape, space and measure-related challenges.

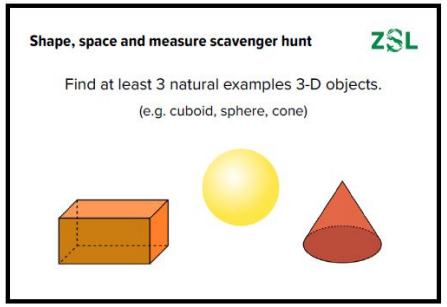


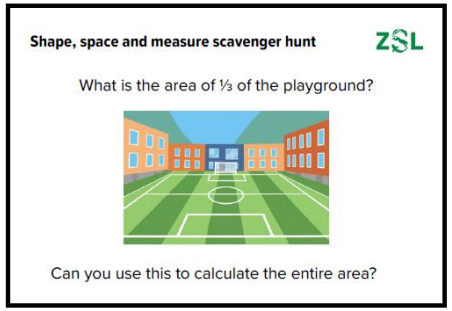


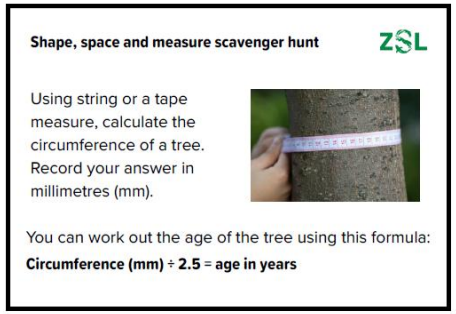












Worksheets available on site

Investigating circles

Use tape measures to measure the circumference of flowerpots, tree stumps and any other circular objects found outside.

If you do not have enough tape measures for all groups of students, use string and then measure with a ruler afterwards.

What is the biggest circle pupils can find?

What about the smallest?

The age of a tree can also be calculated using the measurement of its circumference in centimetres:

- Measure the tree's girth about 1.5m above the ground to avoid the wider tree roots
- To find the age of the tree, divide its girth in cm by 2.5

$$\text{Age of tree} = \frac{\text{circumference in cm}}{2.5}$$

Statistics

Pattern-seeking investigations

Introduce a question for the class to investigate, such as:

- **‘The tallest trees have the largest leaves.’**
- **‘The longest blades of grass are always at the edge of a field/ grassy patch.’**
- **‘The largest fruits have the most seeds/pips.’**

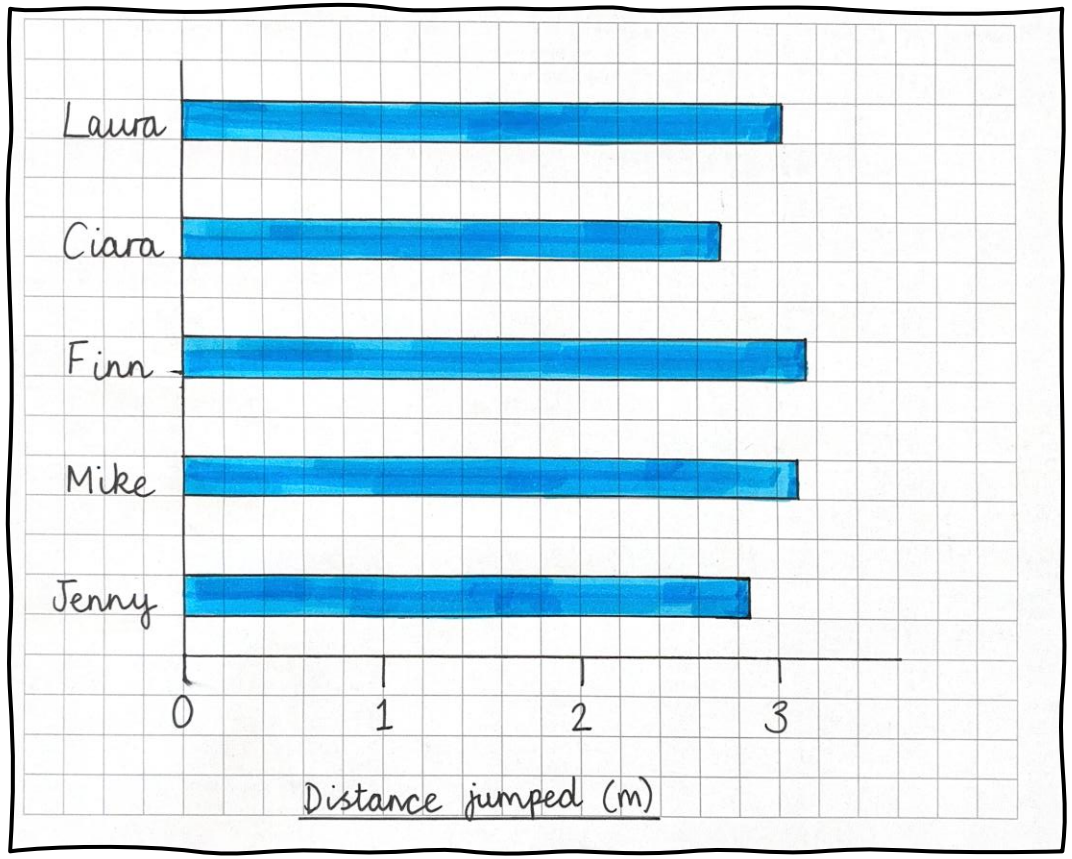
Allow pupils to decide how they will conduct their measurements and record their data. You may also want to consider how many results are needed to ensure a fair test/reliable data set.

What will be the best way to present their findings? (This allows for a discussion about the uses of different types of graph.)

Bar charts

Using the results from the long jump challenge (see **'Measure and Decimals'** under **'Measurement'**), task pupils with creating bar charts for their measurements.

Encourage them to consider how they will divide the space between each whole metre – what value will each square have on their graph paper?



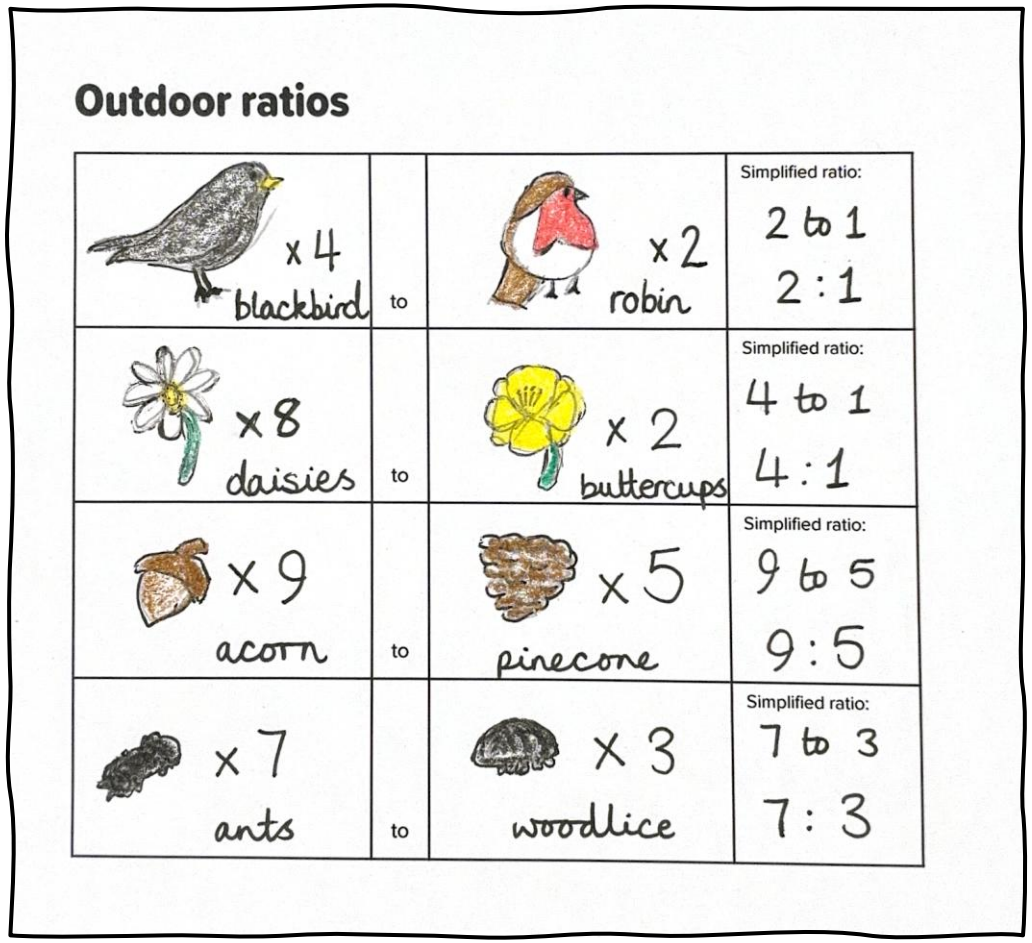
Ratio and proportion

(Year 6)

Observed ratios

Pupils create ratios based on their own observations while outdoors.

Could be adapted to suit current/previous learning.



Outdoor ratios

x 4 blackbird	to	x 2 robin	Simplified ratio: 2 to 1 2 : 1
x 8 daisies	to	x 2 buttercups	Simplified ratio: 4 to 1 4 : 1
x 9 acorn	to	x 5 pinecone	Simplified ratio: 9 to 5 9 : 5
x 7 ants	to	x 3 woodlice	Simplified ratio: 7 to 3 7 : 3

Ratio relationships

Use natural objects to create 1-to-many structures (or vice versa) that allow pupils to recognise that, for example, for every 1 leaf there are 3 stones irrespective of how the objects have been arranged.

Ratio 1:

Ratio 2:

Language focus: “In each structure, for every 1 leaf, there are 3 stones.”

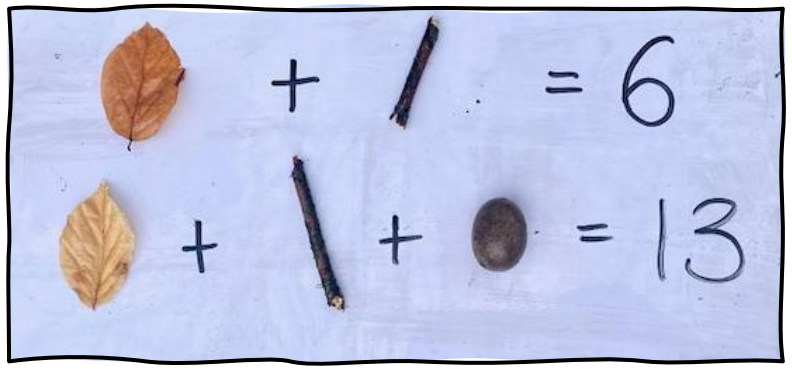
Algebra

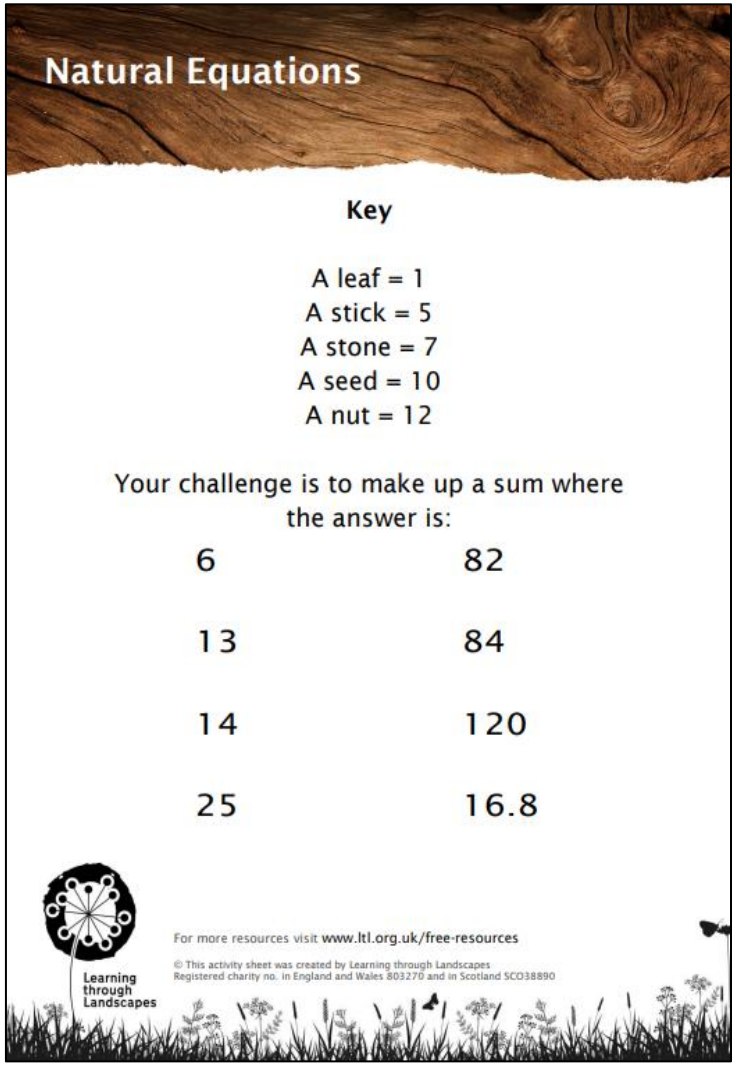
(Year 6)

Natural equations

Using the value sheet opposite from Learning through Landscapes, demonstrate how the objects from the key can be laid out as an equation.

Challenge: Is there more than one possible solution for any of the answers?





Missing values

Challenge pupils to find the value of different natural objects in the same way they would work out an algebraic value.

Pupils could then create their own natural algebra equations for a partner to solve.