Year 6

Number and Place Value

I can statements:

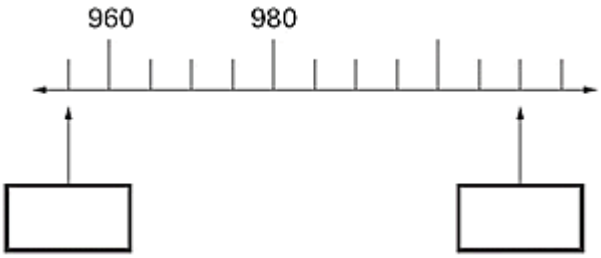
- read, write, order and compare numbers up to 10 000 000 and determine the value of each digit
- round any whole number to a required degree of accuracy
- use negative numbers in context, and calculate intervals across zero
- solve number problems and practical problems that involve all of the above

Exemplification

Examples of what children should be able to do, in relation to each (boxed) Programme of Study statement

Read, write, order and compare numbers up to 10 000 000 and determine the value of each digit

Children should be able to determine the steps used in different scales, and so complete activities such as;



Round any whole number to a required degree of accuracy

Children should be able to circle the best estimate of the answer to questions such as;

72.34 ÷ 8.91

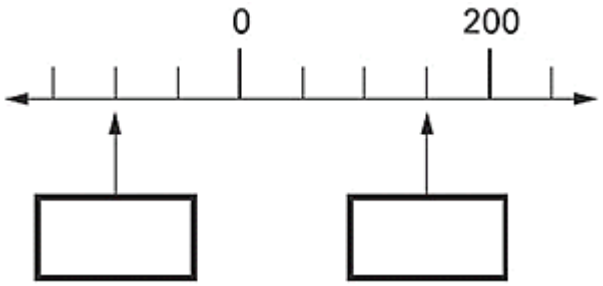
When given

6 7 8 9 10 11 as possible answers

Children should **estimate** the position of numbers on a number line. They should suggest which number lies about two-fifths of the way along a line from 0 to 1000, or a line from 0 to 1. They should be able to justify their decisions.

Use negative numbers in context, and calculate intervals across zero

Children should be able to work with negative numbers in a similar way, determining values on a scale and estimating.



solve number and practical problems that involve all of the above

Children should be able to use rounding and inverse operations to estimate and check calculations such as;

The temperature inside an aeroplane is 20°C The temperatures outside the aeroplane is -30°C. What is the difference between these temperatures?

Activities

Programme of Study statements	Activities			
	A(i)	A(ii)	B	C
read, write, order and compare numbers up to 10 000 000 and determine the value of each digit	●			●
round any whole number to a required degree of accuracy	●			
use negative numbers in context, and calculate intervals across zero		●	●	
solve number and practical problems that involve all of the above.				●

Activity A(i)

Activities related to space will provide opportunities for children to work with large numbers, ordering and rounding. Try these which can be accessed via the NCETM website:

- **model of the solar system**
- **alternative way to model the solar system**

Activity A(ii) www.primaryscience.net

Activities in the context of space and the solar system also provide excellent opportunities for working with positive and negative integers. There are a number of interactive and relevant activities.

Activity B - Tug Harder NRICH

This two player game from Nrich requires the children to use their knowledge of both positive and negative numbers, and the effect they have on each other. Some useful question prompts are included too – to really get them thinking!

It is important that children become familiar with both ordinal and cardinal aspects of number so although moving along a number line is the most common way to teach negative numbers, it is also important for them to see negative numbers as the absence of something – teachers often **dig (concretely or pictorially) holes to represent a negative value.** You could have a lot of fun with moles and holes that will help children develop a robust concept of negative numbers.

The videos **'Negative Numbers 1'** and **'Negative Numbers 2'** show Josie Clark helping her class develop their understanding of the concept of negative numbers and how to do calculations with negative numbers. She takes particular care to get the children to use precise mathematical language.

The interactive spreadsheet **‘Positive and Negative Numbers - Brick Walls’** is a resource that can be used with children to discuss calculations involving negative numbers.

Activity C - Sometimes we lose things NRICH

This intriguing activity introduced children to working in base 9, with a real focus on understanding our number system more deeply.

Useful Resources

Number lines, thermometer

Addition and Subtraction

I can statements:

- multiply multi-digit numbers up to 4 digits by a two-digit whole number using the formal written method of long multiplication
- divide numbers up to 4 digits by a two-digit whole number using the formal written method of long division, and interpret remainders as whole number remainders, fractions, or by rounding, as appropriate for the context
- divide numbers up to 4 digits by a two-digit number using the formal written method of short division where appropriate, interpreting remainders according to the context
- perform mental calculations, including with mixed operations and large numbers
- identify common factors, common multiples and prime numbers
- use their knowledge of the order of operations to carry out calculations involving the four operations
- solve addition and subtraction multi-step problems in contexts, deciding which operations and methods to use and why
- solve problems involving addition, subtraction, multiplication and division
- use estimation to check answers to calculations and determine, in the context of a problem, an appropriate degree of accuracy.

Exemplification

Examples of what children should be able to do, in relation to each (boxed) Programme of Study statement

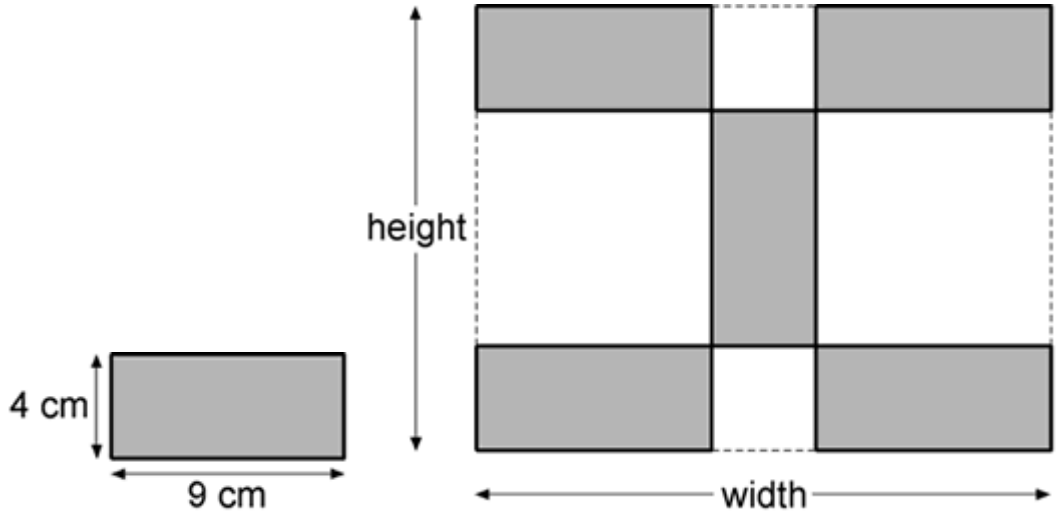
solve addition and subtraction multi-step problems in contexts, deciding which operations and methods to use and why

Two numbers have a difference of 1.583. One of the numbers is 4.728. What is the other? Is this the only answer?

solve problems involving addition, subtraction, multiplication and division

use estimation to check answers to calculations and determine, in the context of a problem, levels of accuracy

- Identify subtractions they can do without writing anything down
- Identify why it is possible to solve a calculation mentally, explain the clues they looked for and then solve it
- Peter has £10. He buys 3 kg of potatoes at 87p per kg and 750 g of tomatoes at £1.32 per kg. How much money does he have left?
- Each tile is 4 centimetres by 9 centimetres.



Calculate the width and height of the design.

Write down the calculations that you did.

Activities

Programme of Study statements	Activities		
	A	B	C
perform mental calculations, including with mixed operations and large numbers	●		
solve addition and subtraction multi-step problems in contexts, deciding which operations and methods to use and why		●	
solve problems involving addition and subtraction use estimation to check answers to calculations and determine, in the context of a problem, levels of accuracy			●

Activity A

Present the children with problems such as:

- Taznim measured two lengths of material. One measured 3.45m and the other 2.65m. How much longer was the longest? What is the total length?

  Discuss mental calculation strategies that can be used to answer these, for example complementary addition for the subtraction, number facts and partitioning for addition.

- Louis poured 1998ml of water into one bucket and 2550ml into another. How much water did he have? How much more was in the second bucket?

  Discuss suitable mental calculation strategies, for example, rounding and adjusting for both addition and subtraction.

Teachers could decide on the mental calculation that they wish the children to rehearse, practice and then make up problems for them to answer. Common mental calculation strategies for addition and subtraction include:

- Partitioning and recombining
- Doubles and near doubles
- Use number pairs to 10 and 100
- Adding near multiples of ten and adjusting
- Using patterns of similar calculations
- Using known number facts
- Bridging though ten, hundred, tenth
- Complementary addition

Activity B

Set problems such as this for the children to solve:

Sammy wanted to buy a DVD player for £326.98 and a DVD box set for £49.50. How much money will she need? How much more will the DVD player cost?

Encourage the children to use the method they think best to calculate with these numbers, e.g. the column method, rounding and adjusting (£326.98 + £50 – 50p), sequencing (326.98 + 40 + 9 + 50p).

Give the children a set of 0-9 digit cards. They pick five, make a five-digit number and write it down. They then use those five cards to make up another number. They find the total of the two numbers and then make up a problem using their numbers and calculation. They could do the same for subtraction.

This **Nrich activity** asks children to solve a subtraction calculation where the numbers are represented by letters.

Activity C

The children could be presented with problems such as:

- Kieran was saving to buy a laptop for £465.98 and a printer for £126.78. How much money does he need to save?
- Maddie saved £1987.50. She wanted to buy a new TV. It cost £1268.45. Has she enough money left to buy a games console costing £474.99?
- The children could be given a selection of amounts of money, e.g. £852.79, £1089.50, £60.98, £284.99. They could pick two of the amounts and find their totals and differences. They could then make up problems to go with their calculations.

For each problem, ask the children to check their answer by rounding the amount to the nearest pound or £10. They could also use this method to estimate what the answer might be at the beginning.

Multiplication and Division

I can statements:

- multiply multi-digit numbers up to 4 digits by a two-digit whole number using the formal written method of long multiplication
- divide numbers up to 4 digits by a two-digit whole number using the formal written method of long division, and interpret remainders as whole number remainders, fractions, or by rounding, as appropriate for the context
- divide numbers up to 4 digits by a two-digit number using the formal written method of short division where appropriate, interpreting remainders according to the context
- perform mental calculations, including with mixed operations and large numbers
- identify common factors, common multiples and prime numbers
- use their knowledge of the order of operations to carry out calculations involving the four operations
- solve addition and subtraction multi-step problems in contexts, deciding which operations and methods to use and why
- solve problems involving addition, subtraction, multiplication and division
- use estimation to check answers to calculations and determine, in the context of a problem, an appropriate degree of accuracy.

Exemplification

Examples of what children should be able to do, in relation to each (boxed) Programme of Study statement

Multiply multi-digit numbers up to 4 digits by a two-digit whole number using the formal written method of long multiplication

- Look at long-multiplication calculations containing errors, identify the errors and determine how they should be corrected.
- Solve problems such as:Printing charges for a book are 3p per page and 75p for the cover. I paid £4.35 to get this book printed. How many pages are there in the book? Write down the calculations that you did. Seeds are £1.45 for a packet. I have £10 to spend on seeds. What is the greatest number of packets I can buy?

Divide numbers up to 4 digits by a two-digit whole number using the formal written method of long division, and interpret remainders as whole number remainders, fractions, or by rounding, as appropriate for the context

- Every day a machine makes 100 000 paper clips, which go into boxes. A full box has 120 paper clips. How many full boxes can be made from 100 000 paper clips?

  Each paper clip is made from 9.2 centimetres of wire. What is the greatest number of paper clips that can be made from 10 metres of wire?

- A DJ has two different sized storage boxes for her CDs. Small boxes hold 15 CDs. Large boxes hold 28 CDs. The DJ has 411 CDs. How could the DJ pack her CDs?

Solve problems involving multiplication and division
use estimation to check answers to calculations and determine, in the context of a problem, levels of accuracy

Children should be able to:

- Give the best approximation to work out 4.4 × 18.6 and explain why. Answer questions such as: roughly, what answer do you expect to get? How did you arrive at that estimate? Do you expect your answer to be greater or less than your estimate? Why?

Perform mental calculations, including with mixed operations and large numbers

- Use mental strategies to calculate in their heads, using jottings and/or diagrams where appropriate. For example, to calculate 24 × 15, they multiply 24 × 10 and then halve this to get 24 × 5, adding these two results together. They record their method as (24 × 10) + (24 × 5). Alternatively, they work out 24 × 5 = 120 (half of 24 × 10), then multiply 120 by 3 to get 360.

Identify common factors, common multiples and prime numbers

- Children should be able to answer questions such as:
    - How can you use factors to multiply 17 by 12?
    - Start from a two-digit number with at least six factors, e.g. 72. How many different multiplication and division facts can you make using what you know about 72? What facts involving decimals can you derive?
    - What if you started with 7.2? What about 0.72?
    - Which three prime numbers multiply to make 231?
    - use their knowledge of the order of operations to carry out calculations involving the four operations
- Children should be able to find answers to calculations such as 5.6 □ = 0.7 or 3 × 0.6, drawing on their knowledge of number facts and understanding of place value. They should be able to approximate, use inverses and apply tests of divisibility to check their results.
- Children should know the square numbers up to 12 × 12 and derive the corresponding squares of multiples of 10, for example 80 × 80 = 6400.

Activities

Programme of Study statements	Activities						
	A	B	C	D	E	F	G
multiply multi-digit numbers up to 4 digits by a two-digit whole number using the formal written method of long multiplication	●	●					
divide numbers up to 4 digits by a two-digit whole number using the formal written method of long division, and interpret remainders as whole number remainders, fractions, or by rounding, as appropriate for the context			●	●			
perform mental calculations, including with mixed operations and large numbers					●		
identify common factors, common multiples and prime numbers						●	
solve problems involving multiplication and division use estimation to check answers to calculations and determine, in the context of a problem, levels of accuracy							●

Activity A

Teachers could ask the children to create their own numbers to multiply using digit cards and dice. Make the link between the grid method and the compact method, for example, asking the children what is the same and what is different about the two methods:

	3000	500	60	7		
20	60000	10000	1200	140		71340
4	12000	2000	240	28		14268
					Total	85608

71340

X24

14268

71340

85608

Activity B

Set problems such as:

Naomi had a stamp album; it had 135 pages. On each page there were 45 stamps. How many stamps did she have?

This Nrich activity entitled **'Long Multiplication'** requires children to solve a multiplication puzzle where all except one of the digits are missing. A wonderful challenge!

Activity C

Set problems such as:

Yukesh was given a box of 755 books to put on the shelves in the library. He put 24 books on each shelf. How many shelves did he fill? How many shelves did he need for all the books?

Courtney had a collection of 1256 coins. She put them into piles of 16. How many piles did she have? How many were left?

Activity D

Give the children a set of 0-9 digit cards. They choose four of the cards, make a four-digit number and write it down. They then use two of those cards to make the divisor. They calculate the answer and then make up a linked problem using their numbers.

Activity E

Provide the children with problems that involve using mental calculation strategies, such as:

- x4 by doubling and doubling again,
- x5 by x10 and halving
- x20 by x10 and doubling
- x9 by multiplying by 10 and adjusting
- x6 by multiplying by 3 and doubling

Activity F

‘Abundant Numbers’, an activity from Nrich requires children to explore factors of numbers. **‘Factors and multiples’** is another Nrich game, perfect for practising skills.

Activity G

Provide problems such as:

- Milly is saving £2.75 a week to buy a pair of jeans. The jeans cost £37. For how many weeks does she need to save?
- In Sports 4 U, there are 18 larges boxes each containing 136 footballs. How many footballs are there altogether?

For each problem, ask the children to check their answer by rounding. They could also use this method to estimate what the answer might be before solving the problem.

Fractions

I can statements:

- use common factors to simplify fractions; use common multiples to express fractions in the same denomination
- compare and order fractions, including fractions >1
- add and subtract fractions with different denominators and mixed numbers, using the concept of equivalent fractions
- multiply simple pairs of proper fractions, writing the answer in its simplest form [for example, ¼ × ½ = ⅛]
- divide proper fractions by whole numbers [for example, ⅓ ÷ 2 = ⅙]
- associate a fraction with division and calculate decimal fraction equivalents [for example, 0.375] for a simple fraction [for example, ⅜]
- identify the value of each digit in numbers given to three decimal places and multiply and divide numbers by 10, 100 and 1000 giving answers up to three decimal places
- multiply one-digit numbers with up to two decimal places by whole numbers
- use written division methods in cases where the answer has up to two decimal places.
- solve problems which require answers to be rounded to specified degrees of accuracy
- recall and use equivalences between simple fractions, decimals and percentages including in different contexts.

Exemplification

Examples of what children should be able to do, in relation to each (boxed) Programme of Study statement

Use common factors to simplify fractions; use common multiples to express fractions in the same denomination

Children should be able to recognise that a fraction such as $\frac{5}{20}$ can be reduced to an equivalent fraction of ¼ by dividing both numerator and denominator by the same number [cancelling] They should also be familiar with identifying fractions in different units. E.g. what fraction is 20 pence of two pounds? Of four pounds etc…

Compare and order fractions, including fractions >1

Children should be able to:

i] Position fractions on a number line; e.g. mark fractions such as $\frac{7}{5}$, $\frac{11}{20}$, $\frac{19}{12}$ on a number line graduated in tenths

ii] Answer questions such as: What number is half way between 5 ¼ and 5 ½ ?

iii] Which is larger, ⅓ or ⅝? Explain how you know.

Associate a fraction with division to calculate decimal fraction equivalents (e.g. 0.375) for a simple fraction (e.g. ⅜)

Children should be able to find fractions of numbers and quantities;

i] What fraction of £1 is 35p, … 170p ?

ii] Write $^{23}/_{100}$ of 4 kilogrammes in grams

iii] What fraction of 1 litre is 413 ml?

Convert a fraction to a decimal using known equivalent fractions:

i] ¼ = 0.25

ii] ⅖ = 0.4

Add and subtract fractions with different denominators and mixed numbers, using the concept of equivalent fractions

Children should be able to solve practical problems such as;

Here is a chocolate bar.

William eats 3 pieces and Amber eats 2 pieces. What fraction of the chocolate bar remains?

Joe has some pocket money. He spends three-quarters of it. He has fifty pence left. How much pocket money did he have?

Multiply simple pairs of proper fractions, writing the answer in its simplest form, (e.g. ¼ × ½ = ⅛)

Children should be able to:

i] Recognise that ¼ of 12, ¼ x 12 and 12 divided by 4 are equivalent

ii] Use cancellation to simplify the product of a fraction and an integer

eg ⅕ x 15 = 3

⅖ x 15 = 2 x ⅕ x 15 = 2x3 = 6

ii] Work out how many ½s in 15, how many ⅖s in 15, how many 2/5s in 1 etc.

Divide proper fractions by whole numbers (e.g. ⅓ ÷ 2 = ⅙)

Children should be able to:

Decide whether they would prefer to share ½ of a pizza with 2 people or ¾ of a pizza with 4 people and explain why.

Associate a fraction with division and calculate decimal fraction equivalents (e.g. 0.375) for a simple fraction (e.g. ⅜)

Children should be able to:

Explain how much pizza each person would get if they divided 4 pizzas between 5 people, as a fraction and a decimal

Identify the value of each digit to three decimal places and multiply and divide numbers by 10, 100 and 1000 where the answers are up to three decimal places

Children should be able to identify the value of each digit in the number 17.036 and multiply and divide this by 10.100 and 1000

Multiply one-digit numbers with up to two decimal places by whole numbers

Children should be able to calculate the answer to questions such as;

What is 3.86 multiplied by nine?

Use written division methods in cases where the answer has up to two decimal places

Children should be able to calculate 601 divided by 36, to two decimal places

Solve problems which require answers to be rounded to specified degrees of accuracy

Children should be able to solve problems such as;

Four friends win £48,623. The money is to be shared equally between them – how much will each person receive?

107 pupils and teachers need to be taken to the theatre. How many 15-seater minibuses will be required?

How many boxes of 60 nails can be filled from 340 nails?

Recall and use equivalences between simple fractions, decimals and percentages, including in different contexts.

Children should be able to put a ring around the percentage that is equal to three-fifths;

20% 30% 40% 50% 60%

As well as circle the two fractions that are equivalent to 0.6.

$\frac{6}{10}$ $\frac{1}{60}$ $\frac{60}{100}$ $\frac{1}{6}$

Activities

Programme of Study statements	Activities						
	A	B	C	D	E	F	G
Use common factors to simplify fractions; use common multiples to express fractions in the same denomination	●						
Compare and order fractions, including fractions >1		●					
Associate a fraction with division and calculate decimal fraction equivalents [for example, 0.375] for a simple fraction [for example, ⅜]			●				
Add and subtract fractions with different denominators and mixed numbers, using the concept of equivalent fractions				●			
Multiply simple pairs of proper fractions, writing the answer in its simplest form [for example, ¼ × ½ = ⅛]				●	●		
Divide proper fractions by whole numbers [for example, ⅓ ÷ 2 = ⅙]						●	
Identify the value of each digit to three decimal places and multiply and divide numbers by 10, 100 and 1000 where the answers are up to three decimal places							●

Activity A : Factors and Multiples Game

This game from Nrich could replace standard practice exercises on finding factors and multiples. In order to play strategically, pupils must start to think of numbers in terms of their factors

Activity B(i) : Rod Fractions

Compare a series of coloured rods and the relationships between them with this clearly presented **Nrich activity**

Activity B(ii) : Laundry Line

This activity features a laundry line with 'fraction washing.' The aim is to hang the fractions on the line in the right order between 0 and 1. Once a game has been completed, you can raise the level of difficulty.

Activity B(iii) : Chocolate

Using chocolate bars to **compare fractions** – a context guaranteed to keep them focused!

Activity C : Fraction strips

The **'Fractions' Interactive Teaching Programme,** allows the user to divide a strip into equal parts and colour them as needed. Strips can be labelled as a fraction, decimal or percentage. The ratio of parts can also be displayed. Multiple strips can be created to demonstrate equivalence.

Activity D(i) : Clock Faces

Give children the chance to explore clock faces as a way of representing time. Talk about 5 minute sectors of the clock being equivalent to twelfths, ten minute sectors to sixths, fifteen minute chunks to quarters etc…

Use this to support them in adding 20 minutes plus 15 minutes as 1/3 + 1/4

Activity D(ii) : Andy's Marbles

This **challenging activity** from Nrich requires children to use their conceptual understanding of fractions, and their sums, to determine the answer to Andy's marble problem

Activity D(iii) – Soccer Shoot Out

Score and save goals by correctly answering fraction based calculations. A range of difficulty levels makes **this game** easy to adapt.

Activity E(i) : Folding ribbons

Show the children a lengths of ribbon (or string) measuring 3/4 metre in length. Fold it into three parts. What fraction of the ribbon have we found? (1/3). Measure the folded piece together. How long is it? (1/4 m). So, 1/3 of 3/4 or 1/3 x 3/4 = 1/4.

Try this with other fractions and starting lengths.

Activity E(ii) – ratio tables

Ask children to use their multiplication tables to scale recipe quantities up and down to complete the table below. Consider their multiplication of simple fractions for quantities of vanilla extract and chocolate chips.

Ingredients	**3 cupcakes**	**6 cupcakes**	**12 cupcakes**	**18 cupcakes**	**24 cupcakes**
Self- raising flour			130 gm		260 gm
Caster Sugar			100 gm		

Butter			125 gm		
Large Eggs			2		
Vanilla extract			½ teaspoonful		1 teaspoonful
Chocolate chips			¾ cupful		

Activity F(i) - Pizzas

This **pizza themed fraction resource** from the TES can be used in many different ways, and includes several suggestions from the author.

Activity F(ii) – Planetary Wars

Published by BEAM, and hosted within the National STEM Centre E-library, **this two-player dice game** requires children to find fractional quantities of numbers.

Activity G – Decimal Point Chair

When multiplying or dividing by powers of ten, the key issue to emphasise in many classrooms is that it is not the decimal point which moves, but the digits of the number. Prepare a range of cards to include several zeros, a decimal point and two whole numbers [e.g. 2 and 7]. Give a group of children one card each and ask the child with the decimal point to sit in the middle of a row of chairs, facing the class. Ask the 2 children with the cards with whole numbers to choose a chair to sit on, leaving no empty chairs between them and the decimal point. Explore ways to do this. Then introduce one zero in various places and talk about the numbers created. Add a second zero and do the same. Move on to asking the children to decide what happens to the number created if we multiply or divide by 10, then 100, then 1000 – emphasise that the decimal point must not move. Ask children to consider ways in which they might record this.

For a similar activity visit the National Stem Centre E-library, for the Interactive Teaching Programme **'Moving Digits'**

Please note that you will need to log in to this site in order to access the materials. This is free and simple to do.

Useful Resources

Activity B(i) - coloured rods

Activity B(iii) – several bars of chocolate

Activity D(i) – analogue clocks

Activity D(ii) – marbles

Activity E(i) – ribbon/string, tape measures, scissors

Ratio

I can statements:

- solve problems involving the relative sizes of two quantities where missing values can be found by using integer multiplication and division facts
- solve problems involving the calculation of percentages [for example, of measures, and such as 15% of 360] and use percentages for comparison
- solve problems involving similar shapes where the scale factor is known or can be found
- solve problems involving unequal sharing and grouping using knowledge of fractions and multiples

Exemplification

Examples of what children should be able to do, in relation to each (boxed) Programme of Study statement

Solve problems involving the relative sizes of two quantities where missing values can be found by using integer multiplication and division facts

Answer problems such as:

- Here is a recipe for pasta sauce.

  Pasta sauce

  300 g tomatoes

  120 g onions

  75 g mushrooms

  Sam makes the pasta sauce using 900 g of tomatoes. What weight of onions should he use? What weight of mushrooms?

- A recipe for 3 portions requires 150 g flour and 120 g sugar. Desi's solution to a problem says that for 2 portions he needs 80 g flour and 100 g sugar. What might Desi have done wrong? Work out the correct answer.
- This map has a scale of 1 cm to 6 km.

  The road from Ridlington to Carborough measured on the map is 6.6 cm long. What is the length of the road in kilometres?

Solve problems involving the calculation of percentages (e.g. of measures) such as 15% of 360 and the use of percentages for comparison

Find simple percentages of amounts and compare them. For example:

- A class contains 12 boys and 18 girls. What percentage of the class are girls? What percentage are boys?
- 25% of the apples in a basket are red. The rest are green. There are 21 red apples. How many green apples are there?

Solve problems involving similar shapes where the scale factor is known or can be found

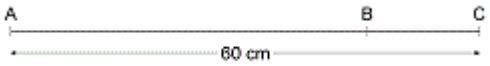
- Solve simple problems involving direct proportion by scaling quantities up or down, for example:

  Two rulers cost 80 pence. How much do three rulers cost?

- Use the vocabulary of ratio and proportion to describe the relationships between two quantities solving problems such as:

  Two letters have a total weight of 120 grams. One letter weighs twice as much as the other. Write the weight of the heavier letter.

  The distance from A to B is three times as far as from B to C. The distance from A to C is 60 centimetres. Calculate the distance from A to B.



Solve problems involving unequal sharing and grouping using knowledge of fractions and multiples

Relate fractions to multiplication and division (e.g. 6 ÷ 2 = ½ of 6 = 6 × ½), simplify fractions by cancelling common factors, find fractions of whole-number quantities and solve problems such as:

- What fraction is 18 of 12
- What fraction is 500ml of 400ml?
- What is $^{14}/_{35}$ in its simplest form? $^{2}/_{5}$
- What ⅓ × 15? What about 15 × ⅓? How did you work it out?
- What is two thirds of 66?
- What is three quarters of 500?

Activities

Programme of Study statements	Activities			
	A	B	C	D
solve problems involving the relative sizes of two quantities where missing values can be found by using integer multiplication and division facts	●			
solve problems involving the calculation of percentages [for example, of measures, and such as 15% of 360] and the use of percentages for comparison		●		
solve problems involving similar shapes where the scale factor is known or can be found			●	
solve problems involving unequal sharing and grouping using knowledge of fractions and multiples				●

Activity set A

You could give the children, for example, one green and three yellow counters, the children could identify, for example, the ratio of green to yellow, the proportion of green. They could then work out other numbers of counters that would give the same ratio, for example two green and six yellow, three green and nine yellow,. This would help them to understand that the numbers of counters might change but the ratio does not change, if the relationship between the different parts remains the same. You could ask them to explore what they need to do to find a formula for ‘g’ green and ‘y’ yellow so that they can work out any number of these counters that give the same ratio and proportion.

Give the children some blue and white interlocking cubes and ask them to show you different ratios and proportions, such as:

- a 5:2 ratio of blue to white
- a 2:5 ratio of blue to white
- blue is 2/5 of white
- blue is 5/2 or 2½ of white
- the proportion of cards from a normal pack of 52 that is red
- the proportion of cards from a normal pack of 52 that are aces

You could give the children a selection of recipes from the internet and ask them to work out the ratio of, for example, flour, sugar, margarine in a sponge cake, or the proportion of a ready meal that should be eaten by 2 people if the meal is intended to serve 6 people. You could then ask them to rewrite a list of ingredients for a recipe, originally written for 4 so that it will serve 6 or 12 people.

You could give the children problems such as:

- Tom and Nafisat win £750 between them. They agree to divide the money in the ratio 2:3. How much do they each receive?
- A necklace is made using gold and silver beads in the ratio 3:5. If there are 80 beads in the necklace:
    - How many are gold?
    - How many are silver?
- To make a tasty chocolate milkshake James needs one part chocolate sauce to six parts milk. Each part is 150ml
    - If he used 4 parts of chocolate sauce how much milk would he need?
    - If he had 420 ml milk, how much chocolate sauce?

Activity set B

The children could construct a pie chart and then make up and solve problems from it. You could set scenarios such as: the local health authority are surveying the eating habits of school children and want to know how many of the 360 children in a local school have school dinners, packed lunches or go home. If appropriate the children could find out this information or could make up the data. They could then construct a pie chart using a protractor with every degree representing one child. They could then find the numbers, fractions or percentages of children having each type of lunch.

Set problems such as this for the children to solve:

- Tammy was saving for a laptop. The laptop she wanted cost £360. She has saved 60% of the amount. How much more money does she need?

  Encourage the children to use effective methods to find 60%, such as find 50% by halving and then 10% by dividing £360 by ten and adding the two amounts together.

- In the sale a coat has been reduced by 20%. It now costs £56. What was its original price?

  The children could use the bar model to help them solve this:

  Each section of the bar is worth £14 so the original cost of the coat must be £70.

You could give the children the Nrich activity **'Rod Ratios'** or, as a challenge, **'Weekly Problem 27'**

Activity set C

- Children could look at photographs of themselves or famous buildings and discuss why they are smaller than the actual children or buildings. Establish that they have been scaled down. Discuss where else they might see scaled down images, for example, maps, models, architects plans.
- The children could measure the lengths/heights and widths of objects around the classroom, scale these measurements down by an amount they choose and then sketch the object to that size on paper. Other children could estimate by how much these have been scaled down.
- The children could look at maps and work out distances from one place to another using the given scale.

- You could discuss when objects might need to be scaled up – explain that this is called ‘enlarged’. A good example would be looking at very small objects under a magnifying glass or microscope. If you have any available the children could use the equipment to see what different objects, such as an apple pip or the head of a pin, would look like if scaled up by the magnification on the apparatus.

Activity set D

- The children could look at paintings such as **‘Tiger in a storm’,** by Henri Rousseau. They could explore mixing blue and yellow paints to get the colours that Rousseau has achieved. What ratios of blues and yellows have they made? What are these as proportions or fractions of the total paint mix? They could paint a jungle scene using their mixed paints.
- See **The Art of Mathematics** for other ideas of how to link ratio and proportion to art

Measurement

I can statements:

- solve problems involving the calculation and conversion of units of measure, using decimal notation up to three decimal places where appropriate
- use, read, write and convert between standard units, converting measurements of length, mass, volume and time from a smaller unit of measure to a larger unit, and vice versa, using decimal notation to up to three decimal places
- convert between miles and kilometres
- recognise that shapes with the same areas can have different perimeters and vice versa
- recognise when it is possible to use the formulae for area and volume of shapes
- calculate the area of parallelograms and triangles
- calculate, estimate and compare volume of cubes and cuboids using standard units, including cubic centimetres (cm^3) and cubic metres (m^3), and extending to other units [for example, mm^3 and km^3]

Exemplification

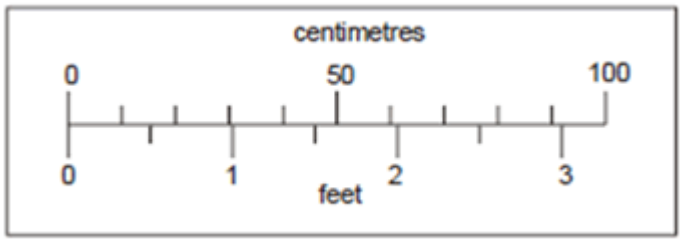
Examples of what children should be able to do, in relation to each (boxed) Programme of Study statement

Solve problems involving the calculation and conversion of units of measure, using decimal notation up to three decimal places where appropriate

- Children should be able to draw a flow chart to help someone else convert between mm, cm, m and km.
- They should be able to answer questions such as: approximately how many litres are there in 3 gallons? Give your answer to the nearest litre.

Use, read, write and convert between standard units, converting measurements of length, mass, volume and time from a smaller unit of measure to a larger unit, and vice versa, using decimal notation to up to three decimal places

This scale (not actual size) shows length measurements in centimetres and feet.



Look at the scale. Estimate the number of centimetres that are equal to 2 ½ feet.

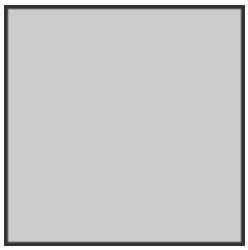
Estimate the difference in centimetres between 50 cm and 1 foot.

Convert between miles and kilometres

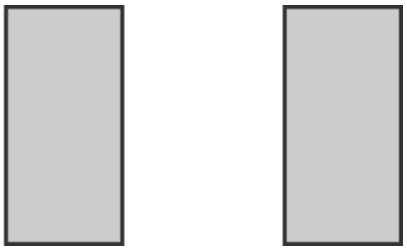
- Pupils should know the approximate equivalence between commonly used imperial units and metric units:
  e.g. 1 litre is approximately 2 pints (more accurately, 1 ¾ pints)
  4.5 litres is approximately 1 gallon or 8 pints
  1 kilogram is approximately 2 lb (more accurately, 2.2 lb)
  30 grams is approximately 1 oz
  8 kilometres is approximately 5 miles
- Children should be able to use conversion graphs that show miles/kilometres. They should be able to use it to estimate a distance of 95 miles in kilometres.

Recognise that shapes with the same areas can have different perimeters and vice versa

The perimeter of a square is 72 centimetres.



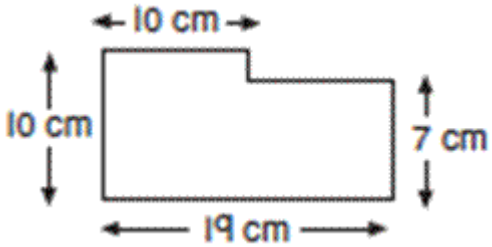
The square is cut in half to make two identical rectangles.



What is the perimeter of one rectangle?

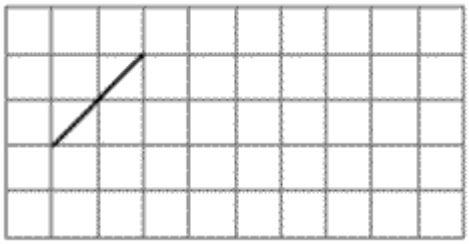
Recognise when it is possible to use formulae for area and volume of shapes

Children should be able to calculate the perimeters of compound shapes that can be split into rectangles. For example,



Calculate the area of parallelograms and triangles

This is a centimetre grid. Draw 3 more lines to make a parallelogram with an area of 10cm^2. Use a ruler.



Activities

Programme of Study statements	Activities				
	A	B	C	D	E
solve problems involving the calculation and conversion of units of measure, using decimal notation up to three decimal places where appropriate			●	●	●
use, read, write and convert between standard units, converting measurements of length, mass, volume and time from a smaller unit of measure to a larger unit, and vice versa, using decimal notation to up to three decimal places					●
convert between miles and kilometres					●
recognise that shapes with the same areas can have different perimeters and vice versa	●	●	●		
recognise when it is possible to use formulae for area and volume of shapes	●		●		
calculate the area of parallelograms and triangles			●		
calculate, estimate and compare volume of cubes and cuboids using standard units, including cubic centimetres (cm^3) and cubic metres (m^3), and extending to other units [for example, mm^3 and km^3				●	

Activity A : Numerically Equal NRICH

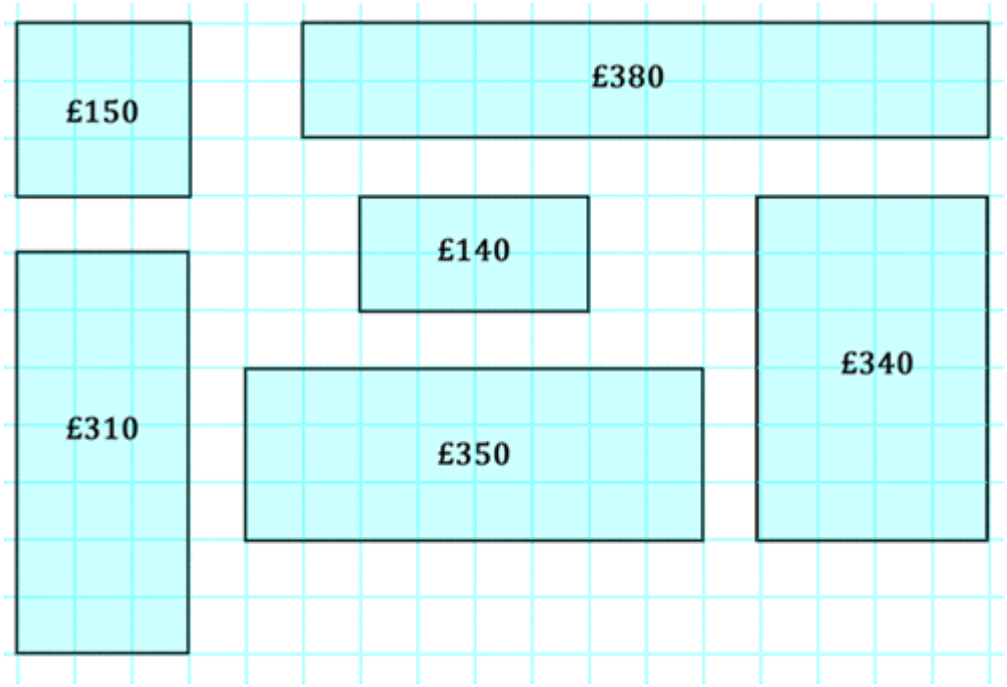
Challenge the children to see if they can draw a square in which the perimeter is numerically equal to the area. What about other shapes?

Activity B: Weekly Problem 20 – 2011 NRICH

Can you find the perimeter of this unusual shaped polygon?

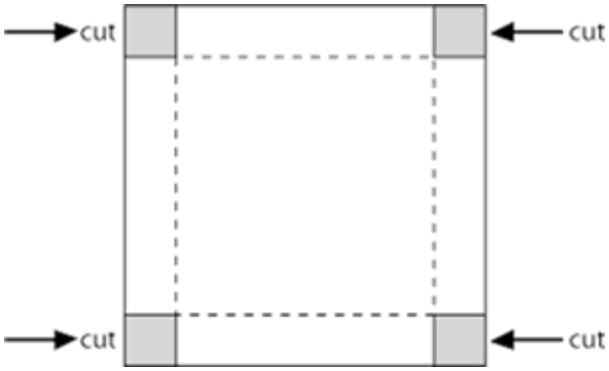
Activity C : Through the window NRICH

The local DIY shop calculates the price of its windows according to the area of glass and the length of frame used. Can you work out how they arrived at these prices?



Activity D : Making boxes NRICH

Cut differently-sized square corners from a square piece of paper to make boxes without lids. Do they all have the same volume? How do we know?



Activity E : A little bit of history - Marco Polo NRICH

Compare historical journeys and convert units of measure whilst learning all about the well-known traveler, Marco Polo.

Useful Resources

Activity B : Images of polygons

Activity D : Pre-cut squares to support initial investigation

Squared paper for children to use to explore ideas

Geometry – properties of shapes

I can statements:

- draw 2-D shapes using given dimensions and angles
- recognise, describe and build simple 3-D shapes including making nets
- compare and classify geometric shapes based on their properties and sizes and find unknown angles in any triangles, quadrilaterals, and regular polygons
- illustrate and name parts of circle, including radius, diameter and circumference and know that the diameter is twice the radius
- recognise angles where they meet at a point, are on a straight line, or are vertically opposite, and find missing angles.

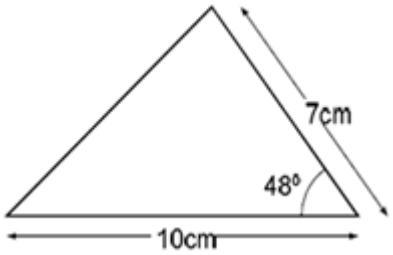
Exemplification

Examples of what children should be able to do, in relation to each (boxed) Programme of Study statement

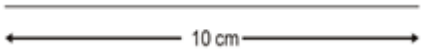
Draw 2-D shapes using given dimensions and angles

Children should be able to construct a triangle given two sides and the included angle

Here is a sketch of a triangle. (It is not drawn to scale).



Draw the full size triangle accurately, below. Use an angle measurer (protractor) and a ruler. One line has been drawn for you.



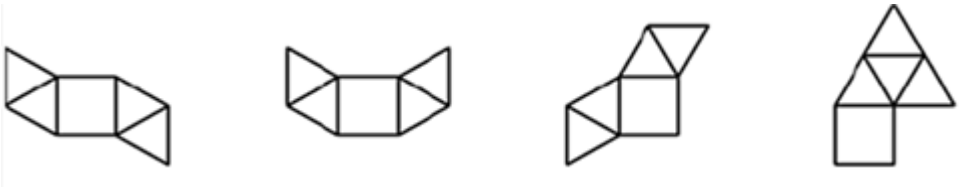
Recognise, describe and build simple 3-D shapes, including making nets

Children should be able to identify, visualise and describe properties of rectangles, triangles, regular polygons and 3-D solids; use knowledge of properties to draw 2-D shapes and identify and draw nets of 3-D shapes

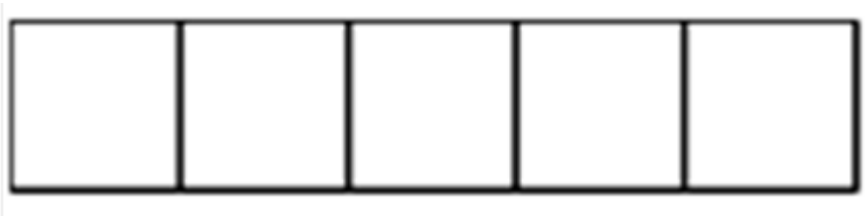
They should be able to respond accurately to questions such as;

‘I am thinking of a 3D shape. It has a square base. It has four other faces which are triangles. What is the name of the 3D shape?’

‘Which of these nets are of square based pyramids? How do you know?



‘Is this a net for an open cube?’ How do you know?



Compare and classify geometric shapes based on their properties and sizes and find unknown angles in any triangles, quadrilaterals, and regular polygons

Children should be able to make and draw shapes with increasing accuracy and knowledge of their properties.

They should be able to carry out activities such as;

‘Give me instructions to get me to draw a rhombus using my ruler and a protractor’

‘On the grid below, use a ruler to draw a pentagon that has three right angles’

Illustrate and name parts of circles, including radius, diameter and circumference and know that the diameter is twice the radius

They should know that:

- The circumference is the distance round the circle
- The radius is the distance from the centre to the circumference
- The diameter is 2 x radius

Recognise angles where they meet at a point, are on a straight line, or are vertically opposite, and find missing angles

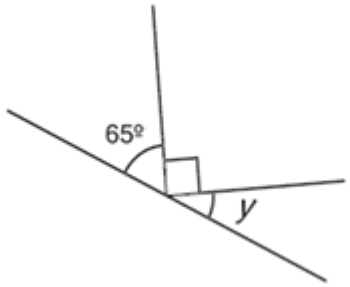
Children should be able to estimate angles, use a protractor to measure and draw them, on their own and in shapes. They should know that the angle sum of a triangle is 180˚, and the sum of angles around a point is 360˚.

They should be able to use this knowledge to respond accurately to questions such as;

‘There are nine equal angles around a point. What is the size of each angle?’

‘There are a number of equal angles around a point. The size of each angle is 24°. How many equal angles are there?’

Children should be able to calculate the size of angle ‘y’ in this diagram without using a protractor.



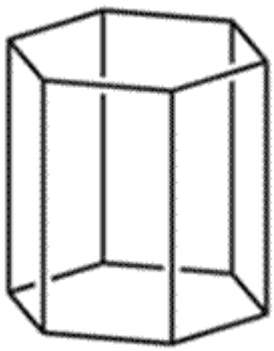
(Not to scale)

Activities

Programme of Study statements	Activities						
	A	B	C	D	E	F	G
draw 2-D shapes using given dimensions and angles					●		
recognise, describe and build simple 3-D shapes, including making nets	●					●	
compare and classify geometric shapes based on their properties and sizes and find unknown angles in any triangles, quadrilaterals, and regular polygons		●		●	●		
illustrate and name parts of circles, including radius, diameter and circumference and know that the diameter is twice the radius			●				●
recognise angles where they meet at a point, are on a straight line, or are vertically opposite, and find missing angles		●					

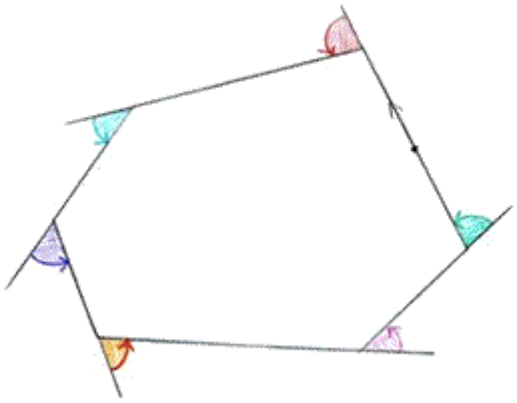
Activity A - Thinking 3D NRICH

A series of activities designed to support the development of transferring a 2D representation of a 3D object into a model of the object itself as well as gaining an understanding of positional language.



Activity B - Round a Hexagon NRICH

An activity from Nrich supporting the finding of missing angles, including internal and external angles and the use of a protractor.



Activity C - Watching the wheels go round and round NRICH

An NRIH activity to support understanding of the term circumference. Links are made to converting units of measure.

Activity D - Quadrilaterals Game NRICH

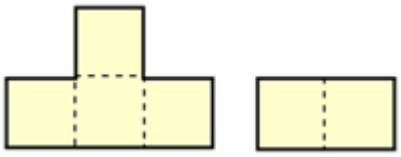
An activity to compare and classify geometric shapes based on their properties in a game that is linked to the card game rummy.

Activity E - Property Chart NRICH

This activity used property charts to compare and classify geometric shapes based on their properties.

Activity F - Cut Nets NRICH

An Nrich activity to support the skills of visualisation in building simple 3-D shapes from nets.



Activity G - Dynamic Geometry NRICH

An introduction to dynamic geometry with helpful links to websites offering free software to support the exploration of properties of circles and the formation of nets for a comprehensive selection of 3-D shapes.

Useful Resources

Protractors or angle measurers, rulers, dot isometric paper, pair of compasses, set squares, dynamic geometry software, set of folding geometric shapes, pinboards and geoboards, Perspex mirrors, 2-D shape dice, class sets of ‘polydron’ or other 3D shape construction materials.

Geometry – Position and direction

I can statements:

- describe positions on the full coordinate grid (all four quadrants)
- draw and translate simple shapes on the coordinate plane, and reflect them in the axes.

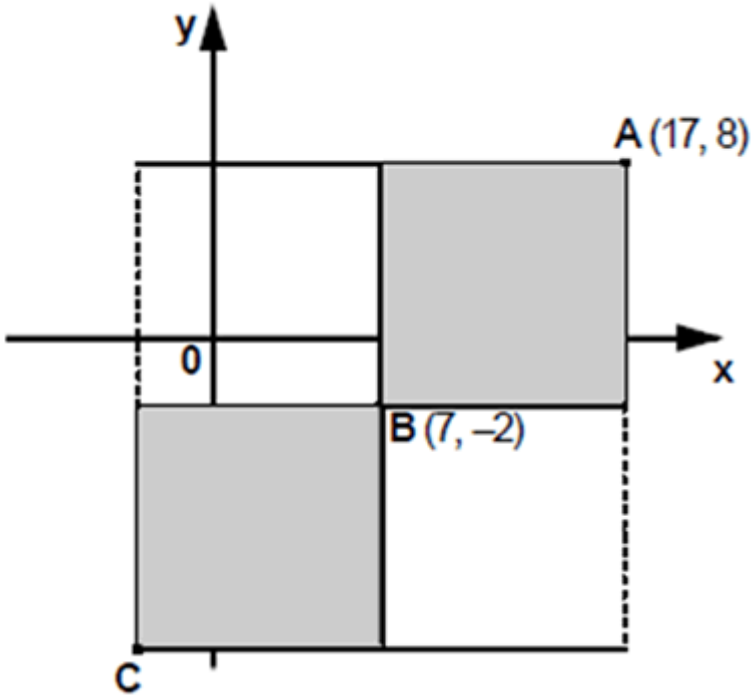
Exemplification

Examples of what children should be able to do, in relation to each (boxed) Programme of Study statement

describe positions on the full coordinate grid (all four quadrants)

Children should be able to answer questions such as;

The two shaded squares below are the same size.



A is the point (17,8). B is the point (7,-2).

What are the co-ordinates of the point C?

draw and translate simple shapes on the coordinate plane, and reflect them in the axes

Children should be able to draw a shape with corners at given vertices, and describe the properties of the shape. Can they create the same shape where all of the coordinates will be positive? Negative?

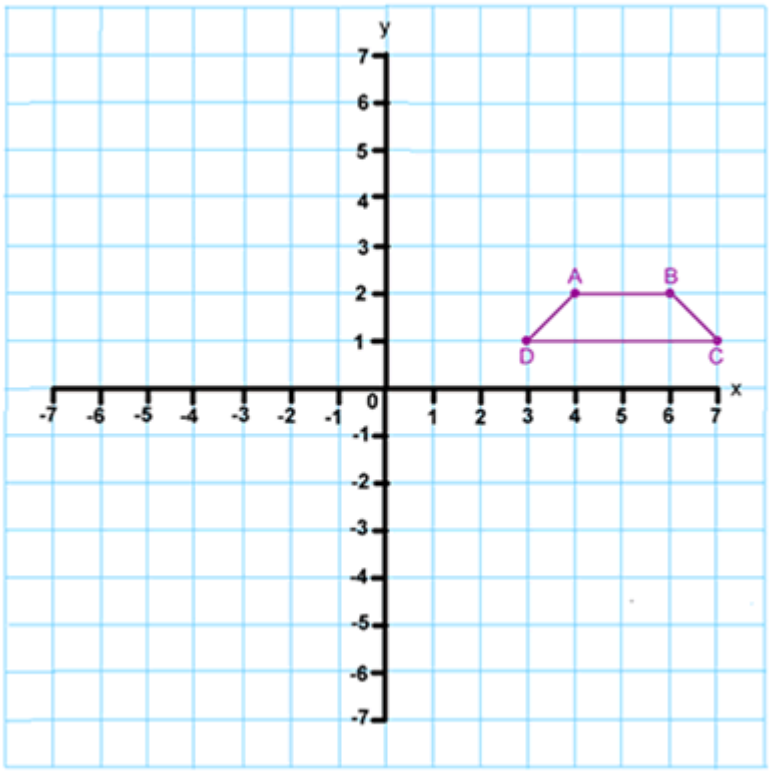
They should be able to sketch the reflection of a simple shape in two mirror lines at right angles and find the coordinates of selected points.

Activities

Programme of Study statements	Activities	
	A	B
describe positions on the full coordinate grid (all four quadrants)	●	●
draw and translate simple shapes on the coordinate plane, and reflect them in the axes	●	

Activity A – Transformation Tease

An investigation into positioning and transforming through reflection and rotation. using all four quadrants



Activity B – Battleships

The traditional game of battleships can provide a useful reminder for children when using coordinates. Challenge the children to create their own version of the game, perhaps with a different theme, using all four quadrants.

Useful Resources

Squared paper

Statistics

I can statements:

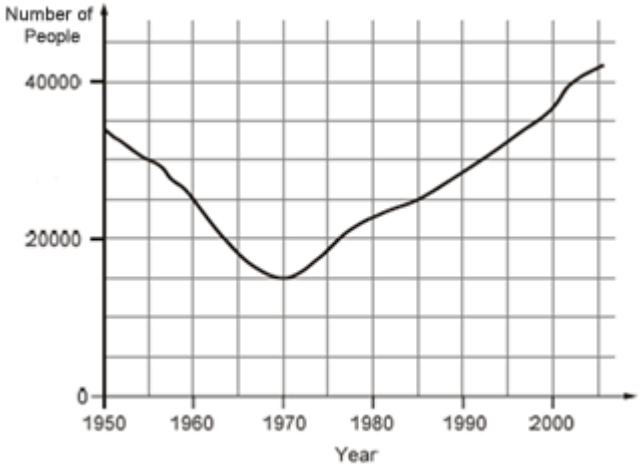
- interpret and construct pie charts and line graphs and use these to solve problems
- calculate and interpret the mean as an average

Exemplification

Examples of what children should be able to do, in relation to each (boxed) Programme of Study statement

Interpret and construct pie charts and line graphs and use these to solve problems

This graph shows the number of people living in a town.



How many people lived in the town in 1985?
In which year was the number of people the same as in 1950?

Find the year when the number of people first went below 20 000.

KS2 2008 Paper A level 5

Class 6 did a survey of the number of trees in a country park. This pie chart shows their results.

Estimate the fraction of trees in the survey that are oak trees. The children counted 60 ash trees. Use the pie chart to estimate the number of beech trees they counted.

KS2 2006 Paper A level 5

Calculate and interpret the mean as an average

From a simple database, children should be able to find the most common score (mode) as well as the mean score for each test.

Scores for 10 spelling and 10 mental answers

Name	Mental test score	Spelling test score
Danny	8	9
Elizabeth	10	7
Anil	7	9

Children should be able to choose their own sets of data to match given criteria, e.g. find a set of five numbers that have a mean of 5 and a range of 7.

Activities

Programmes of Study statements	Activities				
	A	B	C	D	E
interpret and construct pie charts and line graphs and use these to solve problems	●	●	●	●	
calculate and interpret the mean as an average.			●		●

Activity A - Take your dog for a walk NRICH

An interactive activity from Nrich to explore story telling with a line graph.

Activity B - Graphing Number Patterns NRICH

Does a graph of the triangular numbers cross a graph of the six times table? If so, where? Will a graph of the square numbers cross the times table too?

Activity C - Weekly Problem 12 - 2010 NRICH

This short problem from Nrich challenges children to calculate mean averages of a set of emerging data.

Activity D - The television NCETM

Issue 49 of the NCETM Primary Magazine provides information about the history of the television, and explores viewing data.

Activity E – A little bit of history (Britain since 1945) NCETM

Issue 41 of the NCETM Primary Magazine looks at how elements of everyday life, with a mathematical 'feel', have changed in recent years. There are lots of ideas here to get you started… why not explore how the average wage has changed throughout history. How does the average pocket money vary throughout the school?

Useful Resources

Compass, protractor, graph paper

Algebra

I can statements:

- use simple formulae
- generate and describe linear number sequences
- express missing number problems algebraically
- find pairs of numbers that satisfy number sentences involving two unknowns
- enumerate possibilities of combinations of two variables

Exemplification

Examples of what children should be able to do, in relation to each (boxed) Programme of Study statement

Find pairs of numbers that satisfy number sentences with two unknowns

Enumerate all possibilities of combinations of two variables.

Children should be confident to answer questions such as;

Here are five number cards:

A and B stand for two different whole numbers.

The sum of all the numbers on all five cards is 30.

What could be the values of A and B?

Express missing number problems algebraically

Use simple formulae

Children should be able to express a relationship in symbols, and start to use simple formulae. For example:

- Use symbols to write a formula for the number of months m in y years.
- Write a formula for the cost of c chews at 4p each.
- Write a formula for the nth term of this sequence: 3, 6, 9, 12, 15…
- The perimeter of a rectangle is 2 × (l + b), where l is the length and b is the breadth of the rectangle.
- What is the perimeter if l = 8 cm and b = 5 cm?
- The number of bean sticks needed for a row which is m metres long is 2m + 1. How many bean sticks do you need for a row which is 60 metres long?
- Plot the points which show pairs of numbers with a sum of 9.

Generate and describe linear number sequences

Children should experience activities such as;

A number sequence is made from counters.

There are 7 counters in the third number.

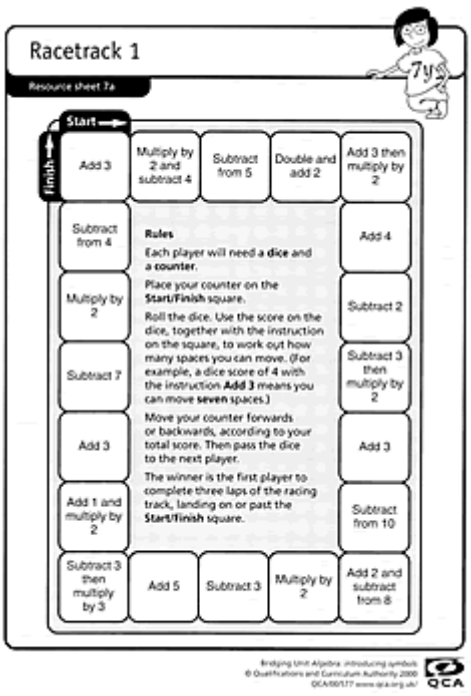
How many counters in the 6th number? the 20th...?

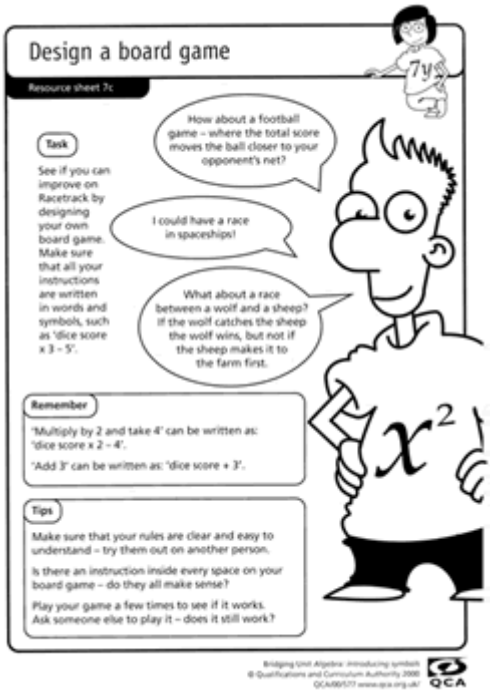
Write a formula for the number of counters in the nth number in the sequence.

Activities

Programme of Study statement	Activities				
	A	B	C	D	E
express missing number problems algebraically	●				●
use simple formulae expressed in words	●			●	
generate and describe linear number sequences		●		●	
find pairs of numbers that satisfy number sentences involving two unknowns			●		
enumerate all possibilities of combinations of two variables.			●		

Activity A: Racetrack and Design a board game



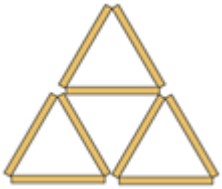


(Taken from Bridging units in mathematics – Algebra: introducing symbols, Qualifications and Curriculum Authority (QCA), 2000)

This pack of lesson materials (10 lessons for Y6 and 6 for Y7) was designed to support better continuity and progression in the learning and teaching of algebra between primary and secondary schools. The year 6 lessons contain the following themes: using function machines, notation and recording, generalising the results of an investigation and writing instructions using letters.

Activity B: Sticky Triangles

A puzzle in which match sticks are used to make a different number of triangles. An opportunity to generalise and symbolise.



Activity C: This Pied Piper of Hamlyn

The 'Pied Piper of Hamelin' is a story you may have heard or read. This man, who is often dressed in very bright colours, drives the many rats out of town by his pipe playing - and the children follow his tune.

The challenge is to investigate how many children/rats there could be if the number of legs was 600.

Follow **this link** for a wealth of other NRICH activities where the focus is on finding all possibilities

Activity D: Generating Sequences

Say together the three times table: one three is three, two threes are six, … Ring the multiples 3, 6, 9, … up to 30 on the grid with a red pen as you say them.

Remind pupils that multiples of 3 are numbers that divide exactly by 3 and include the numbers in the three times table.

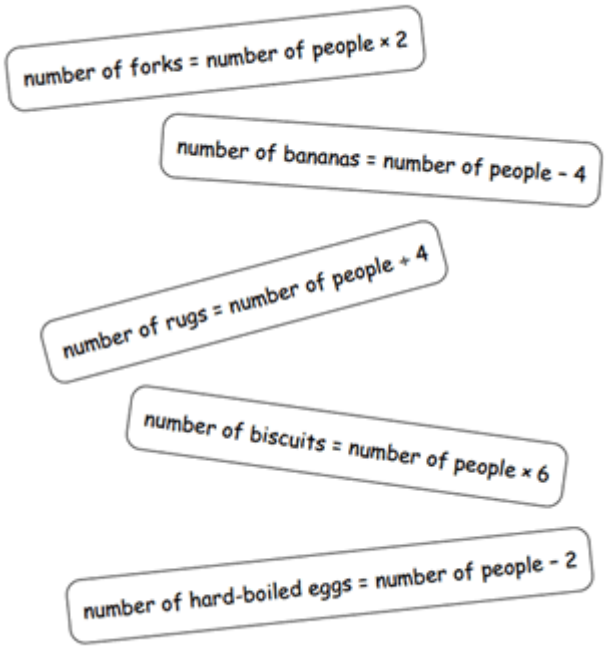
1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60

- Q Are the multiples of 3 odd or even? (they alternate)
- Q Can you describe the pattern the ringed numbers make? (sloping lines). How will it continue? (the sloping lines will extend across the grid)
- Q Will 36 be in the extended three times table? How do you know? Encourage pupils to look down the sloping lines of ringed numbers to judge whether 36 would be included. Repeat for 57 and 41.

Repeat this process for the four times table, marking them with a blue square. Draw out that all the multiples of 4 are even. This is taken from a series of four algebra lessons held on**the National STEM Centre eLibrary.**

The 'Algebra 1' lesson includes tasks on generating number sequences and describing them using formulae expressed in words.

N.B.You may wish to support the main activity of this lesson by using the **ITP Number grid.**



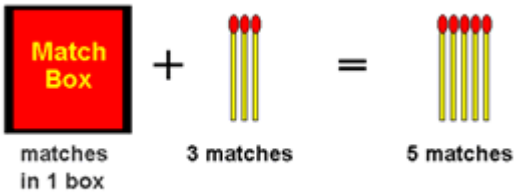
Ask:

- How many bananas are needed for 30 people going on a picnic?
- All 16 bananas were eaten at a picnic. How many people went?
- How many rugs are needed for 12 people on a picnic?
- 5 rugs were taken to a picnic. How many people went?
- How many biscuits are needed for 8 people for a picnic?
- 60 biscuits were packed for a picnic. How many people went?

- 12 hard-boiled eggs were packed for a picnic. How many people went?

The **'Algebra 4' lesson** includes tasks on using formulae and solving simple equations

Activity E: Matchbox Algebra



Matchbox Algebra is an applet which poses missing number problems in the context of matches and matchboxes and allows the use of symbols to represent them.