



Introducing Numicon 6

Build a secure future in mathematics for every child



OXFORD

Award-winning whole curriculum Maths resources

With resources and professional development from Early Childhood to Level 4 NZ Curriculum Level plus support for Intervention and Inclusion, *Numicon* provides all you need to create confident mathematicians throughout your whole school.

- Embodies the NZ Curriculum Levels pre Level 1 – 4 by developing fluency, mathematical reasoning and problem-solving
- Structured apparatus and imagery ensures children master the skills needed to gain deep understanding
- Ensures every child meets end of year expectations and National Standards with robust and reliable assessment tracking
- Professional learning is built in, however *Numicon* is supported by professional development courses for sustained school improvement

Preparation for Formal Testing: self-assessment, fluency and problem-solving strategies
Investigations: inspiring mathematical investigations to deepen understanding and stretch your highest achievers



Supporting you in teaching the NZ curriculum

With resources for Numeracy, Algebra, Geometry, Statistics and Measurement, you can teach right across the NZ Curriculum Level 4 with confidence. Typically this is in Years 7 and 8. If your whole school is using *Numicon* as your programme, then your Year 6 students will be working at this level with success and confidence.

Numicon 6 also introduces two new features:

Self assessment in preparation for formal assessments, fluency in problem-solving strategies

Investigations: Inspiring mathematical investigations to deepen understanding and stretch your highest achievers

Autumn
2016

Numicon 6

Covering key topics such as algebra, ratio and proportion, calculating with fractions, long division, coordinates in four quadrants, finding the mean and pie charts, the **Activity Groups** have careful progression and adaptable, easy-to-follow steps built in.

For assessment, the **Explorer Progress Books** allow you to gather evidence of each child's understanding, and the regular **Milestones** enable you to track their progress throughout the year. The **Explore More Copymasters** provide fun activities for children to practise and discuss maths at home.

All you need for Numicon 6:

Number, Pattern and Calculating 6 Easy Buy Pack

Contains:

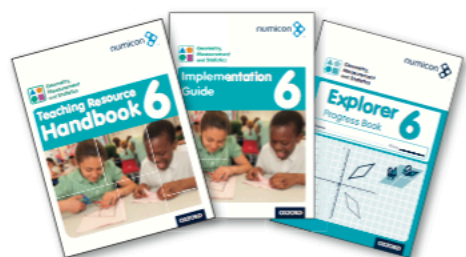
- Number, Pattern and Calculating 6 Teaching Resource Handbook and Implementation Guide
- Number, Pattern and Calculating 6 Explorer Progress Books A, B and C (30 copies of each)
- Number, Pattern and Calculating 6 Explore More Copymasters



Geometry, Measurement and Statistics 6 Easy Buy Pack

Contains:

- Geometry, Measurement and Statistics 6 Teaching Resource Handbook (includes Explore More Copymasters) and Implementation Guide
- Geometry, Measurement and Statistics 6 Explorer Progress Book (Pack of 30)



Starter Apparatus Pack C

Contains a new selection of apparatus ready for every element of the Year 6 curriculum.




Numicon Online

Online support to introduce and implement *Numicon* in your school. Find editable planning documents, assessment tracking and video guidance on implementation.

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inspirational resources, advice
and professional development
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Numicon overview chart

	NURSERY	FOUNDATION	AGE 5–6	AGE 6–7
TEACHING SUPPORT	<div>1ST STEPS WITH NUMICON IN THE NURSERY KIT</div> 	<div>NUMICON FIRM FOUNDATIONS KIT</div> 	<div>Teaching Resources (Number, Pattern and Calculation)</div> 	
APPARATUS			<div>STARTER APPARATUS PACK A</div> 	
ASSESSMENT			<div>(Three Explorer Progress Books for Number, Pattern and Calculation)</div> 	
ACTIVITIES FOR HOME	<div>1ST STEPS WITH NUMICON AT HOME KIT</div> 			

AGE 7-8	AGE 8-9	AGE 9-10	AGE 10-11
Teaching Resource Handbook and Implementation Guide (Number, Pattern and Calculating, and Geometry, Measurement and Statistics teaching packs available separately)			
STARTER APPARATUS PACK B		STARTER APPARATUS PACK C	
Explorer Progress Books (Number, Pattern and Calculating, one for Geometry, Measurement and Statistics)			
Explore More Copymasters			

NEW

NUMICON ONLINE ONLINE PLANNING AND ASSESSMENT SUPPORT

ALSO AVAILABLE

Investigations with Numicon:

A supplementary teaching manual and apparatus pack to stretch children in Level 2



ALSO AVAILABLE

Breaking Barriers

Designed specifically for students with High Learning Needs or those experiencing learning difficulties with maths requiring long-term intervention

Number, Pattern and Calculating 6 Teaching Resource Handbook

Sample activity group

Key mathematical ideas Generalizing, Pattern and algebra, Functions, Inverse, Equivalence, Mathematical thinking and reasoning

Pattern and Algebra

Using symbols and letters for variables and unknowns

4



Educational context

In this activity group, children continue to explore how to describe general situations and rules mathematically. They are supported to express patterns numerically, e.g. as sequences and functions, and to identify and describe relationships between numbers, e.g. as formulae. This links to children's work with formulae in the *Geometry, Measurement and Statistics 6 Teaching Resource Handbook*, Measurement 3. This leads into describing general rules which apply in any instance of the same type of situation, and, building on their work in Pattern and Algebra 3, to expressing these rules concisely using algebra, with letters standing for unknown values and variables. For example, in Activity 6 they work out how to describe the commutative property of adding two numbers – the property that the order in which the numbers are added doesn't matter – more succinctly, as $a + b = b + a$. Connecting with the work of Pattern and Algebra 2, we explore general rules of divisibility for help in finding factors.

Learning opportunities

- To describe a numerical pattern or general relationship in words and algebraically, as a formula.
- To recall and use tests of divisibility by 2, 3, 5, 9 and 10.
- To describe and explain the commutative property of adding and multiplying.

Words and terms for use in conversation

algebra, algebraic notation, symbol, generalize, reasoning, logic, systematic, show, prove, pattern, sequence, constant difference, term, first term, term-to-term rule, predict, relationship, general rule, general term, n th term, unknown, variable, value, expression, equation, equivalent, inverse, function, function machine, input, output, divisibility, test of divisibility, factor, multiple, prime, composite, commutative property, associative property, number trio, part-whole relationship

Assessment opportunities

Look and listen for children who:

- Use the words and terms for use in conversation effectively.
- Can identify the term-to-term rule in a linear sequence, e.g. in the sequence 38, 43, 48, 53, ... the term-to-term rule is 'add 5'.
- Describe a rule for finding the general term of a linear sequence and express this with an algebraic expression, e.g. $5n + 33$ in Activity 1.
- Can explain algebraically how 'think of a number' problems work.
- Can explain the general relationship between an 'input' (x) and an 'output' (y) for a particular function (e.g. for a function described by $y = 3x$, y is always three times x is always one third of y).
- Can identify a missing input or output for a given function machine, and a missing instruction, e.g. 'x 3' for a given set of inputs and outputs.
- Can write an equation to show the general relationship between input and output for a given function, represented as x and y respectively, e.g. $y = 3x$.
- Use tests of divisibility to sort numbers.
- Describe the commutative properties of adding and of multiplying in general terms, including algebraically, e.g. $a + b = b + a$, $ab = ba$.
- Can explain why adding and multiplying are commutative, while subtracting and dividing are not.

Explorer Progress Book 6b, pp. 20–23

After completing work on this activity group, give small focus groups of children their Explorer Progress Books and ask them to work through the challenges on the pages. As children complete the pages, assess what progress they are making with the central ideas from the activity group. Refer to the assessment opportunities for assistance. Children will also have the opportunity to complete their Learning Log (pp. 22–23) where they can reflect on the mathematics they have done so far.

Explore More Copymaster 4: Secret Function Machine

After completing work on Activity 4, give children Explore More Copymaster 4: Secret Function Machine to take home.

Clear assessment opportunities for every activity group.

Explorer Progress Book pages help you assess children's understanding of the central ideas from the activity group.

Explore More Copymasters give children a further opportunity to practise at home what they have been learning in class.

A clear outline of the content covered in the activity group and how it connects with other activity groups.

Focus activities are broken down into easy-to-follow steps.

Pattern and Algebra

Focus activities

Activity 1: Investigating rules and generalizing with algebra

Have ready: Numicon Shapes, 100 square (photocopy master 2) or 100 square on the Numicon Software for the Interactive Whiteboard (optional), number rods

Step 1
Show a 100 square and choose a 'starting number', e.g. 5. Give a starting rule, e.g. 'find the total of the starting number, the two numbers to its right and the two numbers below it,' illustrating on the 100 square (see Fig. 3.1). Agree that, following the rule, we get $5 + 6 + 7 + 15 + 25 = 58$.

Step 2
Ask children to investigate the result of using different starting numbers. Support them to work systematically and organize their findings (e.g. Fig. 3.2).

Step 3
Encourage children, as they work, to illustrate their findings with apparatus or imagery of their choice and to look for patterns and relationships among both the numbers being added and the totals.

Look and listen for those who spot the repeating pattern in the units digit of the totals (8 where the starting number is odd, 3 where it is even) and the constant difference between each total and the next (5). Agree that the totals form a sequence with first term 58 and term-to-term rule 'add 5' (make links, as needed, to children's previous work on sequences, e.g. in Pattern and Algebra 2 or in the Number, Pattern and Calculating 5 Teaching Resource Handbook, Pattern and Algebra 1).

Step 4
Ask children whether there is a way to predict the 22nd term in the sequence (without simply repeatedly adding 5). Some may suggest using patterns, e.g. identifying that the units digit for the 22nd term will be 3, since 22 is an even number. Encourage them instead to look for relationships between the number of the term and the numbers being totaled, allowing plenty of time for them to experiment and explore.

Step 5
Look and listen for children who can illustrate and describe in general terms the relationships between the numbers which are added together to give each term in the sequence. Invite them to explain their thinking.

Agree that the starting number always matches the position number of the term, so, e.g. the 5th term has starting number 5. Guide children to explain that the two numbers to the right of the starting number are always 1 more and 2 more than the starting number; then, similarly, the two numbers below are always 10 more and 20 more than the starting number. Encourage children to come up with ways to illustrate this visually (e.g. Fig. 3.3).

Invite children to use their illustration to explain why the term-to-term rule for the sequence is 'add 5'. Look and listen for children who can explain, e.g. the only number that changes when adding to find a new term is the starting number, which is 1 more each time; since 5 is added into the total 5 times, each term is 5 more than the previous term.

Pattern and Algebra

4

Step 6
Work with children to write number sentences to show how to use these relationships to calculate some of the terms, e.g.
5th term: $5 + (5 + 1) + (5 + 2) + (5 + 10) + (5 + 20) = 58$
6th term: $6 + (6 + 1) + (6 + 2) + (6 + 10) + (6 + 20) = 63$
7th term: $7 + (7 + 1) + (7 + 2) + (7 + 10) + (7 + 20) = 68$
Prompt children, as needed, to generalize to describe in their own words a rule for finding any term, e.g. 'Add 5 lots of the position number, then add 33.'

Step 7
Talk with children about how to calculate. Work with them to use the pattern identified in Step 6, replacing the starting number with the term; then use the general rule identified in Step 6 to find the 22nd term in the sequence.

Step 8
Recall with children their work on using to represent unknowns or variables (e.g. Algebra 3). Tell children that n is often used to represent a number in a sequence; that is, n represents a number.

Ask children whether they can write an expression for the n th term. Once they talk about and explore this, invite them to work with them to use the pattern identified in Step 6, replacing the starting number with the term; then use the general rule identified in Step 6 to find the 22nd term in the sequence.

Invite children to confirm that this expression is correct by substituting values for n in it. The first term is $(2 \times 5) + 33 = 43$, and the second term is $(2 \times 6) + 33 = 45$.

Step 9
Work with children to use a different rule, e.g. 'find the total of the starting number, the two numbers on either side and the two numbers diagonally to top left and bottom right' (see Fig. 3.4). Limit the starting numbers to 2 digits and wrap around as in Step 2. To find the first few terms of a sequence, then an expression using n as the starting number (e.g. Fig. 3.5). (For the example given here, use, e.g. 12 as the first starting number.) Look and listen for children who can explain the patterns in the numbers being added and the link.

Starting numbers in a row, term to interpret reading of line of the 100 square numbers 'to the right' is starting numbers. Size the 100 square 'below' 81 are 91 only as a way of starting children to identify the to generate further

8	9	10
18	19	20
28	29	30
38	39	40

Pattern and Algebra

4

Step 2
Talk with children about how to sort the numbers in the list according to whether they are prime or composite and, if they are composite, to decide which of 2, 3, 5, 7 and 10 they are divisible by.

Encourage plenty of discussion and explore children's ideas. Look and listen for children who suggest checking first for numbers which are divisible by 2, 5 and 10, since these are relatively easy to spot.

Step 3
Talk with children about further tests of divisibility, encouraging them to describe these in their own words. (For children who need further support, refer to the Number, Pattern and Calculating 5 Teaching Resource Handbook, Pattern and Algebra 4.)

Agree that a number is divisible by:
2 if it is even; that is, if the units digit is 0, 2, 4, 6 or 8
5 if the units digit is either 0 or 5
10 if the units digit is 0.

Prompt children to compare these rules, and invite them to reason whether any number divisible by 10 is also divisible by both 2 and 5. Look and listen for children who can make links with previous work on factors, e.g. in Pattern and Algebra 1, to explain that this is because 2 and 5 are factors of 10. Number rods are very useful for illustrating these relationships.

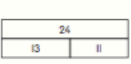
Agree that numbers in the list which are even or which end in 5 are called composite. Some children may be able to reason that the only even prime number is 2 itself, because ...

Step 4
Recall with children that a number is divisible by 3 if the sum of its digits is divisible by 3, and explain that, similarly, a number is divisible by 9 if the sum of its digits is divisible by 9. Check children's understanding by giving example numbers for them to test, e.g. for 468, $4 + 6 + 8 = 18$ and $1 + 8 = 9$; since $9 \div 3 = 3$ and $9 \div 9 = 1$, 468 is divisible by both 3 and 9. Prompt them, as needed, to check that this is true by carrying out the original dividing calculations, e.g. $468 \div 3 = 156$ and $468 \div 9 = 52$.

Number	5059	5179	5307	5402	5608
Divisible by	(prime)	(prime)	3	2	2

Number	5107	5235	5336	5409	5625
Divisible by	(prime)	3, 5	2	3, 9	3, 5, 9

Number	5171	5273	5340	5454	5735
Divisible by	(prime)	(prime)	2, 3, 5, 10	2, 3, 9	5



Children may also be able to generalize that any number divisible by 9 is also divisible by 3, since 3 is a factor of 9. Again, number rods are very useful for illustrating this.

Step 5
Guide children to find and record the composite numbers in the list, and state whether they are divisible by 2, 3, 5, 7 or 10, and so identify which numbers are prime (see Fig. 3.6). Look and listen for children working systematically.

Activity 6: Expressing general laws of arithmetic

Have ready: Numicon Shapes, Numicon Coloured Counters or number rods

Step 1
Use Shapes or rods to show a 'part-whole' or 'number trio' adding relationship (e.g. Fig. 3.7). Ask children to describe the relationship in as many different ways as they can, e.g. 'the pink and the dark green rod together equal the length of the orange rod', 'the sum of six and four is ten', 'the 4-rod is the difference between the 10-rod and the 6-rod'.

Step 2
Ask children to illustrate a similar relationship using apparatus or imagery of their choice (e.g. Fig. 3.7). Ask them to describe it in as many ways as they can.

Step 3
Challenge children to write as many number facts as they can about the relationship they have illustrated. Look and listen for children using the inverse relationship between adding and subtracting and working systematically, and for those who can identify that there are four possible facts (e.g. Fig. 3.8). Some children may recall from previous work that each number trio relationship generates a 'family' of four facts, e.g. in the Number, Pattern and Calculating 4 Teaching Resource Handbook, Pattern and Algebra 2.

$$4 + 6 = 10$$

$$4 + 6 = 10$$

$$5 + 4 = 10$$

$$10 - 6 = 4$$

$$10 - 4 = 6$$

'Look and listen for...' points help you to assess how children are responding to activities.

Concrete materials help illustrate children's thinking and reasoning.

Geometry, Measurement and Statistics 6

Teaching Resource Handbook

Sample activity group

Key mathematical ideas provide a summary of important concepts children will meet in the activity group.

Key mathematical ideas Representing and interpreting data, Speed and Distance

Measurement

Statistics and graphs

1



Educational context

This activity group involves children working with data to calculate the mean, or average, of the set. This allows them to compare different data within the same context, for example growing green beans. They move on to looking at estimated values in the context of packaging food, and how the mean is affected by different values in the set. They also consider 'outliers' and how they can skew an average to be higher or lower.

This activity group builds on the work on charts and graphs in the *Geometry, Measurement and Statistics 5 Teaching Resource Handbook, Measurement 2*.

Later in the activity group, they consider average speed and how to plot distance-time graphs to show speed. They extend this to plotting more data points for distance and time, and discuss how the gradient of the graph shows the speed. These activities develop work in the *Number, Pattern and Calculating 6 Teaching Resource Handbook, Pattern and Algebra 2*, where children plot graphs showing fuel used and distance travelled, and discuss how this relates to speed.

Learning opportunities

- To become familiar with the mean as an average of a set of data.
- To know how to calculate the mean (sum of all data divided by the number of data points).
- To work with different units for speed and convert between them (e.g. m/s to km/h).
- To convert between metric and imperial units (kilometres and miles).
- To plot distance-time graphs and understand how they can be used to work out speed.

Words and terms for use in conversation

data, data set, survey, sample, sample size, value, maximum, minimum, range, spread, statistic, statistician, average, mean, outlier, skewing, central, rate, conversion, rate, speed, metre, kilometre, mile, second, minute, hour

Assessment opportunities

Look and listen for children who:

- Use the words and terms for use in conversation effectively.
- Calculate the mean from a given data set.
- Explain that an outlier can skew a data set.
- Present, interpret and read data on distance-time graphs.
- Use distance-time graphs to calculate average speed.

Explorer Progress Book 5, pp. 2–3

After completing work on this activity group, give small focus groups of children their Explorer Progress Books and ask them to work through the challenges on the pages. As children complete the pages, assess what progress they are making with the central ideas from the activity group. Refer to the assessment opportunities for assistance.

Explore More Copymaster 4: Finding The Mean

After completing work on Activity 2, give children Explore More Copymaster 4: Finding The Mean to take home.

Important words and terms are highlighted for use in mathematical conversation.

Topics are introduced through real-life scenarios. In this activity group, children learn about fractions, e.g. finding the mean size of a set of beans.

The learning opportunities come from real classroom experiences and are designed to help children develop their understanding of the key ideas in each activity group.

A clear list of the apparatus used to support learning is provided at the start of every focus activity.

Opportunities for whole-class, paired and individual practice activities are included in every activity group to give children the opportunity to build on their knowledge, deepen their thinking and develop their mathematical conversations with others.

Careful progression is built into every activity group, and across the whole teaching programme, helping children to become fluent through understanding.

Activity 4: Converting between units of speed

Have ready: graph paper, rulers, number rods

Step 1

Talk with children about how fast humans can run. Establish that the very fastest sprinters run 100 m in approximately 10 seconds. Ask children how they can use this information to calculate a top sprinter's approximate speed. Look and listen for children who suggest dividing 100 by 10, and for those who (making links with their work in Activity 3) recognize that this will give an average speed. Encourage children to recognize that the calculation gives the (average) number of metres travelled in 1 second, so the units are metres per second and write the result as '10 m/s'.

Step 2

Talk with children about how it is quite difficult to appreciate how fast (or slow) 10 m/s might be, since we don't often talk about speeds measured in metres per second. Agree that many people are likely to be more used to thinking in kilometres per hour or miles per hour. Recall with children that kilometres are a 'metric' unit of distance while miles are 'imperial'. Discuss what this means, and establish that units of both systems are commonly in

Step 4

Invite children to share their ideas and findings. Work with them to reason through the steps of one possible method, e.g.:

- to convert from metres to kilometres we divide by 1000, so 10 m/s (10 metres in 1 second) is equivalent to $10 \div 1000 = 0.01 \text{ km/s}$.
- given that 0.01 km is covered each second and 60 seconds = 1 minute, $0.01 \times 60 = 0.6 \text{ km}$ are covered in 1 minute; similarly, given 60 minutes = 1 hour, $0.6 \times 60 = 36 \text{ km}$ are covered in 1 hour.
- so 10 m/s = 36 km/h.

Check children's understanding by asking them to describe the general procedure for converting any quantity in metres per second to kilometres per hour using this method: divide by 1000, then multiply by 60 and 60 again. Prompt children to describe any other methods they can think of, e.g. doing the same calculations in 'reverse order' – multiplying by 60 and 60 again then dividing by 1000. Other suggestions might include dividing by 1000 and multiplying by 3600 (since $60 \times 60 = 3600$), or even multiplying by 3.6 (since $3600 \div 1000 = 3.6$).

Step 5

Next, ask children whether they can convert 36 km/h to miles per hour, or 'mph'. Guide them to explain that this means finding the distance in miles that is equivalent to 36 km. Encourage children to recall and illustrate equivalences between miles and kilometres. Agree and write $1.6 \text{ km} = 1 \text{ mile}$ (e.g. $1.6 \times 5 = 8 \text{ km} = 5 \text{ miles}$) (e.g. $1.6 \times 3 = 4.8 \text{ km} = 3 \text{ miles}$). Emphasize that these are approximate, as shown by the 'x' sign. (For those who need further support with converting between miles and kilometres, refer to the Geometry, Measurement and Statistics 5 Teaching Resource Handbook, Measurement 1, Activity 4.)

Step 6

Practice and discussion

Support children to choose suitable scales to work out equivalences in order to plot points. 0 km = 0 miles followed by 8 km = 5 miles or the points with a straight line.

Step 7

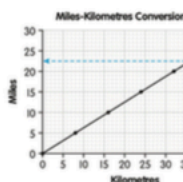
Show a completed line graph (see 2.2.3). Guide children how to identify equivalent values to points, and why joining the plotted points is appropriate. Guide them to appreciate that of kilometres and miles increase at the same rate always in the same 'proportion' or 'ratio' 8 to 5, and to explain in terms of multiplying equivalent values by the same number, e.g. so, multiplying by 10, $16 \text{ km} = 10 \text{ miles}$, 8 km multiplying by 5, $40 \text{ km} = 25 \text{ miles}$. Continue that the relationship shown by the graph is

Step 8

Ask children to demonstrate using the graph conversion (e.g. $22.5 \text{ mph} = 36 \text{ km/h}$). Agree that $36 \text{ km/h} = 22.5 \text{ mph}$.

Step 9

Ask children whether this helps them to judge humans can run. Listen for children who can 22.5 mph (or 36 km/h) with speeds they have e.g. a car or bus in a built-up area might be 30 mph, and can think about a human mile pace for 10 seconds. Some children may use of 'top' speeds for other animals, e.g. a cheetah about 65 mph.



Focus activities

Activity 1: Introducing the mean

Have ready: picture of edible bean pods (e.g. green beans), number rods

Step 1

Show children a picture of some edible bean pods, e.g. green beans. Set the scene: Kai and Jodie are both growing beans, and they want to know whose beans are growing more. They both measure the length of the first six beans they harvest and record two sets of data, see 2.2.3.

Step 2

Ask children how they could decide whose beans are longer. Encourage them to explore different ideas and to look carefully at the data. Allow plenty of time for discussion. Suggestions might include identifying who has the longest bean overall (Kai, with 13 cm) or who has more long beans (e.g. Jodie has more beans which are 10 cm or more).

Agree children could find and compare the total length of the beans from each plot. Establish that for Kai this is 54 cm and for Jodie it is 57 cm, so Jodie's are longer overall.

Step 3

Set the scene again: Amman is also growing beans, but has only harvested five so far. Show children their lengths (in centimetres), see 2.2.3. Establish that the combined length of Amman's beans is 52 cm, but he has only harvested five of his. Ask children how they could tell whether or not Amman's beans are generally growing longer than Jodie's or Kai's?

Step 4

Some children may suggest discarding one measurement each for Kai and Jodie. Guide children to appreciate that this means 'losing' some of the data, and it would also be difficult to decide which measurements to discard (e.g. longest, shortest).

Some children may have mentioned finding an 'average' length for each group of beans. Encourage children to talk about where they have seen or heard the word 'average' before. Suggestions might include news reports, sports statistics, descriptions of people (e.g. on being of 'average height') or 'average contents' values on packaging.

Talk about what they understand by this term. Guide them to appreciate that an average is a 'typical' or 'central' value. Explain that it is a single value, which can be used to summarize and represent a set of data with a spread of values.

Kai	7 cm	9 cm	11 cm	13 cm	8 cm	6 cm
Jodie	8 cm	10 cm	11 cm	12 cm	12 cm	4 cm
Amman	8 cm	12 cm	12 cm	11 cm	9 cm	

Step 5

Work with children to find an average for the length of Kai's beans. Model the beans with rods, see 2.2.3. Explain that one way of 'averaging' the data is to 'even out' the values until they are all the same. Prompt children to do this by moving and swapping rods until all the 'beans' are the same length, e.g. 9 cm . Emphasize that the combined length stays the same, 54 cm. Agree that, because they can make the total with six 9-rods, the average is 9 cm.

Tell children that the mathematical name for this kind of average is the 'mean', we can say that the 'mean length' of Kai's beans is 9 cm. Explain that when we talk about an 'average' in everyday language we are talking about the mean.

Encourage children to talk about whether they think 9 cm is a good representative length. Listen for children comparing the actual lengths and noticing that, e.g. in this case the mean lies approximately halfway between the shortest and longest.

Step 6

Ask whether there is a quicker way to work out this mean. Look and listen for children who make the connection with having six 9-rods and suggest calculating $54 \div 6$. Agree that the total of the six different lengths (54 cm) is the same as six lots of the mean length (9 cm); children may also make links to the sharing structure of dividing – that is, the mean can be found by 'sharing' the total equally between the six beans. Guide children to generalize that the mean is given by the sum of the values divided by the number of values.

Using and applying is supported through use of real-life contexts.

Number, Pattern and Calculating 6

Explorer Progress Book 6b

Sample pages

**FOR
ASSESSMENT**

Pattern and Algebra 4: Using symbols and letters for variables and unknowns

Date ____/____/____

Function Machines

Leo made a function machine that gave the following input and output:

5 → [?] → 20

What are the different functions that might have been in the machine?

What if it was a two-step function? What could the function be?

What if Leo's machine also did:

6 → [?]
7 → [?]

What do you think the function was? Was it a one-step function?

Teacher notes

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Explorer Progress Books are an invaluable assessment resource, providing a record of achievement and the opportunity to see children's thinking, monitor their progress and assess their understanding.

Open activities give you the opportunity to see how well children can use and apply their maths learning in new contexts.

Each activity has space for you to offer support and encouragement to children.

Pattern and Algebra 4: Using symbols and letters for variables and unknowns

Date ____/____/____

Mini-Marathon

Freya is training for a mini-marathon. She wants to calculate how many calories to eat to replace all the energy she will use as she runs. She knows that someone her age uses 10 calories per hour for every kilogram of their weight, running at a steady pace.

Freya weighs 36 kg and she runs for half an hour every day after school. How many calories will she use in a week?

Freya's friends would like to do the run too, and want to know how to make this calculation for each of their weights. How could Freya write her calculation for them, if A = calories burned per hour and B = weight in kg?

Teacher notes

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Children have the freedom to record their answers in their own way, allowing you to see their thinking.

Number, Pattern and Calculating 6

Explore More Copymasters

Sample pages

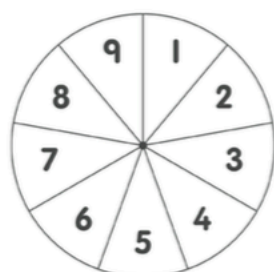
FOR HOME

Activities for home offer further opportunities for children to explore maths in an engaging way.

Short, simple instructions guide parents through the activity.

Name _____ Date ____/____/____

Secret Function Machine



Notes:

input



$\times 5$	$- 3$	$\times 5$	$+ 6$	
squared	$- 5$	$\times 4$		

Number, Pattern and Calculating 6
Pattern and Algebra 4, Generalizing and writing general rules

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Number, Pattern and Calculating 6

Pattern and Algebra 4, Generalizing and writing general rules

Secret Function Machine

How this will help your child

- This activity will help your child to look for relationships between numbers.
- It will also help them to express these relationships in words and letters (algebraically).
- It will also help them to find the 'missing rule' using inputs and outputs of function machines.

Words and phrases to use

relationship, general rule, function, function machine, input, output

You will need

- Scissors
- 2 pencils
- A paper clip
- Card Numicon Shapes 1–10 (optional)

During the activity, look at what your child can do

- Identify a missing function to explain how two numbers are related (e.g. the missing function between 10 and 11 might be $\times 11$).
- Write an equation to show how two numbers are related.

What to do

- Use a paper clip and pencil to make the spinner from the Secret Function Machine sheet. 1
- Cut out the function cards from the sheet. Place them face down in a pile.
- Ask your child to spin the spinner. The number spun is the 'input', e.g. 3.
- Pick up a function card from the pile, without showing your child. Write the input on the left-hand side of the function machine. 2
- Tell your child the 'output'. E.g. if you pick up $\times 5, - 3$, multiply their number by 5 and subtract 3; so if a 3 is spun, the output is 12 ($3 \times 5 = 15; 15 - 3 = 12$). Record the output on the right-hand side of the function machine. 3
- Explain to your child that they have to work out the function of the machine (what is written on the card) and that this could involve two instructions. They could use Numicon Shapes to help them.
- Ask your child to spin the spinner again. Say the output using the same function. Record the input and output on the function machine.
- Keep going until your child can work out what the secret function is.
- Encourage your child to describe how the input and output are related using x and y . E.g. y is five times x with 3 then subtracted; $y = 5x - 3$.
- Repeat with different function cards.

Next steps...

- Make up your own functions using the blank function cards and complete the activity again.
- Ask your child to find the missing function when converting pounds to pence ($\times 100$), kilograms to grams, or kilometres to metres ($\times 1000$).



input

output



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Practical links to real life help children think about how maths can be used and applied.

Simple illustrations help to explain the purpose of activities.

Your next steps . . .

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