numicon®

Online
Numicon 3 Sample

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Strand and Activity Group Number		Activity Group Title
Getting Started		Getting started with Number, Pattern and Calculating 3
Calculating	1	Developing fluency with adding and subtracting facts to 1
Numbers and the Number System	1	Finding how many by grouping in 10s and 100s
Calculating	2	Developing fluency with adding and subtracting facts to 2
Numbers and the Number System	2	Exploring hundreds, tens and units with base-ten apparatus
		NPC Milestone 1
Pattern and Algebra	1	Exploring the inverse relationship between adding and subtracting
Numbers and the Number System	3	Keeping count and writing numbers down
Calculating	3	Mental methods for adding single-digit numbers
Calculating	4	Mental methods for subtracting single-digit numbers
Geometry	1	Investigating the parts and properties of polygons and polyhedra
Pattern and Algebra	2	Exploring steps of constant size through sequences of multiples
Calculating	5	Revising multiplying as repeated adding
		NPC Milestone 2
Calculating	6	Exploring multiplying through arrays
Calculating	7	Introducing dividing as 'How many … in …?'
Geometry	2	Identifying and comparing angles by size
Numbers and the Number System	4	Partitioning 2- and 3-digit numbers with and without money
Geometry	3	Sorting and classifying 2D and 3D shapes
		GMS Milestone 1
Numbers and the Number System	5	Ordering and structuring numbers to 1000
Calculating	8	Adding and subtracting multiples of 10 and 100
		NPC Milestone 3

SAMPLE

Strand and Activity Group Number		Activity Group Title
Calculating	9	Patterns of similar adding and subtracting calculations
Pattern and Algebra	3	Reading and creating scales with different intervals
Numbers and the Number System	6	Finding half way, rounding to the nearest 10 or 100
Calculating	10	Learning multiplying facts and looking for patterns
Calculating	11	Introducing the sharing structure of dividing
		NPC Milestone 4
Pattern and Algebra	4	Extending sequences and finding difference
Calculating	12	Partitioning strategies for adding and subtracting
Measurement	1	Telling the time to the minute on the 12-hour clock
Measurement	2	Exploring units of time
		GMS Milestone 2
Calculating	13	Using apparatus and imagery to introduce the written column method for adding
Calculating	14	Using apparatus and imagery to support subtracting and introducing the written column method
Calculating	15	Exploring ratio and scaling problems and introducing the short written methods of multiplying and dividing
		NPC Milestone 5
Measurement	3	Measuring accurately and calculating with metres, centimetres and millimetres
Measurement	4	Calculating with pounds and pence, and handling money
		GMS Milestone 3
Calculating	16	Making connections between dividing into equal parts and calculating with fractions
Measurement	5	Measuring and calculating with grams and kilograms
Measurement	6	Measuring and calculating with litres and millilitres
Numbers and the Number System	7	Understanding fractions of a whole and fractions as numbers
Numbers and the Number System	8	Using fraction notation to describe parts of a discrete set
Pattern and Algebra	5	Finding all possibilities and investigating a general statement
		NPC Milestone 6
Geometry	4	Using grids and grid references
		GMS Milestone 4

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Calculating 6: Exploring multiplying through arrays

Key mathematical ideas Multiplying, Mathematical thinking and reasoning

Educational context

This activity group develops children's understanding of the image of an array building on their earlier work in Number, Pattern and Calculating 2, Calculating 9. An array is a powerful way to model multiplying and understand its commutative property. It is recommended that teachers start a class collection of objects that show arrays and invite children to add to it by bringing in objects they find at home. In the first two activities, children build arrays to find solutions to real problems, and then relate them to multiplying sentences. In the later part of this group, children meet the associative property of multiplying in a correspondence situation which involves combining different items of clothes to make winter outfits.

Learning opportunities

- To realize that multiplying can be represented by building arrays.
- To understand the commutative and associative properties of multiplying and to make the connection that adding also has these properties.
- To realize that some number arrays can only have one row (prime numbers).
- To notice that in real-life situations the order of numbers in multiplying sentences sometimes makes a difference.
- To realize that knowing multiplication tables can help us to work out other multiplying facts.

Terms for children to use

array, product, multiplying sentence, commutative property, balances, equal, equivalent, equation, multiplication table, compare

Assessment opportunities

Look and listen for children who:

- Use the terms for children to use effectively in discussion.
- Are developing fluent recall of some multiplying facts.
- Work in an organized way to build arrays.
- Realize that there are some numbers for which they can only make rows.
- Can represent an array with two multiplying sentences.
- Are able to derive a commutative fact when given a multiplying sentence.
- Know that changing the order of numbers in multiplying sentences does not change the product.

NPC Milestone 3

- Recall most multiplying facts of 2, 3, 4, 5, 8 and 10 multiplying tables (NPC 3:3f)
- Know and use the commutative property of multiplying (NPC 3:3g)
- Represent multiplying problems with structured apparatus and arrays (NPC 3:3h)
- Know that changing the order of numbers in multiplying problems does not change the product (NPC 3:3i)

Explorer Progress Book 3b, pp. 4–5

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 20: Sowing Seeds

After completing work on Activity 1, give children Explore More Copymaster 20: Sowing Seeds to take home.

Pupil Book 3, pp. 46–49

These pages in the Pupil Book provide further practice and challenging questions. You can use them to follow up the activities and deepen the learning.

Focus activities

1. Making arrays and writing multiplying sentences
2. Introducing the commutative property of multiplying with arrays
3. Using the commutative property of multiplying when solving problems
4. Finding equivalent multiplying facts
5. Exploring the associative property

Key Mathematical Ideas provide a summary of the important concepts covered this week

Learning Opportunities are linked with the Assessment opportunities, detailing the range of Focus Activities for this week

Assessment is supported by Explorer Progress activities at the end of the week or later. These are recorded along with the Milestones to provide a record of learning that is stored in the assessment Tracker

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I: Making arrays and writing multiplying sentences

Quit activity

Intro | Links | 1 | 2 | 3 | 4 | +

Learning opportunities:

- See all learning opportunities

Terms for children to use:

array, product, multiplying sentence, commutative property, balances, equal, equivalent, equation, multiplication table, compare

Have ready:

- Numicon Coloured Pegs or Numicon Coloured Counters
- Numicon Baseboard Laminates
- Explore More Copymaster 20: Sowing Seeds

I: Making arrays and writing multiplying sentences

Quit activity

Intro | Links | 1 | 2 | 3 | 4 | +

Links:

Full activity group overview
Starter image
Whole-class practice and discussion
Photocopy masters
Implementation guide
Pupil Book 3 opening questions p. 46
Pupil Book 3 Answer Book
IWB Software
MyMaths

Next steps:

Explorer Progress Book 3b, pp. 4–5
Explore More Copymaster 20: Sowing Seeds
Numicon 3 Milestone Assessment cards (NPC 3:3f, NPC 3:3g, NPC 3:3h, NPC 3:3i)
Numicon 3 Milestone Tracking chart

Implementation Guide

Exploring multiplying through arrays

There is a third view of multiplying that will help children to see its commutative property and, later in their schooling, to connect multiplying with the measurement of area: to understand how multiplying by fractions makes answers smaller, and to understand how multiplying of large numbers can be broken down into smaller calculations (the distributive law). This view involves seeing multiplying as an **array**, i.e. seeing 3 × 4 as:

• • • •
• • • •
• • • •

Using Numicon involves showing multiplying as repeated adding using number rods laid end to end, and then rearranging those lines of rods alongside each other to form arrays, thus uniting the repeated adding and array structures. As all Numicon Shape patterns are themselves simple arrays of holes, children following this approach will have become familiar with the idea of arrays informally from their earliest experiences with the Numicon materials.

When reading and recording multiplying sentences (e.g. 4 × 7 = 28) there are many choices, and often a surprising amount of controversy about whether '4 × 7' really means 'four sevens' or 'seven fours'. Of course, the array structure quickly demonstrates that their product is the same, but some teachers feel that only one option can be mathematically correct. The truth is that we have choices and that there are good reasons for choosing either way.

Practice and discussion: Whole-class

- Discuss with children how and when the mathematics they have been learning could help them in solving problems.
- Bring in some objects that show arrays, e.g. an egg box, a muffin baking tray. Discuss the arrays and how these might be written as multiplying sentences.
- Invite children to find objects that show arrays and make a class collection of pictures, packages or products that are arranged in arrays, e.g. packs of cakes, paint boxes. Display these with multiplying sentences.
- Give children a variety of multiplying sentences and ask them to make the arrays.
- Show children an array and ask them to write two multiplying facts.
- Ask children to draw arrays to represent a range of problems, e.g. 'I went to the shops and I bought 4 bags of 4 apples' or '3 groups of 4 children performed a play'.
- Explore the idea of the commutative property in real-life situations. Talk about how the total value is the same but in the real-life situation the appearance is different. For example:
    - A new house is going to have 6 windows and each has 4 panes of glass. How would this be written as a multiplying sentence, 6 × 4 panes of glass = 24 panes of glass or 4 × 6 panes of glass = 24 panes of glass? Look and listen for children who recognize that '4' applies to panes of glass in the first example and to the number of windows in the second example.
    - The aeroplane has 30 seats in total arranged as 10 rows of 3 seats. How would this be written as a multiplying sentence, 10 × 3 seats = 30 seats or 3 × 10 seats = 30 seats? Look and listen for children who recognize that '3' applies to seats in the first example and to the number of rows in the second example.
- Ask children which fact is easier to work out or remember, 4 × 10 = 40 or 10 × 4 = 40? Discuss why it is useful to know that these are equivalent when learning our tables. Give children a copy of the **Times Table Square (photocopy master 49)**. Point to different multiplying facts and ask children to highlight the corresponding commutative facts.

Focus activities

1. Making arrays and writing multiplying sentences
2. Introducing the commutative property of multiplying with arrays
3. Using the commutative property of multiplying when solving problems
4. Finding equivalent multiplying facts
5. Exploring the associative property

I: Making arrays and writing multiplying sentences

Quit activity

Intro | Links | 1 | 2 | 3 | 4 | +

Step 1

Set the scene by explaining to children that their parents are invited to a special assembly and the chairs for the audience need to be organized into rows.

I: Making arrays and writing multiplying sentences

Quit activity

Intro | Links | 1 | 2 | 3 | 4 | +

Step 2

Start children thinking about the task, suggesting that they experiment with ways of arranging 10 chairs, by giving them 10 Counters to arrange in rows of different lengths, e.g. 1 row of 10 chairs or 2 rows of 5 chairs, (see image).

Discuss how they can check there are 10 in the single row – children are likely to suggest counting. Compare this with the 2 rows of 5 chairs and ask children how they can check there are 10. Look and listen for children who say that they can see without counting that there are 10 chairs because they recognize the Numicon 10-pattern.

I: Making arrays and writing multiplying sentences

Quit activity

Intro | Links | 1 | 2 | 3 | 4 | +

Step 3

Discuss with children how these arrangements of Counters could be represented as multiplying sentences. Agree that we could write 1 × 10 = 10, which represents 1 times 10 chairs in a row, or 2 × 5 = 10, which represents 2 times 5 chairs in a row. Tell children that the arrangement of objects into rows of the same length makes an image called an array.

I: Making arrays and writing multiplying sentences

Quit activity

Intro | Links | 1 | 2 | 3 | 4 | +

Step 4

Explore making other arrays to represent rows of chairs, for audiences of 12, 15, 16, 18 and 20. Challenge children to write multiplying sentences for the different arrays they construct for each number. Look and listen for children who can use the language of times as well as referring to the number of rows and chairs.

After completing work on Activity 1, give children Explore More Copymaster 20: Sowing Seeds to take home. This activity will give children the opportunity to practise their maths learning around this activity group outside of the classroom environment.

Sowing Seeds

How this will help your child

- It will allow your child to practise making arrays to show multiplication facts.
- It will help them to recall some multiplying facts.

Note: An array is a mathematical term that is used to describe a pattern of objects in rows of the same length.

Words and phrases to use

array, multiply, times, rows, equals

You will need

- 35 counters (or coins, buttons or pasta shapes to use as counters)
- Scissors

During the activity, look at what your child can do

- Build arrays accurately.
- Recall some multiplying facts.

What to do

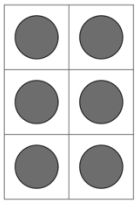
- Give your child the Sowing Seeds sheet.
- Help them to cut out the 5 'seeds' cards and the 5 'rows of' cards. Shuffle the cards and put them face down in 2 separate piles.
- Ask your child to pick a 'rows of' card while you pick a 'seeds' card. Arrange these into a multiplying sentence, e.g. 3 rows of 2 seeds. 1
- Now ask your child to make this array on the grid using counters to act as seeds. 2
- Ask them to say the multiplying sentences out loud to describe the array, e.g. '3 rows of 2 seeds equals 6 seeds', '3 times 2 equals 6'.
- Pick another 'rows of' card and another 'seeds' card, then make and say this array.
- Continue until all the cards have been used.

Next steps...

- Play the game again, asking your child to predict the number of seeds needed before making the array.
- Challenge your child to look for arrays at home, e.g. egg boxes, window panes and telephone key pads.

3 rows of	2 seeds

1



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A clear guide and suggestions on how to extend the activity

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

Name ..... Date ...../...../.....

20

Sowing Seeds

1 row of	2 seeds
2 rows of	3 seeds
3 rows of	4 seeds
4 rows of	5 seeds
5 rows of	6 seeds

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Practical real-life contexts help children think about how maths can be used and applied

I: Making arrays and writing multiplying sentences

Quit activity

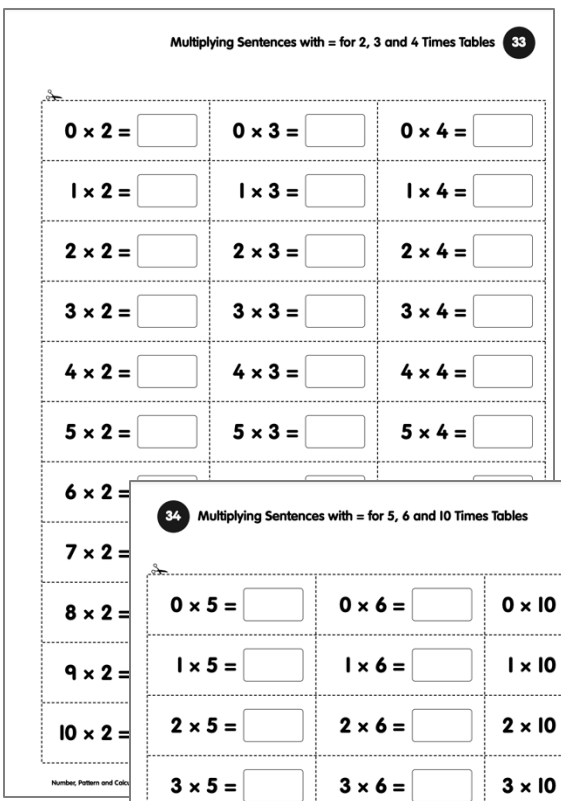
Intro | Links | 1 | 2 | 3 | 4 | +

Paired work

Have ready: Multiplying Sentences with = for 2, 3 and 4 Times Tables and 5, 6 and 10 Times Tables (photocopy masters 33 and 34) cut into individual cards, Numicon Coloured Counters or Numicon Coloured Pegs

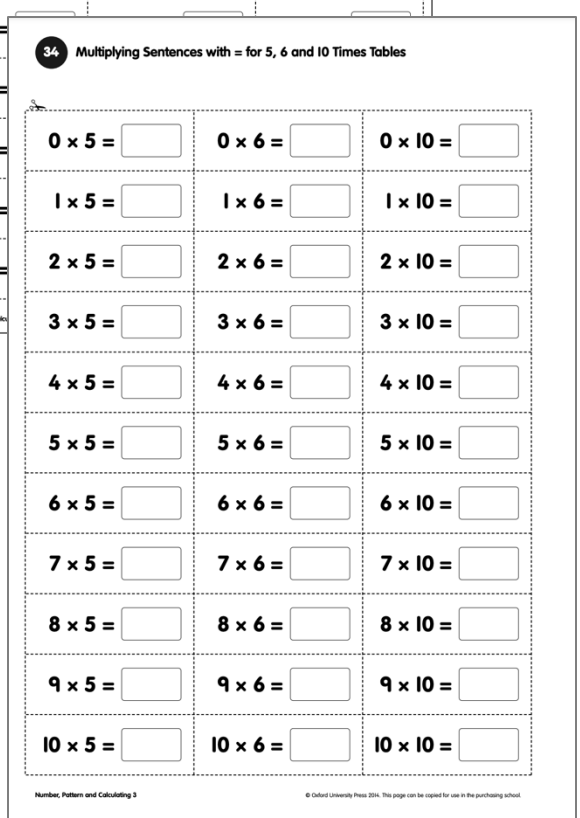
The first child selects a multiplication sentence card (photocopy masters 33 and 34), e.g. '2 × 6 ='. The second child arranges the Counters into two rows of 6 and says the product. Both children draw the array and write the commutative facts.

Numicon Pupil Book 3 pp. 46–49
Numicon Pupil Book 3 Answer Book p. 32



Multiplying Sentences with = for 2, 3 and 4 Times Tables 33

0 × 2 =	0 × 3 =	0 × 4 =
1 × 2 =	1 × 3 =	1 × 4 =
2 × 2 =	2 × 3 =	2 × 4 =
3 × 2 =	3 × 3 =	3 × 4 =
4 × 2 =	4 × 3 =	4 × 4 =
5 × 2 =	5 × 3 =	5 × 4 =
6 × 2 =		
7 × 2 =		
8 × 2 =		
9 × 2 =		
10 × 2 =		



34 **Multiplying Sentences with = for 5, 6 and 10 Times Tables**

0 × 5 =	0 × 6 =	0 × 10 =
1 × 5 =	1 × 6 =	1 × 10 =
2 × 5 =	2 × 6 =	2 × 10 =
3 × 5 =	3 × 6 =	3 × 10 =
4 × 5 =	4 × 6 =	4 × 10 =
5 × 5 =	5 × 6 =	5 × 10 =
6 × 5 =	6 × 6 =	6 × 10 =
7 × 5 =	7 × 6 =	7 × 10 =
8 × 5 =	8 × 6 =	8 × 10 =
9 × 5 =	9 × 6 =	9 × 10 =
10 × 5 =	10 × 6 =	10 × 10 =

Number, Pattern and Calculating 3

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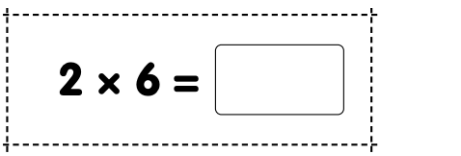
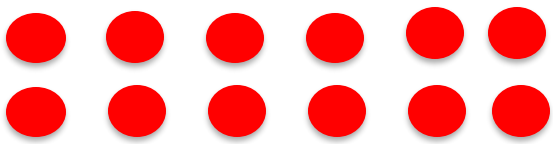
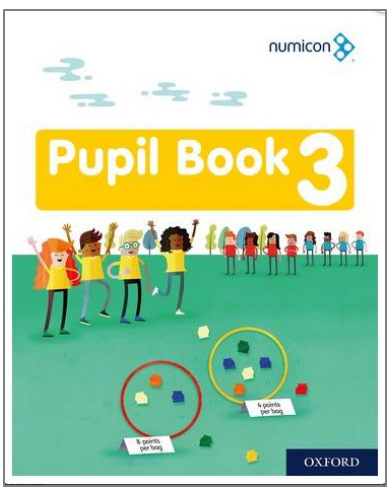


2 × 6 =





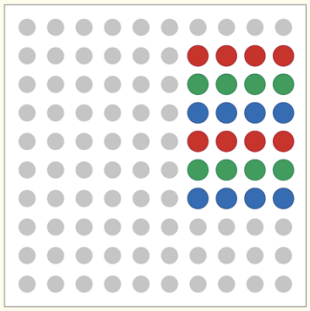
Step 1

Remind children about the different arrays made in Activity 1. Ask them to explore how the chairs could be arranged if an audience of 24 were expected and to show this as an array, encouraging them to look for more than one answer. Allow children to work in pairs, giving them time to explore this problem and record their work by drawing their arrays and writing matching multiplying sentences.

Step 2

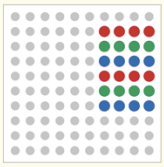
Look and listen for children who have found a variety of ways to arrange 24 Counters into rows (see image) and ask them to explain how their arrays can be recorded as multiplying sentences, e.g. $6 \times 4 = 24$.

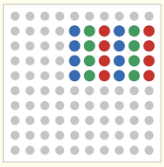
Children may also suggest 12×2, 8×3 and 24×1. Choose one of their suggestions to work with.



Step 3

As children work on the problem, listen for those who see the similarities between arrays like 6×4 and 4×6, (see first image and second image). Agree that 6 rows of 4 chairs and 4 rows of 6 chairs make the same array in rotation. Talk with children until they realize that each array can be rotated 90° and recorded as another multiplying sentence.





Step 4

Give children ample opportunity to explain the similarities and differences between the rotated arrays and the multiplying sentences, e.g. 6×4 and 4×6. Look and listen for children who notice that while the arrays look different and have a different numbers of chairs in their rows they both use the same number of chairs in total. Introduce the term 'commutative property' and agree that changing the order of the numbers to be multiplied does not change the total in the array.

Ask children if they know of any other types of number sentences where changing the order of the numbers in the calculation does not change the answer. Look and listen for children who make connections with adding and who also realize that subtracting does not have a commutative property.

Step 5

Repeat the above by investigating how 36 or 48 chairs could be arranged in the hall.

Step 6

Explore the idea of the commutative property further by discussing how we interpret multiplying sentences in real-life situations. Talk about how the total value is the same but in the real-life situations the appearance is different.

For example, 'In our school hall there are 4 benches, each holds 6 children, so 24 children can sit on the benches in total. How would this be written as a multiplying sentence, 4×6 children = 24 children or 6×4 children = 24 children?' Look and listen for children who recognize that '6' applies to children in the first multiplying sentence and to the number of benches in the second example.

Paired work

Have ready: Numeral Cards 0–20 (photocopy master 36) cut into individual cards, Numicon Coloured Counters or Numicon Coloured Pegs

Children turn a numeral card (photocopy master 36) and investigate which numbers can be arranged into arrays with Counters. Look and listen for children who are working systematically and discuss whether there are any numbers that can only be arranged in a line.

Paired work

Have ready: digital camera

Give children a digital camera and ask them to find and photograph examples of arrays around the school.

Paired work

Have ready: number rods, Multiplying Sentences with = for 2, 3 and 4 Times Tables and 5, 6 and 10 Times Tables (photocopy masters 33 and 34) cut into individual cards

The first child selects a multiplying sentence (photocopy masters 33 and 34), e.g. '$4 \times 10 =$'. The second child shows the multiplication as an array built with rods, e.g. four 10-rods side by side, and says the product. The first child now builds an array to show the commutative multiplication, e.g. by placing ten 4-rods side by side on top of the four 10-rods, (see image).

Both children record the commutative multiplying sentences, e.g. $4 \times 10 = 40$ and $10 \times 4 = 40$.

Paired work

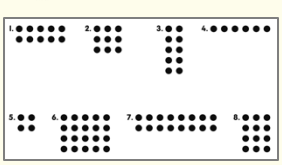
Have ready: Multiplying Sentences with = for 2, 3 and 4 Times Tables and 5, 6 and 10 Times Tables (photocopy masters 33 and 34) cut into individual cards, Numicon Shapes and Numicon 10s Number Line or number rods and Numicon 1–100 cm Number Rod Track

Player 1 takes a multiplying card (photocopy masters 33 and 34), collects the corresponding Shapes and puts them along the 10s Number Line. Player 2 builds the commutative multiplying sentence alongside. The players record both multiplying sentences.

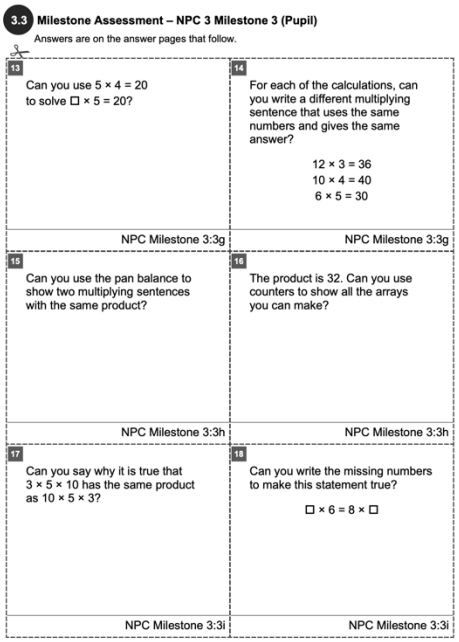
Individual work

Have ready: Multiplying Arrays (photocopy master 30), cm-squared paper

Children copy the arrays (photocopy master 30) on squared paper (to help them organize their work) and write two multiplying sentences for each array.



Milestone
ASSESSMENT CARDS



3.3 Milestone Assessment – NPC 3 Milestone 3 (Pupil)

Answers are on the answer pages that follow.

13 Can you use 5 × 4 = 20 to solve □ × 5 = 20?

NPC Milestone 3:3g

14 For each of the calculations, can you write a different multiplying sentence that uses the same numbers and gives the same answer?

12 × 3 = 36
10 × 4 = 40
6 × 5 = 30

NPC Milestone 3:3g

15 Can you use the pan balance to show two multiplying sentences with the same product?

NPC Milestone 3:3h

16 The product is 32. Can you use counters to show all the arrays you can make?

NPC Milestone 3:3h

17 Can you say why it is true that 3 × 5 × 10 has the same product as 10 × 5 × 3?

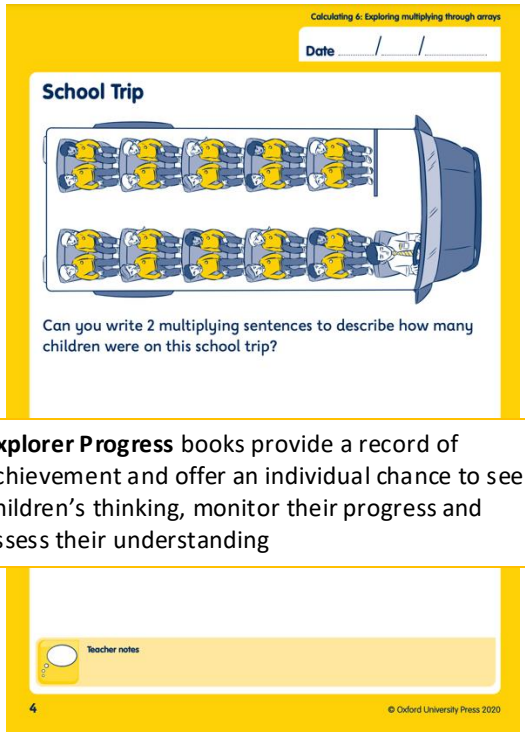
NPC Milestone 3:3i

18 Can you write the missing numbers to make this statement true?

□ × 6 = 8 × □

NPC Milestone 3:3i

Explorer Progress
– weekly assessment tool



Calculating 6: Exploring multiplying through arrays

Date ____/____/____

School Trip

Can you write 2 multiplying sentences to describe how many children were on this school trip?

Teacher notes

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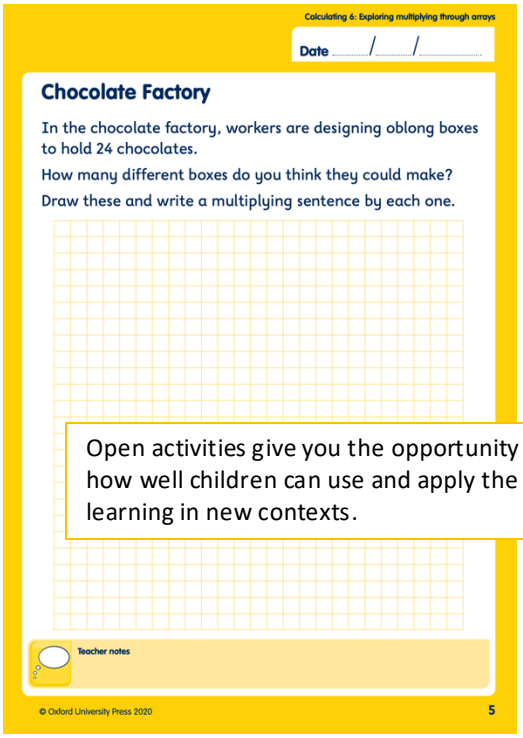

Calculating 6: Exploring multiplying through arrays

Date ____/____/____

Chocolate Factory

In the chocolate factory, workers are designing oblong boxes to hold 24 chocolates.

How many different boxes do you think they could make?

Draw these and write a multiplying sentence by each one.

Teacher notes

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Explorer Progress books provide a record of achievement and offer an individual chance 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 the maths learning in new contexts.

Assessment Tracker
– weekly assessment tool

Milestone	Code	NPC / GMS	Numicon strand	AG	NC strand	John Smith	
Number, Pattern & Calculating 3 Milestone 3						Started	Not started
By this point, children should be able to:						6 out of 16	0 out of 16
• Understand relative values of numbers to 1000, including recognizing the idea of a range of numbers and use of symbols '–', '<' and ' >' for labelling a range of numbers	NPC3:3a	NPC	NNS	NNS5	Number & place value		
• Partition numbers up to 1000 into hundreds, tens and units and to derive other ways of partitioning them	NPC3:3b	NPC	NNS	NNS5	Number & place value		
• Relate pounds and pence notation to hundreds, tens and units	NPC3:3c	NPC	NNS	NNS4	Number & place value		
• Use knowledge of partitioning to solve money problems	NPC3:3d	NPC	NNS	NNS4	Number & place value		
• Relate knowledge of patterns on a 100 square to an array for 1000 and use patterns when finding numbers in different arrays and number squares	NPC3:3e	NPC	NNS	NNS5	Number & place value		
• Recall most multiplying facts of 2, 3, 4, 5, 8 and 10 multiplying tables	NPC3:3f	NPC	C	C6	Multiplication & division		
• Know and use the commutative property of multiplying	NPC3:3g	NPC	C	C6	Multiplication & division		
• Represent multiplying problems with structured apparatus and arrays	NPC3:3h	NPC	C	C6	Multiplication & division		
• Know that changing the order of numbers in multiplying problems does not change the product	NPC3:3i	NPC	C	C6	Multiplication & division		

GREEN – Achieved
ORANGE – on the way
RED – to target
WHITE – not started

Your next steps…

Find out how Numicon can make a difference in your school and discover Numicon's potential, **arrange an appointment, or Professional Development with us:**

Web: www.numicon.co.nz and www.edushop.nz

Email: info@numicon.co.nz

Phone: 0800 678 581