Numicon is a proven approach for teaching and learning maths that builds deep understanding and engagement. Through active investigation with problem-solving at its heart and supported by structured apparatus, children reason and communicate mathematically with confidence.

Your Teaching Resource Handbook contains:
• A coherent teaching progression, supported by easy-to-follow long- and medium-term planning, that helps you to scaffold children’s learning
• Step-by-step activities with specific learning and assessment opportunities
• Helpful illustrations that demonstrate how apparatus can be used to illustrate children’s reasoning
• Contexts that develop children’s ability to think and talk mathematically and apply their understanding to solve ‘non-routine’ problems
• Assessment milestones that clearly signpost where children are and what they need to do next and allow you to monitor children’s progress

This book is designed to be used alongside the Number, Pattern and Calculating 4 Implementation Guide, Explorer Progress Books, Explore More Copymasters and the Planning and Assessment Support.

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Calculating
Developing fluency with multiplying facts to 12 × 12

Educational context
This activity group is about revising all the multiplying structures that were introduced in Number, Pattern and Calculating 3, and continuing to develop children’s fluency in calculating. The children will meet a range of multiplying problems in a variety of contexts, including correspondence problems where \( n \) objects are connected to \( m \) objects. A variety of imagery is used to support children’s understanding, and to support them memorizing times tables facts. Key connections are made to everyday contexts (including measuring) in which multiplying is used. The activities in this group can be adapted with any of the times tables as a focus, according to children’s abilities, in order to help them consolidate and learn multiples to 12 × 12 off by heart, both in sequence and at random.

Learning opportunities
• To interpret an array as a model of multiplying.
• To know that multiplying is what we do instead of adding repeated groups.
• To record sequences of multiples systematically in a table, and read products.
• To find products on multiplying squares.
• To know the effects of multiplying by 0 and by 1.
• To learn and improve fluency with the times tables up to 12 × 12.
• To know that we multiply to find the area of rectangles.
• To recognize that we multiply by numbers greater than 1 to scale up an amount.

Words and terms for use in conversation
multiply, times, lots of, groups of, sets, array, product, multiplying sentences, multiplication tables, times tables, times tables square, commutative, multiplying facts, multiples, dimension, length, width, rectangle, square, area, multiplied by, scaling, scaled up by

Assessment opportunities
Look and listen for children who can:
• Use the words and terms for use in conversation effectively.
• Write multiplying sentences for problems involving repeated amounts.
• Find products of two numbers on multiplying squares.
• Write two multiplying sentences for an array and notice that, e.g. 4 × 6 and 6 × 4 give the same product.
• Recall multiplying facts to 12 × 12.
• Explain the effects of multiplying by 0 and by 1.
• Illustrate a scaling problem with apparatus and a multiplying sentence.

Explorer Progress Book 4a, 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 (p22–23) where they can reflect on the mathematics they have done so far.

Explore More Copymaster 21: Multiply Game
After completing work on Activity 5, give children Explore More Copymaster 21: Multiplying Game (enlarged to A3) to take home.
Calculating

Focus activities

Activity 1: Exploring a multiplying context

Have ready: Numicon Coloured Counters, Numicon 10s Number Line, Numicon Shapes

Step 1
Talk to children about games where players need a certain number of, e.g. cards or counters. Say that, e.g. each player of a board game needs 4 counters. Ask children to show how many counters are needed if they play with two others. Look and listen for children organizing their Counters into groups or arrays, and for those limited to counting in ones.

Step 2
Compare children’s arrangements. Agree an array (see Fig. 1) allows us to see without counting that we have 3 sets of 4 Counters. Look and listen for children counting in groups or using number facts to find three ‘times’ or ‘lots of’ 4. Encourage children to discuss how the array shows there are three sets of 4 Counters, rather than four sets of 3 Counters.

Step 3
Work with children to write a number sentence for the number of Counters. Listen for children using the language ‘times’, ‘sets’, ‘groups’ or ‘lots of’, and linking to 3 people with 4 objects each. Wait for children to suggest repeated adding or multiplying. Agree these are written, e.g. 4 + 4 + 4 = 12 and 3 x 4 = 12, recalling the action and symbol for multiplying (see Fig. 2). Encourage children to see that the multiplying sentence is more succinct.

Step 4
Encourage children to use Shapes on the 10s Number Line to illustrate the problem. Look and listen for children placing a 4-shape (for 4 counters) three ‘times’ (see Fig. 3). Agree that this shows ‘3 times 4’ is equal to 12. Remind children that when multiplying the total is called the ‘product’.

Step 5
Repeat Steps 1–4 for a different number of players.

Step 6
Introduce a different game and number of objects per player, e.g. a hoopla game where each player needs 3 hoops. Ask how many hoops would be needed for 2, 3, 4, … turns. Each time, ask children to illustrate with Counters or Shapes, and to write a multiplying sentence before finding the product.

Activity 2: Writing multiplying sentences

Have ready: Numicon 10–100 cm Number Rod Track, number rods

Step 1
Work with children to create words, pictures or patterns using several same-size rods, e.g. Fig. 4.

Step 2
Ask children to write multiplying sentences for each creation, e.g. (for Fig. 4) 10 x 4 = 40. Support children who need help to find the product by placing the rods used in the Number Rod Track.

Step 3
Repeat for other suggestions, e.g. Fig. 5. Next, allow children to use a mix of rods, e.g. Fig. 6 gives 5 x 10 = 50, 3 x 6 = 18 and 1 x 2 = 2.

Step 7
Show children a list of objects per player for other games, e.g. 4 cards, 3 marbles, 5 dominoes, 6 counters, 2 dice. Ask about the number of items needed for different numbers of players. Look and listen for children working confidently to write multiplying sentences and find products.

Step 8
For one of the contexts, ask children how many objects are needed for zero players. Encourage them to agree no items. Then ask about zero items and 5 players. Agree that, again, zero items are needed. Use Shapes to help children understand the effect of multiplying by zero: ask them to pick up zero Shapes ‘five times’ or to pick up the 5-shape ‘zero times’. Write the multiplying sentences for this: 0 x 5 = 0 and 5 x 0 = 0.
Activity 3: Making a table for multiplying

**Have ready:** Numicon 10s Number Line, Numicon Shapes, Numicon 1–100 cm Number Rod Track, Times Table Square (photocopy master 49), a variety of multi-item packs (e.g. packs of pens), number rods

**Step 1**
Show children a range of everyday items in packs, e.g. stationery. Talk about these and other examples that children suggest. Look at some of the packaging and notice the way the amounts are shown. Identify the language used, noting any that is unfamiliar, e.g. ‘5 per pack’, ‘3 boxes of 12’, ‘4 sets’. Notice that some packaging uses the multiplying symbol.

**Step 2**
Develop the discussion to include how many of a particular item there would be in 0, 1, 2, 3, 4 or 5 packs. Look and listen for children who start to count in multiples or refer to known multiplying facts. Use Shapes and the 10s Number Line or rods and the Number Rod Track to illustrate the product in each case.

**Step 3**
Encourage children to draw a table showing products for 1–10 packs of different item, e.g. **Fig. 7**. Look and listen for children spotting the patterns of multiples and for those who can work quickly using known facts rather than adding a group each time.

**Step 4**
Ask children to use their tables to write some multiplying sentences, e.g. ‘4 sets of cutlery containing a fork, knife and spoon each would be 4 × 3 = 12 pieces of cutlery.’

**Step 5**
Show children a times table square (photocopy master 49). Look and listen for children comparing it to the table they have made.

Explain that this table is useful for looking up products of numbers for any situation. Give an example for children to find, e.g. how many apples there are in 6 bags, if each bag contains 4 apples. Look and listen for children finding both points in the table where a column and row for 6 and 4 meet, and identifying the product as 24. Some children will know that multiplying has a commutative property, and will realize that in both cases, 4 × 6 and 6 × 4, the product is the same. Repeat with further examples, until children can come up with similar examples themselves.

Activity 4: Using arrays to explore the commutative property of multiplying

**Have ready:** Numicon Coloured Counters, number rods, squared paper

**Step 1**
Set the scene: a gardener needs some help with planting his vegetables. He wants to plant 3 rows of 5 carrots. Encourage children to draw or use Counters to show the arrangement of the carrots in rows.

**Step 2**
Share children’s solutions. Agree that arranging the carrots in rows and repeating these rows makes an array. Talk with children about multiplying sentences. Ask which ones match the array they have drawn or made. Look and listen for children noticing that they have drawn 3 rows of 5, or 3 times 5. Some may have drawn or made 5 rows of 3 – this makes for an interesting discussion about the language used.

**Step 3**
Draw the array on the board, then redraw it rotated 90°, e.g. **Fig. 8** to show children that 3 × 5 and 5 × 3 can be represented by the same array, and have the same product.

Explain that this is because multiplying has a commutative property. Encourage children to make connections with adding, which also has a commutative property, e.g. the total of 3 + 8 and 8 + 3 is the same.
Calculating

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Step 4
Ask children to use rods to make arrays for $3 \times 5$ and $5 \times 3$. Lay one array on top of the other and compare them side by side (see Fig. 9) to help children see that although the arrays look different they are equal in size and value.

Step 5
Provide children with more examples about helping the gardener plant his vegetables, for them to draw or make arrays and to write the corresponding number sentences to show that multiplying has a commutative property. Include examples like $7 \times 1$ to encourage children to explain that this array can be described as one row of 7 or seven rows of 1. Help children to generalize that multiplying by 1 is the same as making an array with one row.

Activity 5: Improving fluency with multiplying facts

Have ready: Numicon 12-shape (photocopy master 33 enlarged to A3), Times Table Square (photocopy master 49), 2p, 5p, 10p and £2 coins, 20p and 50p coins, counting sticks, Numicon Software for the Interactive Whiteboard (optional), Explore More Copymaster 21: Multiplying Game (enlarged to A3)

Step 1
Give children a pile of 2p coins. Practise counting the money in twos. Remind children about the word ‘multiples’ and occasions when it’s quicker to count in groups. Ask children to make a group of five 2p coins ($5 \times 2p$). Look and listen for children quickly making the 5-pattern (see Fig. 10). Agree that $5 \times 2p = 10p$.

Repeat with £2 coins (see Fig. 11).

Step 2
Arrange 2p or £2 coins in different Numicon Shape patterns for children to write or say multiplying sentences, giving the total without counting. Then call out numbers 1–12 for them to create Numicon Shape patterns and say the totals as fast as they can.

Step 3
Repeat Steps 1 and 2 with 5p and 10p coins, until children can make any Numicon Shape pattern and say the total without counting. Some children might like to work with 20p or 50p coins in the same way.

Talk with children about learning multiplying facts. Ask if using the coins has helped.

Step 5
Show a similar strategy for learning other multiplying facts: work with children to write the multiples of 3 inside each hole of an enlarged Numicon 12-shape (photocopy master 33; see Fig. 12). Alternatively, display Numicon Shapes for 12 on the Numicon Software for the Interactive Whiteboard and fill in the multiples.

Step 6
Encourage children to notice which multiples of 3 are odd and which even, and to compare the values of the second and fourth, third and sixth, and fifth and tenth multiples. Look and listen for children who notice doubles and can explain why this is helpful for learning multiplying facts. Explore ways children can work out the ninth multiple when they know the tenth.

Step 7
Give children a Numicon 12-shape sheet to write the multiples of 3 on as fast as they can. Play games to find the third, fifth, seventh, … multiples. Look and listen for children giving multiples quickly, without counting from the beginning.

Step 8
Repeat Steps 5–7 for other multiples, up to $12 \times 12$.

This activity can be repeated with other resources, such as counting sticks or times table squares (photocopy master 49), to help children remember multiples both in sequence and at random. Write multiplying facts in a times table format and chant, sing or rap them frequently.

After completing work on this activity, give children the opportunity to take home and complete Explore More Copymaster 21: Multiplying Game (enlarged to A3). This will help children practise multiplying facts up to $12 \times 12$. 

![Fig. 9](image_url)

![Fig. 10](image_url)

![Fig. 11](image_url)

![Fig. 12](image_url)
Activity 6: Making connections between multiplying and finding the area of rectangles

**Have ready:** number rods, cm-squared paper, plain paper, rulers

**Step 1**
Work with children to make an array with rods, then draw around it on cm-squared paper to show a rectangle, e.g. Fig. 13.
Discuss the size of the rectangle. Look and listen for those who make connections between its size and the rods used, e.g. an array made from three 9-rods makes a rectangle which is 3 squares wide and 9 squares long. Repeat with different arrays.

**Step 2**
Record the dimensions along the length and width of one of the rectangles. Ask children to use this information to work out how many centimetre squares there are inside the rectangle. Look and listen for children who count squares or rows and those who use a multiplying method.
Compare children’s methods. Agree that the multiplying method is the most efficient. Write a multiplying sentence for the rectangle, e.g. $3 \times 9 = 27$.
Repeat for the other rectangles.

**Step 3**
Talk with children about the word ‘area.’ Ask if they have ever heard it used. Encourage children to offer examples such as ‘play area’, ‘restricted area’, ‘local area’ or ‘art area’. Help them make connections with the idea of a space within a region. Tell them that they have been working out the areas of their rectangles and explain that we can write the area or number of centimetre squares using the notion cm$^2$.

**Step 4**
Work with children to measure and draw more rectangles, this time on plain paper using a ruler to measure in centimetres. Label each rectangle with a multiplying calculation that can be used to find the area. Encourage children to draw their own rectangles with dimensions up to 12 cm × 12 cm.

Activity 7: Using scaling in a recipe problem

**Have ready:** Numicon Shapes, number rods, lists of ingredients for simple recipes

**Step 1**
Show children a list of ingredients for a simple recipe, e.g. Fig. 14.

**Step 2**
Talk with children about the list of ingredients. Explain it would make one smoothie. Ask children how much of each ingredient they would need if they wanted to make two smoothies. Look and listen for children who suggest doubling the amount of each ingredient on the list.

**Step 3**
Next, ask how much of each ingredient they would need to make three smoothies. Listen for children talking about, e.g. the number of strawberries they would need for three smoothies. Wait for children to suggest that 4 strawberries are needed ‘for every’ smoothie, and we need ‘3 times’ as many for three smoothies. Encourage children to explain that we are ‘scaling up’ the recipe ‘by 3’, which will make ‘3 times more’.

**Step 4**
Work with children to write and read multiplying sentences showing the quantities of ingredients needed for three smoothies. Look and listen for those who can say that, e.g. 4 strawberries multiplied ‘by 3’ means the recipe makes ‘3 times more’, and who can write this as $4 \times 3 = 12$.
Continue to explore scaling up the ingredients to make three smoothies using the phrases ‘3 times more’ and ‘multiplied by 3’.
Ensure that children are secure with the idea of scaling up, and that they can write multiplying sentences (such as $4 \times 3$) in response to all the different terms and interpretations used to describe the scaling problem.

**Step 5**
Repeat for five or more smoothies, until children are confident with the idea that the quantities need to be multiplied by however many smoothies we want to make.

**Step 6**
Repeat with other recipes.

**Berry Fruit Smoothie**
- 4 strawberries
- 5 raspberries
- 8 blueberries
- 3 blackberries
- 1 small glass of milk
- 2 teaspoons of yoghurt
- 6 ice cubes
Calculating

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Activity 8: Using a ‘correspondence’ structure to work out how many partners

Step 1
Set the scene by telling children that there are 6 boys and 5 girls learning to dance at the after-school club and for practice they have to dance with as many different partners as possible. Ask children to talk about how many different boy/girl partners they can make altogether.

Step 2
Discuss this problem with children and ask them whether they could work systematically to find all possibilities. Look and listen for children who organize their approach using drawings or tables.

Step 3
Talk with children about their suggestions and agree that constructing a table is a systematic way to find all the possibilities. Work with children to draw a table to do this (see Fig. 15).

Step 4
Look and listen for children who can see a connection between the number of columns and rows in the table and the number of boys and girls at the club. Help children to also notice that the table is a 6 by 5 array, showing there would be 30 combinations of dance partners because $6 \times 5 = 30$.

Step 5
Encourage children to suggest what would happen if there had been 4 boys and 5 girls or 4 boys and 3 girls. Look and listen for children who can talk about a pattern for working these out.

Practice and discussion

Whole-class

- Discuss with children how and when the mathematics they have been learning could help them in solving problems.
- Give children a problem, picture or array and ask them to write a multiplying sentence that goes with it, or give them a multiplying sentence and ask them to make up a problem, and use apparatus or draw an array to go with it.
- Provide regular practice of doubling, making connections with multiplying by 2.
- Work with children to use a times table square to find facts quickly and explore the commutative property of multiplying.
- Improve children’s fluency with multiplying facts using a range of strategies to help them commit the facts to memory, e.g. chanting, singing, rapping, writing or using a counting stick.
- Give children products, e.g. 40, for them to say corresponding multiplying facts, e.g. $8 \times 5$ and $5 \times 8$.
- Talk with children about multiplying calculations that involve 0 and 1.
- Show children some rectangles and tell them their dimensions in centimetres. Ask children to work out the area of each rectangle using multiplying facts.
- Give children simple calculations with three small numbers, e.g. $2 \times 3 \times 4$ that require them to use multiplying facts up to $12 \times 12$.

$$\begin{array}{c}
18 \\
\times 5 \\
90 \\
\end{array}$$

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15
Independent

**Paired or small group work for Activity 1**

*Have ready: Numicon Shapes*

Children take turns to write balancing number sentences to show the equivalence of repeated adding and multiplying facts, e.g. \(4 + 4 + 4 = 3 \times 4\), and to show this with Shapes. Vary the task by asking children to take turns to write their equivalences as empty box problems for another child to solve, e.g. \(5 + 5 + 5 + 5 = \square \times 5\).

**Paired or individual work for Activity 2**

*Have ready: Numicon 1–100 cm Number Rod Track, number rods*

Ask children to make designs using rods, find the products of the rods used (with the Number Rod Track, if appropriate), and write the matching multiplying sentences.

**Paired or individual work for Activity 3**

*Have ready: timer (optional)*

Children draw a blank 5 \(\times\) 5 multiplying square, e.g. Fig. 16. They write numbers 2–9 in random order in the first row and column, e.g. Fig. 17. They complete the square with the products, playing against a partner or the clock.

**Paired or small group work for Activity 4**

*Have ready: number rods*

Children take turns to make an array with rods for another child to make the commuted array, e.g. Fig. 9.

**Paired or small group work for Activity 5**

*Have ready: Numicon Coloured Counters, Numicon Spinners and 1–6 and 7–12 Spinner overlays (cut from photocopy master 43), Numicon 12-shape (photocopy master 33, laminated), dry-wipe pen*

Children write the products for a chosen times table, e.g. the 5 times table, inside the holes of the laminated 12-shape template, then cover each product with a Counter. They spin to generate a number, 1–12, then say the corresponding 5 times table fact, e.g. if they spin 6 they say \(6 \times 5 = 30\). They check by removing the appropriate counter, and score a point if they are correct. They play until a child has 12 points.

**Paired work for Activity 5**

*Have ready: Numicon Shapes or number rods, an envelope containing Multiplying Sentences (cut from photocopy masters 19–22)*

Children take turns to choose a multiplying sentence from the envelope and to write the product. The other child checks the product using Shapes or rods.

**Individual work for Activity 5**

*Have ready: Numicon 0–12 Numeral Cards, a minute timer*

Children spread the 0–12 Numeral Cards face down on the table. They work against the clock to select two 0–12 Numeral Cards at a time and write the corresponding multiplying sentences, completing as many as they can in a minute.

**Paired or small group work for Activity 6**

*Have ready: cm-squared paper or plain paper, rulers*

Children take turns to draw rectangles on cm-squared paper or on plain paper (by measuring centimetres with a ruler) for their partner to label each rectangle with a multiplying sentence giving its area.

**Individual work for Activity 7**

Ask children to write their own recipe for one smoothie, then to scale it up for making 6 or 8 smoothies, or to write similar scaling problems for other contexts.

**Individual work for Activity 8**

Ask children to make a table to show all the possible partners for 7 boys and 4 girls at the dance club.
Developing fluency with dividing facts to $12 \times 12$

Key mathematical ideas  Dividing, Inverse, Mathematical thinking and reasoning

Calculating

Educational context

This activity group is about revising all the dividing structures that were developed in Number, Pattern and Calculating 3 and continuing to develop children’s fluency in calculating. The children will meet a range of dividing problems in a variety of contexts including correspondence problems. A variety of imagery is used in order to support children’s understanding, and emphasis is placed on the use of multiplying facts when dividing. Key connections to everyday contexts in which dividing is used continue to be exploited, including sharing situations in which $n$ objects correspond to $m$ children. These activities can be adapted to focus on different dividing facts, according to children’s needs and their progress in recalling multiplying facts to $12 \times 12$.

Learning opportunities

• To use the inverse relationship between multiplying and dividing.
• To write dividing sentences using the $\div$ symbol.
• To recognize that there are three structures for dividing (grouping, sharing and ratio) and that all use the $\div$ symbol.
• To learn the related dividing facts for times tables to $12 \times 12$.
• To realize two dividing facts can be derived from a multiplying fact.
• To know that multiplying facts can help us to find numbers that are missing in dividing situations.
• To recognize that we divide when we are solving problems where we have to find ‘how many … in …’, when sharing into equal amounts and when scaling down.
• To know that we divide when working out one dimension of a rectangle from its area and the other dimension.

Words and terms for use in conversation

dividing, multiplying, total, array, dividing symbol, dividing sentences, systematically, dividing facts, grouping, how many in, divided into, inverse, sharing, divided equally, dividing by, shared equally, sharing between, sharing amongst, area, dimensions, squares, rectangles, sides, length, scaling, scale down, half, halving, half the amount, halve the amount, half as much as, groups of

Assessment opportunities

Look and listen for children who can:

• Use the words and terms for use in conversation effectively.
• Write dividing sentences using the $\div$ symbol.
• Write two dividing sentences for an array.
• Use knowledge of multiplying facts to work out dividing facts.
• Recall dividing facts related to multiplying facts to $12 \times 12$.
• Explain that we divide to find ‘how many … in …’, when ‘sharing … into …’ and when scaling down, and know that all these cases can be written as dividing sentences.

خب Explorer Progress Book 4b, 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.

 XB Explore More Copymaster 22: Farm Fencing

After completing work on Activity 2, give children Explore More Copymaster 22: Farm Fencing to take home.
Focus activities

Activity 1: Exploring a dividing context

Have ready: Numicon Coloured Counters, Numicon 10s Number Line, Numicon Shapes

Step 1
Remind children about Calculating 5, Activity 1, where children found the total number of counters needed for particular numbers of players to play a board game. Ask how many players can join in if each one needs 4 counters and we have 20 counters in total. Look and listen for children making connections with multiplying. Encourage them to use Counters to show that 5 people can play. Look and listen for children who start to organize their Counters into groups or arrays, and for those who are limited to counting in ones.

Step 2
Agree that by arranging the 20 Counters as an array we can make 5 rows of 4 Counters (see Fig. 1), showing that 5 players can play. Look and listen for children making connections with multiplying to explain that 5 groups of 4 make 20.

Step 3
Work with children to write a number sentence for this problem. Agree that we could write the multiplying sentence $5 \times 4 = 20$ or the dividing sentence $20 \div 4 = 5$. Remind children how these inverse facts are related. Encourage them to see that, although the sentences are connected, the dividing sentence matches the situation more closely because we knew we had 20 counters and each player needed 4, and wanted to know how many could play: $20 \div 4 = 5$.

Remind children about the action and symbol used for dividing (see Fig. 2). Look and listen for children using the language ‘how many fours’ or ‘divided into four’ as they talk about the problem and read the dividing sentence.

Step 4
Ask children to use Shapes on the 10s Number Line to illustrate the problem. Look and listen for children who suggest using a 4-shape to represent 4 counters, and placing 4-shapes on the 10s Number Line to show that five 4-shapes are equal to 20 (see Fig. 3). Look and listen for children making connections between multiplying and dividing.

Step 5
Repeat Steps 1–4 for a total of 28 or 32 counters, and 4 counters per player.

Step 6
Vary the context further, by changing the game and the number of objects per player, asking, e.g. ‘Each player in a game needs 3 cards. How many players can play if there are 18, 24 or 27 cards altogether?’ Ask children to write dividing sentences to show the situation. They can continue to use Counters or Shapes to illustrate it.

Step 7
Show children a list of the objects needed for other games, e.g.: 4 cards, 3 marbles, 5 dominoes, 6 counters, 8 beanbags, 2 dice.

Pose questions based on these contexts about the number of players that can play for given total numbers of objects. Look and listen for children working confidently to write dividing sentences.

Step 8
Include some problems that leave ‘remainders’, e.g. ‘How many people can play a marble game if we have 28 marbles?’ Look and listen for children who realize that we need 27 marbles for 9 players and this leaves 1 marble as a ‘remainder’. Explain that children will explore remainders in later work on dividing (in Calculating 11).
Activity 2: Writing dividing sentences

**Have ready:** number rods, Explore More Copymaster 22: Farm Fencing

**Step 1**
Show children a ‘path’ made from two 10-rods (see Fig. 4). Ask if they can make paths the same length using a different colour of rods. Look and listen for children who refer to the two 10-rods as 20, and who can use either trial and error or known number facts to find another path, e.g. four 5-rods. Some children will start to make connections with multiplying facts to select rods that will fit.

**Step 2**
As children work, encourage them to work systematically to explore which rods make 20 exactly, and to explain ‘how many’ of each type of rod are used.

**Step 3**
When children are happy that they have found all the possible paths that can be made for 20, ask them to write a dividing number sentence for each one. Look and listen for children who can write dividing sentences for each path, e.g. 20 ÷ 10 = 2, and who make connections with the language ‘how many … in …’ and ‘… divided into …’, e.g. ‘How many tens there are in 20 can be written as 20 divided into tens.’

Some children may write multiplying sentences instead of dividing sentences. Help these children to see that the problem involves starting with an amount (20) to be divided up by the number of rods.

**Step 4**
Work on other dividing problems in a similar context by drawing diagrams and asking questions, e.g. ‘How many 10-m paving slabs will make a pavement 60 m long?’ (see Fig. 5).

After completing work on this activity, give children the opportunity to take home and complete Explore More Copymaster 22: Farm Fencing. This will help children understand the connection between multiplying and dividing and practise dividing sentences.

Activity 3: Finding two dividing facts from an array

**Have ready:** Numicon Coloured Counters, whiteboard, dry-wipe pen

**Step 1**
Set the scene: a gardener is planting his carrots in rows. Ask children to work out the number of rows the gardener can plant with 24 carrots altogether, and 4 in each row.

Give children Counters to work with. Look for those who organize the Counters into an array of rows of 4 (see Fig. 6). Some may know the times tables well enough to know that they will be able to make 6 rows of 4; others will make rows of 4 and count how many rows there are at the end.

**Step 2**
Ask children to explore what would happen if the gardener wanted to plant the same number of carrots, but in rows of 6. Look and listen for children who do not move the Counters, and who know that the array already shows 4 rows of 6. These children are likely to have a secure knowledge of multiplying facts and the commutative property of multiplying, and to be able to draw on this in dividing situations.

**Step 3**
Draw the array on a whiteboard, then turn it 90° to show children that 4 × 6 = 24 and 6 × 4 = 24, and 24 ÷ 6 = 4 and 24 ÷ 4 = 6 can be represented by the same array.

Ask children to make a different array with Counters. Talk with them about the commutative multiplying facts the array shows, and the dividing facts they can derive from them.

**Step 4**
Some children may notice that the same number of Counters can be arranged into different arrays, and want to explore this further. Encourage them to see how many different arrays they can make with the 24 Counters they have been using in Steps 1–3, and how many dividing sentences they can write. Encourage children to arrange 24 Counters in one row and to write the corresponding dividing facts. Look and listen for children who can write 24 ÷ 1 = 24 and 24 ÷ 4 = 6 and explain that one calculation describes the array as one row of 24 and another describes it as twenty-four rows of 1. Help children explain the effects of dividing a number by 1 or by itself using these arrays.
Activity 4: Improving fluency with dividing facts

Have ready: Numicon 12-shape (photocopy master 33, including one copy enlarged to A3), Times Table Square (photocopy master 49), counting sticks, Numicon Software for the Interactive Whiteboard (optional)

**Step 1**
Ask children to count in multiples of 3. As they do this, write the multiples on an enlarged version of the 12-shape sheet (photocopy master 33) [see Fig. 7].

Talk with children about the multiples of 3. Encourage them to notice which multiples are odd and which are even, and to compare the values of the second, fourth and eighth; third, sixth and twelfth; and fifth and tenth multiples, noticing the doubling and halving relationships. Look and listen for children who can explain why this can be helpful when learning dividing facts. Look and listen for children noticing that, e.g. 15 is the fifth multiple of 3, and making connections with $15 \div 3 = 5$.

**Step 2**
Ask children to find 24. Agree it is the eighth multiple of 3. Ask children to write the dividing sentence for this: $24 \div 3 = 8$.

**Step 3**
Ask dividing calculations, e.g. $27 \div 3$ or $30 \div 3$, for children to answer quickly. Use the language ‘divided into’ and ‘how many … in … ?’

**Step 4**
Give children a copy of the Numicon 12-shape sheet and ask them to write in the multiples of 3 as fast as they can. Ask them to find different, non-consecutive multiples, e.g. the third, fifth, seventh. Look and listen for children who move quickly from one multiple to another, avoiding the need to count from the beginning. Ask children to write or say the corresponding dividing facts.

**Step 5**
Repeat Steps 1–4 for other multiples, up to $12 \times 12$.

This activity can also be repeated using other teaching tools and images, such as counting sticks or a times table square (photocopy master 49), to help children remember multiples both in sequence and in random order.

List dividing facts in times table format, e.g. $9 \div 9 = 1$, $18 \div 9 = 2$, $27 \div 9 = 3$, …, and chant, sing or rap them frequently, to encourage children to commit the patterns and facts to memory.

Activity 5: Using the inverse to derive missing numbers

Have ready: Numicon Shapes, Numicon 1–100 cm Number Rod Track, number rods

**Step 1**
Talk with children about everyday items that come in packs. Develop a discussion about multiplying and dividing, asking, e.g. ‘If there are 10 pens in a pack, how many pens are there in 6 packs?’ or ‘How many packs are needed for a class of 30?’ Listen for children who can identify which problems involve dividing.

**Step 2**
Discuss problems that involve dividing. Encourage children to describe them using dividing sentences, and to use Shapes or rods to illustrate their thinking.

**Step 3**
Draw a table showing the numbers of different items in 5 packs [see Fig. 8]. Talk with children about the information and what other information they can work out from it. Listen for children talking about the number of items in each of the 5 packs. Some children will use their knowledge of multiplying facts to explain that if there are, e.g. 40 pencils in 5 packs, then there are 8 pencils in a pack, since $5 \times 8 = 40$, so $40 \div 5 = 8$.

**Step 4**
Show children eight 5-rods in the Number Rod Track, then five 8-rods [see Fig. 9]. Agree both sets of rods equal 40. Help children to use the rods to explain that 40 pencils could make 5 packs of 8, or 8 packs of 5.

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<td>Sets of coloured pencils</td>
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<td>Boxes of pencil sharpeners</td>
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Calculating

**Step 5**
Ask children to explore how many items there are in each of the other packs. Look and listen for children who can use multiplying facts to derive the relevant dividing facts to explain how to do this.

**Step 6**
Show children some empty box dividing problems, e.g. $20 \div \square = 5$. Ask how they can use the strategies discussed in this activity to find the missing numbers. Listen for children using the terms ‘multiplying’ and ‘dividing’ and the inverse relationship between multiplying and dividing in their explanations.

Explore how the inverse can be used to solve empty box dividing calculations such as $\square \div 3 = 5$. Ask, ‘Which inverse fact will help us solve this problem?’

**Activity 6: Dividing in a correspondence context**

**Have ready:** Numicon Coloured Counters, paper circles

**Step 1**
Talk with children about the mathematics involved in planning a birthday party. Listen for children talking about having enough food, drinks or prizes for the guests, and using the language of dividing in this context. Notice children who talk about dividing in terms of ‘sharing’. Agree that instead of splitting a quantity into equal groups and finding how many groups we can make, ‘sharing’ means making a certain number of equal groups and finding how many we have in each group.

**Step 2**
Talk about an example involving 18 party gifts and 6 party bags. Explain that the gifts will be shared equally between, or ‘amongst’, the party bags. Write the dividing sentence $18 \div 6 = \square$ on the board. Encourage children to notice that the same dividing symbol is used, even though this problem involves ‘sharing’. Read the sentence aloud as ‘18 divided equally between 6’.

**Step 3**
Give children 18 Counters and 6 paper circles. Ask them to explore sharing into 6 bags. Look and listen for children assigning Counters one by one to each of the 6 circles (see Fig. 10). Agree this is different from making groups of 6 Counters. Some children will need to make groups of Counters and share Counters several times before they can distinguish these as distinct processes.

Listen for children who can talk about the connections between grouping and sharing, and who are able to explain that in both cases 18 divided by 6 is 3.

**Step 4**
Make a 3 by 6 array using the same 18 Counters (see Fig. 11). Make connections between the array and 6 bags containing 3 gifts each. Complete the number sentence: $18 \div 6 = 3$. Read this as ‘18 divided between 6 equals 3’.

**Step 5**
Next, using the same array, ask children, ‘If we had 18 gifts and made each guest a bag of 6 gifts, how many gift bags could we make?’ Encourage children to notice the switch between knowing how many bags but not how many gifts in each, and knowing how many gifts in a bag but not knowing how many bags. Look and listen for children using the language associated with making equal groups, e.g. ‘how many sixes in 18’, rather than, e.g. ‘sharing 18 between 6’.

**Step 6**
Look and listen for children who can see from the 3 by 6 array that the columns of 6 are repeated 3 times, showing we could make 3 bags with 6 gifts in each. Complete the number sentence as before: $18 \div 6 = 3$. Read it as ‘18 divided into 6 equals 3’. Agree that both sharing and grouping can be written with the same dividing sentence.

**Step 7**
Repeat Steps 2–6 for 6 guests with other multiples for the number of gifts, e.g. 24, 30, 42, or 8 guests and 16, 32, 48 gifts. Encourage children to switch between finding how many bags and how many gifts in each bag. Make comparisons with the relevant arrays and highlight the differences between the processes.
Step 8
Look and listen for children who realize that sharing can be time-consuming with larger numbers, and so choose to count groups of the divisor or use multiplying facts, with a good understanding of why they do this. Explore this with specific examples, e.g. dividing 27 into ‘3 equal groups’ or into ‘groups of 3’ to see which is the most efficient way to calculate $27 \div 3$.

Activity 7: Dividing in the context of working with areas

Have ready: Numicon Coloured Counters, cm-squared paper, rulers

Step 1
Draw squares and rectangles on squared paper and remind children about the work they have done on calculating areas (in Calculating 5). Look and listen for children multiplying the dimensions of the shapes to find the area, instead of counting squares.

Step 2
Work with children to make an array of 28 Counters arranged in 4 rows. Look and listen for children using dividing facts to work out that they can make 4 rows of 7 Counters (see Fig. 12).

Step 3
Next, ask children to draw a rectangle with a width of 4 cm and an area of 28 cm-squared on cm-squared paper (see Fig. 13). Look and listen for children who can use the same dividing facts to draw a rectangle with dimensions 4 cm by 7 cm.

Step 4
Work with children to make connections between the array and the area of the rectangle. Agree that 4 rows of 7 cm-squares make a rectangle with an area of 28 cm-squared. Write the dividing sentence $28 \div 4 = 7$ and the related multiplying fact $4 \times 7 = 28$.

Step 5
Repeat by encouraging children to find the dimensions of and draw other rectangles with, e.g. an area of 45 cm-squared and a width of 5 cm, or an area of 40 cm-squared and a length of 10 cm. Look and listen for children using multiplying and dividing facts to work quickly to complete their drawings.

Activity 8: Dividing in a scaling problem

Have ready: Numicon Shapes, number rods, a list of ingredients

Step 1
Show children a list of ingredients for a recipe, e.g. Fig. 14. Talk about the list of ingredients, explaining they make 20 oatcakes. Ask children to work out the ingredients needed for a smaller batch of 10 oatcakes.

Step 2
Look and listen for children who start talking about reducing the quantities for 20 oatcakes to make 10 oatcakes, and those who recognize this relationship as ‘halving’. Talk about the amount of porridge oats needed for 10 oatcakes. Wait for children to use comparative phrases about needing, e.g. ‘half the amount’ or ‘half as much’.

Step 3
Encourage children to relate halving to dividing by 2 by reminding them that halving or folding paper in half divides it into two equal parts. Show halving with apparatus, e.g. Fig. 15. Write the dividing sentence $80 \div 2 = 40$ and agree that 40 g of porridge oats would be the amount needed for half a batch of oatcakes.

Step 4
Work together with children to write a dividing sentence for each ingredient on the list, using apparatus to illustrate and modelling the comparative language until children can use it themselves.

Some children may realize that they can work out the quantities needed for making even smaller batches of oatcakes by dividing the quantities in the recipe by 4, 5, 10 or 20.

Step 5
Repeat for other everyday contexts in which amounts can usefully be reduced by a scale factor, e.g. if 20 bus tickets cost £40 so 10 cost £20, or if 30 children need 4 benches to sit on then 15 children need 2 benches.
Calculating

Practice and discussion

Whole-class
- Discuss with children how and when the mathematics they have been learning could help them in solving problems.
- Give children a problem, picture or array and ask them to write a dividing sentence that goes with it. Alternatively, give them a dividing sentence and ask them to make up a problem and use apparatus or draw an array to go with it.
- Provide regular practice of halving, making connections with dividing by 2.
- Ask children to change a multiplying sentence into a dividing sentence and vice versa.
- Work with children to use a Times Table Square (photocopy master 49) to find dividing facts quickly and explore inverse facts.
- Improve children’s fluency with dividing facts using a range of strategies to help them commit the facts to memory, e.g. chanting, singing, rapping, writing.
- Play games that require children to say dividing facts quickly and answer quick-fire questions, including questions which involve remainders.
- Have a discussion about the effect of dividing any number by 1.
- Give children products, e.g. 40, for them to say corresponding dividing facts, e.g. $40 \div 8 = 5$, $40 \div 5 = 8$, $40 \div 10 = 4$.
- Give children the areas and one dimension of rectangles for them to work out the other dimension of the rectangles and the length of one side of the regular shapes using dividing facts.
- Give children empty box dividing problems to solve.

Independent

Individual work for Activity 1
Ask children to write dividing stories, and write the corresponding number sentences, e.g. ‘A group of 9 children paid £27 to go to the cinema. This is £3 each. $27 \div 9 = 3$.’ Ask them to include examples that involve remainders.

Paired or small group work for Activity 2
Have ready: number rods
Children take turns to make or draw a path with one type of rod for another child to write the corresponding dividing sentence.

Paired or individual work for Activity 3
Have ready: Numicon Coloured Counters
Give children 36 Counters to use to make different arrays. Ask them to write two multiplying and two dividing sentences for each array they make.

Paired or individual work for Activity 4
Have ready: Numicon Feely Bag, Numicon 12-shape (photocopy master 33, enlarged to A3), small sticky notes or slips of paper
Ask children to write the multiples for a chosen times table, up to the twelfth multiple, on small sticky notes or pieces of paper and place them in the Feely Bag. They select multiples from the Feely Bag at random and place them on the correct hole on the 12-shape sheet, e.g. for the 6 times table, 30 would be placed on the fifth hole.
Alternatively, ask children to select multiples from the Feely Bag and write a dividing sentence for each one, as quickly as they can.

Paired work for Activity 5
Have ready: Numicon 1–100 cm Number Rod Track, number rods
Ask children to use rods and the Number Rod Track to help them write empty box dividing problems, e.g. $24 \div \Box = 6$, $\Box \div 8 = 7$, for a partner to solve.

Paired work or individual work for Activity 6
Have ready: Numicon Coloured Counters
Ask children to make or draw an array and talk about the arrangement in terms of sharing and grouping, e.g. 27 Counters can be ‘shared into 3 groups’ or ‘divided into groups of 3’.

Paired or individual work for Activity 7
Have ready: Numicon Coloured Counters, Numicon 1–100 cm Number Rod Track, number rods, cm-square tiles, cm-squared paper
Ask children to use apparatus to explore which rectangles they can make or draw that have an area of 36 cm-squared.

Individual work for Activity 8
Ask children to solve scaling problems, e.g. ’If I need 60 oranges to make 20 glasses of orange juice, how many oranges will I need for 5 glasses?’ Ask them to write some similar problems of their own.
### Multiplying Sentences for 2, 3 and 4 Times Tables

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