

Getting Started

Pupils with no experience of Numicon will need to start with the first activities in this kit and progress at their own pace. Some may progress to work at the level of their age-peers very quickly; the Activity Extensions are designed for these pupils.

Pupils who take longer to assimilate the ideas in the basic activities will benefit from following the Smaller Steps suggested for each activity.

For pupils who have previously worked with Numicon we suggest that teachers establish the pupil's starting point by using the Assessment Signposts (included in the Assessment Tools).

What you will find in Closing the Gap with Numicon



Numicon Shapes and Pegs
The Shapes give pupils a tactile and visual representation of number ideas, the two boxes of Shapes each contain 80 Shapes. The Pegs are designed to fit into the holes in the Numicon Shapes. Please note there are only 4 colours of Pegs, this is because pupils need to move beyond matching by colour.



Baseboard and Overlays
The Baseboards, designed to hold the Shapes and Pegs, are used in many activities. The Picture Overlays fit over the Baseboard and are used in matching activities. These are useful for early independent work. The Number Fact overlays are used in addition activities.

Feely Bag
This is a key component! By feeling for Shapes in the Bag, pupils are encouraged to visualize the properties of the Shapes, this helps them to develop their own mental imagery of number.



Spinners
These are used in various games and activities.

Numicon Large Format Table Top Number Line
There are two of these included in this Kit. Numicon Number Lines provide a key image for pupils that helps them to connect Numicon Shapes with the image of the number line and understand the value and order of numbers.

Teaching Materials
This Book contains 4 sections: The Teaching guide, The Programme of Activities, Assessment Tools and Photocopy Masters.

Teaching Materials

Section 1: Teaching Guide

This provides suggestions to help teachers make the basic ideas of number accessible to pupils experiencing difficulty. There is also guidance on how to address the underlying difficulties that may hinder pupils' learning. It is strongly recommended that teachers read through the Teaching Guide prior to starting to teach the activities.

Section 2: Programme of Activities

At the beginning of this section there is a key, which explains the layout of the Activities. This is followed by an Activity Summary, which details the Activity Title, Key mathematical ideas and Aims.

The Programme of Activities is designed to be followed sequentially. However, the first four Activities on Counting and Pattern are ongoing and should run concurrently with the rest of the programme. The remaining Activities can be followed in order, although many of them will need to be repeated often until pupils' understanding is secure. Pupils enjoy repeating the games independently and this gives them useful practice.

Section 3: Assessment Tools

This section includes three Assessment Tools: Numicon Assessment Signposts, Individual Record of Progress, and Pupil Profile. The pupil profile is used to build a picture of a pupil's strengths and difficulties in order to highlight the mathematical teaching strategies and Numicon Activities that should be used to address these needs.

Section 4: Photocopy Masters

Resources to be copied and used when teaching the activities, the Photocopy Masters are referenced throughout the Activities.

Teaching the Activities

The Activities in this Kit are designed to help pupils experiencing difficulty with maths to develop a secure foundation of basic number understanding. Guidance on creating suitable learning environments, structuring teaching sessions and adapting these sessions to meet the needs of individuals may be found in Sections 5 and 6 of the Teaching Guide. The Activities can be used for teaching one to one or for small group work. Each Activity comes with suggestions for smaller steps and ideas for extending the activities, to help teachers provide a suitable level of challenge for each individual. Pupils of any age who are new to Numicon need opportunities to explore and construct their own meaning for the Shapes before they are taught the Activities. Ideas for this early exploration are explained in Activity 1a. We strongly recommend that adults try out each Activity before teaching it for the first time.

Recording

The Numicon activities are essentially practical. However, suggestions for recording are given when appropriate.

Training

In the Closing the Gap section of our 'Working with Numicon' training DVD there is an example of a learning support session using Numicon. There are also many suggestions in the Teaching Guide to support teaching approaches and develop teachers' subject knowledge.

For information about live training please get in touch or visit our website www.numicon.com.

Keep in touch

We hope you enjoy teaching with Numicon and would be delighted to know how you get on. Please share your ideas with others via our website, where you will also find information about what is going on, and new products, www.numicon.com.

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2. Key mathematical Ideas

Difficulties that pupils may have in acquiring understanding

The National Curriculum for England and Wales acknowledges learning mathematics involves more than learning certain facts and calculation techniques; it includes learning how to use mathematics in practical situations and learning about mathematics as an *activity* (see also Section 4). Therefore, as pupils learn about number and calculation, they need also to learn how to do mathematics. There are several elements involved in thinking mathematically, most stemming directly from the essentially abstract character of mathematical ideas. Probably the most fundamental aspect of mathematical thinking is the need to be *logical* when dealing with abstract ideas; without logic we cannot trust the outcome of our thinking, that is, our conclusions.

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Mathematical Thinking

Piaget (1952) teaches us that young pupils do not think logically - in the way that most adults are able to do, and that their gradual progress toward adult logical thinking is partly experiential, partly maturational. We cannot expect young pupils to think like adults, but we can discuss their thinking with them and help them to reflect on the reasoning behind it.

Pupils' earliest mathematical reasoning should be shared, explored and reflected upon; young pupils (and some children with special needs) will not frame clear, logical arguments, but it is important that they understand that the way they think matters to us, and that 'thinking' is worth thinking about. For pupils to be willing, and increasingly able, to share and develop their mathematical thinking, they need to feel confident that their thoughts are welcomed, respected and important; if their ideas are dismissed as 'wrong' or low-level, or are ridiculed, this will make pupils close up and lose faith in their abilities. Central to the Numicon approach is building confidence in mathematical thinking and reasoning; it is important to exploit every opportunity to nurture these abilities in pupils and provide them with a supportive environment.

The relationship between language and thinking has been much debated by philosophers, linguists and psychologists among others, but there is a consensus that thought and language are closely linked. People who experience difficulties learning mathematics often have problems with speech, language and communication even when they have not been categorized as having 'speech and language difficulties' or 'specific language impairment'. And speech, language and communication difficulties underlie many SEN. Because of the close relationship between language and thought, pupils with language needs will require additional support in developing mathematical thinking, in the form of:

1. modelling of mathematical thinking by the teacher;
2. scaffolding of the pupil or young person's thinking in relation to a particular mathematical task, through the provision of a visual framework of the sequence of thinking activities needed to solve a particular mathematical task;
3. supportive correction of erroneous or unhelpful thinking, ensuring that the pupil is not left feeling that his or her approach was completely 'wrong'.

Another fundamental characteristic of mathematical thinking is the focus on generalizing. It is important to look for patterns in all situations; when a pattern is identified it is possible to generalize and predict. Teachers should encourage generalization by taking every opportunity to enquire: 'Do you think that this will *always* happen?'

It is also essential for pupils to approach situations systematically. Being systematic is an aspect of effective reasoning and provides a foundation for generalizing (and thus predicting). Working with Numicon provides many opportunities to encourage pupils to work systematically; there are frames included in the set of master sheets to help pupils organize their work in certain activities (see figure 1). Teaching Activity 13b specifically invites pupils to think systematically about possibilities, to resist the impulse to make wild guesses, and to have the patience to explore in detail what *could* happen, before reaching any conclusions.

The final element of mathematical thinking is the ability to use and apply abstract mathematical ideas in real situations. The Teaching Activities signal opportunities for teachers to help pupils to connect their developing understanding of mathematical ideas with their everyday world.

Fig 1: Using the Baseboard as a frame to organize different combinations of Shapes to make 6.



3. Barriers to pupils’ access to mathematical teaching and learning

How the Numicon approach can overcome them

In this section the strategies suggested to assist pupils in overcoming barriers to mathematical learning relate specifically to the use of Numicon. However, other strategies may also be of help in overcoming barriers to mathematical learning and, therefore, this section could be useful to all teachers, whether or not they use Numicon.

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Difficulties with numerosity

Pupils’ development of numerosity (the size of sets) is obviously of crucial importance to their understanding of mathematics. However, pupils’ other cognitive abilities and, more importantly, the way they are taught, are clearly significant if not decisive factors in the acquisition and application of arithmetic skills. There has been much debate about whether arithmetic difficulties result from deficits in pupils’ awareness of numerosity, or whether these difficulties result from deficits in other cognitive areas. The typical developmental sequence for arithmetic competency is summarized by Brian Butterworth as :

- discrimination of small numerosities (the numbers of objects in sets) (from birth)
- beginning to learn the sequence of counting words and an ability to undertake ‘one-to-one correspondence in sharing tasks (2 years)¹
- the ability to add and subtract one with objects and number words, and the ability to use the cardinal principle to establish the numerosity of a set (3 years 6 months)
- the ability to add small numbers without being able to count out the sum (5 years)
- the understanding of the commutativity of addition, the ability to count on from the larger number when adding and the ability to count correctly to 40 (5 years 6 months)
- the understanding of the complementarity of addition and subtraction and the ability to count correctly to 80 (6 years 6 months)
- the retrieval of some arithmetic facts from memory (7 years). (Butterworth, 2005: 12)

The activities included in this kit take account of this progression and include many suggestions, on the Counting Activity Cards, for teaching pupils to count and encouraging them to learn the count sequence and understand the system for naming numbers. However, in pupils’ work with Numicon they are able also to add numbers without counting and to see that numbers can be added together in any order, that is, that addition is commutative. When they put Numicon Shapes together in addition, and separate or compare Shapes in subtraction, they can see the inverse relation between addition and subtraction – they can see how one operation ‘undoes’ the other.

Difficulties with the language of mathematics – meaning

Although many pupils with verbal or spatial problems may experience difficulties with mathematics, these difficulties ‘cannot be used as definite predictors of either the existence or type of mathematical difficulty that a pupil may have’ (Dowker, 2004: 10). However, the language of mathematics does present specific problems for many children. Size (cardinality) and order (ordinality) of numbers, and early calculation, are taught through explanations that rely upon comprehension of spoken language, for example, concepts such as big (bigger, biggest), small (smaller, smallest) more (most), few (fewer), less (least), before, after, next, etc. The learning of mathematics depends on an accurate understanding of these concepts *in the context of number*. However, in mathematics these words are used in specific ways, which are often subtly different to their use in other contexts, both at school and at home.

The mathematical use and understanding of the concepts big/bigger/biggest and small/smaller/smallest are important in mathematics, this is manifest in the frequency with which we resort to their use to explain other concepts, or to discuss mathematical ideas more generally. For example, using statements such as ‘the number after six is one *bigger* than six’; ‘as we count forward along the number line the numbers get *bigger*’; ‘the sum of four and five can’t be two (in response to a pupil’s mental miscalculation), it must be *bigger* than the *bigger/biggest* of the two numbers that you are adding’, etc.

¹ All approximate chronological ages.

Key to the Activities

Title

The Title indicates the broad scope of the Activities on the card.

Key mathematical ideas

Refer to Section 2 of the Teaching Guide for explanation of the key mathematical ideas pupils are meeting through each Activity and the aspects of the ideas that pupils are likely to find challenging.

Aim

The intended learning pupils should achieve.

The Activities

The core Activities are described step by step. Many activities will need to be repeated and practised many times before the aim is achieved.

Subtraction

Aims, Language and Assessment

The Activities

Smaller Steps

Extending the Activities

Language

Both the language of instruction and the mathematical language are shown on each Activity. The language of instruction is used to explain to pupils what they have to do. The language of mathematics expresses the mathematics that pupils are learning.

Assessment

A cross-reference to the Numicon Record of Progress in the Assessment Tools section of the Kit

Smaller Steps

Some pupils who have special needs benefit from following these smaller steps. Pre-teaching ideas are suggested for some Activities.

Extending the Activities

For pupils who are moving on quickly there are suggestions for increasing the challenge. The suggestions for Using Numicon and Connecting Activities are suitable for the majority of pupils.

Activity Summary

The Closing the Gap with Numicon Activities are Summarized below. The first four Activities on Counting and Pattern are ongoing and run concurrently with the rest of the programme. The remaining Activities can be followed in order.

Counting A Activity Title Counting Key mathematical ideas Counting Aims To learn to recite the number names in order (the count sequence). To begin to learn to count one to one.	1a Activity Title Getting to Know the Numicon Shapes Key mathematical ideas Pattern, Shape Aims To explore freely the Numicon Shapes.	3b Activity Title Getting to Know the Numicon Shapes Key mathematical ideas Order, Comparison Aims To use the language of comparative size with Numicon.
Counting B Activity Title Counting Key mathematical ideas Counting, Cardinal property of number Aims To learn to count one to one. To begin to use 'more' and 'fewer' or 'less' when comparing number values. To understand that the last number of the count tells you its size (cardinal value).	1b Activity Title Getting to Know the Numicon Shapes Key mathematical ideas Pattern, Order, Shape Aims To learn to match Numicon Shapes by colour and shape.	4a Activity Title Learning to Order the Numicon Shapes Key mathematical ideas Order, Comparison Aims To put Numicon Shapes in order of size.
Pattern A Activity Title Pattern Key mathematical ideas Pattern Aim To learn to copy, continue and devise repeating patterns.	2a Activity Title Getting to Know the Numicon Shapes Key mathematical ideas Pattern, Order, Space Aims To match Numicon Shapes to coloured pictures of the Shapes.	4b Activity Title Learning to Order the Numicon Shapes Key mathematical ideas Order, Comparison Aims To order Numicon Shapes confidently and securely.
Pattern B Activity Title Pattern and Sequence Key mathematical ideas Pattern Aims To develop visual spatial perception and organisational skills. To develop understanding of direction.	2b Activity Title Getting to Know the Numicon Shapes Key mathematical ideas Order, Comparison Aims To understand and use the language 'bigger' with Numicon.	5a Activity Title Getting to Know the Numicon Shapes and Patterns Key mathematical ideas Pattern, Shape Aims To match Numicon Shapes to grey pictures of the Shapes, outlines of the Shapes, and small representations of the Numicon patterns as shown on the Spinner Overlays.
	3a Activity Title Getting to Know the Numicon Shapes Key mathematical ideas Order, Comparison Aims To understand and use the language 'smaller' with Numicon.	5b Activity Title Getting to Know the Numicon Shapes and Patterns Key mathematical ideas Pattern, Shape Aim To learn the patterns of the Numicon Shapes.

Key mathematical ideas: Addition

Addition

Aims, Language and Assessment

Aims

- To relate addition to combining two or more Shapes and to use the language of addition.
- To know that addition is used to answer 'How many altogether?'

Language of instruction

build, find, talk about, explain, put together, combine

Mathematical language



altogether, add, how many, same way, different way, makes, same number, same as

Assessment

Record of Progress:
Calculating 3, 4.

The Activities

Activity 1 Numicon towers

1. Have ready Baseboard, Number Bond Overlays and Numicon Shapes and Pegs. Put an Overlay on the Baseboard and ask the pupils what they notice.
2. Pupils match Shapes on to the Overlay, thus making different combinations of the number. 
3. Pupils fill the single Shape with Pegs and place one of the combinations on top. In this way pupils progressively build a tower until all the combinations are used. 
4. Ask pupils to describe the combination for each layer of the tower, e.g. for the 8-tower 'four and four', 'seven and one', 'one and one and two and four', etc.



1




2

Activity 2 How many altogether?

1. Have ready Numicon Shapes and Numeral Cards 1-10 (Photocopy Master 11) in order and a Spinner with Overlay 1-5 (Photocopy Master 6).
2. Pupils spin a numeral and pick up the corresponding Shape. They spin again and pick up another Shape.
3. Ask pupils, 'How many do you have altogether?' Pupils find out 'how many altogether' by combining the two Shapes and saying the whole number sentence, e.g. 'I have put 5 and 3 together to make 8'.
3. Pupils pick up the Shape that shows the total and place it on top of the combined Shapes to check.

Activity 3 Feel and make

1. Have ready Shapes and Numeral Cards 1-10 (Photocopy Master 11) in order and a Feely Bag containing two each of Shapes 1-5. Pupils take turns to feel in the Bag and take out two Shapes.
2. Pupil combines the two Shapes and says how many it makes altogether using the language of addition, e.g. 'I added 3 and 4 together to make/equal 7'. Ask pupils to point to the numeral that shows the total.
3. Pupil picks up the Shape that shows the total and places it on top of the combined Shapes to check. 



3

9b

Smaller Steps

For Activity 1

If pupils have fine motor difficulties that may make using the Pegs frustrating, ask them to build towers by simply placing different combinations of Shapes on top of one another.

For Activities 1 and 2

By this stage of the teaching programme pupils have had much practice in manipulating the Shapes. However, for some rotating the 'odd' Shapes may still be very challenging. These pupils may benefit from an introduction to addition using combinations of 'even' Shapes.

Model the activities and the mathematical language before asking pupils to do them, as shown below:

- Take the 2-shape and 4-shape and say 'We can find out how many these Shapes make altogether by putting them together'. Then combine the Shapes whilst modeling the mathematical language 'I am putting 2 and 4 together to make 6 altogether' then pick up the 6-shape and put it on top to check.
- Invite pupils to try the activity and then to practise by repeating with different combinations of even Shapes until they are confident with using the mathematical language.
- Gradually introduce combinations of odd Shapes and odd and even Shapes.

Extending the Activities

Activity 1 for pupils moving on quickly

Ask pupils to find their own combinations of two or more Shapes to fit the base Shape.

Activities 1 and 2 for pupils moving on quickly

Ask pupils to find the total on the Numicon Number Line and/or a 0-20 number line.

Activities 2 and 3 for pupils moving on quickly

- Show pupils different combinations of Shapes and ask pupils to say the addition sentence, e.g. '3 add 6 makes/equals 9'.
- Vary the language so that pupils are able to answer the question 'How many is 2 add 4 altogether?' and say '2 add 4 equals 6' or '2 and 4 together equal 6', for example.

Using Numicon

- Exploit opportunities to encourage pupils to connect addition situations and their work with Numicon, e.g. three pupils are listening to a story, another pupil joins them, illustrate by combining the 3-shape and 1-shape.
- Ask pupils questions such as 'If we had four biscuits and five more biscuits, what can we use to help us find out how many biscuits we have altogether?' Encourage pupils to solve this using Numicon Shapes.
- Make up other addition problems and encourage pupils to think about ways of solving them with Numicon Shapes.
- Pupils choose two or more Shapes and use these to tell their own addition stories.
- Pupils could record their stories in words and pictures, including drawing the Numicon Shapes. Pupils can use the 'Baseboard' Frame (Photocopy Master 8) to help with drawing the Shapes.

Connecting activities

Take any opportunities to point out addition in everyday situations. For example at snack time 'We have three green apples and three red apples, how can we find out how many apples we have altogether?' Remind pupils that instead of counting to find 'how many altogether' they can find the Numicon Shapes and put them together.

Assessment Tool 1: Assessment Signposts

<p>1. Can pupil match Shapes and copy the pattern of a Shape with Pegs on the Baseboard?</p> <p>How to find out</p> <ul style="list-style-type: none">• Show pupil a 7-shape and ask him/her to make the corresponding pattern with Pegs on the Baseboard.• Make a 9-pattern with Pegs on the Baseboard and ask pupil to find the corresponding Shape. <p>Yes? Move on to next question</p>	<p>No? Go to the activity from the relevant Numicon kit:</p> <p>Firm Foundations: 2a, 2b, 3a, 5a, 6a</p> <p>Closing the Gap: 1, 2a, 5</p> <p>Old Foundation Cards: 1-2</p>
<p>2. Can pupil copy a repeating pattern?</p> <p>How to find out</p> <ul style="list-style-type: none">• Make yellow red yellow red (at least five repeats) repeating pattern with Pegs on the Numicon Baseboard.• Ask pupil to copy the pattern on the Baseboard. <p>Yes? Move on to next question</p>	<p>No? Go to the activity from the relevant Numicon kit:</p> <p>Firm Foundations: 5b</p> <p>Closing the Gap: Pattern Card</p> <p>Old Foundation Cards: 2a Making Connections</p>
<p>3. Can pupil continue a repeating pattern?</p> <p>How to find out</p> <ul style="list-style-type: none">• Make a blue green blue green repeating pattern (three repeats) with the Pegs on the Numicon Baseboard.• Ask pupil to continue the pattern. <p>Yes? Move on to next question</p>	<p>No? Go to the activity from the relevant Numicon kit:</p> <p>Firm Foundations: 5b</p> <p>Closing the Gap: Pattern Card</p> <p>Old Foundation Cards: 2a Making Connections</p>
<p>4. Can pupil order Shapes and give them number names?</p> <p>How to find out</p> <ul style="list-style-type: none">• Give pupil a set of jumbled 1-10 Shapes. Ask pupil to put them in order starting with the 1-shape.• Point to a 6-shape ask pupil to say its number name. Continue to ask him/her to name each Shape (not in order). <p>Yes? Move on to next question</p>	<p>No? Go to the activity from the relevant Numicon kit:</p> <p>Firm Foundations: 3b, 4a, 4b, 6b, 7a</p> <p>Closing the Gap: 2b, 3a, 3b, 4a, 4b, 6</p> <p>Old Foundation Cards: 3, 4</p>

Name:

Date of Birth:

Numbers and the Number System

Recognition of Shapes, Counting and Place value

Pupil is able to	Comments
1. Recite numbers to...	
2. Match Numicon Shapes by colour.	
3. Recognize Numicon Shapes by colour.	
4. Find Numicon Shape to match Numicon pattern built with Pegs on Base Board 1 2 3 4 5 6 7 8 9 10. (do not use number names with the pupil yet, see later steps.)	
5. Build Numicon pattern with Pegs on Base Board in response to seeing the Numicon Shape 1 2 3 4 5 6 7 8 9 10 (do not use number names with the pupil yet, see later steps).	
6. Count objects to... (note pupil's one-to-one counting range)	
7. Recognize numbers within stories and rhymes.	
8. Compare two Shapes and say which has more holes and which has fewer/less holes.	
9. Find position of Numicon Shape on Numicon Number Line by matching.	
10. Find Numicon Shape in response to hearing the number name 1 2 3 4 5 6 7 8 9 10.	
11. Name Numicon Shapes 1 2 3 4 5 6 7 8 9 10 (pupil says number name in response to seeing Shape).	
12. Recognize numerals (pupil points to numeral in response to hearing the number name) 1 2 3 4 5 6 7 8 9 10.	
13. Name numerals (pupil says number name when shown numerals – out of order) 1 2 3 4 5 6 7 8 9 10.	
14. Remove 2 objects from a set of 10.	

Photocopy Masters

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The following pages feature the Photocopy Masters referred to throughout the Closing the Gap with Numicon Activities

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Photocopy Masters

Closing the Gap with Numicon: Sheet 2

Outline Numicon Shapes

