

# Mathematical vocabulary

## Objectives

- To develop a structured approach to using mathematical vocabulary
- To suggest strategies to support pupils to learn and retain spellings in mathematics

## Resources

### For the tutor

Slides 4.1–4.4

Several large sheets of paper and felt pens, for groups of three or four

Materials for the activities recommended in handout 4.3 (optional)

Dictionary (optional)

Display copies of:

- *Mathematical vocabulary (National Numeracy Strategy)*

### For each participant

Handout 4.1	Using words in different contexts (cut up into cards, one set for each pair)
Handout 4.2	Effective development of vocabulary
Handout 4.3	Activities for developing mathematical vocabulary
Handout 4.4	Word level objectives

### Each participant should bring

*Framework for teaching mathematics: Years 7, 8 and 9*

## Session outline

60 minutes

### Introduction

Identifying the importance of language in mathematics	Talk Whole group, pairs	5 minutes
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### Vocabulary

Looking at ambiguity in mathematical vocabulary	Talk, activity Whole group, fours	10 minutes
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### Developing and reinforcing vocabulary

Developing the use of mathematical vocabulary	Talk, activity Whole group, pairs	25 minutes
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### Spelling strategies

Developing strategies for teaching pupils how to learn and retain spellings	Talk, activity Whole groups, small groups	10 minutes
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### Moving on

Agreeing action to follow up in school	Talk, activity Pairs	10 minutes
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## Introduction

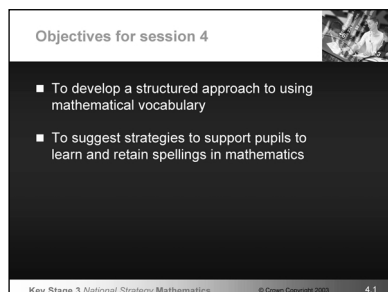
5 minutes

Briefly explain the structure and content of this session. Remind participants that the National Curriculum statement on the use of language across the curriculum states that:

*Pupils should be taught the technical and specialist vocabulary of subjects and how to use and spell these words.*

Show **slide 4.1** to introduce the objectives for this session.

### Slide 4.1



Say that developing pupils' understanding and correct use of mathematical vocabulary can support their understanding of mathematics.

Explain that analysis by QCA of pupil performance in Year 7 showed that:

*Pupils at all levels found difficulties with questions that assessed their understanding and use of mathematical vocabulary. These difficulties may have been due both to unfamiliarity with the definitions and to lack of confidence with the underlying concepts.*

Remind participants that the vocabulary checklist, in section 5 of the *Framework for teaching mathematics: Years 7, 8 and 9*, includes the key mathematical vocabulary used in the teaching programmes and supplement of examples. Pupils should be expected to use, read and write, and spell these words correctly.

Refer participants to the checklist on pages 8 and 9 of section 5 in the Framework, and ask them to read through the vocabulary expected by the end of Year 9. Allow **2 to 3 minutes** for this.

## Vocabulary

10 minutes

Explain that teachers often use informal, everyday language alongside technical mathematical language. Although this can help pupils to grasp the meaning of different words and phrases, a structured approach to the teaching and learning of vocabulary is required if pupils are themselves to use correct mathematical terminology.

Subject-specific terminology is important as it enables teachers and pupils to convey precise meaning, but not all words in mathematics are non-ambiguous.

- Many words used in mathematics are also used in everyday contexts but they have different meanings in mathematics, for example, *brackets, origin, volume*.
- Words used in mathematics often have a precise definition but are used more loosely in everyday contexts, for example, *diagonal, similar*.

Distribute sets of cards from **handout 4.1**, 'Using words in different contexts'.

Ask participants to:

- match each word with its subject-specific meaning and its everyday meaning;

- identify the words that cause confusion for their pupils.

Allow **5 minutes**. Take brief feedback about the words that cause confusion for pupils.

## Developing and reinforcing vocabulary

**25 minutes**

Draw out the importance of teaching subject-specific vocabulary. Stress that teachers cannot assume that pupils know subject-specific meanings. Refer participants to **handout 4.2**, 'Effective development of vocabulary'. Ask them to consider these features in relation to their school and to identify:

- an aspect that they feel is developing well within their department;
- an aspect that needs to be developed further.

Ask them to discuss their choice with the person sitting next to them.

Allow **5 minutes**.

Say that there is a range of activities that can be used to develop mathematical vocabulary. They have been suggested by teachers and could be used for oral and mental starters, or as more extended activities during the main part of the lesson.

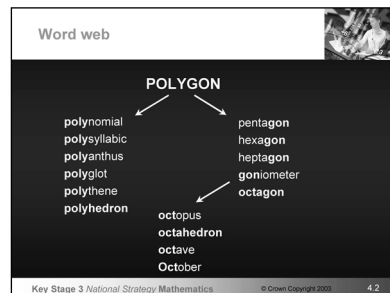
Introduce 'Word webs' as a taster activity.

## Word webs

Word webs can be used to highlight the patterns in words by examining their roots. This aids spelling and understanding. Remind participants that mathematics is rich in words that have their roots in Latin and Greek.

Show **slide 4.2** to demonstrate how to construct a word web, by taking a single word from each list to start a new list.

### Slide 4.2



Ask participants to generalise from the lists to deduce the meaning of the roots (*poly*, *gon*, *oct*, *hedron*):

- *poly* means many;
- *gon* means angled;
- *hedron* means base;
- *oct* means eight (October was originally the eighth month of the year).

Provide large sheets of paper and felt pens. Ask participants, in groups of three or four, to work together to create their own word webs. Give each group different starting words, for example, *binary*, *circumference*, *equilateral*, *kilogram*, *triangle*.

After **5 minutes** ask participants if they have all established the meaning of the roots of their words. Have some dictionaries available for reference. Display the sheets.

Give participants a few moments to read **handout 4.3**, 'Activities for developing mathematical vocabulary'. Ask them, in pairs, to discuss these questions.

- What other effective activities have you used?
- Choose an activity you have not used before and agree how you will use it in a future unit. How will you know if it is successful?

Allow **10 minutes**.

Take feedback. Draw out these points.

- The best learning is achieved through active tasks. Those in the handout are intended as refresher activities.
- Using these activities 'a little and often' is likely to have the greatest impact.
- Teachers need to take care to make sure that the activities are suitably challenging.

## Spelling strategies

10 minutes

Introduce this part of the session by acknowledging that teachers know that pupils often find it difficult to spell mathematical words correctly.

Show **slide 4.3**.

### Slide 4.3

Some mathematical words

associative	congruent	hypotenuse
isosceles	indices	multiple
parallelogram	perimeter	quadrilateral
rhombus	sphere	tessellation

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Ask participants to look at the words on the slide and to discuss these questions, in groups of three or four.

- How might you help pupils who are struggling to remember how to spell these particular mathematical words?
- What strategies would you suggest for each word?

Allow **5 minutes**. Take feedback by asking participants to help list the range of strategies suggested.

Use **slide 4.4** to highlight some strategies promoted by the English strand.

### Slide 4.4

Spelling strategies

- Refer to root meanings  
e.g. *quad* means four, *lateral* means across
- Break it into sounds  
e.g. c-o-n-g-r-u-e-n-t
- Break it into syllables  
e.g. cir-cum-fer-ence
- Refer to a word in the same word root family  
e.g. multiply, multiple, multiplication

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Spelling strategies (cont)

- Look for words within words  
e.g. *dice* in *indices*, *ten* in *hypotenuse*
- Say it as it looks  
e.g. *isosceles*
- Use a mnemonic  
e.g. two sleeves, one collar, for *associative*
- Visual memory  
(look-say-cover-write-check)

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## Moving on

10 minutes

Refer participants to **handout 4.4**, 'Word level objectives', which gives a selection of word level objectives from the *Framework for teaching English: Years 7, 8 and 9*. Explain that the selected objectives highlight aspects of improving vocabulary and spelling that are particularly relevant to mathematics.

Allow participants **5 minutes**, working in pairs, to think of specific points in their current schemes of work where the objectives could be taught.

Refer participants back to **handout 4.3** and ask which activities they might use in their own teaching. Take feedback, aiming to build up a list of opportunities for teaching vocabulary and spelling.

Conclude the session by explaining that:

- using literacy objectives helps to focus the teaching of spelling strategies and vocabulary;
- further support is available in Unit 4, 'Spelling and vocabulary', in the *Literacy across the curriculum* training file.

# Using words in different contexts

## Handout 4.1

average	Estimate a general standard	Used synonymously with arithmetic mean; for a set of discrete data this is the sum of quantities divided by the number of quantities
difference	Being dissimilar, non-identical	The result of a subtraction
even	Level or smooth	A positive integer that is divisible by two
expression	Intonation of voice or aspect of face indicating emotion	A mathematical form expressed symbolically
face	Front of head from forehead solid to chin	One of the flat surfaces of a solid shape
mean	Small-minded; malicious, ill-tempered	The arithmetic mean of a set of discrete data is the sum of quantities divided by the number of quantities
negative	Image on developed film	A number less than zero



# Using words in different contexts

(continued)

## Handout 4.1

odd	Extraordinary, strange, remarkable	A positive integer that has a remainder of 1 when divided by 2
power	Mechanical or electrical energy as opposed to manual labour	This is a way of indicating how a number (or symbol) must be operated on by using another number written as a superscript to the first
prime	Chief or most important	A whole number greater than 1 that has exactly two factors, itself and 1
product	A thing or substance produced by a natural process or manufacture	The result of multiplying one number by another
root	Part of a plant below the earth's surface, which attaches it to the earth and carries nourishment from the soil to the plant	A value, which satisfies the equation which has been formed by putting an expression, containing one variable, equal to zero
sign	Write one's name as a signature	A symbol used to denote an operation. In the case of directed numbers, indicates the direction in which the number is located from the origin
term	Period of weeks during which there is teaching in school, alternating with holiday	A quantity added or subtracted from others in an arithmetic or algebraic expression



# Effective development of vocabulary

## Handout 4.2

Effective teachers:

- are aware of the language demands of particular tasks and how words are used in a mathematics lesson;
- introduce terminology at the time it is in use in the topic, so that pupils see how it is used in context;
- model mathematical language, using appropriate resources and visual displays;
- ensure that, as well as introducing new vocabulary, pupils consolidate familiar terms;
- are explicit about specialist vocabulary and ensure that pupils have opportunities to pronounce, explore and practise using new vocabulary;
- expect pupils to use correct mathematical terms and notation and to talk about their insights, rather than give single-word answers;
- use every opportunity to draw attention to new words or symbols with the whole class, in a group or when talking to individual pupils.



# Activities for developing mathematical vocabulary

## Handout 4.3

Teachers have suggested these activities to help pupils to develop their mathematical vocabulary. They can be used for oral and mental starters or as more extended activities during the main part of the lesson. Other ideas such as cloze procedure, word searches and key word crosswords are given in Unit 4, 'Spelling and vocabulary', in *Literacy across the curriculum* (DfEE 0235/2001).

### Back to back

This is an activity for pairs. One pupil is given a geometrical drawing on a card and is asked to describe the drawing; their partner draws it from the description.

This works well with tangram pieces arranged in a 'picture'. One pupil has the 'picture' on a card; the other has to assemble it.

### Definition dominoes

This is an activity for pairs, small groups or a whole class. In this game each card has two ends (like dominoes) with a combination of key words and definitions. Pupils play the game in the same way as *Dominoes*, matching key words and definitions.

### Flash cards

This is an activity for a whole class. Each pupil is given a set of six to ten flashcards linked to a topic, for example, key words related to number properties. The teacher then reads out a definition. Pupils hold up the word they think the teacher is describing. The teacher can easily see which are correct.

### How many things can you think of that ...

This is an activity for groups of pupils. Each group is asked to list as many items as they can to match a particular definition.

For example, How many things can you think of that:

- ... have parallel lines?
- ... are cylindrical?
- ... have an even chance of occurring?
- ... give an answer of  $4^3$ ?

# Activities for developing mathematical vocabulary (continued)

## Handout 4.3

### Loop card games

This is an activity for a whole class. A set of 30 loop cards with definitions and key word answers is prepared. The cards follow on from one another with the key word answer on one card following from the definition on the previous card. For example:

	A flat surface of a solid shape	FACE	The intersection of two surfaces
EDGE	An angle between $0^\circ$ and $90^\circ$	ACUTE	Two geometric shapes that are the same in every way
CONGRUENT	A polygon with seven sides	HEPTAGON	

Each pupil is given a card. One pupil starts the game by reading out the definition on their card. The rest of the class read their cards to find the correct key word answer. The pupil with the correct answer reads out their word and then reads out the definition on their card. The game continues until the 'loop' is completed. The game can be timed and then repeated over a week, aiming to beat the class record each day.

### 'Three in a row' game

This is an activity for a whole class, small groups or pairs. Each pair of pupils is given, or asked to make, a 3 by 3 grid with cells labelled to link with a particular objective, such as:

*Recognise and use multiples, factors (divisors), common factors, highest common factors, lowest common multiples and primes; use squares, positive and negative square roots, cubes and cube roots).*

Square number	Multiple of 7	Cube number
Factor of 24	Prime number	Triangular number
Negative number	Multiple of 4	Factor of 40

# Activities for developing mathematical vocabulary (continued)

## Handout 4.3

The teacher draws numbers from a pack of 1–100 number cards and calls them out. Pairs try to put the numbers into the correct category. The first pair to complete the card or get ‘three in a row’ are the winners.

Objectives related to other aspects of the curriculum can be used. For example, in shape and space, *Begin to identify and use angle, side and symmetry properties of triangles and quadrilaterals.*

For this objective, cells could be labelled with geometric properties such as ‘two equal sides’, ‘a right angle’, ‘all angles equal’, ‘two pairs of parallel sides’, ‘two lines of symmetry’, ... and names of shapes could be called out.

### Word and definition cards

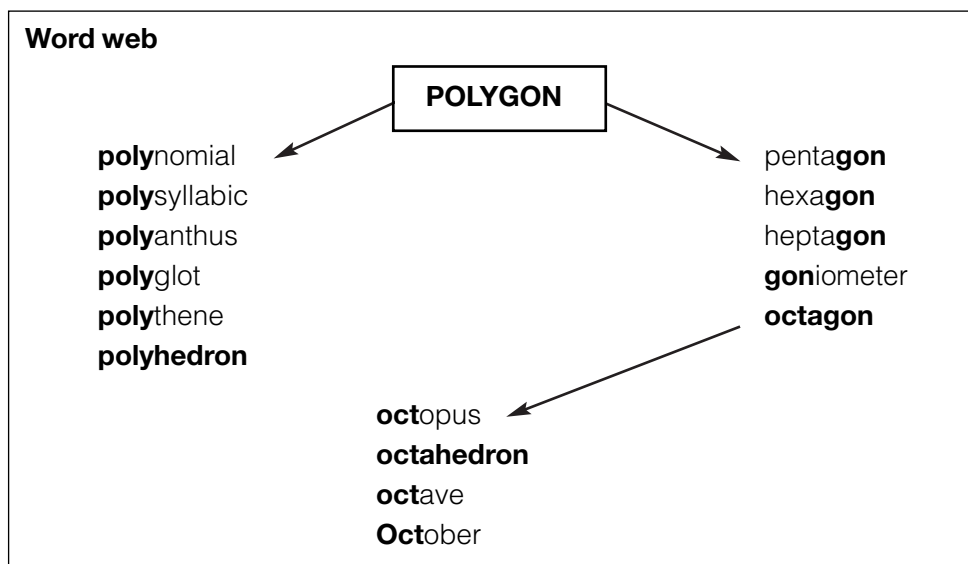
This is an activity for pairs or a small group. Cards for a topic are placed in two boxes or envelopes, one containing word cards, the other definition cards. Pupils work in pairs to match their word cards and definitions. Alternatively, the words and their definitions could be stored on a computer and pupils could cut and paste the correct pairs, or they could play *Palmanism* in small groups.

### Word webs

This is an activity for small groups or pairs. Small groups are given different starting words and asked to work together to construct word webs. Pupils add words they find with the same word root, using dictionaries for reference. Pupils can create word web posters for their mathematics classroom.

The purpose of this activity is to highlight the patterns in words through focusing attention on other roots. This helps spelling as well as understanding. This could be used as a homework activity.

Example:



# Word-level objectives

# Handout 4.4

<b>Year 7</b> Pupils should be taught to:	<b>Year 8</b> Pupils should be taught to:	<b>Year 9</b> Pupils should be taught to:
<p><b>Spelling</b></p> <p><b>Pupils should revise, consolidate and secure:</b></p> <p>7 the spellings of key words in each subject;</p> <p><b>Spelling strategies</b></p> <p><b>To continue learning, constructing and checking spellings, pupils should be able to:</b></p> <p>10 draw on analogies to known words, roots, derivations, word families, morphology and familiar spelling patterns;</p> <p>11 identify words which pose a particular challenge and learn them by using mnemonics, multi-sensory reinforcement and memorising critical features.</p>	<p><b>Spelling</b></p> <p>5 secure the spellings of key terms and new words from across the curriculum;</p>	<p><b>Spelling</b></p> <p>2 spell accurately all high-frequency words and new terms from all subject areas.</p>
<p><b>Vocabulary</b></p> <p><b>To continue developing their vocabulary, pupils should be able to:</b></p> <p>14 define and deploy words with precision, including their exact implication in context;</p> <p>16 work out the meaning of unknown words, using context, etymology, morphology, compound patterns and other qualities such as onomatopoeia;</p> <p>21 read accurately and use correctly, vocabulary which relates to key concepts in each subject, distinguishing between everyday uses of words and their subject-specific use, e.g. <i>energy</i>, <i>resistance</i>.</p>	<p><b>Vocabulary</b></p> <p>9 appreciate the precise meaning of specialist vocabulary for each school subject, and use specialist terms aptly in their own writing.</p>	