Key Stage 3
National Strategy

Guidance

Curriculum and Standards

Literacy in Mathematics

For school-based use or self-study

Heads of mathematics and teachers of mathematics

Status: Recommended

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department for
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creating opportunity, releasing potential, achieving excellence

General introduction to the Literacy in *series*

The aim of the subject-specific material in the *Literacy in …* series is to exemplify aspects of the *Literacy across the curriculum* training file for individual subjects.

Where appropriate, the relevant module from the *Literacy across the curriculum* training file is indicated, so that you can refer to it.

Key principles

- To develop consistent approaches to teaching and learning in literacy across departments, and to build increased awareness of the skills, knowledge and understanding that pupils could be expected to bring to lessons.
- To use speaking and listening to develop subject learning.
- To develop active-reading strategies to increase pupils' ability to read for a purpose and engage with text and the learning to be gained from it.
- To demonstrate the sequence for writing and modelling writing for a key text-type within the subject; seeing how it is done helps pupils to achieve it for themselves more quickly.
- To make suggestions for the learning of subject-specific vocabulary.

Making use of the Literacy in *materials*

Each subject is available on a CD-ROM. On the disc you will find both the text (a combination of information, guidance, case-study materials, mini tasks and ideas for practical application in classrooms) and the video clip(s) that accompany it. Where a short task has been suggested, you are invited to check your responses against those of other teachers provided in the examples.

'Doing' the modules by reading through them is not enough. You will gain much more from them if you try out and evaluate ideas in the classroom, and incorporate successful aspects into your teaching plans.

Try to get some support or mentoring for your study. There may be points which you are unsure about, and it is useful to have someone to ask or talk to. It also helps if you study the modules at the same time as another colleague, so that you can discuss what you are learning as you go along. In this way, activities in the classroom can also be trialled and discussed, and greater consistency of practice ensured.

English Framework objectives

The objectives from the *Framework for teaching English: Years 7, 8 and 9* (DfEE 0019/2001) which apply across the curriculum appear in an appendix; most are the key objectives (in bold) but others have been added for clarity or exemplification. This will help you to set literacy targets and ensure common approaches through the objectives.

Contents

DfES 0918-2004

Introduction

Aims

- ***To exemplify aspects of* Literacy across the curriculum *for mathematics.***
- ***To develop consistent approaches to teaching and learning of literacy in mathematics.***
- ***To raise awareness of pupils' skills, knowledge and understanding of literacy.***

Outline

This material consists of the following four modules:

Module 1 Speaking and listening

In this module you look at why talk is important in mathematics and explore the implications for teaching. You consider how to organise discussion effectively and explore how oral frames can support discussion. You analyse some pupils' talk in mathematics.

Module 2 Reading

In this module you explore the skills of reading in mathematics and the variety of different text-types used. Two strategies to develop pupils' reading skills (modelling the process of reading and using active-reading strategies) are suggested.

Module 3 Writing

In this module you consider the different types of writing required in mathematics. A video sequence demonstrates the use of modelling to develop writing in mathematics. You explore strategies to develop and practise writing skills.

Module 4 Mathematical vocabulary

In this module you identify the importance of language in mathematics. You consider ambiguity in mathematical vocabulary and look at activities to develop the use of mathematical vocabulary. You also consider strategies for teaching pupils how to learn and retain spellings.

The audio-visual materials

The video

The CD-ROM *for Literacy in mathematics* contains one video sequence 'Developing writing in mathematics'. The optional video material mentioned in Module 1, is from the *Interacting with mathematics in Key Stage 3 Year 8* video (DfES 0217/2002).
The extracts of lessons show how mathematics teaching is developing in the schools that were filmed.

The extracts are not intended as examples of 'perfect' lessons but have been chosen so that you can reflect on them as part of your professional development. When you are watching the video you will be asked to focus on particular aspects of teaching and learning.

Module	Duration	Title	Description
3	14 mins	Developing writing in mathematics	Helen teaches a lesson on writing explanations to a Year 8 mixed-ability class

The audio CD-ROM

The CD-ROM to which these notes for course tutors refer is from the *Interacting with mathematics in Key Stage 3: Year 9* materials (DfES 0591/2002).

Acknowledgements

The Key Stage 3 Strategy is grateful to all the teachers and pupils of the schools that feature in the video and CD-ROM.

1 Speaking and listening

Aims

- ***To consider the ways in which speaking and listening can support the development of concepts in mathematics.***
- ***To identify teaching strategies to support the development of speaking and listening in mathematics.***

Content

The module is in five parts:

1 Purpose of speaking and listening

2 Organising discussion

3 Oral frames

4 Using talk to deepen understanding

5 Moving on

Resources

- *Framework for teaching mathematics: Years 7, 8 and 9* (DfEE 0020/2001).
- CD-ROM, *Interacting with mathematics in Key Stage 3: Year 9* audio and text files.
- Resource sheet 1.1: Strategies for organising group talk.
- Appendix 1.

Study time

Allow approximately 75 minutes.

Purpose of speaking and listening

The development of pupils' speaking and listening skills, and the strengthening of oral and mental work, are core principles of the mathematics strand of the Key Stage 3 Strategy.

Speaking and listening enhances the learning of mathematics when:

- pupils have regular opportunities to describe, explain and justify their understanding of mathematical concepts, and practise using precise mathematical vocabulary;
- pupils are given opportunities to 'think together', discuss and explore ideas with each other, and share their mathematical reasoning and understanding.

Talk is important because it allows thinking and reasoning to be rehearsed before writing. When talk is modelled well, it helps pupils to write by giving them a voice into their writing.

Activity 1: Framework objectives supporting discussion

For this activity you will need a copy of the *Framework for teaching mathematics: Years 7, 8 and 9 (DfEE 0020/2001)*.

Using the yearly teaching programmes in section 3 of the Framework, look at the mathematics objectives for one year group.

Write down objectives which **particularly** support discussion. Highlight the words in the objectives which are about pupils' ability to communicate their learning in mathematics.

Compare your answers with the following examples drawn from the leaflet *Mathematics and the use of language* (SCAA, 1997).

There are many occasions when talk can help to raise pupils' attainment in mathematics at Key Stage 3. When pupils are:

- exploring mathematical concepts;
- describing visualisations of shapes, movements and constructions;
- explaining calculation strategies and talking about methods for the solution of problems;
- reasoning in working towards a solution and justifying results;
- comparing different mathematical processes for their efficiency and effectiveness;
- talking about mathematical expressions using mathematical and non-mathematical language;
- discussing which mathematical equipment and materials to use;
- comparing different solutions in order to arrive at a correct solution;
- discussing and interpreting data and drawing conclusions;
- presenting their findings to an audience.

In a statement on the use of language across the curriculum, the *National Curriculum for mathematics* states that pupils should be taught to listen to others, and to respond and build on their ideas and views constructively. There are many opportunities to use talk in mathematics. Mathematical discussion should be seen as an activity in its own right, as well as a valuable part of other tasks. The discussion of ideas helps pupils to clarify their understanding of mathematics.

Organising discussion

There are some key principles for organising discussion, whether with the whole class or in small groups/pairs. To be effective, discussions need to:

- **be planned**
  Effective speaking and listening does not just happen – it needs to be planned for and the teaching focused on specific objectives. Classroom furniture may need to be rearranged to enable group discussion.
- **have clear, explicit and useful outcomes**
  You should explain to pupils why 'talk' is useful in their activities and also make explicit how you expect them to talk in groups and how the groups should record and give feedback on the outcome of their discussions.
- **have precise time limits**
  You need to time discussion sessions appropriately and set clear limits for pupils. Discussions which are too short may not give all pupils time to develop and express their ideas. Those that are too long may allow pupils to lose interest.
- **engage all pupils**
  One way of ensuring that all pupils are engaged is to allocate specific roles to pupils, so that they take responsibility for aspects of the discussion.

Activity 2: Effective talk

Write down examples of particularly effective talk which you have observed, or ask a colleague for some examples that they have used successfully. Describe the features that made it effective.

Read Resource sheet 1.1: Strategies for organising group talk. This provides practical suggestions on the various ways in which paired or group talk can be managed according to the task. This sheet is from module 7 of *Literacy across the curriculum* (DfEE 0235/2001).

Activity 3: Group talk

Try out some group talk with one of your classes. You might start with using paired talk before trying any of the other strategies. Invite your mentor or another colleague to observe the lesson and provide you with some feedback.

Oral frames

'Oral frames' are a practical way of supporting pupils' talk. The following are examples of phrases that can be used in both speech and writing when working towards solutions of **word** problems.

- To begin with …
- At first …
- I know that …
- One problem was …
- I think the answer will be …
- A possible solution would be …
- Perhaps I could have …
- To improve this I need …
- The result is …
- Overall, I feel …

Activity 4: Oral frames

Write down some similar phrases for 'exploring mathematical concepts', for example, What If …?, Supposing …

Compare your list with the following suggestions:
Supposing …, I wonder if ...?, Imagine …, It might …, Conceivably …, What about …?, Perhaps …, Why would …?, Maybe …, It's possible that …, Could we …? It's probable that …

Activity 5: Aspects of talk

Now focus on each of the following aspects of talk which were drawn from the SCAA *Mathematics and the use of language* leaflet:

- Explaining calculation strategies and talking about methods for the solution of problems.
- Comparing different solutions in order to arrive at a correct solution.
- Discussing and interpreting data and drawing conclusions.

Write down some useful phrases linked to these aspects. Discuss these with a colleague.

Gathering useful phrases would make a good starter activity prior to discussion work and could also feed into written work.

Using talk to deepen understanding

In the English strand (*Year 7 speaking and listening bank*, DfEE 0141/2001), talk is sometimes referred to as a 'tool for clarifying complex ideas' for learning.
Talk can help us to:

- think through ideas;
- express thoughts and opinions;
- influence or convince other people;
- articulate ideas;
- share knowledge;
- feed back and review ideas;
- adapt and refine ideas;
- negotiate solutions;

… and much more.

Activity 6: Talking about visualisation

For this activity you will need to listen to an audio recording from *Interacting with mathematics in Key stage 3: Year 9 Geometrical reasoning*.

The recording is of a group of pupils talking about a visualisation task involving two parallel lines. To set the pupils' discussion in context, you will need first to listen to and try out visualisation 6, 'Two pairs of parallel lines'. The activity is a mental one so you should try to avoid drawing pictures.

You now need to listen to part of a discussion conducted by Sue with her Year 9 set 2 class. Focus first on the pupils and jot down your observations on the following grid as you listen to the audio track.

Identify how the group of pupils used talk in the context of a visualisation to:

think through ideas
express thoughts and opinions
influence or convince other people
articulate ideas
share knowledge
feed back and review ideas
adapt and refine ideas
negotiate solutions

Now reflect on how the teacher supported the pupils' discussion. You may need to listen to the audio track again.

Jot down some thoughts on the teacher's role in the discussion.

Compare your own thoughts with the following observations on the discussion:

- Sue, the teacher, started by defining the task 'What were we asked to do?'.
- Talk was tentative; pupils were thinking aloud and expressing their opinions.
- Talk was co-operative, with pupils supporting and convincing each other.
- The pace was varied; periods of excited, speedy talk interwoven with pauses.
- Pupils' use of language was informal but specialist terms such as rhombus and parallelogram were used.
- Pupils' talk revealed some misconceptions that may not have been identified in written work.
- Sue, the teacher, did not interject or correct pupils; she allowed them to develop their language and thought processes through talk.
- Sue, the teacher, identified where it was appropriate to take stock of the discussion and move on to the next step.

Moving on

In mathematics, pupils should be able to hypothesise, speculate, solve problems and justify their findings. Explicitly teaching the language to do this helps pupils to think more clearly, express themselves with precision and develop the language skills needed in writing. Using literacy objectives helps to inform the teaching of skills needed to become an effective speaker and listener. Planning for speaking and listening ensures that talk supports the learning in mathematics and ensures progression in the talk.

Activity 7: Speaking and listening objectives

Look at Appendix 1, which contains a selection of speaking and listening objectives from the *Framework for teaching English: Years 7, 8 and* 9 (DfEE 0019/2001). The objectives selected are ones that are particularly relevant to supporting a focus on improving the quality of talk in mathematics.

Preferably with your mentor or a colleague, identify specific points in your department's current scheme of work where these objectives could be taught or reinforced. Refer back to Resource sheet 1.1 and decide which strategy would be most appropriate for each point in the scheme of work.

Links to other materials

Further guidance is available in module 7, 'The management of group talk', and module 8, 'Listening' from *Literacy across the curriculum* (DfEE 0235/2001) and in the *Year 7 speaking and listening bank* (DfEE 0141/2001).

Pair talk

Pupils work together in pairs – possibly friendship, possibly boy/girl. Pairs can be used to promote 'response partners' during the drafting process, and to work as reading partners with an unfamiliar text. It is also ideal for quick-fire reflection and review and for rehearsal of ideas before presenting them in the whole class.

It is easy to organise even in cramped classrooms. It is also ideal to promote high levels of participation and to ensure that the discussions are highly focused, especially if allied to tight deadlines. It can be used in the early stages of learning for pupils to recall work from a previous lesson, generate questions or work together to plan a piece of work.

Pairs to fours

Pupils work together in pairs – possibly friendship, possibly boy/girl. Each pair should then join up with another pair to explain and compare ideas.

Listening triads

Pupils work in groups of three. Each pupil should take on the role of talker, questioner or recorder. The talker explains something, or comments on an issue, or expresses opinions. The questioner prompts and seeks clarification. The recorder makes notes and gives a report at the end of the conversation. On another occasion the roles should be swapped round.

Envoys

Pupils work in groups on a task. Once groups have carried out a task, one person from each group should be selected as an 'envoy' and move to a new group to explain and summarise, and to find out what the new group thought, decided, or achieved. The envoy should then return to the original group and feed back. This is an effective way of avoiding tedious and repetitive 'reporting back' sessions. It also puts a 'press' on the envoy's use of language and creates groups of active listeners.

Snowball

Individuals explore an issue briefly, then pairs should discuss the issue or suggest ideas quickly, then double up to fours and continue the process into groups of eight. This allows for comparison of ideas, to sort out the best or to agree on a course of action. Finally, the whole class should be drawn together and a spokesperson for each group of eight should feed back their group's ideas. This is a useful strategy to promote more public discussion and debate.

Rainbow groups

After small groups have discussed together, pupils should be given a number or colour. Pupils with the same number or colour should then join up, making groups comprising representatives of each original group. In their new group, pupils then take turns to report back on their group's work and perhaps begin to work on a new, combined task. This is a way of ensuring that pupils are regrouped and learn to work with a range of others.

Jigsaw

A topic is divided into sections. In 'home' groups of four or five, pupils should be allocated a section each, and then regroup into 'expert' groups. In these groups experts should work together on their chosen area, then return to their original 'home' groups to report back on their area of expertise. The 'home' group should then be set a task that requires pupils to use their different areas of 'expertise' for a joint outcome.

Advanced planning is needed but this strategy is very effective in ensuring the participation of all pupils.

Spokesperson

Each group should appoint a spokesperson. The risks of repetition can be avoided if:

- one group gives a full feedback and others offer additional points only if they have not been covered;
- each group is asked in turn to offer one new point until every group 'passes';
- groups are asked to summarise their findings on A3 sheets which are then displayed – the class can then be invited to compare and comment on them.

2 Reading

Aims

- ***To identify teaching strategies to support the teaching of reading in mathematics.***
- ***To explore ways in which developing pupils' reading enhances understanding of mathematics.***

Content

The module comprises five parts:

1. Why teach reading in mathematics?
2. Reading in mathematics
3. Teaching reading in mathematics
4. Active-reading strategies
5. Moving on

Resources

- *Framework for teaching mathematics: Years 7, 8 and 9* (DfEE 0020/2001)
- Appendix 2

Study time

Allow approximately 75 minutes.

Why teach reading in mathematics?

Read the following mathematics question:

> If the exchange rate is 1 Australian dollar for 37.02p, how much money would Amanda get for the A$48.65 she brought to England with her?

Some Year 9 pupils made the following comments, which illustrate their difficulty in reading the question.

'Need to make questions more clear.'

'I don't get it – it's too complicated. Too full of info. Should be broken down into easier bits.'

'Is that £s or what?'

Many able readers find reading tasks in mathematics demanding because of the complexity of the reading that they are required to do. Questions are often difficult to interpret because of the syntax that is used. For example, the question above was written in the subjunctive tense and the information is not in chronological order. This makes it difficult for pupils to 'hold on to' the important facts which they need to answer the question. The words used are relatively easy; it is the way the sentence is constructed that makes it difficult.

Activity 1: Reading questions

If the question is written in chronological order, it makes it much easier to interpret. Teachers should teach pupils to re-phrase difficult questions to help their understanding. Rephrase the question below to make it easier to understand:

> If the exchange rate is 1 Australian dollar for 37.02p, how much money would Amanda get for the A$48.65 she brought to England with her?

Take a few moments to consider the following list of skills that good readers have. It is adapted from the *English department training 2001*, module 8, 'Reading'. (DfEE 0234/2001).

Good readers …

- see images;
- hear a reading voice;
- predict what will happen next;
- speculate;
- ask questions;
- pass comments;
- feel;
- rationalise what is happening;
- reread;
- reinterpret;
- interpret patterns;
- relate to own experience;
- make judgements – likes, dislikes;
- relate to previous reading experience;
- establish a relationship with the narrator.

Activity 2: Reading skills

> Write down the five skills that you think pupils need to use most frequently when reading in mathematics.

Although, at first glance, many of these reading skills may not appear relevant to mathematics, reading in mathematics involves a range of skills, including visualisation, interpretation, prediction and personal response. Reading skills underpin information-processing skills. These enable pupils to find and organise relevant information, to compare and contrast it and to identify and analyse relationships (*Guide to the Framework*, p.20) when using and applying mathematics. Explicitly acknowledging this range of skills can help pupils to transfer skills learned in other areas of the curriculum.

Reading in mathematics

Now consider the range of text-types used in mathematics lessons, and the reading demands that these place upon pupils.

Activity 3: Text-types

Before working through this section, write down examples of things which pupils are expected to read in mathematics.

Compare your own list with the following examples of text-types. Did you identify any additional text-types?

- Instructions
- Exercises
- Explanations
- Tables
- Diagrams
- Charts
- Expressions

The reading that pupils are asked to do in mathematics makes further demands, because:

- reading in mathematics is not always linear;
- pupils are expected to read 'backwards and forwards' to find information and examples;
- pupils are frequently required to interrupt their reading while carrying out calculations.

In addition, pupils may encounter the variety of text-types in ICT contexts as well as in printed form.

Teaching reading in mathematics

Mathematics teachers need to use a range of teaching strategies to help develop pupils' reading skills. Effective teaching develops pupils' skills in:

- recognising terminology, numbers, mathematical symbols and technical language;
- recognising patterns and relationships;
- reading mathematical expressions, formulae and problems;
- reading charts, diagrams, tables and graphs, in order to interpret data.

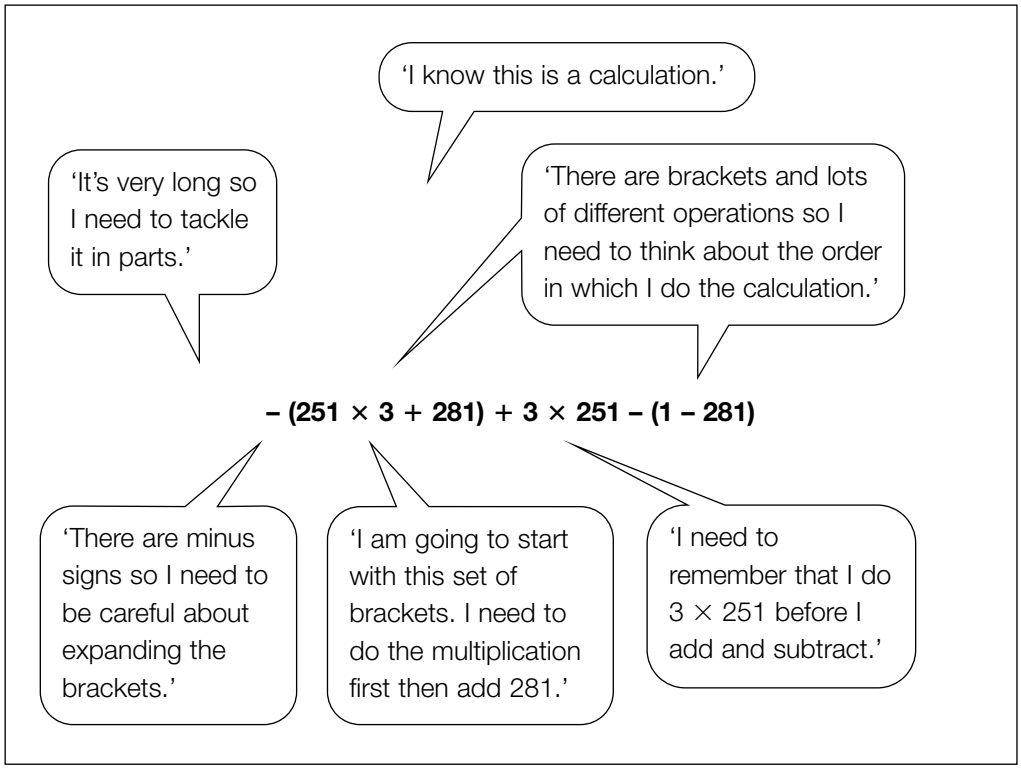
Drawn from the leaflet *Mathematics and the use of language (SCAA 1997)*

One useful teaching strategy is **modelling** the process of reading in mathematics. Modelling the skill of annotation can help pupils to read the following mathematical expression.

Find the value of …

$$-(251 \times 3 + 281) + 3 \times 251 - (1 - 281)$$

The following annotations were used.



As part of the modelling process, you need to:

- explain out loud the questions that readers may ask themselves as they interpret the expression;
- draw out explicitly how you tackle the calculation without calculating each element;
- emphasise that the verbalisation of the reading process helps make the invisible and highly complex process of reading in mathematics visible;
- be prepared to repeat the process.

Notice that for this calculation if it was read as a 'whole' you can see that you are subtracting 251 × 3 in the first bracket from 3 × 251 and subtracting 281 from – (– 281).

$$3 \times 251 - 251 \times 3 - (-281) - 281 - 1 = -1$$

Activity 4: Annotating questions

Copy each of the questions below onto the middle of a large piece of paper. Annotate each question, making explicit the reading processes that are needed in order to tackle and answer it.

Questions

- Solve the equation $3x + 2 = 2x + 5$
- If the exchange rate is 1 Australian dollar for 37.02p, how much money would Amanda get for the A$48.65 she brought to England with her?
- Draw a simple shape on a coordinate grid. Take the origin as the centre of enlargement. Enlarge the shape by a whole-number scale factor.

Active-reading strategies

Another effective strategy for teaching reading in mathematics is 'active reading'.

Active-reading strategies (often referred to using the acronym DARTS, which stands for 'Directed Activities Related to Texts') are designed to enable pupils to engage with texts in active ways by having something specific to do with the text – such as sequencing it, highlighting specific information or supplying missing words or phrases. Active-reading strategies can be extremely useful when developing pupils' reading during group or paired work.

Pupils internalise the knowledge or information because the text is transformed in some way. The activity should be chosen carefully, to ensure that it helps pupils to achieve the lesson objective and not simply as an engaging activity. Using active-reading strategies as group or paired activities ensures that oral work is incorporated. The activities are designed to be interactive as well as active.

Activity 5: Active-reading strategies

Draw lines between each objective and an appropriate active-reading strategy. Some may link to more than one. Use the objective to guide your choice.

OBJECTIVE	***ACTIVE-READING STRATEGY***
Interpret diagrams and graphs (including pie charts) and draw simple conclusions based on the shape of the graphs and simple statistics for a single distribution. (Y7)	Cut up a piece of text and sequence it.
Recognise the equivalence of percentages, fractions and decimals. (Y7)	
Understand that algebraic conventions follow the same conventions and order as arithmetic operations. (Y7)	Highlight and underline key words or phrases.
Identify the necessary information to solve a problem; represent problems and interpret solutions in algebraic, geometric and graphical form. (Y8)	Highlight and label a diagram, graph or chart to explain key features.
Decide which data to collect to answer a question. (Y8)	
Solve problems using properties of angles, of parallel and intersecting lines, and of triangles and other polygons, justifying inferences and explaining reasoning with diagrams and text. (Y9)	'True or false' Show and read statements written on cards. Ask pupils to show true/false cards to identify whether the statement is correct or incorrect.
Solve increasingly demanding problems and evaluate solutions.	

Take a few moments to consider some benefits of using active-reading strategies.

Possible benefits are that they:

- encourage close reading;
- engage pupils and encourage participation;
- make text that appears daunting more accessible;
- go beyond 'just reading' to construct meaning;
- draw out key points very clearly;
- allow teachers to identify pupils' misconceptions at an early stage in the learning process.

Moving on

Mathematics is dependent on pupils being able to find, organise and analyse relevant information. Explicitly teaching reading skills to do this helps pupils to process information more effectively.
It is important that you now try to put into practice the ideas discussed in this section.

Activity 6: Reading strategies in the classroom

Try out one of the suggested reading strategies with a Key Stage 3 class. Ask some pupils for feedback on whether this helped their understanding. Discuss this with your mentor or a colleague.

Activity 7: Reading objectives

Appendix 2 contains a selection of reading objectives from the *Framework for teaching English: Years 7, 8 and 9* (DfEE 0019/2001), which support the focus on improving reading skills particularly relevant to mathematics.
Preferably with your mentor or a colleague, consider where in your current schemes of work these objectives could be taught or reinforced.

Links to other materials

Further guidance is available in *Literacy across the curriculu*m (DfEE 0235/2001), module 6, 'Reading for information'.

3 Writing

Aims

- ***To consider different types of writing used in mathematics.***
- ***To look at how writing can be modelled in mathematics lessons.***
- ***To identify teaching strategies to develop pupils' writing in mathematics.***

Content

The module is in four parts:

1 Writing in mathematics
2 Teaching writing in mathematics
3 Extended writing in mathematics
4 Moving on

Resources

- *Framework for teaching mathematics: Years 7, 8 and 9* (DfEE 0020/2001)
- Video sequence 'Developing writing in mathematics'
- The resource sheets at the end of this module.
  3.1: Modelling
  3.2: Helen's lesson plan
  3.3: Questions
  3.4: Ways of working with pupils to develop writing skills
- Appendix 3

Study time

Allow approximately 90 minutes.

Writing in mathematics

Consider this level 5 National Curriculum test question.

Extract of a question from Key Stage 3 mathematics test

Winter mixture
Mix **1** part screenwash with **4** parts water

Is this statement correct?

25% of **winter** mixture is **Screenwash**

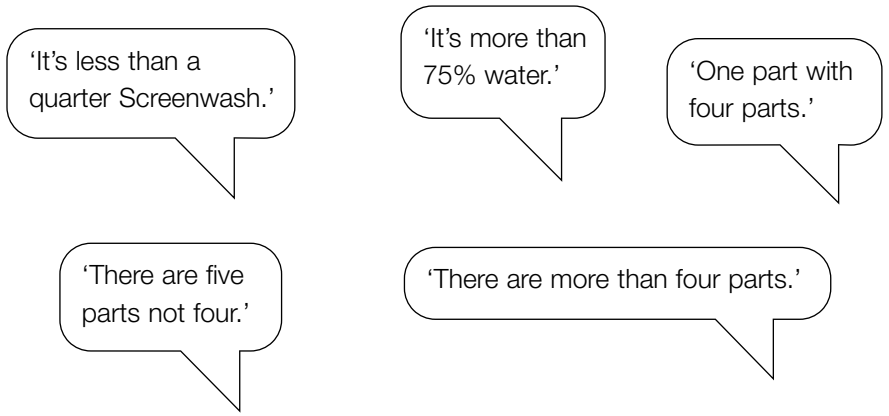
Tick Yes or No. Yes ☐ No ☐

Explain your answer.

In questions of this type, pupils have to demonstrate their understanding in their explanation to be awarded a mark in the test. Think about the kinds of explanations that Year 9 pupils are likely to give.

Here are some explanations given by pupils to support the answer 'No'.

Pupils' explanations



Teachers might accept some of these answers, given verbally, as showing some evidence of pupil's understanding of ratio, but they would address the misunderstandings illustrated above by, for example, following up the immediate answer with an explanatory connective phrase, such as 'because …' or 'which means that …'.

Given as written answers, only one of the statements would be awarded a mark ('There are five parts not four.'). Fewer than 20% of pupils at level 5 received a mark for this question.

In spoken explanations, pupils often clarify their own thinking by verbalising their ideas. The listener provides feedback for spoken explanations, by asking questions or making statements that prompt the speaker to redraft or clarify their ideas. This was illustrated in the audiotape of pupils discussing geometrical visualisations in module 1, Speaking and listening. However, for written explanations there is no immediate feedback. Pupils need help to develop their own feedback in order to monitor their answers for precision.

It is helpful to know which types of writing pupils will use in mathematics.

Activity 1: Text-types

Before working through this section, write down examples of things which pupils are expected to write in mathematics, for example, 'Explanations of reasoning'.

Write down as many other different text-types that you can think of that are expected of pupils in mathematics. Consider as broad a range as possible.

Compare your list with the following text-types.

- Instructions
- Definitions
- Answers to exercises
- Explanations of reasoning to justify or convince
- Tables, diagrams, charts and graphs
- Interpretations or data
- Algebraic or numerical expressions
- Reports of investigations

Remember that, in mathematics, the use of words may be replaced by writing algebraic expressions and drawing tables, graphs, diagrams and charts. Pupils need to be taught how to use correct algebraic conventions and to label diagrams correctly, so that the meaning is correctly conveyed without ambiguity.

Teaching writing in mathematics

Many pupils find writing in mathematics difficult. In their evaluation of the second year of the Strategy, Ofsted highlighted that the skills of writing in mathematics are not well developed.

Initially, you need to focus on developing pupils' short written explanations. Helping pupils to work on short writing activities will also encourage improvement in their longer written tasks.

One teaching strategy to help pupils to improve their skills in writing in mathematics lessons is **modelling the process of writing**.

Activity 2: Modelling

Read Resource sheet 3.1, which is a summary of module 6, 'Modelling' from the *Training materials for the foundation subjects* (DfES 0350/2002).

Reasons for using modelling are to:

- show how something is done;
- give pupils an insight into the principles and concepts that lie beneath new skills and techniques;
- scaffold learning by supported, structured activities;
- help pupils on the way to independence.

Modelling involves the teacher as an 'expert' demonstrating how to do something whilst thinking through the process aloud. Teachers use modelling to make explicit to pupils skills, decisions and processes that are normally hidden. As teachers model, they can also demonstrate the need to make alterations and corrections, revise and edit information. Modelling helps pupils to develop the confidence to use these processes themselves.

Activity 3: Writing explanations

Watch the video clip of a mathematics lesson, which focuses on writing explanations and on using connectives effectively to improve clarity. The teacher, Helen, models the processes of writing an answer to an 'explain why' question. Read Resource sheet 3.2, Helen's lesson plan, and Resource sheet 3.3, which gives the questions that Helen uses in the lesson.

The lesson takes place at South Camden Community School, an inner-city comprehensive in the London borough of Camden. Pupils' attainment on entry to the school is below average in mathematics and English. The Year 8 pupils are being taught in a mixed-ability class and have a wide range of prior attainment, from below what might be expected for their age to above age expectation. Many pupils are learning English as an additional language (EAL). However, the school recognises that **ALL** pupils will benefit from developing their language and writing skills. Helen is an advanced-skills teacher.

While watching the video clip, consider the following questions.

- What skills, processes or procedures are being modelled?
- How does the modelling make explicit the thinking and decisions behind the task?
- How does the teacher scaffold the learning following the modelled activity, in order to move pupils towards independence?

The model used by Helen gave pupils a structure which they could use for their own writing. The focus on connectives enabled pupils to join different parts of the explanation together. Hearing the writing read aloud helped pupils to absorb the style and identify whether it 'sounded right', and pupils were encouraged to work in pairs and fours to read and redraft their writing. Modelling the process of writing with pupils will lead to improvements in pupils' writing *only* if the pupils are given opportunities to practise writing.

Extended writing in mathematics

In mathematics, pupils are expected to produce extended writing to describe strategies, reasoning and other mathematical processes, particularly in investigations or problem-solving. Many pupils, even some who are successful mathematicians, find this task difficult. Teachers of mathematics often say they would appreciate a bank of strategies, additional to the modelling process.

Candia Morgan, from the University of London Institute of Education, has undertaken a research study of pupils' written reports of mathematical investigations. She has concluded that the development of written mathematical language does not happen spontaneously. It needs to be taught. Working with a group of mathematics teachers, she has developed a list of suggested teaching strategies to help pupils develop their awareness of the characteristics of writing in mathematics, and their skills in producing effective reports of extended mathematics work, such as investigations.

Candia Morgan lists these teaching strategies under four key headings:

- Getting started.
- Supporting developments.
- Nurturing a sense of audience.
- Developing critical reading and writing.

Activity 4: Strategies to develop writing skills

Read Resource sheet 3.4, Ways of working with pupils to develop writing skills, which lists under the four key headings some strategies to help teachers develop writing and provide some starters and connectives to support pupils' writing.

After reading the summary, identify a strategy that you have already used in your classroom. This strategy may or may not be from the list. Now identify one or two new strategies that you will try out in your classroom.

Moving on

Writing is important in mathematics, because it helps pupils to consolidate their understanding and also allows this understanding to be assessed over time. You need to provide opportunities for pupils to write and to assess their own writing. You can help your pupils to improve their writing by using strategies such as 'sentence starters', and by modelling the process of writing.

It is important that you now try to put into practice the ideas discussed in this section.

Activity 5: Writing strategies in the classroom

Try out one of the suggested writing strategies with a Key Stage 3 class and evaluate pupils' responses. Discuss this with your mentor or a colleague.

Activity 6: Writing objectives

Appendix 3 contains a selection of writing objectives from the *Framework for teaching English: Years 7, 8 and* 9 (DfES 0019/2001) which support the focus on improving writing skills particularly relevant to mathematics.

Preferably with your mentor or a colleague, consider where in your current schemes of work these objectives could be taught or reinforced.

Links to other materials

Further support is available in *Literacy across the curriculum* (DfEE 0235/2001), in module 3, 'Writing style'.

A research project 'Teaching strategies to improve writing in mathematics', commissioned as part of the TTA Teacher Research Grant Scheme, 1996/7 provides further ideas.
(http://www.tta.gov.uk/assets/itt/providers/research/grant/96-97/tta19.pdf05/12/03)

Modelling

Resource sheet 3.1

Definition of modelling

Modelling involves the teacher as 'an expert' demonstrating how to do something while thinking through the process aloud. By 'thinking aloud' the teacher shows the importance of making decisions such as:

- how to begin;
- how to select information which is relevant to the task or audience;
- how to organise the information or ideas;
- the use of protocols relating to the presentation of information or ideas;
- how to end.

Teachers use modelling to make skills, decisions and processes which are normally hidden explicit to pupils. As they do so, they can also demonstrate the need to make alterations and corrections, and revise and edit information. This helps pupils to develop the confidence to use the processes themselves.

Examples of modelling

Processes, concepts or skills which could be modelled include:

- writing an account or explanation;
- constructing a mind-map;
- evaluating a piece of artwork or a finished product in design and technology;
- considering options when receiving the ball in an invasion game, for example, football or netball;
- drawing a field sketch in geography.

This is an extract from a teacher commentary which illustrates the last example.

> Teacher (*modelling the activity on a board or OHT*):
>
> 'OK, now where do I start? … if I want to make an accurate sketch then I need to make sure I draw a frame that is the same shape as the 'view' …
>
> Now I'm ready to draw the field sketch itself … it's important to draw in the main landscape lines first so that I divide up the different areas of land use …
>
> Now I have an outline of the main areas I can put in the detail … a few outlines of buildings … oops … it doesn't really matter that they don't look like buildings … this isn't a piece of art … the most important thing is that the labels we add in next are detailed and accurate …
>
> Now to start annotating the sketch … because this sketch is about Chester as a tourist destination, it's important that I pick out the main attractions … hmmmm … first the cathedral … I'll pick out some important details from this guidebook to Chester …'

This definition of modelling and these examples are from the *Training materials for the foundation subjects*, DfES 0350/2003: module 6, 'Modelling'.

Helen's lesson plan

Resource sheet 3.2

Total time
60 minutes

Objectives

- Develop different ways of linking sentences e.g. choice of connectives (Literacy)
- **Identify the necessary information to solve a problem; represent problems and interpret solutions**
- **Use logical argument to establish the truth of a statement**

Starter

Vocabulary
connectives

Lesson to focus on writing explanations in mathematics and on using connectives effectively to improve clarity.

Establish that pupils know about connectives.

Resources
none

Q. Can anyone explain what a connective is?
Q. Why do we use connectives?
Q. What connectives do you know?

Ask pupils to suggest some connectives and record on the board. Establish which ones are particularly useful when writing mathematical explanations (so, therefore, if, then, but, …).

Main teaching activity

Vocabulary
justify
if … then
therefore
proportion
ratio
fraction
percentage

Screenwash

Ask a pupil to read the Screenwash question aloud.
Explain that I'm going to model how to solve the problem.
Model how I would think through the problem explaining that I can't answer the question 'Yes or No' without thinking it through. Be explicit about the talking.

I am looking at the winter mixture, so I have one part of Screenwash and four parts of water. That means I have five parts altogether. But 25% is a quarter, so there must be four parts so the statement can't be true.

Resources
mini-whiteboards

'Screenwash' and 'Orange juice' questions (one for each pair)

Write on the board:

If 25% of the mixture is Screenwash then I will have four parts, because 25% is 1/4. However I have five parts in the mixture; therefore the statement is incorrect.

Emphasise how I use connectives to make the justification as clear as possible

Ask pairs to:

- read the problem about the summer mixture of Screenwash;
- talk through their answer;
- write their answer in sentences on the mini-whiteboard, using the model on the board to help them;
- improve and redraft their answer on the mini-whiteboard.

Ask pairs of pupils to form groups of four and to:

- read out their answers;
- work together to refine their answers;
- produce one 'best' answer from the group.

Mini-plenary

Bring the class together. Select one pupil to read their answer out to the class.
Ask everyone:

> **Q. How could you improve this answer?**

Take some ideas. Write the pupil's answer on the board, with improvements if appropriate.

Ask pupils to repeat the process for the Orange juice question.

Plenary

Resources
'Hannah's cycling question' (one for each pupil)

Ask everyone to read 'Hannah's cycling question'.

> **Q. Can you explain why Hannah is wrong?**

Work with the whole class to agree a statement to show that Hannah is wrong.

> **Remember:**
> - **Talk through your answer before you write anything down.**
> - **Draft your answer thinking about the connectives you will use.**
> - **Read your answer aloud to someone else to check that it is clear. Make any changes that you need to improve your answer.**

Questions

Resource sheet 3.3

These questions have been adapted from Key Stage 3 mathematics test papers.

1 Screenwash

Screenwash is used to clean car windows.

Winter mixture	**Summer mixture**
Mix **1** part Screenwash with **4** parts water.	Mix **1** part Screenwash with **9** parts water.

Is this statement correct?

> **25%** of **winter** mixture is **Screenwash**.

Explain your answer.

Is this statement correct?

> $\frac{1}{10}$ of the **summer** mixture is **Screenwash**.

Explain your answer.

2 Orange juice

There is 20% of orange juice in every litre of a fruit drink.

> I mix 1 part of orange juice with 6 parts of water to make this drink.

Is this statement correct?
Explain your answer.

3 Cycling

Hannah went on a cycling holiday. The table shows how far she cycled each day.

Monday	Tuesday	Wednesday	Thursday
32.3 km	38.7km	43.5 km	45.1 km

Hannah says: On average, I cycled over **40 km** a day.

Show that Hannah is wrong.

Ways of working with pupils to develop writing skills

Resource sheet 3.4

Getting started

1 The whole class or group works on the same investigation. They produce a class or group report of the investigation.

e.g. The teacher acts as the scribe, taking suggestions from individuals about what to write next and encouraging the class to discuss, evaluate, assess and amend each suggestion. Use large sheets of paper and a marker pen so that the report can be kept and displayed.

2 The whole class works on the same investigation and each individual produces a report. The teacher constructs a single amalgamated 'write-up' of the investigation by cutting and pasting sections from all the pupils' work, then displays this class report for discussion with the pupils.

Supporting development

3 Set restricted tasks, focusing on just one aspect that might appear in a full report.

e.g. Describe the patterns you can see in this table/diagram.
Explain how you worked out the generalisation from the table.

Such tasks may be set in the context of everyday classwork (not necessarily investigational work).

e.g. Explain how to add fractions.
Describe the properties of a rhombus.

4 Give pupils, in pairs, writing tasks. Encourage them to talk before they write.

5 Provide starts of sentences as a writing frame and ask pupils to use them to support their work

Here are some useful sentence starters to use in an investigation report.

I decided to … (so that … because …)

I noticed that …

I noticed a connection between …

When I looked at … (the results/table/graph),

I noticed that …

Using the numbers in the table, I looked at …

(the sum/product/square/…)

I tried … (multiplying/adding/doubling/…)

This reminded me of … (the triangle numbers/ Pythagoras' theorem/…) so …

I tested …

I wondered why …

This didn't work, so …

This worked, so …

I already know that … so …

This is true because …

Add your own (or the pupils') starters to the list.

Many teachers find it useful to display such a list in their classrooms.

Nurturing a sense of audience

6 Encourage pupils to read each other's writing and evaluate and assess it.

e.g. Pupils could write a first draft of their investigation report, then get together in small groups to read, ask for clarification and make suggestions for editing.

7 Ask pupils to write reports for a specific audience and purpose.

e.g. For a younger year group, to show them how to do an investigation or how to write an investigation report.

For display at a parents' evening, to show how much they have achieved.

8 Some types of practical problem and statistical investigation lend themselves to addressing particular audiences.

e.g. After conducting surveys of traffic passing the school, pupils write a report to the local council presenting the case for a pedestrian crossing.

After an investigation of shapes, surface areas and volumes of boxes, pupils write a report to a manufacturer recommending a particular design of packaging for their product.

9 When assessing pupils' investigation reports, give them feedback after reading their report and suggest where they might improve it.

e.g. 'I didn't quite understand this explanation, perhaps a diagram would help.'

'You say you "found" the formula but I don't see how you did it. Did you try some ideas out in your head? What were they?'

Developing critical reading and writing

10 Give pupils investigation reports to read, ask them to answer comprehension questions about the reports and, where necessary, to rewrite. Give both good and poor examples.

11 After they have done an investigation, instead of asking them to write their own reports give pupils reports written by a previous class. Ask them to edit and improve these reports.

12 When a group or whole class has worked on reading and rewriting the same report, discuss this with them. Then ask them to develop their own list of hints for writing good investigation reports.

4 Mathematical vocabulary

Aims

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

Content

The module is in four parts:

1 Vocabulary

2 Developing and reinforcing vocabulary

3 Spelling strategies

4 Moving on

Resources

- *Framework for teaching mathematics: Years 7, 8 and 9* (DfEE 0020/2001)
- The resource sheets at the end of this module.
  4.1: Using words in different contexts
  4.2: Activities for developing mathematical vocabulary
- Appendix 4

Study time

Allow approximately 60 minutes.

Vocabulary

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.*

Developing pupils' understanding and correct use of mathematical vocabulary can support their understanding of mathematics. The analysis of pupil performance in Year 7 by QCA 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 but also to lack of confidence with the underlying concepts.*

The Vocabulary checklist (section 5) in the *Framework for teaching mathematics: Years 7, 8 and 9* (DfEE 0020/2001), includes the key mathematical vocabulary used in the teaching programmes and supplement of examples. Pupils should be expected to use, read, write, and spell these words correctly.

Activity 1: Vocabulary checklist

Read through the checklist on pages 8 and 9 of section 5 which lists the vocabulary expected at the end of Year 9.

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 needed if pupils are to use correct mathematical terminology themselves.

Subject-specific terminology is important, because it enables teachers and pupils to convey precise meaning. However, not all words in mathematics are unambiguous; many words used in mathematics are also used in everyday contexts, where they have a different meaning, e.g. *bracket, origin, volume*. Words used in mathematics often have a precise definition but are used more loosely in everyday contexts, e.g. *diagonal, similar*.

Activity 2: Words in different contexts.

For this activity you will need Resource sheet 4.1. Cut up the cards and shuffle them. Then match each word with its subject-specific meaning and its everyday meaning. Identify the words which you think cause confusion for your pupils. Consider using this activity with pupils.

Developing and reinforcing vocabulary

It is important to teach pupils subject-specific vocabulary, because it cannot be assumed that pupils will know subject-specific meanings.

Activity 3: Development of vocabulary

Consider the features listed below and highlight aspects which you think you are developing well, and others that you could develop further.

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

There is a range of activities to develop mathematical vocabulary. Resource sheet 4.2 provides some examples which 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.

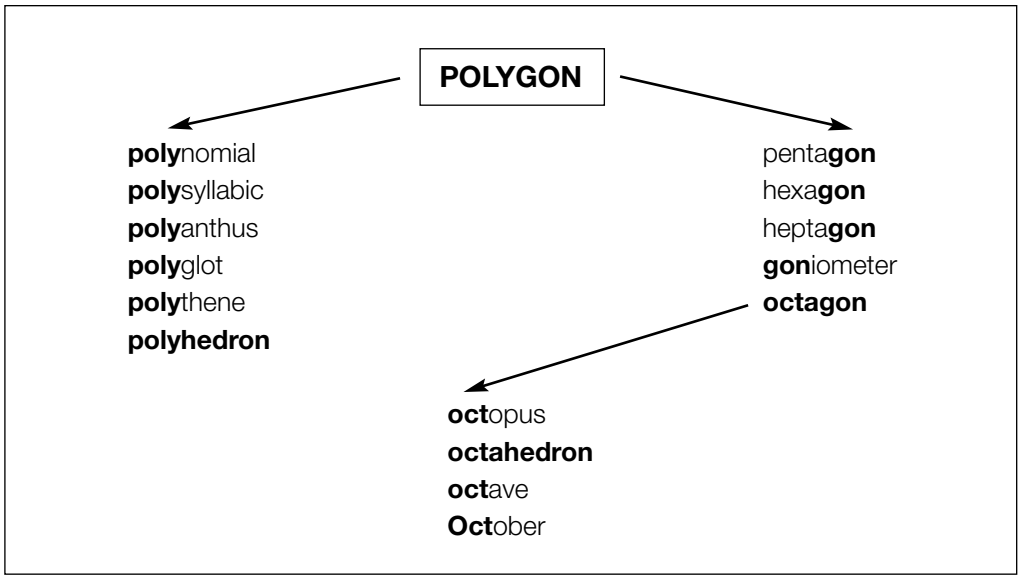
The best learning is achieved through active tasks; those on the resource sheet are intended as refresher activities. For the greatest impact, activities need to be used 'little and often' and you need to ensure that they are suitably challenging. Other ideas such as cloze procedure, word searches and key word crosswords are given in module 4 'Spelling and vocabulary' in *Literacy across the curriculum* (DfEE 0235/2001).

Word webs

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

This activity can be used to highlight the patterns in words through attention to word roots, and so aid spelling and understanding. Mathematics is rich in words that have their roots in Latin and Greek.

A word web is constructed by taking a single word from each list to start a new list. For example, starting with **POLYGON**, the following word web could be constructed.



The meanings of the roots (poly, gon, oct and hedron) can then be deduced:

- poly means many
- gon means angled
- hedron means base
- oct means eight (October was originally the eighth month)

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

Activity 4: Word webs

Create some word webs of your own. Choose a couple of starting words from *binary*, *circumference*, *equilateral*, *kilogram*, *triangle*. It may be helpful to have a dictionary available for reference. Try this idea with a class as a starter.

Activity 5: Activities in the classroom

Try out at least one of the activities from Resource sheet 4.2 with a class in the next fortnight. Evaluate the activities. Are there other effective activities used by teachers in the department?

Spelling strategies

Pupils often find it difficult to spell mathematical words correctly.

Activity 6: Remembering spellings

Think about how you might help pupils who are struggling to remember how to spell the mathematical words below? What strategies would you suggest for each word?

Some mathematical words

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

Here are some strategies promoted by the English strand for remembering spellings.

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

Activity 7: Strategies for remembering spellings

Try some of these ideas during the next fortnight. Discuss with pupils which strategies they find most helpful.

Moving on

Using literacy objectives helps to focus the teaching of spelling strategies and vocabulary.

Activity 6: Word-level objectives

Appendix 4 contains a selection of word-level objectives from the *Framework for teaching English: Years 7, 8 and 9* (DfEE 0019/2001) which highlight aspects of improving vocabulary and spelling particularly relevant to mathematics.

Preferably with your mentor or a colleague, consider where in your current schemes of work these objectives could be taught.

Links to other materials

Further support is available in module 4 'Spelling and vocabulary' in the *Literacy across the curriculum* (DfEE 0235/2001) training file.

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 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

Power	Extraordinary, strange, remarkable	A positive integer that has a remainder of 1 when divided by 2
Prime	Mechanical or electrical energy, as opposed to hand 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 some weeks alternating with holiday during which there is teaching in school	The quantities that are linked to each other in a simple algebraic expression by means of + or – signs

Activities for developing mathematical vocabulary

Resource sheet 4.2

Back to back

This is an activity for pairs. One pupil should be given a geometrical drawing on a card and be asked to describe the drawing to their partner, who then draws it from the description. (This works well with Tangram pieces arranged in a 'picture'. One pupil has the 'picture' on a card and their partner has to assemble it.)

Definition dominoes

This is an activity for pairs, small groups or a whole class. In this game, each card contains two ends (like dominoes) with a combination of key words and definitions. Pupils play the game like dominoes, matching key words and definitions across cards.

Flash cards

This is an activity for a whole class. Each pupil should be given a set of six to ten 'flash cards' linked to a topic, e.g. key words to do with number properties. The teacher should then read out a definition and pupils should hold up the word which they think the teacher is describing. The teacher can easily see which pupils are correct.

How many things can you think of that …

This is an activity for groups of pupils. Each group should be asked to list as many items as they can which 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?

Loop card games

This is an activity for a whole class. A set of thirty loop cards should be prepared, containing definitions and key word answers. The cards should 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° and 90°

ACUTE	Two geometric shapes that are the same in every way

CONGRUENT	A polygon with seven sides	HEPTAGON	

Each pupil should be given a card. One pupil starts the game by reading out the definition on their card. The remaining pupils then look at their cards to find the one with 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 pairs of pupils. Each pair should be given, or be asked to make, a 3 x 3 matrix, 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

The teacher should then draw numbers from a pack of 1–100 and call them out. The pairs should 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 called out.

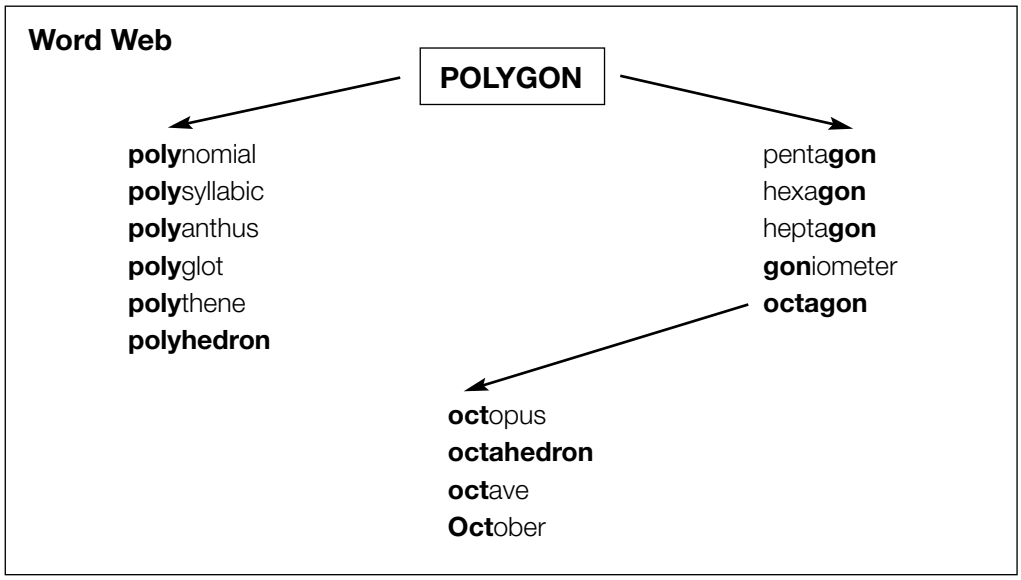
Word and definition cards

This is an activity for pairs. Cards for a topic should be placed in two boxes or envelopes – one containing word cards, the other definition cards. Pupils then 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 'Pelmanism' in small groups.

Word webs

This is an activity for small groups or pairs. Small groups should be given different starting words then be asked to work together to construct word webs. Pupils then 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 attention to other roots. This helps spelling as well as understanding. This could be used as a homework activity. For example:



Speaking and listening objectives

Year 7	Year 8	Year 9
Pupils should be taught to:	**Pupils should be taught to:**	**Pupils should be taught to:**
Speaking **1 use talk as a tool for clarifying ideas, e.g. by articulating problems or asking pertinent questions;** **4** give clear answers, instructions or explanations that are helpfully sequenced, linked and supported by gesture or other visual aid; **5** promote, justify or defend a point of view using supporting evidence, example and illustration which are linked back to the main argument.	**Speaking** **5** ask questions to clarify understanding and refine ideas.	
Listening **7** answer questions pertinently, drawing on relevant evidence or reasons.	**Listening** **7 listen for a specific purpose, paying sustained attention and selecting for comment or question that which is relevant to the agreed focus.**	**Listening** **5** compare different points of view that have been expressed, identifying and evaluating differences and similarities.
Group discussion and interaction **12** use exploratory, hypothetical and speculative talk as a way of researching ideas and expanding thinking; **13** work together logically and methodically to solve problems, make deductions, share, test and evaluate ideas.	**Group discussion and interaction** **10 use talk to question, hypothesise, speculate, evaluate, solve problems and develop thinking about complex issues and ideas;** **12** take different roles in discussion, helping to develop ideas, seek consensus and report the main strands of thought.	**Group discussion and interaction** **9 discuss and evaluate conflicting evidence to arrive at a considered viewpoint;** **10** contribute to the organisation of group activity in ways that help to structure plans, solve problems and evaluate alternatives.

Reading objectives

Year 7	Year 8	Year 9
Pupils should be taught to:	**Pupils should be taught to:**	**Pupils should be taught to:**
2 use appropriate reading strategies to extract particular information, e.g. *highlighting, scanning*; **3** compare and contrast the ways information is presented in different forms, e.g. web page, diagrams, prose; **4** make brief, clearly-organised notes of key, points for later use; **6** adopt active-reading approaches to engage with and make sense of texts, e.g. visualising, predicting, empathising and relating to one's own experience; **8 infer and deduce meanings using evidence in the text, identifying where and how meanings are implied.**	**1** combine information from various sources into one coherent document; **2 undertake independent research using a range of reading strategies, applying their knowledge of how texts and ICT databases are organised and acknowledging sources;** **3** make notes in different ways, choosing a form which suits the purpose, e.g. diagrammatic notes, making notes during a video, abbreviating for speed and ease of retrieval.	**1** review and extend their own strategies for locating, appraising and extracting relevant information; **2 synthesise information from a range of sources, shaping material to meet the reader's needs;** **3** increase the speed and accuracy of note-making skills and use notes for re-presenting information for specific purposes.

Writing objectives

Year 7	Year 8	Year 9
Pupils should be taught to:	**Pupils should be taught to:**	**Pupils should be taught to:**
Text level – writing **1 plan, draft, edit, review, proofread and present a text with readers and purpose in mind;** **2** collect, select and assemble ideas in a suitable planning format, e.g. *flow chart, list, star chart.*	**Text level – writing** 3 use writing for thinking and learning by recording ideas as they develop to aid reflection and problem solving.	
Write to inform, explain, describe **11** select and present information using detail, example, diagram and illustration as appropriate; **13** give instructions and directions which are specific, easy to follow and clearly sequenced.	**Write to inform, explain, describe** **11 explain complex ideas and information clearly, e.g. *defining principles, explaining a scientific* process.**	**Write to inform, explain, describe** **10** explain the precise connections between ideas with clarity and an appropriate degree of formality.
Write to persuade, argue, advise **16** find and use different ways to validate an argument, e.g. *statistical evidence, exemplification, testimony.*	**Write to analyse, review, comment** **17** integrate evidence into writing to support analysis or conclusions, e.g. *data, quotation.*	

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

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Great Smith Street
Westminster
London SW1P 3BT

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