Section 1

Focusing teaching to improve pupil performance

Helping pupils prepare for Key Stage 3 mathematics tests

The Key Stage 3 National Strategy aims to improve standards in all subjects. This guidance is designed to help teachers enable pupils to maximise their achievements in mathematics at the end of Key Stage 3. Pupils will then enter Key Stage 4 confident and better prepared for GCSE and other courses.

The guidance reinforces approaches that teachers in schools are using in the mathematics strand of the Key Stage 3 National Strategy. It reflects existing good practice in many schools and will help all schools to strengthen pupils' understanding of mathematics before the National Curriculum tests in May.

Although this guidance is particularly for Year 9 teachers of mathematics, it should also be read by headteachers and senior managers responsible for the Key Stage 3 National Strategy in schools. Similar guidance is provided for English and science. The school's senior management need to ensure that booster provision is carefully planned and coordinated across the school, particularly as many of the same pupils will benefit from extra provision in all three subjects.

The Key Stage 3 National Strategy has prepared a set of materials designed to support schools in organising revision and running booster classes. These comprise:

- this guidance;
- a set of 12 booster lessons, tightly focused on the skills, knowledge and understanding required to achieve levels 5 and 6 in mathematics;
- a leaflet for pupils that focuses in an accessible way on revision technique and test preparation;
- a leaflet for parents and guardians, designed to provide relevant information on the Year 9 tests, and useful guidance on the support that they can offer in the run up to the tests.

The leaflets and lessons are also available on the Key Stage 3 National Strategy website so that you can download and customise them for your school and pupils: www.standards.dfes.gov.uk/keystage3

Planning for revision inside and outside lesson time

New learning in mathematics often depends on previous knowledge and skills. Revision needs to be a continuous process and not merely pre-test cramming. The planning structures recommended for the Key Stage 3 mathematics strand include revisiting work during the year and over the key stage.

Revision can take the form of recapping quickly on a topic before moving on to new work. You might also use part of some lessons to keep basic facts, skills and techniques 'on the boil'. You need to highlight revision techniques for pupils.

This guidance can be used to support teaching in mathematics lessons through a well-planned and targeted revision programme. It can also support any additional teaching. You may choose to provide extra help:

- by creating an **extra set** for a short period before the tests;
- before and after school through **homework clubs** and other support networks;
- through **revision classes** outside the school day staffed by a teacher;
- by arranging **additional time** during the school day supervised by a teacher or other competent adult, for example at lunchtime clinics or in tutorial time;
- through providing **extra lesson time** within the school day for some or all pupils;
- by providing a series of **feedback tutorials** after practice questions or a practice paper for pupils who produce disappointing work;
- by setting up a series of **coaching tutorials**, where a tutor observes how a targeted group of pupils tackle a practice paper and provides specific support and guidance on test technique;
- by providing **mentoring support** to a targeted group of pupils, offering a diagnostic review of their work, identifying specific improvement targets, with regular monitoring and mentoring sessions;
- through **additional adult support** such as teaching assistants, SEN support assistants, etc. during lessons.

When planning revision strategies and booster provision, schools will need to take account of the specific needs of pupils, timetabling options, and the available expertise. While using additional adults and teaching assistants may appear an attractive option, it is vital that those employed are sufficiently competent and both fully prepared and supported in the role.

Securing the attendance of the pupils most likely to benefit from booster lessons is a crucial issue; the experience of some schools in the Pilot was that when lessons were offered on a voluntary basis, the pupils most in need of them often did not attend.

Examples

One pilot school ran a series of eight after-school lessons, each focused on a particular mathematical topic. These topics addressed pupils' previously identified weaknesses. The programme was run in conjunction with English and science, targeting appropriate pupils. Teachers were paid for this additional teaching.

Another pilot school created an extra mathematics set in the lead up to the tests. The class was taught by a non-specialist teacher under the guidance of the head of department. This, together with targeted teaching during the year, enabled the school to increase the number of pupils attaining level 5 in mathematics by 15%.

In a third school, small groups of pupils were withdrawn from other lessons for a 15-minute revision session on a particular topic that was linked to their class teaching in mathematics. A teaching assistant, who received training, supported the sessions under the guidance of the head of department.

Supporting teaching and learning

Paying regular attention to the following points will help you in your teaching and pupils in their learning.

- Use direct interactive teaching to emphasise specific aspects of mathematics.
- Engage pupils in discussion. Encourage them to articulate and describe the methods and reasoning they use and to compare these with others' ideas.
- Ensure that pupils understand and use vocabulary correctly, particularly subject-specific vocabulary. Study the vocabulary and make sure that all pupils can read and write these words correctly.
- Give pupils practice in interpreting questions by focusing on both the subject vocabulary and the language typically used in test questions.
- Use errors from previous work as key teaching points. This technique is central to assessing what pupils know, and to planning subsequent work to move learning forward and raise standards. Talk about common errors with pupils. Avoid re-teaching work in the same way.
- At the end of each lesson, stress the main learning points and assess pupils' progress informally.
- Work with pupils to sort out misconceptions and identify progress, to summarise key facts and ideas and what needs to be remembered. Give pupils strategies to help them remember key facts. Discuss the next steps and set regular work to do at home.
- Make sure that pupils check their work.

Throughout the year, you should:

- give pupils practice at working a variety of questions from previous Key Stage 3 tests;
- ask pupils which topics they feel most confident about and which they feel least confident about – practise the latter;
- give pupils regular practice in completing work within a restricted period of time.

Previous tests on CD-ROM

Previous years' tests are available on the Testbase CD-ROM produced by QCA / Testbase. This is obtainable from Testbase, PO Box 208, Newcastle on Tyne, NE3 1FX; tel. 0870 9000 402; fax 0870 9000 403; website www.testbase.co.uk.

The CD-ROM is supplied free of charge. Individual key-stage subjects can then be accessed using registration codes at a cost of £25 per subject. Some LEAs have purchased a licence. An updated version to include 2001 tests is available.

Using these materials can help pupils to see what they know and can do, to review and extend their learning, to gain experience of the types of questions included in the tests, and to become familiar with the format and timing of the tests.

Effective practice using Testbase in mathematics lessons includes:

- shared reading of questions and mark schemes;
- supporting pupils with the same personal target in tackling a question;
- setting group and individual targets based on analysis of answers to test questions;
- pupils working in pairs to analyse each other's answers and to review targets.

National performance in recent Key Stage 3 mathematics tests

In 2001, 66% of Year 9 pupils gained level 5 and above in mathematics, while 43% gained level 6 and above. In 1998, 58% of pupils in this same cohort gained level 4 at Key Stage 2 in mathematics tests.

In 2000, 65% of Year 9 pupils gained level 5 and above in mathematics, while 39% gained level 6 and above. In 1997, 62% of pupils in this same cohort gained level 4 at Key Stage 2 in mathematics tests.

It is useful to analyse the performance of previous Year 9 pupils in National Curriculum tests within your own school . This may give you pointers to common weaknesses that you can address across the school.

Improvements over time

Improving performance in tests is not secured in a last-minute act of revision. It is much more efficient to build pupils' performance over a long period, addressing weaknesses and consolidating new skills.

Moreover, improvements are not simply done to pupils, but are cultivated and self-acquired. One of the most effective approaches to improvement is to recruit the commitment of pupils themselves to class, group or personal targets. Such targets are framed as achievable aims and 'owned' by the pupils. They can be based on the list on pages 11–14 or you may choose to share appropriate key objectives as listed in section 2 of the *Framework for teaching mathematics: Years 7, 8 and 9.* Make sure that pupils know clearly what you intend them to learn and that you can evaluate their progress; for example, 'Today we are going to learn …' and 'Let's check that you now know …'

Having identified pupils' weaknesses, select appropriate teaching objectives from the Framework as a basis for your planning and teaching. You should address these objectives explicitly and not just through a passing reference. Make sure that in lessons you focus some time on developing oral and mental work. This is an excellent way of checking pupils' understanding in order to inform your future planning. It also provides opportunities to keep past work fresh in pupils' minds.

Implications for teaching and learning across the key stage

This guidance draws on the *Framework for teaching mathematics: Years 7, 8 and 9* and recent QCA reports on *Standards at Key Stage 3 Mathematics*. It highlights objectives in mathematics on which you need to focus in order to improve the performance of Year 9 pupils. Remember that the Year 8 teaching programme in the Framework consolidates level 5 while the main Year 9 teaching programme targets level 6 of the mathematics National Curriculum.

General points

Pupils need to understand that the instruction 'Show your working' is to remind them to indicate their methods as well as their answers. Pupils may be awarded partial credit even if the final answer is incorrect.

Pupils need to use notation correctly, for example giving two decimal places in money and positioning the decimal point correctly.

Make sure that you focus on the correct use of mathematical vocabulary and notation.

Mental mathematics

To improve pupils' mental skills you need to be guided by the expectations set out in the Framework. Use the supplement of examples, pages 88–103 (mental methods and rapid recall of number facts). However, virtually all topics in mathematics can form the basis of oral and mental work. You can use oral work to identify gaps in pupils' knowledge and understanding as well as weaknesses in calculating. You also need to build in sessions that focus on teaching mental strategies as well as time to recall facts and practise skills. Make sure that you include some problems leading to multi-step calculations.

To help pupils to achieve **level 5** you need to:

- teach place value so that they can multiply and divide decimals by 10, 100 and 1000;
- explain and help them to see links between similar calculations, for example:

  Use 234 ÷ 15 = 15.6 to work out 468 ÷ 15
- develop their understanding of fractions, decimals and percentages including giving them confidence in calculating, for example, $\frac{1}{5}$, $\frac{3}{5}$, 25%, 10% and 70% of quantities;
- teach a range of strategies to complete mental calculations involving decimals, for example:

  15 – (3.9 + 6.1)

  Find the sum of 3.8, 1.2, 3.8 and 1.2

  Halve 3.5
- develop pupils' ideas about ratio and proportion and use them to solve simple problems;

- demonstrate and give pupils practice in approximating answers to calculations involving whole numbers, for example:

  502 ÷ 49
- give pupils experience of reasoning about shapes based on a visual stimulus, especially examples involving rotation;
- support pupils in imagining situations described by a series of instructions, for example:

  Imagine a semicircle cut out of paper.
  Imagine folding it in half along its line of symmetry.
  Fold it in half again, and once more.
  How many degrees is the angle in the corner of the shape?

Pupils targeting **level 6** need to:

- be secure in approximating answers to calculations such as 50.6 ÷ 0.49 and compound examples using the four operations, simple powers and roots;
- develop an understanding of the equivalences of fractions and decimals, for example:

  What fraction is equivalent to 0.8? Simplify the answer.

Using and applying mathematics to solve problems

To help pupils to achieve **levels 5 and 6** you need to:

- model how to tackle word problems and investigations;
- give them experience of tasks requiring a series of steps to reach a solution, for example, using set routines to solve simple equations or solving problems that require the calculation of intermediate steps;
- demonstrate how to set out working in order to answer multi-step questions;
- use mathematical language correctly, model its use in explanations, and give pupils similar opportunities to use the language themselves, both orally and in written form;
- encourage pupils to justify answers and to convey understanding by giving explanations or reasons.

Number and algebra

To help pupils to achieve **level 5** you need to:

- consolidate their understanding of place value to eradicate mistakes such as 0.5 – 0.25 = 0.2;
- make sure that they are confident in using efficient written methods of calculation for all four operations with whole numbers and simple examples involving decimals;
- develop appropriate methods – mental, written or calculator – to solve problems involving percentages such as:

  8% of £26.50
  12.5% of £98
- give them experience and practice at using negative quantities;

- help pupils understand algebra as generalised arithmetic by developing number sentences to include, for example:

  $3x + 2y = 7$, so $6x + 4y =$ **?**

  $x - 1 = 45$, so $x + 2 =$ **?**

  and understand that algebraic operations follow the same conventions and order as arithmetic operations;
- understand and simplify algebraic expressions such as:

  $7 + 2t + 3t$ and $b + 7 + 2b + 10$
- build on the use of inverse operations to find missing numbers and to solve equations either mentally or by formal methods, for example:

  $26 - 2n = 8$
- give practice at substitution into simple expressions, for example:

  If $x = 1$, $2x + 1 =$ **?**

  $m = 6$ and $h = \frac{7m}{2}$, so $h =$ **?**
- encourage them to express generalisations algebraically and to explain generalisations by relating the terms of a number sequence back to the spatial pattern that it describes.

Pupils targeting **level 6** need to:

- achieve confidence in calculating with fractions, decimals and percentages including calculating one number as a percentage of another;
- understand proportional reasoning and use it to solve problems, always being clear as to which amount represents one whole or 100%;
- understand and simplify algebraic expressions, for example:

  $w^2 \times w$ $w^2 + 3w^2$ $3m - (^{-}m)$

  Factorise $7y + 14$
- handle index notation, substitution and algebraic manipulation and be clear on the difference between equations and expressions. You need to explain and demonstrate these differences.

Shape, space and measures

To help pupils to achieve **level 5** you need to:

- give them experiences to develop ideas of rotation, including locating the centre of rotation;
- give opportunities to develop their understanding of perimeter;
- teach the appropriate use of a calculator to solve problems involving measures, including time;
- teach the names and properties of polygons, including special quadrilaterals such as trapezium and kite;
- demonstrate that by marking on diagrams any lengths or angles which are known often helps to see how to obtain the final answer;
- provide opportunities for them to explain their reasoning.

Pupils targeting **level 6** need to:

- be able to solve angle problems involving properties of lines and polygons using a series of linked calculations and give reasons to justify their results;

- practise operating mentally on shapes, for example, by visualising views of 3-D shapes represented in diagrams;
- understand and use the formulae for the area and circumference of a circle, in particular that they calculate πr^2 and not $(\pi r)^2$ for the area of a circle.

Handling data and probability

You need to make sure that there is a consistent approach to handling data and graphs across all subjects in the school.

To help pupils to achieve **level 5** you need to:

- use class or group discussion of a range of graphs focusing on interpreting the data presented;
- develop the use of number lines to assist in the interpretation of scales;
- explain and give practice in calculating and using appropriately the mean, median, mode and range for discrete data;
- provide opportunities to compare information and draw conclusions from two graphs and to use an average and the range to compare two distributions;
- encourage them to give the probability of an event as a fraction in its simplest form and link this fraction to a percentage.

Pupils targeting **level 6** need to:

- interpret a range of statistical diagrams, including pie charts, time series and scatter diagrams, and draw inferences from them;
- identify and represent outcomes from a combination of events or experiments;
- know and use the fact that the sum of probabilities of all mutually exclusive outcomes is 1.

Use of calculators

You need to systematically teach pupils how to use a calculator effectively and efficiently. Guidance is given in the *Framework for teaching mathematics from Reception to Year 6*, section 6, page 71, and in the *Framework for teaching mathematics: Years 7, 8 and 9*, section 4, pages 108–109. Pupils need to recognise that when mental and written methods are time consuming, it is appropriate to use an efficient calculator method on Paper 2.

All pupils need to:

- write down the expression to be evaluated;
- make sure that their calculator is on the correct settings before starting work;
- make sure that they do not use approximated or truncated answers for further parts of a question;
- write down the displayed answer before writing the final answer to the correct degree of accuracy;
- check their answer by approximating or by carrying out an equivalent calculation, always considering whether the answer is of the correct order of magnitude.

Preparing for the tests: revision strategies

You need to build in regular ‘assess and review’ sessions during the year to give pupils practice in test conditions and test questions. It is vital to give feedback on such sessions and use the results to inform pupils’ future learning targets. Some pupils may need extra teaching or extra time to assimilate some points.

To ensure that pupils perform to their full potential in a test, use previous test materials to make them aware of the need to:

- listen carefully to the tapes of mental arithmetic tests and use the correct box on the answer sheet to record their answers;
- attempt as many questions as possible on written tests (point out that they may be able to do some of the later questions on the paper even if they have found some earlier questions difficult);
- show appropriate working in questions, especially on papers that permit the use of calculators (mention that a mark can often be obtained by showing the method or mathematical operation used; demonstrate what is appropriate working);
- always check their answers, asking ‘Is this reasonable?’

In the final lead up to the tests you may want to organise revision classes that focus on identified weaknesses. You may be able to use extra teacher or teaching assistant support.

Year 9 booster lessons in mathematics

The lessons have been written to a common format (outlined on page 18) and are designed to last 50 to 60 minutes. The teaching objectives of each lesson are listed below. You will need to adjust each lesson to match the particular needs of your pupils.

Pay particular attention to the teaching points and consider the amount of time that you allocate to the starter, main activity and plenary.

Template

This shows features to include in booster lessons. While many of these are likely in all lessons there are slight differences; for example, booster lessons are less likely to introduce new work.

1 Place value

- Understand and use decimal notation and place value; multiply and divide integers and decimals by 10, 100, 1000, and explain the effect (Y7)
- Read and write positive integer powers of 10 (Y8)
- Multiply and divide integers and decimals by 0.1, 0.01 (Y8)
- Extend knowledge of integer powers of 10 (Y9)

2 Fractions, decimals and percentages 1

- Use the equivalence of fractions, decimals and percentages to compare proportions (Y8)
- Calculate percentages (Y7, 8, 9)

3 Fractions, decimals and percentages 2

- Calculate percentages and find the outcome of a given percentage increase or decrease (Y8, 9)

4 Using a calculator

- Make and justify estimates and approximations of calculations (Y7, 8, 9)
- Use a calculator efficiently and appropriately to perform complex calculations with numbers of any size; use sign change keys and function keys for powers, roots, brackets and memory (Y9)

5 Ratio and proportion

- Reduce a ratio to its simplest form (Y8)
- Divide a quantity into two or more parts in a given ratio (Y8)
- Use the unitary method to solve simple word problems involving ratio (Y8)

6 Algebraic expressions

- Understand that algebraic operations follow the same conventions and order as arithmetic operations (Y7)
- Use index notation for small positive integer powers (Y8)
- Simplify or transform linear expressions by collecting like terms; multiply a single term over a bracket (Y8)

7 Sequences

- Generate and describe sequences (Y7, 8)
- Generate terms of a sequence using term-to-term and position-to-term definitions of the sequence (Y8, 9)

8 Lines and angles

- Use correctly the vocabulary, notation and labelling conventions for lines, angles and shapes (Y7)
- Solve geometrical problems using side and angle properties and explaining reasoning with diagrams and text (Y8)

9 Area

- Use formulae for the area of a triangle, parallelogram and trapezium (Y8)
- Calculate areas of compound shapes made from rectangles and triangles (Y8)
- Solve increasingly demanding problems (Y9)

10 Circles

- Know the definition of a circle and the names of its parts (Y9)
- Know and use the formulae for the circumference and area of a circle (Y9)
- Solve increasingly demanding problems (Y9)

11 Probability

- Use the vocabulary of probability (Y8, 9)
- Estimate probabilities from experimental data (Y9)
- Find and record all possible mutually exclusive outcomes for single events and two successive events in a systematic way (Y8)
- Compare experimental and theoretical probabilities in different contexts (Y8)

12 Solving word problems

- Identify the necessary information to solve a problem (Y8)
- Solve more complex problems by breaking them into smaller steps or tasks (Y8, 9)
- Enter numbers and interpret the display in different contexts (Y8)
- Carry out more difficult calculations effectively and efficiently (Y8)

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