

The National Strategy for Key Stage 3

The Government intends to set ambitious targets for achievement in the National Curriculum tests for mathematics by 2007, with a milestone target for 2004. To reach these goals will require effective teaching, raised expectations of all pupils, and prompt, effective catch-up support for those who need it. That is why the National Strategy focuses on four important principles:

- ◆ **Expectations:** establishing high expectations for all pupils and setting challenging targets for them to achieve
- ◆ **Progression:** strengthening the transition from Key Stage 2 to Key Stage 3 and ensuring progression in teaching and learning across Key Stage 3
- ◆ **Engagement:** promoting approaches to teaching and learning that engage and motivate pupils and demand their active participation
- ◆ **Transformation:** strengthening teaching and learning through a programme of professional development and practical support

The Literacy and Numeracy Strategies for Key Stages 1 and 2 were announced in 1997, also with ambitious targets. Primary pupils are already close to achieving those targets. For mathematics, the expectation is that, by 2002, 75% of 11-year-olds will achieve at least level 4 in the National Curriculum tests. In May 2000, the proportion of Year 6 pupils who achieved the expected level was 72%.

The challenge now is to secure and build on pupils' achievements in Key Stages 1 and 2. The Strategy for Key Stage 3 aims to meet this challenge, drawing on the best practice in secondary schools, experience in the 205 schools that have piloted developments, and findings from inspection and research about what helps to raise standards.

The Framework for teaching mathematics

The *Framework for teaching mathematics from Reception to Year 6*, published in 1998, has been an important and popular element of the Numeracy Strategy. It has helped teachers to set appropriately high expectations for their pupils and to ensure progression through the primary years.

The launch of the Key Stage 3 Strategy is accompanied by the publication of the *Framework for teaching mathematics: Years 7, 8 and 9*. This extends the primary Framework and gives guidance on planning, teaching and assessing the National Curriculum for mathematics in Key Stage 3.

It is now available to order. Every teacher of mathematics in Key Stage 3 needs his or her own copy. It can be obtained free from:

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This management summary is for headteachers, governors, heads of departments in secondary schools, those who train teachers or who support mathematics teaching in schools, and school inspectors. It describes the contents of the mathematics Framework and summarises some of the management issues that need to be addressed to ensure the success of the mathematics strand of the Key Stage 3 National Strategy.

About the mathematics Framework

The Framework gives practical support to teachers and trainee teachers of mathematics in Key Stage 3 on planning and teaching appropriately challenging work for pupils. It helps teachers to build on pupils' achievements in Key Stage 2 and to provide catch-up support for pupils entering Key Stage 3 below level 4.

The Framework is also important for:

- ◆ heads of secondary-school mathematics departments, lecturers and others such as numeracy consultants who guide teachers or lead INSET activities;
- ◆ senior managers in secondary schools and LEA inspectors and advisers who monitor and support mathematics teaching and standards.

Contents of the Framework

The Framework contains a set of **yearly teaching programmes**, based on the National Curriculum programmes of study, summarising teaching objectives for mathematics for each of Years 7 to 9. The **key objectives** are highlighted in bold. These are the most significant of the objectives in each yearly programme. They can be used to set targets for whole classes or groups of pupils, and pupils' progress can be assessed against them.

The teaching programmes continue and extend the progression and expectations that were established in the primary Framework, so that work in each year corresponds to these levels:

Year 5	revision of level 3, but mainly level 4
Year 6	consolidation of level 4, and start on level 5
Year 7	revision of level 4, but mainly level 5
Year 8	consolidation of level 5, and start on level 6
Year 9	revision of level 5, but mainly level 6 objectives for able pupils at level 7, with some at level 8

The teaching programmes reflect new emphases in the National Curriculum for Key Stage 3, such as reasoning in algebra and geometry, the data-handling cycle, and the strengthening of links between algebra and number.

After the teaching programmes is a **supplement of examples** to illustrate what pupils should know and be able to do by the end of each year. The examples are a selection, not a full set, and are not intended to be taught as a 'scheme of work' or used on a series of worksheets. Their main purpose is to help teachers first to interpret the level of the work and then to plan, teach and assess it so that there is steady progression throughout the year, and from one year to the next. The examples that illustrate the key objectives, in particular, could be used to help formulate pupil target statements.

The final section of the Framework is a checklist of the main mathematical vocabulary used in each yearly teaching programme.

Using the Framework

As part of the National Strategy for Key Stage 3, schools are expected to:

- ◆ set targets for 14-year-olds in English, mathematics and science;
- ◆ participate in the training programmes, which are designed for heads of department and other experienced staff, and separately for less experienced and non-specialist teachers, and follow them through at school level;
- ◆ hold an INSET day for literacy across the curriculum in the autumn term of 2001 and for numeracy across the curriculum in the spring term of 2002;
- ◆ provide catch-up classes for all Year 7 pupils who did not previously achieve level 4;
- ◆ use the English and mathematics Frameworks, or be able to justify not using them by reference to what they are doing.

Most mathematics teachers in Key Stage 3 pilot schools have found the Framework to be a valuable tool for reviewing and adjusting their practice, and are using it for planning their lessons. There is, after all, no point in teachers re-inventing solutions to problems and challenges that are common to all. However, schools should make a professional judgement about this, once they have studied the Framework, reflected on their training, and reviewed their current practice.

The factors below should influence the degree to which a mathematics department adjusts its current practices and follows the Framework in detail:

- ◆ pupils' past, current and expected attainment in mathematics and the extent to which the department is likely to meet its target for raising standards;
- ◆ the curriculum leadership in the department and the department's effectiveness in evaluating its strengths and weaknesses in mathematics, and in planning further action to maintain or improve standards;
- ◆ the quality of the department's planning and monitoring of its teaching, and the extent to which the teaching objectives and expectations of pupils compare with the level and rigour of those in the Framework;
- ◆ the quality of the teaching and assessment of mathematics and how these compare with the criteria identified in the Framework;
- ◆ the extent to which the department is staffed by non-specialist teachers of mathematics who require support with their planning and teaching;
- ◆ whether the department is already involved in an initiative to raise standards in mathematics in Key Stage 3, through a properly supported programme that incorporates practices similar to those described in the Framework, making it possible to continue its own project development alongside the National Strategy.

Senior managers of schools will need to keep all these factors in mind when they are supporting and monitoring work in mathematics.

Raising standards in mathematics

Other factors to bear in mind when work in mathematics is being considered are those that help to promote higher standards.

Where the **leadership, management and planning** of mathematics in secondary schools are concerned, better standards occur when:

- ◆ the head of department is well informed, provides strong leadership and sets high expectations for what can be achieved by staff and pupils;
- ◆ a desire to secure high standards pervades the whole department;
- ◆ there are clear targets for raising standards in mathematics, and a manageable plan for achieving them, with regular evaluation of the plan's progress;
- ◆ there is systematic monitoring, led by the head of department, of teachers' planning, teaching and assessment, followed up by discussion and feedback;
- ◆ there is sufficient timetabled teaching time for mathematics, and regular homework;
- ◆ a scheme of work for mathematics is based on identified teaching objectives, and ensures high expectations, consistent approaches and good progression;
- ◆ staff teaching mathematics have opportunities to observe each other teach, and meet regularly to discuss and develop common understanding of the mathematics curriculum and appropriate teaching methods.

Where **teaching** is concerned, better standards of mathematics occur when:

- ◆ lessons have clear objectives and are suitably paced;
- ◆ teachers convey to pupils an interest in and enthusiasm for mathematics;
- ◆ a high proportion of lesson time is devoted to a combination of demonstration, illustration, instruction and dialogue, suited to the lesson's objectives;
- ◆ pupils are involved and their interest maintained through suitably demanding and varied work, including non-routine problems that require them to think for themselves;
- ◆ regular oral and mental work develops and secures pupils' recall skills and mental strategies, and their visualisation, thinking and communication skills;
- ◆ teachers question the class effectively, give pupils time to think, expect them to explain their reasoning, and explore reasons for any wrong answers;
- ◆ pupils are expected to use correct mathematical terms and notation and to talk about their insights rather than give single-word answers;
- ◆ written activities consolidate the teaching and are supported by judicious use of information and communication technology (ICT), textbooks and other resources;
- ◆ explicit links are made between different topics in mathematics and to mathematics in other subjects;
- ◆ targeted support helps those who have difficulties to develop their mathematics.

Where **assessment** is concerned, better standards of mathematics occur when:

- ◆ pupils are asked to reflect on and evaluate their own progress;
- ◆ teachers use pupils' contributions to assess their strengths and difficulties, to set group and individual targets for pupils to achieve and to plan the next stage of work;
- ◆ assessments include informal observations, oral questioning and occasional tests or special activities designed to judge progress;
- ◆ marking of written work includes comments which help pupils to improve;
- ◆ recording systems give teachers the information that they need to plan and report successfully, but are not too time-consuming to maintain.

The role of the head of department

Positive and sustained leadership of the mathematics department will ensure that it operates as effectively as possible. Although some tasks may be delegated, the head of department is generally responsible for:

- ◆ inspiring and enthusing mathematics staff and supporting their professional development and training;
- ◆ auditing mathematics, setting annual targets for the subject and producing an annual development plan outlining the actions needed to achieve the targets;
- ◆ reviewing and updating the mathematics scheme of work and teaching resources;
- ◆ directing and coordinating numeracy across the curriculum;
- ◆ organising mathematics teaching groups and allocating staff to teach them;
- ◆ monitoring and evaluating teachers' planning and teaching of mathematics and the assessment of pupils' work and progress;
- ◆ liaising with other departments in the school, including the special needs department;
- ◆ keeping senior managers informed about the department's plans and progress.

Heads of department have a crucial role to play in implementing the National Strategy in Key Stage 3. There are three key responsibilities.

Leading an audit

The first is to **lead an audit** of the teaching and learning practices in mathematics in Key Stage 3, using the criteria in the Framework and in the Strategy's audit guide, which will be distributed at local briefings. The purpose of the audit is to identify for the school's senior managers and the department:

- ◆ what, if any, changes are needed to the department's work in order to raise standards and reach its targets for mathematics;
- ◆ which teachers could benefit most from the training offered through the Strategy.

An outline action plan is then needed to make sure that the identified changes are tackled in order of priority, at a pace that is manageable for the department with the resources available to it, and in a way that ensures that the changes can be sustained.

Providing curriculum leadership

The second responsibility is to inspire and enthuse colleagues by offering **curriculum leadership** so that all staff teaching mathematics regularly discuss and develop common understanding of how to teach certain mathematical topics or particular groups of pupils. Such discussions help to develop teamwork and consistent approaches. They can lead to refinements of a scheme of work and the preparation of teaching materials that all teachers of mathematics can use. From time to time the discussions can be extended to other departments so that mathematics staff consider with other teachers matters such as the development of pupils' numeracy skills across the curriculum, or the use of ICT resources for mathematical activities in other subjects.

Monitoring and supporting teaching

The third key responsibility is the **monitoring and support role**. Part of the work of the head of department is to be aware of the quality of teaching among mathematics staff and to advise and support teachers accordingly. The head of department also reviews regularly with mathematics staff the written work of pupils in different classes in order to monitor the progress of each class and to check that marking and other assessments are being carried out satisfactorily. Observations of this kind are best when they are followed up with feedback and collective discussion, and can be of particular help to newly qualified and non-specialist teachers of mathematics.

Timetabling issues

The recommended approach to teaching is based on ensuring:

- ◆ sufficient regular teaching time for mathematics, including extra support for pupils who need it to keep in step with the majority of their year group;
- ◆ a high proportion of direct, interactive teaching;
- ◆ engagement by all pupils in tasks and activities which, even when differentiated, relate to a common theme;
- ◆ regular opportunities to develop oral, mental and visualisation skills.

In Key Stage 2, a daily mathematics lesson of 50 to 60 minutes is provided, accounting for some 20% of the total teaching time. In Key Stage 3, the typical proportion of teaching time given to mathematics is 12%, equivalent to about three hours a week. School timetablers should aim to ensure that mathematics lessons in each year group are frequent and spread across the week, not bunched together.

Organisational models such as four lessons of 50 minutes are useful. They satisfy the principle of frequency, ensuring that pupils maintain and sharpen their mathematical skills through regular contact. Other models, such as three 70-minute mathematics lessons, or six 35-minute lessons made up of double and single periods, need to be organised carefully, particularly where fortnightly timetables operate. Seventy minutes can be too long for pupils to maintain their concentration if the teaching is to be intensive and direct; on the other hand, a single 35-minute period offers too little time for ideas to be developed and consolidated in the main part of the lesson.

Recommended lesson structure

The structure and timing of a mathematics lesson will depend partly on its length. The outline structure of a three-part lesson described below is highly recommended since it can be adapted to different circumstances. It provides 'a beginning, a middle and an end' in which teachers explain to pupils and prepare them for what they are to learn, teach it to them, then help them to recognise what they have achieved. It allows a variety of patterns of teaching methodology and organisation, depending on a lesson's objectives and its position in a series of lessons.

- ◆ **An oral and mental starter** (about 5 to 10 minutes)
whole-class work to rehearse, sharpen and develop mental skills, including recall skills, and visualisation, thinking and communication skills
- ◆ **The main teaching activity** (about 25 to 40 minutes)
varied combinations of teaching input and pupil activities
work as a whole class, in pairs or groups, or as individuals
interventions when the whole class or groups are brought together to identify and sort out misconceptions, clarify points and give immediate feedback
- ◆ **A final plenary** to round off the lesson (from 5 to 15 minutes)
whole-class work to summarise key facts and ideas and what to remember, to identify progress, make links to other work, discuss the next steps, set homework

This outline structure is not a mechanistic recipe to be followed. Teachers should use their professional judgement to determine the activities, timing and organisation of the lesson to suit its objectives.

Mathematics across the curriculum

Mathematical skills can be consolidated and enhanced when pupils have opportunities to apply and develop them across the curriculum. Poor numeracy skills, in particular, hold back pupils' progress and can lower their self-esteem. To improve these skills is a whole-school matter. Each department should identify the contribution it makes towards numeracy and other mathematical skills so that pupils become confident at tackling mathematics in any context.

Good liaison helps to ensure that all staff use common approaches that mirror those used in mathematics lessons. For example, the approach to calculation should be the same in science as in mathematics. When calculations are used in any subject of the curriculum, teachers need to be aware of:

- ◆ the importance of mental calculations as a first resort, and particularly the expectation that pupils should add and subtract pairs of two-digit numbers mentally;
- ◆ the use of informal, expanded written methods, especially with lower attaining pupils;
- ◆ how and when calculators should be used.

Besides the approach to calculation, agreed practice across departments should include:

- ◆ the use of units of measurement and their abbreviations;
- ◆ the mathematical notation and terms to be used;
- ◆ algebraic and other mathematical techniques, such as how algebraic expressions are to be simplified or how equations are to be solved;
- ◆ how graphs are to be represented;
- ◆ how and when ICT resources such as graph plotters or graphical calculators will be used to support mathematics.

The whole-school INSET day on mathematics across the curriculum in the spring term of 2002 is intended to provide time for these matters to be considered.

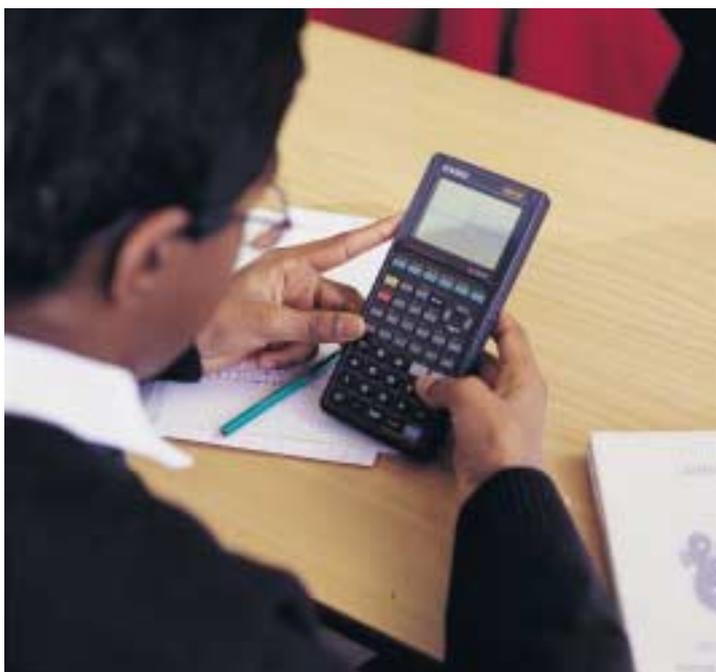


Mathematics and ICT

Information and communication technology (ICT) includes calculators and extends to the whole range of audiovisual aids, including educational broadcasts and video film. The main uses of ICT in mathematics in Key Stage 3 stem from:

- ◆ the use of calculators for calculating purposes;
- ◆ small programs, such as number games or investigations in a particular context;
- ◆ programming languages, such as Logo or Basic, and the programming capabilities of graphical calculators;
- ◆ general-purpose software, particularly spreadsheets, but also databases;
- ◆ content-free mathematics software, such as graph plotters, dynamic geometry software and data-handling packages;
- ◆ ILS (Independent Learning Systems), which provide and manage practice in mathematical techniques tailored to the needs of individual pupils;
- ◆ graphical calculators and data-loggers;
- ◆ CD-ROMs and the Internet.

If mathematics teachers in Key Stage 3 are to maximise the use of ICT in mathematics lessons, they need access to appropriate hardware and software, and to the training provided through the New Opportunities Fund. Teachers could also take advantage of the Government's Computers for Teachers scheme which this year is dedicated to subsidising the purchase of laptops for teachers of mathematics in Key Stage 3.



Progression from Key Stage 2 and target setting

As pupils move to Key Stage 3, it is essential to continue to build their mathematical skills. Year 7 teachers need to know what their pupils can already do. Many pupils now leave Year 6 with personal targets, records and a history of intervention. This body of information can help secondary teachers to make a quick start on work that is well matched to pupils' capabilities.

A 'clean-sheet' approach is too slow, and allows pupils to coast or to fall back when they need to be challenged. As a minimum, teachers of Year 7 classes should survey the information available to them about the mathematical attainment of incoming pupils to help plan in advance the work of the first term. Individual records can then be reviewed more closely when staff have had three or four weeks of experience with their new classes. This alerts them to unexpected changes in performance which need to be resolved and enables them to adjust teaching expectations accordingly.

Priorities for each new cohort can be derived from Key Stage 2 levels and from raw scores and the qualitative information provided by work sampling and other monitoring in the early part of Year 7. This helps a mathematics department to translate wider ambitions such as 'improve number skills' first into numerical targets such as 'increase by 5% the proportion of pupils achieving level 4 in number and algebra by the end of Year 7', then into specific curricular targets, such as: 'All pupils will know that algebraic operations follow the same conventions and order as arithmetic operations.'

Inclusion and differentiation

The aim is that, as far as possible, pupils work together through the planned programme for their class so that all are included in each unit of work, participate fully in lessons and benefit from the discussion and interaction with their teacher and their peers.

Many secondary schools organise pupils into ability sets for mathematics, since planning tends to be easier if the attainment gap in a class is not too wide. The success of setting depends on close teamwork, cooperative planning and careful monitoring by mathematics staff to make sure that pupils can move from set to set as their progress demands and that expectations for all pupils are suitably high; lower expectations are not justified simply because pupils are in a 'lower set'.

Even where pupils are organised into ability sets for mathematics, there can still be a range of attainment in a class. There are several ways of meeting the needs of mixed ability classes or of ability sets with a spread of attainment. The first step is to establish a classroom climate where all pupils feel that they can contribute, and which secures their motivation and concentration. The next step is to adopt teaching and organisational strategies to keep all pupils involved and suitably challenged, while giving them the maximum opportunity to interact with their teacher. This includes providing appropriate support, aids or interventions to give particular pupils access to the planned programme and to keep any who might fall behind in step with the rest of their class.

The mathematics Framework contains more detailed advice on working with particular groups of pupils, such as those with special educational needs or those learning English as an additional language. However, to meet one expectation of the National Strategy, one group will need particular attention: pupils who need to catch up.

Pupils who need to catch up

A large and important group of pupils face relatively minor difficulties in learning, reflected in mathematical attainment just below the level expected at entry to Year 7. Some may have been disadvantaged by factors associated with circumstances at home. Some may have been moved to a number of different schools, or have gaps in learning resulting from missed or interrupted schooling: for example, travellers, refugees, those in care or those with medical conditions. Others may have misconceptions remaining from earlier work, or have weaker literacy skills which have impeded their progress.

Early targeted support will help these pupils most, as it is much easier to catch problems early on than to struggle with a backlog. The National Strategy's pack of teaching materials, *Springboard 7*, provides a two-term 'catch-up' programme of mathematics for such pupils.

It is crucial that pupils in 'catch-up' groups are not withdrawn from mathematics lessons for their year group, since they need to maintain the development of their mathematical skills along with their peers. More than most, they need to consolidate new learning as well as catching up on unlearned skills. *Springboard 7* can be incorporated into the main teaching programme for Year 7, and used in normal timetabled lessons, but extra support is also of great benefit, perhaps in tutorial time, at lunchtime clinics or after-school homework clubs, or in extra timetabled sessions.

Pupils who are very able

Pupils who are very able also need consideration. The yearly teaching programmes in the Framework are targets for the majority of pupils in the year group. Able pupils deal with abstract mathematics more readily than other pupils do. They will progress more quickly through these programmes and will need extension and enrichment activities to develop the breadth of their mathematics and the depth of their thinking.

Where there are sufficient numbers, very able pupils are sometimes taught in an express set. There they can benefit from discussion with other pupils working at a similar, more advanced level. Where this is not the case, very able or gifted pupils who are markedly ahead of others in their year group should study topics with the rest of their class, but with far fewer practice examples and many more challenging problems to tackle.

Where to begin

The Framework is a guide to what to teach to each class. However, there are a few secondary schools where, at present, relatively few pupils attain level 5 or above at the end of Key Stage 3. To begin with, these schools should look carefully at the teaching programmes for Years 5 and 6 and draw suitable objectives from them when they are planning work for Year 7, making corresponding adjustments for Years 8 and 9.

Where a school sets pupils for mathematics lessons, teachers of higher sets may well base their pupils' work on the teaching programme for an older age group, while teachers of lower sets may need to work mainly from objectives in the teaching programmes for a younger age group. For example, after the first few weeks of the autumn term, a Year 7 class in a selective school, or a top set in a comprehensive school, is likely to follow a programme based largely on the Year 8 objectives.

Decisions such as these will need to be reviewed before the start of the next school year to allow for improving standards over time.