Focusing teaching to improve pupil performance

Helping pupils prepare for Key Stage 3 science 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 science 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 science 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 science before the National Curriculum tests in May.

Although this guidance is particularly for Year 9 teachers of science, 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 mathematics. 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 level 5 in science, and tied in to an imaginative approach to supporting pupils in key aspects of test preparation;
- 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

You may use the guidance to support planning and teaching in science lessons. It is also intended to support any additional teaching outside these times.

You can provide extra help in a number of ways:

- 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.

New learning in science 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 science 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.

On pages 17–19 you will find some case studies of how schools managed booster work in preparation for the tests in 2001.

Supporting teaching and learning

Use direct interactive teaching to emphasise **specific aspects** of science:

- 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 to raise standards. Talk about common errors with pupils. Avoid re-teaching work in the same way.
- Engage pupils in discussion. Encourage them to articulate and describe the methods and reasoning that they use and to compare these with the ideas of others.
- 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 at interpreting questions by focusing both on the subject vocabulary and the language typically used in test questions.

- 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.
- At the end of each lesson, stress the main teaching points and assess pupils' progress informally.
- 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.

National performance in recent Key Stage 3 science tests

In 2001, 66% of Year 9 pupils gained level 5 and above in science. This was a 7% improvement on 2000 and above the previous high of 60% gained in 1997.

Key Stage 2 results in science have continued to make year-on-year gains, from 68% at level 4 and above in 1997 to 87% in 2001. Of the 1998 Key Stage 2 cohort (which is the group that took the Key Stage 3 tests in 2001) 69% gained level 4 and above.

In 2000, 59% of Key Stage 3 pupils gained level 5 and above in science, and 30% gained level 6 or above. In 1997, 68% of this same cohort gained level 4 or above in the Key Stage 2 science 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. The *Autumn Package*, provided by the DfES and sent to all schools, offers much useful information which will support your own analysis.

Improvements over time

Having identified pupils' weaknesses you then need to concentrate on identifying appropriate expectations from the DfES/QCA Scheme of Work for Key Stage 3 science as a basis for your planning and teaching. You need to address these expectations, and the objectives which are required to bring them about, explicitly and not just through a passing reference.

You need to give pupils short-term learning targets so that they can see an improvement in their performance. You can select such targets from the expectations in the DfES/QCA Scheme of Work. Make sure that pupils know clearly what you intend them to learn and that you can evaluate their success. For example: 'Today we are going to learn …' and 'Let's check that you now know …'

All teachers need to know who are the borderline pupils. Early booster classes aimed at borderline levels are likely to be attractive to such pupils, and allow teachers to target work very effectively. These lessons can be during or outside the usual school day.

Make sure that in lessons you focus some time on 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 section of the guidance focuses on the needs of most pupils expected to achieve levels 5 or 6 on the test papers for the 3–6 or 5–7 tiers. It draws on weaknesses identified in recent QCA reports on standards at Key Stage 3 in science and on activities within the DfES/QCA exemplar Scheme of Work. From 2001, QCA have replaced the standards report with a poster entitled 'Implications for teaching and learning' which was sent to all schools in November 2001. A new *Standards at Key Stage 3: science* document, sent to schools in January 2002, contains analysis of pupils' responses to questions and suggestions of what teachers might do to help improve pupil responses in the future.

Remember that in the DfES/QCA Scheme of Work the expectations target for most Year 8 pupils is to consolidate level 5, while for most pupils in Year 9 the expectations target is level 6.

In the following paragraphs references are to units in the DfES/QCA Scheme of Work for science.

General issues

Teachers should use a variety of strategies to help pupils to **use language precisely** when they talk and write about scientific ideas and concepts. For example:

- Unit 8H 'Reviewing work', where pupils relate to each other key ideas about geological changes;
- Unit 8K 'Checking progress', where pupils explain everyday reflections using words and/or ray diagrams;
- Unit 9D 'Checking progress', where pupils make a concept map using appropriate terms such as 'produce', 'consumer' etc.;
- Unit 9G 'Reviewing work', where pupils use scientific terminology about the environment accurately and with understanding to identify the causes and effects of acid rain.

Teachers should continue to make explicit the '**key ideas' or patterns** in science, use a **wide range of contexts** to illustrate ideas and concepts, and provide pupils with opportunities to **apply their scientific knowledge and understanding** in both familiar and novel contexts. For example:

- Unit 8I 'Reviewing work', where pupils produce a leaflet explaining heat transfer in a situation of interest to them such as on a mountaineering expedition above the snowline;
- Unit 8L 'Reviewing work', where pupils relate to each other ideas about sound and hearing;
- Unit 9H 'Checking progress', where pupils are asked to match scientific principles such as photosynthesis to a set of statements about chemical reactions.

To help pupils to achieve **level 5** they should be given opportunities to:

- practise using appropriate scientific language, terminology and conventions in a range of contexts involving both quantitative and qualitative data;

- consider a wide range of contexts and everyday applications illustrating the knowledge and understanding set out in the programme of study.

To achieve **level 6** pupils need to develop the knowledge and skills required at level 5. They should also be given opportunities to:

- consider different ways of expressing ideas using scientific language, terminology and conventions, and select appropriate methods;
- identify similarities and differences in processes and concepts;
- apply for themselves the knowledge and understanding set out in the programme of study.

Scientific enquiry

Teachers should continue to provide opportunities for pupils to develop and consolidate their ability to **interpret tables and graphs**. For example:

- Unit 9F 'How can we find out more about the reaction of acids with metals?';
- Unit 9K 'How fast is it moving?'.

Teachers should continue to provide frequent opportunities for pupils to **use key facts, terms, symbols and units** and, through practical work, to **identify possible hazards and risks**.

To help pupils to achieve **level 5** they should be given opportunities to:

- select material to use from a range of information sources;
- present and interpret data in appropriate tables and graphs, including line graphs;
- explain conclusions and identify their evidence;
- consider conclusions drawn by others from evidence and discuss whether the conclusions are justified;
- describe patterns and relationships in data, check that conclusions are consistent with the data, and explain and justify them using appropriate scientific knowledge and understanding.

To achieve **level 6** pupils need to develop the knowledge and skills required at level 5. They should also be given opportunities to:

- select and use sources of information to provide effective support for their work;
- consider data, and identify measurements and observations that do not fit the pattern;
- make predictions of additional readings from data they have collected;
- explain conclusions, making clear their evidence and how the conclusions are based on scientific knowledge and understanding;
- explain clearly how evidence from either historical or contemporary secondary data can be used to draw conclusions and develop scientific ideas.

Life processes and living things

Teachers should provide more opportunities for pupils to **extend their knowledge beyond the names of parts** of plants and animals, to enable them to **discuss and explain their functions**. For example:

- Unit 8B 'What is the role of the lungs?';

- Unit 9C ‘What is the role of the leaf in photosynthesis?’, ‘What is the role of the root in photosynthesis?’ and ‘Reviewing work’, where pupils are asked to construct a flow chart around a diagram of a tree to show functions or processes that take place.

Teachers should make clear that **cells form tissues and organs and how cells function in life processes**. For example:

- Unit 7A ‘What do cells do?’.

Teachers should develop pupils’ understanding of **more complex aspects of life processes and living things**, such as the differences and relationship between respiration and photosynthesis in plants. For example:

- Unit 8B ‘Do other organisms respire in a similar manner?’;
- Unit 9D ‘Checking progress’, where pupils make a concept map using terms such as ‘energy’, ‘glucose’ etc.

Teachers should use a wide range of examples of familiar and less-familiar habitats when teaching about **feeding relationships**, and help pupils to consider these in terms of pyramids of numbers and the effects of changing the numbers of one member of the chain or web on other members. For example:

- Unit 8D ‘How do living things in a community depend on each other?’;
- Unit 9D ‘Where does our food come from?’ and ‘How do pests affect plant growth?’.

To help pupils achieve **level 5** they should be given opportunities to:

- discuss and explain, using appropriate scientific terminology, the part different organs of plants and animals play in life processes;
- compare food chains and food webs in different habitats and explain differences in terms of environmental factors.

To achieve **level 6** pupils need to develop the knowledge and skills required at level 5. They should also be given opportunities to:

- discuss and describe the sequence of events during a process such as respiration or photosynthesis, relating these to the organs involved;
- identify and discuss distinctions between processes such as pollination and fertilisation in plants or respiration in plants and animals;
- consider how changes in environmental factors can affect the abundance of organisms and how this might affect food chains and food webs;
- begin to quantify the abundance of organisms in a variety of food chains.

Materials and their properties

Teachers should use demonstration and pupils’ own practical work to ensure that pupils are **familiar with a wider range of apparatus and practical laboratory situations**. For example:

- Unit 8E ‘How do we represent changes when new materials are made?’;
- Unit 8F ‘Do compounds react chemically?’;
- Unit 9E ‘What happens when metals react with acids?’;
- Unit 9H ‘What happens to atoms and molecules when new materials are made?’.

Teachers should use a variety of approaches to help pupils become **familiar with chemical names and symbols** and with writing and understanding **word equations**. They should discuss with pupils how the names and symbols of elements relate to the constituents and names of compounds. For example:

- Unit 8E 'Checking progress', where pupils are asked to agree whether statements are true or false;
- Unit 8F 'Reviewing work', where pupils are asked to identify familiar chemical names and assign statements of properties to one or more of 'element', 'compound' and 'mixture';
- Unit 9E 'Checking progress', where pupils work in groups to make sets of cards for word or symbol equations of different reactions;
- Unit 9H 'Reviewing work', where pupils are asked to group together similar reactions when provided with word and/or symbol equations, general equations and descriptions of reactions.

Teachers should help pupils **describe and explain chemical reactions** in terms of the rearrangement of atoms between molecules in order to develop their understanding of elements, compounds and conservation of matter. For example:

- Unit 9H 'What happens to atoms and molecules when new materials are made?'.

Teachers should provide opportunities for pupils to investigate a variety of **physical and chemical changes** so that they can distinguish between them. Teachers should help pupils understand how these changes relate to **change of state or particle reactions** in order to develop an understanding of conservation of mass. For example:

- Unit 7F 'Checking progress', where pupils are asked to group cards of words or phrases about reactions into sets to describe the three types of chemical reaction covered in the unit;
- Unit 7H 'Reviewing work', where pupils match cards describing a change or technique to their explanations;
- Unit 8F 'Checking progress', where pupils produce a concept map related to chemical change;
- Unit 9E 'What evidence is there of a chemical reaction between acids and metal oxides?';
- Unit 9H 'What happens to atoms and molecules when new materials are made?'.

To help pupils achieve **level 5** they should be given opportunities to:

- identify the change – for example, dissolving, evaporation or neutralisation – taking place in a range of contexts, and the features specific to the change;
- describe a range of changes using appropriate scientific terminology;
- consider and discuss the reasons for selecting apparatus for a particular purpose;
- use chemical names for substances encountered and distinguish between common elements and compounds;

- practise naming the starting materials and products for chemical reactions encountered.

To achieve **level 6** pupils need to develop the knowledge and skills required at level 5. They should also be given opportunities to:

- distinguish between changes that can be reversed easily and those that cannot;
- explain, using appropriate scientific terminology, similarities and differences in different changes;
- discuss the measurements that can be made with apparatus with different scale divisions and decide what is appropriate in a particular case;
- relate the chemical names of compounds to the elements they contain;
- summarise chemical reactions by writing word equations and identifying the patterns in these.

Physical processes

Teachers should provide pupils with more opportunities to **set up and work with more complex circuits**, including parallel circuits, and to **represent these in circuit diagrams**. Pupils should be asked to explain how such circuits operate. For example:

- Unit 7J 'What happens in a circuit', 'What kinds of circuits are useful and what are the hazards?' and 'Reviewing work', where pupils are given a range of circuit diagrams, showing series and parallel connections, switches and fuses, with some current values identified, and asked to work out the other current values;
- Unit 9I 'How does electricity transfer energy?'.

Teachers should provide pupils with a variety of familiar and unfamiliar situations so that they can gain experience in **explaining energy transfers in different contexts**. For example:

- Unit 9I 'Checking progress', where pupils are asked to summarise ways in which electricity can transfer energy to provide people with useful facilities;
- Unit 9I 'Reviewing work', where pupils are asked to draw flow diagrams identifying energy transfers in a wide range of situations such as home insulation, etc.

Teachers should draw on pupils' understanding of particles and differences between solids, liquids and gases when teaching about **thermal transfer** by conduction, convection and evaporation. For example:

- Unit 8I 'How do materials change when they are heated and cooled?' and 'How can we explain change of state?'.

Teachers should draw attention to similarities and differences between bar magnets and electromagnets, building on pupils' **understanding of magnetism**. For example:

- Unit 8J 'Checking progress', where pupils construct a concept map on magnets and magnetism and respond to a series of written and oral questions, 'How do we explain how electromagnets work?', and 'Reviewing work', where pupils construct a set of cards of key facts based on information about types of magnets and their uses.

Teachers should provide pupils with more opportunities to **use and draw ray diagrams** to represent **accurately** the behaviour of light rays in various situations. For example:

- Unit 8K ‘How do mirrors reflect light?’ and ‘Can light be bent?’.

Teachers should give pupils more opportunities to do **calculations**, including substituting into formulae and then solving the resultant equations, and ensure they can select or derive appropriate units. For example:

- Unit 9K ‘How fast is it moving?’;
- Unit 9L ‘What is pressure?’ and ‘Reviewing work’, where pupils discuss numerical answers to questions and explain to each other the methods and reasoning they used.

To help pupils achieve **level 5** they should be given opportunities to:

- set up and work with circuits containing a variety of components, including some in parallel, and describe how changes in the circuit affect the way components function;
- consider a wide range of everyday contexts illustrating energy transfers;
- investigate the magnetic fields of electromagnets and their similarities to bar magnets;
- observe and describe the path of light in a variety of situations, and record this using ray diagrams;
- work with quantitative measurements, for example, in discussing and explaining the effect of forces on an object or in comparing the speeds of different objects;
- make measurements and record these using the correct units.

To achieve **level 6** pupils need to develop the knowledge and skills required at level 5. They should also be given opportunities to:

- explain changes in current in more complex circuits;
- work out for themselves the energy transfers taking place in a range of contexts which may be novel to them;
- investigate how the properties of an electromagnet can be altered, and explain the changes simply;
- apply their understanding of reflection, refraction and dispersion to a variety of everyday contexts;
- work with data to get a feel for how quantities such as speed are calculated.

Preparing for the tests: revision strategies

You need to build in regular 'assess and review' sessions during the year to give pupils practice of test conditions and test questions. It is vital to give them feedback on these sessions and to use the results to inform future learning targets. The use of Key Stage 3 test questions for three or four minutes as a whole-class teaching exercise – at the start of a lesson to reinforce the learning from a previous lesson, or at the end of the lesson to reinforce learning within the lesson – is very effective. Some pupils may need extra teaching or extra time to assimilate some points.

Ensure you obtain a copy of the QCA documents for science which identify strengths and weaknesses in pupils' performance in the previous tests. Around October/November QCA publishes a poster entitled 'Implications for teaching' and in January the standards report. Use this information alongside your assessment of your own pupils to identify aspects of the science curriculum that need further reinforcement.

Activities that focus on producing exemplar answers are also helpful both during the course of the key stage and during revision for the tests. Examples are:

- Unit 9A 'Reviewing work', discussing correct and incorrect answers;
- Unit 9E 'Reviewing work', discussing what test questions are really asking;
- Unit 9F and Unit 9L 'Reviewing work'.

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

- attempt as many questions as possible, emphasising that they may be able to do some of the later questions on the paper even if they have found some earlier questions difficult;
- always check their answers, asking 'Is this reasonable?'.

In the final run-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 to assist in this.

Science booster case studies

Here are a number of strategies employed by different schools to help pupils to do themselves justice in the tests. Schools may find them helpful and could consider, depending on circumstances, whether they could use similar approaches.

School A

School A is an 11 to 18 comprehensive of around 1000 pupils on the edge of a large town in the south. Some 15% of pupils are from ethnic minority communities, mainly black or Asian. Although the local area is socially advantaged, the school draws many pupils from areas where there are higher levels of social deprivation.

Pupils achieving at the margin of level 5 in science were identified and, via a letter to their parents, invited to attend after-school work sessions. Some parents even replied by telephone to ensure that their child got a place.

Pupils attending all sessions were promised a £5.00 CD token. About 25 pupils attended.

One-hour sessions were held twice per week. The department purchased core science textbooks and allowed each pupil to take a set home. The sessions involved different activities and styles of teaching, including team-teaching. Resources included various texts, BBC Bitesize revision videos and past Key Stage 3 test questions. Pupils attempted questions in small groups and then were invited to share their answers with the rest of the class. Teachers gave pupils plenty of opportunities to voice their difficulties, and tried to address any misconceptions.

The pupils were keen to attend, quite serious in their attitudes towards the work, and all attended most of the sessions. The week before the Key Stage 3 tests teachers gave out old papers for pupils to work on at home, and several were returned with requests for them to be marked. The pupils were very motivated and wanted to know what level they were reaching.

Staff found the sessions worthwhile and very satisfying and, because there was a larger staff-to-pupil ratio, the workload seemed less fraught. There were no discipline problems because it was made clear that the classes were voluntary. The whole ethos of the sessions was relaxed yet busy. The percentage of pupils achieving level 5 and above rose from 51% the previous year to 62%.

School B

School B is a high-achieving school with an impressive level of achievement in science. In the 2000 Key Stage 3 tests, 82% of pupils achieved level 5 or above. The school incorporated booster classes within the school timetable through the creation of additional Year 9 groups.

The science department was fortunate in being able to utilise the services of an effective, retired science teacher to take on responsibility for delivering booster sessions to selected Year 9 pupils during normal science curriculum time.

The initial target group comprised those pupils who were achieving around the level 4/5 borderline and who were therefore in danger of not attaining level 5. At first pupil reaction was cautious, and the reasons for their extraction into a new group needed to be carefully explained by teaching staff. This was handled successfully by the science staff and soon pupils were competing for places in the booster groups.

A crucial characteristic of the success of the boosters was the use of an effective member of staff to plan and run the sessions. Planning time was allocated and the programme was planned to revisit key concepts and targeted areas of the science Key Stage 3 programme of study.

Of the 24 selected pupils, 22 achieved level 5, taking the school results to 92% at level 5 or above.

School C

School C is an 11 to 16 comprehensive with around 560 pupils and situated in a small northern city. A large number of pupils come from backgrounds with social and economic difficulties.

The science department identified as their target group nine of the lowest-achieving pupils out of a possible 31 who were attaining at the margins of levels 4/5. These pupils were removed from six of their normal science lessons and taught as one group by a qualified science teacher. The teacher worked part-time in the school and increased her hours to teach the booster classes.

Pupils were taught about key concepts and common misconceptions as well as doing past paper questions. Of the nine selected pupils, six achieved level 5 in the Key Stage 3 tests.

Once booster pupils understood the reasons for being withdrawn, they saw it as a privilege; they appreciated it and worked very well. The teacher who ran the classes found the pupils very enthusiastic and enjoyed the lessons. The school exceeded its science target for the Key Stage 3 tests with 55% achieving level 5 and above compared to a three-year average of 36%.

School D

School D is a large 11 to 16 comprehensive situated in a northern city with around 1600 pupils. The catchment area is mixed with a significant number of pupils from ethnic minority groups.

77 pupils were identified as attaining around levels 4/5 and therefore potentially benefiting from booster support. Building confidence was identified as a major aim. Pupils were invited through their teachers and via letters sent home to attend out-of-school sessions. 68 responded positively.

Lessons commenced with one-hour after-school sessions in each of the last two weeks of the spring term. This was followed with two full days during the Easter break. The initial lessons focused on those aspects of the programme of study which were identified as weaknesses in the QCA standards report. Revision guides were purchased and distributed, and pupils were encouraged to spend time at home extending and developing their understanding of the topics covered.

The first full day was spent on a structured teaching programme divided equally into aspects of Sc2, Sc3 and Sc4 and a computer-related revision exercise. The second day was spent at Jodrell Bank to enhance aspects of Sc4. To ensure a different learning climate pupils were given free break-time snacks and lunch (pizza from a local restaurant). A pleasant, industrious atmosphere was evident throughout the two days and attendance was excellent.

Six staff took part. All pupils demonstrated increased self-confidence, a more positive attitude to work, and a genuine desire to learn. Of the 68 pupils, 18 achieved level 6, 39 achieved level 5, 10 achieved level 4 and one was absent for the test.

Science booster lessons

Using the materials

The suite of 12 booster lessons has been provided to support you in preparing a programme of supplementary teaching for some pupils. The lessons are aimed at pupils who may be attaining just below level 5 or whose attainment at level 5 is not fully secure. You may well find activities and materials that can be used successfully with other pupils at the end of Key Stage 3.

These materials should be considered to be a first draft. The science Key Stage 3 Strategy team would welcome feedback. Please send comments on elements that worked well and those that may need modification to:

Sophie Poynting
Year 9 booster kit: science
The Centre for School Standards
60 Queens Road
Reading
RG1 4BS

The lessons have been planned in some detail. In many ways these are special lessons and the plans should not be seen as examples of what good planning looks like. Effective short-term lesson plans in a department contain enough detail to enable the lessons to be successfully taught. Each department should decide for itself what such plans need to look like.

You should familiarise yourself with the complete suite before deciding whether to make use of some or all of the lessons, for the following reasons:

- The suite is based around topics that presented difficulties for pupils aiming to attain level 5 in Key Stage 3 tests over the past couple of years. Not all of these difficulties may be evident in your school.
- Each lesson has a lesson plan which includes objectives and a selection of teaching activities that are broadly intended to take an hour. If your lessons last more or less than an hour, you will need to adjust the activities.
- Individual activities have an indicated time but this is likely to vary depending on the pupils, etc. You may need to adjust the activities and/or the time allowed to suit your requirements.
- Experience from the science pilot has shown that booster classes tend to be smaller than the usual teaching groups. If the group is larger than 20 pupils, more time will be needed for activities where pupils report back their ideas.

What topics are included?

The lesson titles are:

1 The characteristics of animals

2 Plant structure and function

3 Human growth and reproduction

4 Feeding relationships between organisms

5 Physical changes

6 Metals and non-metals

7 What are reactions?

8 Electric circuits

9 Reflection of light

10 Magnetic fields and electromagnets

11 Sound

12 Balanced and unbalanced forces, and speed

What's in the lesson resources?

The lesson plan includes most of the details needed for a teacher to be able to follow and use the activities. The plan also includes lists of vocabulary, resources and some suggestions for relevant homework.

The majority of paper resources are supplied in photocopiable form. As appropriate, these include word lists, worksheets, reading materials, cards for card sort and similar activities, examples of diagrams, concept maps, etc. All you generally need to do is decide whether you want to use the resources and prepare sufficient copies for your group. Quantities required are indicated in the resource list.

Only in lesson 4 do you need to find and prepare your own paper resources. This is because you need examples of drawings or photographs of animals and plants. This sort of picture is commonly available in magazines or as photocopiable resources to accompany textbooks. Most departments will find no difficulty in obtaining them.

Where practical activities are involved only standard science equipment is needed except for lesson 12 where a range of simple materials is required to build model dragsters. Suggested materials are listed.

In the main the intention is that the lessons should present the minimum of difficulty in preparation either for the teacher or the science technician.

What sorts of activities are included?

These lessons are intended for revision purposes to support pupils who have not grasped some ideas when they were originally taught. To be successful therefore the lessons utilise techniques and activities which may be different from those which were used originally. We intend that pupils do not repeat what they did before but tackle the work in a different way.

Most activities are fully explained in the lesson plans but below you will find some information on concept maps, and taboo and card loop word games.

A key strategy is to give pupils an activity to get them going and present them with decisions to make. They are required to talk to each other about these decisions and frequently to report back to the rest of the class. By making the pupils talk about what they think, you can more easily identify misconceptions and the pupils have to organise and refine their own thoughts. You may need to prepare by thinking through how such whole-class and small-group discussions can and should be handled to ensure they are productive.

Practice test questions are not included. Science departments are generally very skilled at using, setting and marking tests. To support this, past Key Stage 3 test questions are available on the Testbase CD-ROM, as detailed on page 9. Departments will have in place for all Year 9 pupils a programme of test practice to aid revision and to improve pupils' confidence and skills in taking tests. These booster lessons are intended to support this programme, not to be an alternative nor to replicate it.

Cognitive maps

Cognitive maps are representations of ideas and thinking which show connections between elements within a topic. They have proved to be effective in aiding pupils' memory and in developing their thinking and their understanding of various aspects of science.

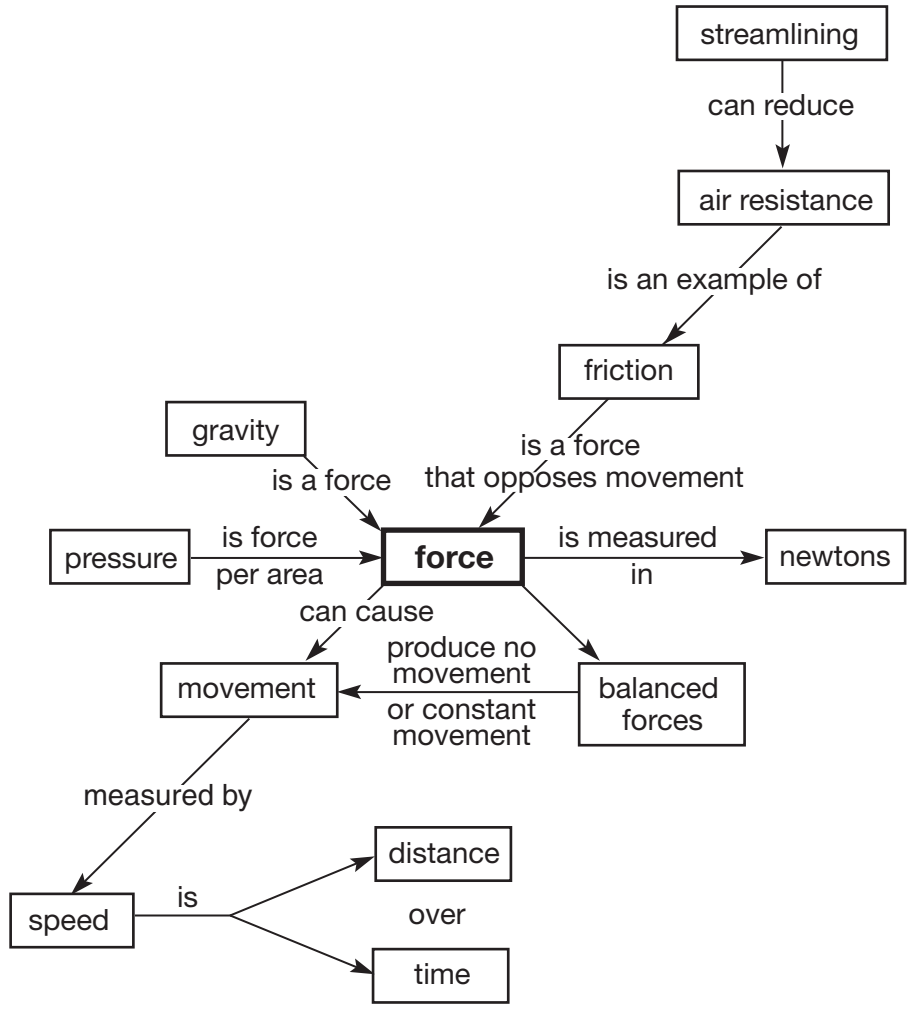
They are useful as:

- a means of summarising information;
- a technique for note-taking;
- a technique to aid revision;
- a means of finding out what pupils already know or understand about a topic;
- a means of revealing misconceptions;
- a means of establishing links between ideas.

Three common types of cognitive maps are:

- **Flow charts or flow maps**
  These summarise information and show how one idea leads to another. They can be useful for summarising a topic or for revision.
- **Radiant maps**
  These start with a central theme (e.g. 'energy') and allow the learner to organise and summarise information by showing how one idea links to another. They are useful for summarising, note-taking, revision, finding out what pupils know, and establishing links between ideas.
- **Concept maps**
  These are essentially radiant maps but make clear what the connection is between ideas by writing words or phrases on the link line that shows the relationship. These are useful for summarising, note-taking, revision, discovering misconceptions and establishing links between ideas.

  An example of part of a concept map is shown opposite.



heart

taboo words:
blood, pump

Taboo

This simple activity for groups of three pupils, used in lesson 1, is good as a plenary session at any stage in a lesson.

One pupil acts as a *describer*, one as a *listener/guesser*, and the third as *referee*. The describer is given a 'taboo' card (as on the left) with a key word printed in bold and various taboo words. The guesser has to work out what the key word is from the describer's description. In this the describer is not allowed to say the key word or the taboo words; the referee checks that the describer doesn't cheat and that no taboo words are used. The describer therefore has to challenge their own understanding of the key word on the taboo card and describe it in ways other than relying on scientific terminology. This raises the stakes in terms of 'thinking skills' and means pupils have to reconstruct scientific terms in a different way.

When each word is guessed, roles pass around the trio. Each person therefore gets a turn to be guesser, describer or referee.

Some of the cards have no taboo words. If the desciber has one of these cards, then the trio should think up taboo words to write on it. Again this links the science behind the word to other concepts or processes as in the concept mapping exercise.

The number of taboo words included on a card varies. Some key words are easy to describe because associated scientific phrases/words have not been included as taboo words. However, some rely on the description being without associated scientific terminology.

Loop card games

Lessons 6 and 7 include examples of these.

A set of cards is prepared, each one having a question and an answer to a different question. For this reason you can only play the game with the full set of questions and answers.

Divide the cards among the teaching group, one card per pupil, or ask pupils to work in pairs, each pair having more than one card. Nominate one pupil to start the game by reading the question from their card. The rest of the group have to decide whether they hold the card with the answer; if so they must put up their hands and at your request read the answer out loud. Ask the remainder of the group whether they agree that this is the answer. If so then the pupil who answered reads out the question on their card. The game continues in like manner until all the questions and answers have been used.

You can use the game more than once by challenging pupils to complete the game in less time than they previously took. The game can be repeated within a single lesson or in a subsequent lesson.