The National Strategies
Secondary

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Narrowing the Gaps in science:

A practical guide for science staff and leaders

department for
children, schools and families

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First published in 2010
Ref: 00162-2010PDF-EN-01

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1. Overview

There are some things we have no control over, such as whether we are born male or female, or our ethnic origins. There are other factors that are outside our control as children, such as our parents' or carers' economic security. However, in terms of educational outcomes the differences can be stark.

For example, more females than males are graduating from top UK universities and with 'better' degrees.[1] In fact the trend is the same across developed nations – more females than males are going to university and graduating.[2]

In 2009, 26.9 per cent of pupils entitled to Free School Meals (FSM) attained at least five GCSEs with grades of C or higher as opposed to 54.5 per cent of pupils not entitled to FSM.

In science in 2009, nationally 54.4 per cent of pupils achieved A*–C grades in two+ sciences (including BTEC/OCR Nationals). However only 34.5 per cent of pupils entitled to Free School Meals (FSM) achieved A*–C grades. FSM girls attained 35.9 per cent compared to 33.1 per cent for boys.

These inequalities do not sit comfortably with us, nor should they. We may accept that some pupils will make more progress than others but it should not be through accident of birthright. The playing field should be level; schools are distributors of life chances and they should be equitable in their operation.

When science outcomes for pupils are considered, the biggest 'contribution' to underperformance is whether pupils are entitled to FSM. Many pupils reach their expected outcomes in science but some do not. Progress will depend on their individual context and the gender or groups these individuals belong to such as whether they receive FSM or are members of an ethnic group. Teachers should focus on all pupils who are not making the expected amount of progress in science.

The purpose of this guide is to support science teachers and subject leaders to establish how well pupils are doing in science at all stages of their secondary education and to give ideas as to how any emerging issues can be addressed as part of a development programme. The guide has a particular focus on narrowing the gaps for vulnerable or disadvantaged pupils; schools may have concern about underperformance by other groups of pupils, including those who are gifted and talented. The National Strategies have published guidance materials for use by schools and these are referenced at the end of this guide. However, a detailed treatment lies outside the remit for this guide.

1 Higher Education Policy Institute (2009)
2 OECD (2003) Education at a Glance

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2. Introduction: how this guide supports gap narrowing

Differences between children start at an early age. The reasons behind these differences are a cause of much debate. Some believe that differences are inherent, that the reasons are both genetic and hormonal, established before a child is even born. However, others argue that differences in attainment are products of the environment in which pupils are raised.

There are many references in the media to the relative performance of different pupils. Sometimes it is a gap in attainment that is highlighted and in others it is suggestions as to how improvements can be made.

The evidence base

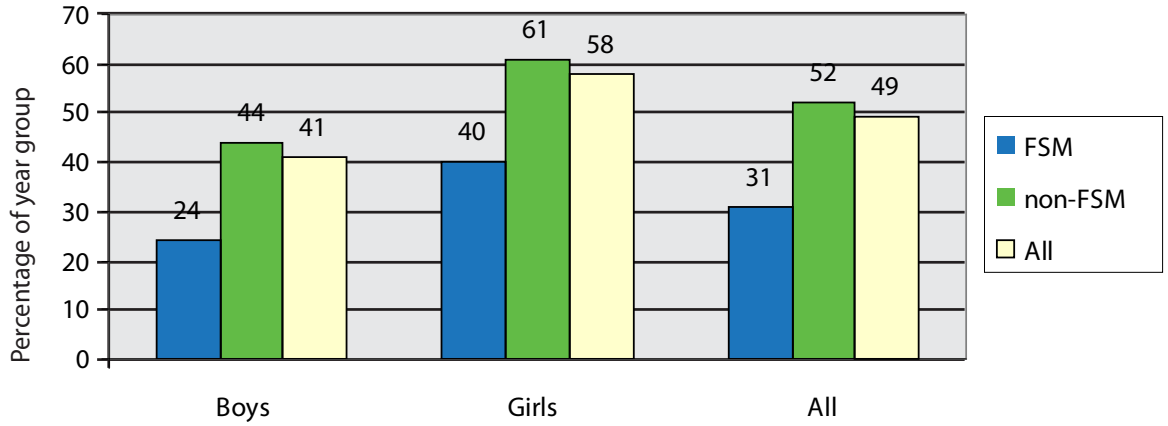
The PISA report[3] (2006) noted that Year 11 boys outperformed girls in England and Wales in their ability to explain scientific phenomena. There was little difference in identifying scientific issues and using scientific evidence. However, the TIMSS[4] report (2007) states that in England there were no gender differences in mathematics or science at either Year 5 or Year 9.

ROSE[5] (2006) highlighted that girls and boys as groups have preferences for the types of science they wish to learn about.

> When asked what they wished to learn about, there are marked differences in the responses of boys and girls. For girls, the priorities lie with topics related to the self and, more particularly, to health, mind and well-being. The responses of the boys reflect strong interests in destructive technologies and events. Topics such as 'Famous scientists and their lives' and 'How crude oil is converted into other materials' are among the least popular with both boys and girls.

Children who start off in the bottom 20 per cent in the Foundation Stage are six times more likely to be in the bottom 20 per cent at Key Stage 1 than their peers. Chart 1, based on 2008 (provisional outcomes) for the Early Years Foundation Stage Profile, shows the stark difference in attainment between FSM and non-FSM children, boys and girls.

Chart 1
EYFSP 2008 outcomes (provisional)



3 PISA report – Programme for International Student Assessment. A triennial assessment of 15-year-olds within OECD member countries
4 TIMSS report – Trends in International Mathematics and Science Study – NFER and DCSF, 2007, published December 2008. Reports on Year 5 and Year 9 pupils
5 The Relevance of Science Education Project (ROSE) in England, Jenkins, E.W. and Pell, R.G. (2006) Centre for Studies in Science and Maths Education, University of Leeds

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By the end of Key Stage 4, FSM pupils are more than three and a half times less likely to attain five or more (5+) A*–C grades at GCSE, including English and mathematics, than the rest of the cohort and, although the gap has narrowed slightly for girls, the gap between FSM boys and, in particular White British FSM boys, and their peers shows little sign of narrowing.

Chart 2
Momentum: KS4 5A*–C including English and mathematics

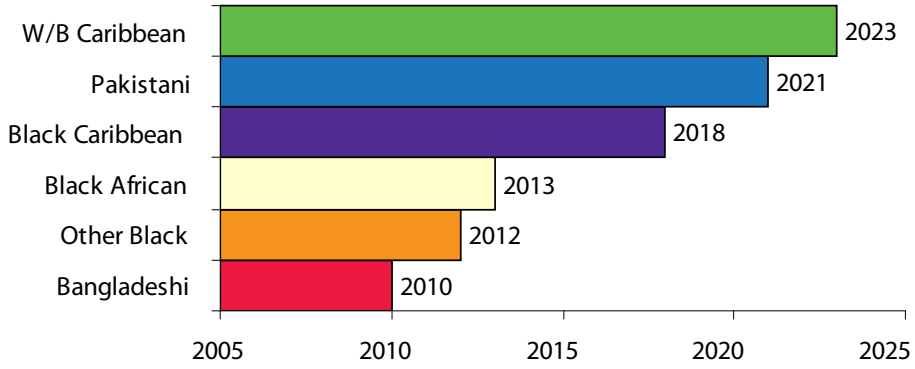

Chart 2 shows that, in relation to underperforming minority ethnic groups, at the current national rate of improvement the talents of too many pupils from minority ethnic groups will not be fulfilled. Some schools and some local authorities (LAs) have shown that they can buck the trend and increase rates of improvement; this gives us the confidence that we should and must see similar improvements elsewhere.

Chart 3
Attainment in GCSE science

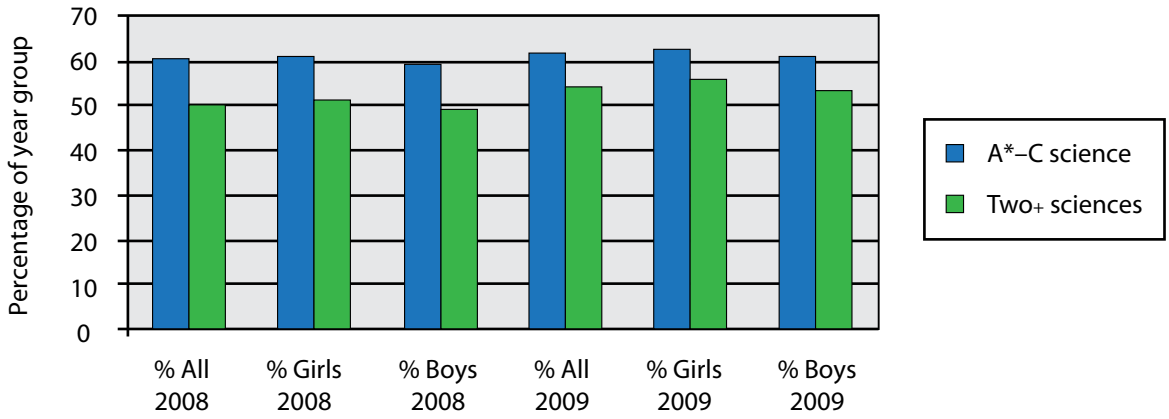

Chart 3 shows how attainment compares between boys and girls in any science at GCSE (grade C or higher) and in two or more sciences to grade C or higher. For each group the trend is rising, but the gender gap remains.

Chart 4
Percentage of pupils by FSM entitlement attaining two or more GCSE science A*–C

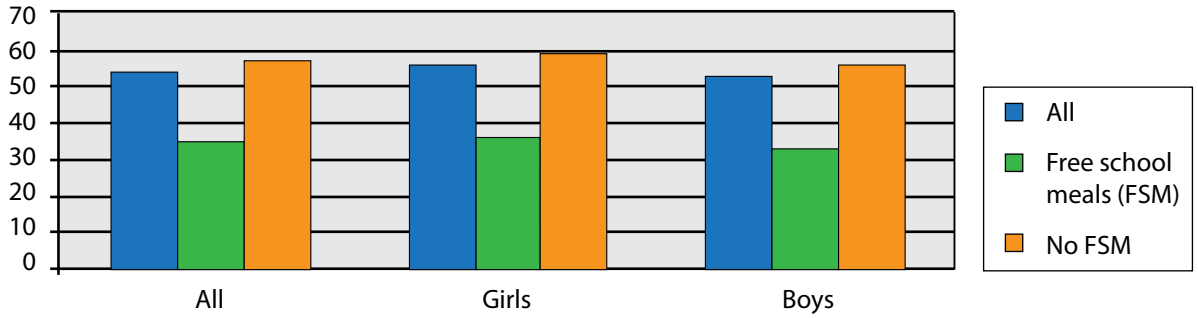

Chart 4 shows that attainment of two or more GCSEs in science at grade C or higher is significantly affected by entitlement to FSM. The gender gap is also apparent but is much smaller in comparison.

Chart 5
Percentage of pupils from ethnic groups attaining two or more GCSE science A*–C

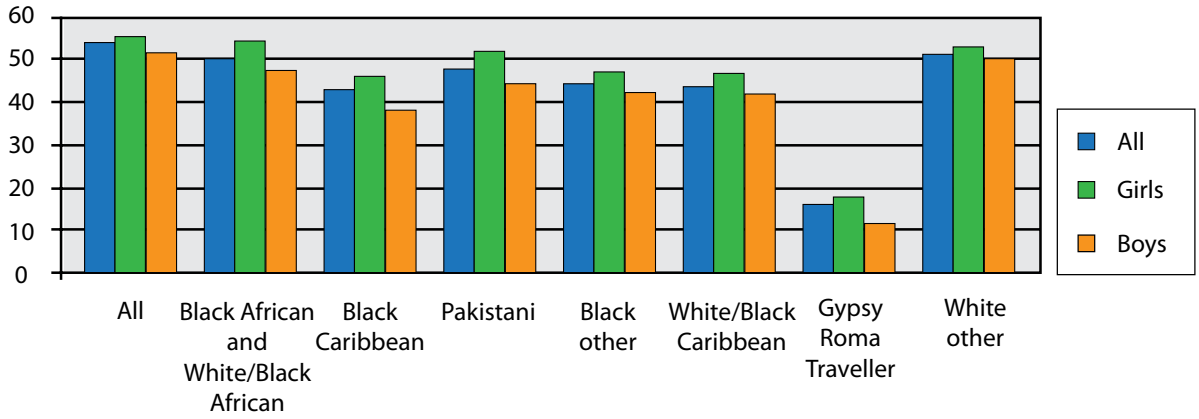

Chart 5 shows how attainment of two or more GCSEs in science varies according to ethnic group. There is a marked variation between groups; the gender gap is also apparent and can be placed in context.

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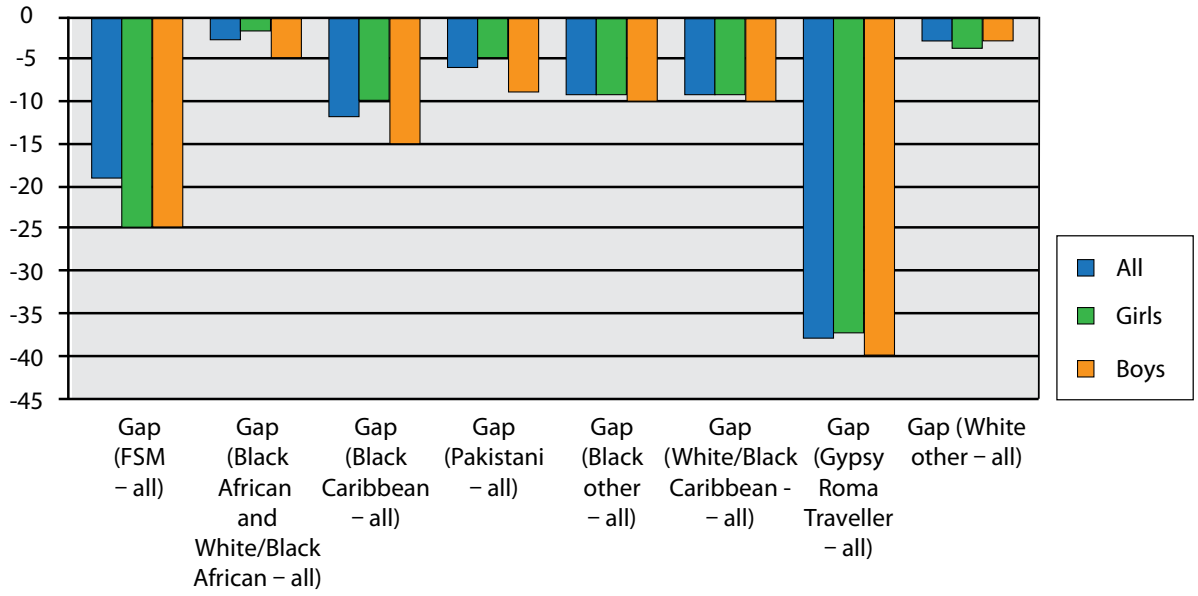
Chart 6
Gaps in attainment by FSM and ethnic group in attaining two or more GCSE science A*–C



This shows the gap in attainment of two or more GCSEs in science related to entitlement to FSM and by ethnic group. The comparison in each case is with all pupils. This clearly places the different factors in context: the largest gap (apart from Gypsy Roma Traveller pupils) is due to FSM entitlement, followed by ethnicity and then gender. It is worthwhile noting that there is regional variation so schools need to look at the underperformance of the pupils in their schools compared with the national.

Progress data

Chart 7
Percentage of pupils by entitlement to FSM making three or more levels of progress in science from 11 to 16

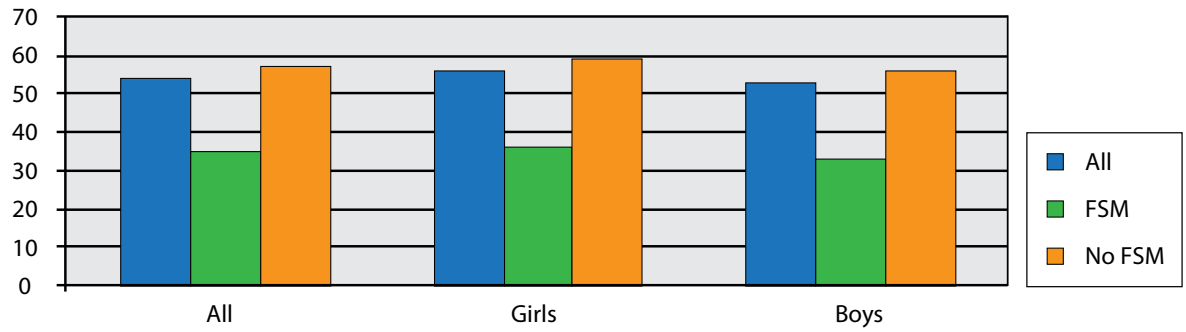


Chart 7 clearly shows that a significantly smaller percentage of pupils entitled to FSM make good progress from 11 to 16 in science.

Chart 8
Percentage of pupils by ethnicity making three or more levels of progress in science from 11 to 16

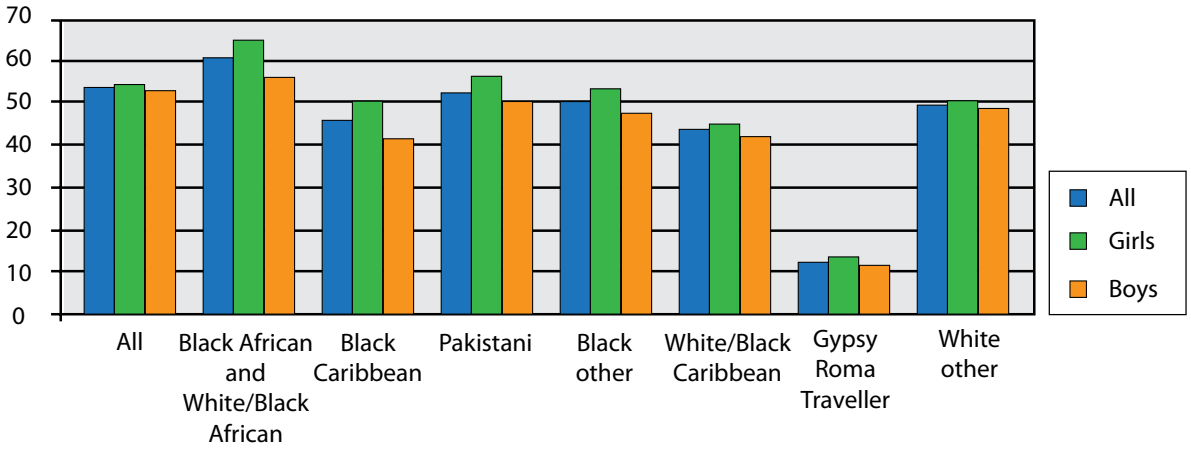


Chart 8 shows the proportion of pupils from different ethnic groups making good progress from 11 to 16 in science. A comparison of this chart with chart 5 (showing attainment) is interesting; several groups make as good progress (and some make better progress) than 'all pupils' in their secondary education though the outcomes are not as good.

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Chart 9
Differences in proportions of pupils making three or more levels of progress in science from 11 to 16 by FSM entitlement and ethnicity

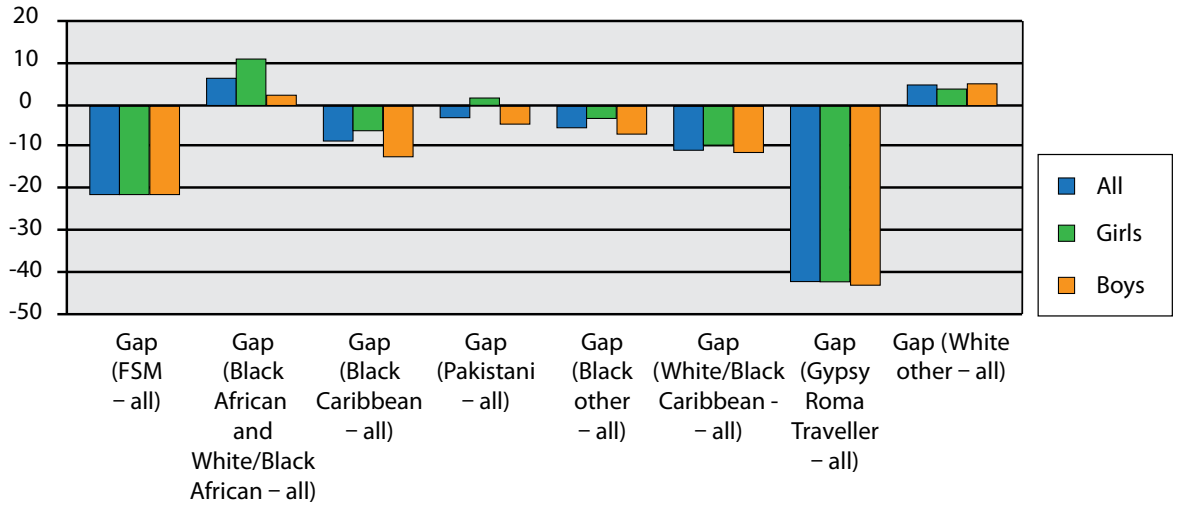


Chart 9 shows how the proportion of pupils making good progress in science (three or more levels from 11 to 16) varies compared to all pupils according to entitlement to FSM and ethnicity. This shows that some groups have a greater than average proportion of pupils making good progress. However it also clearly indicates that a smaller proportion of FSM pupils than any other group (apart from GRT pupils) make good progress in science.

When the national data is considered, gender differences with reference to attainment and progress in science are relatively small, but there is significant variation in girls' and boys' attainment between and within schools. However, all pupils are also part of other groups, for example FSM and ethnicity. Non-FSM boys generally do better than FSM girls. These factors have a bigger influence on pupil outcomes than gender alone.

The evidence is clear. We need a concerted effort to narrow the gaps in attainment between disadvantaged vulnerable pupils and their peers. This is a national priority, reflected in the Government's targets of individual progress to achieve world-class standards, and narrowing the gaps in educational achievement for children from disadvantaged families. The focus on narrowing gaps is reflected in one of the strategic aims of the National Strategies.

> '…[to] improve outcomes for all children, with a particular focus on those from disadvantaged backgrounds, those on free school meals (FSM), those with special educational needs, gifted and talented pupils, and those from minority ethnic groups who are vulnerable to underperformance.'
>
> **National Strategies Annual Plan Summary, 2009–10**

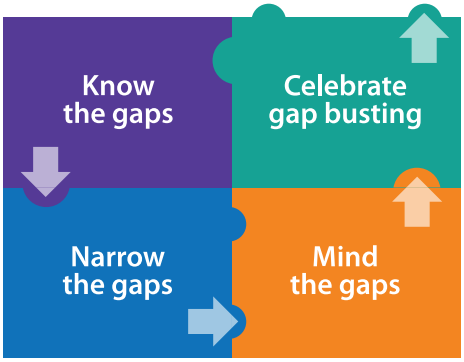
It will be essential for every school and LA to work through to a point of absolute clarity on where the gaps lie and which are the pupils whose progress needs to accelerate.

3. How to use this guide

This guide offers some practical strategies that science subject leaders and teachers can use to address underperforming groups. The techniques suggested are tried and tested by practising teachers.

The Narrowing the Gaps approach

The National Strategies approach to narrowing gaps is based on four areas of action. These are:



Know the gaps (good data analysis that leads to action and impact)

Narrow the gaps (planning for progression, effective pedagogy, personalised intervention)

Mind the gaps (systematic assessment and tracking)

Celebrate gap busting (acknowledge and build on successes)

This publication focuses particularly on what secondary science departments can do in the first three areas. To find out more about whole-school practice, visit the Narrowing the Gaps area at: www.standards.dcsf.gov.uk/nationalstrategies (select 'Narrowing the Gaps').

Strategies and outcomes

As part of the Narrowing the Gaps project in science, an extensive research project was undertaken to identify key features of effective practice in this area. Schools that were successful at 'narrowing the gaps' as well as 'raising the bar' were identified from progress and attainment data and a series of visits arranged. Pupils were interviewed, lessons observed, key staff at all levels interviewed and practice scrutinised. The findings from some 25 visits were accumulated, analysed and synthesised into a set of strategies and outcomes; these form the basis of the latter part of this resource.

The strategies are categorised under senior leaders, subject leaders and classroom science staff (including teacher and teaching assistant); the outcomes are ones that all staff can be expected to work to achieve and are focused on the pupil. The outcomes and strategies have been tabulated against the four areas of action, which form the basis of the rest of this resource.

Supporting your continuing professional development (CPD)

Notes and planning that are completed as part of this work can be added to a CPD portfolio. It could provide evidence of meeting professional standards to support career progress at Core, Post-Threshold, Excellent Teacher or Advanced Skills Teacher (AST) levels.[6] In addition, the evidence gathered could be used in your application for CSciTeach (Chartered Science Teacher)[7] or count towards accreditation of an MA.[8]

6 www.tda.gov.uk/teachers/professionalstandards
7 Contact The Association for Science Education (ASE): www.ase.org.uk
8 Contact your local higher education provider

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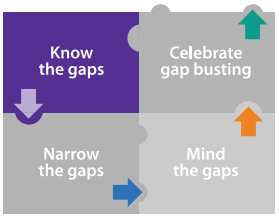

4. Know the gaps

Introduction

Based on extensive research and analysis of key factors in schools that are successful in narrowing the gaps in science a series of strategies and outcomes have been identified under the four aspects of the National Strategies' Narrowing the Gaps work.

The table below shows what senior leaders, subject leaders and classroom staff can do to know more about the gaps in progress and attainment and the outcomes they can expect to achieve.

Know the gaps

- Identify and use data
- Use data to set targets
- Build data confidence

Strategies and outcomes: Knowing the gaps

Which of these can be found in your classes, your department and your school?

	Strategies to use in school			Outcomes
	Senior leaders	**Subject leaders**	**Classroom science staff**	
a. Identify and use data	Data on vulnerable and disadvantaged groups is identified and collated; historical performance data is used to identify the relative contribution of various factors to underperformance (see pp.12–15). Relevant data informs discussions with senior leaders, pastoral leaders and subject leaders to identify vulnerable and disadvantaged pupils most at risk of underperforming.	Science subject leaders identify and share the data on pupils most at risk of underachievement with science teachers (see pp.12–15). Science subject leaders agree the most useful data sets to use in the department tracking system, taking account of the views of the staff (see pp. 12–15).	Teachers use data to track the progress of pupils. Teachers ensure that they are aware of the individual vulnerable and disadvantaged pupils in each class (see pp. 12–15). Teachers use discussions with vulnerable and disadvantaged pupils to triangulate information gleaned from the data (see pp.16–17).	Underperforming pupils or those at risk of underperforming are identified using a range of quantitative data and qualitative information.

	Strategies to use in school			Outcomes
	Senior leaders	**Subject leaders**	**Classroom science staff**	
b. Use data to set targets	Senior leaders set the expectations of at least three levels of progress from Key Stages 2 to 4 in science. The expectation is that vulnerable and disadvantaged pupils will make at least as much progress as their peers and more progress where they are underperforming to catch up to their peers (see pp.15–16).	Subject leaders work with science staff to share individual pupil targets, based on prior attainment and taking into account other factors (see pp.12–16).	Science teachers monitor individual pupil progress against these targets and amend as necessary to ensure they remain challenging (see pp.12–16). Teachers share targets with vulnerable and disadvantaged pupils and their parents/carers.	All pupils are set, and made aware of, realistic but aspirational targets for achievement in science.
c. Build data confidence	Senior leaders broker data competency training for all new staff as part of their induction (see pp.12–16). Senior leaders ensure that middle leaders are confident in the use of data from RAISEonline and other agreed data sources (see pp.12–15).	Science departmental meetings regularly focus on and review pupil level data, including periodic and Key Stage 4 assessments and maintain a regular dialogue on the use of data. Moderation of data takes place periodically across the science department.	Teachers maintain a regular dialogue on the effective use of data with their line manager and peers (see pp.12–15). Teachers' knowledge and skills of addressing underperformance are monitored regularly and areas for development are addressed through performance management.	Staff use data confidently and regularly to identify those vulnerable and disadvantaged pupils who are, or are at risk of, underperforming.

Know the gaps: Identifying and using data

How does the attainment and progress of pupils in various groups compare in science?

How do these compare with attainment and progress of pupils overall and in other subjects in the school?

Scrutiny of the data may reveal issues and raise further questions. There are many sources of data as shown in the list below; explore with your line manager the options available in your school. Some data for science is only available in the web-based versions; if these are not available you will need to rely on school-level data for your analysis.

The outcomes of your analysis will be more robust if you consult more than one source. Consider the statistical significance of any differences that emerge before you jump to conclusions.

Data sources

- RAISEonline and FFT live. Access to the interactive RAISE online (www.raiseonline.org) and FFT live (www.fftlive.org) will be required to see science-specific data for boys and girls; the green and blue boxes show areas that are statistically significant).
- Fischer Family Trust (FFT) *Analyses to Support Self-Evaluation* booklet will provide progress data for science including comparisons of low-, middle- and high-ability boys and girls.
- SSAT Data Enabler
- Post-16 progression to A Level sciences
- Local authority data
- School internal analysis

Using the data

How do the attainment and progress of pupils in different groups compare in science? How do these compare with attainment and achievement of pupils overall and in other subjects in the school? To answer these questions, a range of data needs to be accessed and compared. Scrutiny of the data may reveal issues and raise further questions. This may lead to further enquiry before solutions can be trialled and evaluated.

Trends over time – for all pupils, various groups; school and national

- 5 A*–C
- 5 A*–C English + mathematics
- 2 sciences A*–C (%)
- 1 science A*–C (%)
- At least three levels of progress Key Stage 2–4
- Progression to A Level sciences
- English A*–C (%)
- Mathematics A*–C (%)
- Key Stage 3 – L5/6+

Activity for teachers: using data to build a picture of the progress of a class.

Tracking data for your class may not automatically look at differences between pupils in different groups. You might wish to extend your analysis to include other underperforming groups. If you do not already know, ask your line manager for a list of pupils who:

- take free school meals
- belong to ethnic minority groups
- have Special Educational Needs.

1. Look at the results from internal (or external) assessments including outcomes from periodic assessments using APP.
2. Calculate the differences between those children who are part of the designated group and those who are not.
3. Compare these differences with similar classes in your school and, if available, against the performance of these groups locally and nationally.

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4. Does the data support your hypothesis that some pupils are not making as much progress as similar pupils in other classes/schools/nationally?

Activity for subject leaders: using data to build a picture of the progress of a year group.

If you do not already know, ask your line manager for a list of pupils who:

- take free school meals
- belong to ethnic minority groups
- have Special Educational Needs.

1. Look at the school-level results using one or more of the data sources listed below.
2. You should also include departmental results from internal tracking including outcomes from periodic assessments using APP or external interim assessments.
3. Adjust the spreadsheet template to help you calculate the differences between those pupils who are part of the designated group and those who are not and to compare these differences with other subjects in your school and, if available, against the performance of these groups locally and nationally.
4. Does the data support your hypothesis that some pupils are not making as much progress as similar pupils in other classes/schools/nationally?

Once you have developed some reasons for the differences triangulate this evidence by using another source.

Activity for senior leaders: using data to build a picture of progress and attainment in science.

1. **How does the performance of pupils in various groups compare across English, mathematics and science in school and national data?**

The purpose of this analysis is to determine if there are trends across all core subjects. For example, if attainment by pupils in a particular group is lower than national across all subjects, not just science, it may be that the mean ability of pupils in that group is lower than other pupils or that pupils in that group are underachieving across all three subjects.

Look at trends in science attainment by pupils in a particular group…

- Percentage of pupils attaining 1 grade A*–C in any GCSE science (or equivalent)
- Percentage of pupils attaining 2 or more grade A*–C in permitted combinations (for data purposes) of GCSE sciences (or equivalent)
- Percentage of pupils attaining grade A*–C in Triple sciences
- At least three levels of progress Key Stage 2–4
- BTEC science
- Any other sciences

…and compare to whole-school attainment…

- 5 A*–C
- 5 A*–C English + mathematics
- A*–C English

- A*–C mathematics

2. What does value added data tell us?

Do pupils in a particular group appear to have significantly lower achievement across English, mathematics and science?

If so, what are the Contextual Value Added (CVA) values for those pupils?

(Pupils in a particular group may appear to be underperforming compared to other pupils but value added data suggests they make good progress. The mean ability of the pupils in a particular group is lower than that of other pupils.)

What does the FFT *Analyses to Support Self-Evaluation* booklet tell you about the achievement of pupils in a particular group over time? Look at the following sections first:

- KS2 to KS4: Value Added (Significant Areas)
- KS2 to KS4: Value Added (Significant Areas Summary)
- KS2 to KS3: Value Added (Significant Areas)
- KS2 to KS3: Value Added (Significant Areas Summary)
- KS3 to KS4: Value Added (Significant Areas)

3. How does science compare with other subjects in the school?

What does RAISEonline tell you about the relative performance of pupils in a particular group in science over time? (Relative performance indicators (RPI) tell you how the pupils performed in science relative to the other subjects they took.)

Look at the following which can be found in Home > Reports & Analysis > View All Analyses > Key Stage 4 > Attainment > Thresholds > KS4 Relative Performance Indicators in full GCSE subjects by subject:

- RPI Sig+/Sig–/no Sig All
- RPI Sig+/Sig–/no Sig BOYS
- RPI Sig+/Sig–/no Sig GIRLS

4. Additional data sources (e.g. school, progression to post-16) – do these give you any additional information?

Use your most recent RAISE online Full Report, Fischer Family Trust *Analyses to Support Self-Evaluation* documents and any LA/internal data to determine if there are significant differences between the performance of pupils in a particular group in general and/or in science. Access to RAISEonline (**www.raiseonline.org**) and FFTlive (**www.fftlive.org**) will provide further analyses.

Effective guidance on using data to identify trends in pupil performance is given in *Narrowing the Gaps: from data analysis to impact – The golden thread* (DCSF ref: 00792-2009PDF-EN-01). Go to **www.standards.dcsf.gov.uk/nationalstrategies** and search using the DCSF reference.

Know the gaps: Using data to set targets

Obviously the use of data is essential not only to inform views about the effectiveness of current provision in securing good progress for all pupils, but also in the setting of challenging but achievable targets for those pupils.

The starting point for this should be at least three levels of progress from 11–16. However it may be appropriate for vulnerable and disadvantaged pupils to have more ambitious targets; these pupils may have fallen behind their peers in the progress they make as a result of poor provision previously and specific interventions may be called for.

As pupils progress through the school it is important to review their targets; several of the schools successful at narrowing the gaps worked on the basis that such reviews rarely if ever lowered targets but would raise them if it became clear that they were insufficiently aspirational.

It is also appropriate that pupils know and understand what their targets are. However what is more effective is for pupils to have a clear understanding of how they can make progress. Schools visited in the course of the research for the strategies and outcomes had made a clear priority of pupils having a sound grasp of what they could do to make good progress.

National Strategies approaches and resources include work on learning targets for pupils. A learning target summarises the next step in expected pupil learning that has been identified through any assessment or review process. Learning targets help communicate these next steps to pupils, parents and carers and should be used to inform teachers' ongoing planning.

Activity for subject leaders and teachers:

- Think about a pupil who was at level 5 at the end of Key Stage 2 and who you judge to be capable of making outstanding progress during Key Stage 3.
- Suggest some possible learning targets that would enable them to stand a good chance of reaching level 8 by the end of Key Stage 3. These should make it clear what they might have to focus upon.
- What learning targets should they then be set to be 'on track' for a Grade A* at GCSE?

Know the gaps: Using pupil voice to build up a picture of attitudes

What do pupils think about their experiences of learning in science?

To know the gaps it is important to take into account views that pupils have formed about the nature and effectiveness of teaching and learning in science. One way of doing this is to interview a group of pupils; appendix 3 shows details of how such an interview might be set up and the kind of questions it is useful to ask. Another way is to present pupils with cards showing various types of learning activity and ask them to sort them out according to effectiveness; an example of such an activity including a sample set of cards is in appendix 4.

Teacher activity: teaching and learning in the classroom

Identify two significant differences between the responses of pupils in different groups. Reflect on the reasons for these. You could use this evidence to guide decisions about how you improve teaching and learning in your classroom.

Activity for subject leaders: teaching and learning across the department.

Identify two significant differences between the responses of pupils in different groups. Reflect on the reasons for these. You could use this as part of the evidence to support the need for change in current practice in your department. Try out some strategies; monitor the impact by repeating the pupil–voice process after about six weeks of trialling a strategy.

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Know the gaps: Using lesson observation to review the effectiveness of learning activities

Are there significant differences in teacher interaction or pupils' actions between pupils in different groups during the course of a lesson?

Activity:

Ask a colleague, perhaps another teacher, subject leader or senior leadership team member to use the observation form to help you identify your strengths and areas for development when looking at underachieving groups in lessons.

Notes for observer

Be clear with the teacher that the purpose of the observation(s) is to collect evidence to formulate ideas about strengths and areas for development about teaching and learning across the department. The outcomes will be in the form of a general report which will provide evidence for future actions. An example of a typical lesson observation form is included in appendix 4.

Know the gaps: Department discussion scenarios

How do groups of pupils respond in science lessons?

Activity:

As a subject leader you could use comments that pupils have made about their experience of science lessons to promote discussion in a departmental meeting. You may select particular ideas in the light of initial observations or use various ideas to explore ideas and raise awareness about classroom practice. A sample set of ideas is provided in appendix 6.

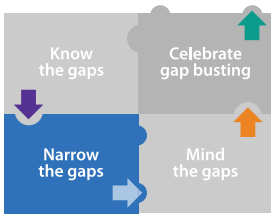
Activity for senior leaders:

- Do your staff say things like this?
- Compare these with their comments about the groups they teach.

Activity for subject leaders and teachers:

The ideas may prompt you to identify areas that you may choose to look at in greater depth.

- Are there any that you identify with?
- Why might the teachers saying these things have said them?
- What thoughts do they prompt about the pupils that you teach?
- What do you think about the way that pupils respond in your lessons?
- How could you use these ideas to prompt discussion at a team meeting or CPD event?



5. Narrowing the Gaps: agreeing department actions

Introduction

After collection of information from different sources it is important that a plan is then made of how the gaps between pupils can be narrowed. The following outcomes and strategies are those commonly used in schools which are successful in narrowing the gaps in science. They include:

- Curriculum provision and planning
- Quality First teaching including literacy in science
- Science pedagogy including *How science works*
- Intervention
- Working with parents/carers
- Effective STEM enhancement and enrichment.

The outcomes in this table can be used to help focus the use of the evidence, review departmental approaches and then choose the strategies which could be used to narrow the gaps found in the department.

Strategies and outcomes: Narrowing the gaps

Which of these are being used in your classes, your department and your school?

	Strategies to use in school			Outcomes
	Senior leaders	**Subject leaders**	**Classroom science staff**	
Curriculum provision and planning	Senior leaders ensure that the statutory entitlement in science is met and analyse the contribution that 'two or more sciences at grade C or higher' makes to overall targets (see p.24).	Subject leaders use a thorough knowledge of all science courses available to match pupil needs and local provision for studying science post-16. Taking into account persistent absence, pupil interests, parental views and career pathways to inform decisions (see p.24).	Teachers identify appropriate teaching and learning (T&L) approaches to meet the demands of the specific science courses and the needs of the pupils on those courses. Teachers maintain a regular dialogue to canvass pupil and parent/carer opinions on the success of the teaching approaches (see pp.16–17 and 26).	Pupils have access to a curriculum in science that is comprehensively planned to provide a range of pathways well matched to their needs and supports their progression and aspirations 11–19.

	Strategies to use in school			Outcomes
	Senior leaders	**Subject leaders**	**Classroom science staff**	
	Strategic discussions take place between senior leaders and the science subject leaders to ensure that the there is capacity in the science department to effectively deliver an appropriate range of curriculum pathways in science. A range of curriculum pathways are offered that are matched to pupils' needs and progression from 11 to post-16 (see p.24). Sufficient curriculum time is allocated for delivery of science courses to enable pupils to make sufficient progress while maintaining a balanced curriculum offer. Appropriate CPD for staff to deliver courses is supported and prioritised.	Subject leaders identify and develop the strengths and expertise of teaching staff to deliver the most appropriate courses. Subject leaders coordinate the evaluation of pupil voice and outcomes to reflect on curriculum provision and T&L and adjustments are made accordingly (see pp.16–17 and 24). The subject leaders monitor and respond to staff CPD needs. Senior leaders and subject leaders review curriculum provision in the light of feedback from pupil voice, staff evaluation and progression data (see pp.16–17 and 24).	Teachers self-evaluate to identify their continuing professional development (CPD) needs to deliver science courses effectively.	

	Strategies to use in school			Outcomes
	Senior leaders	**Subject leaders**	**Classroom science staff**	
Deliver Quality First teaching (QFT) including literacy in science and behaviour for learning.	Senior leaders coordinate and facilitate a whole-school focus on literacy. Senior leaders lead the effective evaluation of the quality of teaching.	Subject leaders lead the department in identifying effective and engaging strategies in scheme of learning to support the delivery of HSW, linked to a whole-school focus on literacy (see pp.24–25).	Teachers plan opportunities for vulnerable and disadvantaged pupils to develop spoken and written explanations, arguments and decision making in response to scientific challenges and questions through a range of pedagogies (see pp.24–25).	Pupils are confident and competent in developing spoken and written explanations, arguments and decision making in response to scientific challenges and questions.
	Senior leaders take an effective lead in the development of high-quality teaching strategies (see pp.24–25). Senior leaders work with subject leaders to provide regular opportunities for the most effective teachers to teach pupils at greatest risk of underperforming.	The sharing of effective practice focusing on literacy development is scheduled into science departmental meetings and dedicated CPD time (see pp.24–25). The sharing of effective practice on behaviour for learning is scheduled into science departmental meetings and dedicated CPD (see pp.24–25). Subject leaders work with senior leaders to provide regular opportunities for the most effective teachers to teach pupils at greatest risk of underperforming.	Teachers use behaviour for learning strategies effectively in their lessons so there is a positive learning environment in science lessons (see pp.24–25). Peer review and sharing of what works well inform teachers' practice.	

	Strategies to use in school			Outcomes
	Senior leaders	**Subject leaders**	**Classroom science staff**	
Science pedagogy/ *How science works* (HSW)	Senior leaders actively support the science subject leaders in the department focus on HSW through monitoring and evaluating processes (see p.25).	Subject leaders actively promote a vision for HSW through a culture of open dialogue within the department and the identification of good practice. Subject leaders encourage a risk-taking culture through exploring the uncertainty of science. Subject leaders ensure that schemes of learning have been developed by all staff and include clear pathways of progression in HSW (see p.25).	Teachers plan learning opportunities for vulnerable and disadvantaged pupils to use scientific models and theories to develop arguments, make decisions and explain the world around them (see pp.24–25). Peer review and sharing of what works well inform teachers' practice.	Pupils are confident and competent in using scientific models and theories to develop arguments, make decisions and explain the world around them.

	Strategies to use in school			Outcomes
	Senior leaders	**Subject leaders**	**Classroom science staff**	
Intervention	Interventions for vulnerable and disadvantaged pupils are coordinated across the school. Regular meetings with personal tutors and middle leaders are coordinated to identify pupils who are underperforming, or at risk of underperforming, in science and agree the most appropriate interventions (see pp.24–25). Senior leaders maintain a high-profile dialogue with pupils and teachers on which interventions work well.	Subject leaders monitor progress of all pupils and triangulate evidence of underperformance to inform discussions with classroom teachers, senior leaders, personal tutors and parents/carers (see p.26). Subject leaders monitor and evaluate the impact of interventions in science on the progress of vulnerable and disadvantaged pupils.	Teachers use 'learning discussions' or one-to-one discussions with vulnerable and disadvantaged pupils to identify causes of underperformance and address issues accordingly through appropriate teaching and learning strategies. Teachers use targeted and agreed interventions and scheduled catch-up sessions and to access support from other adults where appropriate (see p.26). Intervention is targeted and planned at scheduled times on a one-to-one basis for pupils with persistent absence (PA pupils) and focuses on scientific skills and ideas missed (see pp.24–25).	Vulnerable and disadvantaged pupils are enabled to make at least as much progress as their peers and through Quality First teaching and appropriate intervention they make more progress than when they are underperforming.
Work with parents, families and other adults	Home–school contracts formalise the roles and responsibilities of both parents/carers and the school in supporting pupil learning (see p.26).	Parents/carers are regularly informed of their child's progress in science, through both formal and informal meetings and communications, e.g. reports, postcards home and phone calls (see p.26).	Science teachers support a dialogue with parents/carers to clarify specific strategies that can be used to support their child's learning in science.	Pupils' learning is supported by an effective home–school partnership with parental/carer involvement in learning and regular dialogue on pupils' progress.

	Strategies to use in school			Outcomes
	Senior leaders	**Subject leaders**	**Classroom science staff**	
	The exam officer communicates exam dates and external assessment deadlines to the subject leaders and parents/carers.	A dialogue takes place between subject leaders and science teachers to clarify specific strategies that parents/carers can use in supporting the interventions for underperforming pupils.	Teachers use opportunities well for parents/carers to support and be involved in pupil learning activities in science both within the school and in the community (see p.26).	
Effective STEM enhancement & enrichment (E&E)	Common processes and skills in STEM subjects are identified, and a programme of E&E is brokered from STEM providers. The involvement of vulnerable and disadvantaged pupils in STEM events is tracked year on year and supported financially where necessary (see p.26). Parents/carers are made aware of the importance of STEM skills and careers and are invited to take part in events whenever possible. Analysis of the progression rates for vulnerable and disadvantaged pupils to the study of STEM subjects post-16 is analysed to evaluate the impact of STEM E&E.	Subject leaders ensure that a programme of STEM E&E is integrated into schemes of learning, tailored to specific areas of the science curriculum, with clear outcomes for pupils planned into each science curriculum pathway to support learning and improve progression to post-16 studies (see pp.24–26). Liaison with local STEMNET provider, Science & Engineering Ambassadors, business and industry, local role models and other partnerships develops STEM opportunities (see p.26). The STEM Directory is used to identify local contacts (see p.26).	Teachers link science to contexts in the real world, make explicit links to STEM careers and use local partners and providers to enhance learning and engage pupils in science (see p.26). Teachers identify and make use of the expertise from parents/carers and other experts involved in STEM careers to augment teaching and learning.	Pupils are enthused by and engaged in learning in science and other STEM subjects, and are keen to study them beyond the age of 16.

Narrowing the Gaps: Curriculum provision and planning

There is a series of routes that pupils can choose to follow when studying science from 11 to 19 and when planning curriculum provision it is important to plan the routes most appropriate for the learners. To do this effectively it is essential that the teaching and learning styles inherent in the different pathways are not only understood but exploited so that pupils have a real choice.. The provision of courses needs to be based on a clear understanding of the pedagogy of the specifications.

The National Strategies web area has clear guidance for middle and senior leaders who are planning curriculum pathways in science, for example, *Curriculum provision in secondary science*, which can be found at **www.standards.dcsf.gov.uk/nationalstrategies** (search using the title).

Activity:

- Consider the curriculum pathways currently on offer in your school in Key Stage 4. Identify, for each:
  - The positive features
  - The negative features
  - Other factors that are particular features of that course.
- Now tag each of those features with P (for pupil), T (for teacher) or S (for school) depending upon who they relate to.
- Read the guidance booklet at the link shown above and compare the analysis with yours.
- Are there aspects of your current provision that might not meet the needs of vulnerable or disadvantaged pupils?

Narrowing the Gaps: Quality First teaching including literacy in science

a. As part of the Progressing to level 6 and beyond project the National Strategies have developed a wide range of resources and approaches which will help to support better progress in science. These are available within the e-learning course *Progressing to level 6 and beyond in science with added 'How science works'* at: **www.standards.dcsf.gov.uk/nationalstrategies** (search using 'progressing beyond level 6'). Within this course you will find a virtual school offering routes to access suggested resources.

A fundamental part of these materials is the use of the 'steps and layers' approach; this has proved to be particularly successful in areas such as literacy.

Activity:

Go to the e-learning course mentioned above and enter the 'Grouped Resources' area.

- Find the 'Library of Resources'.
- Identify materials that have a particular focus on literacy and locate the steps tables.
- Think about pupils you teach that have poor literacy skills. Which step are they on?
- Look at the strategies for progression that are suggested. How do these compare with learning activities that are offered to your pupils?

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b. Behaviours for Learning (BfL) can be developed to support an effective range of learning activities in the classroom.

Activity:

Subject leader development materials in science have provided support and guidance for middle leaders looking to address issues and develop positive behaviours for learning in the classrooms. These are available at **www.standards.dcsf.gov.uk/nationalstrategies** (search using 'Science subject leader development meetings').

- What use has the school made of deploying these Behaviour for Learning strategies?
- How well known are the skills that various teachers have in terms of being able to run a wide range of learning activities?

Narrowing the Gaps: Science pedagogy/*How science works* (HSW):

How science works is the name given to the processes that collectively represent scientific enquiry and show how scientists develop explanations by posing questions, gathering evidence, identifying patterns and trends, constructing explanations and strengthening our understanding of phenomena and their significance. These processes need to be fully integrated with lesson design and delivery so that all pupils are able to develop an increasing mastery of them.

Information and guidance on *How science works* is available on the National Strategies web area at **www.standards.dcsf.gov.uk/nationalstrategies** (search using 'How science works').

Activity:

Science departments vary considerably in terms of the quality of their provision of *How science works*.

- Detailed guidance is contained in appendix 7 (which can also be found within the e-learning course: *Progressing to level 6 and beyond in science with added 'How science works'*) in which the rows correspond to:
  - What is happening in lessons
  - What teachers are doing
  - What pupils are doing.
- Look at the table and decide where your department is at in terms of current provision.
- Decide where you could realistically expect your department to move to over the next year.
- Explore strategies that would make this move possible.

Narrowing the Gaps: Intervention

The *Intervention in Science* e-learning course explores the process of **intervention in science**, particularly within the context of Quality First teaching to support successful learning. There are **five areas** to explore:

- **Which** – This section explores how to identify which pupils are underperforming and require intervention to enable them to make appropriate progress in their learning of science.
- **What** – This section explores how to identify what gaps in learning have prevented pupils from making appropriate progress in their learning of science.
- **Why** – This section explores ways in which you can find out why pupils are making less progress than you expected.

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- **Try** – This section explores ways in which you can help meet the needs of your pupils and considers an example taken from one school.
- **Evaluate** – This section explores some ideas on how to carry out a robust evaluation of the impact of your intervention.

Activity:

Consider the current provision within your department regarding intervention. Determine:

- How pupils are identified for intervention.
- How their gaps in learning are identified.
- Why you think these pupils may be making less progress than expected.
- How effective this intervention is.

Narrowing the Gaps: Work with parents and families

Schools that are effective in narrowing the gaps know that all families are important, should be welcomed and are different. Children may live with one or both parents/carers, with other relatives or carers, with same-sex parents/carers or in an extended family. Families may speak more than one language at home; they may be travellers, refugees or asylum seekers. Practitioners will benefit from professional development in diversity, equality and anti-discriminatory practice whatever the ethnic, cultural or social make-up of the setting. Support and guidance on Parents as Partners is at: **www.standards.dcsf.gov.uk/nationalstrategies** (search using '2.2 Parents as Partners').

Activity: research the number of communications to parents or carers in a typical week in your school.

- What is the ratio of communications with a positive message to ones that raise concerns?
- What is the overall effect of this?

Narrowing the Gaps: Effective STEM enhancement & enrichment (E&E)

Science, Technology, Engineering & Mathematics (STEM) subjects offer exciting and rewarding futures for many young people, as well as supporting the economic stability of the country. Enhancement and enrichment (E&E) activities can increase pupils' awareness of this but for the opportunity to be effective, it must be carefully planned, so that the pupils' learning is enhanced and their experience is positive and motivating.

Each opportunity provided should be seen as part of the wider learning experience of those pupils. Before embarking on a course of action, it is important to consider why you are providing a particular opportunity, what it will achieve, how it will be conducted and who will be involved.

The National Strategies web area has an extended and detailed section on this which can be found by using the searching term 'Managing effective STEM enhancement and enrichment' which contains specific guidance for teachers, subject leaders and senior leaders.

Activity:

Think about the last STEM E&E activity that took place in your school.

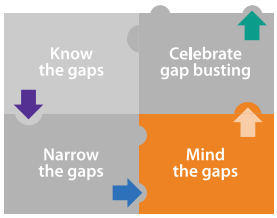
- Who was it aimed at?

- How effectively were vulnerable and disadvantaged pupils involved?
- What was the impact?
- What was its impact upon vulnerable and disadvantaged pupils?
- How could this be increased?

Next steps

Once you've decided on the focus of your development, decide on between one to three actions. Writing a clear action plan will then help you to focus on what needs to change and identify from the outset what success will look like. There are a variety of templates available. Investigate what is currently used in your school or department. For example:

Issue	Action	Lead person/ people involved	Timescale (to/from)	Resources	Monitoring, evaluation & review (who, when & how)	Success criteria
Some pupils not well engaged with group work activities and inclined to be 'off task'.	Teacher to use 'think-pair-share' to apply structure and clarify outcomes.	Two teachers involved with trialling approach (MS&LN) along with team-based TA (EW).	Approach to be used in two-week period immediately following autumn half-term break.	Group talk steps table from *Progressing to level 6 and beyond*.	Three staff involved to meet in week following trial to agree effectiveness and report to subject team.	1. Pupils take to approach. 2. Pupils on-task and completing task. 3. Outcomes show that effective learning has taken place.



6. Minding the gaps

Introduction

Having identified key issues, agreed on strategies to use to address these and put these into place the next challenge is to 'mind the gaps' – to establish procedures to monitor and track progress.

The following outcomes and strategies are those commonly used in schools which are successful in narrowing the gaps in science. They include:

- Assessment for Learning (AfL) with APP
- Tracking pupil progress
- Relentless focus on narrowing the gaps.

The outcomes in this table can be used to help support the use of approaches to embed good practice in the life of a school so that progress and attainment for all pupils is ensured in the future.

Strategies and outcomes: minding the gaps

Which of these are established strategies in your classes, your department and your school?

	Strategies to use in school			Outcomes
	Senior Leaders	**Subject leaders**	**Classroom science staff**	
Assessment for Learning (AfL) with Assessing Pupils' Progress (APP)	Senior leaders drive a whole-school focus on AfL, with a clear time line for the development of periodic assessment using APP integrated in the School Improvement Plan (see pp.30–32). Senior leaders coordinate a strategic approach to AfL/APP across all subjects, identifying best practice and promoting collaborative working.	Subject leaders monitor and evaluate the use of AfL in science lessons and audits best practice and areas for development. Subject leaders coordinate a programme of CPD and sharing of best practice to promote AfL across science lessons (see pp.30–32).	A broad range of AfL strategies are carried out by all teachers in science to provide day-to-day assessments, identify individual barriers and misconceptions and is linked to progression in the scheme of learning (see pp.30–32). AfL is used to inform periodic assessment and to provide pupils with learning targets (see pp.32–34).	All vulnerable and disadvantaged pupils are aware of how they are achieving and what they have to do to make further progress. All pupils are developing the skills to function as independent learners.

	Strategies to use in school			Outcomes
	Senior Leaders	**Subject leaders**	**Classroom science staff**	
	Senior leaders regularly monitor and evaluate teaching and learning with the use of AfL/APP as a key focus (see pp.30–32).	Subject leaders identify a clear time line for the implementation of APP in science which is integral to the Departmental Development Plan. Subject leaders schedule regular opportunities for teachers to sample and moderate periodic assessment of pupil work in Key Stage 3 against APP standards files; in Key Stage 4 work is evaluated using criteria from awarding bodies to assess progress.	Pupils are given effective feedback so they identify and agree with the teacher the next steps for making progress in their learning in science (see pp.30–32).	
Tracking pupil progress	Senior leaders monitor department tracking systems to identify all pupils who are underperforming, or who are at risk of underperforming including those who are vulnerable and disadvantaged, across more than one subject area (see pp.32–34).	Science subject leaders analyse and regularly monitors attainment and progress of all pupils including those who are vulnerable and disadvantaged to identify any underperformance and conducts a dialogue with teachers to agree actions. Reliable data is used from periodic and summative assessments to track pupils' progress (see pp.32–34).	Teachers regularly submit reliable data from periodic and summative assessments to track pupils' progress (see pp.32–34). They regularly monitor the attainment and progress of vulnerable and disadvantaged pupils to identify any underperformance. This informs a dialogue with pupils to agree appropriate intervention.	Vulnerable and disadvantaged pupils' underperformance is addressed by intervention prompted by continuous tracking.

	Strategies to use in school			Outcomes
	Senior Leaders	**Subject leaders**	**Classroom science staff**	
Relentless focus on narrowing the gaps	Senior leaders communicate high expectations to pupils, teachers, parents/carers and governors: all pupils are expected to make at least three levels of progress Key Stages 2–4. Senior leaders ensure that narrowing the gaps remains a key focus for the school, identifying and addressing barriers to progress. Senior leaders ensure effective deployment of one-to-one tuition so that vulnerable and disadvantaged pupils are able to access support.	Progress data is regularly analysed against that of comparable schools to ensure that vulnerable and disadvantaged pupils make at least as much progress as their peers and more progress where they are underperforming to catch up (see pp.32–34). Pupils are set, and are made aware of, aspirational targets of at least at least three levels of progress Key Stages 2–4.	Teachers identify barriers to learning and use intervention such as 'science learning discussions' to address these (see reference on page 41). Teachers communicate a 'can-do' culture in the classroom, through the use of differentiated learning strategies that enable all pupils to succeed. Teachers provide regular, constructive oral and written feedback on what the pupil has done well and how to improve, including the effective use of reporting to parents and carers.	There is a 'can do' culture throughout the school with zero tolerance of barriers to progress. It is expected that **all** pupils, including vulnerable and disadvantaged pupils will make good progress and achieve at least three levels of progress across Key Stages 2–4.

Minding the gaps: Assessment for learning with Assessing Pupils' Progress

The effective use of periodic assessment using APP is a fundamental part of minding the gaps, not only because it generates data to inform the tracking of pupil progress but also because it supports the teacher in developing learning targets for pupils.

In order to 'mind the gaps' effectively there are three aspects of curriculum policy and practice that need to be secure.

a. **Assessment for Learning.** There needs to be an effective use of AfL with regular periodic assessment of pupils' progress using APP in Key Stages 1–3 to support and guide teachers in drawing on a range of evidence to track progress and modify teaching accordingly. If this is done effectively it means that teaching will be 'in tune' not only with the requirements of the course but with pupils' learning needs. This will help prevent the opening up of gaps in attainment.

Recent years have seen a significant investment in the development of AfL practice in schools and there has been good progress as a result. For AfL practice to be embedded in a department, teachers need to be making effective use of objective-led lesson planning, drawing on a range of evidence to inform their views of how learning is developing and 'fine tuning' their teaching as a result. Furthermore, it is likely that classroom practices relating to questioning and to self and peer-assessment will be developing. It is also likely that teachers will be adept at identifying learning targets for pupils.

Activity for senior leaders:

The classroom quality standards for Assessment for Learning policy and practice can be found in the courses area at **www.standards.dcsf.gov.uk/nationalstrategies** (search using 'Classroom Quality Standards (CQS) guided resource'). A flyer that introduces them called *The Classroom Quality Standards for Gifted and Talented education: A subject focus (flyer)* (DCSF ref: 00256-2009LEF-EN) can also be found at the site. Search using '00256-2009'.

- Look at the Quality Standards for AfL produced by the National Strategies..
- How does your school compare with these?
- How does development of these feature in the School Improvement Plan?

Activity for subject leaders and teachers:

Look at the progress tables for AfL in science within *Assessment for Learning in science – Unit 1: Lesson scaffolding: structuring learning to develop Quality First teaching in science* (DCSF ref: 00932-2009-PFD-EN-01).

- Whereabouts on this is your department?
- Whereabouts on this are your pupils?
- Whereabouts on this are your vulnerable and disadvantaged pupils?

Activity for subject leaders and teachers:

Look at the following support and guidance and decide how you could use it to improve the progress of your disadvantaged and vulnerable pupils.

- *Assessment for Learning in science – Unit 2b: Developing written feedback in science* (DCSF ref: 00932-2009PDF-EN-03)
- *Assessment for Learning in science – Unit 2a: Developing oral feedback in science* (DCSF ref: 00932-2009PDF-EN-02)
- *Assessment for Learning in science – Unit 3: Developing peer and self-assessment in science* (DCSF ref: 00932-2009PDF-EN-04)

b. ***How science works***. APP in science is based upon the development of a wide range of processes and skills that are collectively referred to as *How science works*. Some aspects of this are well known and understood both in terms of their place in the science curriculum and also with regard to their development; others are less secure and may need more attention.

Activity:

- Look at the HSW development grid produced by the National Strategies (in appendix 7), showing eight steps of progress with regard to what pupils are doing, what teachers are doing and what happens in lessons.
- What is practice in your school like?
- What strategies may secure improvement in this?

c. **Periodic assessment.** Assessment for Learning is what good teachers do on a daily basis, responding to pupils, modifying learning activities as they teach and developing pupils as self-critical learners on an iterative basis. Assessing Pupils' Progress is periodic assessment: an opportunity for the teacher (and the pupil) to stand back and take a synoptic view of the pupils' progress. Nevertheless, APP draws on a similar set of skills; teachers who are good AfL practitioners tend to deploy APP more easily and more effectively.

The National Strategies web area has materials available to support the effective use of AfL, APP and target setting – including the effective use of learning targets. As a result of a periodic assessment teachers must use their professional judgement to decide which learning targets will be most appropriate for their class, groups of pupils or an individual pupil. These should then be discussed with pupils, parents and carers to enable pupils to become more independent in their learning. Examples of learning targets to support the APP assessment criteria can be found at: **www.standards.dcsf.gov.uk/nationalstrategies** (search using 'Assessing Pupils' Progress (APP): Science')

This has powerful implications for 'minding the gaps'; it means that the skilled practitioner can make their lessons more effective and better focused upon pupils' learning needs. When this includes pupils whose progress may falter it can play a key role in making the school more effective.

Minding the gaps: Tracking pupil progress

There needs to be a focus on tracking progress. The effective use of AfL with APP will generate valuable evidence relating to the progress that pupils are making; this can be used to track progress across the curriculum. From this patterns may emerge relating to pupils in different curriculum areas or with certain groups of pupils. All pupils need to be clear about the next steps in learning to make progress. Teachers need to provide appropriate learning targets to make the next steps.

Policy and practice in the tracking of pupil progress should involve someone, or some people, in drawing together evidence of pupil progress to identify patterns and trends. They will be asking key questions.

Activity for senior leaders:

- How does the performance of pupils in science compare with their performance in English and mathematics?
- Are there groups of pupils that are making less progress in science?
- What is the progress in science of the vulnerable and disadvantaged pupils?

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Activity for subject leaders and teachers:

- What periodic assessment practices are being followed by you and in your department?
- How are your judgements being moderated within your department and between schools in your area?
- How is information from periodic assessment being used to identify and track vulnerable and disadvantaged pupils who are underperforming or who are at risk of underperforming?

There is a real skill to having enough evidence to produce a detailed and current picture of progress, without drawing in so much that the process of collation detracts from the processes of analysis and response.

When patterns have been identified, there then needs to be an effective dialogue. This needs to take place between teachers as professionals to identify effective actions and between teachers and pupils. The concept of a dialogue is fundamental here as pupils need to be expressing and responding to ideas about what will support effective learning on their part.

Support and guidance related to the tracking and recording of pupil progress are available on the National Strategies web area at: **www.standards.dcsf.gov.uk/nationalstrategies** (search using 'Science APP recording and progress spreadsheets').

Activity for subject leaders and teachers:

- When tracking data is produced what is done with it?
- How is it used to support better pupil progress?
- How it is used to track progress of vulnerable and disadvantaged groups?
- How are various trends communicated to staff?
- What is happening in your school to address this issue?

Using APP to periodically track pupils' progress can be helpful. One form of tracking which schools might use in science, *The pupil tracking tool*, can be found at: **www.standards.dcsf.gov.uk/nationalstrategies** (search using 'pupil tracking tool').

Minding the gaps: Relentless focus on narrowing the gaps

There needs to be a relentless focus on narrowing the gaps. Schools that are successful at narrowing the gaps have high expectations of all pupils, including the vulnerable and disadvantaged, and expect them to make the necessary progress to reach and exceed national standards. When the intervention has been decided upon it needs to be based upon challenging expectations. There may be a tendency to lower expectations for pupils in underperforming groups, either because the teacher knows from experience that such pupils tend not to make as much progress or because the target-setting system is based on the trajectory that such groups have made in the past, which may not have been great.

It is then important for there to be a clear and comprehensive view of the barriers to progress that may affect pupils. These may arise from:

- the nature or the delivery of the course
- concepts or skills that some pupils may find are not easily accessible
- more generic issues, such as pupils lacking the skills to review previous learning for the purposes of summative assessment
- wider issues such as low expectations of success by the pupils themselves.

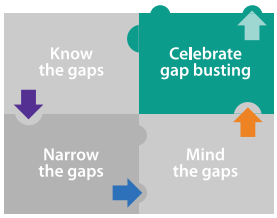
Then there needs to be a positive and effective solution-focused approach to deploying and following through interventions from a whole-school level through to individual classroom level.. Some teachers may feel that the barriers to progress for some pupils are so far outside their control that they cannot make any impact on them. This is rarely true; the focus needs to be on what the teacher and the school can do that will have a positive influence.

One of the strategies repeatedly and effectively used in science is that of the learning discussion, which can be used to increase the rate of progress of underperforming groups.
Go to: **www.standards.dcsf.gov.uk/nationalstrategies** and search for 'The learning discussion: A strategy to support better progress for underperforming groups in science'.

Another is one-to-one tuition, which can provide intensive support for targeted pupils.
To view the *One-to-one tuition toolkit* (DCSF ref: 01068-2008PKT-EN) go to:
www.standards.dcsf.gov.uk/nationalstrategies and search using the DCSF reference.

Activity:

- What is the process of target setting in your school based on?
- How does it support higher expectations for underperforming groups?
- How do teachers address barriers to learning in science?
- All staff need to address underperformance by means of appropriate intervention at an early stage. In your school what role in this is performed by:
  - Senior leaders?
  - Subject leaders?
  - Teachers?
  - Teaching assistants?



7. Celebrating gap busting

Introduction

A school that narrows gaps in attainment while raising the bar is successful and deserves recognition. It has managed to redress the negative impacts of some powerful factors and will only have done so by analysing and interpreting evidence, identifying and deploying powerful strategies and then embedding that good practice; this is no mean achievement.

The public recognition of success is not only a case of giving credit where it is due. It is also an identification of successful strategies that can, in many cases, be used by other schools. Furthermore, the process of celebration itself helps to embed those practices in the life of the school. It is a shared recognition of effective practice: part of being a self-evaluating school.

It is also a good opportunity to set the school in good standing with a range of stakeholders. If they feel that the school is effective they will be more likely to respond positively in the future if a challenge arises.

Strategies and outcomes: celebrating gap busting

The following strategies and outcomes were found in the schools most successful at gap busting. They include:

- sharing what works well
- positive involvement of parents, carers and governors.

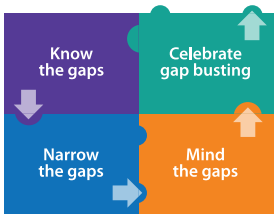
Which of these are found in your class/department/school?

	Strategies to use in school			Outcomes
	Senior leaders	**Subject leaders**	**Classroom science staff**	
Share what works well	Senior leaders establish a protocol for celebrating achievement through events such as assemblies, and presentation evenings, ensuring the inclusion of good progress of vulnerable and disadvantaged pupils. Senior leaders provide opportunities for celebrating and sharing of good practice in teaching and learning across all subjects. Senior leaders play a key role in the ongoing debate about ways of celebrating success and make a priority of both disseminating effective practice to other schools and drawing on effective practice from other schools.	Subject leaders promote the celebration of pupils' achievements in assessments in science through assemblies and communication home to parents/ carers. Subject leaders encourage the use of departmental work displays and photos to celebrate success. in science. Subject leaders award science prizes and other rewards to be presented at whole-school events, assemblies and presentation evenings. Subject leaders use networking opportunities to disseminate effective practice to other departments and draw on effective practice from other departments.	Teachers exemplify wherever possible opportunities in science to make positive comments to pupils and parents/carers based on good progress.	A wide range of pupils' achievements in science are celebrated. Pupils' achievements and successes in science are regularly celebrated with parents and carers.

	Strategies to use in school			Outcomes
	Senior leaders	**Subject leaders**	**Classroom science staff**	
Positive involvement of parents, carers and governors	Parents/carers are provided with a number of regular formal and informal opportunities throughout the year to discuss curriculum and pupils' progress with teachers and agree contracts of support to address underachievement if necessary.	Subject leaders establish protocols and expectations for science teachers to communicate successes to parents/carers, e.g. postcards home, regular school bulletins, letters and phone calls home. Pupils' successes in science are regularly shared with governors who are often involved in celebrations.	Teachers communicate success based on departmental protocols with tutors, pupils, parents/carers and encourage all informed to develop a 'can do' ethos with the pupils.	Parents/carers and the wider community know that progress and attainment in science are valued. Pupils' achievement and successes in science are regularly celebrated with parents/carers and governors.

Activity for senior leaders:

- How good is your school at recognising the key components of its success?
- How wide a range of success criteria does your school apply to pupils?
- How good is it at making pupils feel proud of their successes?
- How good is it at celebrating the success of vulnerable and disadvantaged pupils?
- What action are you going to take to celebrate gap busting in science/in school?



8. Case studies

Case study 1: Improving the performance of underachieving girls targeted A and A*

I was interested in using this approach because I wanted to get some ideas of how I could get more girls to A/A*. Data showed that some girls were underachieving. This prompted me to think about what their experience of science was. My initial ideas were that these girls were not making expected progress because they were bored, thought science was difficult and thought they were not good at it.

I decided to use the pupil voice materials. I got the views of pupils from every year group. I also carried out some paired lesson observations with my line manager with a gender focus. My findings were that girls did not know how well they were doing or how to improve. In the lesson observations the majority of questions were answered by the boys (girls did not put hands up).

As a result of this I decided to raise staff awareness of variation in gender progress. For the next half-term we focused on improving oral and written feedback to pupils and our questioning techniques. We then repeated pupil voice and found that pupils had noticed that their teachers were involving them more in the lessons. Pupils were better informed about how well they were doing and what they needed to do to improve.

Case study 2: Addressing the FSM gap

We were looking for ideas to make lessons more appealing to pupils. In particular we were concerned about the progress of a number of pupils, some of whom were entitled to FSM. We were concerned that they did not seem very interested in the work we were doing for the exam course. They did what we asked them to do but did not really engage with the lessons. We wanted to make the lessons more interesting; we suspected that pupils were not very aware of what they could do with science after leaving school.

We used the pupil-voice materials and asked colleagues to observe our lessons. The pupils said they did not see the relevance of science to their future career plans. The observers noticed that some of the pupils sometimes tended to ask questions that the teacher did not see as being directly relevant to the lesson and that we expected pupils to listen to us for long periods of time. We tried suggestions from the *Narrowing the Gaps in Science* resource and in the next round of observations there were some improvements with most pupils on-task and engaged.

Case Study 3: Engaging with English as an Additional Language (EAL) learners

I was aware that a number of pupils in one of my Year 7 groups were having difficulty in developing written responses to lesson activities that were of as high a quality as their oral responses. These pupils were mainly advanced EAL learners, who were enthusiastically engaged with a variety of activities.

I wanted to make the lessons more successful at supporting the pupils in producing work that would lead to success in summative assessment activities and I felt that the lessons were not effective at supporting high-quality written outcomes. I used the pupil–voice materials and asked the school's EAL coordinator to observe one of my lessons.

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The pupils said that they enjoyed the lessons but found the writing difficult and off-putting because they 'never knew what to write'. The observer noticed that I tended to devote a lot of lesson time to writing and tended not to give pupils the opportunity to rehearse the development of ideas before they committed them to paper. I tried using group talk activities as a preamble to written tasks and there were a number of encouraging improvements in some pupils' written work.

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Resources

The following resources are available to download from: **www.standards.dcsf.gov.uk/nationalstrategies**
Search using the reference numbers or titles provided.

Generic Narrowing the Gaps documents can be found by following the 'leadership>narrowingthegaps' breadcrumb trail.

Assessment for Learning (AfL): Whole-school training materials (DCSF ref: 0043-2004)
A suite of guidance and support materials on a variety of topics. Of particular relevance to the AfL role in Narrowing the Gaps is Unit 4: Module 1: Oral feedback (pp.23–4).

Assessment for Learning:

- The classroom quality standards for Assessment for Learning policy and practice can be found in the courses area (search using 'Classroom Quality Standards (CQS) guided resource'). A flyer that introduces them called *The Classroom Quality Standards for Gifted and Talented education: A subject focus (flyer)* (DCSF ref: 00256-2009LEF-EN) can also be found at the site. Search using the DSCF reference.
- Progress tables for AfL in science can be found within *Assessment for Learning in science – Unit 1: Lesson scaffolding: structuring learning to develop Quality First teaching in science* (DCSF ref: 00932-2009-PFD-EN-01).
- Written feedback guidance: *Assessment for Learning in science – Unit 2b: Developing written feedback in science* (DCSF ref: 00932-2009PDF-EN-03).
- Oral feedback guidance: *Assessment for Learning in science – Unit 2a: Developing oral feedback in science* (DCSF ref: 00932-2009PDF-EN-02).
- Developing peer and self-assessment guidance: *Assessment for Learning in science – Unit 3: Developing peer and self-assessment in science* (DCSF ref: 00932-2009PDF-EN-04).
- Support and guidance related to the tracking and recording of pupil progress (search using the title)

Creating a progress culture (DCSF ref: 00905-2007PDF-EN-01)
This booklet focuses on building challenge into lessons.

Curriculum provision in secondary science (DCSF ref: 01101-2009BKT-EN)
Guidance on planning curriculum pathways in science.

Improving progression to post-16 (DCSF ref: 00130-2008DWO-EN-01)
Report summarising the findings from an enquiry into the factors that are influential in achieving high levels of take-up of science subjects post-16.

Information and guidance on *How science works* (search using the title).

Intervention in science e-learning module, is useful within the context of Quality First teaching (search using the title).

Managing effective STEM enhancement and enrichment includes specific guidance for teachers, subject leaders and senior leaders (search using the title).

Narrowing the Gaps: from data analysis to impact – A practical guide (DCSF ref: 00912-2009PDF-EN-07)

Narrowing the Gaps: from data analysis to impact – The golden thread (DCSF ref: 00792-2009PDF-EN-01)

Narrowing the Gap: The Gender Agenda – making a difference in science (DCSF ref: 00667-2009)
The purpose of this guide is to support science teachers and subject leaders to establish how well both girls and boys are doing in science at all stages of their secondary education and to give ideas as to how any emerging issues can be addressed as part of a development programme.

Narrowing the Gap – Leadership for impact (DCSF ref: 01021 2009PDF).
These materials focus on what leaders and managers can do to accelerate the progress of children to narrow attainment gaps.

One-to-one tuition toolkit (01068-2008PCK-EN)

Pedagogy and Practice: Teaching and Learning in Secondary Schools Unit 18: Improving the climate for learning (DCSF ref: 0441-2004G)
A study guide offering some practical strategies that teachers can use to improve the climate for learning. See classroom routines (p.3).

Progression guidance 2009–10 (DCSF ref: 00553-2009BKT-EN)

Progressing to level 6 and beyond e-learning (search within 'courses' tab using the title) includes resources and approaches to support better progress in science.

Science subject leader development materials (search using the title)
Support and guidance on the development of positive behaviours for learning in the classroom.

Support and guidance on Parents as Partners (search using '*2.2 Parents and Partners*').

Strengthening teaching and learning in science through using different pedagogies – Unit 1: Using group talk and argument (DfES 0697-2004G)
Practical suggestions to use in classroom when using group talk and argument to stimulate discussion. Contains case studies and tasks for teachers to undertake.

Strengthening teaching and learning in science through using different pedagogies – Unit 2: Active questioning. (DfES 0698-2004 G)
Practical suggestions to use in the classroom when using active questioning techniques. Contains case studies and tasks for teachers to undertake. See planning effective questioning (pp.6–7), classification of question types (p.10), classroom tactics (pp.11–12).

See also: *Pedagogy and Practice: Teaching and Learning in Secondary Schools Unit 7: Questioning* (DCSF ref: 0430-2004G)

Strengthening teaching and learning in science through using different pedagogies – Unit 3: Improving the learning climate (DCSF ref: 0699-2004G)
Study unit offers practical suggestions for science subject leaders, Key Stage 3 science coordinators and science teachers to use in the classroom.

The learning discussion: A strategy to support better progress for underperforming groups in science (search using the title).

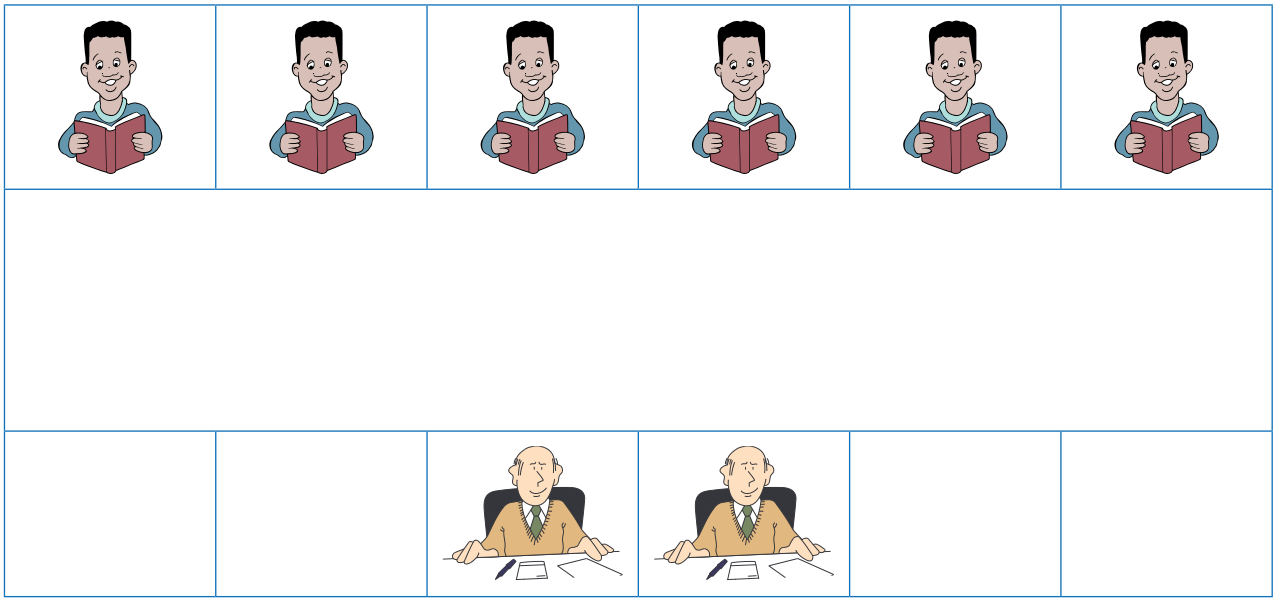
RAISE online (**www.raiseonline.org**)

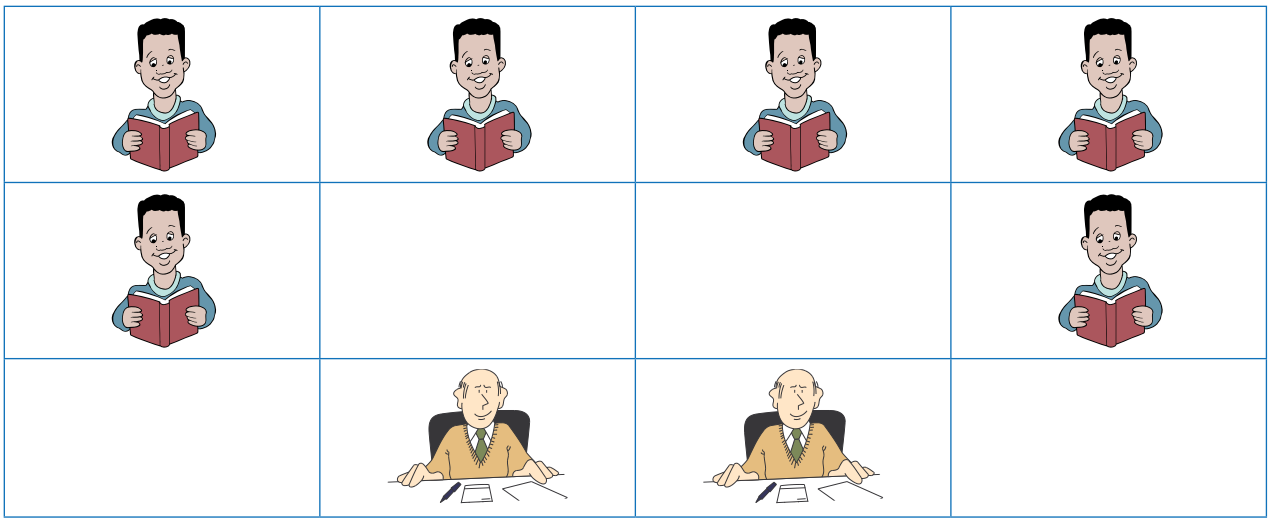
FFT live (**www.fftlive.org**)

Appendix 1

Guidance on running interviews to support the articulation of pupil voice

- Select a small group; for example, five to eight pupils, those groups which your data has indicated are underperforming. These should be the same year group and of similar ability. (Some pupils' responses can be influenced by older pupils or those they perceive to be more able.) You may wish to speak to pupils from different groups separately.
- Decide how many groups you will be able to see allowing at least 40 minutes per interview.
- If two people can be present, one could record pupil responses while the other (teacher, consultant, subject leader, senior leadership team, higher-level teacher assistant, etc.) asks the questions.
- Swapping over the roles during the interviews may also help. If you are alone consider using a recording device.
- Arrange the seating so that equal eye contact can be maintained with all the pupils. Two possible arrangements are shown below:





- Some of the questions will not be applicable if you are a teacher finding out about your own classes. In this case choose the ones that are suitable to your enquiry.
- Explain to the pupils that you are going to ask them a series of questions which they can answer openly; they should say if they agree, disagree or have anything to add to what another person in the group has said. Recommend that they do not refer to teachers by name.
- Thank all participants for their time and engagement with the process.

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Appendix 2

Interview questions

Purpose	Possible questions
1. Putting at ease	What are your three favourite subjects? Why? (Follow up if needed) What position (approximately) would you say science is in your list? Why do you like/dislike science?
2. Reflection on ability (does it match teachers' perception?)	How well are you doing in science? How do you know?
3. Perception of organisation of a science lesson	What are science lessons like? Describe a typical lesson. What's the difference in science lessons since you: • Were at primary school (if in Year 7)? • Were lower down the school (if in Year 8 or 9)? • Started Key Stage 4 courses (if in Year 10 or 11)?
4. Exploring opportunities for learning styles or context	In a typical lesson how often do you get a choice of what to do? What most helps you to learn in science lessons? What gets in the way of your learning in science lessons? When asked to write in science, what are you mainly asked to do?
5. Assessment and feedback (or combine with no.2)	When you get a piece of science work back from the teacher, how do you know what you have to do to improve the next time? What kinds of comments help you?
6. Awareness of structural arrangements	Which class/set/group are you in? Does anyone move up/down groups? Why does this happen? What science course are you doing at GCSE? (for Key Stage 4 pupils) How did you choose which science course to take? How many different teachers have you had for science this year? Since joining the school?
7. Effect of gender of the teacher(s)?	Does it make a difference to your learning if the teacher is male or female? How? Why?

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Purpose	Possible questions
8. Opportunity for engagement	Prepare sets of cards, or photocopy the cards in appendix 3. First ask pupils to rank the activities to show a list that describes their experiences of science lessons (those they do most to those they do least). They can use the blank cards to show anything else. Take a photograph. Secondly they should choose the nine activities that help them to learn best. Ask them to use the cards to carry out a 'Diamond 9' activity. You may have to model what you mean by this. Ask them to work in groups of twos and threes. If possible arrange for each group to be homogeneous with respect to the factor being investigated (for example, single gender groups). Listen in and, if possible, write down relevant statements they make while sorting. Take a photograph of their 'diamonds', and include an indication of which group is which.
9. Confidence and how the teacher encourages this	When would you answer a question in class? Who does the teacher expect to answer questions in class?
10. Perceptions of enhancement and enrichment opportunities	Are there any science clubs running in school? Do you go? Have you ever been? How many times have you been involved in learning outside the classroom for science, for example, fieldwork or science-related trips? How enjoyable was this?
11. Use of 'other adults'	If you need help with your science homework, what do you do or who do you go to? Do you talk to your parents/family about your science school work, if so what sort of things do you talk about? Do they know how well you are getting on in science?
12. Perception of science in the real world	How is science important to: • You in your life? How? • Your family? How? • Your country? How? • The World? How?
13. To elicit contexts that might be overlooked	What aspects of science are you interested in?
14. Aspirations	What would you like to do when you leave school? How did you decide? Once you have done your GCSEs will you consider a career or further study that includes aspects of science? Why?
15. Making improvements in science?	What could your schools and teachers do to help you improve in your science work?

Appendix 3

Ranking exercise and Diamond Nine – (How do I learn best in science?)

Instructions to teacher – prepare the card-sort cards; have enough sets for one set between two to three pupils. Using a digital camera to make a record of the responses helps with analysis after the interviews.

1. Working in silence	2. Discussing in pairs to agree answers	3. Pupils using the interactive whiteboard (IWB)	4. Teacher explaining to the whole class
5. Discussing in small groups to share ideas	6. Using data-logging equipment	7. Hands-on experiments	8. Answering questions from a sheet or book
9. Drawing graphs	10. Watching the teacher doing an experiment	11. Reading a text book	12. Using models to help you explain a scientific idea
13. Deciding how to carry out an investigation	14. Teacher using digital technology to help with explanations (e.g. IWB, podcast, etc.)	15. Pupils using digital technology to explain their ideas. (e.g. IWB, podcast, etc.)	16. Going through homework

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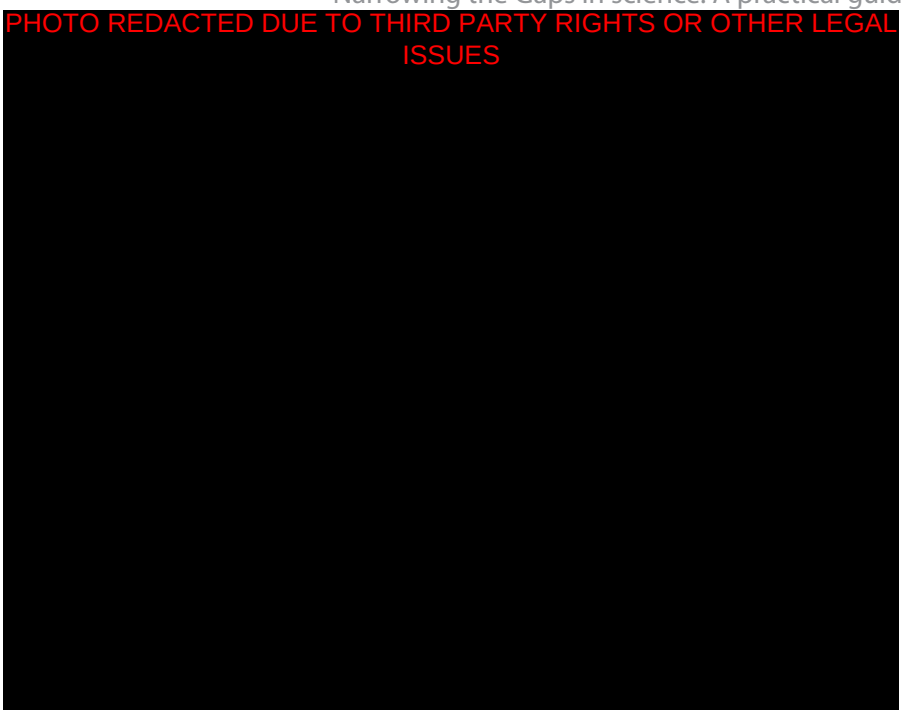
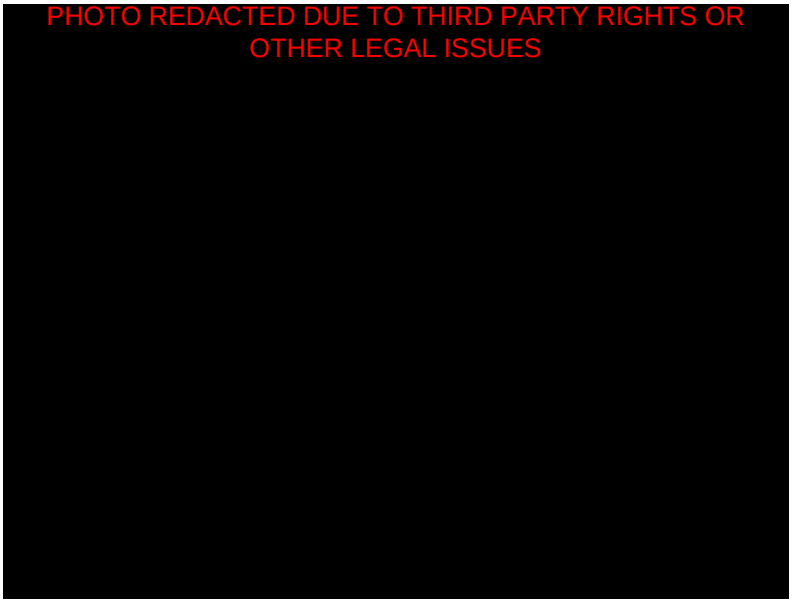


Example of pupil responses when asked to order the cards to reflect what happens most in lessons to what happens least (picture shows only part of the continuum).

This picture shows an example of a pupil response when asked to select the nine activities that enabled them to learn best. These were then diamond ranked (most to least useful).



Appendix 4

Lesson observation form

Year group		Set/mixed ability	
No. of boys		No. of girls	
Teacher gender		Lesson focus	

Context	Area	Detail	Observation	Possible implications
	Lesson planning	Objectives and outcomes. Include HSW and encourage pupils to think scientifically.		
	Starter	Proportion of pupils engaged. Any particular group more engaged?		
	Organisation	How are groups seated generally for group work and for practical work?		
	Active engagement	How actively involved are the pupils in the lesson?		
	Plenaries	At the end of the lesson. Mini plenaries during the lesson.		

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Context	Area	Detail	Observation	Possible implications
	Questioning	What proportion of the questions were answered by different groups during the lesson?		
	Questioning	Were open and closed questions answered equally by all groups? Did the teacher respond to pupil responses from different groups that were correct or incorrect in the same way for different groups?		
	Pupil questions	Was there opportunity for pupils to question the teacher, or other adult or each other?		
	Planning of use of time	What proportions of time during the lesson were given to teacher talk, discussion, writing, practical and other activities?	TT D W P O	
	Developing thinking	Examples of how the teacher challenged pupils' thinking during the course of the lesson.		
	Assessments	Evidence for assessments where context for different groups has been considered.		
	Any other observations of note			

Appendix 5

The things teachers say

That Year 8 group I've got, well, they're not, you know, very well integrated. They don't seem to be unhappy or anything, but there seem to be a lot of small groups in there that just won't have much to do with each other. If I try and mix them up, they just won't talk.
Some of those pupils have got some really amazing ideas about what they want to do in the future. I wouldn't have guessed it, but I happened to start asking some of them and all these ideas came out. Mind you, they didn't seem to have much idea about how they could get there.
It's odd, you know, but some of my Year 8s really have a problem with explaining things clearly. Yet others seem to find it so easy. But sometimes the ones that struggle will do a cracking piece of written work. I'm not sure you can tell just by listening to them who's got a clear idea and who hasn't.
It's always the same with that group. Whenever we do practical work half of them can't wait to get started and the other half aren't really bothered. Maybe I have to accept that some learn by doing and some don't.
It's got to the stage now where it's all driven by what the exam boards want. The pupils ask me 'if it's needed for the exam' or 'if it counts towards the final grade' – they seem quite positive but there's not much love of learning.
How does Smithy do it? I walked past his lab this morning, door wide open, him in full flow, kids eating out of his hand. I mean, I think it's great and he's a star. I couldn't do it though and I wonder if some of the kids would prefer it if I could. He must be wrecked by 4 o'clock though.
It's not that the kids aren't interested in things – it's more that they're not interested in the things on the course. They've got lots to talk about – just not what I want them to talk about. Is it that making something part of the subject is the 'kiss of death' for it, or is it that the people who designed the course got it wrong?

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Appendix 6 Progression in developing *How science works* (HSW)

Practical skills are alluded to in general terms in the scheme of learning (work).	Practical skills are expected to be taught but left to teacher's discretion with little monitoring of practice across the department.	HSW activities are added to some units in the scheme of learning but in an ad hoc fashion.	HSW activities are written into the scheme of learning for all units but not all the skills are well represented. Activities are not used by the whole department.	HSW activities and objectives are planned into scheme of learning so that all skills are represented but there is no clear progression.	HSW activities have agreed objectives and outcomes that support better progression in the scheme of learning.	HSW objectives and outcomes are plotted progressively across all schemes of learning in Key Stage 3 and 4.	HSW objectives and outcomes are personalised for pupils in response to their progress.
Teachers do not see the importance of teaching HSW and restrict it mainly to Years 7, 8 and 10. Objectives and outcomes are focused on content.	Teachers consider HSW to be the same as practical work. This practical work is 'recipe driven' with the assumption that pupils will pick up skills with practice.	Teachers are unclear about the different purposes of practical work e.g. to illustrate a piece of science knowledge, to develop a practical skill or to develop non- practical skills such as argumentation.	Teachers are unsure how to plan with a HSW focus and find it hard to deliver the activities in scheme of learning (work) with any confidence.	Teachers are clear about the importance of teaching HSW. The purpose of practical work is made explicit to pupils.	Teachers are comfortable with, and plan for, progression in HSW. Lessons are well designed to deliver the HSW outcomes.	Teachers are confident in their understanding of progression in HSW.	Teachers have integrated their understanding of HSW skills into their whole approach to teaching science.
Pupils spend a lot of time on low- level tasks which occupy their time but add little to skill development.	Pupils will say that they like the practical work but actually learn little from it.	Pupils' investigations show little improvement and often rely on a planning frame.	Pupils make haphazard or accidental gains in HSW skills of developing explanations or argumentation.	Pupils are aware that HSW is more than just practical work and are supported in making decisions and using HSW skills in lessons.	Pupils make appropriate decisions and use a range of HSW skills in lessons.	Pupils use the skills of HSW to engage with content, e.g. by exploring the strengths and weaknesses of models.	Pupils independently use a range of skills to explain, evaluate, develop explanations and arguments about scientific ideas and identify next steps in their learning.

00162-2010PDF-EN-01

Audience: Science teachers and subject leaders
Date of issue: 03-2010
Ref: **00162-2010PDF-EN-01**

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