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# Secondary mathematics planning handbook

Developing your scheme of work  
Spring 2010





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# Introduction

This planning handbook is designed to support subject leaders as they work with their colleagues to develop an effective scheme of work in mathematics across the secondary phase. It comprises a collection of linked tasks, to help subject leaders prioritise, plan and implement a manageable development programme that involves the department working collaboratively.

It sets out ways in which the mathematics line manager can actively support the subject leader in improving and monitoring the quality of teaching and learning in mathematics. It explains how a good scheme of work is structured and offers practical help on how to organise plans and resources.

The handbook sets out parallel tracks of development, based on the principle that developing the scheme of work requires attention to the big picture of progression, as well as the detail of individual units of work.

The *Framework for secondary mathematics* provides extensive additional resources to support planning, including learning objectives, guidance on teaching and learning, templates for planning and review and ideas for rich tasks. These can be found at [www.standards.dcsf.gov.uk/nationalstrategies](http://www.standards.dcsf.gov.uk/nationalstrategies). Select 'Secondary', and then 'Mathematics Framework'.





### The characteristics of good and weaker subject leadership

...the best leaders...used the outcomes of monitoring and analysis of test results to inform approaches to teaching and learning and the development of the curriculum. They also used professional development opportunities to disseminate and build on good practice and to tackle areas of inconsistency and weaknesses. Effective practitioners helped colleagues to develop aspects of their work. Occasionally, this included developing teachers' knowledge of mathematics, as well as how it might be taught. Teachers' readiness and commitment to giving and receiving such support was a hallmark of the school or department's ethos. Such an approach was seen not simply in high-achieving schools but also often in those working hard and effectively to improve, sometimes in challenging circumstances.

Conversely, weaker leaders tended to rely heavily on their assumptions about the strengths of individual teachers, the degree of consistency, and the extent of teamwork among staff... some senior managers interpreted quiet individual work on textbook exercises as good learning in mathematics. While informal strategies provided some useful insights, they did not reliably uncover weaknesses and pinpoint areas for development. Monitoring which was insufficiently systematic and robust generated too rosy a view of provision and little impetus for improvement.

*Mathematics: understanding the score*  
Ofsted 2008 (paragraphs 69 and 70)

## Section 1: Developing the scheme of work: role of the subject line manager

The role of subject line manager is to support the subject leader in improving and monitoring the quality of teaching and learning in mathematics. Crucial to improvement is establishing a climate in the department that encourages collaboration in developing fresh approaches and taking risks.

Enabling a department to work together to review and improve the scheme of work is an effective way of developing the staff in the department, at the same time as improving the infrastructure of planning. The *Secondary mathematics planning handbook* (this booklet) structures this developmental work through a series of tasks. They are addressed to the subject leader and suggest ways in which a line manager should also be consulted and involved.

Taking an active part in the development of the mathematics scheme of work, for example, through lesson observation, pupil interviews and attendance at department meetings, will sharpen the focus of judgements made by the line manager. Reviewing the impact of this development work will provide a focus for the regular meetings between them and subject leader.

### Actions for a line manager

1. Arrange a meeting with your subject leader; read Section 2 of this handbook before the meeting.
2. Meet the subject leader, using the agenda suggested at the end of Section 2.
3. Review the impact of scheme developments as a fixed item in regular meetings with the subject leader.



A positive development in departments which were effective and improving was the use of meeting and planning time to discuss teaching and learning and share ideas...

...there is an urgent need to give far greater weight to ensuring that subject leaders focus on improving the quality of teaching and learning and on the curriculum that pupils receive...

...A prime reason for improving professional development is the need for schools to nurture and develop their staff. This is especially important in secondary schools, many of which experience severe difficulties in recruiting teachers and departmental leaders...

*Mathematics: understanding the score*  
Ofsted 2008 (paragraphs 77, 83 and 85)

## Section 2: Developing the scheme of work: role of the subject leader

### What is this section about?

This section describes features of an effective scheme of work in mathematics and sets out the key elements. It gives an overview of the other sections of the booklet and provides guidance on leading and managing the process of developing your scheme of work.

### What are the benefits of reading this section?

Reading this section will help you to decide how to plan a time line of actions to review and improve your scheme of work. It will clarify key aspects of your role and how to involve other members of the department and your line manager.

### After working through this section

Your next steps may be to:

- review and improve the progression described in your scheme of work so that you set the right expectations year-on-year and term-by-term (Section 4, Planning for progression);
- work on the detail of particular units, starting with the pitch and structure of the unit (Section 5, Collaborative planning, see Unit planning) or starting by working together on how to develop a particular piece of mathematics (Section 5, Collaborative planning, Rich tasks).

## A scheme of work in mathematics

There is a commonly accepted pattern to a teaching programme.

- The *programmes of study* are divided into teaching units in such a way that related mathematical concepts and skills can be taught coherently over a sequence of lessons. Units are usually sequenced so that all strands of the subject are kept moving forward and concepts are revisited over time.
- Each *unit* is structured to achieve progression in learning within the identified area of mathematics, aiming to build on what pupils already know and to lead to observable progress. Often a unit is planned at more than one level in order to meet the needs of different pupils within a year group.
- Individual *lessons* are sequenced within the overall unit plan, working towards the intended outcomes of the unit. Teachers work to a common unit plan, but lessons may unfold differently in each classroom as teachers adapt to the responses and needs of their classes.

An effective scheme of work will address the first two of these aspects, supporting teachers' planning and helping to ensure that pupils have positive experiences of mathematics and make good progress. A good scheme of work will:

- set out a teaching programme that embraces the aims of the National Curriculum and the vision of the school, ensures balanced coverage of the curriculum and a clear progression, taking account of the opportunities and constraints of the school calendar and resources;
- outline the intended development within each unit of work, helping teachers to plan and to manage the transition from lesson to lesson, keeping the need for lesson notes to a minimum;
- incorporate a variety of rich learning tasks that:
  - involve pupils in their learning through the mathematical processes;
  - promote mathematical talk for deeper understanding;
  - assist teachers in building on pupils' prior learning, differentiating according to need.

In summary, the key elements of the scheme of work are as follows.

- **The curriculum overview or 'map'**, showing how the curriculum is divided and sequenced into teaching units. This visual image aims to communicate interconnections and interdependencies of the teaching units.
- **The teaching calendar** showing how units will be fitted into the school year alongside significant school events.
- **Unit plans** including, as a minimum, the learning objectives for the unit, tasks and key resources that will be used. The units will inform teachers' day-to-day planning of lessons and will make it more consistent across the department.

## Using the handbook to develop your scheme

### The sections

This handbook sets out strategies and manageable tasks to help you and your colleagues develop or revise your scheme of work in mathematics. There is no suggestion that the scheme of work is a product, to be completed by a certain date. It is better to regard the sections of this handbook as support for the ongoing process of improving teaching and learning in the department. In that way you establish a practice of collaboration that allows your scheme of work to evolve in response to changing needs.

The sections, outlined below, are not intended to be tackled in the sequence as laid out. Collaborative planning at the level of a unit should be seen as an ongoing process while the other sections will be revisited periodically. In this way, you will find yourself moving between the different sections to make adjustments or additions as your scheme develops.

Section	Tasks	Involving
<p><b>Section 3</b> <b>Organising a scheme of work</b></p>	<p>Three strategic tasks addressing the organisational aspects of improving a scheme of work. They prompt you to consider how efficiently your scheme is maintained and updated, how it is scheduled against the school calendar and how the overview and interconnections are shared with colleagues.</p>	<p>Subject leader and one or two selected colleagues.</p>
<p><b>Section 4</b> <b>Planning for progression</b></p> <p>Working at the overview level, reviewing collections of learning objectives</p>	<p>Three strategic tasks describing how to review and improve progression in your scheme of work. Each addresses a different timescale: the secondary phase, a single year, one term.</p>	
<p><b>Section 5</b> <b>Collaborative planning</b></p> <p>Both sub-sections involve working at the level of a single unit or sequence of lessons</p>	<p><b>Rich tasks</b></p> <ul style="list-style-type: none"> <li>● An introductory task involving working together on the mathematics of a rich task.</li> <li>● Colleagues plan and teach the mathematics through the task they have explored and then review the impact.</li> <li>● Finally, a section that introduces general types of rich task.</li> </ul> <p><b>Unit planning</b></p> <ul style="list-style-type: none"> <li>● An introductory task involving teachers working together to consider structures of a teaching unit.</li> <li>● Colleagues plan by gathering suitable objectives and sequencing mathematical activities, including rich tasks. They then teach the unit and review its impact.</li> </ul>	<p>All members of the department, working collaboratively in cycles of plan–teach–review.</p>

## Establishing parallel tracks of development

Aim to establish development activities that pay attention to the interplay between the big picture of progression in your scheme and the detail of guidance in your units. Working at both levels will develop the people in your department as well as the scheme of work. This might involve, for example:

- a strategic review guided by one of the tasks from Section 4, Planning for progression
- some collaborative planning drawn from Section 5, Collaborative planning – Rich tasks or Unit planning.

	Working on the 'big picture' – Planning for progression	Working on the detail – Collaborative planning
<b>What are the benefits?</b>	To ensure that pupils make good progress, you need to have a scheme that sets the right expectations for all pupils, year-on-year and term-by-term. Teachers can plan for improved progression of underperforming groups if they are supported by a scheme that offers guidance on pitch and challenge, a variety of learning experiences and structures for assessment.	Well-led collaborative planning is highly effective as professional development for staff. Good ideas and practice are shared and all teachers develop, regardless of their experience or specialist knowledge. The benefits to pupils' learning go far beyond the actual units planned, influencing teachers' other lessons, securing greater consistency across the department and enhancing your leadership role.
<b>What should we aim to do?</b>	This involves reviewing how learning objectives are collected and sequenced into units in your scheme of work. Start from where you are and develop part of your scheme. Use the learning objectives and guidance from the Framework to set trajectories for your pupils and agree approaches to teaching, learning and assessment. Evaluate and, where appropriate, adapt and supplement your existing resources.	This involves detailed planning of selected units, not reworking your whole scheme. Start small, allow colleagues to see the benefits so that they want to do more. Build up to developing perhaps one unit per half-term. Eventually you may be able to accelerate the process by planning a sequence of related units together.

Working on these parallel tracks will lead to aspects of recording and organisation that need to be changed. Section 3, Organising a scheme of work can be used as a resource to be referred to periodically, as the need emerges. The newly developed detail of unit plans, for example, will have to be incorporated into the curriculum map and new collections of objectives will need to be added to suites of units.

## Managing and leading the development

### Setting out a development plan

Use the guidance in this handbook to set out a plan over a period of time, outlining what you want to achieve in the next term, the next year and beyond. Your team needs a positive steer from you, especially during times of change, and you can offer this by setting out a clear process for developing the scheme of work.

Setting out a shared time line for developments will help you to pace the work and manage change. If members of the department are aware of the plan then work moves ahead, with a sense of direction and purpose, and often with less conscious effort. The inevitable changes of plan can then take place in a more considered way, rather than as a reaction to events.

It is important that developments are captured for the long term and become embedded in your scheme of work. Paying attention to organising filing systems for your scheme of work, and associated resources, will make it easier to incorporate changes and additions. Do not take on every task; delegate to key members in the department and, most importantly, ask for and use administrative or technician support to help keep your files and resources up to date.

### Securing strategic support

Give careful consideration to roles and responsibilities, aiming to strike the right balance between your own leadership and delegation of aspects, so that you make full use of the expertise available in your department and in the rest of the school. Consider with whom you will work on 'big picture' tasks such as Section 4, Planning for progression. Think about when and how a small strategic group could meet so that whole-departmental meetings are carefully planned and used to their maximum effect. Clarify which tasks require collaborative work as a whole department, or perhaps from the teachers teaching a particular year group, and which can be followed up by pairs of teachers, or individuals, reporting back later.

Make sure that you work closely with the senior leader with responsibility for mathematics. They need to understand how you are structuring your scheme of work, for example, the role of unit plans and how they inform the preparation of individual lessons. Discuss the details of your development priorities with them and the practical support that you need. For example, they can help to facilitate arrangements for regular departmental planning time and for the provision of support from a technician.

Clarify with your line manager how you see roles and responsibilities developing within the department and identify support that may be useful from colleagues outside the department. Negotiate the line manager's role in your development plans, particularly supporting the process of plan-teach-review. This handbook includes specific suggestions that can help line managers to be actively involved. You and your line manager should jointly evaluate the impact of developments; these can feed into whole-school systems of accountability and inform future plans. The task described on the next page will help you to shape the strategic partnership between you and your line manager.

## Involving the subject line manager

### Preparing for a meeting

1. This handbook provides a manual to inform and guide your action plan. It is important that you become familiar with all of it so that you can make strategic decisions. Read each section, discussing your thoughts with another colleague in the department, as appropriate.
2. Arrange a meeting with your subject line manager, using the text from Section 1 to highlight the importance of their role in supporting the scheme of work. Provide this section (Section 2) as pre-reading for the meeting.
3. Meet the subject line manager, using the agenda below.

### Agenda for meeting between subject leader and line manager

1. Discuss the section entitled A scheme of work in mathematics to clarify the structure and agree terminology.
2. Draw attention to Establishing parallel tracks of development and discuss and share your emerging priorities and the suggested plan of action.
3. Describe the practical support required to facilitate this plan:
  - regular time for collaborative planning;
  - technician support for maintaining the scheme of work and resources.
4. Discuss and agree the role of the line manager in the cycle of plan–teach–review.

#### Plan:

- supporting the planning by contributing whole-school perspectives on priorities;
- attending planning meetings to raise the profile of the development and to support your role;
- agreeing templates for lesson observations and pupil interviews, showing the identified priorities for development (for suggested teaching and learning review templates refer to the Framework for secondary mathematics online at [www.standards.dcsf.gov.uk/nationalstrategies](http://www.standards.dcsf.gov.uk/nationalstrategies). Go to Secondary, then Mathematics Framework).

#### Teach:

- offering expertise in the form of practical classroom guidance;
- drawing on and coordinating coaching support from other leading teachers;
- using the templates to inform lesson observations.

#### Review:

- using the templates to inform interviews with small groups of pupils;
- attending review meetings to feed in evidence of impact and priorities for further development.



The best schemes of work included guidance on approaches, interesting activities and resources that help nurture pupils' understanding. They were seen as living documents, subject to regular discussion and review, which helped staff to develop their expertise... However, these separate policies and guidance were not always kept up to date or implemented consistently.

*Mathematics: understanding the score*  
Ofsted 2008 (paragraph 45)

## Section 3: Organising a scheme of work

### What is this section about?

This section has three strategic tasks; these are best tackled by you, as the subject leader, working with a selected colleague. The tasks address the organisational aspects of improving a scheme of work. They prompt you to consider how efficiently your scheme is maintained and updated, how it is scheduled against the school calendar and how the overview and interconnections are shared with colleagues.

### What are the benefits of doing these tasks?

The administrative side of maintaining a developing scheme of work is not trivial. If you have worked together to develop fresh plans to improve teaching and learning it is important to position these at points in the scheme where they will have maximum impact. The teaching in your department is more likely to be consistently good if teachers know the big picture of progression and if unit plans are clear and associated resources are accessible.

### After working through this section

Your next steps may be to:

- repeat tasks within this section, by working on other administrative aspects of the scheme – the maintenance of a scheme of work is an ongoing task and you might use these tasks to encourage a member of your department to become responsible for the organisation of the scheme of work;
- review and improve the progression described in your scheme of work so that you set the right expectations year-on-year and term-by-term (Section 4, Planning for progression);
- work on the detail of particular units, starting with the pitch and structure of the unit (Section 5, Collaborative planning – Unit planning) or starting by working together on how to develop a particular piece of mathematics (Section 5, Collaborative planning – see Rich tasks).

## Overview

This section addresses the administrative side of maintaining a developing scheme of work. The aim is to help you reflect on whether some of the organisational aspects of your scheme could be adjusted to help improve teaching, learning and progression. Some excellent development work falls victim to organisational glitches, so the reflections here should not be considered as trivial. The three tasks, listed below, each offer prompts for thinking and examples of strategies. They can be tackled in any order.

### The curriculum map – capturing an overview of the curriculum

- How are your teaching units sequenced and interconnected?
- How do you communicate this to your department and to pupils?

### The teaching calendar – sequencing and timing the teaching

How does the timing of your units of work:

- fit around and take advantage of key dates and events in the school calendar;
- take account of interdependencies in the units, across and within strands, and the need for progression;
- allow for opportunities to work across subjects and outside the classroom on real, relevant and purposeful contexts?

### The scheme of work – organising access to plans and resources

- How easy is it to search and navigate the resources and plans that make up your scheme of work?
- Does each member of the department feel confident about how to access plans and draw upon or contribute to the resource base?

Templates and examples to support some of the following tasks are available online at the Framework for secondary mathematics [www.standards.dcsf.gov.uk/nationalstrategies](http://www.standards.dcsf.gov.uk/nationalstrategies). Select 'Secondary', and then 'Mathematics Framework'.

## Task: The curriculum map – capturing an overview of the curriculum

- How are your teaching units sequenced and interconnected?
- How do you communicate this to your department and to pupils?

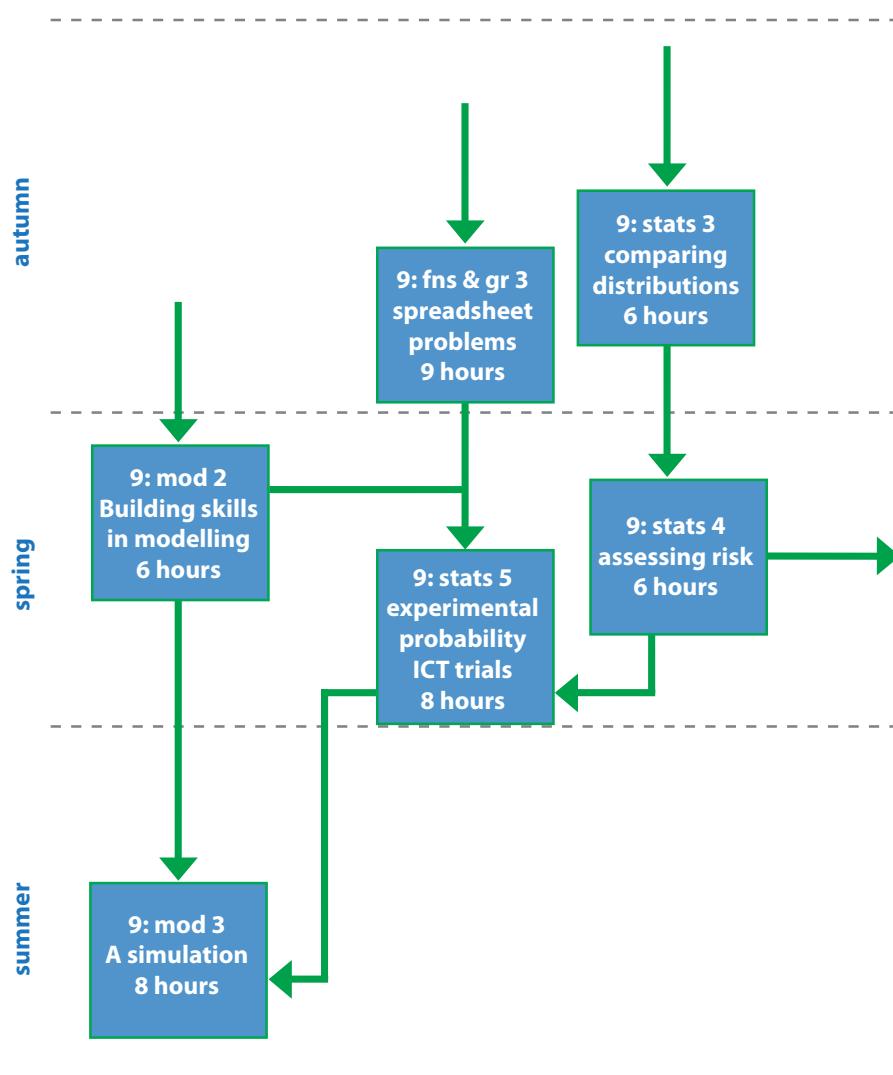
Big-picture planning across a year and across the two key stages is as important as lesson planning and unit planning. Teachers and pupils need to have a sense of the journey they are sharing. Occasionally stepping back from the detailed learning, making links to other experiences and other learning outside the mathematics classroom, all give a sense of progression towards an intended goal.

To communicate this big picture you need to find a way to summarise how each topic in a strand develops across a year and from year to year. This can be a list or an image or a collection of documents, but one of the simplest ways of capturing the interconnections and interdependencies is to design a visual image of a curriculum map.

By summarising your scheme of work on a curriculum map, showing teaching units for each year group, you can incorporate and interlink the strands of mathematics. Typically, a map would provide space in each box for a unit code, a short descriptive title and an indication of the teaching time required.

Figure 1: An extract from a curriculum map is an illustration of part of a curriculum map and gives some sense of the way in which the image could be arranged.

**Figure 1: An extract from a curriculum map**



## Designing, maintaining and communicating the big-picture curriculum

- 1. Designing:** If you do not have a document or image that communicates this big picture to your department, then consider how to design one.

Begin by considering a year group that is the focus of current or potential development work; list the topics and units in the present or new scheme of work. If these include units drawn directly from chapters in a text-book, consult the teachers' guide or online support; these often provide a curriculum map showing the interconnections of the chapters.

Consider the list of units.

- Which need to precede or follow other units and how do you acknowledge interdependencies between units?
- Which are more flexible?
- Could short units be combined to allow greater time to develop thinking and provide learners with opportunities to apply their learning in increasingly complex and unfamiliar situations?
- Could some units be coupled together to make connections clearer?
- Should the big picture include additional opportunities for pupils to build, apply or demonstrate mastery of key mathematical process skills in context?

- 2. Maintaining:** Work with the overview of your departmental scheme of work, which may be in the form of a curriculum map. Think about any changes that are required because of external factors such as a new programme of study or a change in the mode of assessment for a key stage (this could take you back to the design stage). Think about how to locate recent planning developments in the curriculum map.

Consider:

- what the new units replace and whether some units could be deleted or combined;
- the sequence of units within which the new units should be positioned;
- any consequent changes to other units;
- adjustments to unit codes, titles and time allocations, as appropriate.

- 3. Communicating:** Keeping the curriculum map up to date is essential but will have no impact unless you communicate it to your colleagues in the department. Each teacher needs to be aware of the progression that is designed into your scheme of work. This will allow them all to make decisions about how to extend some groups and how to support others. They will also be able to make connections as they teach linked units and take advantage of opportunities for pupils to transfer their process skills from one strand to another.

You will also want to agree with your team about when and how to communicate sections of the curriculum map with each group of pupils. Consider your answers to these questions and whether this is the same for each year group.

- How much of the big picture will you share at any one time?
- At what stage in the term or year will you share this?
- What will be placed on the school website or the Virtual Learning Environment (VLE)?
- Would it be helpful to share this information with parents?

## Task: The teaching calendar – sequencing and timing the teaching

How does the timing of your units work? Do they:

- fit around and take advantage of key dates and events in the school calendar;
- take account of interdependencies in the units, across and within strands, and the need for progression;
- allow for opportunities to work across subjects and outside the classroom on real, relevant and purposeful contexts?

A teaching calendar is a way of capturing the detail of your scheme of work in a way that addresses all these issues. It could be organised as shown below, using a 'Notes' column to provide space for capturing significant events and an overview column to give an 'at-a-glance' view of the content covered in each term.

Half-term	Week beginning	Notes	Unit code	Mathematical content overview

### Constructing or revising the teaching calendar for a year group

- 1. Starting a teaching calendar:** Record important school dates and events in the 'Notes' column of the teaching calendar. Points to consider include:
  - events that need to be interwoven with the teaching sequence, such as focused assessments and tests, including active test preparation and feedback, targeted intervention, projects linked to other subjects, also non-mathematical events such as excursions;
  - events that affect scheduling or departmental organisation, such as access to resources, test entry deadlines, analysis of test papers, departmental meetings and parents' evenings.
- 2. Completing the detail:** Use the teaching order indicated in your scheme of work and weave topics from different strands together in a sequence that will fit the calendar. Factors to consider at this stage include:
  - the balance of topics in a term or half-term, to ensure stimulus and variety;
  - points that you have identified in the 'Notes' column, such as scheduling of assessments or availability of ICT resources;
  - other factors, such as the most suitable time of year to liaise with another department on a joint project.

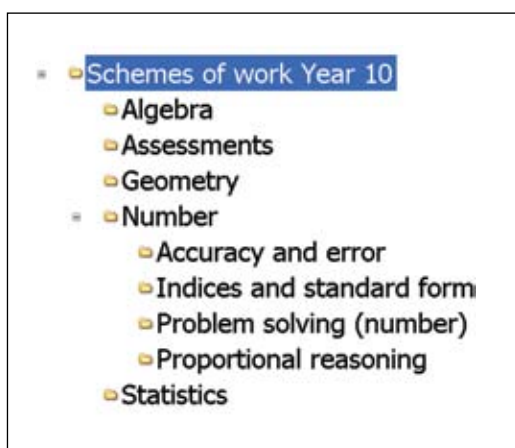
Reconsider the length of each unit, as you plan how to fit units to the calendar.
- 3. Keeping up to date:** An ongoing task will be to update the calendar for each year group as you adapt units and develop the scheme of work.

## Task: The scheme of work – organising access to plans and resources

- How easy is it to search and navigate the resources and plans that make up your scheme of work?
- Does each member of the department feel confident about how to access plans and draw upon or contribute to the resource base?

It is important to make sure that you organise all electronic resources in such a way that they are easy to search and navigate, with a consistent policy for naming and filing documents. Figure 2: Example of a folder structure shows one way in which the files might be organised on the school network.

**Figure 2: Example of a folder structure**



### Organising access to unit plans and other resources

- 1. Agreeing responsibilities:** One or two members of the department could take charge of regularly organising and updating the electronic resources relating to the scheme of work.
- 2. Deciding on the structure:** Consider practical arrangements for organising resources.
  - Make sure that there is a secure place on the school network where your scheme of work will be stored and that it is backed up.
  - Issue permissions or passwords to teachers, teaching assistants and anyone providing technical or administrative support to the department.
- 3. Keeping up to date:** An ongoing task will be to:
  - save each unit plan in a folder by year, strand and coding, to match a curriculum map or equivalent overview document;
  - discuss with colleagues any related electronic files, such as teachers' and pupils' resources, and add agreed documents to the folder for the appropriate unit.

Good schemes of work were rare in secondary schools. It was not uncommon for teachers to use only examination specifications and textbooks to guide their lesson planning, focusing on content rather than pedagogy. Few schemes included guidance on matters such as the most effective teaching approaches, how to meet the full range of pupils' needs or on what constitutes an appropriate level of challenge. They provided insufficient support for teachers who were at an early stage in their professional development or for staff who were not mathematics specialists.

*Mathematics: understanding the score*  
Ofsted 2008 (paragraphs 45 and 46)

## Section 4: Planning for progression

### What is this section about?

This section has three strategic tasks; these are best tackled by you, as the subject leader, working with one or two carefully selected colleagues. The tasks describe how to review and improve the progression in your scheme of work. They each address a different timescale: the secondary phase, a single year, one term.

### What are the benefits of reconsidering progression?

To ensure that pupils make good progress in mathematics you need to have a scheme of work that sets the right expectations for all pupils, year on year and term by term. Teachers can plan for improved progression of underperforming groups if they are supported by a scheme that offers guidance on pitch and challenge, structures for assessment and a variety of learning experiences. These tasks help you to review and improve the support that is offered in your scheme of work.

### After working through this section

Your next steps may be to:

- repeat tasks within this section, perhaps reviewing at a different layer (for a different time period);
- work on the organisational aspects of the scheme, such as how it is maintained and updated, how it is scheduled against the school calendar and how the overview and interconnections are shared with colleagues (Section 3, Organising a scheme of work);
- work on the detail of particular units, starting with the pitch and structure of the unit (Section 5, Collaborative planning, see Unit planning) or starting by working together on how to develop a particular piece of mathematics (Section 5, Collaborative planning, see Rich tasks).

## Overview

This section, which comprises three tasks, is about reviewing and improving the way in which your scheme of work supports progression for all groups of pupils. In most cases, 'planning for progression' starts by reconsidering elements in an existing scheme; there will be few occasions when a subject leader would start this process from a blank sheet of paper. If you are in the position of creating a new scheme of work, the tasks remain valid and will help you to think carefully about how to design and build the structure.

Your first question must be about pupils' rates of progress. It is likely that your review will be motivated by the need to improve progression for some groups of pupils or for a specific aspect of the curriculum, such as mathematical processes and applications. To support your review you could start by considering Figure 3: Learning objectives in the Framework for secondary mathematics – a diagrammatic representation, below.

**Figure 3: Learning objectives in the Framework for secondary mathematics – a diagrammatic representation**

Learning objectives	Year 7	Year 8	Year 9	Year 10	Year 11	Extension
<b>Relevant assessment criteria</b>	Levels <b>4, 5</b>	Levels <b>5, 6</b>	Levels <b>5, 6, 7</b>	Levels <b>6, 7, 8</b> Grades C, B	Levels <b>7, 8, EP</b> Grades B, A	Levels <b>8, EP</b> Grades A, A*

*the objectives in the column for Year 8 support planning for pupil progression from level 5 to level 6*

*the year headings are nominal and serve to show progression in the objectives across the 5 years*

*assessment criteria covering levels 2 to 8 for each element of mathematics are available in the online Framework*

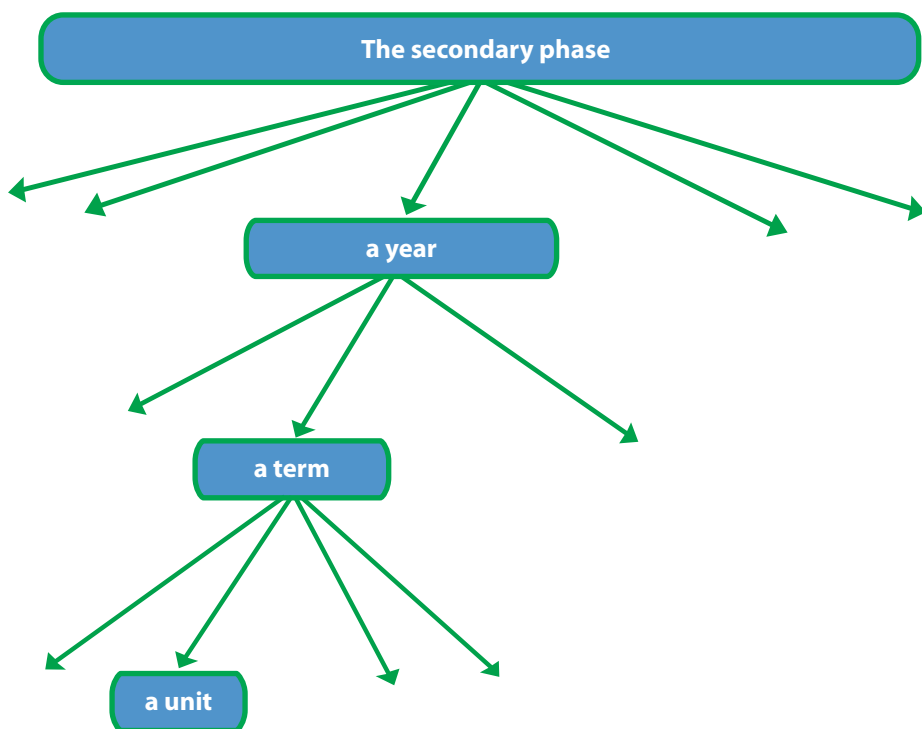
*the objectives in the column for Year 10 support planning for progression by securing level 6, developing level 7 learning and introducing aspects of level 8. This corresponds to GCSE grade C and B (for grade descriptors see GCSE criteria.)*

Note that the year headings are nominal: your scheme should draw from the columns that support the pupils in your school, so that they make progress from level to level and achieve at least three levels of progress across the five years. Your scheme and your tracking system should work together, allowing pupils to make rates of progress appropriate to them, personally. For example, using Key Stage 2 test results and teacher assessment, you would encourage a pupil with a high level 4 to convert to at least a grade B by the end of Key Stage 4; on the other hand, a pupil with a low level 4 might reasonably be expected to convert to a grade C. You can check your scheme against these learning objectives in order to support trajectories of this kind. Each of the three tasks in this section uses the learning objectives in this way.



Planning and reviewing a scheme of work involves moving between overview and detail, so the three tasks focus on progression in the full secondary phase, a year and a term. To begin your review, you need to decide whether you would like to start with the big picture and move to the detail of a term, or focus on a term or year and then move to review the whole phase.

**Figure 4: The layers in a scheme of work**



The process can work equally effectively, using any layer as a starting point. Your decision will be influenced by the need to improve rates of progress of particular groups of pupils or by concerns you may have about aspects of mathematics learning, such as pupils' skills in the key mathematical processes.

Bearing these factors in mind, and after reading over the tasks in this section, you will probably make a quick decision about what feels right for your department. Whatever you decide, it is likely that you will need to make repeated visits to each of the top three layers, making small adjustments to your scheme as it evolves through more detailed collaboration at the bottom layer of unit planning. For example, you may make changes as a result of incorporating more rich mathematical tasks or adding detailed guidance on teaching approaches in particular unit plans.

At each layer you will consider:

- the pitch and expectations built into the scheme of work so that progression is clear from unit to unit, term to term and year to year (see Figure 4: The layers in a scheme of work);
- the teaching and learning approaches, so that pupils are engaged in the key mathematical processes, learn about the big ideas that interconnect the subject and enjoy mathematics;
- the way that assessment is described, so that pupils are able to build on prior learning as a result of planning that responds to assessment evidence.

The review tasks that follow are best done with a small strategic group drawn from your department. The outcomes from your review can then be discussed and refined when you share them with the department as a whole.

## Task: Reviewing and improving progression across the secondary phase

You may be prompted to review this layer of planning because:

- progress across the secondary curriculum from Key Stage 2 to Key Stage 4 is poor for a significant proportion of pupils;
- departmental systems or approaches need refreshing across the whole scheme of work, for example, you wish to reconsider how assessment fits into the scheme of work;
- there is a change to programmes of study and/or external modes of assessment and you wish to consider the implications of this for the whole phase.

You will need:

- to choose a particular strand of the curriculum to review, for example, algebra;
- access to the learning objectives from the Framework for secondary mathematics in printed form or online, projected on a screen ([www.standards.dcsf.gov.uk/nationalstrategies](http://www.standards.dcsf.gov.uk/nationalstrategies), select 'Secondary', and then 'Mathematics Framework')
- document(s) that show how the chosen strand develops in your scheme of work across the five years of learning, which might be on a curriculum map you have designed or an overview document in a published scheme that you use.

### Reviewing and improving progression: one strand of the curriculum – across the secondary phase

#### Establish your aim

Tell colleagues that you are considering the complete secondary phase, so you cannot also look at the whole curriculum. Take an overview of just one strand and resist detail.

At the end of the review you are aiming for:

- clearer collections of objectives in the units in each year, so that expectations of the pace of learning and teaching are well defined and there is no 're-teaching, just in case' at the start of a year;
- threads of progression identified within the strand, so that the 'big ideas' are clear and perhaps drawn together in longer units;
- dates of key assessment points mapped against some units, so that teachers are clear when evidence will be collated and judgements made;
- a clear start to the topic in each year, with a sense that the learning is moving on from 'last year's thinking' to new and exciting territory.

## Reviewing one strand in the Framework

Use the printed set of learning objectives or project the on line Framework for secondary mathematics selecting learning objectives and your strand of the curriculum, for example, algebra. Use Figure 3: Learning objectives in the Framework for secondary mathematics – a diagrammatic representation to clarify the pitch of the columns. For the identified strand, read down the page and note how the objectives are organised into rows. Browse across the page, noting how the learning objectives describe progression, column by column.

Discuss:

1. the advantages of seeing objectives aligned in this way and identify some key features of the 'big picture' of progression in this strand;
2. how groups of objectives are aligned horizontally into 'threads' of progression through the key stages and identify some of the big ideas in these threads; begin to consider how these are represented in the threads of your scheme of work.

## Improving one strand in your scheme of work

Use the Framework to identify the trajectory of objectives that would enable the 'majority group' in your school to make progress to their target grades by Year 11. This is likely to be pupils entering Year 7 at level 4 and heading towards a grade C or better at GCSE.

1. Align this to the trajectory described in your units and decide how to adjust the objectives in a few units to get the expectations right.

If the whole strand needs a rethink, start by collecting objectives into existing or new units so that they build a progression from Year 7 through to the end of Year 11.

2. Review the progression in the units and decide how to build extension and support into the units by drawing on objectives from adjacent columns of the Framework.

You may need to plan for some more detailed work to add richer tasks, where the challenge can be easily adjusted by providing alternative resources or adjusting the level of support.

3. Look for links within the strand and decide how to build in some connections to other contexts, in school and beyond.

This sometimes needs longer or combined units, so that pupils get the chance to develop thinking and apply the skills.

4. Review assessment points in the strand and ensure that assessment criteria are highlighted in the key units where periodic assessment evidence should emerge most strongly.

This may mean mapping key assessment points into the scheme of work, so that teachers are clear when evidence will be collated and judged.

5. Look back at your aims and decide the next steps, which may be to look at a year or a term in more detail.

## Task: Reviewing and improving progression across a year

You may be prompted to review this layer of planning because:

- progress in a particular year is poor for a significant proportion of pupils – a ‘plateau year’;
- there is a change to programmes of study and/or external modes of assessment that affects this particular year first;
- this is a new year to the school or you are picking up from something new in the previous year, for example, an integrated curriculum.

You will need:

- to choose two particular strands of the curriculum to review, for example, algebra and geometry
- access to the learning objectives from the Framework for secondary mathematics in printed form or online projected on a screen;
- *The Secondary mathematics guidance papers*, sections ‘Making connections in mathematics’ and ‘Key processes in ...’ (the relevant strands, for example, algebra and geometry), are available to download from [www.standards.dcsf.gov.uk/nationalstrategies](http://www.standards.dcsf.gov.uk/nationalstrategies). Search using the reference 00343-2008BKT-EN.
- document(s) that show how the chosen strands develop in your scheme of work across the year, which might be summarised on the front page of unit plans or an overview document in your own or a published scheme.

### Reviewing and improving progression: two strands of the curriculum – across one year

#### Establish your aim

Tell colleagues that you are considering an entire year, so you cannot also look at the whole curriculum. Take an overview of two strands and look at a small amount of detail. At the end of the review you are aiming for:

- clearer collections of objectives in each unit, so that expectations of the pace of learning and teaching are well-defined and some units are designed to start by giving pupils a chance to show what they already know;
- stronger guidance on strategies to support and extend pupils, with a focus on the ‘big ideas’ in the strands and less emphasis on small sets of skills;
- explicit connections being made between the two strands and planned opportunities identified for pupils to apply skills that have been built;
- a clear strategic focus on how and when assessment criteria are emphasised in a unit and how this influences planning for this and the next unit.

## Reviewing two strands in the Framework

Use Figure 3: Learning objectives in the Framework for secondary mathematics – a diagrammatic representation, on page 20, to clarify which column of objectives will put the majority of pupils on the right trajectory to targets (this may not match your actual year if pupils enter secondary school significantly above/below national expectations). Use a printed set of learning objectives or project the column of learning objectives from the Framework for secondary mathematics. Focus on the two strands of the curriculum (for example, algebra and geometry) and read down the page to gain an overview of the way objectives are organised into rows within each strand; check to the left and right of the columns, noting support and extension objectives.

In addition, read and reflect on Figure 5: Extract from *The secondary mathematics guidance papers*, page 28. Then discuss:

1. The advantages of seeing objectives aligned to the left and right. Identify some key features of learning for this year group by thinking about what pupils should know from the previous year and what will be their next step.
2. The interconnected ideas within and between the two strands and how this could create opportunities for deeper thinking. Consider the importance of mathematical processes and applications and the need to provide opportunities for pupils to apply problem-solving skills from both strands.

## Improving two strands in your scheme of work

1. Reconsider the collection of objectives in units (existing or new) so that they build a progression through the year for your 'majority group' of pupils.

You could also enrich tasks and add suggestions for support and extension so that the same units can be used across a broader range of groups.

2. Review and strengthen coverage of all the key processes across units in the year. (You may wish to refer to *The Secondary mathematics guidance papers*, which contain a short section illustrating the key mathematical processes in each strand of the curriculum.)

Consider how a greater emphasis on objectives from mathematical processes and applications would strengthen connections and develop transferable skills. Some units might address particular aspects of the key mathematical processes, some the whole cycle of processes and one or two might be free of new content.

3. Review and strengthen the connections between units, both within and between strands.

Judge whether units are of sufficient length to provide learners with the opportunity to develop their thinking and apply their skills independently. Note that combining units could help to forge connections and allow opportunities for pupils to understand and apply 'big ideas'.

Identify opportunities to link related ideas across strands, including solving problems where pupils have to apply skills from both strands. You may wish to build in additional opportunities for the application of skills to other contexts, in school and beyond.

4. Review how assessment is mapped into the units throughout the year.

Do some units identify, as a starting point, rich tasks that reveal what the pupils already know?

Are related assessment criteria identified in particular units where strong evidence should be generated?

Do units build on from one another, using assessment evidence from one unit to identify the pitch of the next unit?

5. Look back at your aims and decide the next steps, which may be to look at a term in more detail or to move on to unit planning or to think about rich tasks.

## Task: Reviewing and improving progression across a term

You may be prompted to review this layer of planning for any or all of these reasons:

- engagement and progress in a particular term is poor for a significant proportion of pupils;
- there is a change to programmes of study and/or external modes of assessment that affects this term first;
- this is a good point to consider building in some fresh learning opportunities, for example, a transition point from one key stage to another, or a term that follows or includes something significant in the school calendar.

You will need:

- a copy of *The Secondary mathematics guidance papers*, available online at the Framework for secondary mathematics (refer particularly to the sections 'Mathematical processes and applications' and 'Teaching and learning approaches'); these can be found at [www.standards.dcsf.gov.uk/nationalstrategies](http://www.standards.dcsf.gov.uk/nationalstrategies). Search using the reference 00343-2008BKT-EN;
- access to the learning objectives from the Framework for secondary mathematics, in printed form or online and projected on a screen;
- the unit plans for the term or equivalent document(s), such as the teachers' guidance in a published scheme.

### Reviewing and improving progression: all strands of the curriculum – across one term

#### Establish your aim

Tell colleagues that you are considering just a term, so you can look at the whole curriculum in some detail. At the end of the review you are aiming for:

- clearer collections of objectives in each unit, so that the expectation of the pace of learning and teaching is well-defined;
- richer tasks in each unit, so that pupils experience a variety of learning opportunities and the units can be adapted for a wide range of abilities;
- a variety of units, reflecting the full range of learning opportunities that pupils should experience;
- strategies to improve day-to-day assessment, identified in each unit, so that teaching and learning move together at a good pace, with tasks that access prior learning and connect quickly to new learning.

#### Reviewing all strands in the Framework

From *The Secondary mathematics guidance papers*, select and read the sections 'Mathematical processes and applications' and 'Teaching and learning approaches'.

Discuss:

1. particular examples of units in this term that include guidance on effective teaching and learning approaches;
2. the extent to which pupils experience variety in their learning through the units in this term, then agree which of the learning principles are evident in your department and which you would prioritise for development.

## Improving all strands in your scheme of work

1. Check the objectives in the units for the chosen term against those in the Framework for secondary mathematics. Make sure that these units will keep the challenge high, so that pupils make the right progress to targets. Consider first your 'majority group' of pupils (this is likely to be pupils entering Year 7 at level 4 and heading towards a grade C or better at GCSE). Next consider groups that require extension or support.

You should also consider how to enrich key tasks in the units. Cater for the needs of different groups of pupils and develop their functionality by providing tasks that become more or less challenging by adjusting the **complexity** of the problem, the **familiarity** of the context, the **technical demand** of the mathematics or the degree of **independence** required.

2. Remind yourselves, for the term in question, about the range of learning opportunities in the units in your current scheme. Ask, 'What does this learning experience feel like for the pupils?' 'Are they engaged?'

Look for opportunities to strengthen how pupils:

- learn about and through the key mathematical processes;
- work collaboratively and engage in mathematical talk;
- work on sequences of tasks;
- select the mathematics to use;
- tackle relevant contexts beyond the mathematics classroom;
- are exposed to the historical and cultural roots of mathematics.

3. Review how your priorities for developing effective teaching can support the learning in this term.

Select from:

- building on the knowledge pupils bring to a sequence of lessons;
- exposing and discussing common misconceptions;
- developing effective questioning;
- using cooperative small-group work;
- emphasising methods rather than answers;
- using rich collaborative tasks;
- creating connections between mathematical topics;
- using technology in appropriate ways.

4. Check that each unit includes strategies for day-to-day assessment.

Suggestions could include:

- rapid response assessment techniques (mini-whiteboards, thumbs up or thumbs down, traffic lights, smiley faces);
- ways of observing what the pupils are thinking and doing (card sorts, posters, practical equipment, visualisations);
- mini-plenaries, key questions in each phase of the unit, probing questions with small groups of pupils.

5. Look back at your aims and decide the next steps, which may be to step back and look at the planning for the rest of the year and make adjustments to other terms. Alternatively, you may move on to the detail of unit planning or think about rich tasks.

**Figure 5: Extract from *The secondary mathematics guidance papers***

## Making connections in mathematics

Although the strands of mathematics are described separately in the tables of objectives, there are, of course, many links between them. Mathematics is not a set of isolated topics or learning objectives but an interconnected web of ideas, and the connections need to be made explicit to pupils. Good planning ensures that mathematical ideas are presented in an interrelated way, not in isolation from each other. Awareness of the connections helps pupils to make sense of the subject, avoid misconceptions and retain what they learn. So when you plan, aim to:

- present each topic as a whole, rather than as a fragmented progression of small steps, for example, show pupils that the place-value system encompasses both whole and decimal numbers of any size, and that decimals and percentages are particular forms of fractions;
- bring together related ideas across strands, for example, link work on metric measures to the decimal place-value system, or link ratio and proportion in number to rates of change in algebra, to enlargement and similarity in geometry, and to proportional thinking in statistics and probability;
- help pupils to appreciate that important mathematical ideas permeate different aspects of the subject, for example, the concepts of equivalence, inverse and order link the four number operations, are the key to manipulating algebraic expressions and are central to the geometrical transformations of reflection, rotation, translation and enlargement;
- use opportunities for generalisation, proof and problem-solving to help pupils to appreciate mathematics as a unified subject, for example, proof and mathematical argument involve chains of reasoning that link ideas together, so to prove that the sum of any three consecutive numbers will always be a multiple of 3 might involve forming algebraic expressions, using the distributive law to factorise an expression and appreciating the relationship between factors and multiples.

Working on the processes of mathematics will also be a unifying theme in your planning and teaching and will help pupils to see that developing these as transferable skills helps them to make progress. For example, you may plan specific points in the learning process at which you explicitly encourage pupils to consider alternative solutions as part of the process of communicating and reflecting. This process will be valid across all strands and will help pupils to see the unity of mathematics as a way of thinking and of solving problems.



# Section 5: Collaborative planning

## What is this section about?

This section has two parts that both involve the department working collaboratively in a pattern of plan–teach–review. The activities work at the level of a single unit or a sequence of lessons.

- *Rich tasks* is made up of three activities. The introductory activity involves teachers in working together on the mathematics of a rich task. The main activity is plan–teach–review; colleagues plan and teach the mathematics through the task they have explored and then review the impact. Finally, there is a section that introduces general types of rich task, to be adapted and incorporated into a number of units in the scheme of work.
- *Unit planning* comprises two activities. The introductory activity involves teachers in working together to consider structures of a teaching unit. The main task is plan–teach–review; colleagues plan by gathering suitable objectives and sequencing mathematical activities, including rich tasks. They then teach the unit and review its impact.

## What are the benefits of collaborative plan–teach–review?

Well-led collaborative planning provides highly effective professional development for staff. Good ideas and practice are shared and all teachers develop, regardless of their experience or specialism. The benefits to pupils' learning go far beyond the actual mathematical tasks or units planned, influencing teachers' other lessons. Such planning secures greater consistency across the department and enhances your leadership role.

## After working through this section

Your next steps may be to:

- repeat activities within this section:
  - work on the *Rich tasks* part of this section, developing the mathematics of a task before teaching it in a sequence of lessons;
  - work on the *Unit planning* part of this section, developing the pitch and structure of a unit;
- work on the organisational aspects of the scheme, such as how it is maintained and updated, how it is scheduled against the school calendar and how the overview and interconnections are shared with colleagues (Section 3, Organising a scheme of work);
- review and improve the progression described in your scheme of work so that you set the right expectations, year on year and term by term (Section 4, Planning for progression).

In the outstanding lessons, the teachers had high expectations of pupils' enjoyment and achievement. They made conscious efforts to foster a spirit of enquiry, developing pupils' reasoning skills through approaches that saw problem-solving and investigation as integral to learning mathematics. They checked that everyone was challenged to think hard and they adapted how they were teaching to achieve this. As a result, their classrooms were vibrant places of learning.

*Mathematics: understanding the score*  
Ofsted 2008 (paragraph 15)

## Rich tasks

### Introduction

It is important to find new ways to stimulate mathematical thinking and talk in the classroom; using rich tasks engages pupils more actively in their learning. Rich tasks in mathematics:

- are accessible and extendable;
- allow learners to make decisions;
- involve learners in testing, proving, explaining, reflecting, interpreting;
- promote discussion and communication;
- encourage originality and invention;
- encourage 'What if...?' and 'What if...not...?' questions;
- are enjoyable and contain the opportunity for surprise.

A good unit plan will include one or more rich tasks, often developed over more than one lesson. It is worthwhile identifying suitable tasks and exploring their mathematical potential whenever you are seeking to enhance, revise or develop a unit plan as a way of improving your scheme of work.

As teachers, we spend a lot of time engaging pupils in doing mathematics but, perhaps more rarely, spend time doing it ourselves. Rather than regarding it as an indulgence, departments that have worked together on some mathematics have found that it stimulates discussion about the subject and sharing of ideas as to how it might be taught. It is easy to assume that all teachers understand and explain concepts in a similar way, but this is not always the case. Talking through their thinking could improve the way in which teachers in your department help pupils to learn mathematics.

This section includes a sequence of activities to help you lead your department in doing some mathematics, before teaching it. The activities describe how to open up discussion through staff working together on a mathematical task, reflecting on its richness and potential to promote mathematical talk and enhance pupils' learning, before using it as part of a plan–teach–review cycle. Ultimately, you will revise the planning and incorporate successful ideas into a unit in your scheme of work.

## Task: Doing mathematics together

Identify a rich mathematical task and think about how you will work on it together. Sources might include:

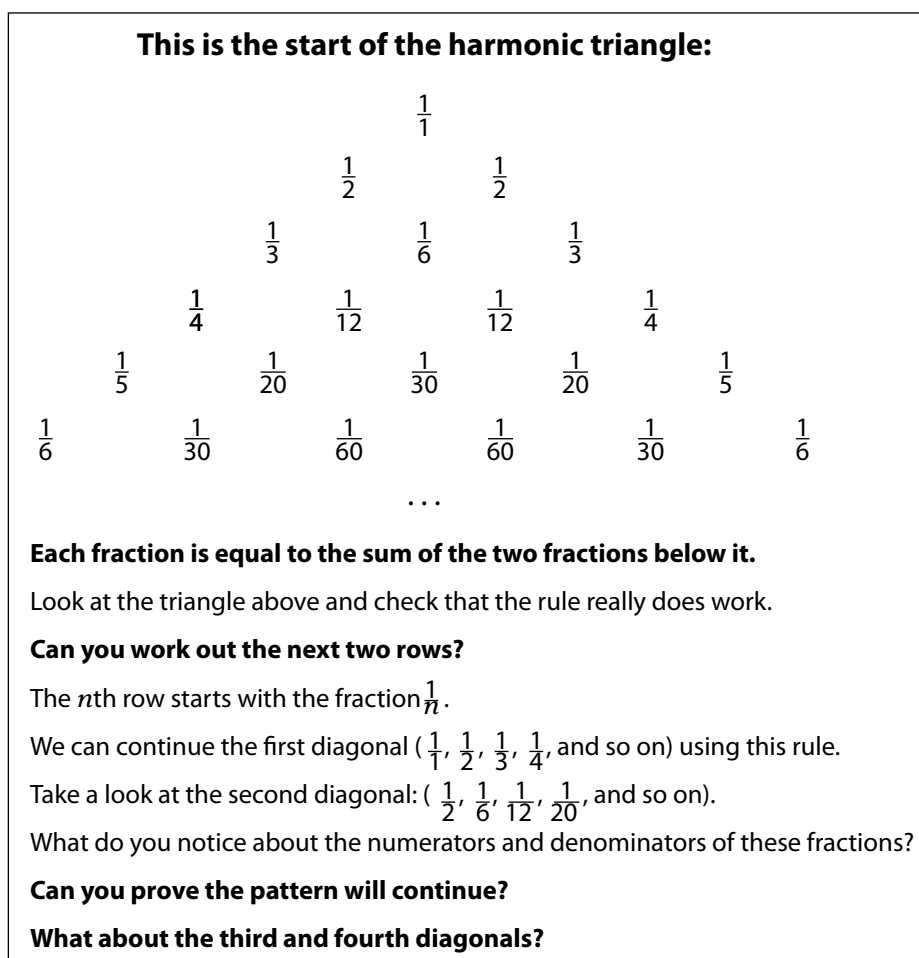
- the online Framework for secondary mathematics;
- other websites, such as QCDA, NCETM, NRICH, schools, the local authority, professional associations;
- your own scheme of work, including ideas from a textbook.

It is necessary to engage colleagues in your department (and ultimately pupils) in deep and more extended mathematical dialogue. Identifying the starting point and considering ways of opening up discussions that reveal thinking is important.

The approach is illustrated below with 'The harmonic triangle', an example drawn from the problems to develop mathematical processes and applications from the Framework for secondary mathematics. The following guidance will help you to present the task so that it stimulates discussion in the department. Any task will need similar preparatory notes and many of the tasks on the Framework website also have related guidance.

On the first occasion that a particular group of colleagues works together on a mathematics problem, you may need to make deliberate efforts to focus the talk on doing and thinking about the mathematics itself. Do not allow the conversation to move too quickly towards pupils or classroom practice – that comes later. Encourage colleagues to enjoy doing mathematics together and to talk openly about how they think through and process the different aspects of the problem and stages of its solution.

**Figure 6: The harmonic triangle**



This resource ([http://nrich.maths.org/public/viewer.php?obj\\_id=4716](http://nrich.maths.org/public/viewer.php?obj_id=4716)) is taken from NRICH (<http://nrich.maths.org>) © University of Cambridge. Used with kind permission.

## Doing the mathematics: using the harmonic triangle

Explain the purpose of the activity, which is to work together on a rich mathematical task in order to see its potential for engaging pupils, particularly in the key processes of representing, analysing, interpreting and communicating. Then consider how to develop the task and trial it with pupils. As a first step, focus on the task itself.

1. Model the mathematical task. Do not be tempted to discuss the task in general because this will defeat the aim of the session, which is to share mathematical thinking. Work on the wording of your questions and press colleagues for precise and carefully worded responses.

- **Example: Harmonic triangle**

Show the harmonic triangle and allow colleagues some time to work on their own, making sense of the addition rule and beginning to identify ways of extending the triangle downwards.

As the triangle grows, new patterns emerge. Extend it on the board and, as colleagues notice the patterns, write them on the board. For example, they might notice that the numerators always appear to be 1. Suggest that they work in pairs and ask them to try to explain why particular patterns appear.

Extend the discussion to explore how it is possible to write generalisations symbolically, for example, using general terms to show there will always be unitary fractions on the second diagonal.

Ask questions that challenge group findings such as, 'Are you surprised that you can continue working from left to right, subtracting fractions, and it still works, even though the triangle is symmetrical? Will this always work?'

Encourage colleagues to comment on one another's arguments and whether they make sense or they have noticed something different.

Extend the triangle together on the board and share ideas about extending sections efficiently. Ask colleagues what methods they liked and why, highlighting methods you found particularly elegant and efficient.

2. When you have explored the task in some depth, reflect on the task by moving the discussion on to these points:
  - reflect on the way in which each of you expressed your understanding and comment on any surprising aspects of the thinking that emerged.
  - consider the power of approaching the task in this manner, for example, how the structure of the activity or paired work helped each of you to develop your thinking and to share your understanding.

## Task: Developing a rich task through plan–teach–review

You are now in a position to use the task to inform a plan–teach–review cycle. To do this you will need to refer to the key mathematical processes that are a priority for development, as part of the new programmes of study, and essential if pupils are to become functional mathematicians.

There are several documents that can inform your discussions and it is important to use one that is familiar and accessible to you. Sources could include:

- the Framework for secondary mathematics for key process maps, suggestions for ways of gathering pupils' views and templates for recording notes to support the review;
- *The Secondary mathematics guidance papers*, 'Key processes in...' and 'Teaching and learning approaches';
- your own scheme-of-work references to key mathematical processes, perhaps from your work on the launch of the new Key Stage 3 programme of study in 2008.

### Developing a rich task: plan

1. Having reflected on how you approached the rich task, shift the focus of discussion to the pupils, particularly to ways in which they could develop or extend the problem and become more autonomous, especially in using the key processes.

When reflecting on the scope and potential of the task for pupils, you might decide to work together on an interconnected map of key processes, noting the range of opportunities that the task offers. An example is shown in Figure 7: Draft key process map, (harmonic triangle). (If some colleagues are less familiar with the key processes, talk them through elements that relate closely to the way in which pupils could be learning through this task.) As you build up a map, reconsider how you might present and develop the task, perhaps over several lessons, and which aspects of processes you will emphasise when you trial the task, but remember, you are not trying to cover everything!

2. Now discuss more explicitly how you could present the task to pupils. To sharpen thinking and discussion, you could refer everyone to particular teaching and learning approaches you are trying to develop.

The *Secondary mathematics guidance papers* describe some principles for effective teaching based on research over many years into the teaching of mathematics. If you are working on this activity you are already emphasising one of the principles, which is to use 'rich collaborative tasks'. The other principles are:

- building on the knowledge pupils bring to a sequence of lessons;
- exposing and discussing common misconceptions;
- developing effective questioning;
- using cooperative small-group work;
- emphasising methods rather than answers;
- creating connections between mathematical topics;
- using technology in appropriate ways.

These papers also describe some principles for effective learning, drawn from the secondary programmes of study in mathematics. Again, if you are working on this activity you are already emphasising two of the principles, which are 'pupils learning through the key processes' and 'pupils working collaboratively and engaging in mathematical talk'. The other principles emphasise pupils:

- learning about the key processes;
- working on sequences of tasks;
- selecting the mathematics to use;
- tackling relevant contexts from beyond the mathematics classroom;
- engaging with the historical and cultural roots of mathematics.

3. Identify some classes with whom it would be suitable to trial the task. Sketch out a plan for the first lesson and identify the resources required. If the task is to be extended over two or three lessons, clarify how it might evolve, but keep plans flexible to allow for different responses among the various classes. (It might be helpful to insert some brief notes into part of a unit-planning template.)
4. Set up the 'teaching stage' by agreeing the support, dates and times, any partnerships for team teaching or coaching and the role of teaching assistants (TAs).

### Developing a rich task: teach

1. Describe to colleagues how you will gather evidence of impact from the 'teaching stage'; for example, you may wish to use an agreed template for note-taking as self-reflection after lessons, team teaching or lesson observations. Focus the notes on what you are doing that is different and what you are trying to achieve, for example:
  - the particular key processes with which you want pupils to engage;
  - the particular teaching and learning principles you are seeking to improve.
2. Teach the rich task to the selected year-group or classes. Provide planned support where possible, for example, coaching or team teaching.
3. Facilitate sharing of experiences, especially where the rich task extends over more than one lesson.
4. Ensure that teachers and observers keep notes on lessons, using the agreed review sheet, which they will bring to the review meeting.
5. Consider interviewing small groups of pupils, particularly about their response to the task and the 'new' aspects of teaching and learning.

## Developing a rich task: review

Make sure that all colleagues bring their notes and observations from the trials to the review meeting.

1. Ask this question.

*Which of the identified features (key processes and teaching and learning approaches) were evident when you trialled the example of a rich task with pupils?*

Discuss each point in turn. First those relating to pupils' learning (particularly engagement with the key processes) and, second, those relating to teaching approaches. Draw out differences between classes in how the task was developed and how the pupils responded. This can help you to:

- gain insights into what is most effective in engaging pupils and developing their learning;
  - appreciate the richness of outcomes that can emerge from a more open starting point.
2. Consider whether you could develop the task further by:
    - adapting or opening it up to incorporate more aspects of key processes;
    - developing other aspects of teaching and learning.
  3. Discuss how you might incorporate the task in a unit of work. Topics might include the objectives that the task addresses, how the task dovetails into the unit and what other modifications are required.
  4. Finally, note any points for consideration when you next explore a rich task together.

As a subject leader, it is important to consider how exploring a rich mathematical task together can have a positive influence on the teaching of all your colleagues and the learning of their pupils. You can continue this process by:

- considering other tasks and/or teaching and learning approaches and embedding them in existing units of work;
- reconsidering unit planning by restructuring selected units of work so that they incorporate one or more rich tasks.

## Task: Developing more rich tasks

This activity is designed to help you to step back and look more broadly at types of rich task. You might use this occasionally with the department, once the idea of rich tasks is established. The aim is to see that there are types of task that can be used and adapted to different areas of mathematics and with different groups of pupils. It is highly effective if teachers become skilled in developing learning through a small collection of such tasks.

Descriptions of types of rich task can be found in a number of places, including the Framework for secondary mathematics. Drawing colleagues' attention to particular activity types to stimulate their thinking can be a creative and rewarding process for many teachers. The following are a few examples of task categories. Choose one from whatever source is familiar to you.

- Visualisation tasks
- Classifying tasks
- 'Odd-one-out' tasks
- 'Always/sometimes/never true' tasks
- Dominoes and jigsaws
- Finding and correcting errors in 'pupil' scripts
- Creating revision maps for a big idea
- Developing and adapting an examination question

### Exploring types of rich task

Explain the purpose of the activity, which is to discuss examples of a particular type of task that you have chosen to consider.

1. Discuss examples of the type of task that are given in the source, to clarify its features and what it has to offer. In particular, consider these questions.
  - What aspect or aspects of the mathematics and the key processes (representing, analysing, interpreting and communicating) will it help to develop?
  - Which of your teaching and learning priorities could it help to strengthen?
2. Sketch out ideas for examples of your own, with teachers perhaps working in pairs for a few minutes. Share ideas and perhaps select one example to develop and trial in the classroom before building it into a unit plan.
3. Consider whether one or two of these ideas could become the focus of a plan-teach-review cycle as described in this section.



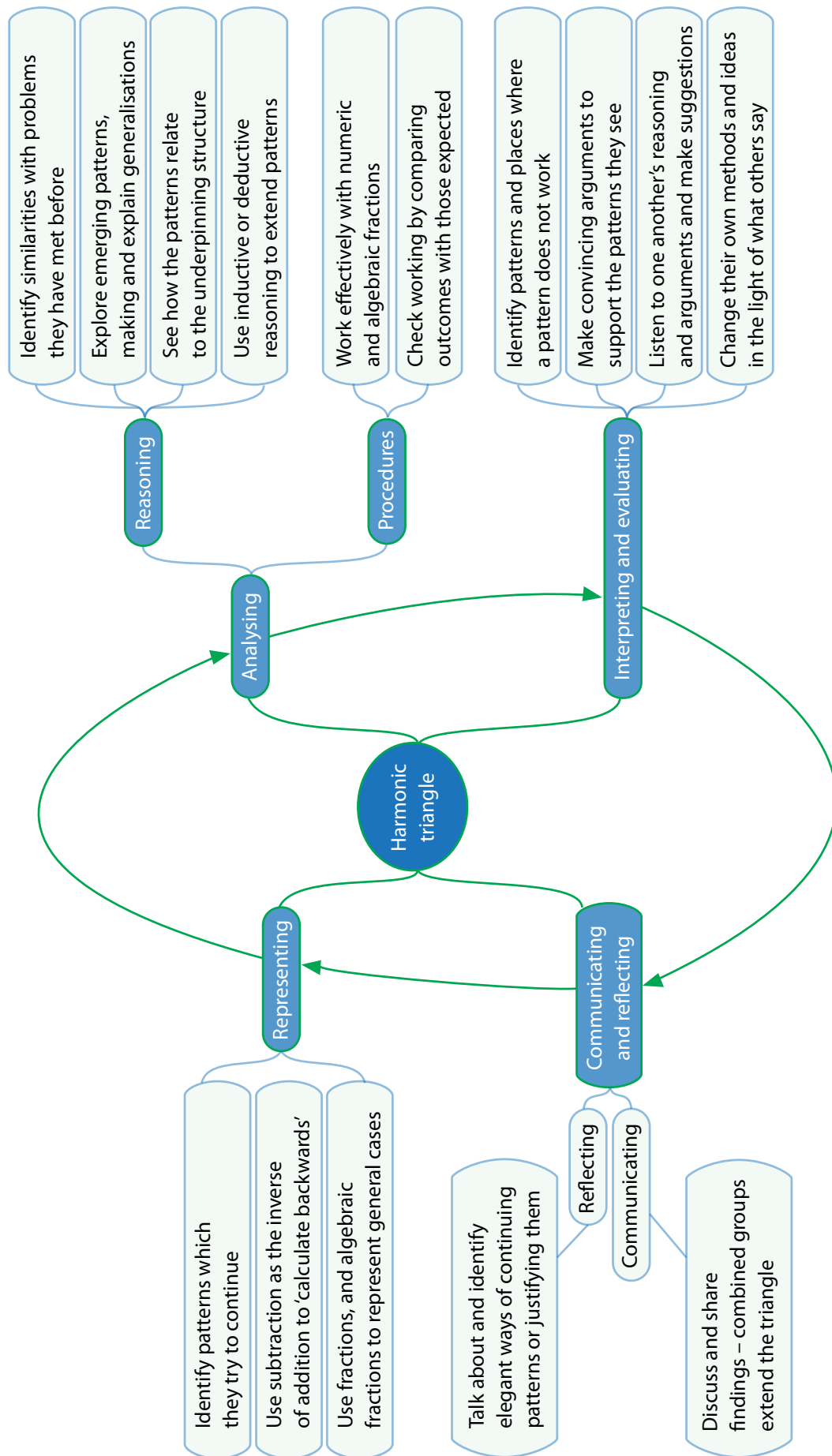


Figure 7: Draft key process map (harmonic triangle)

The best schemes of work included guidance on approaches, interesting activities and resources that help nurture pupils' understanding. They were seen as living documents, subject to regular discussion and review, which helped staff to develop their expertise.

*Mathematics: understanding the score*  
Ofsted 2008 (paragraph 45)

## Unit planning

### Introduction

It is good practice to teach mathematics in units of work that last from two to three weeks, or longer. The approaches described below will support teachers working together to develop sequences of learning through unit planning. The aim is to raise expectations of what the pupils are able to do by planning and teaching mathematics as a coherent set of ideas, focusing on understanding mathematical concepts and developing critical thinking and reasoning. Lessons planned from well-structured units are sharper and more clearly focused, enabling class or group progression to be more easily recognised. Well-structured unit plans will contain:

- strategically chosen clusters of objectives crucial to helping pupils make progress towards identified curricular targets;
- an emphasis on selected teaching and learning approaches, designed around rich tasks, so that pupils are engaged in their learning and make more progress;
- guidance on how to gather day-to-day evidence of pupils' progress so that ongoing assessment is strengthened.

Developing effective unit plans is an ongoing process that strengthens the work of the department, supports teachers' professional development and builds a range of curriculum opportunities for pupils. Introducing a few different structures for unit plans will add variety to pupils' experiences and so develop learning in a more engaging way. As a starting point, there may be obvious occasions when an alternative format is required, for example a unit that:

- addresses widespread misconceptions in a particular strand of the curriculum;
- develops functionality by providing opportunities for real, relevant and purposeful contexts, such as healthy lifestyles;
- aligns with a whole-school thematic approach, such as developing thinking skills or linked to learning in another curricular area.

This section offers a sequence of tasks to help you lead your department in planning, teaching and reviewing a unit. It describes how to agree on a structure and the guidance notes for the unit, before teaching the sequence of lessons and finally reviewing the impact. Ultimately, you will revise the unit and incorporate it in your scheme of work. The notes provide a transferable framework and the process can be repeated for any unit.

## Task: Reviewing existing unit structures together

It is important to remember that the structure of units can be very different, depending on various factors such as pedagogic style, available resources and the topic to be taught. A scheme of work should contain examples of different kinds of unit structure, to ensure a variety of teaching methods are used to engage pupils, sustain interest and secure their learning.

Start by selecting some units from your current scheme of work. You could, for example, use planning notes or chapters from a textbook. This is an activity that is worth revisiting, particularly to consider examples that might be different or more tightly structured, such as those outlined in Figure 9: Building variety into unit structures.

### Reviewing unit structures

1. Ask colleagues to work in pairs, each pair considering a different topic that is taught as a sequence of interconnected lessons (a unit of work) in your present scheme of work. They should try to summarise the structure of how the mathematics is developed over several lessons.

Suggest that they imagine describing this unit of work to a new colleague – what would they say?

If colleagues in the department are finding it hard to get started you could ask these questions.

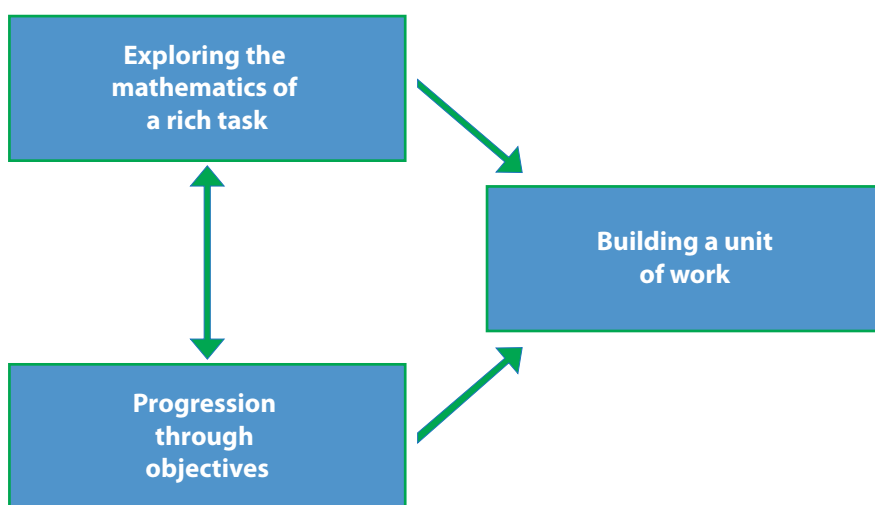
- How are the pupils expected to work? Does this change as the unit develops?
  - How does the teacher support the learning? Is this the same in each lesson?
  - How or when are the new ideas introduced? How are they linked to previous learning?
  - What opportunities are there for pupils to apply or to demonstrate progress in their learning?
2. Allow time for each pair to feed back to the group. Then consider what variety is emerging. You might consider these questions.
    - Do units in your scheme of work have a clear structure?
    - Are some units rather limited, for example, building skills through simple, step-by-step approaches that do not foster deeper thinking?
    - Are there some good examples of units that focus on the application of mathematics and allow for pupils' independence?

Use the questions to gain a perspective on the structure of units in your scheme of work and how these structures or new structures might inform the next stage of your collaborative unit planning.

## Task: Developing a unit of work through plan–teach–review

You may already have in mind an aspect of mathematics to develop. It might be a crucial topic or one that is difficult to teach, perhaps dealing with a big mathematical idea, or a topic that needs a lively and engaging approach. The first step in planning such a unit of work can be to examine objectives or choose a rich teaching activity. Whichever comes first, the other follows closely behind. Effective planning involves constant interplay between the two, as illustrated in Figure 8: Building a unit of work.

**Figure 8: Building a unit of work**



If objectives are your starting point, the choice will be informed by assessment information, such as teacher assessment or item analysis of recent summative assessment. So you can prioritise objectives that address:

- areas of the curriculum that a majority of pupils have not understood;
- areas of the curriculum that pupils have yet to experience.

If you begin from a rich task (or tasks) you will be influenced by those tasks that most engage pupils' interest, stimulate mathematical thinking and talk and help them to learn more effectively.

Think about how you will record this in the unit plan. For maximum flexibility, aim to identify the main activities and sequences of teaching throughout the unit, rather than as a series of detailed lesson plans. You may already have established a good template or you may need to create one. Try to keep it simple to start with, so that it offers a clear overview from which teachers can plan their lessons. The basic ingredients are:

- objectives, including mathematical processes and applications;
- activities and resources and how these are sequenced and organised in terms of teaching approaches, for example, when and how the teacher intervenes to support or extend thinking;
- learning approaches and how the pupils will be organised, for example, in pairs or groups;
- day-to-day assessment strategies that best suit the unit structure.

Other elements are helpful, and can make the unit more effective, but often evolve over time through the plan–teach–review cycle.

To start the development of a unit plan you will need to set aside time for a workshop for your colleagues in the department.

To ensure the smooth running of the workshop you will need to reference documents and share the developing plan. You could use a mixture of hard copy documents, large pieces of paper and electronically projected documents. In all cases you will need:

- a unit plan template;
- the online Framework for secondary mathematics for the learning objectives;
- a source of rich tasks, such as the Framework, QCDA, NCETM, NRICH, local authority, professional associations, your own scheme of work or a textbook.

## Developing a unit: plan

Describe your expectations for the workshop and encourage colleagues to feel comfortable and to be open in their questions and suggestions. Start by explaining why you have chosen a particular topic and what you hope the unit could add to the variety in the scheme of work.

1. Ask colleagues to work together to gain a quick overview of likely objectives, chosen task(s) and where the unit fits in the scheme of work.
2. Use the task(s) to stimulate ideas for the unit plan. Think about lessons that would need to precede, follow or link the tasks together. Ask these questions.
  - *Where might you locate it in the unit?*
  - *What other activities and exercises might be used?*
3. At this stage you will have identified phases of the unit (each phase may be a few lessons with a particular style or focus) and you can make a few notes on your planning template.
4. Look again at objectives and consider whether they are well matched to the tasks and the lesson sequences. For example, it may be clearer how to develop mathematical processes, so you could select specific objectives to clarify this expectation.
5. Write a few supportive notes to describe the sequence of teaching activities. Use prompts such as these.
  - What are the activities?
  - How will the learning be organised and sequenced?
  - What teaching approaches are appropriate?
  - How can the teaching and resources be adjusted in order to provide support or extension?
6. Agree how pupils will work on the tasks and how the teacher will enable this to happen. Note on the plan:
  - how pupils will be grouped;
  - how focused mathematical talk will be increased;
  - how tasks will be designed and sequenced to increase independence.
7. Plan opportunities for day-to-day assessment. Suggestions could include:
  - rapid response assessment techniques (mini-whiteboards, thumbs up or thumbs down, traffic lights, smiley faces);
  - ways of observing what the pupils are thinking and doing (card sorts, posters, practical equipment, visualisations);
  - mini-plenaries, key questions in each phase of the unit, probing questions with small groups of pupils.
8. Start to plan the teaching stage by agreeing the teaching groups, dates and times, support and partnerships for team teaching or coaching and the role of TAs.

## Developing a unit: teach

1. Describe to colleagues how evidence of impact from the teaching stage will be gathered; for example, you may wish to use an agreed template for note-taking as self-reflection after lessons, team teaching or lesson observations. Focus these notes on what is different and what you are trying to achieve, for example:
  - the particular key processes with which you want pupils to engage;
  - the particular teaching and learning principles you are seeking to improve.
2. Schedule the teaching of the unit so that colleagues are fully prepared and the planned support is possible, for example, coaching or team teaching.
3. Check that the team:
  - liaises on planning so that each lesson in the unit builds on the learning emerging from the previous lesson;
  - observes pupils' progress and uses this informal evidence to adjust planning of the next lesson or phase in the unit;
  - keeps notes about the impact of the unit to inform discussions at the review meeting.
4. Consider interviewing a few small groups of pupils about the experience, asking specifically about the 'new' aspects of teaching and learning.
5. Remind colleagues about the time line for the review and make sure that all colleagues bring to the review meeting their notes and observations from the trials.

## Developing a unit: review

Describe your expectations for this review workshop and encourage colleagues to be honest in their reflections and suggestions. Start by reminding them how and why the unit was developed and thank them for 'taking risks' and for their collaboration during the teaching stage.

1. Allocate responsibility for note-taking during the meeting so that the unit plan can be supplemented and filed safely as part of the evolving scheme of work.
2. Check what notes and evidence of impact will be brought to the meeting and agree how you will share these.
3. Keep the evaluation process simple. Use evidence of impact on progress, engagement and pupils' perceptions to inform improvements to the unit for next teaching. Consider these questions.
  - What changes are needed to the structure, objectives, content or emphasis of the unit?
  - What additions to the notes or extra sections are required to enhance the unit plan?
  - What adaptations are necessary to create a unit that would be suitable for pupils with different levels of prior attainment?
4. How will you use the assessment evidence from the unit?
  - If the unit was broadly successful, there will be only a small number of pupils needing focused support in preparation for or during the next related unit. So, note:
    - the starting point and aspects requiring to be developed in related units for the whole class;
    - the curriculum focus and planned support for small groups who have not made sufficient progress.
  - Decide if it is helpful to include related assessment criteria so that you are aware of the opportunities to gather evidence towards periodic assessment. Some units will generate stronger evidence than others because of their position in a sequence of units or because of the nature of the tasks included. You may want a particular unit plan to draw attention to this.

As a subject leader you are responsible for quality-assuring the work of the department. As a personal reflection on this feature of your role you may reflect on the extent to which:

- the unit plan made lesson planning simpler;
- the lessons were better sequenced;
- the learning was developed in a more coherent way;
- teachers and pupils had a better sense of how the mathematics was developing and connecting through the key processes.

If colleagues also see the benefits to teaching and learning, then you are better placed to establish collaborative unit planning on a regular basis, perhaps each half-term. You will need to decide how the plan–teach–review cycle can be used more broadly to make improvements to other units of work, in the same or in a different strand. Key factors in determining which topics or units in your scheme of work are most in need of development will be the engagement and progress of pupils. Your judgements will be guided by analysis of pupils' performance, as well as the views of colleagues and of pupils themselves.

Crucial topics are often those for which a fresh approach seems desirable. If you have achieved some success, perhaps using one or more rich tasks to engage pupils more actively, or to improve their understanding or ability to apply their skills and knowledge, then you may want to extend and develop this approach. This could lead to planning a sequence of related units on a particular strand or topic, either within a year group or across two or more years.

Over time, aspects to consider include:

- the big ideas and interconnections in mathematics and those concepts that are more difficult to teach;
- units that focus on particular mathematical processes and units that focus on the whole cycle of key processes, sometimes without new content;
- applications of mathematics to other subjects and beyond the school, which will develop pupils' functional skills.

As you develop more units, you may wish to use a greater variety of unit structures. To stimulate your thoughts about this, a few alternatives are summarised on the next page in Figure 9: Building variety into unit structures.

**Figure 9: Building variety into unit structures**

<b>Challenge, prepare then solve</b>	
<b>Phase 1</b>	A problem is posed that involves techniques or strategies slightly beyond the present skills of the pupils. The pupils identify the stages of solution and the challenges that need to be resolved.
<b>Phase 2</b>	The pupils step back from the problem and learn some new skills that they know are required for the solution.
<b>Phase 3</b>	Pupils apply the new skills to solve the problem.
<b>Connecting old learning – moving on to new learning</b>	
<b>Phase 1</b>	Pupils are introduced to activities that link together existing learning in a new way, for example, linking similar triangles and gradients of lines.
<b>Phase 2</b>	Contexts or problems are posed that require pupils to apply the new connections, for example, gradients of lines, parallel lines.
<b>Phase 3</b>	Tasks or problems are set that help pupils to reflect on how the new learning connects to existing learning, for example, a concept map to connect ratio, similarity, linear graphs and linear equations.
<b>Prepare, consolidate and apply</b>	
<b>Phase 1</b>	Develop and improve knowledge and skills, for example, visualisation, geometrical properties and ways of setting out simple proofs.
<b>Phase 2</b>	Apply skills to a variety of problems, for example, in geometrical contexts.
<b>Mathematical modelling</b>	
Pupils are supported to establish assumptions so that they can set up and evaluate a mathematical model for a given context.	
<b>Phase 1</b>	Building the skills – pay explicit attention to the skills involved in representing. A simple example from another context is used to establish what building a model means. Pupils then suggest some assumptions as a basis for their own model.
<b>Phase 2</b>	Applying the skills – explore one feature of an established model for a similar context and consider whether it is useful to their design. Design a model and then critique the models developed by other groups.
<b>Phase 3</b>	Reflecting on the skills – consider how these skills might be transferred to other contexts.
<b>Researching a solution</b>	
<b>Phase 1</b>	A task is set so that pupils work independently to represent a situation, using mathematics, for example, which mobile phone to choose.
<b>Phase 2</b>	Pupils collect and analyse the necessary information.
<b>Phase 3</b>	Pupils interpret and communicate their findings; they then critique others' solutions.



# Acknowledgement

The Harmonic Triangle resource ([http://nrich.maths.org/public/viewer.php?obj\\_id=4716](http://nrich.maths.org/public/viewer.php?obj_id=4716)) is taken from NRICH (<http://nrich.maths.org>) © University of Cambridge. Used with kind permission.





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