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GCSE (9–1) and A LEVEL

SCIENCE

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Moving from modular to linear qualifications

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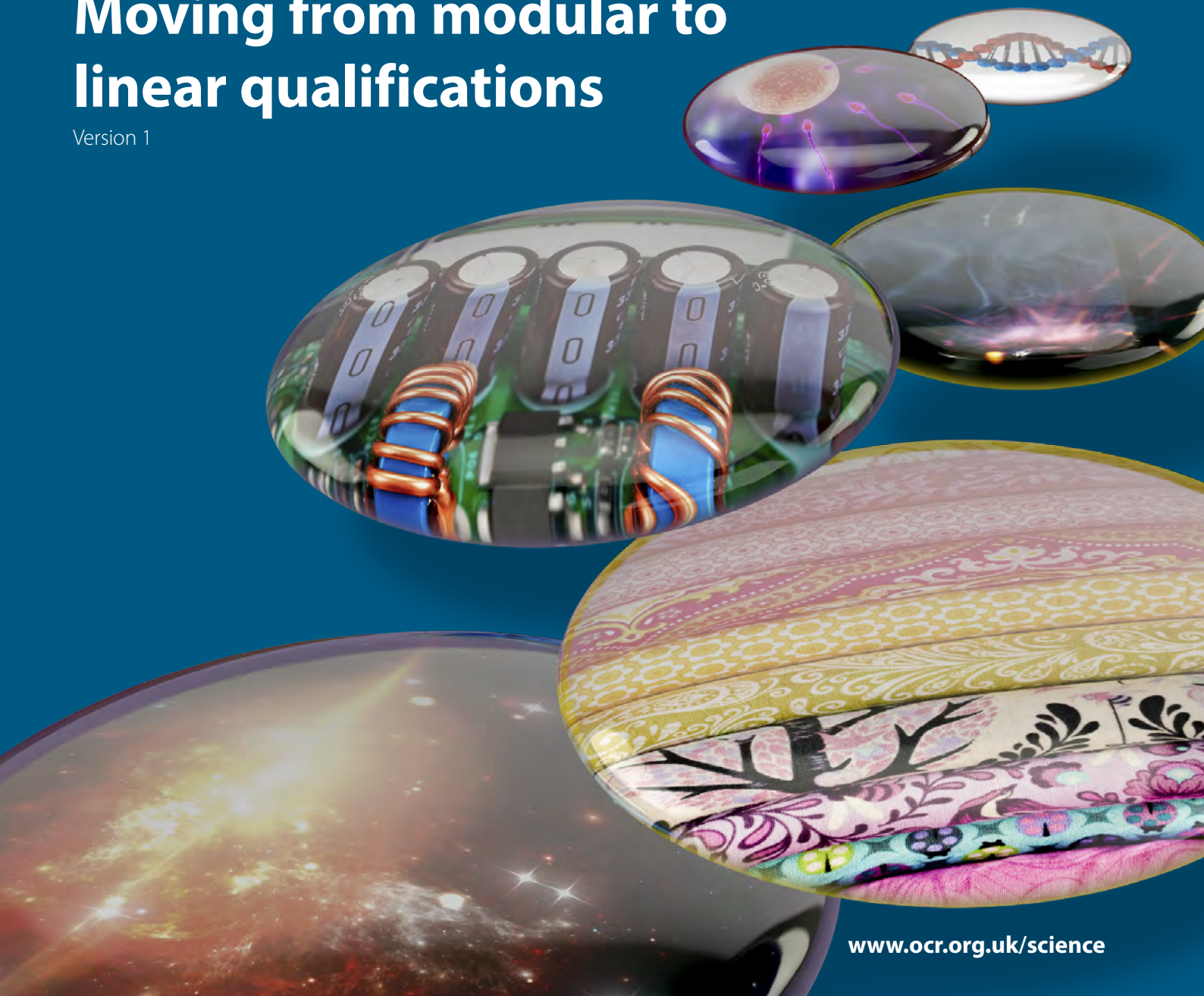

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MOVING FROM MODULAR TO LINEAR QUALIFICATIONS

In transitioning to the newly reformed GCSEs and A levels for first teaching from 2015 onwards, as well as getting to grips with new specifications and sometimes new subject knowledge, there is also an impact on the way knowledge development and assessment opportunities are structured. The structure of all new GCSEs, AS and A levels is moving from a modular towards a linear course structure. The linear approach means that learners take all exams at the end of the course, which gives more time for teaching and learning.

We have produced this guide to support teachers who are moving from modular to linear qualifications. It is particularly aimed at teachers who teach GCSE and A Level. Following reforms announced by the UK government, both these qualifications are moving from a modular (or unitised) structure to a linear structure.

The trend towards linear qualifications is an exciting development for teachers and learners. Linear qualifications give teachers more freedom to plan the course and set the pace of study. This guide is designed to highlight things you will need to think about when moving from a modular course to a linear one, and suggests ways forward in planning, teaching and learning, and assessment.

MODULAR AND LINEAR COURSES: WHAT ARE THE DIFFERENCES?

Organisation of content, concepts and skills

Modular	Linear
Content is divided into a number of self-contained units.	Content is viewed as a whole – there is a more holistic approach.
Content units have well-defined and precise boundaries.	Content will usually be divided into different sections but these will not be totally self-contained.
Content is divided into a number of bite-sized chunks with no links between different topics.	Links between content are emphasised and encouraged.
In many subjects, each unit focuses on a limited range of concepts and skills.	The key concepts and skills usually underpin the entire course.

Exams and resits

Modular	Linear
Learners can be examined on individual units during the course, in both in the first and second years of a two-year course, or even across a three year programme of study. Therefore, a learner could sit exams in different units on 3 different occasions.	Learners sit all the exams at the end of the course. (If there is coursework, it may be completed during the course but will not be externally assessed or moderated until the end of the course.)
Each unit exam tests only the content, concepts and skills in one unit.	All components of the specification are assessed at the end of the course. So each exam paper is likely to test a range of concepts and skills, and questions are likely to link topics from different parts of the course.
Some synoptic assessment is included, usually in a unit in the second year of the course. This is designed to help learners develop a holistic understanding of the subject, and retain content covered in the early units. Learners can resit individual units and many learners do this while they are completing later units. They are usually awarded the better mark achieved in the two sittings of that unit.	The synoptic element happens naturally because the key concepts and skills underpin the entire course. Learners cannot sit parts of the assessment during the course of their programme of study. However, they can resit the assessment in its entirety at a later date (and in some specific instances may be able to resit individual components).

IMPACT ON TEACHING AND LEARNING

Modular specifications

With modular specifications you had to make fewer decisions about the order to teach units and how much time to spend on each one. Modular specifications often provided a clear framework. The topics, concepts and skills for each unit were clearly defined and had to be covered by the time of the unit exams. This means that teaching and learning focussed on just one part of the course at a time. Thus what to teach, and when to teach it, was clear.

Some learners found the short-term goals set by modular examinations manageable and motivating. They only had to cope with a limited number of topics, concepts and skills at any one time. Knowing that there was always an exam not far away encouraged them to work hard and not let things drift.

Linear specifications

With linear specifications, you have greater freedom to plan the two-year course. You can choose the order of topics and set a pace of study that is appropriate for your learners. There is more teaching time available for a linear specification, because less time is taken up preparing for and taking externally set and marked examinations.

A linear specification also allows more time for learners to internalise and practise concepts, and build up their skills, before their external examinations. Research has found that many learners reach a higher standard at the end of a linear course than if they had studied a modular course.

Linear courses also encourage learners to refer to, and build on, knowledge that they have acquired early in the course, so that they arrive at the examination period with a much more holistic view of their subject. Modular courses, on the other hand, can make it more difficult for them to acquire a coherent picture of their subject, instead perceiving it as a series of disconnected fragments.

Many teachers say that, when teaching a linear specification, they notice a distinct change at some point during the course – often during the second term of the second year – when most learners seem to begin to see the subject holistically. This can be an exciting time for both learners and teachers.

It marks a moment when many learners take a significant step forwards in their understanding of the subject, and develop a much deeper appreciation of how various concepts link together. Their intrinsic abilities can show a dramatic improvement during this period. They begin to write much more perceptive answers to questions. They may find it easier to remember facts, because these are now seen as fitting neatly into an overall picture of the subject.

Linear specifications also bring coherence to assessment. The content, concepts and skills in the exam papers do not have to be isolated from each other, and learners may be able, where appropriate, to transfer knowledge, understanding and skills across these papers.

Key Benefits

The removal of modular exams has a significant impact on teaching and learning:

- teaching is not constantly interrupted by assessments at the end of short modules
- knowledge, understanding and skills can be developed over a longer period of time
- key concepts and skills can be taught and revisited throughout the course, and links made between topics, leading to deeper learning
- there is time to innovate and explore those interesting side-roads that are adjacent, but not necessarily central, to the specification content
- without constant pressure from modular exams, weaker learners are given time to develop and stronger learners can read around the subject, pursue their individual interests and develop their skills as independent learners. This increases learners' motivation and leads to deeper thinkers.

PLANNING AND TEACHING A LINEAR SPECIFICATION

Many teachers welcome this shift as an opportunity to take back control of teaching and learning. It allows you to use, and improve, your professional skills. Linear specifications also require that a more holistic approach is taken to course planning. The course needs to be thought about and planned as a whole. The relationship between different topics, regular revisiting of concepts and skills, and opportunities for formative assessment all need to be considered and planned.

Content

Planning content coverage for a linear specification is more complex than planning for a modular specification. With the modular approach, the unit content need not be revisited once the unit examination is taken. The planning for a linear specification needs to be more holistic. Because all the examinations are at the end of the course, no topic can be forgotten about at any stage of the course. In simple terms:

think about the best order to teach topics

include opportunities for revisiting topics

allow time for revision.

Linear specifications provide greater opportunities for all of these activities because less time is spent on preparing for and taking unit examinations. More time is available for more careful and thorough coverage of the course, and for encouraging deeper, and more joined-up, learning and thinking.

Sequence of topics

There are generally many different ways that the teaching of a subject could be organised. Although many teachers will decide to follow the sequence of content as it is set out in the specification, there is no need to do this. It is important to consider progression, so that 'easier' topics are covered earlier in the course, and 'more difficult' ones dealt with later. Topics that include knowledge and concepts that will be used in other topics should come early in the course. Many teachers find that they do not always get the order and timing exactly right when teaching a linear specification at first. Adjustments may need to be made during the course. After completing the course for the first time it is always a good idea to evaluate the order and timing and make necessary changes for subsequent cohorts. We make sure that plenty of support is available for OCR teachers during this process. There are usually opportunities to discuss planning with trainers and other OCR teachers at our training events, during webinars, at teacher networks, and on the subject-specific discussion forums online. We provide delivery guides, as well as having the Schemes of Work Builder tool available on our website for our GCSE, AS and A Level subjects that offer guidance on planning and sequencing of topics.

Concepts and skills

There are often key concepts and skills that underpin the entire linear specification. There will also be concepts and skills that are closely related to a particular topic and also relevant to other parts of the specification. Even when a concept or skill is related to only one topic, learners should be given opportunities to revisit it to enhance their understanding.

Careful thought needs to be given to the development of learners' understanding and skills across the two years. This is very different from planning for a modular specification where a particular skill or concept might be restricted to one unit. In a linear specification, the whole range of learners' skills and understanding need to be developed throughout the course. This might involve covering a particular skill when teaching a part of the content where that skill will not be assessed in the exam. For example, in a history exam, learners might not be required to analyse historical sources in questions about the period 1919 to 1939, but this skill should still be developed during the teaching of that topic. Otherwise, learners could go for months without any further development of the skill. Learners make progress in understanding and skills by being able to revisit them regularly and by having a reasonably long period of time to make progress. Linear specifications give learners two years to learn and develop and the entire two years should be used.

Helping learners to see the subject as a whole

In a linear specification, where all the content will be assessed at the end of the course, teaching and learning need to ensure that content covered early in the course remains in each learner's mind right up to the final examination period. There are several tactics that can help with this.

For example:

- You should constantly encourage learners to make links between the area of the subject that they are currently learning about, and topics covered earlier. This can be done in various ways, such as by oral questioning in class that starts from the current topic and leads learners back to earlier ones; or by setting tasks that ask learners to draw together ideas from past and current topics. This not only keeps earlier topics 'alive' in learners' minds, but also helps them to begin to see the subject as a whole.
- Some teachers like to plan their scheme of work as a 'spiral', where a topic is covered at a fairly simple level early in the course, and then revisited and dealt with at a higher level later on.
- Interim tests can revisit earlier topics. These tests can be quite short – perhaps a 10-question quick quiz on a topic covered one or two terms ago – or longer, more formal written assessments.

Schemes of work

The format of schemes of work will vary from centre to centre and between subjects, but give a useful representation of the structure and timing of the intended sequence of teaching and learning. Suggested patterns of teaching and learning have been provided in the co-teaching guides for AS and A level and posted on the OCR community pages.

On-going assessment

Modular specifications give learners short-term goals and regular feedback through the summative results of unit examinations. Linear assessment provides opportunities for longer-term development of understanding and skills without the distractions of unit examinations and the accompanying retakes, but progress needs to be monitored through regular formative assessment.

You can build opportunities for periodic assessment into the scheme of work, including:

- formal tests similar to the final examination papers
- diagnostic tests focussed on specific knowledge or understanding
- exercises focused on part of the content or a particular concept or skill
- contributions to group work or class debate
- ongoing Assessment for Learning giving formative feedback to students

You can create opportunities for peer and self-assessment. These assessments identify progress, areas of strength and areas that need development for a whole class or, more often, for individual learners. You can use them to inform future teaching and learning. They are also useful for identifying areas that need a special focus during later revision and they provide useful evidence for reports to parents and construction of profiles for individual learners.

Revisiting

Linear specifications also make revisiting topics possible. Learners' understanding of a topic is often improved enormously when they are given the opportunity to revisit that topic. This can be achieved in several ways:

- by approaching the topic through different issues and questions from those used when it was first covered
- by exploring its links with other topics in the specification
- by exploring it at a higher conceptual level.

Revisiting is especially important for topics covered in the first year of the course. Learners' level of understanding of a topic will often be fixed at the level they were operating at when they covered that topic. Once their conceptual understanding has developed, it is likely that a 'revisit' to a topic later in the course will develop a more sophisticated grasp of the topic. Additionally, given the synoptic nature of the terminal assessment, revisiting is essential in order to help learners make links between the different topics they cover in the linear course.

PREPARING FOR THE EXAMINATIONS

All OCR specifications outline the course content, and contain assessment objectives and the forms of assessment so you can see how the exams are structured. The specifications for each subject can be found on our website at www.ocr.org.uk

Revision

Taking all the examinations at the end of the course means that learners spend less time being formally assessed. It also means that time needs to be left towards the end of the course for revision.

Revision has a different purpose from 'revisiting'. Revisiting is for deepening and extending learners' knowledge and understanding. Revision is more about consolidating what learners already know and understand, and helping them to use this to fulfil the requirements of exams.

It is important that learners revise by applying their knowledge and understanding to exam questions rather than just trying to memorise their notes. The greatest weakness of learners' exam answers is often not their lack of knowledge, but their failure to use it relevantly. Learners should also become thoroughly familiar with the layout and organisation of the exam papers to minimise the danger of misinterpreting the instructions given in the question, such as answering both questions in an 'either…or' section. They should also be clear about the different types of questions that appear and the different requirements of these questions.

Learners should also be aware that assessment in linear specifications tends to be more holistic than in modular assessment. This means that they have to be ready to make links between different parts of the specification and to use their understanding and skills across a range of contexts.

Interim assessment

It is important that learners are given the experience of 'mock exams' – taking all, or nearly all the exam papers, in surroundings as close to the real exams as possible – at least in 'exam conditions'. In addition to the sample assessment material provided before the start of first teaching of new specifications, OCR also provides practice papers for many components – these can be found on Interchange, in the Past Paper section.

Past papers and examiner reports

Past papers, mark schemes and examiner reports are available on our website and the most recent papers are available on Interchange. These are very useful for mock exams, interim assessment and for obtaining detailed information on how an exam was marked, and how learners tended to perform on each question. Often the examiner will comment on how well learners coped with a question or will point out common errors.

Example candidate responses

Example candidate responses are available for most OCR AS and A Level subjects on the relevant subject pages. They contain examples of exam questions and candidates' answers at different levels of performance. They also include a commentary from an examiner on why an answer achieved the number of marks or band awarded. You can use the example candidate responses to help you guide your learners in how to write good answers in response to particular types of examination questions.

Read more about the opportunities and pitfalls in using past papers as your own Periodic Assessments in a blog from Neil Wade, one of OCR's Subject Specialists: http://www.cambridgeassessment.org.uk/insights/are-past-paper-questions-always-useful-neil-wade/

SCIENCES

LINEARITY IN SCIENCE

The new OCR suites of A-level and GCSE sciences are all fully linear, with assessment of understanding and knowledge across the whole specification in the exams at the end of the course. All the science qualifications have at least one paper that explicitly assesses across the whole subject within the specification, with the possibility for synopticity throughout all papers, including those where content is split (e.g. Paper 1 and 2 in the A-level A specifications).

The sciences are full of unfamiliar and complex ideas that can be hard to understand and learn. Students' learning can be limited by their cognitive processes, including the capacity of their short-term memory, their ability to decode what is being taught and their ability to link this with their current conceptual understanding. All of this makes pedagogical content knowledge, i.e. the knowledge and skills of teaching specific subject content, a key part of effective teaching. CPD courses focussing specifically on this area of teaching are available from, for example, the Royal Society of Biology, Royal Society of Chemistry and Institute of Physics. OCR also produces Delivery Guides for each qualification that provide support to teachers, and are available on each qualification page.

The science specifications remain subdivided into topic areas, which are in themselves not necessarily synoptic. Initial teaching and learning may involve dealing with the topics in isolation, or within defined limits, before being used in conjunction with material from other topics, in unfamiliar contexts or in problem solving. The application of knowledge in unfamiliar contexts and methods of approach to problem solving may be identified and taught explicitly later in the course. This should help students tackle these types of questions in their assessments.

Case study 1, A level sciences

Our centre has made the decision not to enter students for the AS exams, which gives us teaching time all the way through to the A-level exams in Year 13. Our aim is to teach the content of the specification by February half-term of the Upper Sixth. For the next half term we will concentrate on techniques for answering A-level questions, particularly those which have a synoptic content, before moving on to general revision from Easter to the exams. Our staff are sufficiently experienced to remember linear exams when they were previously used, particularly the idea that many students do not develop the full A-level competence or understanding until the middle of the Upper Sixth (Year 13). Our strategy allows us to help students to build their knowledge while delivering all the content, before building up to the more detailed open ended questions.

Ideas for teaching and learning

The methods used to present new information can influence how easily it is learnt. For example, by using both auditory channels (talking about the ideas) and visual channels (written words and pictorial representations), students are engaging with the ideas through two learning pathways. Practical work and modelling activities can then additionally engage students kinaesthetically, helping embed the ideas more fully. Alongside expert explanations from the teacher, students can then engage with the resources individually, then in pairs/small groups and finally as a whole class, talking over their emerging understanding of the ideas, co-constructing their knowledge. Prior familiarisation with new ideas through flipped learning can also help.

Case study 2, A level sciences

We have made great effort to incorporate the practical activities for the Practical Endorsement into our scheme of work. The college is also very keen to encourage independent study using flipped learning, or at least ideas based on that concept. Students are told in advance the activities which they will be working on for the next week and are expected to research these, being ready to contribute ideas to class discussion before moving on to carry out the practical activities. The motivation and understanding of the more able students has significantly improved, including their breadth of knowledge around the subject. As might be expected, there are groups of students who are less motivated, which can be a disadvantage for them as they are less prepared for practical activities. The gap between those who have engaged and those who have not appears more distinct, but hopefully this is increased capability of the more able, rather than a decrease in those who are not engaged.

Integrating new ideas into current understanding

For new ideas to be retained and added to students' understanding of the subject, it is important for the ideas to be embedded in wider concepts (e.g. energy, forces, genetics). Ideas learnt in isolation can lead to weaker overall understanding and a limited ability to apply ideas to new situations. For example, many students will happily learn the law of conservation of mass, but then be unable to rationalise the 'loss' of mass in combustion reactions. The sciences have a wide range of abstract concepts that have to be tackled, and the relevance and links between these and the 'real' (macroscopic) world make the subjects challenging. Using real examples and representations can help to form bridges between the abstract and the concrete. Modelling and practical work are particularly powerful in this respect. For example, the ideas surrounding equilibrium can become more understandable when alternating addition of hydrochloric acid and water to a cobalt(II) ion solution leads to observable and explicable colour changes.

Once ideas have been understood sufficiently to have a hold in our memory, making links with existing personal knowledge and experience starts the process of embedding the understanding for the long term. Questioning can be central to this process as it helps expose both how the ideas have been learnt and how they have been linked with prior knowledge. Questioning can range from simple closed recall questions through to complex open-ended problems requiring use of the new knowledge to evaluate novel situations. Past-paper questions are commonly used, allowing many different forms of assessment – including self and peer assessment against mark schemes, and teacher assessment to allow formative feedback and dialogue, focusing on the processes the learners have used to answer the questions. Using expert modelling of how to answer the questions, both in the form of worked examples and by working through questions with the learners, can be very powerful in improving learning. Alternating between teacher-completion and student-completion of questions helps to reinforce these processes. As confidence and competence increases, scaffolding support in answering the questions can be reduced.

Case study 3, GCSE (9–1) Sciences

We, like many centres, enter students for all of their Science GCSE examinations at the end of year 11. The result of this is that qualifications that were designed to be modular were treated in a more linear manner. Therefore these new linear Science GCSE courses with exams only available at the end of the course, are an improvement on the current situation. Our students will be able to consider scientific concepts more holistically and can make connections between topics and ideas. We have the freedom to teach the content in whatever order we choose, and to plan our Scheme of Work and rearrange the specification statements to suit our own style and preference. However, this also means that we have to consider how to prepare students for the vast amount of knowledge required for the Science qualifications, including students gaining and using the specific terminology that is vital to their success in the exams. We will obviously include regular formative assessment as part of our assessment policy. The end of topic quizzes provided by OCR will be useful in testing their knowledge of each topic and give us summative results for tracking. We will have to build in guidance and support on using that knowledge to solve problems and answer the more synoptic questions, such as those in the Specimen Assessment Materials. The practical work embedded in all the specifications can be used as a tool to teach students broadly and deeply, and we already do more than the minimum listed as a matter of course.

Remembering new ideas

When ideas have been well understood and can be used effectively in a variety of contexts, the challenge becomes maintaining that understanding over the long term. As with many other skills, without practice, levels of understanding will drop over time. Review and practice then becomes important in ensuring long-term and reliable competence. Explicit summative assessment and practice points can be scheduled at increasing lengths of time from the initial learning – for example after 1 week, 2 weeks, 1 month and 3 months and 6 months. The assessment and practice clearly doesn't need to be as intense as during the initial learning period, and can fit nicely within start of lesson activities when new concepts related to the practiced ideas are being introduced. For example, a multiple-choice questions quiz followed by a more in-depth question to be solved in small groups. Careful thought and planning will be required to make this effective, and will undoubtedly improve year-on-year as the new courses bed-in to your centre. The Learning Scientists group have great articles on this type of spacing out, along with a range of case studies from different subjects.

The Learning Scientists have also released a set of "Learn to Study using..." posters which would be a valuable addition to all classrooms and staff rooms.

Revision, context and synopticity

Revision of key ideas and ensuring a synoptic understanding can be aided by use of interesting contexts – science is helpfully full of these. For example, consideration of the relatively simple substance ethanoic acid allows discussion of a broad range of chemistry, linking the key stands of organic, physical and inorganic together. For example, ethanoic acid takes part in many organic reactions, in addition to reaction with carbonates, oxides, metals etc. It is a weak acid allowing discussion of equilibrium, hydrogen-bonding and pH. As a pure chemical substance, we can consider molar mass, molecular, empirical and structural formulae, as well as pi and sigma bonding. Stimulus material is widely available on the internet, including the Molecule of the Month and Compound Interest websites.

Use of scientific review articles in teaching can also aid synoptic understanding along with scientific literacy. This is assessed explicitly in some specifications, for example the Salters Chemistry A-Level Paper 2, which uses an Advance Notice Article. Similarly the articles for Physics B (Advancing Physics) provide interesting stimulus material relevant to both A-level specifications, from which a wide range of physics topics can be identified for revision. At the end of the identification and review process, the written questions, or a selection from them, can be answered by the students.

Sources of review articles include the Biological Science, Chemistry and Physics Review Magazines published by Hodder Education. Other institutions provide similar articles such as the RSC Mole magazines. Such articles are generally 2-4 pages long, cover a range of scientific concepts and contexts, taking the student beyond the specification and explicitly linking concepts together.

Further reading

A general discussion on good quality planning.

Research on effective teaching and how textbooks support this.

Considerations from Bishop Wordsworth's School on moving to linear A-levels.

A Level reform guidance from the Association of Colleges.

Support from OCR

OCR has produced a variety of freely available resources all the science specifications at http://www.ocr.org.uk/science. Along with the Specification, Delivery Guides and lesson planning support, resources include Topic Exploration Pack (looking in depth at particular topics), topic quizzes and secure practice papers for use as mocks and end-of-year exams.

For further information and support, please contact the OCR Science Team at science@ocr.org.uk, 01223 553998 or @ocr_science.

www.ocr.org.uk

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