

In 2006, the GCSE science curriculum received a big shake up.

Siân Harris investigates Single, Double and Triple Science, along with International GCSEs, examining what the diverse options mean for schools.

spoilt for choice



IOP, BRISTOL CHEM LABS

Science
teaching –
exciting stuff!

'We probably owe it to pupils to offer the widest range of options possible. Some will want to do more science just as some will want to do more languages or hairdressing.'

Mark Ellis, Triple Science Support programme, LSN

IN THE days of the old O Levels and GCEs, school pupils generally chose just one or two science subjects. Their choices were strongly biased by gender too; physics was favoured by boys while girls tended to opt for biology. When GCSEs were introduced in the mid-1980s, there was a move towards a more 'broad and balanced' science curriculum. The National Curriculum, when it came in a few years later, took this aim further by requiring all pupils to do some components of physics, chemistry and biology until the age of 16.

This goal came with a challenge though: in the O Level model, 10 per cent of curriculum time was allocated to each subject. If every pupil did the three sciences separately that would occupy 30 per cent of their time, which, along with the demands of other compulsory subjects, would leave very little time to study anything else.

The solution was the idea of Single or Double Science options, taking 10 or 20 per cent of the curriculum time respectively. The idea was that this would give all students grounding in all the sciences without restricting their other GCSE options too much.

This approach received widespread acceptance throughout the state education sector. But there was a fly in the ointment: schools did not have to switch to the combined science options, and the exam boards continued to offer separate science GCSEs. As a consequence, many independent schools, which are outside the National Curriculum and were therefore not obliged to teach all three sciences to all pupils, continued to offer separate GCSEs in physics, chemistry and biology.

In 2006, three decades on from the start of the first GCSE courses, the 14-16 curriculum received a major overhaul. The Single and Double Science options have remained, evolving into two new GCSEs: core and additional science. However, the separate sciences are now a key part of the GCSE plan again too,



Visits to Bristol ChemLabs, at the University of Bristol...

as 'Triple Science GCSEs'.

This is not simply a recognition that some schools still offer these courses; rather it is a shift in emphasis. It is now a non-statutory entitlement that all Key Stage Four pupils that attained Level 6 or above in Key Stage 3 science have the option to do Triple Science GCSEs. And in February 2009 Prime Minister Gordon Brown announced a national ambition that, within five years, Triple Science GCSEs would be offered in 90 per cent of schools. Since 2007, the government has also contracted the charity LSN to run a Triple Science Support Programme to support this change.

PERSONALISED SCIENCE

Much of the new approach to GCSEs stems from the idea of personalisation and choice. "We probably owe it to pupils to offer the widest range of options possible. Some will want to do more science just as some will want to do more languages or hairdressing," observes Mark

Ellis, programme manager for the Triple Science Support programme at LSN.

The core science GCSE aims to provide the scientific knowledge that citizens should know to understand, for example, their electricity bill or news reports about scientific studies. As Charles Tracy, head of education, pre-19 for the Institute of Physics (IOP), explains: "The hope is that anyone hearing a news story about a new nuclear power station or the results of clinical trials would be able to understand the story and the way that scientists arrived at their conclusions."

The additional science GCSE modules add in the key ideas and theories needed for people to take science further. Triple Science then adds approximately a third more content in each of the three sciences.

TAKING IT FURTHER

One of the goals of promoting Triple Science GCSEs is to raise numbers carrying on with the

sciences to A Level and beyond. However, the requirement for studying any of the science A Levels is to have done Double Science, not necessarily the individual GCSE in that science.

So do Triple Science GCSEs offer any advantages in preparing for science A Levels? IOP's Tracy believes that the answer is not straightforward. "Pupils have more time for the individual sciences so they are presumably more likely to pick physics, for example, and if Triple Science GCSEs are encouraging progression to science A levels that's what we like to see," he points out. "However, the AS and A level courses are based on the assumption that people have done core and additional so there is no reason why it should be harder."

Tracy strongly believes that Double Science should remain a recognised route to A level. "Pupils shouldn't have to make a decision about their future direction at 14. It's right that ▶

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What's more, some schools do not do Triple Science GCSEs so it is important that pupils at such schools are still able to opt for science A levels.

Nonetheless, many teachers feel that having the extra science in Triple Science GCSE gives pupils more confidence and interest in science if they are carrying it on to A level.

"We have a large number of students joining from other schools into our sixth form and many have done double science," commented Tony Baker, head of physics and former head of science at Chesham High School, a grammar school in Buckinghamshire. "The intention is that double science is the basis for A level, and some do very well. However, the extra practice in the triple option is helpful."

THE TIMETABLE CHALLENGE

Offering Triple Science poses a range of challenges. One of these is timetabling. To do Triple Science in three option blocks would require 30 per cent of pupils' time, but this restricts their other options so some schools opt to teach it in less curriculum time.

"An issue that often comes up is that Triple Science is taught in 20 per cent of the time so teachers don't have time to really teach it. This has a potential impact on the grades," observes Tracy of IOP.

"Doing it in the time for two GCSEs is not my preferred solution," adds Ellis of LSN. "However, it depends on the ability of the students and the skill of the teachers. If they manage their time brilliantly, it can work."

One way around the shortage of time is to do some of the extra

work for Triple Science outside of the GCSE curriculum time, either by starting the work in year nine or by using after-school or lunchtime sessions.

"All students routinely take the three separate sciences. They do these in 20 per cent curriculum time. This is quite a squeeze. We reduce the pressure by starting the courses in year nine," says Tony Baker of grammar school Chesham High School.

"Most of the students really thrive on taking the Triple Science course because of the challenge in the extension work. If we find that students are really struggling with all three sciences, we 'roll back' to double in year 11; about five did this last year."

There is a similar approach to teaching Triple Science at Howard of Effingham School, a specialist science college in Surrey. As Andy Laver, director

of science at the school explains, following streaming in year nine, around two-thirds of the students start on the Triple Science course. They are then reassessed in year 10 and those that are struggling – usually about a quarter of those that start the course – switch to the Double Science option so that they can go at a slower pace.

The remaining third of the students in each year group, those who achieved level 5 or below in Key Stage Three, do the OCR Science National qualification but they all spend 20 per cent of their time doing science.

In Bedminster Down School, a specialist technology college in Bristol, everybody does the core science GCSE and they can then take the additional science GCSE or a BTEC in science as part of their options. According to Claire Hobbs, line manager for science at the school, Double Science GCSE is a very popular

... allows school pupils to gain first hand experience of university chemistry...



option. The school also offers Triple Science to its top science set, about 20-30 pupils per year, within two option blocks. For these pupils, the core curriculum is condensed and they have extra teaching during lunchtime sessions. This approach comes with the obvious challenge of the willingness of staff to give up lunchtimes, but Hobbs believes that it helps to ensure that the right pupils take the different courses. "It is very complicated for the head of science to keep track of it all, but when they are on the right pathway pupils thrive," she says.

In Clifton High School, an independent school in Bristol, the three sciences are taught separately, regardless of which GCSE options pupils take. Most take either Double or Triple Science in their options and about half choose to do the Triple Science course. "We try to avoid them just doing core science," says head of science Sue Archer. "We like them to do Triple Science and they choose it as an option so they have the time to do it. We have had to fight a bit for the curriculum time for this."

HELPFUL PARTNERSHIPS

Timetabling and meeting the varying needs and interests of different pupils are not the only challenges either. Lack of specialist teachers can also be a concern for schools as they try to meet the new non-statutory entitlements for GCSE science.

The Triple Science Support Programme has been investigating some ways to help with this. One way is through its coaching programme to help teachers with the additional work for Triple Science GCSEs and to help them coach their colleagues. "If you are the only physics teacher in a department, you will be doing coaching anyway," Ellis of LSN observes.

Partnerships can also help. These might be off the back of successful partnerships set up to offer the new diplomas. They could be based around specialist science schools, which have a

... and the chance to do experiments that no school could offer



remit to support neighbouring schools as part of this status. Further education institutions could also help their partner schools. In some areas there are partnerships between state schools and independent schools or with local companies too.

Another group with a vested interest in helping secondary schools is higher education. One example that LSN is working closely with is the chemistry department at the University of Bristol. Bristol ChemLabS was set up in 2005 with the help of money from HEFCE to make use of the well-resourced teaching labs when they weren't being used by chemistry undergraduates. It employs an experienced chemistry teacher as a teaching fellow in the department, and school pupils regularly visit to gain first-hand experience of university chemistry and the chance to use equipment and do experiments that no school could offer.

"It makes the whole process between schools and university more joined up," explains teaching fellow Tim Harrison. Some school pupils travel from two hours away to spend a day at Bristol ChemLabS. It also

provides support for teachers and has a network of about 600 chemistry teachers across the south of England.

Bristol ChemLabS is also working with the LSN to create a festival for Key Stage Four science teachers, with lectures and practical demonstrations. "Some science teachers are being expected to teach other disciplines," Harrison points out. "If you are a biologist you will know what's going on with human cloning but might not be so well informed on the Large Hadron Collider, for example."

Such activities can help schools to offer the range of science GCSEs. However, there are some concerns about the courses themselves. Richard Pike, CEO of the Royal Society of Chemistry (RSC), has been involved in looking at how science GCSEs have been implemented since the 2006 reforms and he has concerns about a lack of regulation in the system.

"On paper, the way that science has been developing is good but the way that it has been implemented and the regulation of the overall process is weak," he comments. "The more choice and complexity you put into the

system with, for example, different modules and pieces of coursework, the more careful you have to be."

He explains that the specifications from the awarding bodies are sometimes not consistent with the criteria set by the QCDA, and sometimes the exams are not consistent with the specifications. He also says that latitude in the marking schemes means that scientifically-inaccurate answers are sometimes accepted.

He believes that there are still some issues to be addressed with the new core and additional science GCSEs. "In some cases, there are too many multiple choice questions. There have been some examples where papers have no mathematical basis. Some even have no science," he points out.

"The awarding bodies are competing against each other so they don't want to make it too hard," he observes. "We need much better regulation and transparency so public can see what they are getting."

This issue is a concern for Ofqual too. "The results of our monitoring of the new GCSE science specifications in 2007 ▶

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◀ and 2008 raised significant causes for concern," says the regulator in a statement on its website. As a result, Ofqual asked awarding bodies to improve the quality of questions in the exams, to stretch and challenge all students, tighten marking criteria and work to improve the quality of objective tests.

In addition, it asked the awarding bodies to reduce the number of options available to candidates where possible within the specifications.

INTERNATIONAL OPTIONS

Meanwhile, in the independent school sector the issue is complicated further. At the same time as GCSEs were launched, another qualification was born – the international GCSE, or IGCSE. Similar in character to the old O Levels, these qualifications were developed to satisfy schools in other countries, particularly within the Commonwealth, that wanted to offer a UK-style education but were not happy with the new GCSEs.

IGCSEs are not part of the National Curriculum so are not offered in British state schools. However, since the 2006 GCSE reforms, some schools in the independent sector have turned to these as an alternative.

Eton College in Windsor was one of the independent schools that switched to IGCSEs at that time. "We didn't feel that the new GCSEs would stretch our boys enough and we were getting fed up with prescribed coursework and practicals," explains Karl Frearson, head of science at the school.

"We felt that the new GCSE syllabuses had prescribed how science should be used. IGCSEs are very content-driven. We liked the idea that pupils learn the science and think for themselves more about its uses." He also believes that IGCSEs enable teachers to be more flexible, especially in practical work, and that they move away from the pressures of continual assessment. "If students are always asking what the criteria is to get a good mark, it takes

away some of the spark and excitement. We try to stop it seeming like we are only doing it to get a GCSE grade," he says.

Frearson has been very pleased by the response to IGCSEs in science. "We have more boys choosing sciences now; 70 per cent of pupils choose to do all three sciences," he says. "I think pupils enjoy the detail and are more engaged with it." He adds that, at the time of the switch to IGCSEs, the independent schools consulted with universities and he says that they were happy to accept these qualifications. The grades in IGCSEs are intended to be comparable to those in GCSEs.

However, there are some issues about some independent schools offering different qualifications from state schools. "I have a real concern about independent schools doing IGCSEs," comments Pike of the RSC. "It makes it no longer a level playing field."

The IGCSE option can have its own disadvantages too. Clifton High School in Bristol switched to IGCSEs for the separate sciences at the same time as many of its fellow independent schools. However, it has since reverted back to GCSEs.

"For me the decision was easy," explains head of science Sue Archer. "We are a small school and we had effectively split science by attempting to run the core and additional GCSE course for students not wanting to take separate science, but the IGCSE for the Triple Science."

Archer says that there were many positive aspects of IGCSEs. Firstly, she says, the course was excellent. "The IGCSE is, to my mind, definitely more academically rigorous. So far, our best students are not particularly challenged by the GCSE course and can't wait to move on to AS level." In addition, the text books are good, there is a huge amount of resources online, and IGCSEs are highly regarded.

However, running two very

different types of courses prevented students from switching if they realised they had made the wrong option choices. She also says that the IGCSE exams were hard to timetable. "Each student had nine exams and they mostly clashed with other subjects. Five IGCSE science students had to be supervised overnight as their exam hours ran over," she says.

Archer also had problems with lack of support and poor administration of the IGCSEs. In one instance, she was not alerted to a change in the specification, which meant that students could not prepare fully for their exams. "With the GCSEs we have contact with a subject advisor and the opportunity to meet other local teachers at standardisation meetings etc. With IGCSE I felt a bit isolated as a teacher," she says.

Another concern was standardisation in the marking. In the IGCSEs taken at this school, pupils with similar aptitudes in all three sciences ended up scoring more highly in biology than in chemistry and physics.

WHAT'S NEXT

This is not the end of the story for science GCSEs. Although the latest reforms have only recently come in, consultations have already started

for the next set of criteria, which will be implemented from 2011.

For Tracy of IOP it is too soon to make changes. "We haven't really seen enough of how the 2006 criteria are going yet," he argues. "The indications are that the 2006 criteria have been very successful. For example, there has been a 10 per cent increase in AS physics numbers. To make changes so soon would be ill advised."

Whether science GCSEs remain much as they are or undergo another major rethink, one thing is sure: there will be plenty of debate about their future for many years to come. ■

