

SHIFT LEARNING

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SCIENCE TIMETABLE MODELS RESEARCH

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EXECUTIVE SUMMARY

- Shift Learning were commissioned by the learned societies to conduct research to understand the variety of timetable models used by schools to teach the sciences at KS4. The research focused on schools based in England teaching GCSE. For the first stage of the research, an online quantitative survey was disseminated, generating responses from 513 schools. A follow up qualitative interview stage allowed us to explore timetable decision-making in more detail.
- In total, we identified 82 unique timetabling models used by schools surveyed. These models take into account the time allocated to combined science¹, triple science² and optional GCSEs³, as well as whether the teaching periods allocated to GCSE sciences is divisible by 3. Also taken into consideration is how many teachers are allocated to teach a class and whether teachers with disciplinary expertise are available.
- The models identified can be grouped based on similar characteristics. These common threads provide a better understanding of contextual circumstances and decision-making which is likely to foster particular models:


Combined and triple proportional

- A balanced share of resourcing, adequate teaching time and 3 disciplinary experts available across both routes offered. Survey results indicate no schools met all these criteria. 


Combined and triple under-resourced

- Both combined and triple science routes receive disproportionate resourcing. GCSE sciences are not given the equivalent teaching time they deserve in relation to open options. 


Triple science squeezed

- These models are particularly problematic for triple science teaching. Triple science is allocated less than 1.5 times teaching time than combined science. 


Combined science squeezed

- These models are particularly disadvantaging for combined science. Combined science is likely to be the first port of call for resource cuts, particularly for teacher (discipline) allocation. 

Combined science only

- Combined science is the only route offered. Staff shortages were common in these schools, leading to a deficit in disciplinary expertise and less than 3 teachers allocated to a class. 

Triple science only

- Schools offering only a triple science route are likely to consider themselves to be STEM focused. These models provide an equivalent share of teaching given to optional GCSEs. 

1. A combined award GCSE that was introduced in 2016; 2. Three separate GCSEs – biology, chemistry and physics; 3. Optional subjects outside of compulsory GCSEs, vary from school to school.

- The research has identified a wide range of GCSE science timetable models used by schools across England. A key finding is the high number of schools which are using models which can be deemed problematic. For example, the most common model used amongst our sample (1iiiAb) is characterised by an unbalanced or low share of teaching time available for combined and triple compared to optional GCSEs, as well as an unbalanced share between combined and triple science. This model also provides teachers without relevant disciplinary expertise, which suggests students may not be receiving the best teaching possible.
- Findings suggested that a majority of schools were offering teaching from teachers without specific subject expertise at the point of research, wherein...
 - 85% of schools offering only combined science route;
 - 45% of schools offering only triple science route;
 - 78% of schools offering both GCSE science routes...report that teachers are required to teach outside their disciplinary expertise.
- GCSE combined science in particular was commonly under resourced in regards to staff, with 38% of schools reporting that fewer than 3 teachers were allocated to a typical class. This route was thought to be less in need of disciplinary experts due to lower levels of content as well as the likelihood that students with lower prior attainment would be allocated to these classes. Triple science was likely to be prioritised in staffing decisions, including provision of more teachers, more discipline experts and more experienced teachers such as heads of department. These findings suggest that triple science students are likely to receive higher quality teaching, which may be disadvantaging combined science students.
- The availability of teaching time was also a common issue for a majority of our sample:
 - 57% of schools offering combined science do not offer 2 times or more teaching time allocated to optional GCSEs
 - 76% of schools offering triple science do not offer 3 times or more teaching time allocated to optional GCSEs
 - 76% of schools offering both routes do not offer 1.5 times or more teaching time to triple than combined
- Rationale for time allocation differences included a lack of time available within the timetable, a lack of science staff to teach more lessons, insufficient resources e.g. science labs to cater for more classes, as well as schools wanting students to take as many optional GCSEs as possible.

- Triple science classes were most likely to be disadvantaged in terms of time resources. Some schools did not offer this route as an optional subject, whereas other schools which allocated students on an attainment basis expected higher attaining students would be able to cope with more intensive learning. These conditions not only prevent students with lower prior attainment from accessing triple science, but also disadvantage students who are expected to study for triple science in an unsatisfactory and unequal time frame.
- The perception that triple science is more 'difficult' than combined science was thought to be common amongst students – as well as some teachers. While triple science covers more content than combined science, it is no more difficult. However, the research revealed that the conditions in which triple science is taught compared to combined science does in fact make it harder at some schools. Intensive time pressures can result in some students being expected to learn more content without the additional time allowances.
- The research has identified that it is common for both GCSE pathways to receive unbalanced teaching time. The majority of schools surveyed teach GCSE sciences across 3 years, whereas optional GCSEs are commonly taught across 2 years. Despite this, the sciences are still likely to receive less than the equivalent teaching time given to single award GCSEs.
- Our sample rated their combined science students' ability to differentiate between the disciplines a 5.7 out of 7. Differentiation was thought to be significantly clearer within triple science lessons. Clarity was linked to separate timetabling of the disciplines, availability of three teachers with disciplinary expertise and discipline specific job titles. The research identified convincing benefits of these conditions, including higher levels of engagement* amongst students, as well as encouraging KS5 progression as students were able to clearly identify what they enjoyed and possible career paths.
- Qualitative findings indicated that students were unlikely to be restricted in their choices to study A level sciences regardless of their GCSE science route. Those interviewed who were teaching at a school with a 6th form reported that their combined science students were able to progress to KS5 science, with the perquisite that they obtained required grades. Nonetheless, it was acknowledged that other further education institutions may place restrictions on this. This is problematic as some schools do not allow students a choice in which GCSE science route they take.
- Findings indicated that while data on attainment in science, maths and sometimes English were drawn on during student allocation to GCSE science routes, wider student data relating to widening participation was less likely to be taken into consideration. As decisions around allocation commonly included factors outside of student choice, such as a science assessments, this may lead to unintentional ethnic or gender skewing.

*By engagement, we are referring to increased understanding and interest.

BACKGROUND AND METHODOLOGY

The learned societies were seeking to understand the variety of timetable models used by schools to teach the sciences at KS4 in schools based in England. The learned societies were looking for a robust representation of how schools timetable the sciences at GCSE, as well as insight into the decision-making which leads to the adoption of particular timetable models.

- Shift Learning were commissioned to conduct this research by the learned societies, a group of scientific organisations comprising of: the Association of Science Education, the Institute of Physics, the Royal Society, the Royal Society of Biology and the Royal Society of Chemistry.
- Key aims of the research included:

a) To identify and describe the common models for timetabling the sciences at GCSE

b) To determine how many schools use each of these models

c) To find out how teachers are allocated within those timetable models

d) To investigate how common it is for schools to follow curriculum models that are potentially problematic in the sciences.



IOP Institute of Physics

THE
**ROYAL
SOCIETY**



It is known that schools in England use a wide variety of science timetable models at GCSE. Recent research has indicated that it is common for models to be problematic in a number of different ways. This can include both combined and triple science not being allocated equivalent teaching time to each other and other single GCSEs; lack of availability of 3 teachers with expertise in the relevant science disciplines; and *potentially skewed* decision-making on which routes students should take.

- In a recent survey, Tom Sherrington¹ found 40 curriculum models used by secondary schools. The science aspect of each of these models is not always completely distinct and there are certainly common threads. However, the survey identified that it was common for these models to be potentially problematic for the sciences. The research indicated that it is rare to find a curriculum model in which double award combined science is taught in two units of time and triple science is taught in three units of time (where a unit of time is the number of lessons allocated to a GCSE in the curriculum and will be approximately 10% of curriculum time). It is even rarer to find that to be the case and that the allocation can be divided by three. This research suggests that it is common that GCSE sciences are not given adequate teaching time, in relation to single GCSEs as well as across the science disciplines.
- It is also known that the individual disciplines within the sciences are not always taught by teachers with specific discipline expertise. This is likely to impact how identifiable the disciplines are to students. Research² has also suggested that teachers in schools with the lowest economic intake are twice as likely to teach completely outside of their disciplinary expertise, than those with wealthier intake. While this may suggest further disadvantages to low income students in regards to teaching quality, it is also likely to impact their engagement with disciplines and their interest in pursuing science post-16.
- Furthermore, recent research has advocated for a single GCSE route into the sciences. For example, SCORE³ propose that a single route would provide students with equitable access to the sciences and would remove decisions on pathways which could impact students' progression and post-16 choices. Dr Yeasmin Mortuza⁴ uses school case studies to describe some of the rationale behind GCSE science route allocation. The case studies indicate potentially problematic practices which limit students in their opportunities, and can even lead to unintended ethnic or gender skewing.
- This research therefore seeks to understand the variety of science models used by schools in England, and to ascertain how common it is for schools to follow curriculum models that are potentially problematic in the sciences. This research will feed into messages to policy makers to ensure all learners benefit from science teaching equally; that post-16 science uptake is maximized; and that uptake is representative of the diverse student population.

1. <https://teacherhead.com/2017/03/02/curriculum-models-2017-lets-share/>; 2. <https://schoolsweek.co.uk/research-2/>; 3. http://score-education.org/media/17187/des3620_score_sciences%20at%20ks4%20final.pdf; 4. <https://www.ase.org.uk/news/triple-science-equitable-or-elitist>

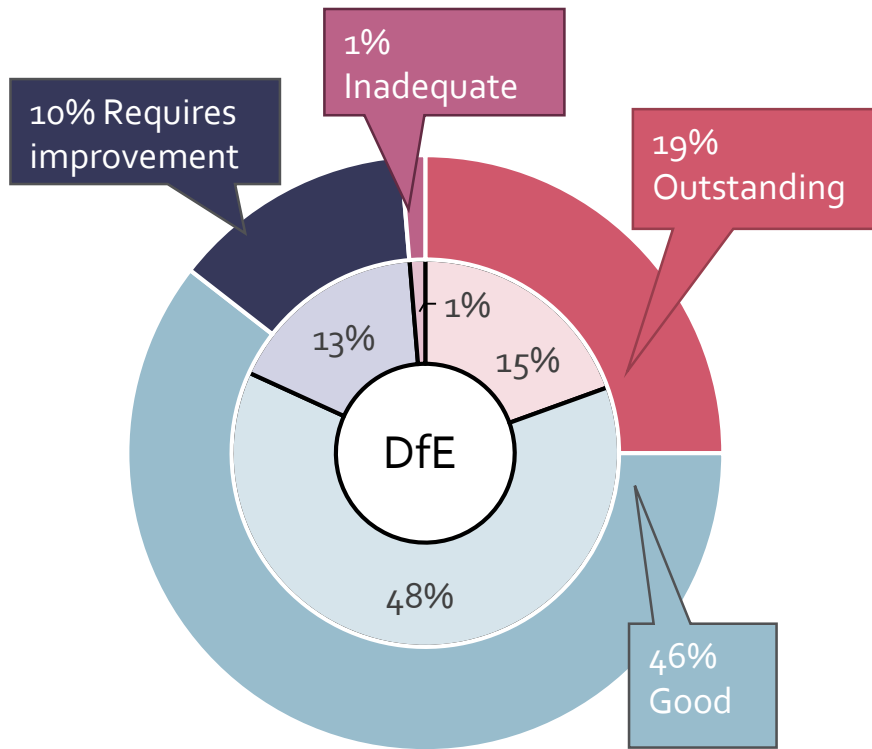
- Our research employed a multi-methodology approach. An online quantitative survey was developed in collaboration with the client which was sent via learned societies communication channels, as well as Shift Learning's research opt-ins database. The survey was targeted at roles who would have a strong understanding of KS4 science tabling (e.g., heads of department, teachers, SLT) who were working in secondary schools in England.
- Following initial data collection, we identified that state schools rated as 'Requires Improvement' and 'Serious Weaknesses' were underrepresented within our sample therefore these institutions were targeted through an additional data send via an external data supplier. Top-up CATI-style telephone interviews were also conducted, which were recruited via the DfE database.

Number of responses	Number of partials (insufficient responses)	Number of usable completes
561	242	513

- In total, we received 513 usable completes to the survey. During data processing, duplicates were removed from the dataset. If we received multiple submissions from 1 school, responses from the most senior staff member were used. Partial with high levels of missing data were not used.
- Current BESA data¹ indicates there are 24,281 schools in England, in which 3,408 of these are secondary institutions. Using these population figures, we are able to determine that our sample size of 513 schools gives us a confidence level of 95% and a margin of error of 3.99 which exceeds market research standards.
- Following the quantitative stage, we conducted 10 in-depth qualitative telephone interviews, each lasting 1 hour, with schools of interest. Contacts were identified using responses provided within the survey. Those chosen were using an array of common, as well as uncommon, timetabling models. This phase of the research helped to provide additional insight into the context and decision-making which had led to adoption of these models. A profile of these respondents can be found in the Appendices.

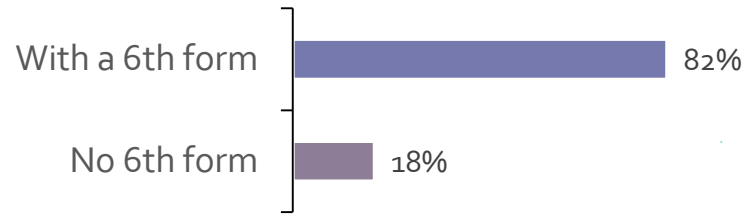
SAMPLE DEMOGRAPHICS

- Our sample (outer circle) closely matched the DfE database (inner circle) when looking at Ofsted ratings:



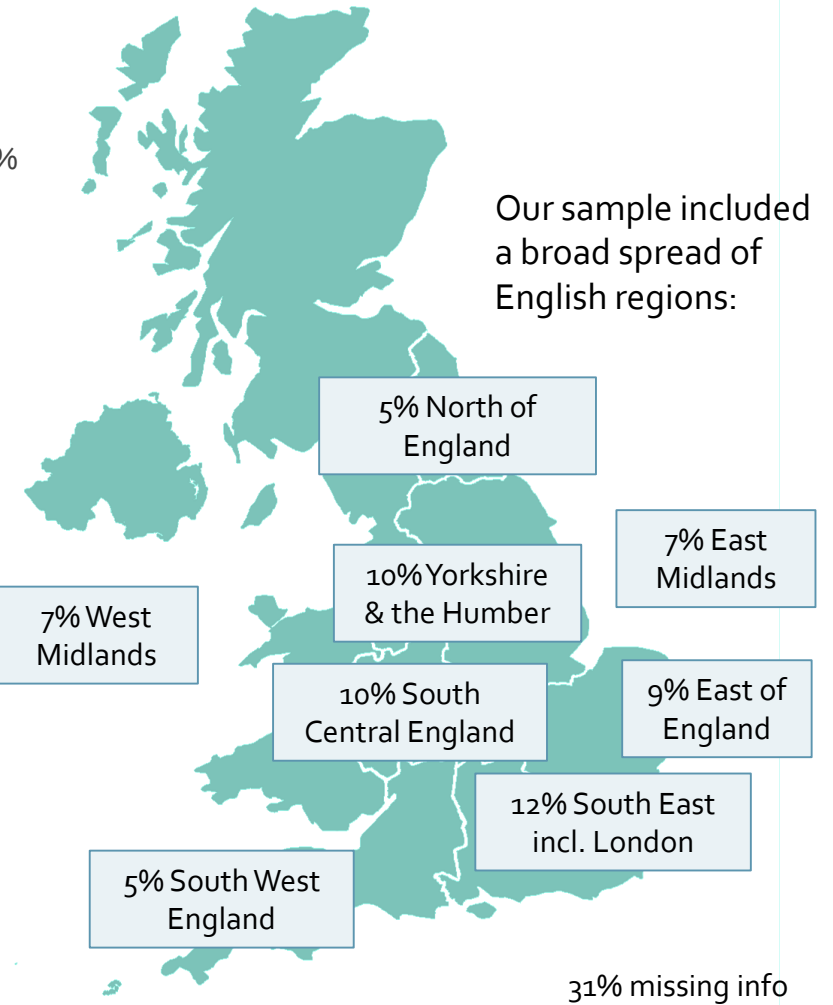
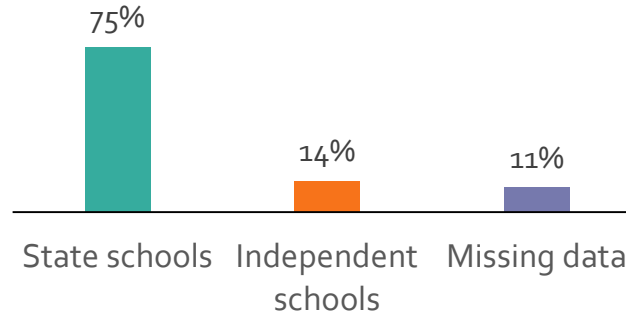
State funded schools only
 Missing data = 20% population, 22% sample
 Base n = 383

The majority of our sample were teaching at a school with a 6th form:



6th form data was missing or not applicable for 85 schools.
 Base n = 428

A majority of our sample are state schools, in which over two thirds are academies:



Base n = 513

A profile of qualitative respondents can be found in the Appendices (page 39).

SCIENCE TIMETABLE MODELS

IDENTIFYING GCSE SCIENCE TIMETABLE MODELS

Our research sought to identify and describe the common models for timetabling the sciences at GCSE. In total, we identified 82 model variations employed by schools using the time and teacher allocation variables outlined below. The following slides detail 6 overarching threads. In-depth qualitative findings have been drawn on to provide context and rationale behind these models. A full list of identified models can be found in the Appendices (pages 37-38).

Time

- This variable takes into account, a) the teaching time allocated to combined science, b) the teaching time allocated to triple science, and c) the teaching time allocated to an open GCSE option across KS4.
- It identifies whether the number of periods available for GCSE sciences is divisible by three, assuming an equal amount of periods is given to each discipline.

Teacher allocation

- This variable specifies whether or not teachers with specific disciplinary expertise are available for combined and triple science, i.e. are teachers required to teach outside of their disciplinary expertise?
- It identifies how many teachers are allocated to teach on each route through sciences at GCSE.

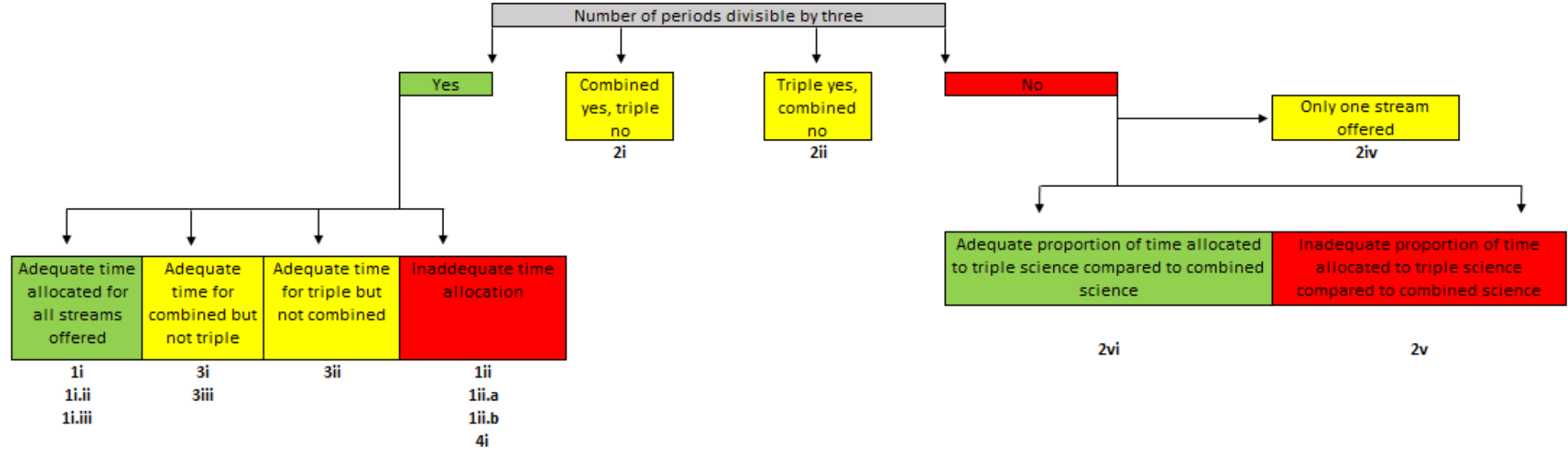
Differing combinations of these variable considerations have led to the identification of 82 unique models used by schools surveyed.

MODEL MAP OUTLINING TIME AND TEACHER ALLOCATION ROUTES

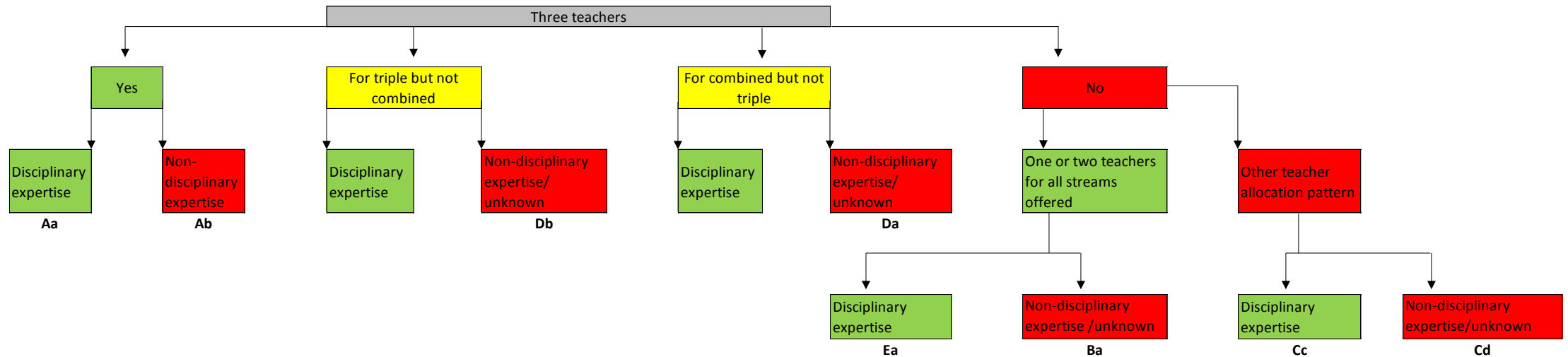
PLACEHOLDER – REPLACE WITH EXAMPLE?

Appendix 2

TIME









TEACHER ALLOCATION



A 'decision tree' has been developed separately to further illustrate the possible routes.

AN OVERVIEW OF THE MODEL GROUPS IDENTIFIED

	Combined and Triple proportional	Combined and Triple under-resourced	Triple science squeezed	Combined science squeezed	Triple science only	Combined science only
Descriptions	A balanced share of resourcing, teaching time and disciplinary experts available 	Both pathways receive disproportionately low resourcing as sciences are not given equivalent teaching time to optional GCSEs 	Particularly problematic for triple teaching time as less than 1.5 times teaching time than combined science 	Combined science is likely to be the first port of call for resource cuts, particularly for teacher allocation 	These models are likely to receive adequate resourcing and an equivalent share of teaching time to optional GCSEs 	Resourcing issues likely to define these models, particularly staff shortages 
Characteristics	<ul style="list-style-type: none"> Both routes offered Number of science periods divisible by 3 Combined is on 2 times allocation of option GCSE Triple science is on 3 times allocation of option GCSE 3 teachers with disciplinary expertise available 	<ul style="list-style-type: none"> Both routes offered Number of science periods not divisible by 3 Combined is on less than 2 times allocation of option GCSE Triple is on less than 3 times allocation of option GCSE 3 teachers with disciplinary expertise unavailable 	<ul style="list-style-type: none"> Both routes offered Number of science periods not divisible by 3 Triple is on less than 1.5 times allocation of combined 3 teachers with disciplinary expertise unavailable for triple 	<ul style="list-style-type: none"> Both routes offered Number of combined science periods not divisible by 3 Combined is on less than 2 times allocation of option GCSE 3 teachers with disciplinary expertise unavailable for combined 	<ul style="list-style-type: none"> Only triple route offered Number of science periods divisible by 3 Triple science is on 3 times allocation of option GCSE 3 teachers with disciplinary expertise available 	<ul style="list-style-type: none"> Only combined route offered Number of science periods divisible by 3 Combined is on less than 2 times allocation of option GCSE 3 teachers with disciplinary expertise unavailable
Sub-models which meet criteria	1iAa	1iiAb, 1iiBa	2vAb, 2vBa, 2vDa	2iiAb, 2iiDb	1i.iiAa	1ii.aAb, 1ii.aBa
Similar sub-models which meet some criteria	1iCc	3iiiAb, 3iiiBa	2iAb, 3iBa	3iiAb	1i.iiBa	2ivBa

COMBINED AND TRIPLE PROPORTIONAL

Common characteristics:

- Both combined and triple science routes offered
- The number of science periods taught is divisible by three, suggesting equal teaching time is given to the 3 disciplines
- Combined science is taught on twice the allocation of an open option and triple is given three times the allocation of an open option
- Three teachers with disciplinary expertise are available for both combined and triple science classes



- None of our sample were found to be using this model (1iAa). Qualitative findings suggest factors which might facilitate this model include a 6th form, adequate resourcing, availability of disciplinary experts and small GCSE cohort sizes. A similar model which offers only a triple science route is 1i.iiAa (0.6% of our sample, 3 schools) and 1iCc (0.2% sample, 1 school) offers more than 3 discipline teachers.

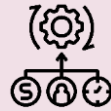
"We do well as a department for the school and we've got the support of the senior leadership, so we get enough time, and in these times where everything is tight our budget is quite healthy."

- This model is considered to be preferable by the learned societies as it indicates a balanced share of resourcing, adequate teaching time and disciplinary expertise across both routes offered. Survey results indicate this criterion is rarely met.
- Providing a balanced share of GCSE science teaching time in comparison to optional subjects requires abundant resourcing. This includes a sufficient number of teachers at KS4 to ensure 3 relevant discipline experts are available per class. Qualitative interviews indicated that schools based in populated areas are more likely to reach these criteria, as rural-based schools commonly report shortages of teachers for disciplines, particularly physics.
- Smaller GCSE cohort sizes are more likely to support sufficient staff resourcing, as teachers are less likely to be stretched.
- Interviews suggested that schools with a strong commitment to science teaching and continued retention at KS5 are more likely to allocate an equivalent amount of time to teaching GCSE sciences and optional subjects. Schools which involve science staff in timetabling decisions are likely to have timetables which reflect science needs.
- To ensure triple science is taught on 3 times the allocation of an open option, it is likely triple is required to be treated as an optional GCSE.

Related models are referred to as 1iAa, 1i.iiAa or 1iCc in the Appendices (pages 37-38).

Common characteristics:

- Both combined and triple science routes offered
- The number of science periods taught not divisible by three for both routes, suggesting an uneven teaching time is given to the 3 disciplines
- Combined science on less than 2 times teaching time allocated to optional GCSEs; and triple science on less than 3 times teaching time allocated to optional GCSEs, suggesting unbalanced resourcing
- Either 3 teachers available without relevant disciplinary expertise or 1-2 teachers available for teaching both routes suggesting non-expertise



- These characteristics were common amongst our sample. Models which meet these conditions include 1iiAb (9% of our sample, 45 schools) and 1iiBa (2% of our sample, 11 schools). A majority of these schools are academies with Good Ofsted ratings.

"We were limited by decisions in the whole school. There were discussions at some point about taking hours off science to give to English and maths. [...] Time is precious. English and maths are always wanting more time, so it's who can scramble for the time first."

- In this scenario, both combined and triple science routes appear to receive disproportionately low resourcing. GCSE sciences are not given the equivalent teaching time they deserve in relation to open options.
- It's unlikely schools using relevant models feel adequate time is available in the timetable. While science GCSEs are likely to commence in year 9, they still fail to obtain an equivalent share of teaching across KS4. Year 9 science teaching must also contend with completion of KS3 and less academically developed students.
- Qualitative findings indicated that schools with relevant models are likely to prioritise coverage of optional GCSEs. Triple science is unlikely to be treated as an open option within these models to ensure optimal time available for additional subjects.
- Assumptions can be made that staff resourcing issues are likely to be present at schools employing these models. Teachers with specific individual disciplinary expertise are not available for either combined or triple routes. Nonetheless, triple science is prioritised in staff allocation as expertise is thought to be more crucial at this level. Staff are likely to be employed as generalist science teachers at these schools, suggesting outside-discipline teaching is the norm.
- Qualitative interviews identified that while 3 teachers are likely to be allocated to triple classes, 1-2 teachers are commonly thought to suffice for combined science as fewer teaching hours are required.

Common characteristics:



- Both combined and triple science routes offered
- The number of science periods taught is not divisible by three, suggesting unequal teaching time is given to the 3 disciplines
- Triple science teaching is on less than 1.5 of time allocated to combined science, suggesting unbalanced resourcing
- Three non-disciplinary expert teachers are available for triple science classes, or 1-2 teachers available suggesting non-expert teaching



- These criteria is common amongst schools. Relevant models include 2vAb (6.6% of our sample, 34 schools), 2vBa (3.9% sample, 20 schools) and 2vDa (0.4% sample, 2 schools). A majority of these schools are academies rated Good by Ofsted with above average GCSE cohort sizes. Similar models also include 2iAb (3.9% sample, 20 schools) and 3iBa (0.8% sample, 4 schools).

"I don't think triple science has ever been part of the Year 9 options process and I don't really know the historical reasons why. It might have been to do with the science department wanting to retain control of who does triple and who doesn't do triple, in terms of keeping the results as high as we can, or making sure the right students are entered for the right courses."

- These characteristics suggest these models are particularly problematic for triple science teaching. Results suggest that it is unlikely triple science is offered as an open option within these models, therefore time constraints are present.
- Triple science is allocated less than 1.5 times teaching time than combined science. Interviewees suggested this is justifiable considering the cohort of students likely to take triple science.
- Common allocation of students to either combined or triple routes is based on science sets and assessments. A minority proportion of students with are likely to be allocated to triple science. Qualitative findings indicated that these students are thought to be able to manage the more intensive learning required in these models.
- This time allowance is therefore likely to prevent students with lower prior attainment taking triple science as they would not be able to cope with the additional content in the reduced time available.
- Staff shortages are likely to be driving the lack of teachers with discipline expertise for triple science. While the research has indicated a majority of teachers feel comfortable teaching out of their main field at KS4, qualitative findings suggest this is not always the case for triple science teaching and is actively avoided where possible.

Common characteristics:



- Both combined and triple science routes offered
- The number of science periods taught is not divisible by three for combined science, suggesting unequal teaching time is given to the 3 disciplines
- Combined science not given 2 times teaching time allocated to optional GCSEs
- Three non-disciplinary expert teachers are available for combined science classes, or 1-2 teachers available suggesting non-expert teaching



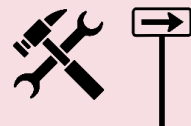
- Identified models which meet these criteria are 2iiAb (5% of our sample, 24 schools) and 2iiDb (6% of our sample, 29 schools). Majority are state funded schools, with above average GCSE cohort sizes. Teachers within these schools are likely to be employed as 'science' teachers. A similar model offered by schools which meets most criteria is 3iiAb (0.2% sample, 1 schools).

"So we tend to keep [combined science] so that teachers aren't sharing groups between three, so we try and keep across all Year groups, just two teachers to a group just to help, kind of, continuity almost [...] The triple science is essentially allocated on the specialist teachers."

- These conditions are particularly disadvantaging for combined science. Within these models, combined science is likely to be the first port of call for resource cuts.
- Results found that teachers with disciplinary expertise are unlikely to be available for combined science classes, experts are instead reserved for triple. Interviewees reported that this GCSE route is commonly thought to be less in need of disciplinary experts compared to triple science, as less content is covered and students are less likely to pursue science at further education.
- Combined science is also less likely to be allocated 3 teachers. Interviewees linked this to staffing issues, as well as assumptions that teachers are more than able to teach outside their main field at KS4. Teachers are therefore likely to be employed as 'science teachers' at schools using these models.
- Non-disciplinary job titles and less than 3 teachers allocated to a class can lead to a lack of differentiation of the science disciplines amongst students. A lack of clarity was found to have a negative impact on students' learning, including a misunderstanding of strengths and weaknesses, as well as disengagement with science further education.
- Within these models, the number of teaching periods available within a timetable cycle is not divisible by 3. It was likely that schools had informal processes around how teaching was split across the disciplines.

SINGLE COMBINED SCIENCE ROUTE

Common characteristics:



- Only GCSE combined science route offered
- The number of science periods taught is divisible by three, suggesting equal teaching time is given to the 3 disciplines
- Combined science on less than 2 times teaching time allocated to optional GCSEs, suggesting unbalanced resourcing
- Three non-disciplinary expert teachers are available for combined science classes, or 1-2 teachers available suggesting non-expert teaching



- A combined science only offer was found to be uncommon. Schools which met the above criteria had the following models: 1ii.aAb (0.6% of our sample, 3 schools) and 1ii.aBa (1.4% sample, 7 schools). A significantly high proportion of these schools were rated Requires Improvement by Ofsted. 2ivBa (1.6% sample, 8 schools) was a similar model identified.

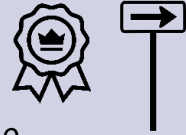
"We basically got rid of the separates [triple science], went just to the combined [...] These are driven by just getting the results out of the kids, it's not about them being educated in science and being good scientists, it's now the results, and our results this year went up. So we massively improved it and improved our value-added."

- Schools which were offering this single route were found to have similar conditions. Qualitative interviews revealed that these schools were competing with large independent or grammar schools, and were based in rural or economically disadvantaged areas.
- Staff shortages were common in these schools, leading to a deficit in teachers with disciplinary expertise and less than 3 teachers allocated to a class. Nonetheless, fewer teachers was an active choice for some schools. A smaller number of dedicated teachers per class was considered beneficial in managing tricky behavioural issues and building on-going relationships with students.
- Qualitative findings identified that a large majority of students attending these schools are likely to be foundation tier. This is core to the decision to only offer a combined science route as it's expected students are more likely to succeed and target grades can be set higher. The decision is data and Ofsted driven.
- High proportions of EAL students attend these schools. Lower levels of English competency is also a contributing factor to opt for a lower content route, particularly when technical language can prove difficult.
- These models do not offer an equivalent amount of teaching time as optional subjects are given. A level provision is not available at these schools therefore science progression is dependent on A level entry requirements at local institutions.
- It is worth noting that offering a combined science pathway only is not problematic in itself– it is the conditions in which it is offered which is key.

Related models are referred to as 1ii.aAb or 1ii.aBa in the Appendices (pages 37-38).

Common characteristics:

- Only GCSE triple science route offered
- The number of science periods taught is divisible by three, suggesting equal teaching time is given to the 3 disciplines
- Triple science on 3 times teaching time allocated to optional GCSEs, suggesting balanced resourcing
- Three discipline teachers are available for triple science classes



A total of 3 schools – 0.6% of our sample – were found to be using this model (1i.iiAa). 2 of these schools were independent schools, we were not able to obtain this data from the final school. A similar model was found which did offer three teachers per class however some were required to teach outside their main field (1i.iiAb – 0.8% of our sample, 4 schools).

"They have double biology lessons, double chemistry lessons, and double physics lessons. They're taught by a chemist, a biologist and a physicist, so in their minds there's no ambiguity [in the differentiation between the disciplines]."

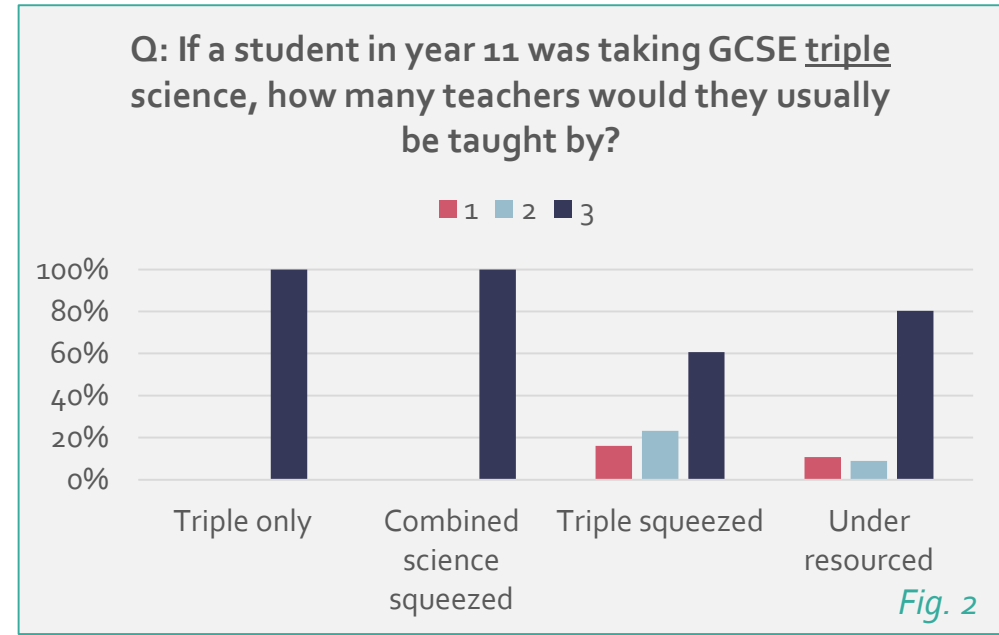
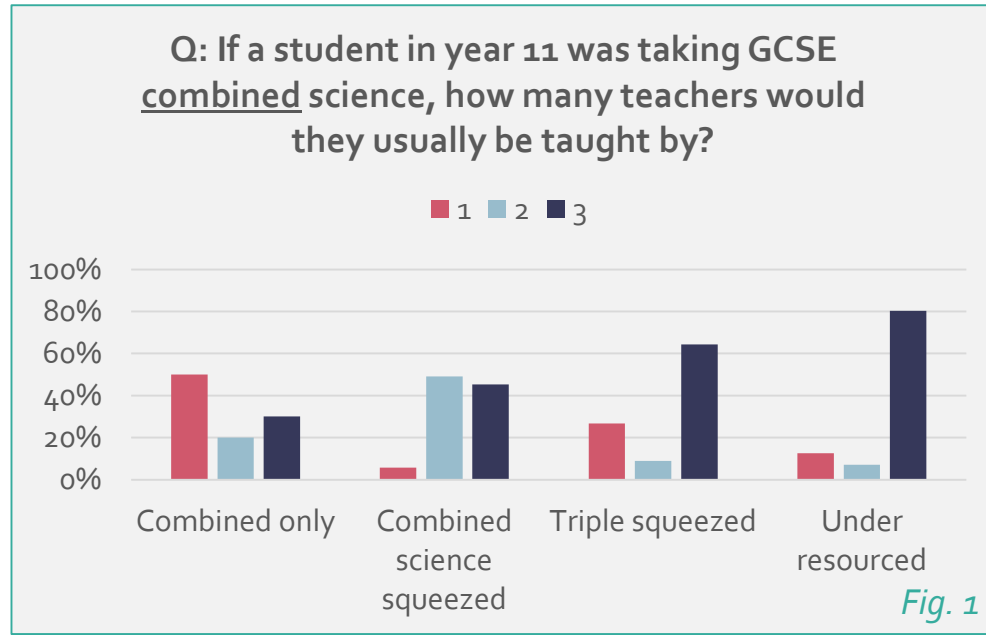
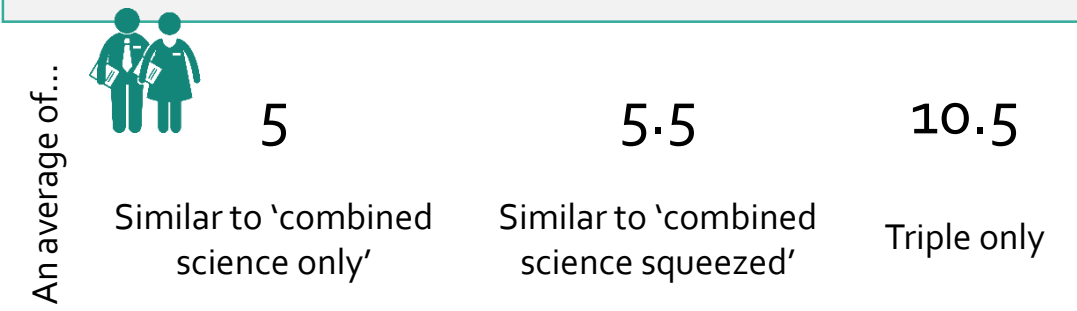
- Schools offering only a triple science route were likely to describe themselves as having a particular STEM focus. Qualitative and quantitative results identified that all have a 6th form and are committed to encouraging progression into science A levels.
- Schools using these models provide an equivalent share of teaching given to optional GCSEs. This ensures all students are given adequate teaching time to tackle the triple science content, regardless of their prior attainment.
- Staff resourcing is unlikely to be an issue for these schools. 3 teachers with relevant disciplinary expertise are available per class – this is made clear to students through staff employment as a teacher of a specific discipline.
- Data suggests that these models are likely to promote clear differentiation of the disciplines amongst students. This clarity was also thought to promote KS5 science as students had more understanding of what they enjoyed and possible career paths.
- Findings suggest this model requires an abundant of resource in regards to time and teaching.

DATA HIGHLIGHTS BASED ON THE MODEL GROUPS

The school with the model closest to combined and triple proportional (1iCc) reports that the allocation of students to combined or triple science is solely based on student choice. This suggests adequate resourcing at this school as triple science is not reserved to higher tier sets.

Schools with models which fall into the 'under resourced' grouping are significantly likely to make use of science sets and science assessments in their allocation processes. This indicates restrictions on which pathways students are able to take which may be preferable at these schools as triple science is considered resource-consuming or to unbalance the timetable in regards to other optional GCSEs.

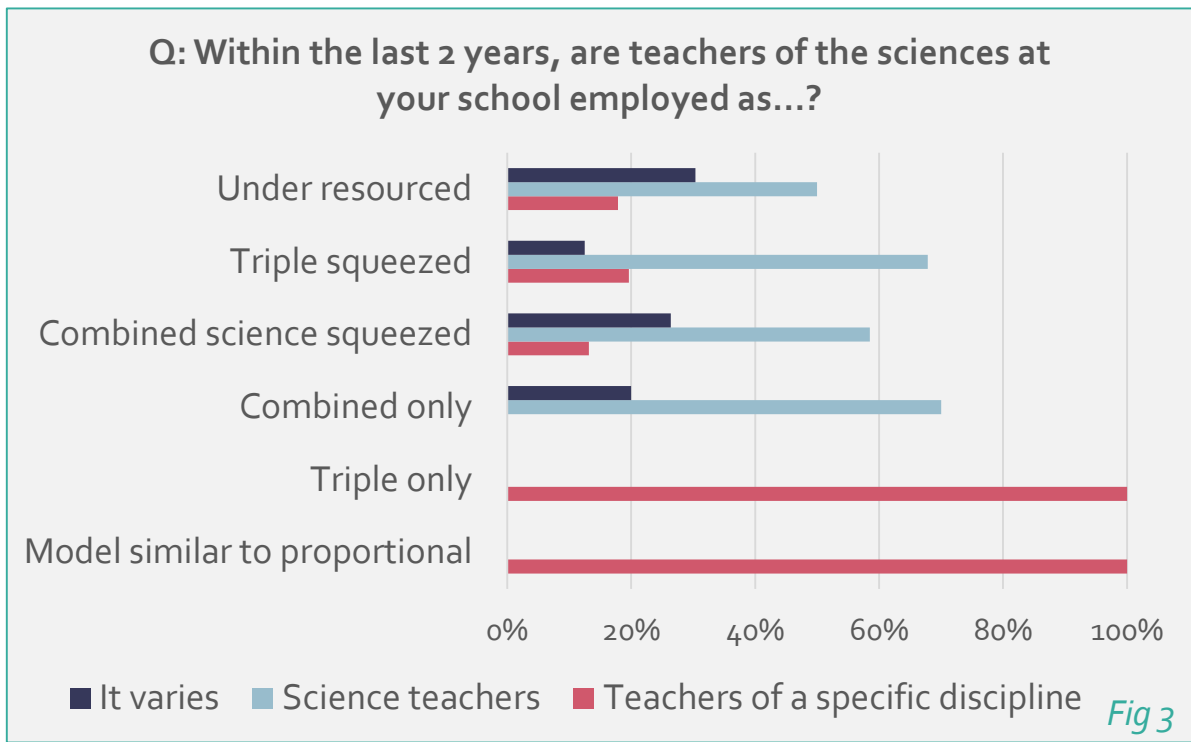
Schools which offer models similar to the combined science only and combined science squeezed groups are likely to have significantly fewer teachers available to teach KS4 than other groups:



Triple science classes are more likely to be allocated 3 teachers than combined science in all model groups.

Despite differing school contexts and decision-making, combined science is unlikely to be prioritised in teaching allocation.





DATA HIGHLIGHTS BASED ON THE MODEL GROUPS | CONTINUED



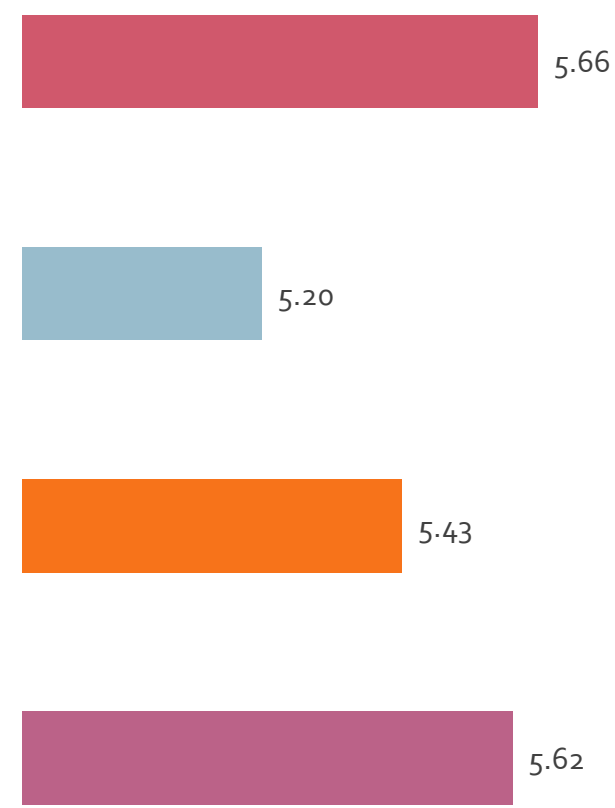
All schools who fall within the 'triple only' group and the model similar to 'proportional' (1iCc) have employed 100% of their staff as teachers of a specific discipline. This is in line with their availability of 3 teachers with relevant disciplinary expertise per class.

All other core groups are more likely to employ teachers as generic science teachers. This is reflected in the way teachers are deployed and the low levels of recognition of the differences between the sciences amongst students.

Q: Is combined science GCSE timetabled separately for each discipline?

- 
20%
Combined science only
- 
38%
Combined science squeezed
- 
50%
Triple science squeezed
- 
71%
Combined and triple under-resourced

Q: To what extent* do you think students are able to differentiate between the disciplines within their combined science GCSE lessons?



*Out of 7

UNDERSTANDING TIMETABLING DECISIONS

WHICH SCIENCE ROUTES DO SCHOOLS OFFER?

Q: Which of the following does your school teach at KS4?

Both combined and triple science

87.3% (n = 448)

A majority of our sample are offering both combined and triple science routes. Schools offering both routes are likely to have larger GCSE cohorts than single route schools.

Triple science only

6.8% (n = 35)

37%* of those offering triple science only are independent schools. 86%* of schools offering only this option have a 6th form at their school.

Combined science only

5.1% (n = 26)

69% of schools offering only combined science employ 'science teachers', rather than teachers of a specific discipline. Schools offering only this route are likely to have significantly fewer teachers allocated to teach GCSE science.

Other route

0.8% (n = 4)

Other routes were likely to be iGCSE Single Science and BTEC Applied Science L2. Pupil referral units are likely to be offering 'other' routes.

- Since the major GCSE reforms, there are now no alternatives for science at KS4 that both count towards performance tables and meet the national curriculum other than combined and triple science.
- Offering only one GCSE science route was uncommon – schools which fell into group were likely to have unique circumstances. For example, one school interviewed reported that their full GCSE cohort were all foundation students. A high proportion of these students were EAL and/or struggling with behavioural issues. While triple science was offered a few years prior, they had since changed to offering combined science only due to extremely poor grades. This was thought to be necessary due to lack of time, teachers and other resources.
- Conversely, those offering only triple science were more likely to have adequate teacher and time resources.

Within a KS4 group, what proportion of students are taking triple science?*



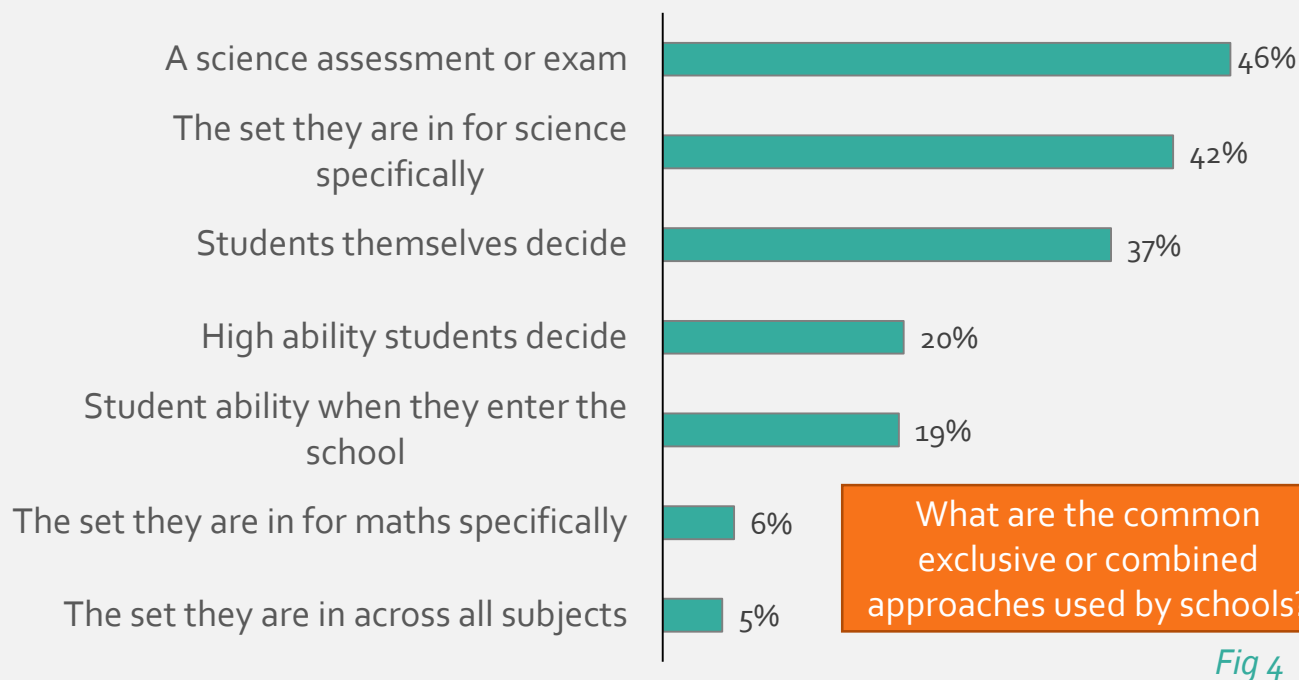
67% of respondents report that less than half of students take triple science

- Qualitative findings revealed that schools commonly expected to put 1-2 higher tier classes maximum into triple science, with the remaining majority taking combined science. This number was unlikely to change year on year. This is a key feature of the inequity of pathways. These decisions were linked to student attainment, class sizes and resources i.e. schools not having the time or staff to teach triple to all.
- Some schools were also likely to encourage students less interested in a science career to take combined science and an additional option GCSE which would otherwise be unavailable if triple science was selected.

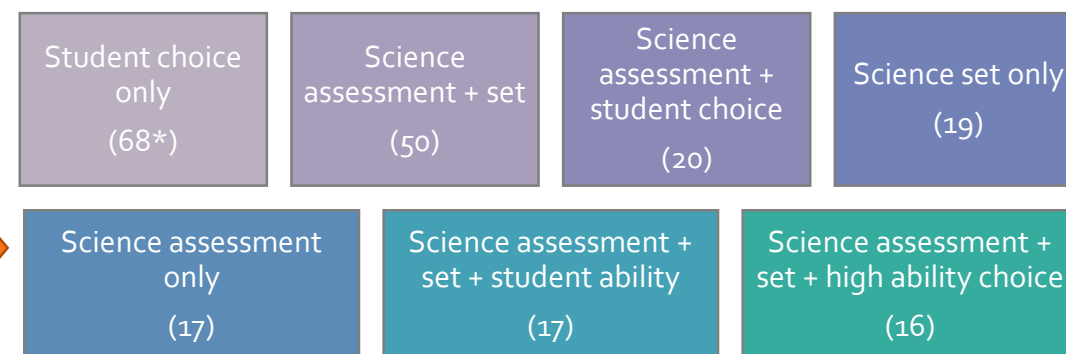
Base n = 513. Statistics include missing data so may be underestimated. *The proportion of students entered for triple science in the UK has drifted between 21% and 26% since 2011, according to the [Science and Engineering Education Dashboard](#).

HOW ARE STUDENTS ALLOCATED TO COMBINED OR TRIPLE SCIENCE?

Q: Which of the following contribute to how the allocation of students to combined or triple science at KS4 is determined? (*Multiple choice*)



- Schools who offered both combined and triple science routes were asked to outline factors contributing to student allocation. While triple science covers more content than combined science, it is no more difficult. Despite this, schools were likely to teach triple science to higher tier only and all foundation tier students were frequently taught combined science only¹.
- While a science assessment or exam was the allocation method most commonly used overall amongst our sample, the most common single or collective approaches are outlined below. Free student choice alone was the most popular allocation approach, followed by a combination of a science assessment and science set:



- Several interviewees suggested maths grades were taken into consideration, particularly for physics. Others reported that English grades contributed, due to high levels of EAL students. Behavioural data was also drawn on by some schools, however few schools reported use of widening participation data which may mean minority groups are restricted in their destinations if they do not fall into top sets.

- Qualitative findings revealed that while schools were likely to specify that students themselves decide, this was usually limited to only high tier students or those who were deemed suitable for both routes. In circumstances where lower set students were given the choice, this was usually with a prerequisite that they meet particular grades to do so.

Base n = 513. 1. Similar findings are outlined here: <https://www.ase.org.uk/news/triple-science-equitable-or-elitist>

*Number of schools in our sample who reported the relevant allocation methods.

WHAT ARE THE PERCEPTIONS OF GCSE SCIENCES ROUTES?

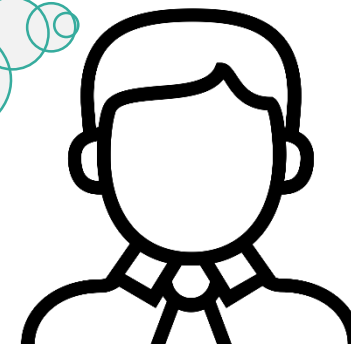
- Several interviewees at schools offering both GCSE science routes suggested that their students were likely to perceive triple science to be 'geeky'. Nonetheless, there was a clear consensus amongst teachers that students considered triple to be the best choice if they wanted to pursue science higher education. There was also a perception that triple was harder than combined science, and even elitist.
- Students who were particularly eager to do triple rather than combined science were able to do so at some schools, if they demonstrated strong commitment. If students were to switch between routes, it was widely acknowledged that it was easier to move across to triple from combined, than from combined to triple.
- Parents were thought to be unanimously more positive towards triple science – with some interviewees reporting complaints from parents when their students weren't selected for this GCSE route. These complaints were sometimes taken into consideration during student allocation. Parents were likely to consider triple science to be more esteemed, as well as to provide students with more opportunities later in life.
- Students were likely to be given information on the difference between combined and triple science at option days, parents' evenings or during lessons. Information given usually included what the choice would allow them to do at A level, possible restrictions for higher education, differing exam lengths and the impact it would have on their available option GCSEs.
- Interviewees stated that triple science was not sold as being 'harder' in regards to content, but instead required more commitment and intensive learning.

Students



"[Students] probably think combined is easier. Whilst I'd say academically the content isn't any trickier, they tend to think it's easier without really knowing the difference...they often think there are more exams [with triple]."

Parents

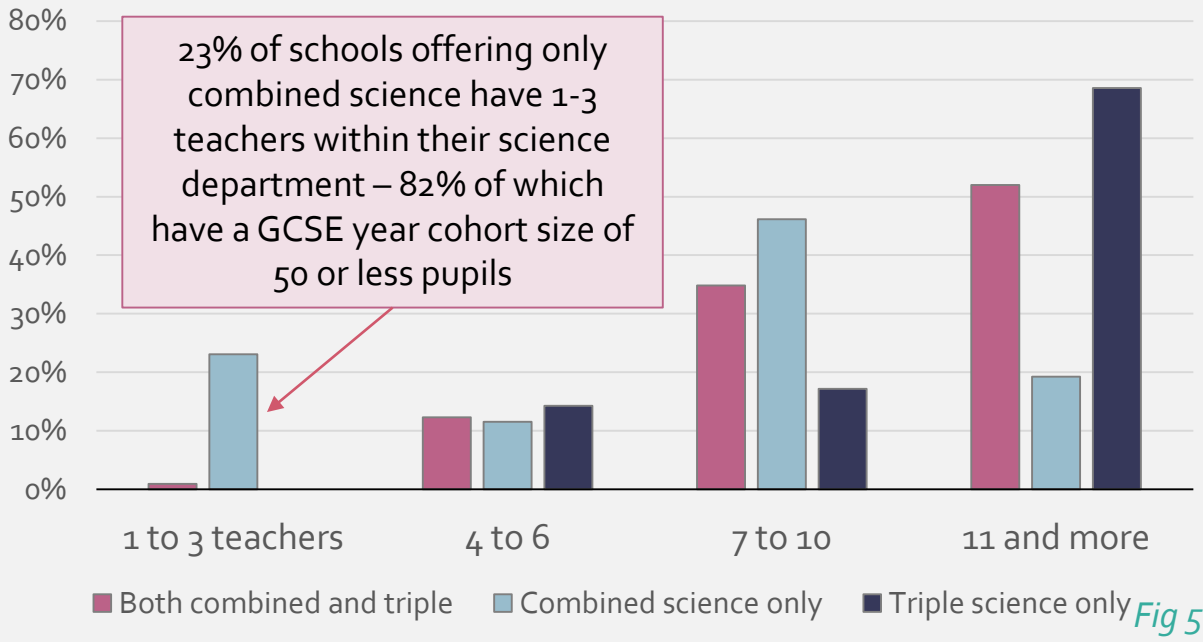


"Most parents want their pupils to do triple [...] Parents normally think, yeah, you'd get an extra GCSE for the same lessons and they're quite keen for it."

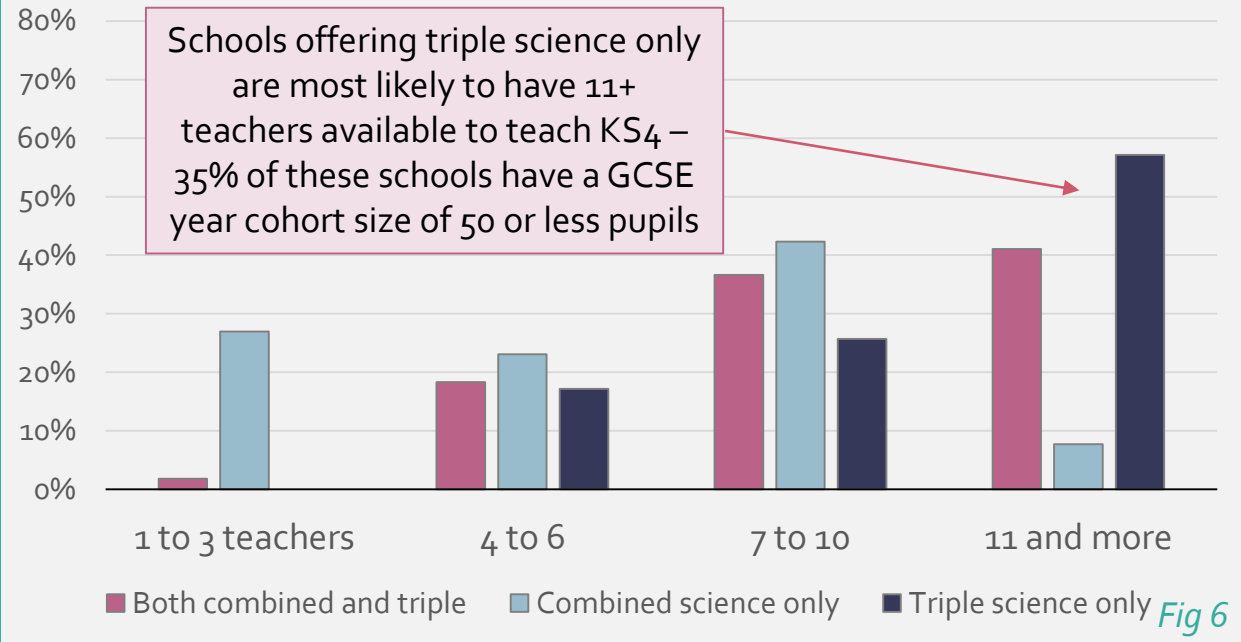
HOW MANY SCIENCE TEACHERS ARE AVAILABLE IN SCHOOLS?

- Unsurprisingly, there is a positive correlation between number of teachers within a science department and GCSE student cohort size. The more students per year group at GCSE level, the higher number of teachers working within the science department. 78% of schools with >200 cohort size have 11 or more teachers working within their science department.
- Similar numbers of teachers working within the science department are allocated to teach at KS4. Qualitative findings indicated that it was common for all full time science staff to teach at KS4. It was likely that the same teachers would carry students through Y10 and Y11. This was less fixed in Y9 for schools teaching GCSE science across 3 years as the route students would take was not necessarily decided at this point.

Q: How many teachers work within your science department?



Q: How many teachers are allocated to teach sciences at GCSE level across all KS4 years?



Base n = 513; Combined and Triple n = 396; Combined only n = 26; Triple only n = 30
11 and more includes those who specified an 'other' amount

HOW ARE STAFF DEPLOYED ACROSS CLASSES?

- Qualitative interviews revealed few restrictions on teachers allocation to teach KS4. Nearly all teachers were considered able to teach at this level – both within and outside of their disciplinary expertise – though part-time teachers were unlikely to be allocated to GCSE classes as students were thought to benefit from fixed teachers.
- In some schools NQTs were less likely to be given triple science classes as the content was thought to be more intensive and better suited for experienced teachers. Nonetheless, some interviewees suggested that NQTs were better deployed in triple science as these classes were less likely to be disrupted with challenging behavioural problems.
- Heads of department or heads of specific disciplines were likely to be given triple science. These more experienced teachers were also given classes which required higher levels of behavioural management.
- If there were shortages of teachers with a specific disciplinary expertise, triple science would take priority over combined science in terms of allocation. These classes were thought to be more in need of expert teachers.

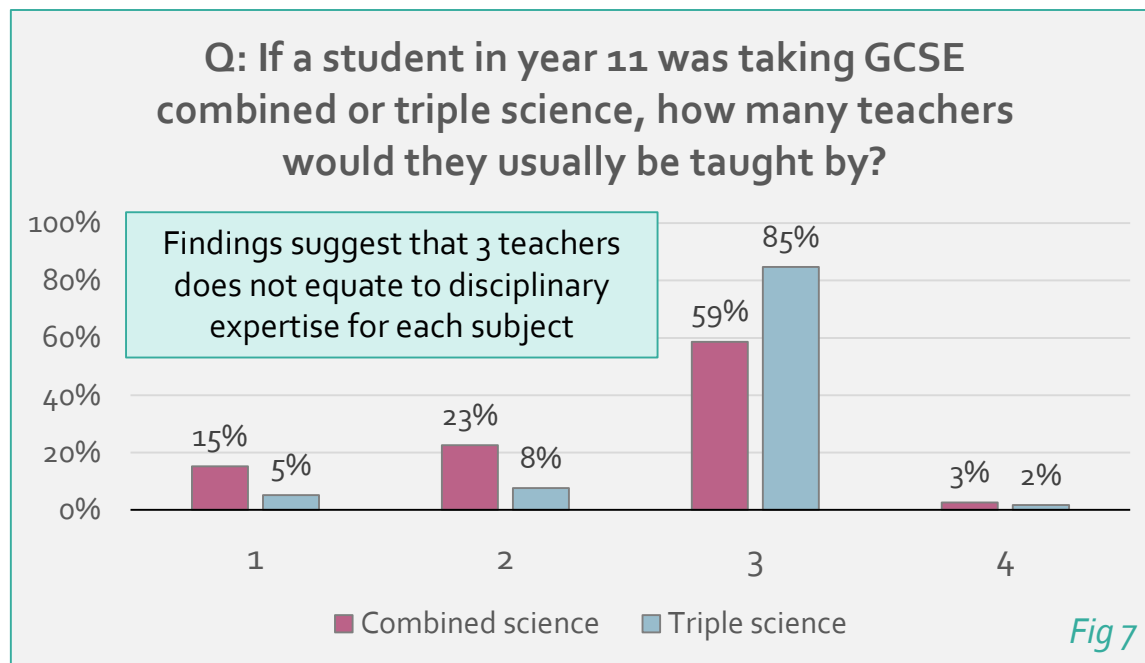
"So we would prioritise putting specialist teachers of each subject into the triple groups because there's more content and some of the content is conceptually more difficult and students might ask more challenging questions, so you want to put [...] the teachers with the best subject knowledge [...] teaching that subject, for the groups where you're more likely to need more of that expertise.

Out of the Physics specialists, if you're looking at a Physics teacher for a group, who gets allocated [to which] group, there's all kind of things to balance. You, kind of, need to look at what the group might be like, who might be the best teacher with that group, who knows students in that group already, who are the other teachers of that group and who would [...] complement. So if there are three teachers who perhaps have all had behaviour issues in the past with some classes, then you might want to make sure that that class doesn't have, say, all three of those teachers, you might want to put somebody whose behaviour management is a real strength in there as well."

- Combined & triple routes, VU



HOW MANY TEACHERS ARE ALLOCATED TO TEACH GCSE SCIENCES?



- One school who had only one teacher allocated to teach a combined science class suggested they were happy with this approach. High incidence of student behavioural issues meant management of this was best achieved through one dedicated teacher:

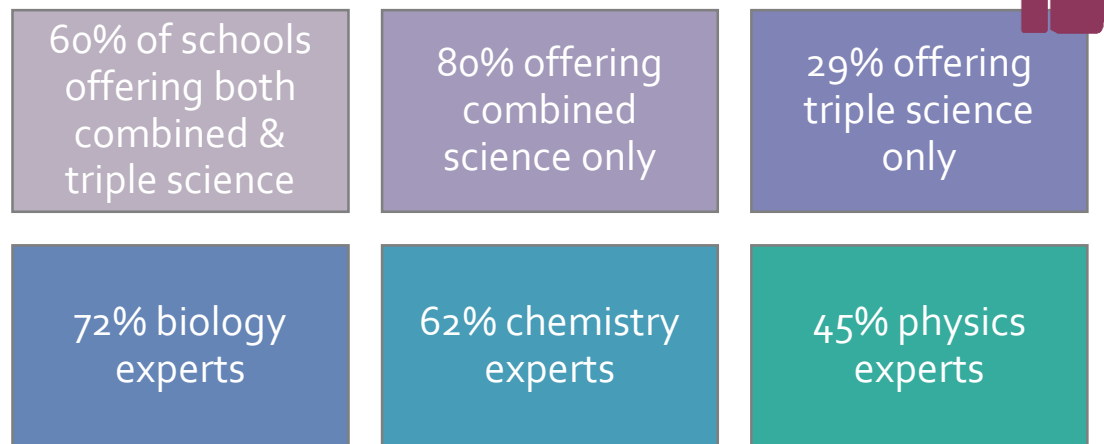
"Our problem is not the subject material. It's building relations with the students [...] They've had huge change, and very many issues in school, and they are very untrusting and nervous, so having a face in front of them continuously is very good for them." – Combined route only, OT

- Findings suggest that triple science is more likely to be allocated 3 teachers than combined science. Nearly a quarter of those offering combined science report that only 2 teachers are allocated to teach a Y11 class.
- This was supported by the qualitative findings. Triple science classes were far more likely to be deployed with 3 teachers. This was related to teacher experience. Combined science was thought to be less in need of teachers with disciplinary expertise than triple science. This rationale was usually two-fold – triple science students were thought to be more likely to progress to A level sciences and therefore would benefit from disciplinary expertise; and experts were considered best placed to cover the additional content within triple science.
- While many schools reported that they aspired to have 3 teachers per class, if staff resourcing issues were present, combined science was usually first port of call for cuts. A level and triple science classes were prioritised.
- Of those who report that 3 teachers are allocated to teach combined and triple science, 69% and 74% (respectively) indicate that science staff are required to teach outside of their main field of teaching. This suggests that despite having 3 teachers allocated, an expert per discipline may not be available.*
- 100% of independent schools report that 3 teachers are allocated to teach triple science, compared to 81% of state schools. 98% of independent schools report that 3 teachers are allocated to combined science, whereas only 52% of state schools have 3 teachers available.

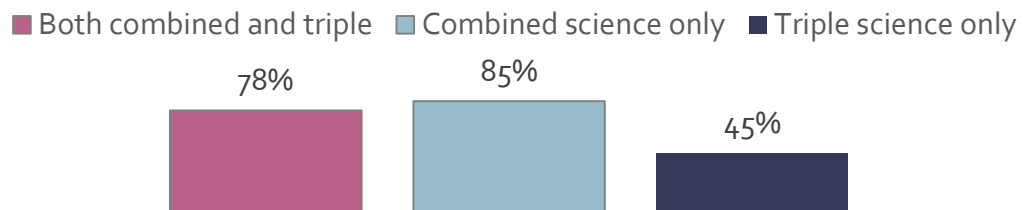
Combined Base n = 474, Triple Base n = 483

ARE TEACHERS REQUIRED TO TEACH OUTSIDE OF THEIR MAIN DISCIPLINE?

Q: Do you consider more than one discipline to be your field of teaching? (% of those who answered 'yes')



Q: Are other teachers required to teach outside of their main field of teaching at KS4? (% 'yes')



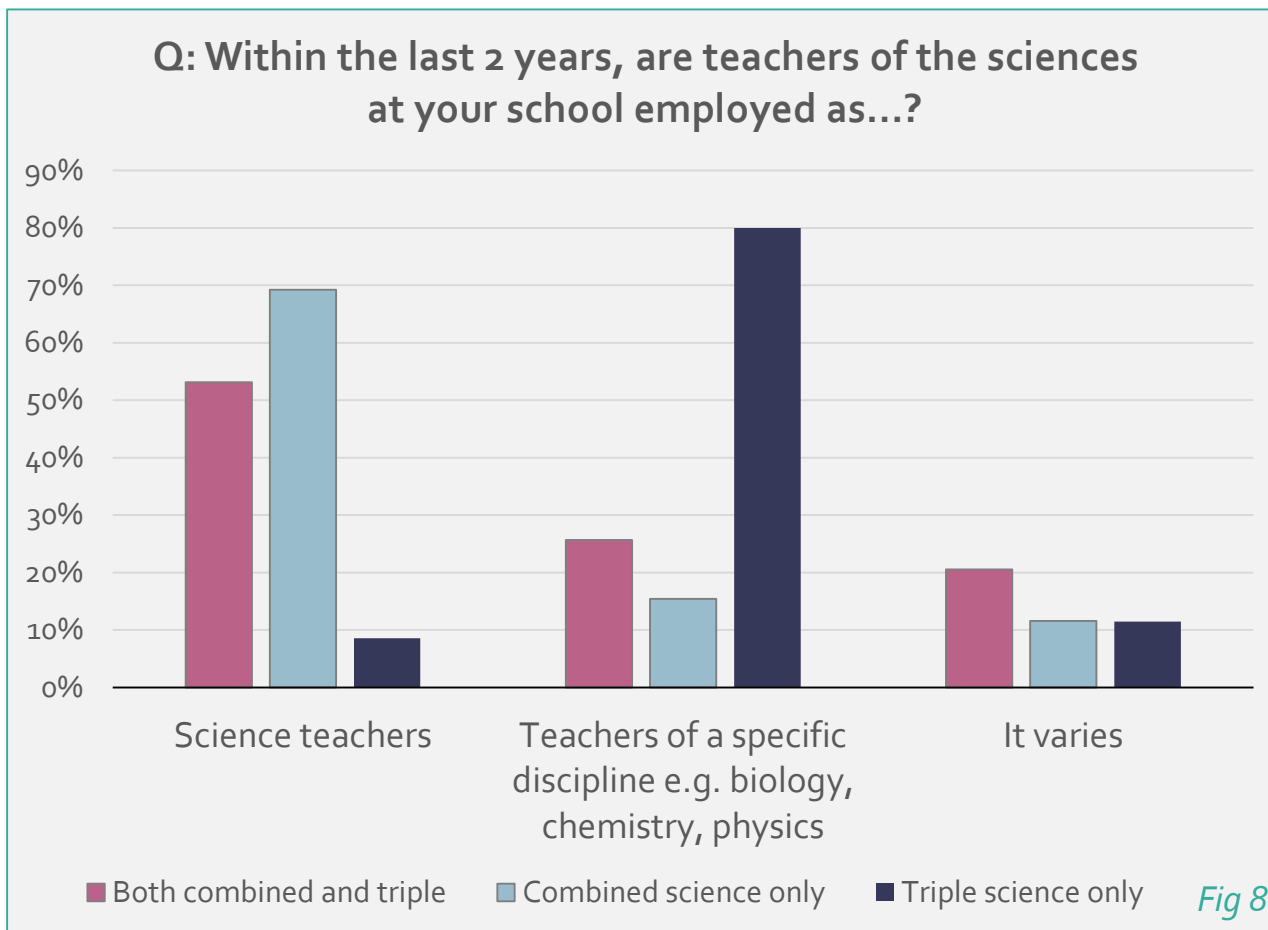
Please note, this question was asked about teachers in general. It was not asked separately for combined science teachers and triple science teachers, rather results have been cross-tabulated by GCSE route offered. Assumptions that combined science is more likely to be taught by non-disciplinary experts than triple science is supported by the qualitative findings.

- 58% of respondents teaching GCSE science reported that they consider more than one discipline to be their field of teaching. Teachers at schools offering only combined science were most likely to agree with this (80%), whereas those offering only triple science were least likely (29%).
- Biology experts* were the group most likely to consider more than one discipline to be their field of teaching, whereas physics experts were least likely – with several interviewees suggesting a shortage of physics teachers. This was corroborated in the qualitative findings, with many suggesting those with a bio-chemistry background were likely to feel confident with multiple disciplines.
- Furthermore, one interviewee suggested that non-experts teaching physics had the biggest negative impact on students, when compared to non-experts teaching the other disciplines. This was linked to the advanced maths elements.
- As corroborated in the interviews, teachers of combined science were more likely to be expected to teach outside of their main discipline than those deployed to triple science. While all teachers were thought to be equipped to teach any discipline, some interviewees acknowledged that this wasn't always preferable at KS4, and certainly not at A level.
- NQTs were less likely to be required to take on non-relevant discipline classes than experienced teachers. One school indicated that extra courses were available for those teaching outside discipline to boost teachers' confidence. There were mixed opinions as to whether staff were happy with teaching outside their main discipline. Some suggested staff enjoyed this and it helped to develop their skills, whereas others indicated it was stressful and unwanted additional workload.

Base n = 437; Combined and Triple n = 384; Combined only n = 20; Triple only n = 31.

* (i.e. main field of teaching)

HOW ARE TEACHERS OF THE SCIENCES EMPLOYED?

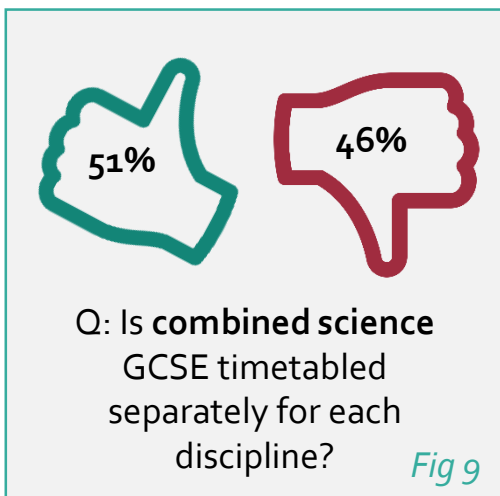


Please note, this question was asked about teachers in general. It was not asked separately for combined science teachers and triple science teachers, rather results have been cross-tabulated by GCSE route offered. Assumptions that combined science is more likely to be taught by 'science teachers' than triple science is supported by the qualitative findings.

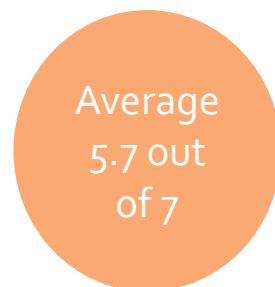
- Survey results identified that schools teaching combined science only were most likely to employ staff as 'science teachers', whereas triple science only schools were highly likely to employ teachers of a specific discipline.
- Qualitative interviews suggested that schools offering both combined and triple were likely to place job ads requiring 'science teachers with particular disciplinary expertise in...'. This was dependent on school needs.
- Several interviewees mentioned disciplinary shortages, particularly for physics teachers. This led to non-expert teaching.
- Students were more likely to be aware of their teachers' main field if they were taught by one teacher per discipline – and of course, if their job title specified this, e.g. chemistry teacher.

"I think the problem there is that, when they have combined science, they have two teachers, they have two exercise books. So, let's say I was sharing a class with a biology teacher, they would teach the biology, I would teach the physics, and then we would share the chemistry between us. [...] There are some students who struggle and they sometimes get a bit blurred between the edges: hang on are we doing physics right now, are we doing chemistry right now?" - Combined and triple routes, OP

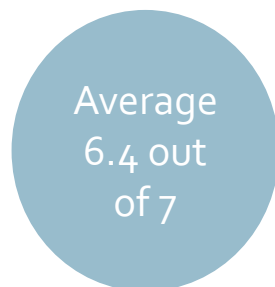
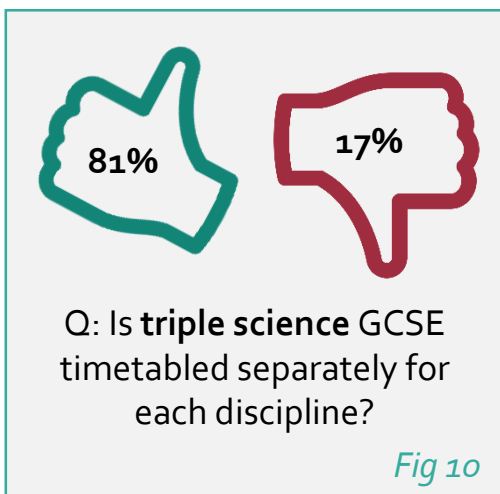
ARE STUDENTS ABLE TO DIFFERENTIATE BETWEEN THE DISCIPLINES?



Q: To what extent do you think students are able to differentiate between the disciplines within their **combined science** GCSE lessons?



Q: To what extent do you think students are able to differentiate between the disciplines within their **triple science** GCSE lessons?

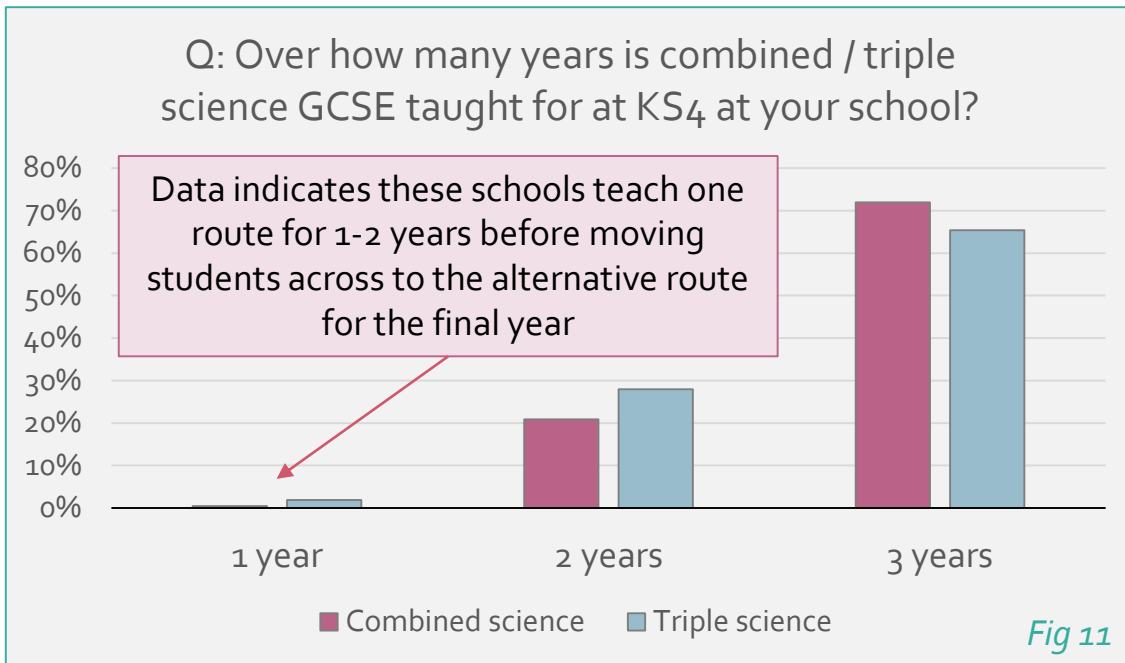


- Findings indicate that students are more likely to be able to differentiate between the disciplines within triple science than combined science. Triple science was more commonly timetabled as the separate disciplines, whereas 46% of schools offering combined science suggested this was timetabled as 'science'.
- Qualitative findings identified a number of factors which contributed to clear student understanding of the differentiation between disciplines:



- Several interviewees suggested classes taught by 2 teachers or non-disciplinary experts led to blurred disciplinary lines. It was reported that crossovers in discipline topics also led to some confusion for lower attaining students.
- Triple science was more likely to have distinct features overall. This was thought to be beneficial for students, as they were able to clearly identify where their strengths and weaknesses lie. This clarity was also thought to promote KS5 science as students had more understanding of what they enjoyed and possible career paths.

OVER HOW MANY YEARS ARE GCSE SCIENCES TAUGHT?



- Findings indicate that the majority of schools teach GCSE sciences over 3 years. Interestingly, combined science is more likely to be taught over 3 years than triple science.
- Qualitative interviews suggested this course length was more prominent following the GCSE reforms. Schools were likely to justify the extended length due to the amount of content that needed to be covered. Several interviewees stated that this was particularly the case for biology, with some schools starting this subject earlier than physics and chemistry.
- Schools who were teaching GCSE sciences over 3 years indicated that KS3 was taught in Y7 and Y8, although there was some crossover into Y9. It was common that KS4 teaching would begin in the second term of Y9. It was uncommon for option GCSE subjects to be taught in 3 years.

Qualitative case studies – schools teaching GCSE sciences across 3 years:

- One school teaches GCSE sciences across 3 years. All students are taught triple science content until the end of Y10, when they are then split into two routes – either continuing on with triple or moving across to combined science. Decisions are largely based on science assessment, with the top achievers remaining with triple science.
- Three schools reported teaching GCSE sciences across 3 years. All students are taught combined science in Y9, but from Y10, the top 2 sets move over to triple science. These students are already ear marked for triple at the beginning of KS4 science, however student progress in Y9 also contributes to final decisions.

- Qualitative interviews indicated that the cut off time for which students were able to move between combined and triple science differed between institutions, although it was largely universal that combined students were unlikely to be able to move to triple – while vice versa was possible. Some schools allowed students to switch up to Y11 mocks, whereas others reported a strict cut off at Y9. Early cut offs were linked to an additional option GCSE being available for combined science.

ARE GCSE SCIENCES GIVEN AN EQUIVALENT SHARE OF TEACHING TIME?

Q: Within a timetable cycle, how many single periods are allocated to GCSE science?
(Ratio combined : open option)

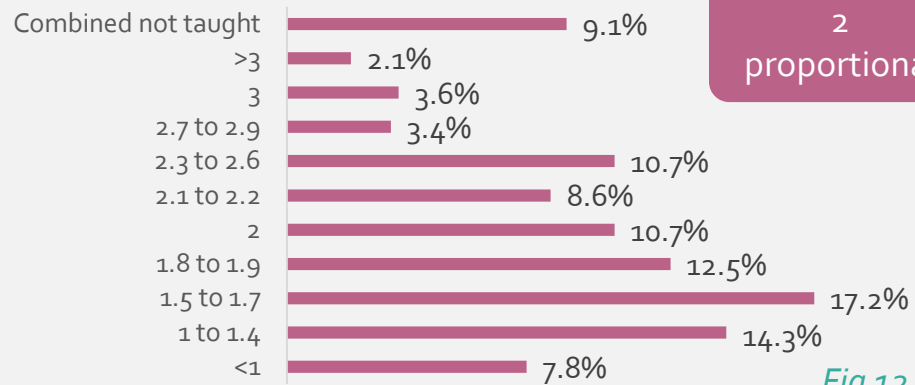


Fig 12

Q: Within a timetable cycle, how many single periods are allocated to GCSE science?
(Ratio triple : open option)

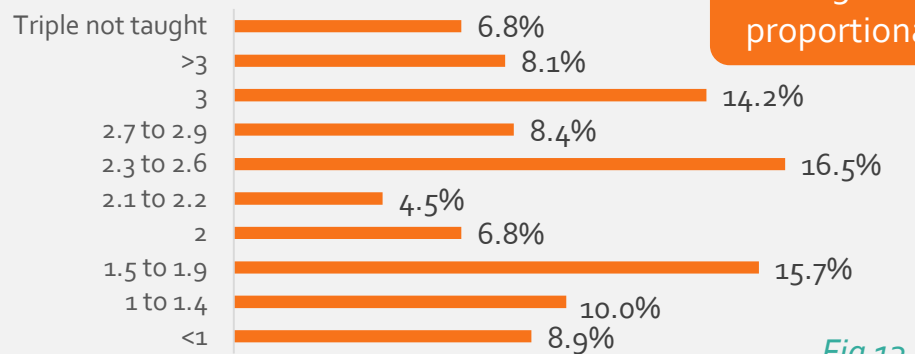


Fig 13

- We explored how many single periods were allocated to teaching GCSE sciences compared to other open option GCSEs. Using ratio calculations that take into account all years taught, we identified that the majority of schools fall below the proportional share of teaching time than above, i.e. combined science (2 GCSEs) should be allocated twice the teaching time as a single GCSE, and triple science (3 GCSEs) should be allocated three times that of a single GCSE. Extreme time deficits were likely to be present between triple science and other open options.

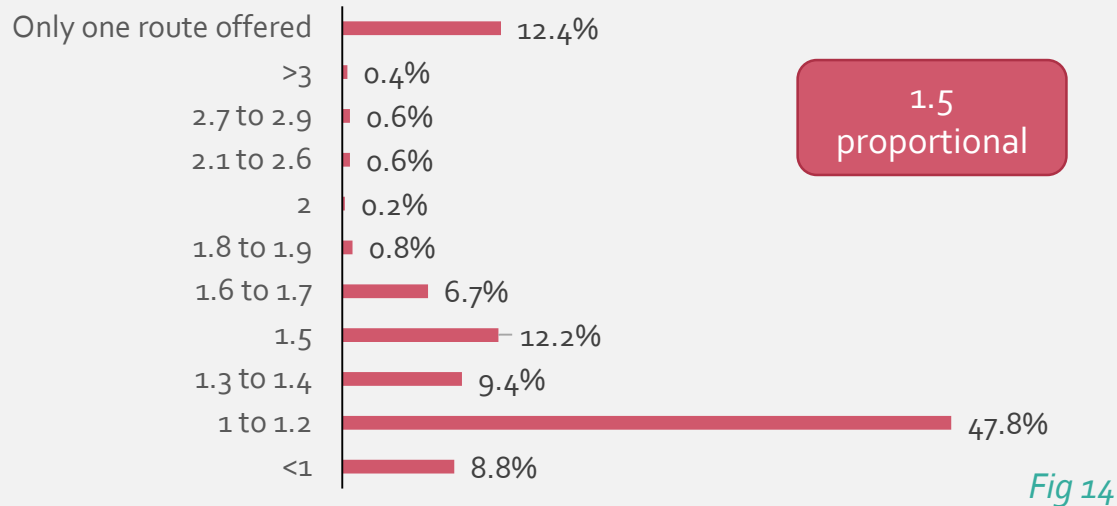
	% above proportional ratio	% below proportional ratio
Combined : open GCSE (n=349, 'combined not taught' removed)	31%	57%
Triple : open GCSE (n=355, 'triple not taught' removed)	9%	76%

- Rationale for time allocation differences included a lack of time available within the timetable, a lack of science staff to teach more lessons, insufficient resources e.g. science labs to cater for more classes, as well as schools wanting students to take as many optional GCSEs as possible. All interviewees who reported unequal time allocation were unhappy with science timetabling, although a majority acknowledged they understood why the decisions had been made. Qualitative findings hinted that schools with SLT members who were also science teachers, or those which involved heads of science in timetabling decisions were more likely to get a balanced share of time.
- Those with an uneven number of GCSE science periods available per cycle were likely to suggest that an even amount was given to each discipline, then, any 'leftover' periods were shared or given as catch up for those who needed. This process was unlikely to be formalised. Another school reported that each cycle was dedicated to a discipline, for example one cycle taught solely biology, the next cycle taught only physics, and so on.

C:O Base n = 384, T:O Base n = 381. Values represent the number of hours allocated to e.g. combined science, divided by the number allocated to e.g. an open science option.

ARE COMBINED AND TRIPLE SCIENCE GIVEN AN EQUIVALENT AMOUNT OF TEACHING?

Q: Within a timetable cycle, how many single periods are allocated to GCSE science? (*Ratio triple : combined*)



- Timetabling which did not allow adequate teaching time for triple science led schools to restrict which students were allowed to follow this route i.e. only higher tier students:

"[Triple science] is a real squeeze, it's really difficult, because I think the additional content, even starting that early in Year 9 [...] I think that's probably the reason why we've kept [student allocation based on student attainment]. We want to be in control of who does triple and who doesn't, because you have to go at a faster pace to fit it in the time that we're allocated as a school." - Combined & triple routes, VU

- We explored teaching time allocations for triple, compared to combined science. Using ratio calculations that take into account all years taught, we identified that the majority of schools fall below (67% - 0 to 1.4) the proportional share of teaching time than above (9% - >1.5). Only 12% of schools were offering a 3:2 ratio.
- A number of reasons were given as to why combined and triple science were not given an equivalent share of teaching time. This included schools wanting to avoid restrictions on optional GCSE subjects, lack of time available within the timetable and lack of staff to teach more classes. Triple pathway in particular was considered time consuming and was thought to unbalance the curriculum, making it harder to offer a broad range of other subjects. It was also thought to be resource consuming and financially draining.
- One teacher provided rationale as to why triple science was allocated the same amount of teaching time as combined science:

"Mainly down to the headteacher not wanting Science to be an option subject, so he doesn't want the extra teaching time to come from a different GCSE. So, yeah, he'd rather them have the same number of option subjects and, if they want to squeeze in Triple, they can [...] I think they kind of see, if they gave that slot over to Science, then there'd be fewer GCSEs being awarded throughout the school".

- Combined & triple science routes, LP

- Several interviewees suggested that the cohort of high tier students selected for triple science were expected to be able to cope with more intensive teaching, therefore uneven time allocation was justified.

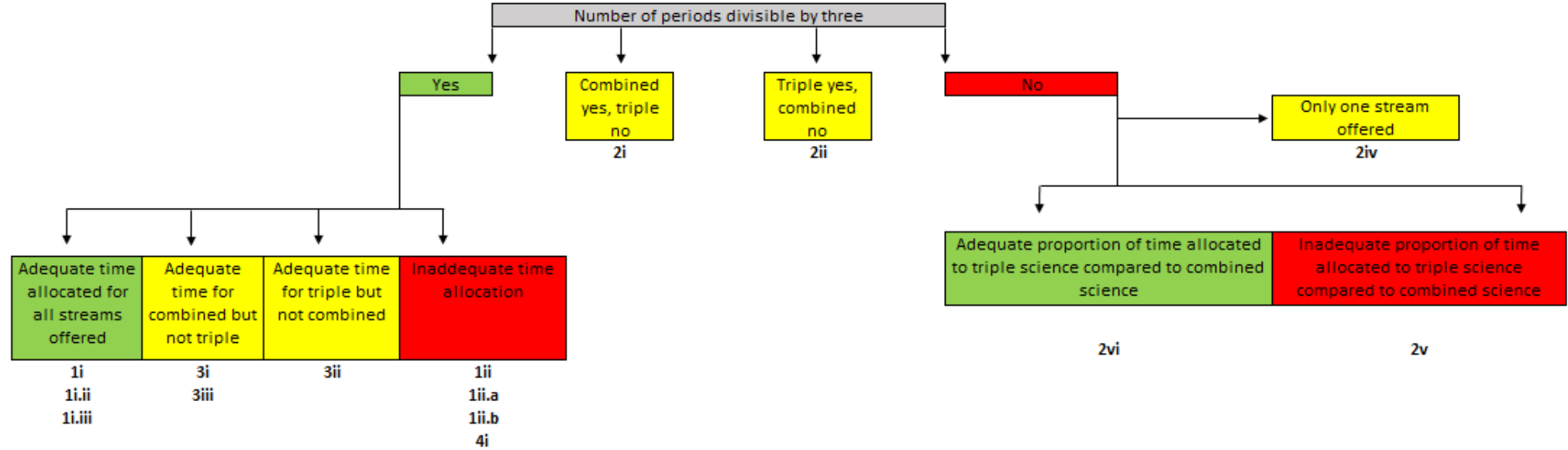
C:T Base n = 490. Values represent the number of hours allocated to e.g. combined science, divided by the number allocated to e.g. an open science option.

APPENDICES

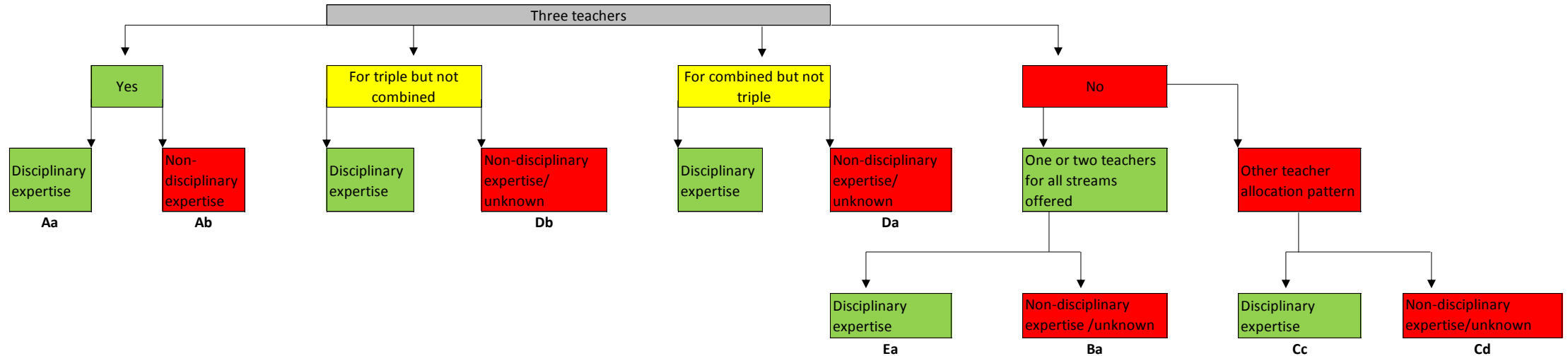
INDEPENDENT MODEL VARIABLES

Time group code	Description
1i	Number of periods divisible by three, and combined given twice allocation of open option and triple given three times allocation of open option and triple/combined allocation is greater than 1.5 times (both streams taught)
1i.i	Number of periods divisible by three, and combined given twice the allocation of open option (combined only offered)
1i.ii	Number of periods divisible by three, and triple given three times allocation of open option (triple only offered)
1ii	Number of periods divisible by three for both combined and triple science and combined/open allocation less than two times or unknown and triple/open allocation less than three times and triple on less than 1.5 times allocation to combined or unknown (both streams taught)
1ii.a	Number of periods divisible by three and combined/open less than two times allocation or unknown (combined only taught)
1ii.b	Number of periods divisible by three and triple/open allocation less than three times or unknown (triple only taught)
2i	Number of periods for combined science is divisible by three, triple is not .
2ii	Number of periods for combined science is not divisible by three, triple is .
2iv	Number of periods not divisible by three and only one stream is offered
2v	Number of periods not divisible by three and triple/combined allocation is less than 1.5 times.
2vi	Number of periods not divisible by three and triple/combined allocation is greater than 1.5 times.
3i	Number of periods divisible by three, combined science given twice (+) time of open, triple not given three time (+) of open
3ii	Number of periods divisible by three, combined science not given twice (+) time of open, triple given three time (+) of open
3iii	Number of periods divisible by three, combined science not given twice (+) time of open or unknown, triple not given three time (+) of open or unknown, triple/combined is greater than 1.5
4i	Number of periods divisible by three, and combined given twice allocation of open option and triple given three times allocation of open option and triple/combined is less than 1.5 (both streams taught)
Teacher allocation code	Description
Aa	Three teachers for all science streams offered and teach within discipline
Ab	Three teachers for all science streams offered and teach without disciplinary expertise
Cf	Three teachers for all science streams offered and teach with unknown disciplinary expertise
Da	Combined science has 3 teachers, triple does not , and teachers are non-experts or unknown
Db	Combined science does not have 3 teachers, triple does , and teachers are non-experts or unknown
Ba	Less than three teachers for all science streams offered, and teachers are non-experts or unknown
Ea	Less than three teachers for all science streams offered, and teachers within discipline
Cc	Other teacher allocation (incl. missing data) but teachers teach within discipline
Cd	Other teacher allocation (incl. missing data) but teachers teach without disciplinary expertise
F	Four teachers

TIME



TEACHER ALLOCATION



A 'decision tree' has been developed separately to further illustrate the possible routes.

FULL LIST OF IDENTIFIED MODELS

Model	Count	Model	Count	Model	Count	Model	Count	Model	Count	Model	Count	Model	Count
1i.iAb	1	1ii.bAb	7	2iBa	3	2iiF	2	2vDb	18	3iiAb	1	MDGAa	3
1i.iiAa	3	1ii.bCd	1	2iCc	1	2ivAa	3	2vF	1	3iiiAa	8	MDGAb	4
1i.iiAb	4	1ii.bCf	3	2iCd	3	2ivAb	3	2viAb	3	3iiiAb	10	MDGBa	1
1iAb	3	1iiAa	19	2iCf	1	2ivBa	8	2viBa	3	3iiiBa	6	MDGDb	3
1iBa	2	1iiAb	45	2iDa	1	2ivCd	2	2viCf	1	3iiiCd	2	1iAa	0
1iCc	1	1iiBa	11	2iDb	12	2ivCf	1	2viDb	7	3iiiCf	2	1i.iAa	0
1iCd	1	1iiCd	1	2iEa	1	2ivEa	1	2vMDG	2	3iiiDb	11		
1iCf	1	1iiCf	5	2iiAa	11	2vAa	15	3iAa	6	4iAa	2		
1ii.aAa	1	1iiDb	17	2iiAb	24	2vAb	34	3iAb	4	4iAb	10		
1ii.aAb	3	1iiEa	3	2iiBa	3	2vBa	20	3iBa	4	4iBa	1		
1ii.aBa	7	1iiMDG	1	2iiCd	4	2vCd	1	3iCc	1	4iCf	1		
1ii.aCf	2	2iAa	9	2iiCf	7	2vCf	8	3iCf	5	4iDb	1		
1ii.bAa	11	2iAb	20	2iiDb	29	2vDa	2	3iDb	3	4iF	1		

Preferred models

Mixed preferability

Problematic models

While more model variations are possible, our sample are using 82 unique models. 'Proportional' combined only and combined and triple route models are not present within our sample.

Identifier	GCSE science routes offered	Funding type	School type	Ofsted rating	GCSE year cohort size	Assigned model
OT (369)	Combined science	State	Academy	Inadequate	170	1ii.aBa
CP (142)	Combined and triple science	State	LA maintained	Outstanding	300	4iDb
MT (454)	Combined and triple science	State	Academy	Outstanding	270	1iiAb
FQ (549)	Combined and triple science	State	Academy	Good	250	2iiAa
FG (206)	Combined and triple science	Independent	-	-	110	3iiiAa
LP (232)	Combined and triple science	State	Academy	Good	250	1iiDb
ON (553)	Combined science	State	State comprehensive	Unknown	150	2ivBa
OP (38)	Combined and triple science	Unknown	Unknown	Unknown	230	2vDb
VU (110)	Combined and triple science	State	LA maintained	Outstanding	200	2vAb
FH (136)	Combined and triple science	State	Academy	Good	150	1iiDb

QUANTITATIVE AND QUALITATIVE RESEARCH GUIDES

Introduction text:

Thank you for taking part in this survey. Your feedback will be really valuable in helping the Institute of Physics, Royal Society of Biology, Association for Science Education, Royal Society and Royal Society of Chemistry understand common models for timetabling of the sciences at GCSE. Findings from this research will help support their education policy work.

Closing date: 4th November 2018

Completion time: 10 minutes

Prize draw: £250

Please note that we strictly abide by the Market Research Society Code of Conduct. If you have any questions about the research or how your details will be stored, please contact Elsie Lauchlan at elsie.lauchlan@shift-learning.co.uk or visit our website or read our privacy policy. Thanks again for your help!

Questionnaire:

Knowledge of science timetabling:

To take part in the survey, you'll need to have a strong knowledge of the timetabling of the sciences at your school. It's important we gather accurate information, therefore if you think another colleague at your school is better placed to answer the survey, for example the Head of the Science Department, please forward it on.

1.	<p>Are you aware of how KS4 science is currently timetabled at your school?</p> <ul style="list-style-type: none"> a) Yes, I'm involved in science timetabling decisions b) Yes, I have a good understanding of how science is timetabled at my school although I'm not directly involved in decisions c) No, I'm not involved or aware of timetabling of the sciences at my school
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School timetabling:		
To start the survey, we want to better understand timetabling at your school. If you are unsure of the answer to any questions, please specify so.		
2.	<p>What is the length of the timetable cycle at your school at KS4?</p> <ul style="list-style-type: none"> a) 1 week b) 2 weeks c) 3 weeks d) A/B format, please give details e) Unsure f) Other, please specify 	
3.	How many periods are there in a timetable cycle at KS4? If you're unsure, please write 'DK' in the box below.	
4.	<p>How long is a standard single KS4 class period?</p> <ul style="list-style-type: none"> a) <Scale from 20-100 minutes> b) Unsure c) Other, please specify 	
5.	Approximately how many students are in a year group at GCSE level?	
Science timetabling:		
We now want to look specifically at the timetabling of the sciences at your school.		
6.	<p>Which of the following does your school teach at KS4? Please select all that apply.</p> <ul style="list-style-type: none"> a) Combined science (e.g. also referred to as double, award worth 2 GCSEs) b) Triple science (leading to 3 distinct GCSE awards in Biology, Chemistry and Physics) c) BTEC applied science level 2 d) Science is taught in a different way <please give details> e) Unsure 	
7.	<p>Within a KS4 year group, approximately how many students are currently taking... If you are unsure, please write 'DK' in the boxes below.</p> <ul style="list-style-type: none"> 1. Combined science 2. Triple science 	

8.	<p>Which of the following contribute to how the allocation of students to combined or triple science at KS4 is determined? <i>Please select all that apply.</i></p> <ul style="list-style-type: none"> a) Student ability when they enter the school b) The set they are in across all subjects c) The set they are in for maths specifically d) The set they are in for science specifically e) A science assessment or exam f) Students themselves decide g) High ability students decide h) Unsure i) Other, please specify
9.	<p>Is combined science GCSE (also known as double science) timetabled separately for each discipline? <i>i.e. with separate timetabled lessons for biology, physics and chemistry.</i></p> <ul style="list-style-type: none"> a) Yes, it is timetabled as separate disciplines b) No, it is timetabled as 'science' c) Unsure d) Other, please specify
10.	<p>To what extent do you think students are able to differentiate between the disciplines within their combined science GCSE lessons? <i>For example, do they know what topics are chemistry as opposed to biology?</i></p> <p>1= Not at all, 7= Completely, Unsure</p>
11.	<p>Is triple science GCSE timetabled separately for each discipline? <i>i.e. with separate timetabled lessons for biology, physics and chemistry.</i></p> <ul style="list-style-type: none"> a) Yes, it is timetabled as separate disciplines b) No, it is timetabled as 'science' c) Unsure d) Other, please specify

12.	<p>To what extent do you think students are able to differentiate between the disciplines within their triple science GCSE lessons? <i>For example, do they know what topics are chemistry as opposed to biology?</i></p> <p>1= Not at all, 7= Completely, Unsure</p>
13.	<p>Over how many years is combined science GCSE taught at your school?</p> <p>a) 1 year b) 2 years c) 3 years d) Unsure e) Other, please specify</p>
14.	<p>In which year(s) is combined science GCSE taught?</p> <p>a) Year 9 b) Year 10 c) Year 11 d) Other, please specify</p>
15.	<p>Over how many years is triple science GCSE taught for at KS4 at your school?</p> <p>a) 1 year b) 2 years c) 3 years d) Unsure e) Other, please specify</p>
16.	<p>In which year(s) is triple science GCSE taught?</p> <p>a) Year 9 b) Year 10 c) Year 11 d) Other, please specify</p>

Science teaching	
Thank you for your answers so far!	
17.	<p>How many teachers work within your science department?</p> <p>a) <Scale 1-15> b) Unsure c) Other, please specify</p>
18.	<p>At this point in time, how many teachers are allocated to teach sciences at GCSE level across all KS4 years?</p> <p>a) <Scale 1-15> b) Unsure c) Other, please specify</p>
19.	<p>If a student in year 11 was taking GCSE combined science, how many teachers would they usually be taught by? <i>Please consider current practice at your school.</i></p> <p>a) 1 b) 2 c) 3 d) 4 e) Unsure f) Other, please specify</p>
20.	<p>Please give more details on how teaching for combined science is divided. <i>For example, are teachers having to teach a subject outside of their expertise?</i></p>
21.	<p>If a student in year 11 was taking GCSE triple science, how many teachers would they usually be taught by? <i>Please consider current practice at your school.</i></p> <p>a) 1 b) 2 c) 3 d) 4 e) Unsure f) Other, please specify</p>
22.	<p>Please give more details on how teaching for triple science is divided. <i>For example, are teachers having to teach a subject outside of their expertise?</i></p>

Science lessons

In this section, we want to find out more about how many periods are allocated to teaching the sciences at GCSE. You specified that the length of your timetable cycle is <mask answer from Q2>. Please note, if science lessons are taught in double periods, please consider this as 2 single periods.

23. Within a timetable cycle, how many single periods are allocated to GCSE **combined science** in...

1. Year 9
2. Year 10
3. Year 11

- a) <Scale from 1-20>
- b) Unsure
- c) N/A
- d) Other, specify

24. Within a timetable cycle, how many single periods are allocated to GCSE **triple science** in...

1. Year 9
2. Year 10
3. Year 11

- a) <Scale 1-20>
- b) Unsure
- c) N/A
- d) Other, specify

GCSE lessons

We'd like to know how the timetabling of science periods compares to other GCSE options.

25. Within a timetable cycle, how many periods are allocated to a GCSE option subject? *For example, Geography or History.*

1. Year 9
2. Year 10
3. Year 11

- a) <Scale 1-20>
- b) Unsure
- c) N/A
- d) Other, specify

About you

We'd now like to learn a little bit more about you. This information will help us to contextualise your responses.

26.	<p>Which of the following best describes your job role? <i>Please select as many as apply.</i></p> <ul style="list-style-type: none"> a) Head teacher b) Member of Senior Leadership Team e.g. Deputy Head c) Head of Science Department d) Head of Biology e) Head of Chemistry f) Head of Physics g) Biology teacher h) Chemistry teacher i) Physics teacher j) Science teacher k) Other, please specify
27.	<p>Do you consider more than one discipline (i.e. Biology, Chemistry, Physics) to be your field of teaching?</p> <ul style="list-style-type: none"> a) Yes b) No c) Other, please specify
28.	<p>Which of the following do you consider to be your <u>main</u> field of teaching?</p> <ul style="list-style-type: none"> a) Biology b) Chemistry c) Physics d) Other, please specify
29.	<p>At this point in time, are you or other teachers in the science department required to teach outside of your/their main field of teaching at KS4?</p> <ol style="list-style-type: none"> 1. You 2. Science colleagues <ul style="list-style-type: none"> a) Yes b) No c) Unsure, N/A

30.	<p>Within the last 2 years, are teachers of the sciences at your school employed as...</p> <ul style="list-style-type: none"> a) Science teachers b) Teachers of a specific discipline e.g. biology, chemistry, physics c) It varies d) Unsure e) Other, please specify
<p>Your school Only a few more questions!</p> <p>It's important that we gain a representative sample to ensure our research is robust. We would therefore like to link your responses to information held by the Department for Education, including your school type, Ofsted rating and your school location. If you are unhappy providing this information, please write 'No' in the boxes below.</p>	
31.	School name:
32.	School postcode:
33.	<p>The Institute of Physics and other learned societies are keen to conduct future research on the impact of science timetabling models on progression rates from GCSE to A level.</p> <p>Are you happy for your responses within this survey to be passed onto the Institute of Physics and the Royal Society of Biology?</p> <p><i>Please note, we strictly abide with GDPR. Your responses will at no point be made available publicly.</i></p> <ul style="list-style-type: none"> a) Yes, I give permission for <u>all</u> my responses to be used for future research b) Yes, I give permission for my responses to be used <u>excluding</u> job role c) Yes, I give permission for my responses to be used <u>excluding</u> my school name, school postcode and job role d) No, I would not like my responses to be used as part of future research

Introduction text:

Thank you for taking part in the interview. Your feedback will be really valuable in helping the **learned societies** understand common models for timetabling of the sciences at GCSE.

Before we start, I'd like to remind you that the interview should last 1 hour and will be audio recorded but we strictly follow the MRS code of conduct and ESOMAR guidelines, meaning that we treat your confidentiality very seriously and your details will not be used for sales or marketing purposes.

After the interview the recording will be turned into a transcript, which you have the right to access. At the end of the interview, we will be seeking permission on how we can use your responses and your preferred level of anonymity. We destroy all personal data at the close of the project.

Are you happy for me to continue? Do you have any questions before we begin?

Script:

About you (2 minutes)	
Great. I'd like to start off just by confirming some of the details that you provided in the survey.	
Can I confirm your job role?	<i>[Interviewer to confirm using survey response]</i> <i>Do you have any TLR points or other responsibilities outside your job role?</i>
You specified that your school offers... <ul style="list-style-type: none"> • Combined science • Triple science ...at GCSE. Is that correct?	<i>[Interviewer to confirm which approach is used using survey response]</i> <i>Prompt: over how many years is the GCSE taught? Which school years? If 3 years, is the whole of KS3 taught in Y7 & 8?</i>
Is science taught in any other way at GCSE at your school?	<i>Prompt: If yes, how? Why do you do this?</i>

INTERVIEW GUIDE

Has this changed recently, for example since the GCSEs were reformed?	<i>Why is this?</i>
Timetabling decisions (5 minutes) Great. I'd now like to think about decision-making.	
Who is involved in GCSE timetabling decisions at your school?	<i>Prompt: How often is this reviewed?</i>
Who is involved in timetabling decisions for GCSE sciences specifically?	<i>Prompt: Can you talk me through the decision making process? How often is this reviewed? How long has science been taught in this way?</i>
What factors impact timetabling decisions?	<i>Prompt: Are there any factors which restrain your decisions around GCSE science timetabling?</i> Interviewer to prompt for reasons at school level, department level, science discipline level.
Has this changed recently, for example since the GCSEs were reformed?	<i>Why is this?</i>
Allocation of students to combined or triple science (10 minutes) [Only asked to those offering both combined and triple routes] I now want to discuss how students are allocated to GCSE science routes.	
Thinking about your current GCSE cohort, what proportion of students are taking combined science and triple science? (note its fine for teachers to answer in terms of number of classes i.e. top two sets always take triple.	<i>Prompt: does this vary year on year? Are there any factors which impact this?</i>
During the survey, you specified that students were allocated to combined or triple science at GCSE, dependent on...	<i>[Interviewer to confirm allocation method using survey response]</i>

INTERVIEW GUIDE

Can you give me more details on how this is determined?	<p><i>Interviewer to determine if this is a school decision or a pupil decision</i></p> <p>If the term “low ability” is used - explore what they mean by that</p> <p>If student choice is suggested – is this all students? Or just ‘high’ ability? If yes, unpack this.</p>
[If determined by the school] What is taken into account in this school decision / recommendation?	<i>Prompt: Is this a formal process? How is students’ ability in science measured? Are students’ interest in science taken into account?</i>
Is broader school data drawn on during the selection process?	<p><i>Prompt: If yes, how is this taken into account?</i></p> <p><i>For interviewer – this might be things like sets for maths or English, other timetabling decisions etc.</i></p>
Who makes the final decision?	
When is this decision made?	
Are there any circumstances when this process might differ?	
[if chosen by ability level or achievement] Why are lower ability / lower set students not allowed / encouraged to take triple science?	<p>Note for interviewer (do not reveal to respondent)</p> <p>In theory triple science does not cover more difficult content, just more of it. Similar to the comment about exploring the term “low ability” if used, we would be interested in exploring more if “more difficult” is used to describe triple – why do the teachers think that?</p>
[if chosen by the student] Does the school influence their choice?	<p><i>Prompt: Are they recommended a particular route?</i></p> <p><i>If so – go back to school determined questions.</i></p>
Can students move between triple and combined science?	<p>At which point can they no longer transfer? How is this determined?</p> <p><i>[If students are moved out of triple classes, or allowed to drop one of the three sciences in Y11] Can you explain why you do this?</i></p>
Do those who do double science take an additional non-science GCSE?	If not, why not?

INTERVIEW GUIDE

At your school, can students from double science take A level Biology, Chemistry or Physics?	<i>Prompt: In what circumstances? Why is this?</i>	
What are students' perceptions of combined science compared to triple science?	<i>Prompt: are students and their parents generally happy with the allocation process or are some unhappy? Does anyone complain?</i>	
What are students told about what the choice will mean for them?	<i>Prompt: what information are they given? [if already mentioned that it restricts A level choice] Do they understand that it may restrict what they can do at A level?</i>	
Has the way students are allocated changed recently, for example since the GCSEs were reformed?	<i>Why is this?</i>	
Single route option (5 minutes)		
[Only asked to those offering a single GCSE route]		
Can you explain the reasoning behind offering only one GCSE science route at your school?	<i>Prompt: are there any factors which have impacted this decision?</i>	
[If double science only] Does your school offer B, C or P at A level?		
[If double science only and offer sciences]	<i>How is that determined? Why is it determined in this way? Would you allow a student that completes double but scores particularly well in one of B,C,P to take that A level?</i>	
Can students choose to take any of the three sciences?		
What are students' perceptions of combined science compared to triple science?	<i>Prompt: are students and their parents generally happy with the school's decision or are some unhappy? Does anyone complain? In theory triple science does not cover more difficult content, just more of it. Similar to the comment about exploring the term "low ability" if used, we would be interested in exploring more if "more difficult" is used to describe triple – why do the teachers think that?</i>	
What are students told about what the choice will mean for them?	<i>Prompt: what information are they given? [if earlier questions establish they are double only and restricted in A level choice] Do they understand that it may restrict what they can do at A level?</i>	

INTERVIEW GUIDE

Differentiation of the disciplines (8 minutes)	
<p>During the survey, we asked you to rate the level to which students were able to differentiate between biology, chemistry and physics within their combined science GCSE lessons.</p> <p>You rated this a [...] out of 7.</p>	<p><i>[Interviewer to confirm rating using survey response]</i></p> <p><i>1=Not at all, 7= Completely</i></p>
<p>Can you explain why you gave this rating?</p>	<p><i>Prompt: Does this reflect the majority of students? Are there any instances when this differs?</i></p> <p><i>Note for interviewer, we might expect to see differences across sets</i></p>
<p>What do you think impacts students' understanding of the differences between the subjects?</p>	<p><i>Prompt: Has a lack of understanding caused any issues? If so, in what way?</i></p> <p><i>What impact does it have on teaching?</i></p>
<p>During the survey, we asked you to rate the level to which students were able to differentiate between biology, chemistry and physics within their triple science GCSE lessons.</p> <p>You rated this a [...] out of 7.</p>	<p><i>[Interviewer to confirm rating using survey response]</i></p> <p><i>1=Not at all, 7= Completely</i></p>
<p>Can you explain why you gave this rating?</p>	<p><i>Prompt: Does this reflect the majority of students? Are there any instances when this differs?</i></p>
<p>What do you think impacts students' understanding?</p>	<p><i>Prompt: Has a lack of understanding caused any issues? If so, in what way?</i></p> <p><i>What impact does it have on teaching?</i></p>

INTERVIEW GUIDE

Science lessons (10 minutes)	
You stated that your school has a [X week] timetable cycle at KS4. Is that right? And there are [X periods] in a timetable cycle?	<i>[Interviewer to confirm using survey response]</i>
How many periods are allocated to GCSE combined science within a timetable cycle?	<i>Prompt: How long are these periods? Does that differ by year group? What do you think of the number of periods allocated to combined science? Why was this decision made?</i>
How many periods are allocated to GCSE triple science within a timetable cycle?	<i>Prompt: How long are these periods? Does that differ by year group? What do you think of the number of periods allocated to combined science? Is this sufficient? Why was this decision made?</i>
Are you happy with the time available for GCSE science?	<i>Prompt: If no, what issues do you face? If relevant, do combined science and triple science receive a fair share of resourcing? If not, why?</i>
Are you delivering additional sessions for double or triple science outside timetabled hours?	<i>Prompt: Can you tell me more about this? What is covered in these sessions? Why do you do it? It for all students or just some? [if some, who decides who has to go]. Are these compulsory?</i>
Has time allocated for science changed recently, for example since the GCSEs were reformed?	<i>Why is this?</i>
How does the time for science compare to GCSE option subjects such as History or Geography?	<i>Prompt: are they given the same time? How many periods are allocated within a timetable cycle? If not, how does this differ?</i>
[If equivalent science time is different to option subjects] Why is science not given the equivalent time in the timetable?	<i>Prompt: what is the reasoning behind this?</i>

INTERVIEW GUIDE

Staff deployment (10 minutes)	
During the survey, you indicated that [X out of X] teachers in the science department were allocated to teach at GCSE level. Is that correct?	<i>[Interviewer to confirm using survey response]</i> <i>Prompt: How is the decision made in terms of who teaches which classes at KS4?</i>
Do any factors impact this allocation?	<i>Prompt: Is there a process behind which teachers are allocated to teach GCSE? Does this differ for combined and triple science?</i>
(if not mentioned) Do teachers often teach the same sets year on year, do they carry a class through Y9, 10 and 11 or do classes get a different set of teachers each year?	
[If not mentioned] Do different types of teachers get allocated to different sets or routes?	<i>Prompt: If not mentioned</i> Do some teachers only teach certain sets or subjects – how is that decided? Do heads of department get particular classes? Do new teachers tend to get a certain type of class?
How is teaching for combined science divided?	<i>Prompt: how many teachers would a student taking combined science typically be taught by? What subject do these teachers specialise in? Do any other staff members support provision, e.g. technicians?</i>
Are teachers expected to teach outside their subject of expertise?	<i>Prompt: If yes, what impact does this have on students' learning, if any? How often is this expected of teachers? How do they feel about this?</i>
How is teaching for triple science divided?	<i>Prompt: how many teachers would a student taking triple science typically be taught by? What subject do these teachers specialise in? Do any other staff members support provision, e.g. technicians?</i>
Are triple science teachers expected to teach outside their subject of expertise?	<i>Prompt: are there any factors which impact this decision? If yes, what impact does this have on students' learning, if any? How often is this expected of teachers? How do they feel about this?</i>

INTERVIEW GUIDE

How common is it for teachers delivering KS4 science to consider more than one discipline to be their field of teaching?	<i>Prompt: for example, biology, chemistry and physics. Generally, would teachers feel comfortable teaching more than one discipline?</i>
Are double science teachers deployed as science teachers or teachers of a specific discipline within your science department?	<i>Prompt: are there any instances when this differs? Are students aware of teachers' main field of teaching? What impact do you think this has on students, if any? What impact does it have on teachers?</i>
Are you happy with the resourcing available for GCSE science in terms of teachers?	<i>Prompt: If no, what issues do you face? If relevant, do combined science and triple science receive a fair share of resourcing?</i>
Have the teachers allocated for science changed recently, for example since the GCSEs were reformed?	<i>Why is this?</i>
Conclusion (2 minutes)	
Thank you for your time, in conclusion do you have anything else you'd like to say about the about what we have spoken about today?	

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