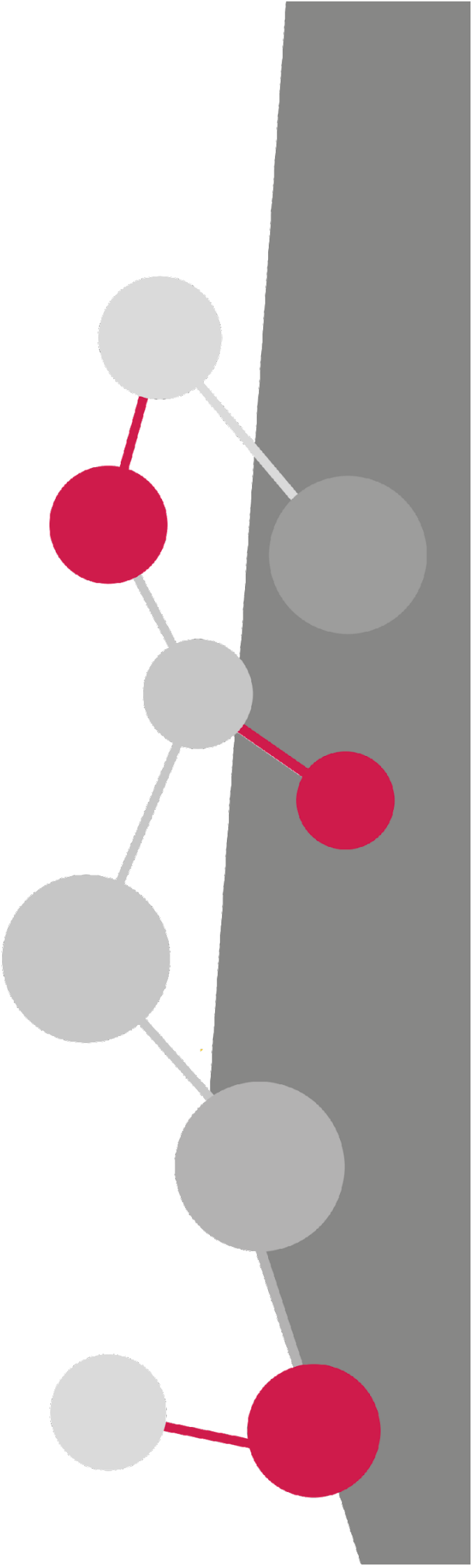
STEM LEARNING



Science Education in England:

Gender, Disadvantage and Ethnicity

Executive Summary

Gender and science attainment

Gender gaps in STEM have received considerable attention – largely focused on the lack of female students progressing to A level physics - and subsequently to physics and engineering in higher education.

This report explores the gender gaps at GCSE, and finds that there is **little difference in the proportion of male and female students entering and passing separate science GCSEs** (i.e. 'Triple Science'). However, when looking at the rate at which students achieve a 'high pass' (grades 9-7), the data shows a **higher proportion of male students achieving in physics, while higher proportions of female students achieve a high pass in biology**. The gaps in physics and biology are substantial (over 1% of the cohort) but chemistry results are much closer.

These gender gaps in GCSE sciences are crucial: students achieving high pass grades will be more confident and schools are more likely to allow them to progress to A levels in these subjects. This analysis of attainment in STEM A levels confirms that **a greater proportion of male students progress to take physics, while more female students take biology**. Interestingly, there is little difference in pass rates between male and female students for those who do enter science A levels, although a greater proportion of male students achieve a high pass in chemistry, more female students achieve a high pass in biology and physics.

Socioeconomic disadvantage

The impact of disadvantage is reflected in the type of science GCSEs taken by students. Every GCSE student in England should take at least two GCSEs in science. Around a quarter of students take Triple Science - separate GCSEs in physics, chemistry and biology. However, 69% of students take 'combined science', a qualification that counts as two GCSEs. Similar to Triple Science, combined science covers all three sciences, but students study less of each.

Our analysis shows a clear **negative correlation between socioeconomic disadvantage and less intensive engagement with GCSE science**. 80% of students from disadvantaged backgrounds take combined science compared to 66% of their peers. In some cases, this will reflect the fact that triple science is not on offer at their school - in 2019, 269 schools entered no students for GCSE triple science. On average, 38% of students at these schools were from disadvantaged backgrounds – compared to an average of 12% students at schools that entered at least three quarters of their students for triple science.

Furthermore, **students from disadvantaged backgrounds also perform less well in their science GCSEs** – whether they take combined science or triple science, they are less likely to pass and less likely to attain a high grade.

The disadvantage gap grows even wider at A level regardless of gender. **Students from non-disadvantaged backgrounds are around twice as likely to take science or mathematics A levels** compared with students from disadvantaged backgrounds. Moreover, there is a clear attainment gap between these two groups, with **students from non-disadvantaged backgrounds more likely to achieve a pass (A*-E) and a high grade (A*-A)**.

Ethnicity and science attainment in schools

There are **substantial variations in the pattern of science attainment across different ethnic groups**. For example, the data shows that around 30% of students from the Chinese ethnic group progress to science A levels, compared to less than 10% of students from a White British background, and less than 5% of students from a Black Caribbean background.

The analysis also separates disadvantaged and non-disadvantaged, male and female students. Similar patterns of lower entry and attainment for disadvantaged students can be seen across ethnicities, however the interaction with gender is more complex. For example, a higher proportion of non-disadvantaged male students from the Chinese ethnic group enter GCSE Triple Science compared to their female counterparts; while the pattern reverses for students from disadvantaged backgrounds - a higher proportion of female students enter. Differing patterns are seen for students from White British backgrounds (where entries to GCSE Triple Science are equal across genders), and students from Black Caribbean backgrounds (where female students are more likely to enter GCSE Triple Science, regardless of disadvantage).

Conclusion

STEM Learning's Science Education in England analysis highlights some of the complexities in understanding how young people achieve and progress in science - including how gender, disadvantage and ethnicity interact with performance and progression.

The work substantially increases our understanding of the challenges faced in science education, including how many of the issues manifesting at A level are apparent at GCSE or earlier. Organisations supporting young people to achieve and progress in their science education should familiarise themselves with the complex interplay between gender, disadvantage and ethnicity to ensure young people are supported in the most effective and appropriate ways.

STEM Learning, February 2022

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1. Introduction

About STEM Learning

STEM Learning is a not-for-profit organisation dedicated to improving young people's lives through the power of STEM. We believe that great STEM education builds knowledge and skills that are vital for everyone, leading to great career opportunities and enabling young people to become informed, thoughtful citizens who can help address the extraordinary challenges and opportunities. For more about STEM Learning and our impact, please see www.stem.org.uk and our latest Impact Report.

About this report

STEM Learning have utilised data from the National Pupil Database to analyse entries and attainment in science subjects. The analysis shows complex patterns of differential attainment correlated with gender and ethnic background. Further details on our analysis – including the full methodology and set of charts – can be accessed via www.stem.org.uk/impact-and-evaluation/data.

2. Triple Science

Every GCSE student in England should take at least two GCSEs in science - usually by taking either Combined Science (sometimes known as 'Double Award' or 'Trilogy'), or the separate sciences (often referred to as 'Triple Science'). In 2019, 96% of GCSE students from state-funded schools in England entered at least two science GCSEs. Around one in four GCSE students entered separate science GCSEs[1], and approximately 69% of students entered Combined Science.

Combined Science is worth two GCSEs and consists of six modules, covering Biology, Chemistry and Physics. The separate sciences or **Triple Science**, are three separate GCSEs in Biology, Chemistry and Physics, covering similar content to Combined Science with an additional module for each science subject.

Separate Sciences and Disadvantage

GCSEs in the separate sciences are often viewed as an aspiration for high achieving students. However, not all students are given the opportunity to study separate science GCSEs. Below, we explore the relationship between disadvantage and entry into separate science GCSEs.

At GCSE, students from disadvantaged backgrounds are identified using the Department for Education definition of disadvantage: students who have ever been eligible for free school meals in the last 6 years, or have been looked after for a day or more, or have been adopted from care. Throughout this report, we have shortened the term to the more widely recognised acronym, 'FSM'.

Table 1 shows that schools with a higher proportion of disadvantaged students are less likely to have any students entering separate science GCSEs. On average, schools with no entries have 38% of their Year 11 students from disadvantaged backgrounds.

% of students entering GCSE Separate Sciences	Mean % of FSM Year 11 students	Total schools	Total Year 11 GCSE students
0%	38%	269	43,769
1-25%	31%	1,467	250,455
25 – 50%	23%	1,102	188,862
50 – 75%	16%	172	27,544
>75%	12%	155	22,485

[1] In 2019, 26.6% of GCSE students from all state-funded schools in England entered the separate science GCSEs. In 2018, this was 27.4% and in 2017 it was 25.2%.

Table 1: Mean proportion of disadvantaged students in KS4 aligned with the proportion of pupils entered for separate science GCSEs.

The 2019 data, presented in Figure 1, show a negative relationship between the proportion of key stage 4 students from disadvantaged backgrounds and the proportion entered for the separate science GCSEs (r = -0.43). This shows that schools with a high proportion of disadvantaged students tend to have fewer students taking separate science GCSEs.

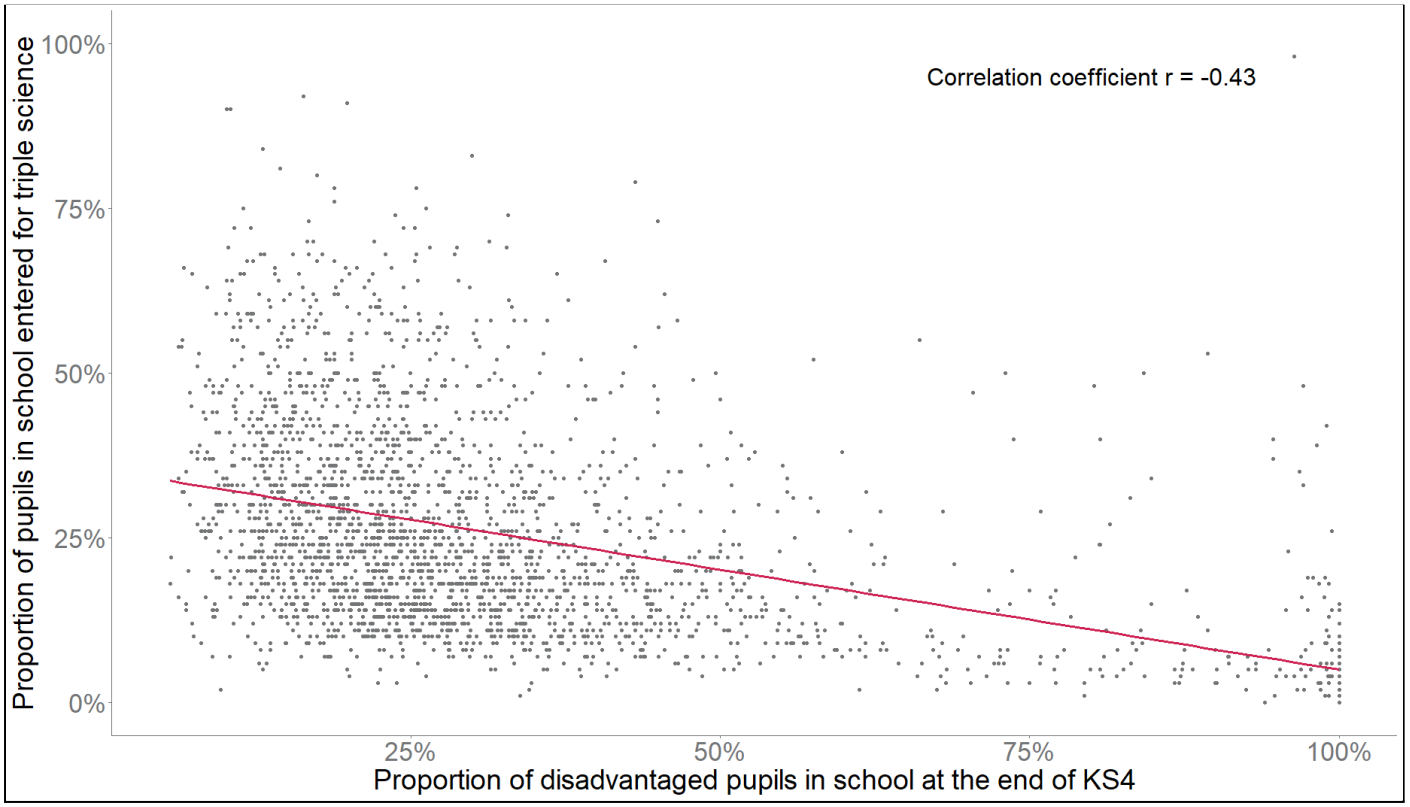

Figure 1: The negative correlation between the proportion of disadvantaged pupils at the end of KS4 and the proportion of pupils entered for separate science GCSEs in state-funded schools across England.

3. Gender

A level

Across biology, chemistry and physics A levels, there are significant differences in the proportion of females and males progressing from GCSE to enter each subject.

- In **mathematics** - the most popular A level subject by number of entries - 14.3% of male students progress from GCSE to take mathematics at A level, compared to only 9% of female students.
- Around 8.3% of male students progress from GCSE to take A level **physics**, compared with just 2.2% of female students.
- This difference is reversed in A level **biology**, with 12.5% of female students progressing from GCSE, compared with 7.2% of male students.
- **Chemistry** shows a much smaller gender difference, with 8.9% of female and 7.4% of male GCSE students progressing to take the subject at A level.

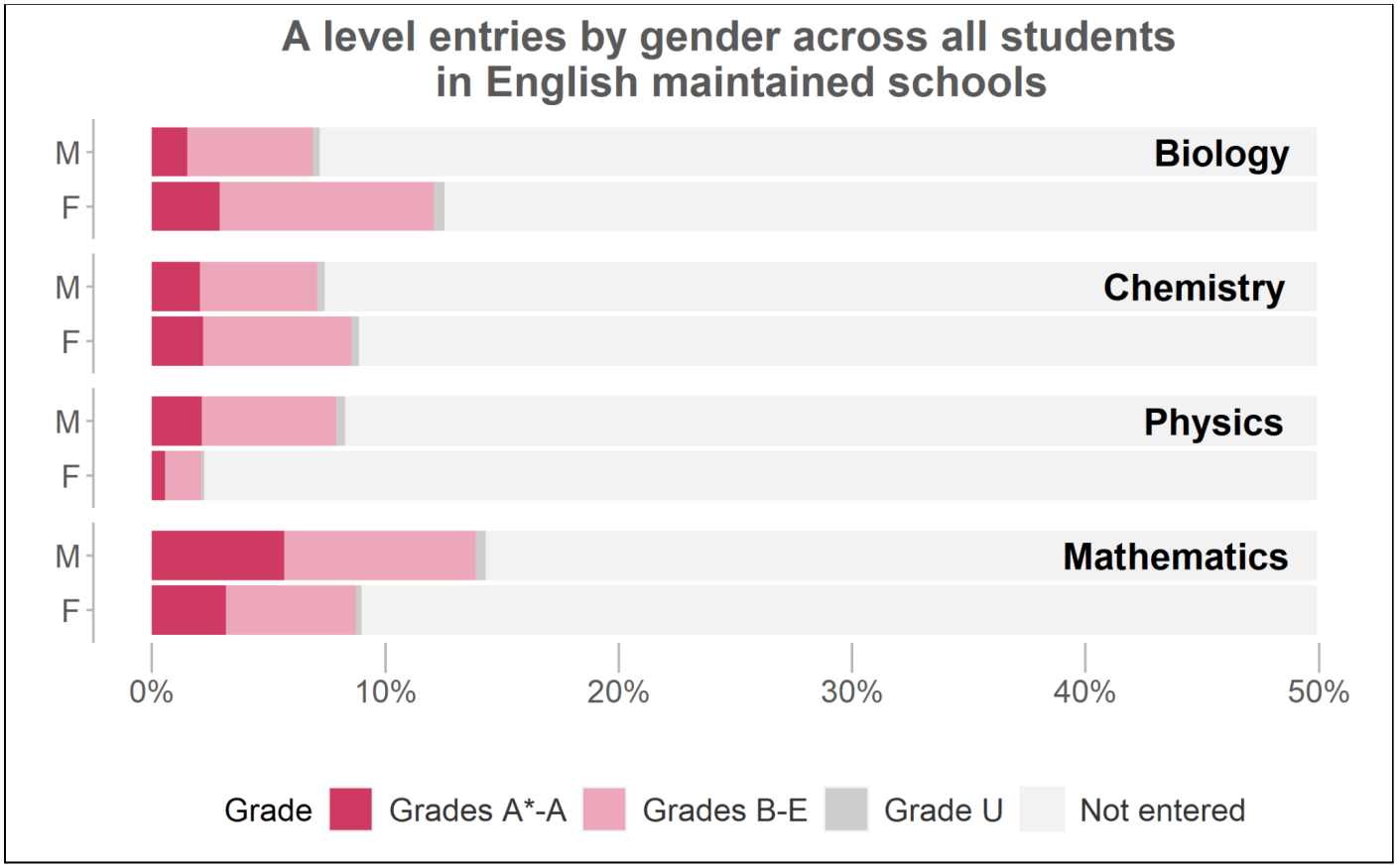

Figure 2: The percentage of the possible key stage 5 cohort in state-funded schools and colleges across England in 2019 entering science or mathematics A level, and those who did not enter, split by gender and grade achieved.

Despite the differences in the amount of students progressing to take science A levels, **there is little difference in attainment between male and female students for those entered**. Table 2 shows data from 2019; around 96% of both male and female science A level students achieved a pass (A* to E). For those achieving the highest grades (A* to A), there is slight variation across subjects. Biology has a lower proportion of students achieving high grades compared with chemistry and physics. There is little difference between the proportion of male and female students achieving high grades in physics; however in chemistry, male students were more likely to achieve a high pass, whereas female students were more likely to achieve a high pass in biology.

	Biology		Chemistry		Physics		Mathematics	
	Male	Female	Male	Female	Male	Female	Male	Female
Pass (grades A*-E)	95.5%	96.3%	95.6%	96.4%	95.4%	95.0%	96.8%	97.3%
High pass (grades A*-A)	22.6%	25.3%	30.5%	27.7%	27.8%	28.9%	42.6%	39.4%

Table 2: Proportion of male and female students from maintained schools and colleges across England entering and achieving a pass or high pass at A level in 2019.

GCSE

Gender differences across all maintained schools in England show that GCSE entries into separate science and combined science do not differ significantly between female and male students. There are slight differences in the attainment of students:

- In **combined science**, female students are more likely to achieve a high pass (5.5% achieved grades 9-7) or standard pass (34.9% achieved grades 6-4) compared with male students (4.2% and 32.2% respectively).
- In **physics**, male students are slightly more likely to achieve a high pass (12.5%) compared to female students (11.0%).
- However, in **biology** this pattern is reversed, with females more likely to achieve a high pass (12.4%) compared to males (11.3%).

The separate science GCSEs manifest distinct patterns across the proportion of male and female students who achieve the high grades (9 to 7). Table 3 shows the proportion of the GCSE cohort who achieved the high grades in 2019, split by gender and subject. **Female students consistently outperform male students in biology and chemistry**. Conversely, **male students consistently outperform female students in physics**.

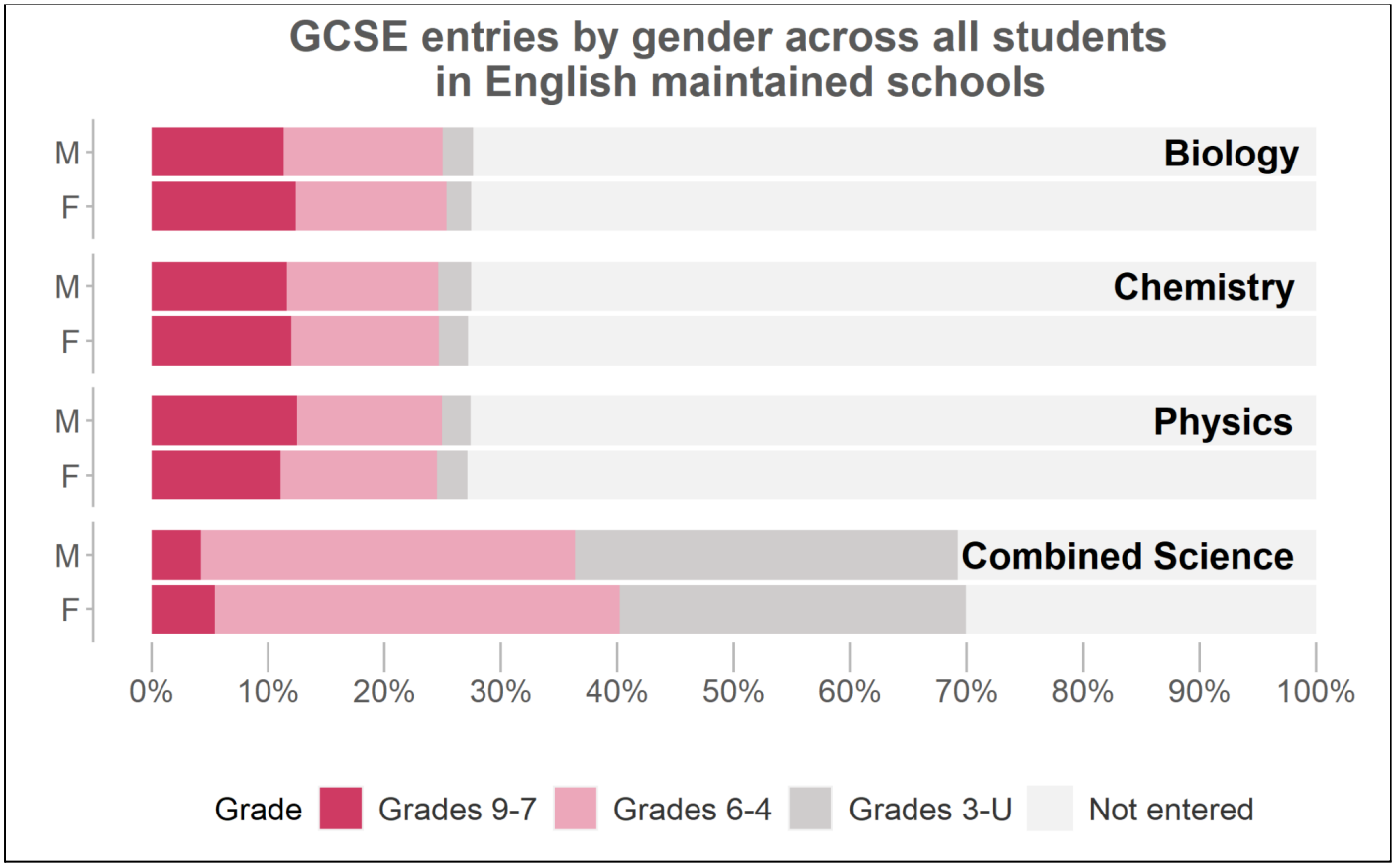

Figure 3: The percentage of the key stage 4 cohort in maintained schools across England in 2019 entering science GCSEs, and those who did not enter, split by gender and grade achieved.

Interestingly, these differences align to the gender differences in A level entries seen in Figure 2, such that **GCSE achievement may be a predictor of A level progression**. That is, female students are more likely to achieve a high grade in biology GCSE and are also more likely to progress to enter biology A level - the reverse is true for physics, with male students more likely to achieve a high grade at GCSE and progress to enter A level.

	Biology		Chemistry		Physics	
	Male	Female	Male	Female	Male	Female
High pass (grades 9-7)	11.3%	12.4%	11.6%	12.0%	12.5%	11.0%
Standard pass (grades 6-4)	13.7%	13.0%	13.0%	12.7%	12.5%	13.5%

Table 3: Proportion of male and female students from the total key stage 4 cohort in maintained schools across England achieving a standard or high pass at GCSE in 2019.

4. Disadvantage

A level

At A level, a higher proportion of students who are not from disadvantaged backgrounds (referred to as 'non-FSM' in the graphs below) both enter and achieve in science and mathematics. The pattern is relatively consistent across genders, with **fewer disadvantaged male and female students entering and achieving in science A levels compared to non-disadvantaged students**. However, the pattern across subjects is more complex.

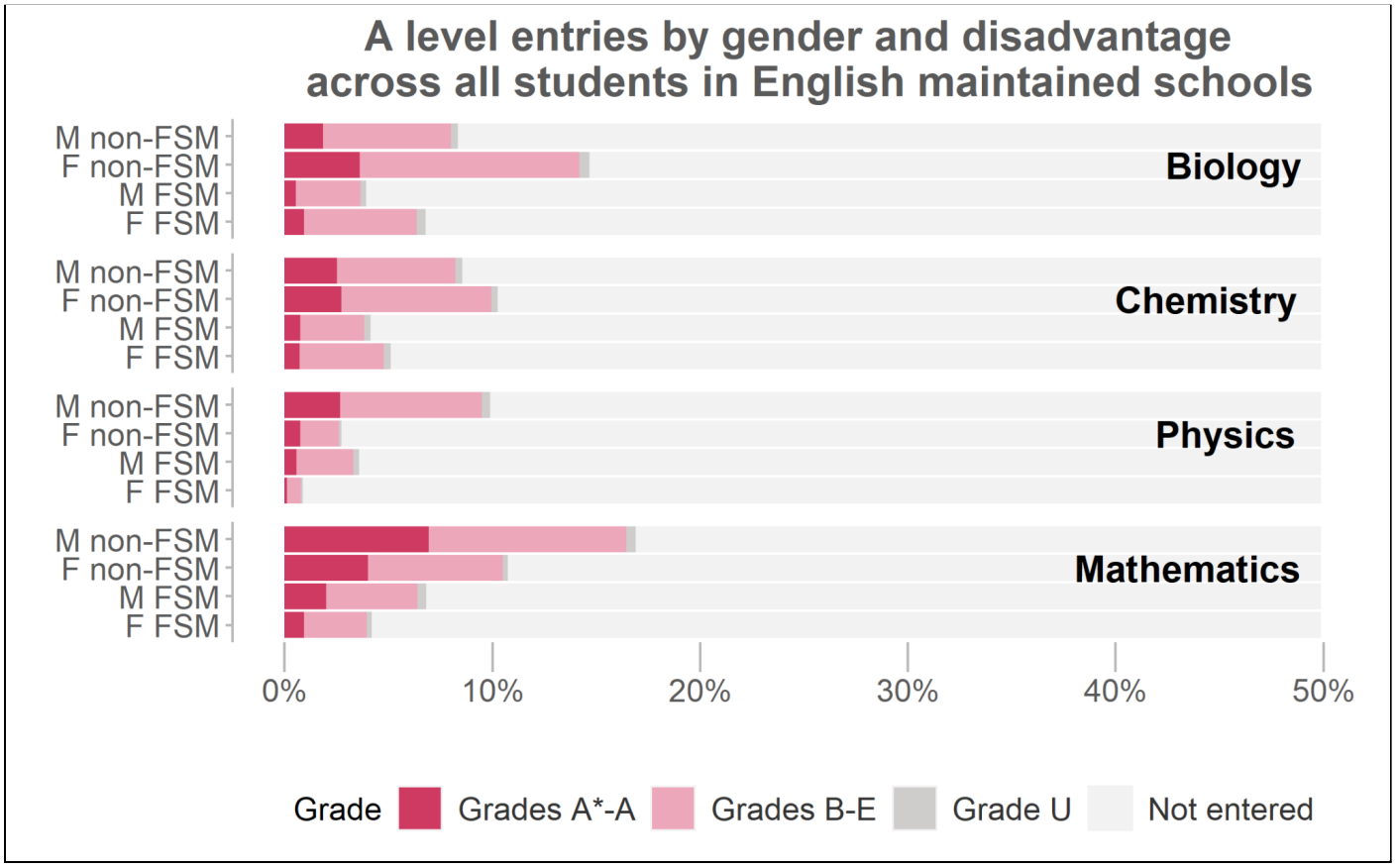

Figure 4: The percentage of the possible key stage 5 cohort in state-funded schools and colleges across England in 2019 entering science or mathematics A level, and those who did not enter, split by grade achieved, gender and disadvantage (FSM).

Figure 4 shows the proportion of students entering and achieving in science and mathematics A levels in 2019, represented as a proportion of the total possible A level students (calculated as those who completed key stage 4 in 2017)[2]. Female students are more likely to enter biology and chemistry, whereas

[2] For example 187,376 female non-FSM students finished KS4 in 2017, with 5,127 taking physics A level in 2019. Therefore, 2.7% of the female non-FSM cohort went on to take physics A level. 404 of these achieved A*, representing 0.2% of the female non-FSM cohort.

male students are more likely to enter physics and mathematics - this is true for students from disadvantaged backgrounds as well as those from non-disadvantaged backgrounds.

On the whole, **students from non-disadvantaged backgrounds are around twice as likely to take science or mathematics A levels compared with students from disadvantaged backgrounds**. Moreover, there is a clear attainment gap between these two groups, with **students from non-disadvantaged backgrounds more likely to achieve a pass (A*-E) and a high grade (A*-A)**.

Table 4 shows this gap for physics A level in 2019. Almost one in every ten male students (9.5%) from non-disadvantaged backgrounds progressed to physics A level and passed - compare this to only 2.6% of female students from non-disadvantaged backgrounds. Similarly, only 0.1% of female students from disadvantaged backgrounds achieved a high grade in physics, six times fewer than male students from disadvantaged backgrounds (0.6%).

	% KS4 cohort achieving physics A level			
	Female		Male	
	FSM	Non-FSM	FSM	Non-FSM
Standard pass (grades A*-E)	0.8%	2.6%	3.3%	9.5%
High pass (grades A*-A)	0.1%	0.7%	0.6%	2.7%

Table 4: The proportion of the key stage 4 cohort progressing to achieve grades A* to E and A* to A in physics A level in 2019, split by gender and disadvantage (FSM).

GCSE

At GCSE, **students from disadvantaged backgrounds are significantly more likely to enter combined science GCSE than the separate sciences**. Around 80% of students from disadvantaged backgrounds enter combined science compared with approximately 66% of their non-disadvantaged peers. This pattern is similar across both male and female students.

Furthermore, **students from disadvantaged backgrounds also perform less well across science GCSEs**. In both combined science and the separate sciences, students from disadvantaged backgrounds were less likely to achieve a high grade (9-7) and less likely to achieve a pass (9-4) compared to non-disadvantaged students.

In 2019, female students from disadvantaged backgrounds were less likely to achieve grades 9-7 - around 7% compared to 21% of non-disadvantaged females. Similarly, around 46% of female students from disadvantaged backgrounds achieved a grade 9-4 in 2019, compared with around 72% of non-disadvantaged females; the pattern is similar for male students (around 42% vs. around 67%).

Again, the pattern is similar for male students, with approximately 6% of disadvantaged students achieving the top grades compared with around 19% of non-disadvantaged students.

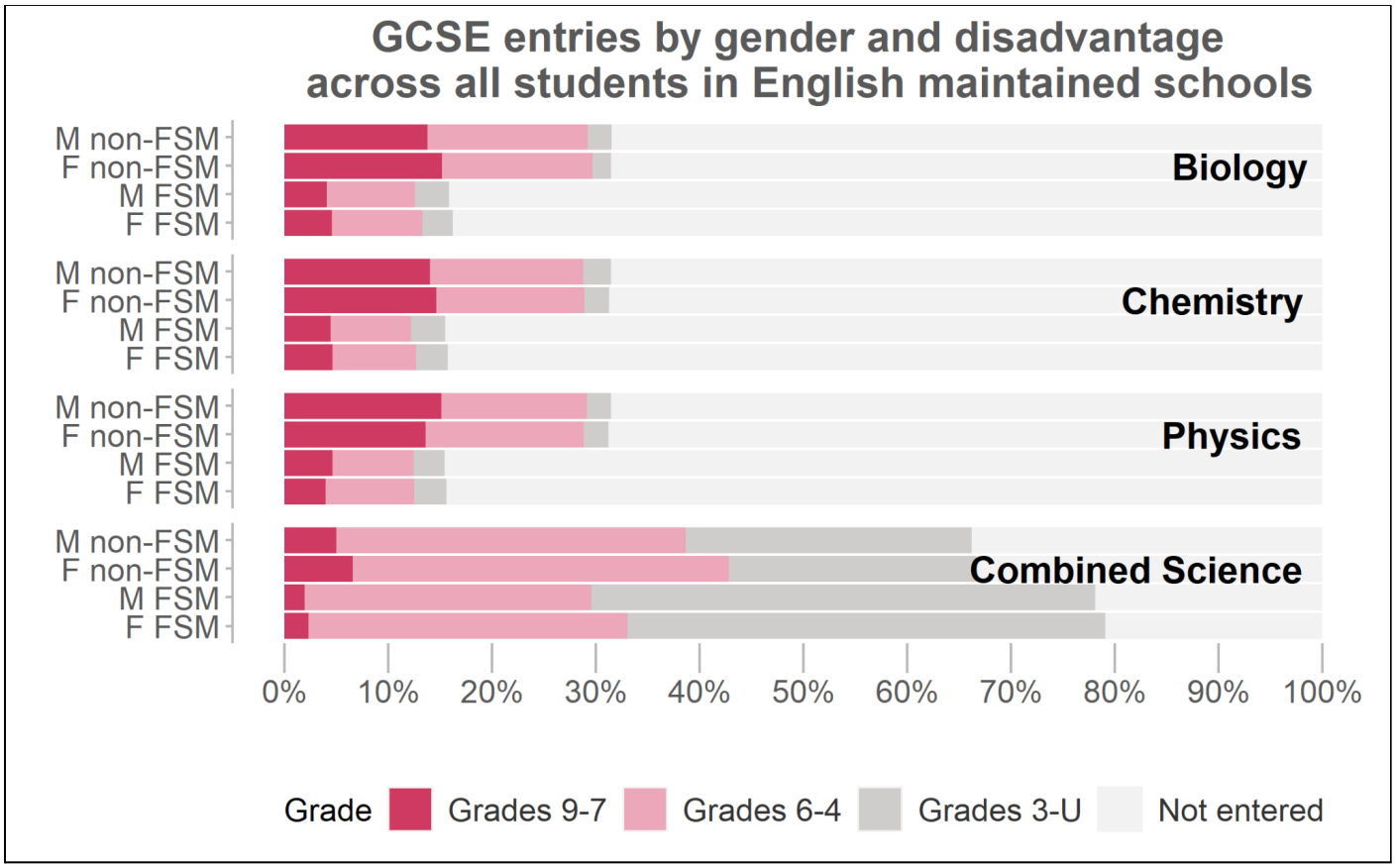

Figure 5: The percentage of the key stage 4 cohort in maintained schools and colleges across England in 2019 entering science GCSEs, and those who did not enter, split by grade achieved, gender and disadvantage (FSM).

In summary, compared with students from non-disadvantaged backgrounds, students from disadvantaged backgrounds are less likely to:

- Enter separate sciences at GCSE.
- Progress to science and mathematics A levels.
- Perform well in science at GCSE.
- Perform well in science and mathematics A levels.

5. Ethnicity

A level

White British students account for over half of the school cohort in English maintained schools and therefore show similar patterns to the overall national trends. Figure 6 allows a comparison of entries and attainment at A level, across science subjects.

Once again, this highlights the stark differences between gender and disadvantage across entries and attainment into science A levels.

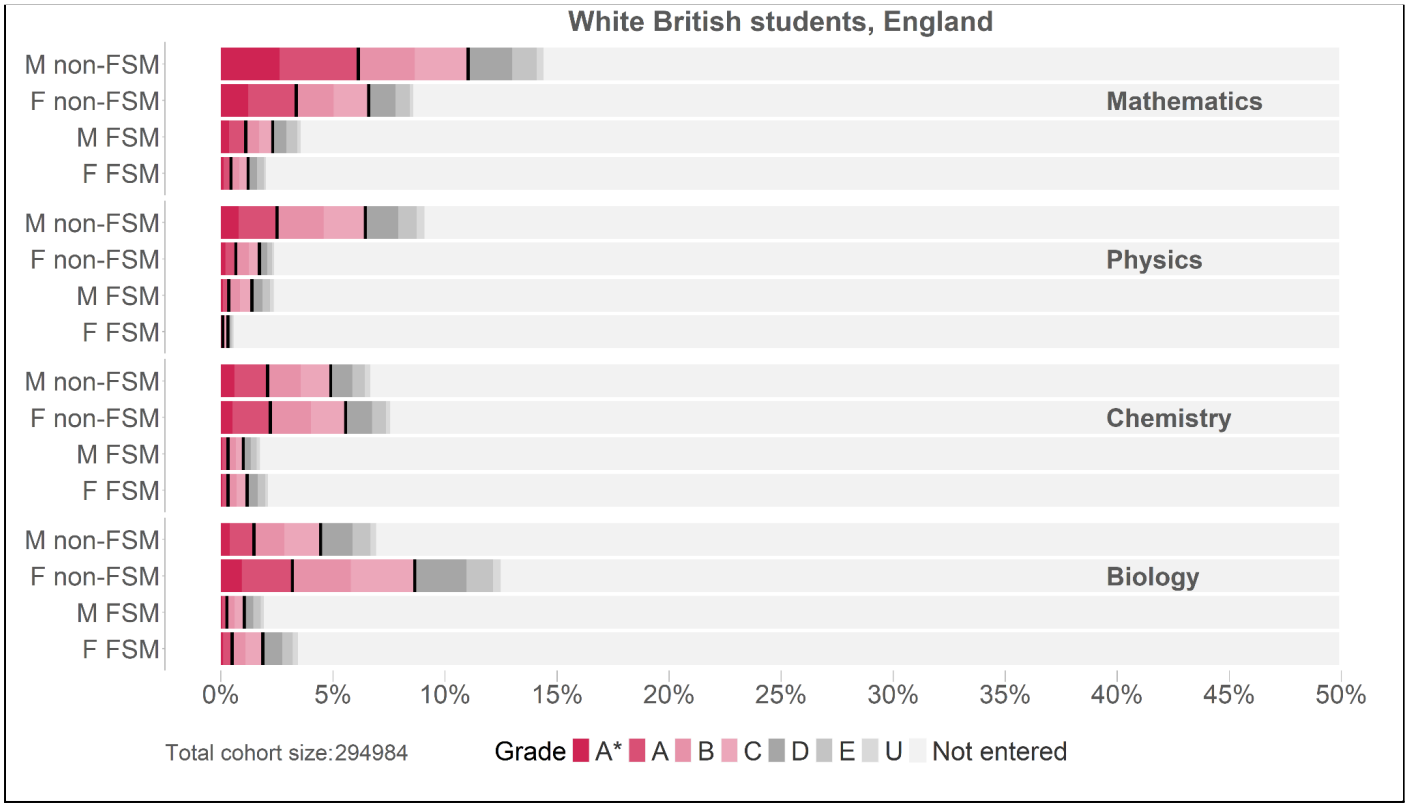

Figure 6: The percentage of White British students from the possible key stage 5 cohort in maintained schools and colleges across England in 2019 entering science and mathematics A levels, and those who did not enter, split by grade achieved, gender and disadvantage (FSM).

Whilst the patterns of gender and disadvantage remain relatively stable across different ethnicities, there are vast differences in the proportion of students progressing to and achieving science A levels.

Figure 7 shows that up to 30% of students from the Chinese ethnic group progress to science A levels, with around 40% progressing to take mathematics A level. In comparison, students from a White British

background show, on average, less than 10% of the GCSE cohort progressing to take science or mathematics A levels.

The analysis showed varying degrees of progression to science and mathematics A levels across different ethnicities. In certain cases, there were too few data points to draw reliable conclusions - such as those students from a Mixed ethnic background, or students from the White Gypsy and Roma ethnic group[3].

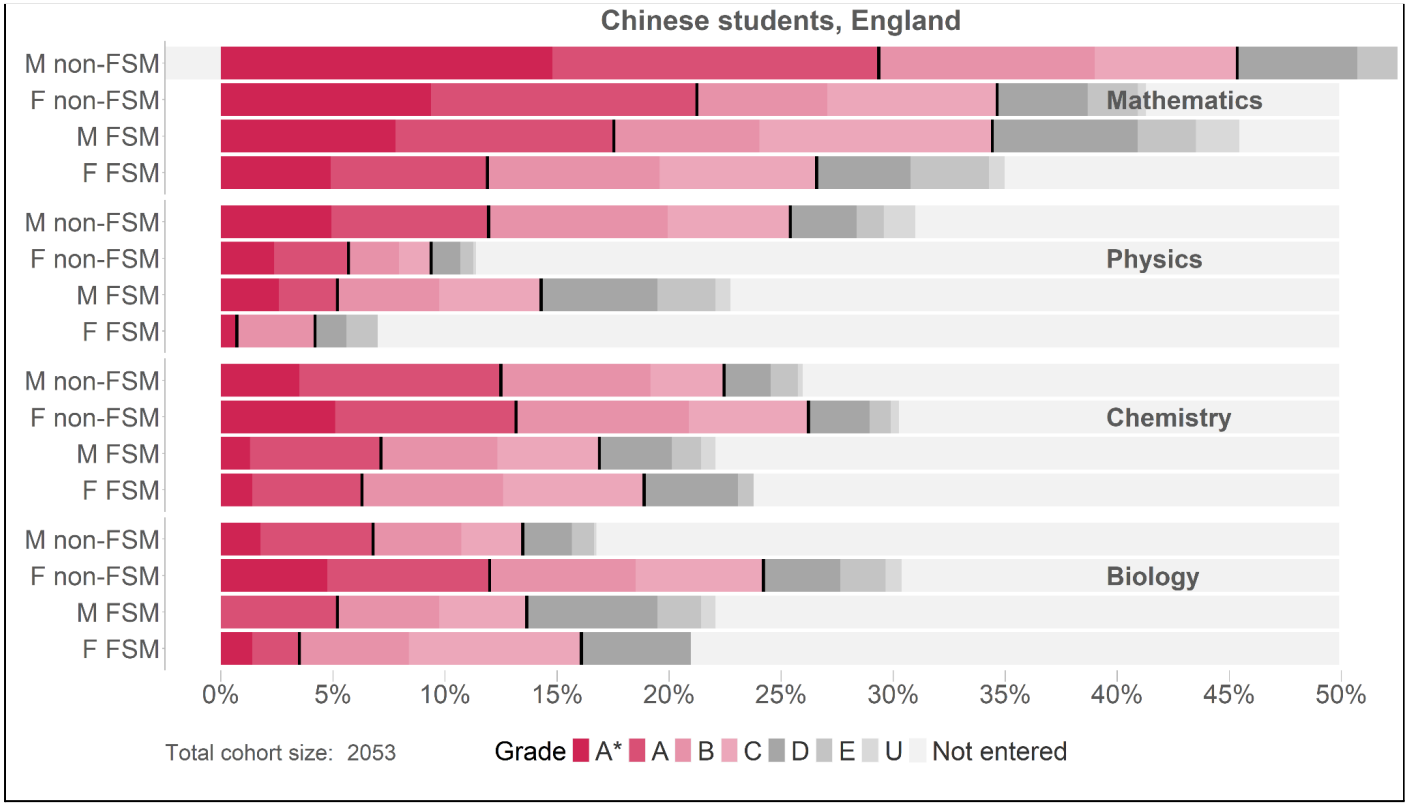

Figure 7: The percentage of students in the Chinese ethnic group from the possible key stage 5 cohort in maintained schools and colleges across England in 2019 entering science and mathematics A levels, and those who did not enter, split by grade achieved, gender and disadvantage (FSM).

Students from a Black Caribbean background are some of the least likely to progress from GCSE to science A levels. Figure 8 shows the patterns of entry and attainment across different science A levels. Once again gender and disadvantage show similar entry patterns to the national picture. However looking more broadly, there are significantly lower proportions of entries into these subjects, averaging at around 5%.

[3] For a full list of ethnic groups included and excluded from the analysis, see the Methodology documentation at https://www.stem.org.uk/impact-and-evaluation/data

Some of the cases that show the lowest entries include:

- Around 0.1% of Black Caribbean female FSM students progress to take computer science at A level. This compares with around 2.9% of students from the Chinese ethnic group.
- Similarly, only 0.9% of Black Caribbean female FSM students progress to take physics at A level, compared with 7% of students from the Chinese ethnic group, or 0.6% of White British students.

In comparison, some of the highest entries include:

- 14.4% of White British male non-FSM students progress from GCSE to take mathematics A level. This compares with 8% of Black Caribbean students, and 55.3% of students from the Chinese ethnic group.
- 10% of Black Caribbean female non-FSM students progress from GCSE to take biology at A level. This compares with 30.4% of students from the Chinese ethnic group and 12.5% of White British students.

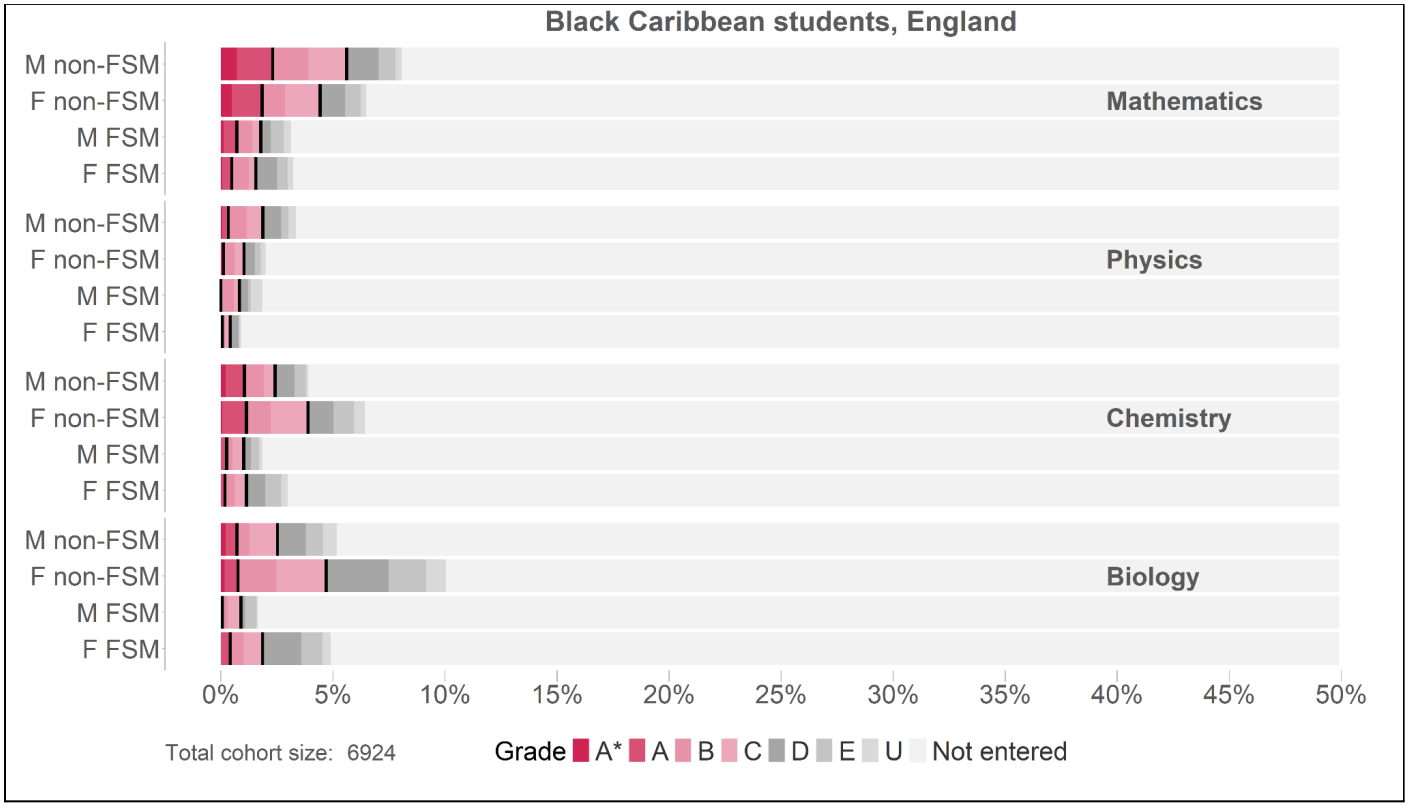

Figure 8: The percentage of Black Caribbean students from the possible key stage 5 cohort in maintained schools and colleges across England in 2019 entering science and mathematics A levels, and those who did not enter, split by grade achieved, gender and disadvantage (FSM).

GCSE

For White British students, entries into science and mathematics GCSEs follow the national trend. Once again, a higher proportion of non-disadvantaged students enter and achieve separate science and mathematics GCSEs compared to students from disadvantaged backgrounds.

Approximately one in every three White British non-disadvantaged students enter the separate science GCSEs, compared with around one in eight White British students from disadvantaged backgrounds.

Figure 9 shows a similar trend to the national picture in terms of GCSE science attainment. White British female students are more likely to achieve high grades in biology and chemistry, whilst their male counterparts are more likely to achieve a high grade in physics.

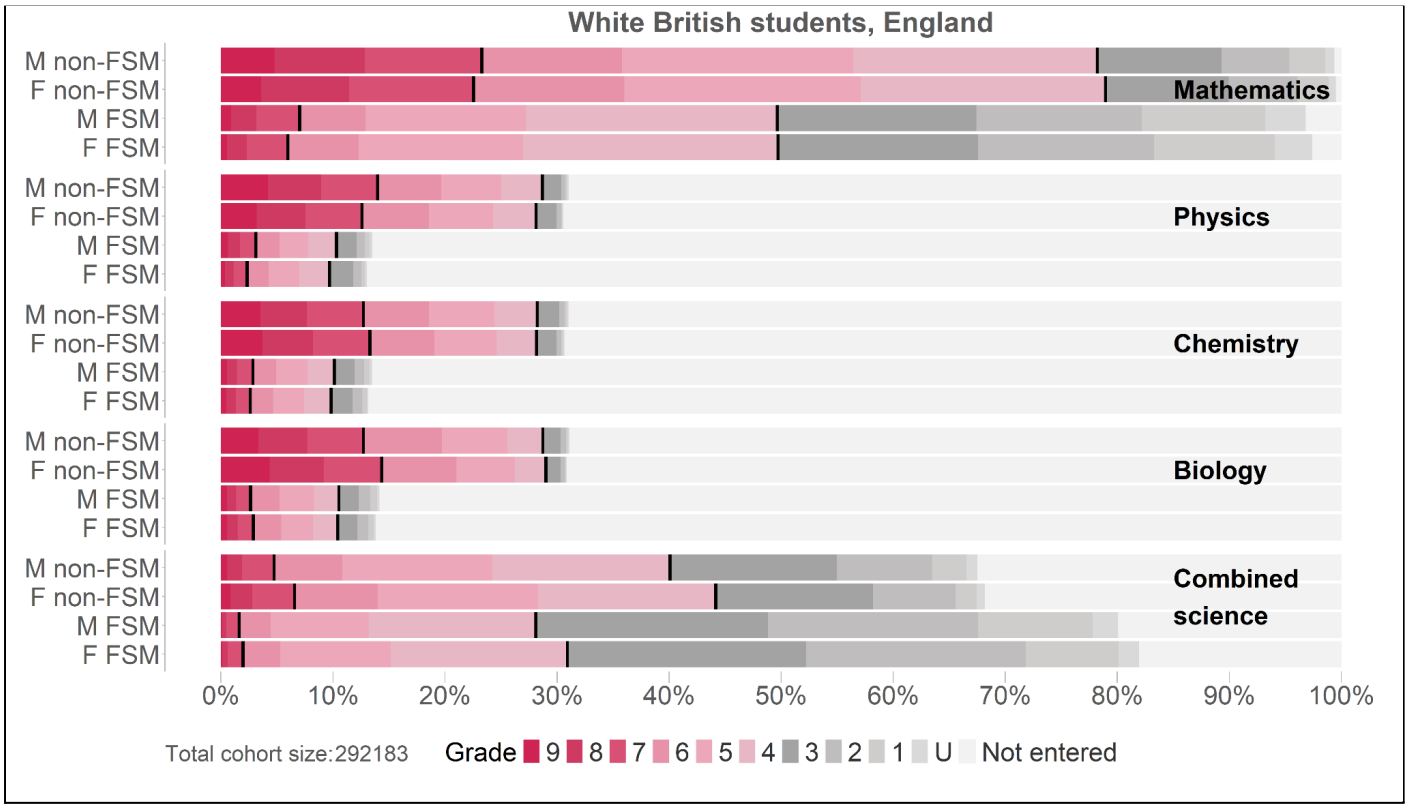

Figure 9: The percentage of White British students from the key stage 4 cohort in maintained schools across England in 2019 entering science and mathematics GCSEs, and those who did not enter, split by grade achieved, gender and disadvantage (FSM).

As with A level, students from the Chinese ethnic group (Figure 10) are one of the highest performing ethnicities, and Black Caribbean students show some of the lowest entry and achievement figures (Figure 11).

Some of the cases that show the lowest entries and attainment in science include:

- Around 10% of Black Caribbean male students from disadvantaged backgrounds enter the separate sciences at GCSE. This compares with around 48% of similar students from the Chinese ethnic group, and 14% of similar White British students.
- Only 35% of Black Caribbean disadvantaged male students achieve a pass in their science GCSE (grades 9-4 in either combined or separate sciences). This compares with 87% of similar students from the Chinese ethnic group, and 39% of similar White British students.

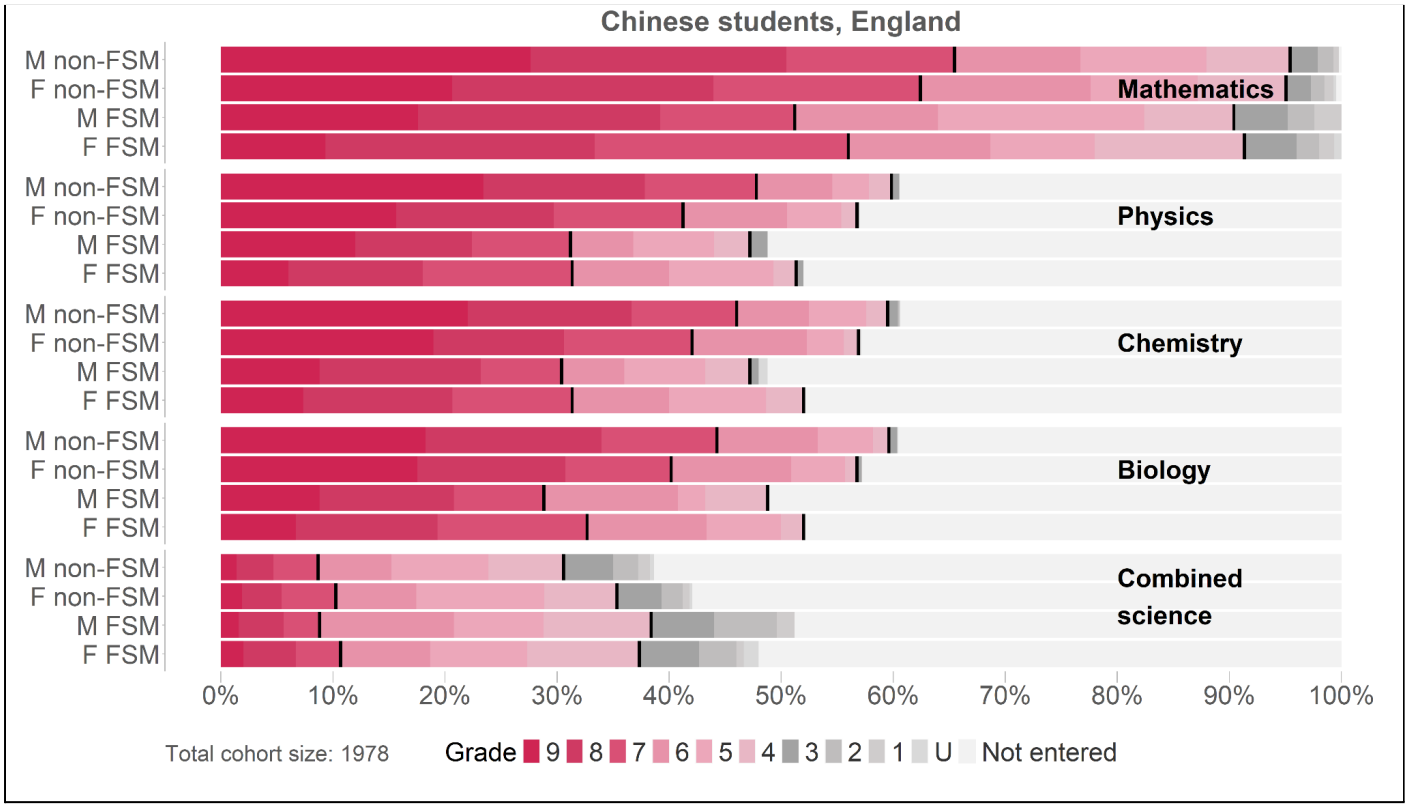

Figure 10: The percentage of students from the Chinese ethnic group within the key stage 4 cohort in maintained schools across England in 2019 entering science and mathematics GCSEs, and those who did not enter, split by grade achieved, gender and disadvantage (FSM).

In comparison, some of the highest levels of entry and attainment show that:

- 60% of non-disadvantaged male students from the Chinese ethnic group entered the separate science GCSEs, much higher than the entries from their Black Caribbean (16%) and White British counterparts (31%).

- Similarly, 44% of non-disadvantaged male students from the Chinese ethnic group achieved a high grade (9-7) in the separate science GCSEs compared with only 5% of Black Caribbean and 13% of White British non-disadvantaged male students.

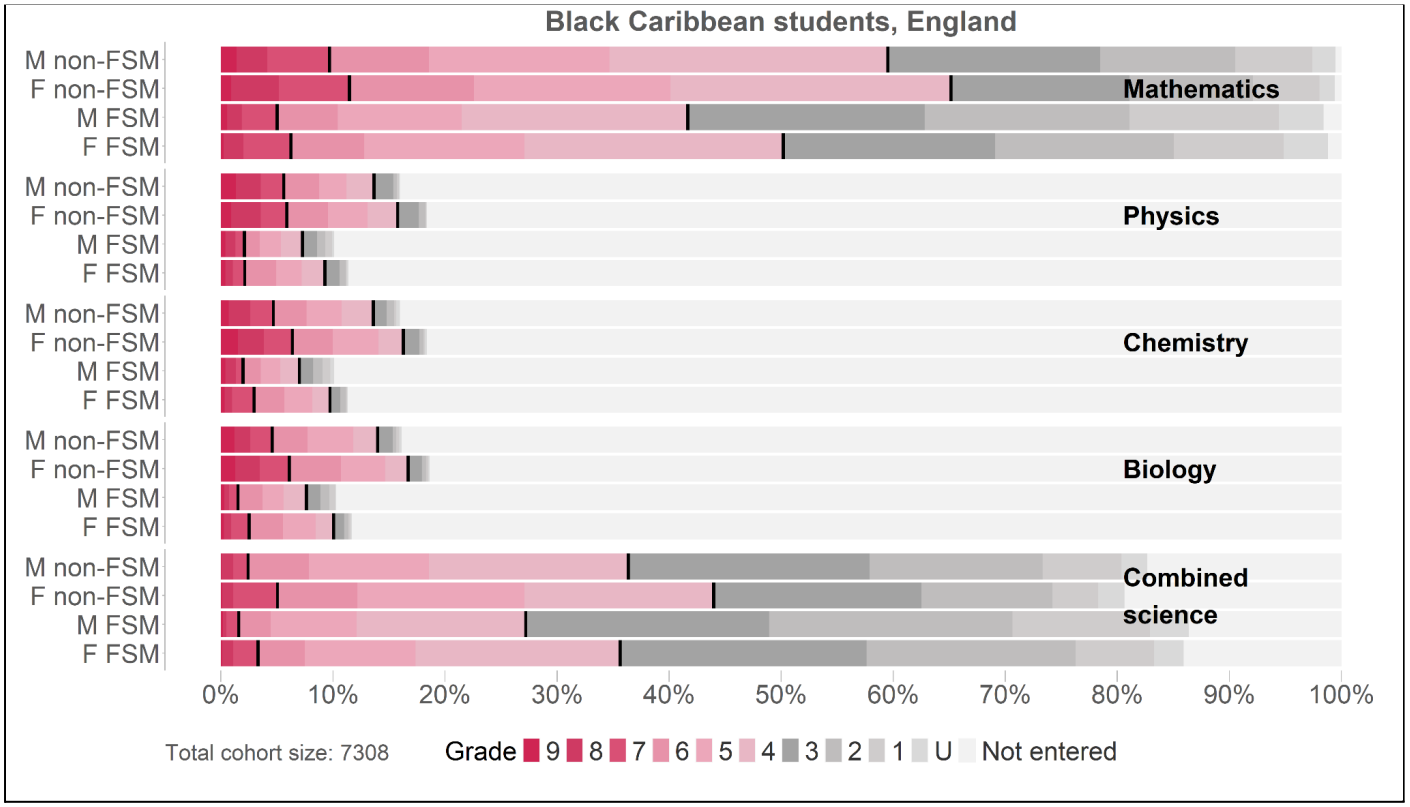

Figure 11: The percentage of Black Caribbean students within the key stage 4 cohort in maintained schools across England in 2019 entering science and mathematics GCSEs, and those who did not enter, split by grade achieved, gender and disadvantage (FSM).

The GCSE data presented above suggests that entry patterns into science A levels across different student characteristics (gender, disadvantage and ethnicity) are likely to be influenced by entry and achievement in science at GCSE - particularly within the separate sciences.

6. Summary

This report explores the trends in science education in 2019 across schools and colleges in England. The key findings highlight the differences in entries and attainment across state-funded schools. Furthermore, the data show differences in entries and attainment for science subjects across gender, student disadvantage and ethnicity at GCSE and A level.

STEM Learning seeks to better understand the trends in science education, to ensure our support is well positioned to meet the changing needs of schools and teachers throughout the UK.

For further information and to explore the data in more detail, please visit our website: https://www.stem.org.uk/impact-and-evaluation/data