An Institute of Physics Report | May 2018

Why not physics?

A snapshot of girls' uptake at A-level

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Foreword

Sometimes it is the idle comments that have the deepest effect in discouraging girls from taking physics to a higher level. An ill-judged quip that girls "can't" do maths, or physics is "too hard", can lead to girls making life-changing decisions that alter the subjects they study or the career they pursue. Women in physics are still in the minority, and this lack of visibility preserves the myth and cements the fact that physics is simply not a subject for girls.

Our 2012 report, *It's Different for Girls*, found that almost half of co-educational maintained schools in England sent no girls to do A-level physics. This report provides an up-to-date view on the data and considers what has changed in the last five years. It is part of our work to try to understand how boys and girls choose their A-levels, to deconstruct the cultural stereotypes and unconscious bias that discourage girls from taking physics, and to encourage schools to provide girls with the opportunity to study physics at A-level. This report shows that while some progress has been made since 2012, the physics community still has a significant way to go to achieve gender parity in the uptake of A-level physics.

The lack of girls studying physics at a higher level has consequences for the UK economy. The government's industrial strategy places emphasis on the high demand for skilled workers in the sciences, technology, engineering and mathematics. Physics-based skills are required in many of these growth areas, and thousands more workers will need to be trained every year in order to keep the UK economy competitive. Addressing the gender gap in A-level physics and in the sciences as a whole will help to ensure that we have a highly skilled workforce for the future.

But, more importantly, generations of innovative, talented and brilliant girls are being led to believe they can't be engineers, scientists, programmers or technicians. Removing the barriers to girls studying physics does not just address the skills need; it also makes our society fairer and our science communities more rich and diverse.

Professor Dame Julia Higgins DBE FRS FREng
President, Institute of Physics

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Introduction

Physics offers huge benefits to individuals and to society – opening doors, broadening horizons and driving innovation. It provides powerful and beautiful explanations about the workings of the world – explanations that have value and are applicable in a wide range of industries and research communities. Furthermore, it develops ways of thinking and reasoning that are rewarding and highly valued by employers in many sectors, from accounting to zoology to engineering, or law and medicine.

Between 2010 and 2016, the number of people studying A-level physics grew by more than 15%. However, in England, only one fifth of the candidates entered for A-level physics are girls, and this has changed little over the past three decades. We believe that although girls and boys currently choose subjects differently, there is no evidence to suggest there are any intrinsic differences in preference, or in ability, which are reason for them to do this. If all things were made equal, there should be no barriers to prevent anyone from pursuing physics.

Gendered stereotypes are pervasive in our culture, ingrained by long-standing biases (both conscious and unconscious). Many of the stereotypes relate to different expectations of boys and girls.

Why does this matter? Not only does the lack of girls choosing A-level physics mean that the nation is missing out on talented engineers, scientists, skilled technicians, programmers and so on, but it is also likely that many women have been steered away from routes that would have been a good match for their interests, desires and capabilities. Losing all this talent contributes to a shortage of science, technology, engineering and mathematics (STEM) skills in the workforce, a problem that concerns governments and employers alike.[1] The scale of this skills shortage has been illustrated by the Social Market Foundation, which found that despite recent increases, there remains a shortfall of around 40,000 STEM graduates in the UK each year.[2]

The number of jobs requiring STEM skills is expected to rise at twice the rate of other occupations over the coming years,[3] so unless much greater numbers of technically-trained individuals enter the workforce, the impact of the skills gap will worsen. Engineering UK estimates that a shortfall in the supply of engineering skills alone is likely to cost the UK economy £27 billion a year from 2022.[4]

Increasing the number of people studying physics at A-level would be one step towards alleviating this shortage and may have a positive bearing on many of the challenges identified in the industrial strategy. For example, many of the growth areas identified in the strategy – such as agri-tech, aerospace, clean growth and artificial intelligence – will require a supply of physics-based skills and expertise.[5]

[1] Gov.UK *Insights from international benchmarking of the UK science and innovation system* **www.gov.uk/government/uploads/system/uploads/attachment_data/file/277090/bis-14-544-insights-from-international-benchmarking-of-the-UK-science-and-innovation-system-bis-analysis-paper-03.pdf**

[2] Social Market Foundation 2013 *In the Balance: The STEM human capital crunch* **www.smf.co.uk/wp-content/uploads/2013/03/Publication-In-The-Balance-The-STEM-human-capital-crunch.pdf**

[3] UKCES 2016 *Working Futures* Summary Report **www.gov.uk/government/uploads/system/uploads/attachment_data/file/514285/Working_Futures_Headline_Report_final_for_web__PG.pdf**

[4] Engineering UK 2015 *The state of engineering* **www.engineeringuk.com/media/1466/enguk-report-2015-interactive.pdf**

[5] Gov.UK High-level STEM skills requirements in the UK labour market **www.gov.uk/government/uploads/system/uploads/attachment_data/file/444048/High_level_STEM_skills_requirements_in_the_UK_labour_market_FINAL.pdf**

Introduction

[6] EDF Energy 2016 *Jobs of the Future* **www.edfenergy.com/sites/default/files/jobs-of-the-future.pdf**

If as many girls studied A-level physics as boys, there would be 15,000 additional young people qualified to move into medium- and high-skilled roles across the economy. This rebalance would open up research and career opportunities for individuals and could dramatically alter the size and balance of the UK STEM workforce. It has been reported that there were 462,000 women working in STEM areas in 2016, making up 19% of the workforce. If there were gender parity, the number would be 1.2 million.[6]

This report offers a snapshot of girls' uptake of physics A-level, but the story it tells is not new. In 2012 we published *It's Different for Girls*, which considered the influence of schools on whether or not girls chose to study A-level physics. Here, we revisit these issues with 2016 data for students in England from the National Pupil Database for students, and consider the influences of school type, science route at GCSE and GCSE performance on A-level uptake.

Through this report, we attempt to shed new light on the evidence about girls in A-level physics, identify some of the important issues around uptake and make recommendations that will create opportunities for individuals and which may, in time, help to address the UK's STEM skills shortage.

Executive summary

- Girls perform just as well as boys in physics at GCSE. However, in 2016, only 1.9% of girls chose A-level physics, compared to 6.5% of boys. This is 5,669 girls compared to 21,032 boys.
- In maths, biology and chemistry, the differences between boys and girls are smaller: 9.5% of girls and 5.6% of boys progress to biology, 5.6% of girls and 6% of boys to chemistry and 8% of girls and 12.3% of boys to maths.
- 68% of all schools with girls send fewer than two girls to A-level physics. 44% of schools send no girls at all. By comparison, 28% of all schools with boys send fewer than two boys to A-level physics.
- The likelihood that a girl will progress to A-level physics is still affected by the type of school she attends: 4.2 times more boys progress to A-level than girls in co-educational maintained schools. In single-sex independent schools, 2.4 times more boys progress to A-level than girls.
- 7.5% of girls in single-sex independent schools progress to A-level physics.
- All students are more likely to progress to A-level physics having studied triple science at GCSE rather than the core route[†]: 6% of girls and 20% of boys who have studied triple science progress to A-level, compared to 1% of girls and 3% of boys who studied core and additional science. However, there is no apparent gender difference between routes taken at GCSE.
- 65% of girls have physics in their top four grades at GCSE. Of these students, only 8% progress to A-level. When chemistry and biology were in a girl's top four GCSE subjects, 25% and 32% progressed to the respective A-level.
- Nearly twice the proportion of girls progress to A-level biology when it wasn't in their top four results than physics when it was in their top four.

[†]In 2016, this was termed "core science" and "additional science"

Recommendations

The large number of schools in England that still send no girls on to study physics at A-level is unacceptable. All young people must be able to study physics to the limits of their ambition and attainment. By lowering or removing the barriers identified in previous reports (see “Context” section), students will have more opportunities to pursue enjoyable and rewarding studies in physics and other STEM disciplines, and will be well equipped for careers in all parts of the economy.

This could lead to greater gender parity in schools, colleges and universities, a dramatic reduction in the STEM skills gap and a much needed boost to the UK’s high-skilled workforce – all of which may help the UK to grow its capacity for innovation, and growth, and achieve higher levels of productivity.

1. Schools should routinely monitor, by gender, the numbers of students progressing to A-level physics and other subjects within their schools, or elsewhere if they do not have a sixth form, and report these figures to school governors. Schools in which the numbers of girls and boys progressing to A-level physics are not comparable, and particularly schools that send no girls to A-level, should consider what factors separate their school from others where more girls progress to A-level physics.

2. Teachers, senior leaders and governors in co-educational schools must put in place measures to address gender inequities until similar numbers of girls and boys progress to A-level physics and other subjects. There is a wealth of evidence, guidance and good practice about identifying and addressing the causes of gendered choices in physics and other disciplines. Schools must be able to demonstrate to parents and inspectors that they are actively drawing on this evidence and expertise and are making serious efforts to address problems where they exist.

3. Girls are currently less likely to progress to A-level physics than boys, even when the subject is one of their best results at GCSE. There is strong evidence that the way that pupils are navigated through their choices is influenced by gender, especially in mixed schools. Schools should provide effective careers guidance that starts at an early stage, focuses on the next educational phase, emphasises the benefit of choosing certain subject combinations to allow progression to a wide variety of opportunities, and actively challenges gender stereotypes and unconscious biases.

4. Gender equity should form part of the Ofsted inspection criteria, so a school cannot be judged outstanding if gender disparity in physics and/or other subjects is not actively being addressed.

5. Students are less likely to progress to A-levels in science subjects when they have studied core and additional science at GCSE. Instead, a single route through the sciences at Key Stage 4 should be established. The features of the different routes and their bearing on progression rates should be investigated with a view to building the evidence base about this important issue.

Context

In 2012, *It's Different for Girls* revealed that almost half of maintained co-educational schools sent no girls on to A-level physics and there was an identifiable gender-based problem with progression in maintained co-educational schools. The report recommended that schools actively challenge gender stereotyping, recognise misconceptions about girls' ability to do physics, and flagged that the large number of schools sending no girls to A-level was unacceptable.

This report finds the situation has changed a little, and there have been small improvements: a smaller proportion of schools send no girls to A-level, and a larger proportion of girls progress to A-level. However, there is still much important work to do to make physics openly accessible to anyone who may want to pursue it. Since 2012, IOP has explored the barriers to students taking A-level physics and how to break them down. *Closing Doors*,[7] published in 2013, showed that schools with an imbalance in one subject tend to have imbalances across the board. This suggested that gender imbalances in physics were indicators of problems across the school rather than isolated issues.

The low number of girls progressing to physics is mirrored by boys' progression into subjects like English and psychology, which are predominantly chosen by girls.[8] A whole-school approach treats the underlying causes rather than the symptoms. In 2015, the Government Equalities Office co-funded *Opening Doors*.[9] This report offered guidance on breaking down the barriers to achieving gender equity in schools. It highlighted nine essential features of schools that actively aim for gender equity (see box 1).

[7] IOP 2013 *Closing Doors* **www.iop.org/education/teacher/support/girls_physics/closing-doors/page_62076.html**

[8] JCQ A-level results 2016 **www.jcq.org.uk/examination-results/a-levels/2016**

[9] IOP 2015 *Opening Doors* **www.iop.org/education/teacher/support/girls_physics/reports-and-research/opening-doors/page_66438.html**

Box 1: Nine essential features of schools that actively tackle gender equity

1. **A senior gender champion** is appointed
2. **Gender awareness and unconscious bias training** is provided for all staff
3. **Sexist language** is treated as unacceptable
4. **Use of progression data** and formal discussion at whole-school level
5. **Initiatives** are developed that address problems identified in the school data
6. **Subject equity:** all subjects are presented to students equally
7. **Careers guidance** starts at an early stage
8. **Student ownership:** students are at the heart of any campaign to tackle gender stereotyping
9. **Personal, social, health and economic education** includes sessions on equality and diversity

Context

The Department for Education (DfE) has funded the IOP's Stimulating Physics Network (SPN), which has the aim of increasing A-level uptake amongst all students by improving the teaching and learning of physics. This is helping, but there is also a need to look beyond the science department to the whole school. The *Improving Gender Balance* project was launched as part of SPN in 2014 to test different interventions in schools, including the essential features described above. DfE has also recently funded Future Physics Leaders, a new project focusing on training and support for school physics departments in target areas.

The Drayson Foundation Pilot showed that the biggest effect occurs with a blended approach: working with the whole school, working with teachers of physics and working with girls. [10]

The IOP is now working with partners to develop a gender-equity mark based on these essential features, and a framework to help schools tackle the problem of inequalities in the school system.

[10] IOP 2017 *Improving Gender Balance* **www.iop.org/education/teacher/support/girls_physics/reports-and-research/improving-gender-balance/page_69157.html**

Girls' progression to A-level physics in 2016

- **A-level physics is an enabling subject and a gateway qualification to many undergraduate STEM courses.**
- **The proportion of girls progressing to A-level physics from all schools was 1.9% in 2016. In 2011 it was 1.6%.**
- **68% of all schools with girls send fewer than two girls to A-level physics. 44% of schools send no girls at all. By comparison, 28% of all schools with boys send fewer than two boys to A-level physics.**

Figure 1 Number of entrants to A-level physics in England, 2001–2016.

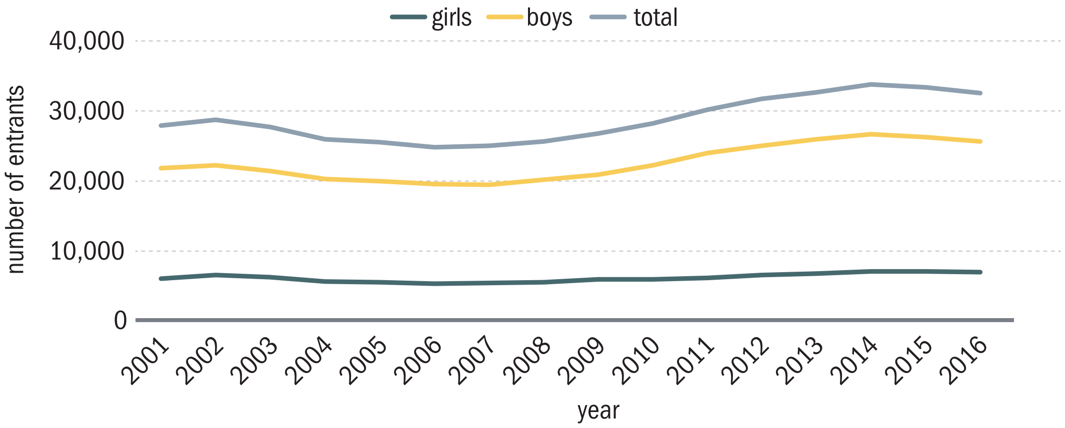


Table 1 Total number of girls and boys progressing to A-level physics at all schools from all GCSE routes.

	girls	boys
2011	5,159	20,302
2016	5,669	21,032

The number of girls studying A-level physics in England is on a slow, upward trajectory, from a low base. In 2016, 5,669 girls progressed to A-level physics from GCSE, alongside 21,032 boys. As a proportion of the total number of students in the KS4 cohort, the number of girls and boys progressing to A-level physics increased between 2011 and 2016 by 9% and 3.6% respectively. However, the proportion of A-level physics entrants in England who are girls has changed little between 2011 and 2016: rising only slightly from 20.6% to 21.4%. In 2016, physics was the second most popular A-level for boys and the 18th most popular for girls.[11]

This trend is reflected at school level: in 2016, 44% of all schools[†] in England sent no girls to study A-level physics. This is 1,627 schools. A further 24% (862 schools), sent only one girl to A-level physics: this is more than double the proportion of schools sending only one boy.

[11] Carroll M & Gill T 2017 *Uptake of GCE A-level subjects 2016* Statistics Report Series No. 116. Cambridge, UK: Cambridge Assessment

[†] See methodology for how we identify "all schools" in this report

> **"I was encouraged by my physics teacher to take A-level physics mainly because I was very good at the subject. There were only seven students in my AS-level physics class, followed by two of us in A-level. More students opted for biology or chemistry, where there was a 50/50 gender split, and the classes were up to 30 in size.**
>
> **Stephanie Yardley, Postdoctoral Research Fellow**

Girls' progression to A-level physics in 2016

Figure 2 Percentage of girls and boys who progressed to A-level physics in 2011 and 2016 at all schools.

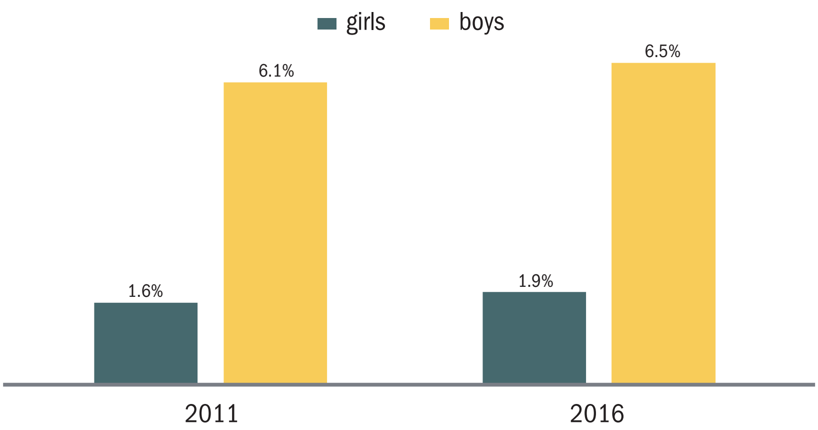


Figure 3 Percentage of all schools sending 0, 1, or 2+ boys to A-level physics, biology, chemistry and maths.

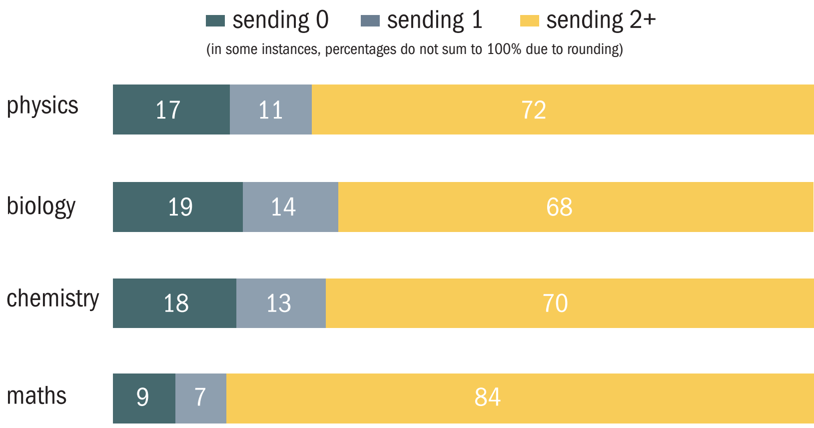
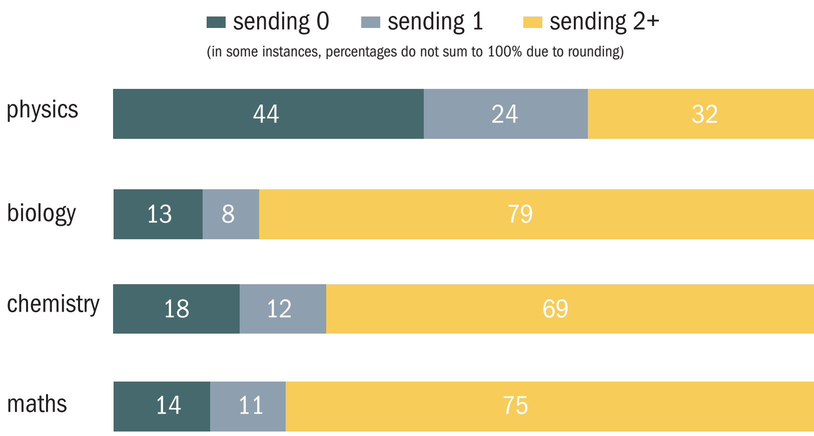


Figure 4 Percentage of all schools sending 0, 1, or 2+ girls to A-level physics, biology, chemistry and maths.



As shown in figures 3 and 4, only 32% of schools send two or more girls to A-level physics. Only 2% of schools (75 schools) send 10 or more girls to A-level. This compares to 72% of schools that send two or more boys to A-level physics, including 19% of schools (620 schools) that send 10 or more boys to A-level.

Considering all schools and all GCSE science routes, the proportion of schools sending no girls or only one girl to A-level physics is higher than for biology, chemistry or maths. Physics is the only one of these subjects where more than 50% of schools send no girls or one girl to A-level. Schools should routinely monitor the numbers of students progressing to A-level physics and other subjects within their schools, disaggregated by gender, or elsewhere if they do not have a sixth form, and report these figures to school governors. Subjects with low numbers of boys progressing should also be scrutinised.

Schools in which the numbers of girls and boys progressing to A-level physics are not comparable, particularly schools that send no girls, should consider what factors distinguish their school from others where more girls progress.

Box 2: Practical guidance to schools to improve A-level uptake

Gender stereotyping can create barriers across the whole school. Our *Improving Gender Balance* work recommended the following interventions to improve uptake:

- Appoint a gender champion – someone senior in the leadership team who is able to drive change within the school
- Analyse progression data by gender for different subjects and discuss what might be driving any gendered patterns
- Train all teachers to understand unconscious bias and how the experiences of boys and girls may differ because of it. Have teachers adopt more inclusive teaching practices, which can have a big impact on progression rates. Equip them to deal with sexist comments and bullying
- Raise students' awareness of the gender stereotypes they face and engage them in addressing them
- Review the options process: look at the options information and presentations through a gender lens and equip students to engage critically with the process
- Consider project-led science clubs to encourage a better gender balance

What kinds of schools send girls to study A-level physics?

- **The proportion of schools sending no girls to A-level physics is almost four times higher in co-educational maintained schools than single-sex maintained schools.**
- **The ratio in progression rates between boys and girls to A-level physics is nearly twice as large in co-educational maintained schools as in single-sex independent schools: the ratio is 1 girl to 2.4 boys in single-sex independent schools, and 1 girl to 4.2 boys in co-educational maintained schools.**

The proportion of girls progressing to A-level physics shows significant variation across different school types. While the number of girls progressing to A-level physics increased at all types of school between 2011 and 2016, the ratio between the numbers of girls progressing from single-sex and co-educational maintained schools remains large.

In maintained co-educational schools, the proportion of girls progressing to A-level physics in 2016 was 1.3%. Although this is a small rise from 1.1% in 2011, it is still considerably lower than independent schools and it is lower than the equivalent drop for boys.

Figure 5 Percentages of girls and boys who progressed to A-level physics in 2011 and 2016 – maintained schools.

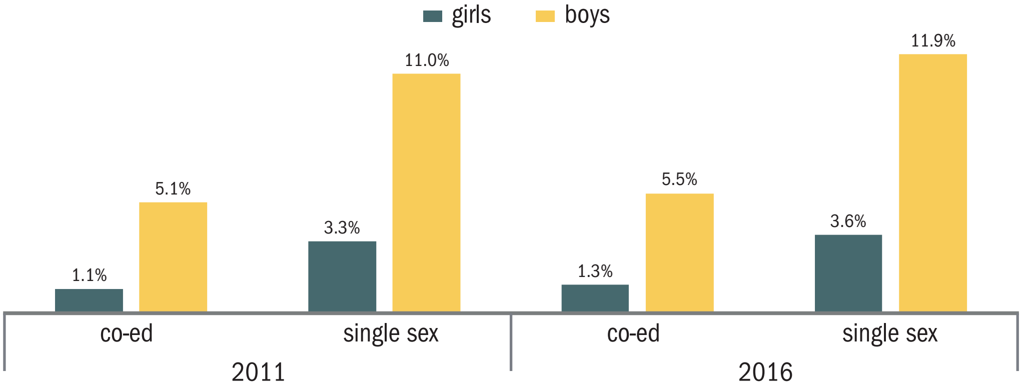
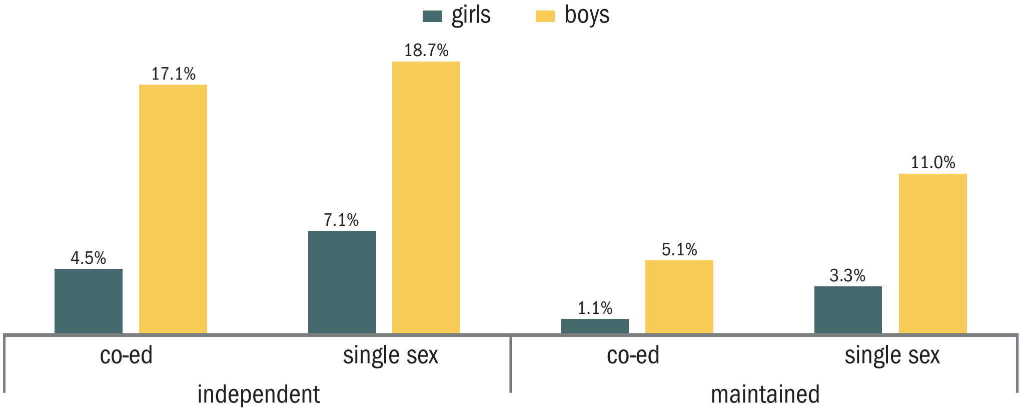
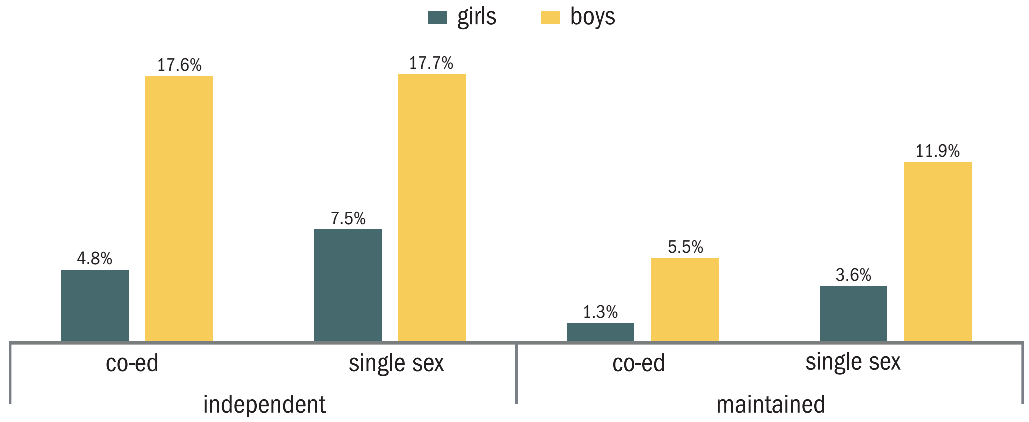


Figure 6 Percentages of girls and boys who progressed to A-level physics by type of school in 2011.



> **I work as an electrical engineer and see gender imbalance every day. I am often the only female engineer in projects and sometimes feel I have to prove myself as 'equal' to the men. Engineering is facing a huge skills crisis with a large proportion of the workforce set to retire in the next 10 years. I did not receive much careers advice at school. I chose physics based mostly on home support and because I enjoyed maths, which links very well with physics. I was interested in engineering from an early age but it was not a career mentioned in my school.**
>
> **Rebekah Endersby, Electrical Engineer, National Grid PLC**

Figure 7 Percentages of girls and boys who progressed to A-level physics by type of school in 2016.



Single-sex independent schools send 7.5% of girls on to A-level physics. This is an indication that, in these conditions, girls do choose physics. If the 7.5% progression rate were to be achieved across all types of school, the number of girls progressing to A-level physics in England alone would be in the region of 23,000 – around the same number of boys that currently progress to A-level physics.

Hypothetically, if these girls went on to university in the same proportions as the current cohort, this would amount to a total of 3,450 women starting first-year undergraduate physics courses from England (in 2016–2017 there were 830), and a large number of others might start a degree in engineering or another STEM subject, or enter the workplace, perhaps starting an apprenticeship.

> **As a patent attorney, I feel that I'm working in a much more gender-balanced field than in my previous career in industry. However, there is still a significant gender imbalance in this field, especially at senior levels. Patent attorneys specialising in physics are highly in demand at the moment and vacancies can be difficult to fill. Working as a patent attorney requires an unusual combination of technical skills, communication skills, commercial awareness, and an interest in a wide breadth of technologies.**
>
> **Kate Adamson, Patent Attorney**

What effect does the route through GCSE have on girls' progression to A-level?

- **Girls and boys are more likely to progress to A-level having studied triple science at GCSE rather than core science and additional science: 6% of girls and 20% of boys who have studied triple science progress to A-level, compared to 1% of girls and 3% of boys who studied core science and additional science**
- **There is no apparent gender difference between routes taken at GCSE.**
- **For girls, the differences in progression to A-level between the two GCSE routes is larger in physics than in chemistry, biology and mathematics.**

There are multiple routes that pupils in England can take through science at GCSE. In 2016, the most common options were to take a single "science" GCSE (where one qualification is obtained) or core and additional science (where two GCSEs are awarded). Around one fifth of students sat "triple science" (separate GCSEs in physics, chemistry and biology).

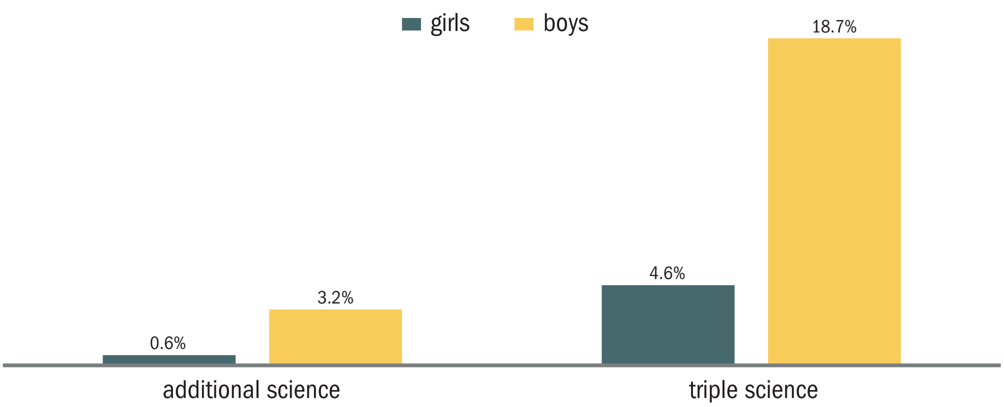
Evidence suggests that students are more likely to progress to A-levels in science subjects when they have studied triple science at GCSE.[12] The data shown here supports this observation. Figure 8 shows the proportion of girls and boys progressing to A-level physics from additional science and triple science in co-educational maintained schools.[†]

In physics, girls were **seven** times more likely and boys were **six** times more likely to progress from triple science over additional science. This does not suggest a substantial gendered difference between the two routes.

Is this pattern observed in other science subjects?

In chemistry, biology and mathematics, students are also more likely to progress to A-level after taking triple science at GCSE. In chemistry, girls and boys were both **six** times more likely to progress having done triple science. In biology, girls and boys were **five** times more likely to progress to A-level having done triple science, and in maths, girls were **five** times more likely and boys **four** times more likely to progress to A-level having done triple science over additional science.

Figure 8 Percentages of girls and boys progressing to A-level physics from co-educational maintained schools from additional and triple science GCSE.



[12]National Audit Office 2010 *Educating the next generation of scientists* **www.nao.org.uk/wp-content/uploads/2010/11/1011492.pdf**

[†]The grade from additional science is used when comparing students who studied core and additional science to those who studied triple science

What effect does the route through GCSE have on girls' progression to A-level?

Figure 9 Percentages of girls and boys progressing to physics, chemistry, biology and mathematics A-level from additional and triple science GCSE at all schools.

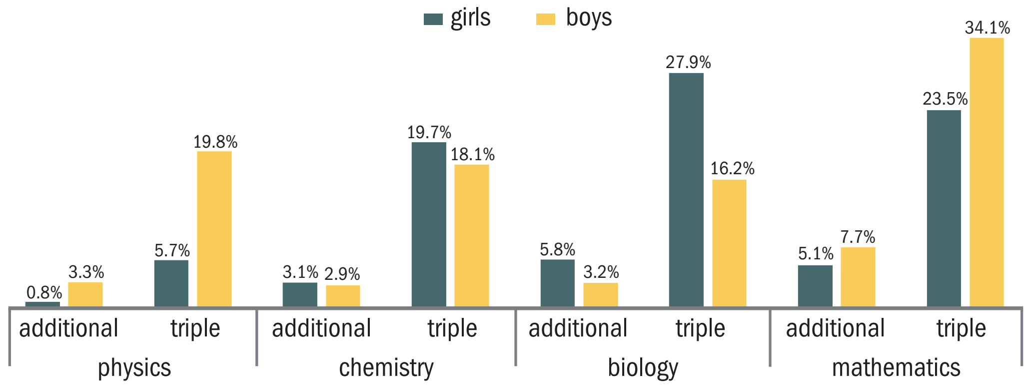


Table 2 Total number of students progressing to each subject at A-level in 2016 from all GCSE routes.

	physics	chemistry	biology	mathematics
girls	5,669	19,462	29,121	25,896
boys	21,032	19,294	17,933	39,746

Figure 9 shows the proportion of girls and boys progressing to physics, chemistry, biology and mathematics from both the core and additional route and the triple science routes. This illustrates the clear difference in progression for all science subjects and maths, and the slightly larger difference in physics.

From this data, there appears to be no gender disparity between the core and additional and triple science routes, but the evidence does illustrate the difference in progression to all science subjects at A-level from the two routes.

A single route through GCSE science could help to increase the number of students taking A-levels in physics, as well as in biology and chemistry. The features of the different routes and their bearing on progression rates should be investigated with a view to building the evidence base about this important issue.

> **“I found studying A-level physics was quite different to GCSE, as we were introduced to the weird and wonderful side of physics, such as relativity and quantum mechanics. The classes were smaller, which made the learning experience more personal. It was more like a conversation, which allowed us to guide the discussion. Quite often we ended up talking about the exciting new research happening in physics. The skills I learnt from studying physics at A-level enabled me to progress rapidly in my career, and the qualification really impressed employers.**
>
> **Emma Osborne, Astrophysicist and Science Communicator**

Progression to A-level based on GCSE performance

- **Physics was in the top four GCSE grades for 81% of boys and for 65% of girls, even though a higher proportion of girls achieve an A* or A grade.**
- **Both girls and boys are more likely to progress to A-level physics if they studied triple science at GCSE and physics was in their top four results.**
- **When physics was in a student's top four GCSE results, boys were three times more likely to progress to A-level physics than girls.**
- **Nine times as many girls progressed to A-level physics if it was in their top four GCSE grades than if it was not.**
- **Nearly twice the proportion of girls progressed to A-level biology when it wasn't in their top four results than chose physics when it was in their top four.**

The effect of choosing your "best" subjects

Girls and boys are more likely to choose A-level physics when it was amongst their "best" GCSE subject grades, and this may be a factor in their decision making.[†] Nine times as many girls with physics (triple science route) in their top four subjects progressed to A-level physics compared with those who didn't have the subject in their top four results. The trend is similar for boys.

More girls achieve high grades in GCSE physics than boys, and girls generally outperform boys across the board at GCSE.[13] However, a smaller proportion of girls have physics in their top four subjects at GCSE (65% for girls compared to 81% for boys). When a student does have physics in their top four results, boys are three times more likely to progress to A-level physics than girls.

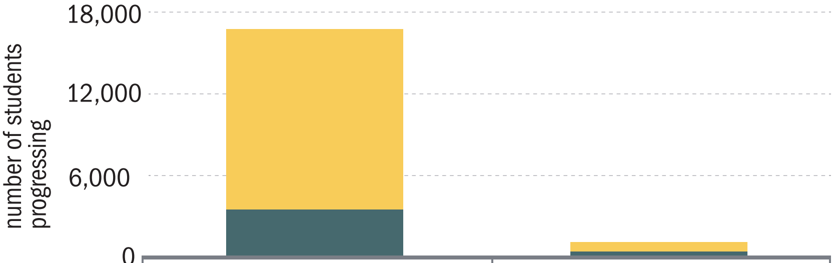
Girls and boys that did not have physics in their top four results were less likely to progress to A-level physics, from both GCSE science routes. Only 101 girls and 194 boys progressed from additional science and 349 girls and 798 boys from triple science when additional science or physics, respectively, was not in their top four results. By contrast, 3,440 girls and 12,995 boys progressed to A-level physics when their physics grade from triple science was in their top four results. A further 950 girls and 4,084 boys progressed from additional science when it was in their top four.

[†]By "best", we mean that physics or additional science was amongst the individual's top four GCSE grades

[13]In 2016, 41.8% of girls in England achieved an A or A* in physics, compared to 41.2% of boys. Data comes from the Joint Council for Qualifications

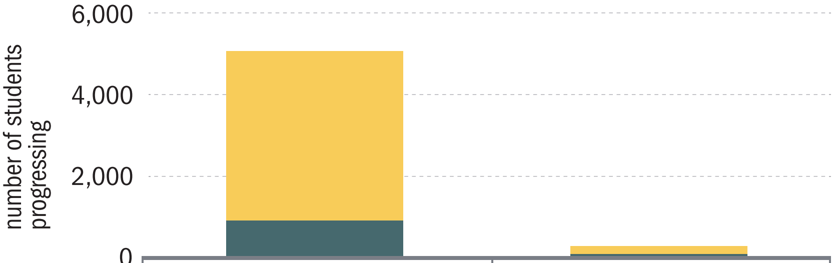
> **"It was a given early on that maths, physics and chemistry was the best A-level combination if you wanted to do science, probably from my parents but reinforced at school. I added further maths to that. There were four girls in our physics class and none in the other out of about 45 students, but I never thought of this as any sort of problem, it was just who had chosen to do what at the time. Having maths and physics opened up doors everywhere and reassured people you can 'pick other stuff up'. The strong A-levels helped me to gain employment to qualify as a chartered accountant, and many years later to enrol for an MSc in planetary science and now my PhD.**
>
> **Jane MacArthur, Planetary Scientist**

Figure 10 Number of students progressing to A-level physics from triple science.



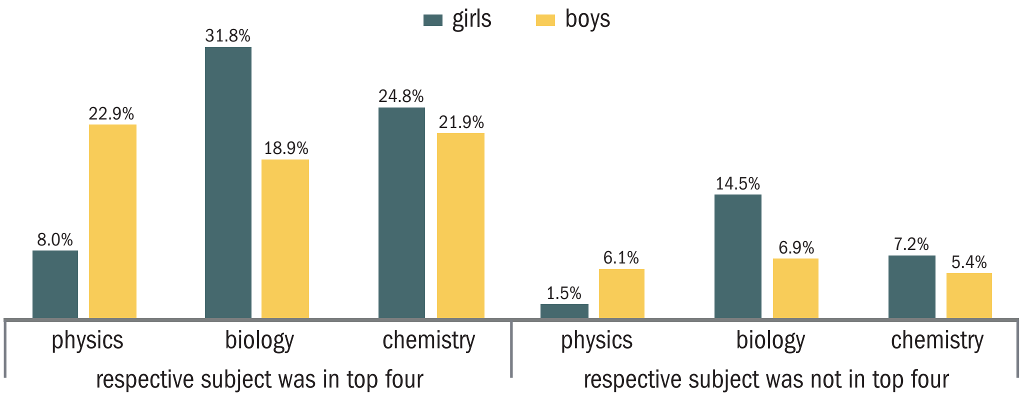
	in top four	not in top four
boys	12,995	798
girls	3,440	349

Figure 11 Number of students progressing to A-level physics from additional science.



	in top four	not in top four
boys	4,084	194
girls	950	101

Figure 12 Percentages of boys and girls progressing to A-level physics, biology and chemistry from triple science.



Progression to A-level based on GCSE performance

Is this physics specific?

A similar trend is apparent in biology and chemistry. More students progress to an A-level in those subjects when it was amongst their top four grades at GCSE. The progression rates for boys are broadly similar for the three sciences both when the subject is and is not in their top four subjects.

Nearly twice the proportion of girls progressed to A-level biology when it wasn't in their top four results than chose physics when it was in their top four. Furthermore, almost four times the proportion of girls progressed to A-level biology when it was in their top four results than chose physics when it was in their top four.

Only 1.5% of girls for whom physics was not in their top four subjects progressed to A-level physics. This is much lower than biology and chemistry, where 14.5% and 7.2% of girls progressed, respectively.

Box 3: Why do students choose physics (or not?)

Recent research[14] suggests that there are a number of approaches which are used by students when choosing subjects to study at A-level, with students often using several of the following strategies:

- It is needed for their chosen career path
- It is a prerequisite for their chosen university course
- They enjoy the subject
- The subject fits their personality, or is an area of knowledge they enjoy
- They have confidence in their ability to study the subject
- They view the subject as a lower risk option
- They want to keep their options open
- The subject is part of a combination that go well together
- The person that taught them the subject
- Their perceived ability
- The availability of the subject on the school timetable
- Views of their teachers and/or their parents

Other work[15] has considered students' aspirations in maths and physics, and found the following in relation to subject choice at A-level:

- Girls' self-concept is lower than boys
- Clear evidence on the importance of classroom teachers
- Girls experience inequalities in their mathematics and physics education

[14] Bennett *et al.* 2013 *International Journal of Science Education* **35:4** 663–689, copyright Taylor & Francis **www.tandfonline.com/10.1080/09500693.2011.641131**

[15] Tamjid Mujtaba & Michael J Reiss 2016 "I Fall Asleep in Class ... But Physics Is Fascinating": The Use of Large-Scale Longitudinal Data to Explore the Educational Experiences of Aspiring Girls in Mathematics and Physics *Canadian Journal of Science, Mathematics and Technology Education* **16:4** 313–330, DOI: **10.1080/14926156.2016.1235743**

> **"Whilst my lessons had more boys in than girls, I didn't feel like it really affected my experience there. I never had any reason to think that physics was a "boys' subject" – I got an A* at GCSE, which was more than half the boys in my class had achieved so I definitely felt worthy of being there! I also knew that by studying a physics degree, I was keeping my options open for what career to choose – due to the amount of maths, computer coding and problem solving in a physics degree, graduates are employable across a range of job sectors. My friends from my course at university all now work in a range of sectors, including academic research, finance and consultancy.**
>
> **Jessica Cliff, Physics Graduate**

The comparisons with chemistry and biology suggest that factors other than performance at GCSE influence girls' choice at A-level. This includes the route taken at GCSE, but there are likely to be a number of factors at play, as explored in box 3.

These influences highlight the role of schools in providing effective careers guidance that starts at an early stage, focuses on the next educational phase, emphasises the benefit of choosing certain subject combinations[16] to allow progression to a wide variety of opportunities, and actively challenges gender stereotypes and unconscious biases.

[16]Physics is a facilitating subject – see Russell Group Informed Choices report **www.russellgroup.ac.uk/media/5686/informed-choices-2018-1-6th-edition-final.pdf**

Methodology

Data in this report covers two non-sequential years. To mirror data from *It's Different for Girls*, we have used data relating to students finishing KS4 (GCSE) in 2009 and finishing KS5 (A-levels) in 2011, as well as students finishing KS4 (GCSE) in 2014 and finishing KS5 (A-levels) in 2016. The data is from the National Pupil Database, tracking students from KS4 to KS5 and to school data taken from Edubase.

Figures derived from the 2011 data found in this report may differ to equivalent figures found in the 2012 report. This is because the data analysis was performed differently in the following ways:

- The approach used for tracking students between their GCSE and A-level study.
- School types that were included and how school types were defined.
- Data sources that were used, and the unwanted omission of schools and students for whom records weren't available in any of the required data sets (National Pupil Database Key Stages 4 and 5 data sets and Edubase).
- The exclusion of A-level equivalents, such as Pre-U and International Baccalaureate.
- The effect of alternative qualifications: data in this report only looks at A-levels. Some schools offer alternatives to A-level that may impact on our results, such as the International Baccalaureate or Cambridge Pre-U examinations. The number of students who were studying for these qualifications in physics in 2016 are small: around 250 for Pre-U and 800 for IB.[17] The effect on our analysis is therefore likely to be small. However, as there are only very small numbers of boys taking A-levels at single-sex independent schools, and the absolute number of students only changed by a small amount, the Pre-U qualification uptake may have affected the data on the proportion of boys choosing A-level.

Data in this report primarily considers "all schools", whereas the headline figures from the 2012 report considered maintained co-educational schools. When we use "all schools" we are considering the following:

- School types at Key Stage 4, identified as independent, maintained, modern or selective.
- For data on girls at all schools, single-sex boys' schools were excluded. For data on boys at all schools, single-sex girls' schools were excluded.

[17] Science and Engineering in Education dashboard **www.seedash.org/index.html**

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