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## What shapes children's science and career aspirations age 10-13?

What do 10-13 year olds aspire to?

What influences inspirations?

Why are science careers not popular?

How can post-16 STEM participation be improved?



## Acknowledgements

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This report was written by Louise Archer, with assistance from the ASPIRES team (Jonathan Osborne, Justin Dillon, Jennifer DeWitt, Beatrice Willis and Billy Wong, and also with the help of Megan Orpwood-Russell, TISME administrator).

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### Why is STEM participation an important issue?

There is a widespread international concern to improve the numbers of people studying and working in Science, Technology, Engineering and Mathematics (STEM) fields<sup>i</sup>.

STEM industries are vital elements of the UK economy and are predicted to expand over the next fifteen years, while many other fields will shrink due to recession<sup>ii</sup>.

Although there is a lack of reliable data on the supply and demand of STEM graduates<sup>iii</sup>, and no consensus on how many scientists the economy needs<sup>iv</sup>, there is widespread agreement about a growing STEM skills gap and a lack of high quality graduates in many STEM sectors, which may impact negatively on the UK's future economic competitiveness<sup>v</sup>.

There is also a strong equity case for the need to *widen* (not just increase) participation in STEM and to ensure high levels of scientific literacy across the population<sup>vi</sup>. Scientifically literate individuals can access favourable (high pay and status) jobs<sup>vii</sup>, and there is a need for citizens to be able to understand, participate in, and shape scientific developments in society.

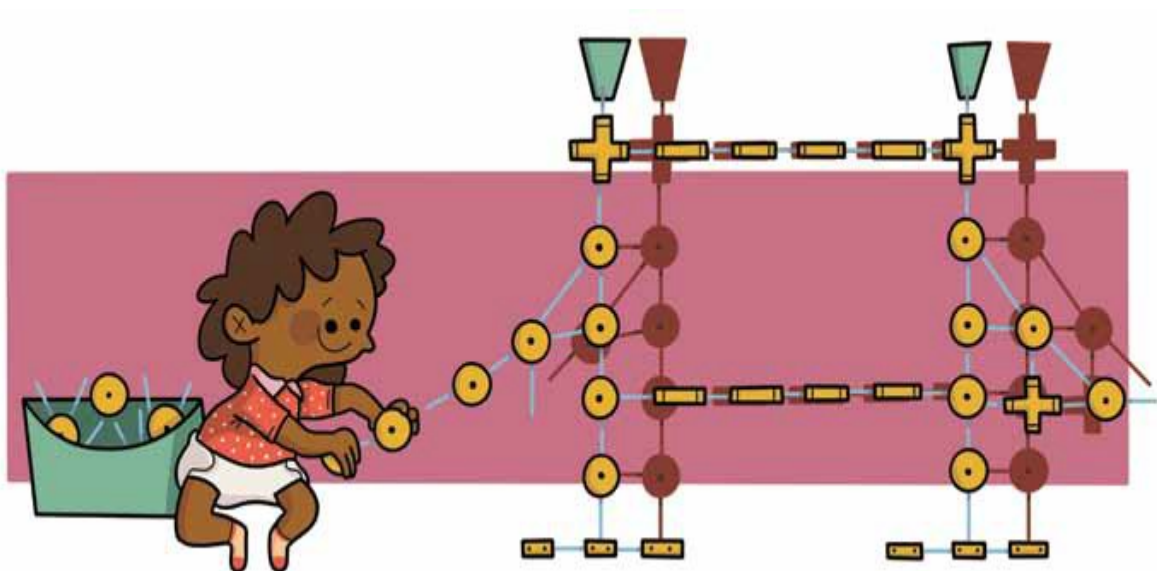
To date, initiatives aimed at increasing and/or widening the profile of STEM graduates appear to have failed to adequately improve higher education participation rates<sup>viii</sup>.

***Understanding the factors shaping STEM participation is a key priority area for the UK and many other governments***

### What can children's aspirations tell us?

There are three key reasons why studying children's aspirations can help us better understand science participation issues:

1. Research indicates that aspirations can provide a probabilistic indication of a young person's future occupation<sup>ix</sup>. A robust body of evidence shows that interest in science is formed by age 14<sup>x</sup> and a US study by Tai *et al* (2006) showed that, by age 14, students *with* expectations of science-related careers were 3.4 times more likely to earn a physical science and engineering degree than students *without* similar expectations.
2. Aspirations are a clear focus of concern within the education policy of both the previous New Labour<sup>xi</sup> and the current Coalition governments<sup>xii</sup>. A focus on 'raising aspirations' is also evident in the work of a wide range of charities and organisations that work with underprivileged young people<sup>xiii</sup>.
3. Researchers can study aspirations to uncover how wider social issues interact and shape people's lives (e.g. how and why gender, social class and ethnicity shape particular patterns of aspiration)<sup>xiv</sup>.

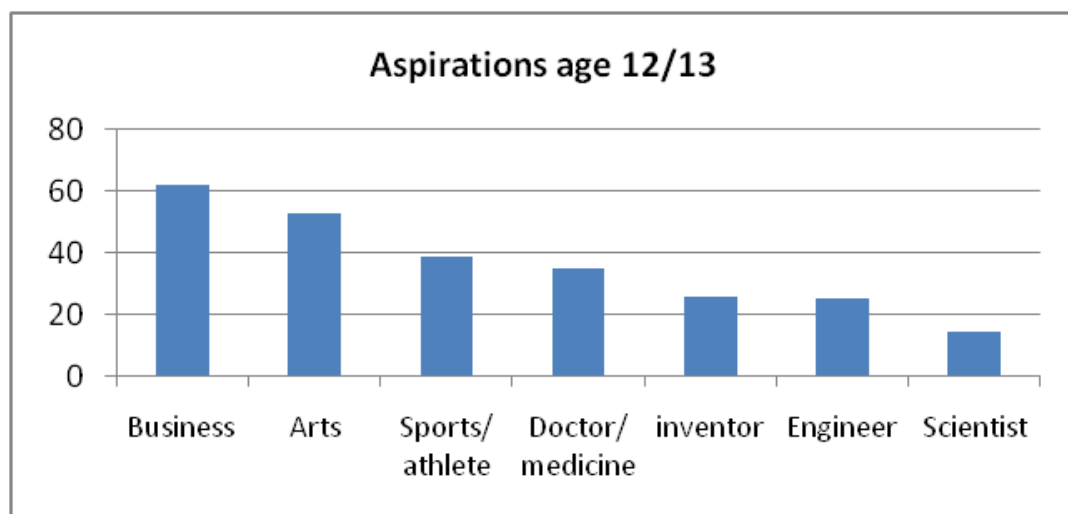


### What do 10-13 year olds aspire to?

We gathered data on young people's aspirations in a number of ways. The most consistently popular aspirations at ages 10/11 and 12/13 are for careers in the arts, sports, medicine and teaching. Business also emerges as a highly popular aspiration among Year 8 pupils.

Analysis of open-ended survey responses (Figure 1) found that the top 5 most popular aspirations in Y6 are sports (16%), performing arts (13%), teacher (10%), doctor (8%) and vet (6%). In year 8, the top five aspirations are performing arts (20%), doctor (10%), business (9%), sports (9%) and teacher (6%).

Figure 1: Percentage of students aspiring to job (most popular coded free responses\*, by age)

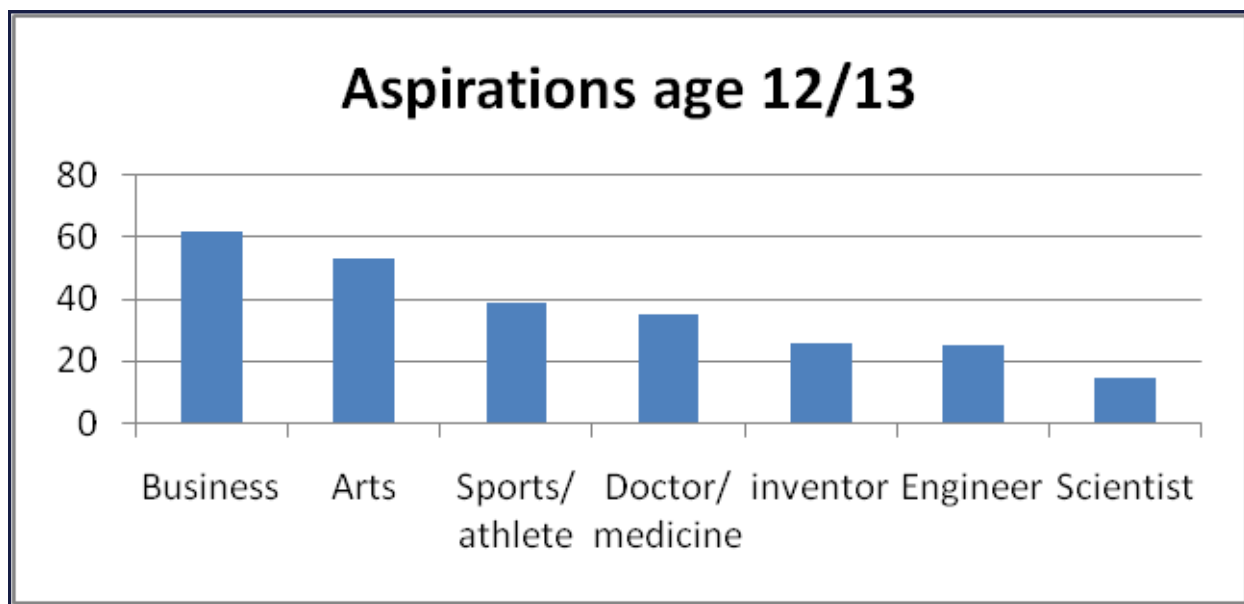


(\*Based on a sample coding of survey responses from c. 3,247 Y6 children and 2,124 Y8 children)

## What do 10-13 year olds aspire to?

When presented with a more limited choice of options (Figure 2), over 60% of pupils agree that they would like a career in business. Arts (53%), sports (39%) and doctor (35%) are all popular aspirations too<sup>xv</sup>. Despite liking school science, less than 17% of Y6 pupils and 15% of Y8 pupils aspire to become a scientist in the future, although other STEM careers are more popular, such as engineering (25%), inventor (26%).

Figure 2: Percentage of Year 8 pupils agreeing they would like to do this job (restricted choice question)





### Young people and their families generally have high aspirations

Young people in our study generally express 'high' aspirations, for professional, managerial and technical careers. This was also found by Croll (2008), who analysed the aspirations of a large number of young people who were aged 15 in the mid 1990s.

We found no evidence of a 'poverty of aspiration' among our sample of young people, with the majority of pupils aspiring to professional, managerial and technical careers. Young people express high aspirations largely irrespective of their social class backgrounds. As in previous research<sup>xvi</sup>, we found that very few aspire to skilled manual jobs and even fewer to unskilled manual occupations.

Most of the young people in our survey aspire to be affluent (91% agree it is important to make a lot of money in the future) and many want to be famous (65% of Year 6 pupils and 51% of Year 8 pupils).

The majority of young people also aspire to a good quality of working life (and work-life balance) and a large number express altruistic aspirations. For example, among 12/13 year olds:

- 96% agree that it will be important to have time for family in the future
- 91% want a job that will enable them to have time for hobbies and other interests.
- Over 90% aspire to 'help others' in their working lives
- 78% want a career that will 'make a difference in the world'

Overall, students report strong parental encouragement and support for their aspirations and future success.

There is no indication of any cultures of low aspirations. For instance, in the Year 8 survey:

- 98% agree that their parents want them to get a good job in the future
- 95% agree that it is important to their parents that their child achieves well in school.
- 77% agree that their parents want them to make a lot of money when they grow up.
- Almost three quarters (72%) of 12/13 year old pupils say that their parents expect them to go to university - although there are social class differences within this figure<sup>xvii</sup>.

### Trends in aspirations by gender, ethnicity and social class

We found that at age 12/13, girls are more likely to aspire to arts careers than boys, and that boys are disproportionately more likely to agree that they are interested in careers in engineering<sup>xviii</sup>.

Social class also seems to make a difference - privileged children are more likely to aspire to professional careers, particularly in medicine and science. For instance,

- **45% of the most socially advantaged pupils in our survey aspire to become a doctor, compared to just 22% of the least advantaged<sup>xix</sup>.**
- **23% of the most socially advantaged pupils aspire to become a scientist, compared to just 9% of disadvantaged pupils.**

Minority ethnic groups are more likely to aspire to work in medicine than White students:

- **60% of South Asian students and 54% of Black students aspire to medicine, compared to 30% of White students<sup>xx</sup>.**
- **Pupils from South Asian backgrounds are the most likely to aspire to become a scientist (23%), compared to 18% of Black students and 13% of White students.**

Business is a generally popular aspiration across most groups of students, with high proportions of boys and girls aspiring to business careers. Over half of students from all social class backgrounds also agree that they would like to work in business in the future<sup>xxi</sup>.

Black students seem particularly interested in business careers, with 80% of Black students agreeing that they would like to work in business (compared to 68% of South Asian, 65% of Chinese and 59% of White students).

What are the main influences on 10-13 year olds' aspirations?

In the interviews, we asked students in detail about their aspirations, the reasons for their interests, how these ideas developed and what had influenced their ideas. Figure 3 details the main sources of influence on young people’s aspirations by the various ‘types’ and categories of aspiration.

Figure 3: Main sources of influence on Y8 children’s aspirations (interview data)<sup>xxii</sup>

<i>Source of Influence (most common aspirations in brackets) % of children</i>	
• Family members or close family friends who do this job: <i>(most frequent jobs: medicine, teaching, business)</i>	47%
• Interest developed through hobby/out of school activity: <i>(mostly sports and arts)</i>	33%
• School: <i>(mostly teacher, science, medicine and writing)</i>	25%
• TV: <i>(most often medical-related)</i>	18%
• Money (job perceived to be well paid): <i>(mostly business and professions)</i>	7%

Our findings show that **families and the home** are particularly important sources of influence on children’s aspirations, with almost half of the interview sample aspiring to the same job as a family member or close family friend. These are most often children from middle-class backgrounds, who aspire to careers in medicine, teaching and other professions.

The second greatest source of influence on young people’s aspirations is the **hobbies, activities and interests** that children pursue outside of school. These aspirations are overwhelmingly for careers related to sports and the arts.

**School** is the third most frequent source of influence. It inspires a sizeable proportion of young people to want to become a teacher but also plays an important role in developing children’s interests and aptitudes through the curriculum (particularly in relation to science, medicine and writing).

A smaller number of young people report that their aspirations are influenced by **television** and 7% are attracted by the perceived **financial returns** of particular careers (notably in business and the professions).

## What influences 10-13 year olds' aspirations?

### The importance of families in shaping aspirations

Students from socially advantaged backgrounds are more likely than their less advantaged counterparts to know someone in their family, or close social circle, working in the job that they aspire to. Working-class students are much less likely to cite a family member's career as the inspiration for their aspirations than those from professional/managerial backgrounds.

Having close social contacts who work in desirable, professional jobs can make these jobs 'conceivable' (knowing about them and/or seeing them as desirable or attainable) and 'achievable' (providing 'social capital', useful social contacts and resources to help students achieve their goals).

*"I think that I would be following my family's footsteps ... 'cos I do want to go into medicine"*

(Tom4, Year 8 boy)

*"My mum always says to me 'You're a really good cook' and my grandma says to me 'We've got cooking in the family', 'cos my grandma cooks, my mum cooks, my Nan cooks, my great grandma used to cook ... so I think it's just like in me in a way."*

(Laylany, Year 8 girl)



### Hobbies and out-of-school activities

In the interviews, 33% of Year 8 students cite hobbies and out-of-school activities as influences on their aspirations. These are predominantly in relation to sports (either as a sportsperson or a coach) and the arts (especially being an author/ writing).

Less-privileged students are far less likely to develop their aspirations through extra-curricular activities compared to other students – perhaps reflecting differences in financial resources and/or the value placed on organised extra-curricular activities between middle-class and working-class families<sup>xxiii</sup>.

Students expressing sports and arts-related aspirations tend to have little, if any, social capital (social contacts, links) in these fields (e.g. only one Y8 student with arts aspirations also has a family member in this line of work).

### School

A quarter of interviewees cite school as a source of influence on their aspirations. Just under half of these young people want to become a teacher, while the others feel that school plays an important role in developing their interests and aptitudes in particular areas (most frequently in relation to science, medicine and writing).

Only four young people feel that their aspirations have been informed or inspired by school careers education resources or activities. Two of these students have been influenced by posters (to become a teacher or physicist) and two mention how careers websites have helped them identify particular careers.

That so few 12/13 year old children should mention careers education sources in relation to their aspirations might suggest that careers education is currently 'too little, too late'. This is particularly concerning given that international evidence from the OECD shows that young people benefit from receiving high quality, appropriate advice and guidance to inform their aspirations<sup>xxiv</sup>.

## Is school science the problem?

### Does school science put children off science careers?

The majority of Year 6 and Year 8 children enjoy science lessons. Science is rated as the fourth most popular subject (behind Design and Technology, then English and Mathematics) by Year 8 pupils.

- **Over 70% of Year 6 and Year 8 pupils agree that they learn interesting things in science classes**
- **Around 80% of Year 8 pupils believe that they have enthusiastic science teachers and say their teachers expect them to do well.**
- **Over two thirds of 12/13 year olds like their science teacher and feel that they do well in the subject.**
- **Only 19% say that they find science difficult.**

The Year 8 pupils who were interviewed also confirmed this view – most students enjoy science classes in secondary school as much as, or more than, in primary school.

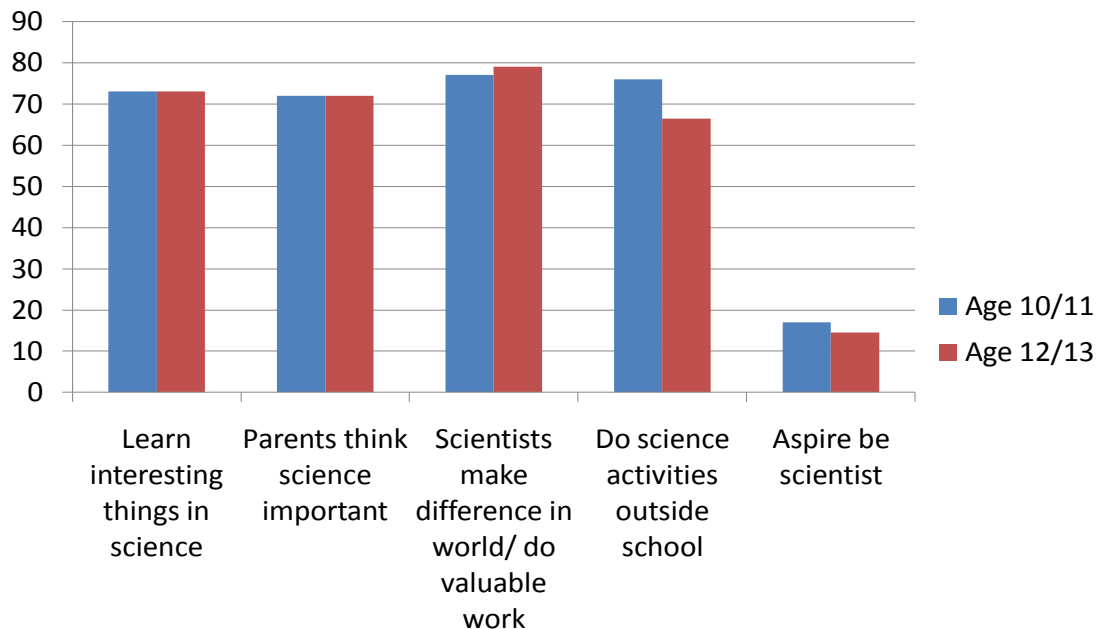
We also asked pupils a range of questions to elicit their views on scientists and science careers. The majority of young people express positive views, for example among Year 8 pupils:

- **79% believe that scientists do valuable work**
- **62% agree that scientists are respected by society**
- **63% think that scientists make a lot of money**

Most young people also indicate that their parents think science is important. Many young people engage in science-related activities in their spare time (e.g. going to museums, doing little 'experiments' at home).

## Is school science the problem?

Comparison of survey responses from Y6 and Y8 pupils (% strongly/ agreeing)



Although pupils enjoy science, schools are failing to convey how science qualifications are valuable and transferable for a wide range of careers. Most young people do not see 'scientist' as a possible or desirable career 'for me'. Only a handful of children with science-related aspirations cite their science classes as a source of career inspiration.

This may reflect a wider lack of careers education in schools, especially at KS3. Only four young people felt that their aspirations had been informed by school careers education resources or activities. Two of these students had been influenced by posters (to become a teacher or physicist) and two mentioned how careers websites had helped them identify particular careers (STEM and non-STEM).

Our evidence indicates that careers education is currently 'too little, too late'. This is particularly concerning given that international evidence from the OECD shows that young people benefit from receiving high quality, appropriate advice and guidance to inform their aspirations.

**Young people are NOT generally being put off careers in science because they find science dull or because of negative views of scientists**

## Why are science careers not popular?

### Why are science careers not popular?

#### *Reason 1: Many families do not have much science capital*

‘Science capital’ refers to science-related qualifications, knowledge, interest, literacy and contacts.

Science capital is unevenly distributed across our sample of participating families. Middle-class families are much more likely to possess science capital than other families (e.g. a parent with degree-level science qualifications, or who works (or knows someone) in a science-related job).

**The more science capital a family has, the more likely their child is to aspire to a science-related career and/or plan to study science post-16.**

When families possess sizeable science capital and take an active role in fostering their child’s aspirations and future success, science careers appear to be more ‘obvious’ and desirable ambitions for children. In these families, science is reinforced in numerous subtle, daily ways as being something that is not unusual, but is part of ‘who we are’ and ‘what we do’. Families without science capital are more likely to reinforce other career paths as more ‘natural’ or ‘thinkable’ ambitions.

Gender, ethnicity and social class can all play a role in making some routes seem more ‘normal’ and desirable than others. For instance, many girls in our interview sample aspire to ‘caring’, nurturing professions.

Most children in our study report liking science but very few see science as a desirable career. We term these children ‘interested, but...’. For most, science does not have a high profile within their home lives. For example, in the interviews, children typically say they have ‘no idea... not a clue’ what their family think about science. We also found in the surveys that one third of Year 6 and almost half of Year 8 children say they ‘never’ read science-related books or magazines.

*“I suppose in everyday life you don’t really get that much to do with science”* (Jane2, mother)

*“They [my family] never talk about science”* (Jack, Y6 Black African boy)

**Integrating STEM careers awareness (and conveying the transferable nature of STEM qualifications in the job market) into mainstream science teaching could help increase science capital among all pupils.**

**Programmes aimed at increasing science capital among working-class families would be beneficial.**



# Why are science careers not popular?

## Why are science careers not popular?

### *Reason 2: Science careers are seen as limited and only for the 'brainy'*

Young people tend to see science careers as only for the exceptional, 'clever' few.

*Over 80% of both Year 6 and Year 8 survey pupils agree that scientists are 'brainy'*

Young people who do express science aspirations tend to describe themselves (and are described by their parents in the interviews) as 'bright' and achieving highly at school. Likewise, those students who describe science as "interesting, but not a career for me" tend to see themselves (and be described by their parents) as 'normal' or 'middling' pupils.

*"Well the clever ones are [into science]. Like the ones that are going to grammar school"*

(Louise, Year 6 girl)

*"She [daughter] said 'oh, you have to be really clever [to study science], you have to be a geek'... She says 'I'm not clever enough to be good at science'"*

(Sandra, mother)

We found that this perception (of science careers as only for the 'brainy' few) is exacerbated by a lack of science capital. Many pupils and parents see science qualifications as only leading to a narrow range of jobs, namely scientist, science teacher or doctor.

There is little general awareness that science qualifications might be useful for a wide range of (graduate and non-graduate) future careers, or that science qualifications tend to be highly 'transferable' (and well-regarded by employers).



The lack of 'non A Level' post-16 science routes (e.g. for those with a C at GCSE science) exacerbates perceptions of post-16 science as 'only for the brainy few'.

High-quality 'applied' post-16 science qualifications (relevant for a broad range of future careers) could help increase and broaden post-16 STEM participation.

## Why are science careers not popular?

### Why are science careers not popular?

#### Reason 3: Science careers are seen as masculine

Young people tend to see science careers as only for the exceptional, 'clever' few.

Although our surveys indicate that a higher percentage of Year 8 girls than boys rate science as their favourite subject, girls are less likely to aspire to science careers. For example, at age 12/13, 18% of boys and 12% of girls aspire to become a scientist. Whereas 64% of Year 8 girls aspire to careers in the arts.

Over half of the parents we interviewed regard science careers as male-dominated areas:

*"Its always seen as ... geeky men"*

(Shelley, mother)

*"Its not very girly ... its not a very sexy job, its not glamorous"*

(Ella, mother)



The majority of girls aspire to work in the (performing and/or expressive) arts and nurturing/ caring jobs (e.g. teacher). In Year 8, business and other professions are also popular. Girls are particularly likely to get lots of reinforcement from home regarding their aptitude for 'caring' jobs. Girls whose families strongly value science are more likely to aspire to post-16 science.

'Glamorous' jobs (e.g. in fashion, hair or beauty) are also popular, echoing popular notions about what constitutes 'normal' and 'desirable' femininity.

*"Actually I don't know what I'd like to be if I didn't get into show business. I'd have to like figure it out ... I'm obsessed with Cheryl Cole at the moment"*

(Louise, Year 6 girl)

Girls who are interested in being feminine and fashionable are slightly more likely to feel that science careers did not fit with their identities or interests, even though most enjoy science lessons at school. Some girls also report being put off by experiences of science as a 'boy thing'.

*"I said [to my daughter] why can't you do science? She said 'oh no it's a boy thing'. They had an after school science club and she said 'I'm not going because it's all boys'. I said well you should at least go along and see if you enjoy it. She went twice and then she stopped going because it was all boys and she had no girls to talk to"*

## Who does aspire to post-16 science, and why?

### Who does aspire to post-16 science, and why?

We found that young people are more likely to aspire to science careers if they have *high levels of family science capital* and *achieve highly* at school. In addition, those who aspire to science careers are slightly more likely to be male.

#### **Key characteristics of GIRLS who aspire to science**

We found a clear drop in the numbers of girls expressing science aspirations between age 10 and age 13 (two thirds of which were for science-related careers, mostly in medicine).

Most girls who express science aspirations describe themselves as ‘not girly’. These girls are very focused on high academic achievement (termed **‘Bluestocking Scientists’**). Their parents describe them as ‘nice’ or ‘good’ girls. They tend to come from either White or South Asian backgrounds.

*“I like studying”* (PJ, Y6 girl)

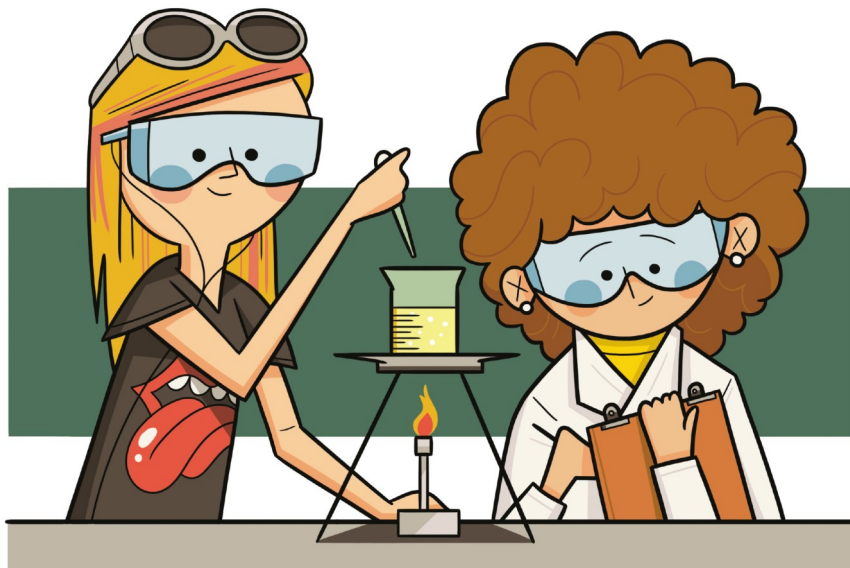
*“We’re kind of the nerds”* (Hannah, Y8 girl)

*“They’re all into music and pop stars and things like that, sort of girly stuff”* (Eva, mother)

A much smaller number of girls ‘balance’ their interest in science with a more ‘girly’ identity, e.g. being fashionable, sociable and sporty (termed **‘Feminine Scientists’**).

*“I would say there are like two types of people that are into science – either there are the really like geeky people. Or there are like people who are like me who aren’t like geeky but they have a knack for it. I play the guitar and do rowing and obviously the girly stuff that other normal girls do”*  
(Davina, Y8 girl)

A number of parents worry about how their daughters would fare within the ‘chilly’, masculine culture associated with many science careers.



## Who does aspire to post-16 science, and why?

### **Key characteristics of BOYS who aspire to science**

In the Year 8 interviews, one third of the boys express science aspirations. Over half of the boys who aspire to science-related careers 'balance' their interest in science with being 'cool' (termed **'cool/footballer scientists'**).

These boys come from a range of social class and ethnic backgrounds. Most are medium or high academic achievers. They describe themselves as into fashion, football/sports and computer games. They also portray themselves as 'fun' and able to 'have a laugh' at school, all of which help them re-buff any potential accusations of 'geekiness' which might result from their academic achievement and interest .

*"No one could say I'm a geek because when they look at my size then, yeah. And being good at football really helps me, yeah. Yeah, cos otherwise if I was no good at sport then people would think I'm a geek, yeah"*

(Gerrard, Year 8 boy)

A smaller number of boys with science-related aspirations prioritise their academic prowess (all very high achievers) but are self-consciously not 'cool' (a group we term the **'young professors'**).

*"I've been called a geek and a goody-two-shoes quite a lot"*

(Victor2, Year 8 boy)

These boys are largely from White, upper-middle class backgrounds. They are confident and self-assured and have pride in their abilities. They experience a close, effortless fit between their own masculinity and the idea of a career in science.

*"I think my hair would suit the job as a mad scientist!"*

(Neb, Year 8 boy)



## How can post-16 STEM participation be improved?

### What can education policy do to improve post-16 STEM participation?

Our study points to a number of things that policy could do to help increase and/or diversify participation in post-16 science qualifications and careers. These are presented below to show both the overarching 'big message' and some more detailed ideas on how this might be achieved.

<b>Big Message</b>	<b>Detail</b>
Create more diverse ('non-A Level') post-16 qualification routes in science	<p>Currently there are too few post-16 options for those who are interested in science but who do not want to take Science A Levels (or degrees).</p> <p>High-quality 'applied' post-16 qualifications in science and mathematics (relevant for a broad range of future careers) could help increase and broaden post-16 STEM participation.</p> <p>Ensuring that these new courses are designed as social projects (with strong engagement from employers and other stakeholders ) could help secure the status of the resultant qualifications and enable content to be appropriate and useful for the job market.</p> <p>An expansion of STEM-related apprenticeships could also form a key part of this delivery model.</p>
Invest in more, better and earlier careers education for all	<p>Support schools to be able to deliver meaningful (high-quality, sustained, embedded) careers education to pupils in KS3 (early secondary years).</p> <p>Provide targeted resources for schools to provide careers education for disadvantaged pupils</p> <p>Invest in/ support high-quality work-related learning within schools, particularly for disadvantaged pupils.</p>
Embed STEM careers awareness in the National Curriculum	<p>Ensure that the value and importance of STEM careers awareness is embedded within the National Curricula for Primary and Secondary Science</p> <p>Explore mechanisms for assessing STEM careers awareness within national examinations at age 16.</p>
Invest in, and prioritise, CPD for science teachers to embed and deliver STEM careers awareness in their teaching	<p>Provide clear messages (e.g. in the Curriculum) regarding the value of embedding STEM careers awareness in mainstream science teaching</p> <p>Encourage the development and provision of high-quality CPD and classroom resources to enable teachers to integrate STEM careers awareness into mainstream science teaching.</p> <p>Allocate ring-fenced funding for teachers to undertake STEM careers awareness CPD.</p>
Raise attainment in science (and mathematics)	<p>Draw on existing research evidence to improve pupil attainment in science and mathematics, particularly in national examinations</p>
Promote a vision of 'science for all'	<p>Collaborate with a range of stakeholders (e.g. BIS, professional societies, teaching bodies, employers, industry and the media) to challenge (actual and perceived) inequitable cultures within STEM.</p>



### Study details

The ASPIRES Project is a five-year, longitudinal study of young people's science and career aspirations (age 10-14). It is funded by the Economic and Social Research Council (ESRC) as part of its Targeted Initiative on Science and Mathematics Education (TISME, [www.tisme-scienceandmaths.org](http://www.tisme-scienceandmaths.org)).

The study is tracking a cohort of young people as they progress through education to try to better understand what their aspirations are, how they develop and what influences these aspirations. In particular, the research wants to understand the factors affecting post-16 science participation.

In Phase One (2009/10), a national survey was conducted in England with over 9000 children in the last year of primary school (Year 6, aged 10/11). We also conducted 170 interviews (with 92 children and 76 parents).

In Phase Two (2011/12), a national survey was conducted in England with over 5600 children in their second year of secondary school (Year 8, aged 12/13). We also held follow-up interviews with 85 of the original 92 pupils.

In Phase Three (2012/13), a national survey will be conducted in England with children in their third year of secondary school (Year 9, aged 13/14). Follow-up interviews will also be conducted with pupils and their parents.

In addition to the research methods described above, we have also been working in parallel with a group of teachers to explore ways of integrating STEM careers awareness into Key Stage Three science teaching.

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<sup>xx</sup> These top-level ethnic descriptors are used here in the text for ease in conveying broad brush patterns. But these top level descriptors were generated from pupils' self-identifications with far more specific subcategories. E.g. Black included Black British, Black African, Black Caribbean and Black Other. 'Asian' included British Asian, and a range of Indian subcontinent ethnic options, such as Indian, Pakistani and Bangladeshi. A range of 'mixed' ethnic identifiers were also used but are not reported here.

<sup>xxi</sup> 56% of students from the most disadvantaged backgrounds aspired to business, and 64% of students from the most socially advantaged backgrounds.

<sup>xxii</sup> Numbers add up to more than 85 due to some children expressing more than one aspiration

<sup>xxiii</sup> OECD (2012), *ibid*.

<sup>xxiv</sup> OECD (2012), *ibid*.



# ASPIRES

Science and career aspirations: age 10:14

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