

Notes for Teachers

Introduction

The aim of this education pack is to provide teachers and parents with the information and resources they need to help more girls develop their interest in science, technology, engineering and maths (STEM). Girls excel in the STEM fields when given a supportive environment in which to do so, yet for many, the cultural pressure to go into more 'appropriate' professions is just too much. But, with the help of teachers and parents, and the vast number of resources available online, girls can develop the self-confidence and resilience they need to pursue careers in the STEM subjects they love.

Girls excel in STEM

Research has shown that girls are just as capable as boys of understanding, enjoying and excelling in STEM subjects. They consistently outperform boys, both academically and via vocational study. For example, 25.2 percent of girls who take AS-Level physics obtain an A, compared to 21.4 percent of boys. At A2, 35.5 percent of girls get an A or A*, compared to just 29.9 percent of boys.

In BTEC Level Two engineering, 37 percent of girls achieve a distinction, compared to 20 percent of boys, despite making up only 5 percent of students. At BTEC Level Three, 14 percent of girls gain a distinction, compared to 9 percent of boys. The story is the same in BTEC Level Two IT, where 31 percent of distinctions go to girls, compared to 21 percent going to boys. At BTEC Level Three, 15 percent of girls achieve the highest grade, compared to 12 percent of boys.

Girls do not lack ambition, either. At degree level, 60 percent of all medicine undergraduates and 75 percent of all veterinary science undergraduates are women. But there are some things that make girls' success more likely:

- **Access to triple science:** The National Audit Office found that students studying separate biology, chemistry and physics GCSEs are more likely to study science at A-Level than those who do a combined GCSE.
- **Continuing physics:** Girls drop physics more than any other subject at A-Level, which closes many STEM doors to them, including engineering.

Why it matters

There is a strong moral case for encouraging and supporting girls who are interested in STEM: We should all have the right to explore the subjects that interest us without suffering peer pressure to conform to arbitrary cultural norms. Just as no child should be denied an education, no child should be denied the opportunity to study STEM or the chance to have a career in STEM.



There is, however, also an equally strong practical case: As an economy the UK and other countries around the world need to expand the STEM workforce. The Society of Biology estimates that “increasing women’s participation in the UK labour market could be worth between £15 billion and £23 billion [1.3 – 2.0% of GDP], with STEM accounting for at least £2 billion of this”.

In engineering, there is a huge personnel shortfall and the only way to make up the numbers is to encourage more women to enter the field. It is estimated that the UK must double the number of engineering graduates and apprentices in order to meet the projected job growth for the sector over the next ten years.

Finally, increasing diversity in teams also results in better solutions and the avoidance of ‘groupthink’. Diversity isn’t just about gender and race, it’s about diverse experiences and ways of thinking. Evidence shows that more diverse companies are more successful.

Interventions

Unfortunately, the evidence is that one-off interventions designed to encourage more girls to take physics have consistently failed. Over the last 30 years, the percentage of girls taking A-Level physics has not changed. Only 20 percent of eligible girls continue from GCSE to A-Level physics.

It may be that one-off interventions do not challenge the cultural biases that are stacked against girls, and do not sufficiently improve girls’ confidence, resilience, and ability to accurately assess their own skills. Girls are far more likely to believe that they are worse at STEM than they are, and some interventions that depend upon competition may even damage girls’ confidence. Where a boy who loses a competition is likely to ‘get back on the horse’ and carry on, a girl may walk away feeling that the loss is an indication that she’s just not cut out for STEM.

This means that we need to make permanent changes to the way that we communicate to girls about STEM, to continually provide positive, constructive messages, and to focus on improving confidence and resilience in the face of failure.

Why do girls reject STEM?

Studies show that by the time they reach 10 or 11, girls are starting to form a self-identity that does not include STEM. When surveyed, they say that they are not given enough information about STEM careers so, lacking any information on the opportunities open to them, they fall back on stereotypes that are both inaccurate and alienating. They find it hard to imagine themselves working in STEM, in part because they think that such careers are only for the most academically gifted of their peers, and they rarely think of themselves as belonging to that group.

It’s not a lack of enjoyment of the subject that causes girls to give up STEM, but a persistent feeling that it is for ‘other people’, for the select few. This feeling can be exacerbated by science-oriented masterclasses.



Making permanent changes

There are a number of permanent changes that can be made to the way that we communicate to girls about STEM.

It is essential that we encourage girls to feel that they are indeed capable of pursuing a STEM career. Achievement is closely linked to self-belief, so nurturing confidence and resilience in the face of failure is very important. However, cultural pressures and unconscious biases often conspire to promote boys' achievements over those of girls, so girls and boys must be visibly held to the same set of expectations and standards. Girls also tend to think that STEM subjects are 'too hard', despite the fact that girls outperform boys. They need to develop the ability to more clearly understand their own abilities, and to understand the learning process ahead of them. For example, failure to fully grasp a concept immediately is not a sign that a student is 'stupid', but that they need to apply a little stubbornness and continue to work at developing their understanding. Persistence is a skill that can be learnt, but anecdotal evidence indicates that culturally, girls are often encouraged to give up on 'hard' subjects rather than persevere and conquer them.

When asked why they don't consider STEM careers, girls often cite a lack of careers information. Unfortunately, though, a lot of careers advice reinforces gender stereotypes, so the responsible teacher must seek gender neutral sources of information. It's also important to emphasise that studying STEM subjects, especially physics, opens doors rather than closing them. Girls are rightly concerned about whether they can get a job when they finish their education, so discussing the variety of jobs available to STEM graduates will help them feel more confident that a decision to pursue STEM is wise. Equally, parental opinion has a big influence on girls' decisions, so teachers need to help parents understand that their daughters are capable of pursuing and succeeding in a STEM career.

Role models are also very important. There are few famous female scientists or engineers that have the kind of name recognition that men do. The famous women in STEM that do exist, such as Florence Nightingale or Marie Curie, are often portrayed in such a way as to make them alienating figures, rather than women we want to be like. Creating a plurality of role models, not just historic figures but modern women in STEM, will help girls to understand that there are women out there like them, from whom they can draw great inspiration. It also helps to challenge gender stereotypes and the pernicious idea that some careers are 'for girls' or 'for boys'.

Research from the Churchill Fellowship has shown that girls "thrive on collaborative and mission-based tasks that have goals to accomplish", rather than competitions. Girls have a tendency to take longer over tasks because they want to do things "properly", whereas boys will settle for "good enough". This results in boys outpacing girls in class, so girls think that they aren't as good as the boys and their self-esteem is eroded. Competition also erodes self-confidence, as failure is seen by girls as a judgement on their capabilities rather than as a temporary state.



Practical actions to take every day include:

- Hold boys and girls to the same set of expectations and standards.
- Help girls develop the ability to persevere with “hard” subjects
- Provide gender-neutral information on STEM careers
- Emphasise variety of STEM careers available
- Help parents understand the career options open to their daughters
- Create a plurality of role models
- Challenge gender stereotypes
- Focus on collaboration, not competition

Further reading

This education pack has been, in large part, based on the report, “*Not for people like me?*” *Under-represented groups in science, technology and engineering*, written by Professor Averil Macdonald for the WISE Campaign. In it, you will find much more detail about most of the issues above, including links to a vast number of relevant reports and studies.

You can download *Not for people like me?* from the WISE website, at <https://www.wisecampaign.org.uk/resources/2014/11/not-for-people-like-me>

The follow-on project from WISE, *People like me*, provides a valuable set of resources, including a quiz to help students identify potential STEM careers, teaching notes and posters, and is available from <https://www.wisecampaign.org.uk/about-us/wise-projects/people-like-me>



Feedback

If you have any feedback on these scenarios, or the rest of the education pack, or if you would like to provide suggestions for improvements, please contact Suw Charman-Anderson at suw@findingada.com.

About this pack

This free education pack comprises of:

- Notes for Teachers
- Introduction to Teaching Scenarios
- Teaching Scenario 1: The Ultrobot
- Teaching Scenario 2: The Recruitment Fair
- Teaching Scenario 3: The Charitable Trust
- Useful Resources
- The Amazingly Enormous Careers Poster
- Ten Types of Scientist poster
- Ada Lovelace poster

All resources have been produced by Ada Lovelace Day, and are available to download for free from their website, findingada.com. These files will be continually updated so please do check the website for the latest versions.

For schools who wish to buy prints of the posters in sizes up to A0, these are available online from the [Ada Lovelace Day RedBubble store](http://AdaLovelaceDay.RedBubble.com), with prices starting at £10.99.

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