



**UK Science and Discovery Centres:
Effectively engaging
under-represented groups**

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Foreword



It gives me great pleasure to introduce this report highlighting how UK science and discovery centres effectively engage people of all backgrounds in all parts of the UK with science.

Science is at its heart a hands-on, ever-changing, investigative pursuit, offering a lively and adventurous career. But not all parts of society are equally engaged or represented in UK science and engineering.

This report brings together a series of 22 case studies to showcase the range of science programmes and activities that are run by science and discovery centres and museums across the UK to inspire under-represented groups with science and engineering. The aim of this report is to share the knowledge, mechanisms, and best practice to enable the most successful programmes to be replicated by science engagement professionals in other parts of the UK.

This report covers specific interventions addressing three groups of society who are under-represented in STEM; school children and families from socio-economically disadvantaged areas, school children and families from a range of ethnic backgrounds, and women and girls in physics and engineering. For each we have sought a series of case studies showcasing what works, and what is successful in attracting these people to participate in science. This is not only needed as a matter of societal equity, but for our future well-being and economic growth.

As a nation and as a global society we have some major challenges ahead, particularly those relating to climate change and creating innovative technologies to reduce carbon output. We need to nurture and develop the scientific talents and entrepreneurial minds across our whole population not just a subset if we are to succeed. Likewise, we want people in every part of UK society to feel confident to contribute to discussions that involve science on matters that will affect all of our futures and will most likely require societal change.

Every year, 20 million people come to a science and discovery centre or museum. 10 million are women and girls who visit to take part in science activities and events. Being part of this network of over 60 public-facing science engagement organisations puts each science engagement professional in the privileged position that together we can actually begin to change these societal inequalities.

A handwritten signature in black ink that reads "P Fidler".

Dr Penny Fidler, CEO of UK Association for Science and Discovery Centres

Executive Summary

Each year in the UK, 20 million people choose to engage with science in person at a science and discovery centre or science museum. Over 10 million of those delving into science are girls and women. Two million are schoolchildren visiting with teachers for curriculum-supporting science workshops, activities, discussions, science practicals and special programmes.

The UK Association for Science and Discovery Centres (ASDC) brings together over 60 of the UK's major science engagement organisations including science and discovery centres, national science museums, environment centres and learned societies and is the nation's largest network of informal science and family science learning organisations.

This national infrastructure spans all regions and countries of the UK and reaches into a huge number of 'hard to reach' communities on a day to day basis in both rural and urban areas. They are trusted hubs of publically-accessible science and work in partnership with schools, teachers, families, universities, scientists, industry and communities.

The subjects covered by the science and discovery centres range from climate science and renewable technologies to space science and brain science. Together ASDC works in partnership with our members towards our shared vision of 'a society where people of all backgrounds are intrigued, inspired and involved with the sciences'.

The UK's future economic success and growth depends on us building a world-leading knowledge-intensive economy underpinned by an exceptional, skilled STEM workforce. However, currently, the UK STEM workforce does not reflect the makeup of the UK population as a whole. Only 15.5% of the STEM workforce is female and they are extremely under-represented in engineering where only 8% are women. Similarly there is considerable under-representation of people from a variety of backgrounds working in STEM, notably people from ethnic backgrounds and those living in areas high on the index of multiple deprivation.

This needs to change. Not only do we want to ensure girls and young people from every background have fair and open access to these hugely exciting and rewarding STEM careers, we need this wider base of skills and experience to drive our future economy. We also need to ensure all areas of society are sufficiently confident and able to contribute to science and society discussions. Not to mention that science and engineering are a big part of UK culture and for that reason alone should be accessible to all.

Science engagement organisations within the ASDC network in all parts of the UK already run a large number of science programmes working directly with these under-represented groups on a large scale. For this reason the Department for Business, Innovation and Skills (BIS) commissioned ASDC to write a report and series of case studies to share best practice of the STEM programmes and activities that are already successfully reaching these groups of people everyday across the UK.

In total, 22 case studies were chosen highlighting the variety of science programmes working with families, communities and schools in disadvantaged urban and rural areas (using the index of multiple deprivation) as well as case studies on specific programmes to inspire girls with physics and engineering. They cover a geographical spread across all four nations of the UK. Each case study was selected on the ease with which it could be replicated by other science engagement organisations in

a cost-effective manner, and all case study contributors are happy to share further information on request.

The science programmes reported range from large-scale community science open-days for families from areas of high deprivation, to schools bursary programmes supporting primary teachers and children from disadvantaged schools who participate in regular science workshops at science centres. Some are national strategic programmes funded by for example the Scottish, Welsh and Northern Irish Governments who wish to ensure their school students have a fair and equitable access to enlivening, inspirational science. Others are targeted at increasing the numbers of girls taking physics and engineering, and are both UK-wide, for example 'Explore Your Universe', which has already inspired 75,000 girls and women, and national, for example the Welsh programmes to look at science programmes through the gender lens.

Practical recommendations of best practices have been made for public engagement professionals working with families, communities and schools in disadvantaged areas, and for engaging more girls in physics and engineering. Increasingly, government funding will be targeted towards science engagement activities that reach these under-served groups and which strive to redress disadvantage and make UK society a fairer place. This is a key part of the new BIS Science and Society Charter as well as the Number 10 'Call to Action' on getting more women into technology and engineering.

We hope the case studies will provide inspiration for public engagement professionals working in a wide variety of organisations across the UK, including within science and discovery centres, museums, learned societies, science festivals and university outreach departments, as well as charitable trusts, funders and policy-makers with an interest in STEM education and the diversity agenda. Together we all have a major role to play in addressing these issues of inequality and ensuring that everyone within UK society has fair and equitable access to explore science and to choose to work in science.

Note: Throughout this report, we have used the terms 'science' and 'the sciences' to refer in the broadest sense to all areas of Science, Technology, Engineering and Maths (STEM). The terms have been used interchangeably, and on occasions we have used 'science and engineering' to highlight broad science programmes that emphasise engineering.

In addition we have used the term 'science centres' to refer to all and any members of the ASDC community engaging people directly with hands-on science including science museums, environment centres, learned societies and other ASDC members. The knowledge and specific items of best practice we hope will be useful to a wider range of science (STEM) engagement professionals working in science festivals, university outreach departments and smaller science engagement organisations as well as policy makers and funders with an interest in STEM education and the diversity agenda.

Introduction

The UK Association for Science and Discovery Centres brings together over 60 of the UK's major science engagement organisations, including science and discovery centres, national science museums, environment centres and learned societies. Together, this vibrant and trusted national infrastructure attracts over 20 million visitors each year who take time to explore and delve into science and engineering in a hands-on, intriguing and personal way.

This national network spans all regions and countries of the UK and reaches into a large number of 'hard to reach' communities. Collectively the science centres and science museums engage over 2 million school students each year from a range of socio-economic backgrounds, who take part in science workshops and activities, discussions, science practicals and science events. Over ten million women and girls participate in science centre programmes every year, and over half of the science staff at these centres are female.

The subjects covered by the science and discovery centres range from climate science to space science and from nanoscience to brain science.

The aim of this report

This report has been commissioned by BIS to provide a series of best practice case studies showing innovative STEM projects and activities being delivered by UK science and discovery centres and science museums that have been particularly effective in engaging 'under-represented audiences' with STEM. We hope that the ideas, knowledge and mechanisms that have worked in these centres will be of wider use to science (STEM) engagement professionals across the UK, including those working in other science centres and museums, discovery centres, science festivals, learned societies, university outreach teams as well as smaller science engagement groups and those supporting the sector with funding and addressing policy in this area.

The term 'under-represented audiences' has many meanings, as do the terms 'diverse' and 'disadvantaged'. The scope of this report was therefore specified to look at programmes and initiatives that have successfully engaged the following groups:

1. Students from specific **socio-economic** backgrounds who are under-represented in STEM (in both school qualifications and STEM careers)
2. Students from specific **ethnic** backgrounds who are under-represented in STEM (in school qualifications and STEM careers)
3. People of all ages and families who **do not usually engage** with STEM, and families with low science capital (as defined by the ASPIRES report¹)
4. **Girls** in Physics and Engineering

Clearly there is a great deal of cross-over between these groups. Case studies take this into account, and often a single intervention is designed to widen access across two or three of the above groups. In general, interventions to inspire more girls into the physical sciences and engineering are somewhat different and the case studies are therefore separated out. To be clear, what is not included within the scope of this report are the multitude of programmes working with people with specific disabilities, for example science programmes for adults with mental health issues, patient groups or science activities adapted for children and adults with visual, hearing or other sensory impairments. One case study gives examples of digital engagement, but on the whole it is difficult to know the background of those engaging in this way.

22 case studies have been commissioned from UK science and discovery centres and museums across the UK. Each one shares the best practice of particularly successful interventions that effectively attracted and engaged under-represented audiences with STEM. Every case study author has offered their contact details and would be happy to advise other science engagement professionals in detail to set up similar programmes. Some of the case studies are useful to all practitioners, others give specific detail and mechanism to enable the major hubs of science engagement within the UK to use the resources they have to maximise their reach.

The report consists of fifteen case studies relating to widening access to science amongst ethnically diverse and socio-economically disadvantaged groups, seven on interventions that have been successful in engaging girls with physics and engineering and one on digital media. The 22 case studies were chosen following a series of interviews with public engagement professionals in science and discovery centres and science museums and festivals and in most cases it is the specific detail, relationships and nuance that has been crucial to making the project successful. We give detail on best practice on how to work closely with your intended target group to co-develop the programme, as well as mechanisms whereby others have successfully developed relationships with funding partners to remove a key barrier to participation – that of cost.

The case studies highlight the variety of family, community and schools interventions attracting people from urban areas high on the index of multiple deprivation, as well as remote rural communities with less access to STEM. They cover a geographical spread across all four nations of the UK. Each case study has elements of best practice that can be replicated by science engagement professionals in other organisations across the UK. Making a success of engaging groups from disadvantaged communities is always about building relationships with these groups, so whilst the case study might refer to an open access day at a science centre, the key learning of *how* that was achieved can be applied to a wide variety of other engagement contexts.

Science and discovery centres are embedded in their communities across England, Ireland, Scotland and Wales, and run a large number of STEM programmes every day. They run or collaborate on the science festivals and work with other STEM engagement professionals and initiatives in their region. The Wellcome Trust Review of Informal Science Learning refers to them as keystones within the UK's informal science learning ecosystem. The power of this national network is that it already brings together every organisation in the UK that physically reaches large numbers of people with science (mostly over 200,000 people each). The centres operate sustainably in their regions 364 days of the year and each share the ASDC vision of 'A society where people of all backgrounds are intrigued, inspired and involved with the sciences'.

This powerful network is brought together by the UK Association for Science and Discovery Centres (ASDC), and is the UK's largest network sharing best practice in the field of science learning and engagement that happens out of school, and in support of school. With around ten million school-age children visiting each year (two million with teachers in school groups) it is also a formidable ally and support for school science learning across the UK. Particularly given that 80% of a child's time is spent out of school, and we know that 67% of school children cite families as key influencers of their career choice.

Effectively engaging under-represented groups

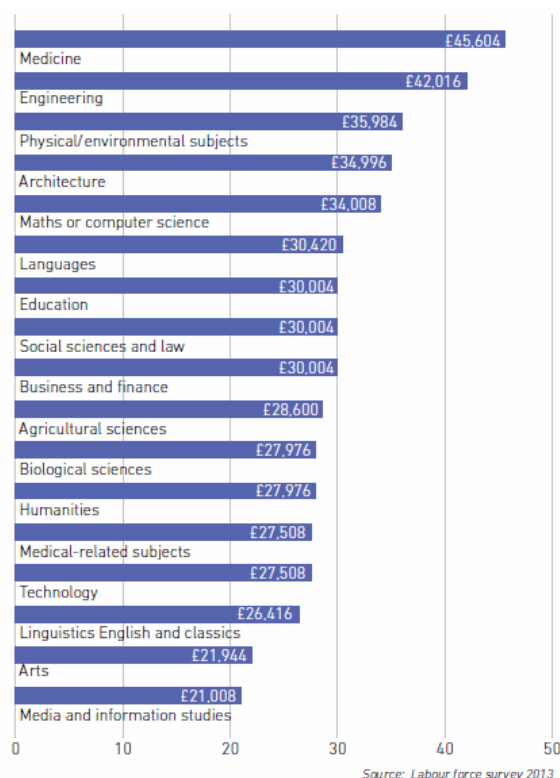
The STEM workforce does not reflect the makeup of the UK population as a whole. This is evident at all levels, from technicians to senior scientists, in all parts of the UK.

This collation of case studies shows example of best practice programmes at UK science and discovery centres and museums that strive to redress this balance and aim to ensure fair access by all to inspirational science.

It is part of the charitable mission of most members of ASDC that they inspire and involve people of all backgrounds with science, and is something the over 5,000 staff in our member science engagement organisations across the UK are hugely passionate about. However much more needs to be done if we are to proudly and honestly say that every child entering the UK education system has equal likelihood of entering a rewarding and interesting career in science, technology, engineering or maths.

One of the key messages for young people and their families is that gaining good qualifications in the sciences keeps your options open. 67% of young people say their main source of careers advice is family. However, families with little or no ‘science capital’ are unlikely to suggest, recommend or nurture a young person to begin thinking of a career in science. This urgently needs to change for issues of societal equity, individual development and our national need for a competitive and highly skilled future STEM workforce. As the major UK network of family science learning we can offer a mechanism to move towards a more equitable society and share best practice with all science engagement professionals working more broadly across the UK.

Embarking on a STEM career is an exceptionally good way of achieving social mobility. Women and men with a first degree in a STEM subject earn 4.47% higher salaries than those with a first degree in other subjects². Higher earnings are seen at all levels from technician to PhD level. Indeed the Centre



for Economics and Business Research reports that those with apprenticeship qualifications in engineering and manufacturing earn on average 12% higher salaries than those without³.

Figure: 1 Average annual Pay for Graduates by Subject

Gaining STEM qualifications will enhance a young person's opportunities to find and retain work as businesses across the UK are already reporting STEM skills shortages. A CBI survey in 2014 found that 39% of businesses who were seeking employees with STEM skills had difficulty recruiting those staff⁴. In addition, the UK Commission for Employment and Skills reports that 26% of core STEM vacancies in England are hard to fill⁵.

STEM qualifications can also enhance the likelihood of securing a job in areas that have levels of unemployment above the national average. For example the UK Commission for Employment and Skills projects that by 2020 there could be significant regional shortages of high level STEM skills in the following English regions:

- East Midlands
- Yorkshire and the Humber
- North West England
- North East England

There are also a variety of sectors that need to rapidly increase the numbers of skilled technicians, engineers and researchers. These include the UK space sector which currently employs around 30,000 people and has a turnover of £9 billion. Growth in this sector is forecast to be robust⁶, achieving a turnover of £40 billion by 2030, requiring a skilled UK workforce of 100,000 women and men. Young people and their parents don't know there are 70,000 jobs coming up in the space sector for technicians, researchers and engineers over the coming decades. The international Relevance of Science Education (ROSE) 2009 research shows there is a high level of interest in space as a subject⁷. Likewise other growth sectors, such as advanced manufacturing, and digital and creative sectors, will need more skilled workers. The BIS report in 2013⁸ showed that 938,000 people work in green businesses, and this is set to expand further. Indeed, specifically 45,000 individuals will be needed to meet growth in the offshore wind sector by 2021⁹. Overall, Engineering UK forecasts that by 2020 engineering companies will increase their demand for staff with engineering skills at all levels to 1.86 million people across the UK, giving a net increase in jobs in the sector of 204,400¹⁰.

The desire for an exciting and worthwhile career is a huge driver for young people, yet most are entirely unaware that these job opportunities exist; most commonly stating it's not for "people like me"¹. This needs to change. Likewise, the nature of a career working with science needs to be made more visible for girls and boys. The inspirational ASDC national strategic programme on the physical sciences showed that many of the 3,000 school students evaluated commented with surprise at the interesting places scientists worked and that they travelled as part of their jobs¹¹.

Above, we have focussed on the need to ensure people from all backgrounds have equal access to science for reasons of social mobility, personal achievement and creating a fairer society. However, this is of course only part of the reason we are all passionate about inspiring people with science. The wider picture is that of increasing scientific literacy, building confidence to contribute to scientific debates where they impact society, and celebrating science as a huge part of our culture, and as such should be accessible to everyone.

Science and discovery centres unfortunately have the burden of having to charge an entry fee to continue offering inspirational science in their regions. Generally the entry fees contribute around a

third of the income needed to run a science centre to deliver the wide-ranging mission of each educational charity, to such a high quality that families and schools want to visit repeatedly. The remaining two-thirds of the income needed is earned through a creative selection of subsidiary businesses, corporate hire and fundraising for science education and engagement projects.

The entry price is a key barrier for people from low income families and generally ranges from £8-£13 for an adult. It is clear from the case studies, that when done right (i.e. in partnership with the community, families and schools) removing this financial barrier for people from disadvantaged backgrounds is all that is needed for thousands of people from low income areas to come for a science day out. Likely, the key factor in the demand here is that they are getting something of high value for free, targeted to their interests, and for a limited period only. In addition, the invitation comes from someone they trust (for example their child, teacher or community group) rather than something that is simply posted anonymously through their door with no relationship attached. In terms of attractiveness, this is quite different from being invited to visit an already free resource or event that they feel 'is not for me'.

Practical recommendations of best practice to increase STEM engagement with under-represented audiences

We acknowledge that many ASDC members are already doing many of the items below:

1. **Don't assume you can do it alone.** Partner with organisations that specialise in working with disadvantaged young people (e.g. the Princes Trust, Kids Company, youth groups) and join forces with community groups to reach families (parents and grandparents) who otherwise would not participate in your programmes or visit your science centre.
2. Obtain the services of a community engagement specialist who already has relationships with all the local groups. This can be achieved by fundraising to hire one (part-time or full-time), sharing one with another organisation with complementary aims, finding a volunteer with these skills or working with the council or local volunteer umbrella group.
3. Contact schools and community groups directly and personally (if needed, ask your regional Voluntary and Community Sector organisation for contacts). Visit in person and meet with the community group or teacher to explore and co-develop a programme and strategy that works for you both. Don't rely on busy gatekeepers to pass on messages, or emails.
4. Meet with your Local Council (ask for the Community or Regeneration sections) to discuss which areas in your region are best targeted to inspire young people, families and community groups who are under-represented in STEM. Generally these are areas high on the index of multiple deprivation, (however, check as some areas high on this index might already be well-served by ongoing interventions).
5. Talk to your council education department to discuss their ambitions in STEM. Particularly discuss how your science engagement organisation can offer valuable support for primary teachers and children from all areas of the city for example giving every schoolchild access to your practical science workshops. Discuss how they might help you cover the participant

cost for each child from a disadvantaged area, and if there are any schemes to contribute towards their travel costs. Ask for the data on schools and free school meals to help with targeting initiatives. This is also available on your national education department website.

6. Approach local science and engineering companies (and other local funders) to fund bursary schemes so all primary schoolchildren can visit you, or you can visit them every year to inspire them with excellent science activities. This year on year approach also acts as CPD for primary teachers, to improve the general science being taught at primary schools.
7. Discuss with the council and science-based industry what the region needs in the way of STEM skills and what your science engagement organisation can offer to deliver this.
8. Work with your local supplementary schools. The UK has a vibrant network of supplementary schools that offer educational support (language, core curriculum, faith and culture) and other out-of-school activities to children attending mainstream schools. They are established and managed by the community. The National Resource Centre for Supplementary Schools has a searchable database of over 2,800 supplementary schools across England <http://www.supplementaryeducation.org.uk/>.
9. Consider what exceptional science experiences you can offer sustainably and cost-effectively by capitalising on the fixed costs of your organisation, and offer these at low cost to engage more diverse groups.
10. Consider holding a community day where you invite families from disadvantaged areas to your science centre or other venue for free over one weekend each year. An effective way to ensure they come is to target schools in these areas that you already have relationships with and send children home with invites and flyers for parents for a special community weekend. Run this alongside all your paying visitors so you don't incur lost revenue. Don't simply post invites through doors in these areas, it doesn't work if there is no existing relationship and trust.
11. Bookings for science engagement activities fluctuate across the year. For example, science and discovery centre visitor numbers are very 'peaky'. They are filled to capacity with families on half terms and holidays and packed with schools in the weekdays in spring and summer. Operating a pre-booking 'slot' system for school bursary schemes, family 'Golden Ticket' schemes and community days enables your organisation to spread the bookings across the year and welcome these visitors at times when you have the staff resources to maximise their experience.

Understanding who does, and does not participate in your science activities

Most science centres routinely collect data on school visits and generally analyse this in house. Schools give postcode data when they book and this can be analysed against the Department for Education data on percentage free school meals. It is very clear that science centres attract school students from across society in a manner that is largely reflective of that society (for example 50% of school students visiting in Birmingham Thinktank are BAME).

However, most science engagement organisations and science centres would like to have considerably more in-depth data on the background of family visitors (holidays and weekends) to better understand who is coming, and who is not. Ideally they want to collect this data year on year. However, for most science centres this analysis is prohibitively expensive. Currently the only organisations that do this in a detailed and regular manner are those with public funding. Case studies from two of these organisations are within this report - one dataset from Thinktank which has an entry fee, and some data from the Science Museum which is a free national museum.

Science centres would like to undertake postcode analysis via Acorn or other methods and relate this to the index of deprivation, combined with sample data on ethnicity and age factors. We propose centres approach funders to try to cover the cost, or ask their regional business development organisations, council and local tourism organisation for financial assistance.

Although the key barrier to collecting and analysing this data is financial, the other barrier is that asking people on a family day out for their postcode can often be seen as intrusive and frequently raises difficult family issues (such as the visiting parent lives in one part of town and the child in another). In addition, Gift Aid data can't be used as it only includes those in paid work.

Once collected however, the data is invaluable for business planning. For example, science centres tell us that once they accepted families from certain areas high on the index of deprivation rarely paid to visit the science centre, it was far easier to provide a mission-driven business case for offering low cost or free entry to these disadvantaged groups at certain times of the year.

Accessing the Indices of multiple deprivation to decide who to target

These are available online for each nation. The interactive map has been particularly useful for the Scottish science engagement organisations.

In Scotland: <http://www.sns.gov.uk/Simd/Simd.aspx> (an interactive map)

In Wales: <http://wales.gov.uk/statistics-and-research/welsh-index-multiple-deprivation/?lang=en>

In England: <https://www.gov.uk/government/collections/english-indices-of-deprivation>

In N. Ireland: http://www.nisra.gov.uk/deprivation/nimdm_2010.htm

The basics when starting out: What not to do!

This advice is for organisations who have not worked with under-represented audiences before. It is in addition to the main recommendations above which should also be followed.

1. **Don't assume you can do this alone!** There are plenty of local charities, city youth groups and community organisations with strong relationships with the groups you want to target and who will share your goals and fully understand what will work. Speak to the people who know what they are doing and take their advice, and meet them before you do anything else. Most science events that do not attract audiences are developed without real partnerships with these vital organisations.
2. **Don't ignore the reason:** If certain sectors of society are choosing not to take part in your excellent science offerings, there is a reason. Understanding and addressing this is paramount. Sometimes it is cost, travel or they simply haven't heard of it, but largely it is a feeling of 'it is not for me'. This is often deep-seated and you need advocates within their community whose recommendations they value and trust. This is key. The advocates can also be their children who have participated with their school and want to bring their families to explore (this is the key to success of the Golden Ticket and other schemes shown in the case studies).
3. Don't assume what works with one audience will work with another. Adapt everything.
4. As with all the general recommendations above, remove all cost barriers, and, if you are a charity rather than a public organisation, seek funding to achieve this. Never assume that because an event is free, it will attract people from under-represented groups. This is unlikely.
5. Running events in communities is obviously a good starting point (supplementary schools, community groups, libraries, youth groups, toddler groups, shopping centres, hospitals etc). However a key point to remember is that you should be building a relationship rather than a one-off experience, and nurturing people's confidence to explore and try out new learning opportunities through follow-on experiences. Social media is an easy way to build on the first interaction and tell them about future events.
6. Consideration of your audience's needs is paramount. For example the timing of your event is obviously key and dependent on when your target group will be available. Should it be day time or evening, weekday or weekend, term time or school holidays and have you considered the relevant religious festivals and customs? Likewise the promotion of the event through social media will be age and target dependent.
7. Be very clear why you are doing this, and have an answer ready when people ask you.
8. The schools are a great way in. Ensure that as standard practice you are engaging with all schools in disadvantaged areas (through incentives and special programmes) to begin to build relationships with those families who don't otherwise engage with science.
9. There is an opportunity to engage young people around interesting jobs and careers that are on offer in science and engineering. Often the young people and their parents will have no idea that the space sector, renewable energy or science in general needs more young women and men like them to pursue interesting careers into the future and parents and young people are keen to find out more.

Inspiring girls with physics and engineering

As a nation and as a global society we have some huge challenges ahead that will need a combination of technological innovation and societal change. We need to mobilise and nurture the scientific talents and innovative approaches of both our young women and our young men if we are to address these challenges. We ignore half the population at our peril.

This vision is echoed by the Number 10 Downing Street 'Call to Action' on getting more girls and women into technology and engineering, which ASDC and many science and discovery centres are early signatories to.

The current situation

Women make up 46% of the UK workforce but only 15.5% of the STEM workforce¹². They are especially under-represented in engineering where just 8% are female.

Girls attain well at physics GCSE but female participation begins to fall at A level. Just 21% of A level physics students¹³, 39% of maths students and 29.5% of further maths students are girls. The situation is different for biology and chemistry, where 58% of biology A level students and 48% of chemistry A level students are female.

Women are also poorly represented in all STEM-related apprenticeships. In 2010-11 women completed 18% of ICT apprenticeships, 4% of engineering and manufacturing apprenticeships and 1% of apprenticeships in construction, planning and the built environment⁴. These patterns are also broadly true for NVQs and SVQs, in which women are under-represented in STEM programmes, except in the field of ICT.

In the workplace, 27% of science and engineering technicians are female, 15% of ICT professionals and 5.5% of engineering professionals are women¹⁴.

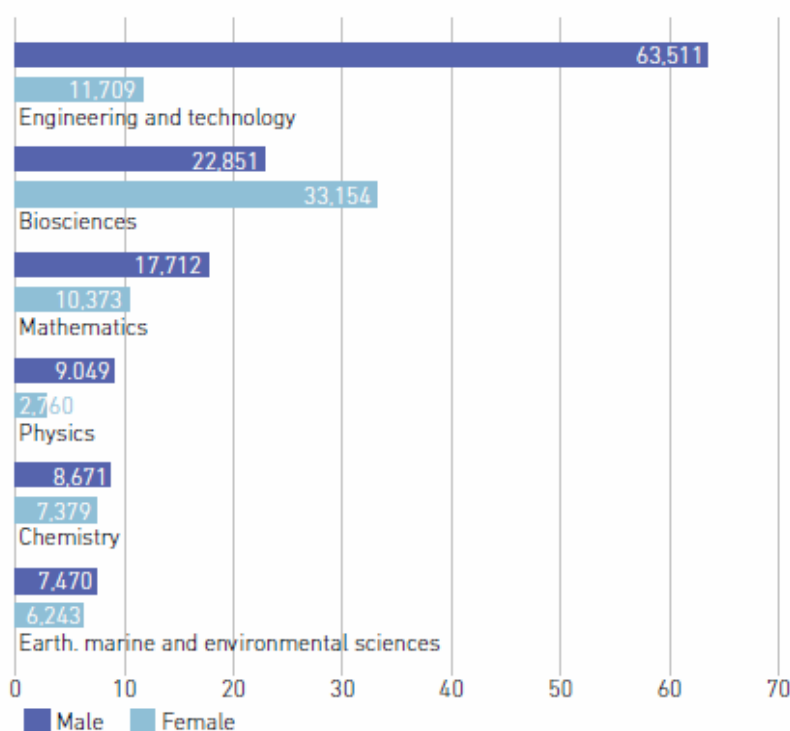


Figure 2: Number of male and female full-time undergraduates in selected STEM subjects, 2011-12 in 000's

Source: HEFCE, Strategically important and vulnerable subjects

The problems arise relatively early on. A recent study looked at the career aspirations of 10-14 year olds and found that only around 15% were interested in jobs in science, compared with around 60% wanting a career in business¹. It seems few realise that many business leaders are STEM graduates.

The Institute of Physics (IOP) excellent report 'It's Different for Girls' revealed the critical data that girls were almost two and a half times more likely to go on to do A-level physics if they came from an all girls' school rather than a co-educational school (for all types of maintained schools in England). That is 1.8% in co-educational schools, compared with 4.3% in all-girls schools, taking A level physics - an increase of 239%. ASDC fully supports the recommendations made to the education system in both the IOP reports 'Closing Doors'¹⁵ and 'It's Different for Girls'¹³.

The critical question is how can we change this situation? What interventions would be best?

Learning is a hugely complex field and many academics have looked at the issue of under-representation of females in physics and engineering. The methodological approach in each study is generally different and often accounts for the seemingly conflicting findings of each study. In addition, women and girls make up half the population and all are different – one solution is unlikely to fit all.

However, one US study sought to address the issues and put five of the most prevalent theories of what most increases female interest in physics¹⁶. The study analysed the schooling of 7,500 female students looking retrospectively at the effect of the following learning conditions they had had:

1. Having a girls-only physics class
2. Having a female physics teacher
3. Having female scientist guest speakers in physics class (role models)
4. Discussing the work of female scientists in physics class
5. Discussing the under-representation of women in physics

The study concluded that the only intervention to have a significant positive effect was discussing the under-representation of women in physics with these girls. Interestingly, girls-only physics classes were not effective unless accompanied by other modifications (which likely also explains why all girls-schools do so much better in physics).

Time and time again 'stereotype threat' is cited as a reason why fewer girls choose to take physics and engineering. Likewise, the ASPIRES study notes the impact of the "it's not for me" phenomenon¹. Some studies have found that positive female role models can have an 'inoculating' effect against negative stereotypes¹⁷ but we need to address firmly why these stereotypes are there, and why girls who achieve as well as boys at GCSE physics, feel they are not confident enough to take the subject at A level. Clearly the boys are not feeling this lack of confidence and go on to have exceptional careers in engineering and physics. Perhaps we need girls to be a little outraged that with equal talent and aptitude to boys, their own and society's expectations and unconscious biases are denying them these great opportunities.

Successfully inspiring girls at science and discovery centres

Gender equity in science has always been a passion of the charitable enterprises that are the nation's science and discovery centres, and for years they have strived to ensure their science

programmes and activities appeal to girls and boys. Indeed they appear to be successful with over half of visitors to science centres and science museums being female (for example; 53% of family visitors to At-Bristol Science Centre are female, 65% of visitors to Thinktank in Birmingham and 50% of all visitors to the Science Museum in London are female).

We are already highly active in this area and believe that increasing the participation of girls and women in the physical sciences and engineering is not only an important matter of fairness and equity, but is also vital to the protecting the long-term economic prosperity of the UK and future well-being of our nation. As a network we are well placed to create a step change in both how girls interact with physics and engineering and how they and their families view careers in these areas.

Together, the UK Science and Discovery Centres engage over 10 million girls and women every year with hands-on science ranging from brain science to particle physics and engineering to green technologies. That equates to **nearly 200,000 women and girls every week of the year who are coming to a local science venue to engage with the sciences.**

Not only do science centres engage women, mums and girls with science and engineering, but they aim to inspire the whole family. This is vital as we know parents and the wider family are key influencers of girl's career choices. Family members suggesting interesting careers in science to a girl has a big positive impact, but equally vital is the removal of subtle and unintentional gendered comments and, for example, the surprise that families often express when a daughter shows an interest in physics or engineering. Indeed, one survey showed parents of girls aged between 5 and 18 are still inclined to encourage their daughters to study subjects other than engineering and science. 73% of mums and dads said they believed that other subjects offer better career opportunities for girls - despite the fact that the UK needs 1 million more engineers by 2020¹⁸.

The UK science and discovery centres already work with over 1 million schoolgirls each year in curriculum-linked hands-on science workshops, discussions, cutting-edge science labs and science events on a huge range of topics. Over half of the professional science learning staff across the ASDC science centre network who interacts with schools and families delivering science activities is female – acting as role models every day. As a specific example, 58% of the 26 science staff in At-Bristol science centre who have post-graduate science qualifications and work directly with children and families are female.

The UK Association for Science and Discovery Centres (ASDC) is running a national strategic physics-based programme to inspire girls and boys with physics and engineering. The hugely successful programme is called *Explore Your Universe: from Atoms to Astrophysics* and is in partnership with the Science and Technology Facilities Council (STFC).

Explore Your Universe is being run at ten science centres and in just one year engaged over 150,000 schoolchildren and adults in exceptional hands-on physics activities, experiments, schools workshops, public shows, meet-the-expert sessions and a variety of other events. **75,000 of the participants were female.**

ASDC designed the entire programme to appeal to girls as much as boys, and have made all the Explore Your Universe resources and physics experiments available online and free for anyone to use. The overall impact of the programme was evaluated by academics at King's College London and

it is now the UK's largest academically evaluated dataset of the impact of out of school science learning.

56% of girls and boys (aged 10-13 year) who took part in a 1-hour physics workshop said the experience had made them now more interested in studying science. Of great interest is that there was no statistical difference between the answers of the girls and the boys – both genders were equally inspired by the engineering and physical sciences through this programme.

Across the UK, science and discovery centres run a wide variety of programmes that are specifically focussed on increasing female participation in STEM. These range from the popular 'Girls Night Out' at Jodrell Bank Discovery Centre where girls can meet inspirational astrophysicists and engineers (all women), to inspirational physics schools programmes for girls funded by the Welsh Government to raise aspirations of girls in physics and engineering. In addition, most science centres across the UK run a variety of girls-only science events for example with Guides and Brownies. The girls programmes are numerous and varied, and this is simply a flavour of what we could, as a national network, easily do more of.

ASDC and the UK science and discovery centres along with other science engagement providers have the enormous potential to deliver a national programme to inspire girls in the physical sciences and engineering. Indeed we are already delivering this in part through Explore Your Universe and could simply re-orientate some of the power of this national network to address the issue of the gender gap.

Likewise ASDC has the infrastructure in place to run gender lens training with science centres and museums across the UK which could have a powerful impact on the 20 million people who are already visiting science centres. To note at this point, all ASDC members strive to ensure all activities appeal to girls and boys and have taken this approach for decades. What we are not yet explicitly doing is discussing the reasons for the gender gap with schools and families and this approach could be a game-changer.

Practical recommendations to increase the participation of girls and women in physics and engineering

1. Commit strongly to initiatives and practices that address how young women perceive themselves, their abilities, and their images of what it means to be a scientist or engineer. Learn the data on the gender gap and share it with colleagues, teachers and school students.
2. Measure and record annually how many of your staff who presents science to the public are female. If this is less than 50% aim to change this within a year.
3. Count how many of your visitors are female. If it is less than 50% run targeted programmes to bring in more girls, mums and women. As the visitor profile changes dependent on if it is a school day, weekend or holiday, we suggest you do this by sampling participants on different days (and different times). Publish these results annually.

4. If none of your female staff are physical scientists or engineers try to get women in these fields volunteering and doing meet the expert events on busy days. Remind them that their personal stories of why they choose these careers, and what they do every day as a scientist or engineer are equally fascinating to visitors as the actual science.
5. Explore subtle ways that mums and dads can find out there is a gender gap issue, and that this is partly caused by some parents unintentionally not encouraging daughters to take these excellent careers in the physical sciences and engineering. Reveal the data that 73% of mums and dads felt that other subjects offer better career opportunities for girls. Add that for example the space sector needs 70,000 extra technicians and engineers by 2030 and they would like half to be girls.
6. Bust the myth that all engineers and physical scientists are male by ensuring over half your visiting scientists, physicists, engineers and experts are female, for all your projects. Ensure you replicate this in all printed material, on the web and on social media.
7. Look at all your practices using 'a gender lens' and train all staff to view every science activity and everything presenters say through a gender lens. Incorporate it in every aspect of what you do and in every part of your in-house training schemes. Send some staff on a gender lens training course to ensure you know exactly what approaches work and ensure gender neutrality in all activities.

UNESCO explains the gender lens as follows:

"Think of the gender lens as putting on spectacles. Out of one lens you see the participation, needs and realities of women. Out of the other you see the participation, needs and realities of men. Your sight or vision is the combination of what both eyes see."

Be aware that just knowing that there is a huge gender gap, and making all staff aware that what they say and present to visitors must be gender neutral is a good step forward and can be done immediately.

8. The key point overall is that it is not impossible for women to enter these kinds of careers, but it is harder than it should be. Any disadvantage (especially one to this extent) is unfair and must be addressed head on. With a little training, every staff member working in science engagement with schools, teachers, families and the wider public is in the privileged position of being able to effect real change in this field.

Case studies: Part 1

Engaging under-represented communities and families with science



The Golden Ticket Scheme and Community Outreach, Dundee

Access to inspirational science for families from areas of high deprivation

Linda Leuchars, Head of Science Learning and Public Engagement

Dundee Science Centre

Dundee Science Centre is a lifelong science learning resource for the whole community engaging 100,000 people each year. The Science Centre runs a wide variety of community engagement initiatives.

The 'Golden Ticket' scheme strives to build science capital in families living in disadvantaged areas (in the top 15% on the Scottish Index of Multiple Deprivation). In 2013, over 2,000 parents and children from these areas took part in science days using a Golden Ticket.

The idea works because it reaches families via established relationships with the children's primary and secondary schools. Certain schools in the most socio-economically deprived areas are given a 'Golden Ticket' for one year, supported by the Local Authority, and this enables any family with a child at that school the opportunity to book free family visits to Dundee Science Centre. The scheme has been very successful in engaging families under-represented in science - and many families become regular visitors.

Dundee Science Centre also hosts 'Open Access' days targeted at those who do not usually visit due to financial constraints. The events are co-created with community partners, such as local Community Planning Partnerships and local authority Community Centres, and remove the barrier of the entry fee to support families from economically disadvantaged areas to take part. They attract 600-900 people each day (4000 per year).

Dundee Science Centre also provides in-centre and outreach visits to inner city youth groups. In partnership with local community centres, youth organisations and colleges, Dundee Science Centre delivers 4-12 week programmes of hands-on science workshops and 'meet-the-scientist' opportunities that are pre-selected by the young adults themselves. 500 13-18 year olds are engaged through these each year.

Like-wise, delivery of the adult community engagement initiatives is community-led, with the topics, activities and venues determined by each individual group, to suit their specific needs and interests.



Key Facts

- A Golden Ticket Scheme aims to build family science capital in partnership with schools in disadvantaged areas. Pupils from these schools can bring their families for free to Dundee Science Centre.
- Open Access days remove the financial barrier to visiting the science centre, helping to engage those in economically-disadvantaged areas.
- Community-led programmes for young people and adults are developed and delivered on a bespoke basis in partnership with local community partners.

Sharing Best Practice

The key to success was to co-develop programmes with partners in the target areas, such as youth groups, schools and community centres. The emphasis is placed on building relationships, to have meaningful and sustainable engagement.

Partnership with the Local Authority education departments enabled us to identify which schools and areas to target our resources.

Contact: linda.leuchars@dundeesciencecentre.org.uk

"I am very proud of our Golden Ticket and other community outreach schemes. They are not a one-off experience, but part of an embedded programme, supporting families to spend time together focussed around science"

Louise Smith, CEO at Dundee Science Centre

Community stargazing events

Dark Sky Discovery: astronomy and hands-on science with rural and other communities

Dan Hillier, Head of Public Engagement with National Laboratories

Royal Observatory Edinburgh (STFC)

Dark Sky Discovery

Things are looking up! Dark Sky Discovery is a national network of science and open space organisations, led by the Science and Technology Facilities Council (STFC), which provides highly popular and accessible astronomy activities for diverse participants and communities.

Astronomy has wide appeal to people of all ages and social backgrounds, both male and female. This makes it a popular and 'safe' context for bringing science and technology to new audiences, particular for events taking place in their own community.

The Dark Sky Discovery approach was forged in Scotland in 2007 with a focus on community stargazing events in rural and remote areas. Cloudy skies are an issue across the UK, so teams (including presenters from Glasgow Science Centre) ran high quality comet-making and rocket-launching activities with the public, which played a critical role in 'weather-proofing' events.

Dark Sky Discovery has now partnered with more than 100 organisations that are not typically part of the STEM landscape. These include many local open space organisations, Natural England, National Parks, Forestry Commission, National Trust and local authorities. We harness their venues, staff and events programmes to expand the scale and geographical spread of engagement with the physical sciences. A recent project with Natural England explored ways to reach new participants including the deaf community, young people from Pupil Referral Units and girls from Muslim Madrassah schools.

A quarter of the UK's science centres have also run these community stargazing activities and the future will see a variety of training workshops to bring astronomy and the physical sciences to open space partners.



Key Facts

- Astronomy has wide appeal to people of all ages and social backgrounds
- Star parties are great for community engagement events
- 20,000 people have taken part in stargazing activities through this national astronomy programme

Sharing Best Practice

There is huge latent interest among the outdoor sector in astronomy activities. By partnering with these organisations, science centres can run star parties and stargazing nights at a variety of new and community venues.

The Dark Sky Discovery network and website lists all the open spaces and community organisations

www.darkskydiscovery.org.uk

Contact: dan.hillier@stfc.ac.uk

"I work for an outdoor centre based in the Lake District. I went on one of your astronomy courses at the Institute of Outdoor Learning conference and it was brilliant."

Community open weekends in Bristol

Science and well-being activities co-developed and delivered with community partners

Jo Bryant, Community Engagement and Volunteer Manager

At-Bristol

Each year, At-Bristol Science Centre runs a community open weekend, offering free entry to families from the 12 wards of Bristol in the top 10% nationally for deprivation.

Families from these communities are typically under-represented in At-Bristol's visitor profile although they do come in school groups. Thousands of flyers were sent to school children in these targeted wards, asking them if they would like to bring their families to visit the science centre for free during the community open weekend. At-Bristol has strong existing relationships with the schools in these areas so batches of the flyers were sent to the schools, and teachers were happy to give them out to pupils. This was key, and on average 2,000 people travel to the science centre to attend the community weekends.

This model of community open days began as a pilot project with funding secured from The Big Lottery Fund. In 2012 the team in At-Bristol worked with community partners from these target areas of Bristol to develop and deliver a health and well-being themed community open weekend for families. 5,454 family members participated over two weekends and 20 different community partners shared the delivery of activities including cookery demos, dental health information (NHS) and street dance. Participants were signposted back to activities and support in their communities.

The key to successfully engaging participants in these community weekends was working closely and collaboratively with community partners and schools in the target areas and having staff time to enable this through the funded project.

Community science open weekends such as these can be run on a sliding cost scale from purely targeting flyers to a specific community and covering associated staff time, to full co-development and co-delivery of a whole community specific programme.



Key Facts

- 2,000 people from under-served communities came, over one weekend once the entry fee barrier was removed
- Families are from Bristol wards in the top 10% of health deprivation nationally
- School children are given invites, to bring their families to the community weekend

Sharing Best Practice

Discussing this with the Local Council and using their data ensured we targeted the appropriate communities.

Working with both local community organisations and schools was vital in terms of ensuring families knew about the event, and for co-creating and co-delivering relevant activities.

The first weekend we ran, attracted 4000 people from the target areas. This meant the science centre was very full as we were also open to all our paying visitors. We now target fewer wards to ensure more manageable visitor numbers on community days.

Contact: jo.bryant@at-bristol.org.uk

“Working collaboratively with the community in this way has proved to be a successful model that we have now embedded in the way we operate”

Phil Winfield CEO At-Bristol

Engagement with disadvantaged communities across North East England

Inspiring science for disadvantaged audiences in cities and remote rural areas of North East England

Ian Simmons, Science Communication Director
The International Centre for Life

The Centre for Life in Newcastle Upon Tyne attracts 220,000 visitors every year from a large area of North East England spreading from North Yorkshire to the Scottish borders, and across to Carlisle. This part of Northern England contains significant areas of both urban and rural deprivation.

When postcode data is examined for family audiences, it is clear that over 50% of the core family visitors to Newcastle's Centre for Life are from what could be termed white working class districts. Many tell us they do not otherwise engage with STEM. As part of their visit and as a family, they take part in hands-on science activities, explore the permanent and temporary science exhibitions and join staff for science theatre shows and planetarium shows. The centre also has a vibrant community outreach programme.

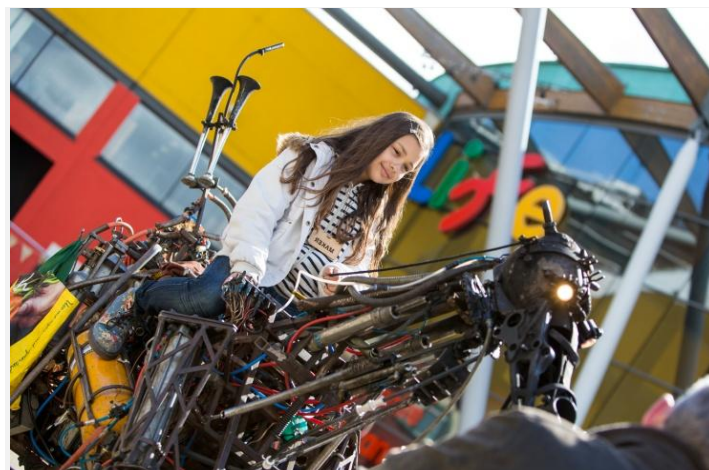
The Centre for Life runs an extensive education programme which delivers 45,000 science workshops to 28,000 school children. This includes a wide variety of high-tech DNA practical workshops which support secondary teachers and students across the region.

Life runs a 'GCSE Assessed Practical Days' for schools in disadvantaged areas to assist students who are not reaching their maximum potential grades. The outcomes are hugely positive, with one school showing science results have improved by two full grades as a result of the programme.

Life also takes inspiring science workshops and activities out to both disadvantaged schools in the inner city and very remote rural communities in the Pennines.

Life runs 'Maker Faire UK', an international gathering of DIY technologists, attracting 10,000 visitors in a weekend, right across our community demographic, and with an approximately 50:50 gender split in participants and attendees.

<http://www.life.org.uk/whats-on/maker-faire-uk-2014>



Key Facts

- The Centre for Life in Newcastle attracts 220,000 visitors every year
- The schools programme includes a series of cutting-edge DNA workshops for students across the region
- Over 50% of the family visitors are from less advantaged backgrounds

Sharing Best Practice

The rural outreach programme brings science to small rural primary schools.

When securing funding, ensure the KPI is the number of schools visited, not numbers of students. This allows you to support teachers in science in tiny remote village schools that have only 10 students in total.

Maker Faire is becoming increasingly popular and 10,000 people took part over one weekend

Contact: ian.simmons@life.org.uk

"Life's GCSE Assessed Practical program was a massive success, with the average improvement upon the previous controlled assessment grade being upwards of two full grades."

Scott Hays - Head of Science Joseph Swan Academy

Manchester Science Festival

Museum of Science and Industry embedding science as culture across the city and beyond

Natalie Ireland, Head of Learning and Public Programmes

Museum of Science and Industry, Manchester

The Museum of Science and Industry (MOSI, part of the Science Museum Group) leads and curates the annual Manchester Science Festival where people are invited to play, create and experiment at a unique blend of science events, exhibitions and installations across the city and Greater Manchester.

The Festival is developed and delivered by MOSI in collaboration with 50 public, cultural, arts, community and academic partners.

Experimentation and quality

The Science Festival enables MOSI to reach non-traditional audiences by testing out new creative ideas and approaches to engage people with science. These include working with eminent artists and scientists in shopping centres; a live 24 hour coding competition; The exhibition 'Brains: Mind as Matter' with an accompanying adult evening programme; a theatrical performance with mathematician Marcus Du Sautoy and large-scale live engineering experiments.

The community relationships and other partnerships we build through the Festival, and the knowledge we gain informs and develops the museum's on-going public programme. The Festival also enhances the work of partners, for example our university partners have set up public engagement working groups as a result of the Festival and have since prioritised public engagement work, and artistic partners now consider science as a theme for their work throughout the year.

Citizen science experiments

Manchester Science Festival's signature project is an annual citizen science experiment, where working with researchers people are encouraged to help answer real research questions. This approach connects with people around the country and the globe. The first project, Turing's Sunflowers, built on unfinished work by mathematician Alan Turing <http://www.turingsunflowers.com/>.

In 2013 the Festival launched #Hookedonmusic exploring musical memory with the potential to provide insights to help people with failing memories www.hookedonmusic.co.uk



Key Facts

- Many UK science centres and museums have set up city-wide science festivals to broaden their reach.
- 88,840 people came to the 2013 Manchester Science Festival which attracts new audiences through different formats and community partnerships.
 - 73% of visitors were first time participants
 - 57% of visitors were female
 - 56% visitors were children aged under 16
 - 13% visitors came from an ethnic minority background

Sharing Best Practice

- The Museum has a strategic commitment to improve access and diversify audiences which is reflected in the aims, objectives and selection criteria for the Science Festival programming
- The Museum has the skilled staff, resources and partners needed to run a successful science festival
- MOSI develops collaborative community partnerships to engage and inspire people of all backgrounds with science

Contact: n.ireland@mosi.org.uk

"Manchester Science Festival is a great platform to test and learn from new approaches that make participation in science accessible to all"

Jean M. Franczyk, MOSI Director

Science outreach to communities across Scotland

Scottish science centres delivering in partnership with the Office of the Chief Scientific Advisor

Sally Pritchard, Community Engagement Officer

Glasgow Science Centre

The Office of the Chief Science Advisor within the Scottish Government has funded four Scottish science centres to use their strong local connections and science expertise to engage adults across Scotland with science.

The programme specifically focuses on adults who do not currently engage with science and live in areas of multiple deprivation and/or rural isolation across Scotland. Most participants are also parents and grandparents. This project is a partnership between Glasgow Science Centre, Our Dynamic Earth in Edinburgh, Dundee Science Centre and Satrosphere in Aberdeen.

All four Scottish science centres took a participative approach to planning their community engagement, empowering community groups to make their own decisions over the theme and style of their engagement. We can clearly demonstrate the success of this approach at a number of stages.

So far, over 2,000 adults from areas in the top 25% on the Scottish Index of Multiple Deprivation have visited the Science Centres. Glasgow Science Centre's Community Engagement Officer supported teams at the other three science centres to engage and deliver quality, needs-led community work. Participants have said that without this programme they would not have visited the science centre.

The science centres have now worked collaboratively with:

- Refugee groups
- Parents so they are more confident to help with homework
- Healthy living groups
- Dads and Lads groups
- Deaf Groups
- Stroke and other patient groups

A joined up approach to community engagement for the four science centres is working well, particularly as many community organisations have branches in different cities. One specific piece of learning was there was absolutely no substitute for visiting the groups and meeting the people direct to inspire them with what is being offered. Relying on intermediaries didn't work.



Key Facts

Over 12 months, The Scottish science centres have engaged with approximately 2,000 people in areas identified by the Scottish Index of Multiple Deprivations as in the top 25%.

80% of the total participants are in the top 15%.

Sharing Best Practice

Partnerships, including the 'Worker's Education Association' (WEA) and the Prince's Trust, have further enhanced the programmes being delivered throughout Scotland. Cohesive working, shared good practice, peer support, community group relevant programme development, improved communication, and needs-led resilient adult literacy and family learning courses are being delivered. All these factors are an important part of the shared learning between community groups and science centres.

The engagement work promotes community buy-in and ownership, which encourages those disengaged to feel more part of wider society and the science world within that.

Contact: sally.pritchard@glasgowsciencecentre.org

"I have lived here all my life and never come here (GSC). It was really interesting and I will come back with my grandchildren".

Participant from a Stroke Support Group, Glasgow

Science Museum, London: engaging diverse audiences

Dr Alex Burch, Director of Learning

Science Museum Group

The Science Museum collects detailed information about its visitors throughout the year. This data helps the Museum understand who visits, the extent to which they feel the Museum is for them and helps the Museum identify those who are under-represented or underserved by our programme. This data feeds into strategic decision making and informs our audience and programme plans.

Over 3.3 million children and adults visit the Science Museum annually. Half of visits are made by females and 21% of the Science Museum's UK family and adult audience are from less economically active groups (NS-SEC 5-8).

In total 442,000 visits are in booked educational groups. Data analysis of this audience reveals that 45% of the Museum's UK school visitors are from BAME backgrounds and 17% are eligible for free school meals. The large and diverse schools audience provides a gateway to under-represented families who may not otherwise think of visiting.

The Science Museum has implemented a 'Partner London Borough' strategy prioritising work in five boroughs in order to reach new and more diverse audiences. The boroughs are RBKC, Westminster, Wandsworth, Southwark and Brent. Through a range of programmes targeting communities, schools and influencers the goal is to increase access to the Museum, to science learning experiences and to build science capital. Interventions include:

- Programmes for head teacher associations
- Delivering science activities and events in schools and at festivals in these boroughs
- Offering bursaries for charged activities such as Science Night
- Partnering with other organisations e.g. Princes Trust to extend reach to new audiences.

The Museum also runs the 'Building Bridges' project with a number of schools in the boroughs. Staff deliver workshops and training in partner schools, then bring students to the Museum to work with scientists and the collections before hosting a family celebration day at the end of the year in the Science Museum. 40% of parents said it was the first time they had taken part in a science activity with their children and all parents said they'd return to the Science Museum. This project builds science capital in families and creates a pathway into the Museum.



Key Facts

- The Science Museum collects detailed information on their visitors to understand who is visiting, and who is not. This informs programme and audience plans.
- The Partner London Boroughs strategy has been implemented to reach new audiences and provide pathways into the Museum.
- Reach is further extended by the Science Museum's national Outreach team. This team delivers workshops, shows and engagement activities to 108,000 people across the UK.
- Research underpins our practice informing who we work with, improving our programmes and providing information that can be used by the sector. For example, the Building Bridges project is being evaluated by Sheffield Hallam.

Sharing Best Practice

- Working in partnership is the key to success
- Build relationships with other organisations that already work with those you wish to reach
- For example last year we partnered with **Princes Trust** helping us to reach and engage new audiences.
- Expand work beyond schools – families are important influencers

Contact: alex.burch@sciencemuseum.ac.uk

'I think it is for her opening a few more paths to have a look how science can be really magical and be interesting and made her think in a different way about the science.'

Parent: Building Bridges Project

Visitor research: evidence of diversity

Analysing who our visitors are to make evidence-based decisions and policies

Dr Kenny Webster, Informal Learning Manager

Thinktank Birmingham Science Museum

Thinktank Birmingham Science Museum attracts 260,000 people each year to science exhibitions, workshops and events. 78,000 of these are schools students taking part in science activities and many thousands visit on community open days.

Thinktank and Birmingham Museums invests a significant resource in conducting independent entrance and exit surveys across nine sites to better understand who their visitors are and their motivations and reasons for visiting us. Each year, we use this data to analyse potential impacts of major interventions that we may have made and also to benchmark ourselves against national trends.

Some of the information that we obtain aligns well with our own self-perception, but other information can be surprising and has led to strategic changes within the organisation.

In 2013, our data showed that 65% of Thinktank visitors were female, 21% came from a C2DE social grade, 49% came from Birmingham and 56% were repeat visitors. 92% of visitors have children in their party and of these children, 40% are in the 0-4 age bracket.

When looking at motivations for visiting, 71% of responses are focussed around the engagement of children, compared with a 25% national benchmark for visitor attractions. Our high levels of repeat visitors come partly from the success of our Annual Pass which has seen a significant increase in take-up over the last 12 months (based on decisions made from the results of previous years' surveys).

Although this data represents a snapshot of our summer holiday visitors and therefore not representative of the more diverse schools and outreach programme or community engagement programmes, this data is invaluable in shaping our business decisions.



Key Facts

- Visitor research is undertaken annually by BDRC on behalf of Thinktank
- Extensive data on family visitors is collected, including 200 face to face interviews
- Around 55,000 visitors each year are from C2DE
- our current data suggests that around 18% of visitors are from a BAME background

Sharing Best Practice

Each year our data becomes more valuable as we view our ongoing relationship with visitors and how they view us. Although always valuable, this data is particularly useful because we now have six years of evidence to compare ourselves against.

Contact: kenny.webster@birminghammuseums.org.uk

"Collecting this level of data is proving invaluable in understanding our visitors, their expectations, needs and behaviours whilst they are with us. We actively use it when planning future initiatives such as changes to our Annual Pass scheme to provide added value."

Lauren Deere, Visitor Experience Manager

Digital and on-line engagement

Dr Penny Fidler

UK Association for Science and Discovery Centres

Science engagement organisations reach audiences via a variety of digital and online mechanisms including e-learning and teacher CPD resources, vibrant social media channels (e.g. Twitter and Facebook), blogs, bespoke science videos and YouTube channels and in-exhibition opportunities for post-visit enhancement. Through these mechanisms they share science content and science resources with the public and schools and build on-going relationships with participants and communities (although data is not collected on the backgrounds of online participants). Some examples of digital engagement are given here.

At-Bristol Science Centre embeds opportunities within the physical visit to enable visitors to 'Explore More' online for free when they get home. To achieve this, each visitor is given a wristband on arrival which contains a unique barcode. As they tour the exhibition they can scan their barcode to store their experiences. Later, at home or school, they simply enter the barcode number online to retrieve their photos and results to experiments, and to continue working on things they have created in the exhibition (such as stop-frame animations). A special feature is that people who have bought entry tickets together (e.g. as a family group or a school group) are linked online so they can continue working and learning together. At-Bristol has also created an 'Explore More' App which explainers have on their phones to extend the interaction with participants.

Eden Project uses digital media extensively and has a YouTube channel (EdenProjecttv) with around 350 videos and 1.1 million views sharing science and environmental content. Many other science engagement organisations have YouTube Channels and staff make bespoke science videos for the public and schools. Other training videos are aimed at science engagement professionals to run high-end science practicals, such as ASDC's series of molecular biology training videos at:

<http://sciencecentres.org.uk/projects/handsondna/videos.html>.

The National Space Centre has produced 25 online CPD programmes for the European Space Agency. These include classroom activities, teacher films, and student problems, and will be released from the summer of 2014 enabling teachers across the UK and Europe to support their students with the curriculum physical sciences using many different inspirational space contexts.

Do Try This At Home



How To Make A Rocket | Do Try This At Home | At-Bris...
by At-Bristol 1,037 views



How to make a meteorite crater | Do Try This At Ho...
by At-Bristol 412 views



How to make instant ice | Do Try This At Home! | At...
by At-Bristol 10,674 views

Astronomy

Free guides to finding constellations, spotting shooting stars and astrophotography.



How to photograph the night sky | A Beginner's G...
by At-Bristol 1,384 views



What is a meteor shower? (and how to watch them)...
by At-Bristol 285 views



Behind The Science: The Planetarium | At-Bristol ...
by At-Bristol 2,571 views

Key Facts

- Most science engagement organisations use social media for sharing science content widely.
- At-Bristol has a barcode mechanism so visitors can store their experiences during a visit and retrieve them online afterwards.
- Many science engagement organisations have digital resources to reach wider audiences, such as EdenProjecttv, and the digital teacher CPD programmes in science teaching being developed by the National Space Centre in Leicester.

Sharing Best Practice

Using a barcode for storing and retrieving experiences means families, children and schools can continue exploring science in a variety of ways after their visit - without the need to ask for their email addresses.

Working with other partners who already have strong YouTube or social media following with hard to reach audiences gives new audiences the opportunity to connect with your work. For example, Eden Project has worked with freerunners, videoing them doing parkour within the Eden Biomes, which has been viewed by 40,000 people who would not otherwise visit.

For more information:

Dan Bird: dan.bird@at-brisol.org.uk

Anu Ojha: anuo@spacecentre.co.uk

Tom Trinkle: ttrinkle@EdenProject.com

Case studies: Part 2

Engaging under-represented schools with science



Bright Futures: a youth membership scheme

Enhancing the career and life prospects of disadvantaged young people in East London

Katie Chambers, Head of Learning

Centre of the Cell

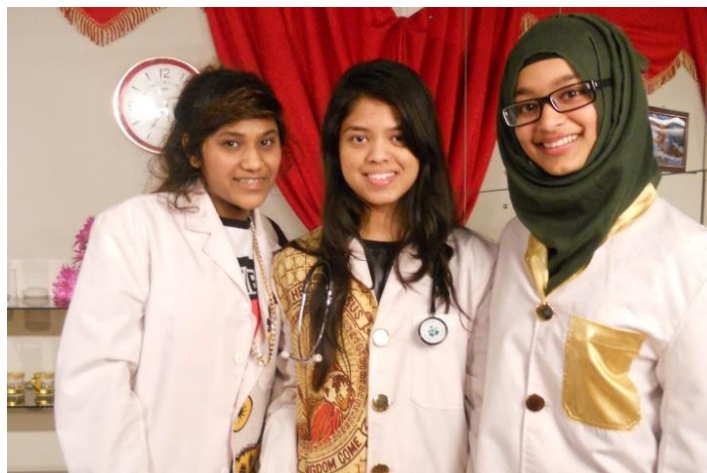
Centre of the Cell is based in East London and works with schools and families in Tower Hamlets, Newham and Hackney, three of the most socio-economically deprived boroughs in England.

It is one of the first science education centres in the world to be based within a medical research laboratory. This means that every young person who visits gets to see practicing scientist at work, and in many cases, to meet them.

Centre of the Cell's 'Bright Futures' scheme for local young people aged 14 – 19 grew organically when local young people began contacting the team at Centre of the Cell with enquiries about work experience and how to get into science. The scheme was set up in response to this. Many of these young people are the first in their family to apply to university, or indeed to gain any formal qualifications. They can feel that they are lacking in the networks, support and contacts that they require to enter science.

To date, there have been around 400 Youth Members (around 100 each year). As well as providing these young people with work experience and volunteering placements in science-related fields (26 placements a year), the scheme has grown to include mentoring sessions for young people by staff at Centre of the Cell, by STEM Ambassadors, and by medical and dental students from Barts and The London School of Medicine and Dentistry.

These fortnightly after-school sessions include advice and guidance on areas such as gaining work experience, writing UCAS applications, and practicing interview skills, as well as times that young people can come to us to help them revise for their GCSE and A level exams. For example, we ran a session on how to write a UCAS personal statement, run by medical students and an admissions tutor from Barts and The London School of Medicine and Dentistry. This programme was launched without any funding, but has since been successful in gaining some financial support from external funders.



Key Facts

Young people from East London visited Centre of the Cell with their schools and met biomedical scientists.

When thinking of careers, many individually contacted the centre to ask how to get involved in science careers. The Bright Futures Scheme was set up in response.

Sharing Best Practice

The key to the success of this programme was that it grew organically through listening to the needs and interests of the young people who contacted us. Their feedback and comments were the driving force behind the programme. We have now been successful in securing funding to continue it.

Contact: k.chambers@qmul.ac.uk

"Volunteering at Centre of the Cell has inspired me to apply to medical school... If I don't become a doctor I would really like to become a research scientist. [They] have helped me gain confidence..."

Young person from Tower Hamlets, aged 17

Free science for every primary schoolchild in Glasgow

A city-wide science bursary scheme to engage every child with science

Stephen Breslin, CEO

Glasgow Science Centre

Glasgow Science Centre has a partnership with Glasgow City Council to ensure that every primary school girl and school boy within Glasgow has the opportunity to be inspired by hands on science through a visit to the city's science centre every year.

This partnership was instigated by the science centre who approached the Council to discuss how together they could help deliver the city council's future ambitions in relation to STEM. The council in their manifesto wanted to tackle the city's looming STEM skills gap and knew that Glasgow's future success depended on excellent science education now.

Now in its third year, the Council funds approximately £4.00 per child (dependent on how many come) so every primary, nursery and additional support needs child from the Glasgow area can have a free science visit to Glasgow Science Centre.

Last year, over 39,000 Glasgow school children were invited of whom nearly 22,000 (56%) are from areas in the top 25% of the Scottish Index of Multiple Deprivation.

In 2012-2013 21,457 school children engaged with science as part of the bursary programme. A dedicated call centre books schools in across the year, meaning dates are offered to schools in a way that evens out the peaks and troughs so science centre staff can dedicate more time working with each child.

Many choose extra science workshops, and schools from areas of rural deprivation are also eligible to ask for help with their transport costs (buses paid by Scottish Government, administered by the Science Centre).

A key advantage of this programme is that the science centre becomes an integral part of school curriculum. Primary teachers, often with no science background, are supported to prepare children in advance and do follow ups back at school. They tell us this is great CPD for them and hugely increases their confidence to teach practical science with their other primary students back in school.



Key Facts

Working with Glasgow City Council to offer inspirational and practical science engagement experiences to support both primary and nursery teachers and children across the city.

Sharing Best Practice

The Scottish Index of Multiple Deprivation (SIMD) is the Scottish Government's official tool for identifying those places in Scotland suffering from deprivation. It is a single index and divides Scotland into 6,505 small areas each containing around 350 households. It is online, brilliant, and everyone can use it.

The Scottish Government has this open access tool which is vital in identifying who to work with

<http://www.sns.gov.uk/Simd/Simd.aspx>

Contact: stephen.breslin@glasgowsciencecentre.org

"This excellent programme enables us to remove the burden of the entry fee. Our overhead is fixed, so we can increase the numbers of students taking part in science at a relatively low cost."

Stephen Breslin, CEO

Bringing high-tech science practicals to schools in Cornwall

High-tech molecular biology workshops for rural schools in disadvantaged areas

Robbie Kirkman, Education Team

Eden Project

In 2011 Eden Project was chosen to be a partner organisation in the 'Hands-on-DNA' project delivered by The UK Association for Science and Discovery Centres (ASDC) in partnership with 18 science centres across the UK.

The aim of this project was to give students in all parts of the UK the opportunity to experience for themselves the amazing techniques of molecular biology, using real cutting-edge lab equipment.

Eden Project has now run inspirational Hands-on DNA workshops with over 600 Key Stage 4 students, approximately half of whom were girls. The vast majority of the participants attend schools in Cornwall, an area with a GDP which stands at 72% of the European average, making Cornwall one of the most economically deprived regions within the European Union.

These 3-hour practical DNA workshops fit well with our mission of engaging young people with science, the natural world and each other. Using the starting point of DNA, we examine the common themes of evolution and adaptation, through practical exploration of microorganisms and link these back to Eden's greatest asset – the rainforest biome.

We have successfully attracted schools by offering something unique and high-end that was previously unavailable in Cornwall. Initially this project was supported by ASDC who provided expertise, training and equipment (with funding from Wellcome Trust) and now Eden Project has embedded it as part of the schools programme.

Across the whole Hands-on DNA project, independent evaluation of the workshops gave the following results for students aged 14-16 who took part in just one workshop:

- 89% felt it increased their interest in science
- 90% of students had never used this type of equipment before in school
- 74% felt it made them think that working in science might be interesting.



Key Facts

- Students in rural Cornwall have limited access to additional inspirational STEM experiences and cutting-edge practical science
- 600 students from rural Cornwall have now participated in Eden Project's high-tech molecular biology practical workshops, and many more will take part in the future

Sharing Best Practice

Initially we offered the workshop as a free teacher training event before running it with students. This enabled us to gain a support base and create a 'buzz' about the forthcoming workshops. We have worked with schools to ensure we offer the workshop at times of year that fit with the curriculum so that they support teaching and learning and at a cost they can afford (£14.50 per student).

Contact: rkirkman@edenproject.com

"A fantastic chance for pupils to use real molecular biological equipment."

Science Teacher

"The Most interesting and enjoyable science we have ever done."

Year 11 pupil

School science bursary programme, Birmingham

A city-wide bursary scheme to engage students from socio-economically challenged backgrounds

Lorraine Kenny, Education Manager

Thinktank Birmingham Science Museum

Thinktank, Birmingham's science museum, provides a £10,000 bursary fund each year to encourage and support visits by schools with a 50% or higher rate of free school meal eligibility.

This bursary fund covers free entry for 2,500 school children each year to the science museum at £4 per head and is available on a first come first served basis. Each school is allowed to bring up to 120 pupils as part of a pre-booked organised school visit. The schools arrange their own transport and any activities or workshops that are requested are still charged for at our standard rates, but the bursary reduces the financial barrier to entry that some schools and families may face when considering a visit to Thinktank.

The scheme has been operating in this way for many years now, since the days when it was first set up as an externally funded project. We have worked hard to keep running it as the internally funded programme. The level of free school meal allocations is a useful indicator of wider socio-economic deprivation within the wards of the city and the number of eligible schools corresponds with areas of high levels of worklessness and unemployment.

Many of the schools that take advantage of the bursary scheme do so repeatedly year on year and this reinforces the value to those schools of learning science outside the classroom, and especially supports the teachers as they take part in different science workshops over the years.

Given the changes that are taking place around the provision of free school meals and the pupil premium, we are looking at ways in which we can continue to offer the same opportunities to local children in the future.



Key Facts

2,500 school children from socio-economically challenged backgrounds are given bursaries each year to visit Thinktank for no charge.

Sharing Best Practice

After we looked at the data and accepted that schools with high free school meal eligibility were less likely to pay to visit us or any other venue, the bursaries became more of an option (initially we were worried some of those schools might be part of our vital income).

We then had to make sure that our operations and communications around the bursary were robust and transparent. Schools have to be able to see whether they are eligible, and if not, why not, using public data if at all possible.

Contact: lorraine.kenny@birminghammuseums.org.uk

"I had a great time. It was one of the best museums I went to. I learned that Neil Armstrong was the first man on the moon and Buzz Aldrin was the second"

Nahum Watson, Yr 5 bursary pupil

Exercise and nutrition programme in Halifax

Science outreach: changing children's attitudes towards physical exercise and healthy eating

Leigh-Anne Stradeski, Chief Executive

Eureka! The National Children's Museum

Using science-based outreach to create lasting behavioural change among 6-11 year olds, in one of the UK's most deprived council districts, is the core objective behind **Mission: Active Future**, a hands-on educational programme of workshops delivered by Eureka! The National Children's Museum.

Originally launched in 2006 and funded by Sport England, Eureka! was approached in 2011 by the Director of Public Health at Calderdale PCT to deliver a third phase of this successful initiative to a further 2,000 children across 21 schools. Fully funding the project with a £90,000 grant meant the project was free to children and schools that participate, critical for ensuring maximum accessibility in local areas of high social deprivation.

Mission: Active Future applies the science of exercise and nutrition to give children the knowledge and self-confidence to build physical activity and healthier eating into their daily lives, both at school and at home.

Presented by Eureka!'s education team in an engaging 'street-wise' format, this travelling exhibition is housed inside an articulated trailer and features 16 activity-focused challenges and multi-media exhibits promoting healthy, active lifestyles.

The Eureka! Team also visit their school to run classroom activities and the children visit Eureka!'s new 'All About Me' gallery, lead-funded by The Wellcome Trust. These multiple interactions further consolidate their STEM-related inquiry into how their bodies work and why being healthy is important.

Permanently embedding this programme into our provision is essential for sustained impact. We are in discussions with the Public Health Manager at Calderdale Council with a view to extending this to neighbouring local authorities.



Key Facts

- 27,000 children will have participated in Mission: Active Future at the end of its third phase (2014)
- 78% of children who took part now have a more positive attitude to being active
- Children's physical activity increased from 454 minutes per week to 655 minutes as a result of the programme

Sharing Best Practice

External evaluation was invaluable in evidencing impact as well as supporting our case for funding each phase.

www.eureka.org.uk/mafreport

Partnerships were essential in developing credible content, and included the Centre for Sport and Exercise at Sheffield Hallam University, the Childhood PE and Exercise Faculty at Liverpool John Moores and Exercise and Obesity at Leeds Metropolitan.

Contact: leigh-anne.stradeski@eureka.org.uk

"I think one of the main things is probably the reward system. Not only can we see their progress from their activity diaries but the children can see how much they are doing each day and it builds up to the bronze, silver and gold award. They know that reward is coming at the end."

W5: cultural diversity and rural inclusion

Ongoing initiatives funded by the Department of Culture, Arts and Leisure and additional funders

Judith Harvey, Director

W5 Science Centre

W5 is Northern Ireland's only purpose built science and discovery centre. With over 250 interactive exhibits, W5 provides a unique experience as well as fantastic fun for visitors of all ages. In addition to permanent exhibits, W5 also presents a changing programme of large and small scale temporary exhibitions and events, and has a daily programme of live science demonstrations and shows throughout the day. W5 attracts over 220,000 visitors a year and an outreach initiative reaching a further 50,000 people.

W5 works closely with schools in delivering enriching and engaging STEM programmes with over 30,000 pupils taking part each year at W5 and a further 20,000 in outreach. Analysis has shown that 67% of schools visiting W5 are C2DE category demographics.

Visitors, including school and community groups pay to visit W5 and take part in their programmes of activities. However to support inclusion and to increase access to the fantastic facilities at W5, the science centre actively seeks funding to enable programmes to be offered to schools and community groups at a reduced cost or free of charge. Funders such as the Department of Culture, Arts and Leisure and the British Council have supported initiatives aimed at increasing social and rural inclusion.

Programmes are targeted using geographic locations and free school meals or using recognised measures of Multiple Deprivation from the NI Statistical Research Agency.

Such initiatives, whether through supported in-house programmes where transport costs are covered or outreach initiatives, remove the main barrier to participation – cost.

Due to the limits of funding available, initiatives are significantly over-subscribed, and demonstrate the huge interest in participating in STEM events and inclusion in activities.



Key Facts

- 50,000 schoolchildren in Northern Ireland are reached by these STEM education programmes
- 67% of these school children are from C2DE families

Sharing Best Practice

W5 works with a wide range of partners across Northern Ireland. This is critical to the ongoing reach and success of its programmes.

Making STEM relevant to young people and their families is paramount, enabling them to see STEM in action in their own localities, impacting on their everyday lives and even as future possible careers.

Contact: judithharvey@w5online.co.uk

“We have a remit to make science relevant for every young person in Northern Ireland, regardless of their location. Too often our students in both primary and post-primary are taught the process of science, but not the relevance it has to their lives, locally, nationally and globally”

Case studies: Part 3

Inspiring girls with physics and engineering



Girls Night Out (*under the stars)

Creating a female-friendly space to encourage girls and women to engage with astronomy and physics

Dr Teresa Anderson, Director

Jodrell Bank Discovery Centre

Over the years there has been considerable controversy around the issue of 'feminising' physics and engineering to try to make them more appealing to a broader range of girls.

Jodrell Bank Discovery Centre has begun to tackle this issue head-on as they had traditionally found it difficult to get a high proportion of girls and women to attend astrophysics and telescope events. They therefore set out to test a new targeted approach to increase the numbers of girls and women engaging with astrophysics and collected evidence to inform future events.

'Girls night Out' was therefore created as a fun evening out at Jodrell Bank specifically targeted at girls and women. The evening includes discussions with astrophysicists, hands-on science activities with engineers and talks from researchers. All these physicists, engineers and experts are female, as are all the participants. The evening also features a competition for decorating astronomy themed refreshments and there are a number of references to 'star girls' and similar. This is openly shown in the marketing and social media which was clearly aimed at girls and women.

Using the controversial female 'signifiers' these events sell out, with girls and women paying £12 each and 120 girls and women attending. The evidence collected shows they attract women and girls of all ages, including a number of school groups. Feedback has been entirely positive, with 100% agreeing the evening was fun and over 90% saying it made them more interested in the subject.

The key to success was acknowledging that a different approach was needed to attract girls, to rely on the results we collected and to put aside our personal preferences (as engineers and physicists). After all – we are the 20% who were interested in physics. We want to increase this to 50%.

Several girls have reported that they are now interested in studying physics to A level as a result of attending these events.



Key Facts

- 100% female astrophysics events, targeted at girls
- Girls Night Out at Jodrell Bank attracts 120 girls and women, who are sufficiently motivated to participate they pay £12 each. Over a third are girls aged 12-16

Sharing Best Practice

Be brave. These events were 'signalled' as safe spaces in which girls will not be regarded as inexperienced and can enjoy astrophysics as a fun topic.

The format of these events is exactly the same as our other talk and telescope evenings, but the atmosphere and 'feel' is entirely different. This is what makes them so appealing to girls and women.

Contact: teresa.anderson@manchester.ac.uk

"This was an absolutely amazing evening, there has to be more like this - just for us girls"

"It was extremely exciting and when I go back to school it will help me with my studying. I would recommend it"

Girls aged 12-16

The National Space Academy inspiring girls

Inspiring girls with physics at an inner-city school in Leicester

Kierann Shah, National Space Academy Manager
National Space Centre

The National Space Centre in Leicester is the UK's only science centre dedicated to space and space exploration and engages over 250,000 children and adults each year.

In 2008, The National Space Centre set up the National Space Academy to support schools with formal science education. Its programme of student masterclasses, teacher CPD and careers events is delivered by a network of outstanding teachers and research scientists and industrial engineers across the UK.

This case study focuses on a class of 30 physics GCSE students from Sir Jonathan North Community College in Leicester. This is an all girls' inner-city school with no track record of students progressing to physics A level.

The National Space Academy provided an intensive programme for the students prior to their GCSE exams.

Following this intervention, 100% of the girls achieved their physics GCSE (grades A* to C) and 63% achieved a grade A/A*. For the first time for the school, 11 girls then choose to progress to A level physics.

National Space Academy methodology is unique and the evidence of its impact is becoming clearer each year. Most of the demand is from schools that do not have specialist teachers (e.g. in physics) or that otherwise struggle in science subjects and proactively seek help. This means that schools in disadvantaged areas or with students who are not naturally disposed to science subjects make up a sizeable proportion of the customer base.

Science centres provide superb venues for formal and informal teaching when context is all-important to bring the subject to life. Over 50% of schools that take part in National Space Academy programmes choose to travel to the National Space Centre to do so. Other research and industrial establishments are used to enrich the learning experience.

www.nationalspaceacademy.org



Key Facts

- The National Space Academy runs a programme of student masterclasses, teacher CPD and careers events
- Last year it delivered intensive science programmes to over 4,000 students and 1,000 teachers
- Evaluation of these interventions has shown that they can increase the uptake of physics amongst students as well as boost attainment

Sharing Best Practice

The Academy, in partnership with Loughborough College, is in the second year of running the post-16 Level 3 Space Engineering course, and has also worked on the development of the post-18 Higher Apprenticeship in Space Engineering. These courses will be rolled out to a number of other colleges in the UK over the coming years.

Contact: nsa@spacecentre.co.uk

In the past, you'd be lucky to get one. Now, at least a third to a half of students raise their hands and say, "yes, we're going to take physics post-16".

Jane Shearer, Sir Jonathan North Community College

Talented women in awesome occupations

High Performance: a 3-day engineering festival at the Science Museum, London

Kat Nilsson, Head of Contemporary Science
Science Museum, London

In 2013 the Science Museum's Contemporary Science team delivered a free 3-day festival celebrating women who work at the cutting-edge of science and engineering.

The festival, called High Performance included both Cambridge University's Eco racing team, and the Viridity Girls Racing team who brought in their vehicles to delight primary and secondary school pupils.

Over 200 pupils from London schools also got to hear former astronaut Helen Sharman talk of her time aboard the International Space Station.

Additional activities ran across the weekend involving leading scientists and engineers including President-Elect of the Royal Aeronautical Society, Jenny Body OBE, Red Arrows Team Manager Squadron Leader Ruth Shackleton, Army Apache chief engineer Major Steph McKenzie, Shell Technology Manager Cara Tredget and Skoda and Audi motorsport engineers Teena and Leena Gade.

In total over 5,000 festival participants aged 7-17 met these talented women excelling in science and engineering.

The Museum funded this first festival and due to its success has secured support from Biogen to deliver another in March 2014. 'Beyond Earth' will focus on women involved in space-related science and engineering including satellite engineers, women working on Mars Rover prototypes, solar physicists and those studying black holes – providing inspiration and role models for young girls today.

These festivals aim to enthral the audience with the amazing work of women in science without labouring the women in science angle. It forms part of the Science Museum's mission to represent diversity in science and engineering and inspire young people.



Key Facts

- High-Performance was a 3-day festival of hands-on workshops, free talks and demonstrations by leading motorsport engineers, scientists and even an astronaut
- All experts were women

Sharing Best Practice

Keep the element of surprise.

The goal was to enthuse participants with the exciting engineering projects and the awesome range of careers that are possible and the real people who do them.

No male experts were involved over the weekend. Visitors expressed surprise, saying they now realised they had simply assumed that the engineers, motorsports experts, astronaut, army major and others would be men.

Contact: kat.nilsson@sciencemuseum.ac.uk

"The best way to educate young women is to give them somebody to look up to. That is why events like these are crucial in shining a light on these inspirational women."

Former Secretary of State for Culture, Media and Sport

Gender equality project in North Wales

A funded project providing role models and activities to raise the aspirations and interest of girls with STEM in North Wales

Dawn Pavey, Project Coordinator: Gender Equality
Techniquest Glyndŵr

The Gender Equality project has been running since April 2013, funded by the Welsh Government. New engineering themed workshops have been developed and delivered to classes in key stages 2 and 3, and a workshop breaking down stereotypes surrounding scientists is available for the foundation phase.

STEM days offer students the opportunity to find out about careers in STEM through industry linked activities delivered by STEM professionals. 86 girls from year 10 across five schools participated in a 'Chemistry at Work' STEM day in partnership with the Royal Society of Chemistry in November 2013 and 129 girls from eight different schools took part in a 'Smart Materials' day in February 2014, organised with the Engineering Development Trust and Glyndŵr University.

Both events provided the girls with opportunities to see science in action and where it applies in the world of work. Thanks to the professionals who gave talks and contributed activities, without which the events would not have been possible.

Role models are important for highlighting the variety of STEM jobs carried out by women. Inspirational, successful women in STEM who are local to the area have engaged with groups of girls through the STEM days, during student visits to industry and through motivational talks in schools. Local female STEM professionals are also profiled on the Techniquest Glyndŵr website, talking about their career choices and current job.

Further STEM days, workshop deliveries and partnerships with female STEM professionals are all planned for the 2014-2015 financial year.

www.tqg.org.uk/genderequality



Key Facts

- From April 2013 to end of February 2014 the Gender Equality project has engaged with:
- 500 Foundation Phase students - 50% girls
- 661 Key Stage 2 students - 62% girls
- 246 Key Stage 3 students - 75% girls
- 295 Key Stage 4 students - 100% girls

Sharing Best Practice

Working with local female STEM professionals creates a project relevant to the girls involved.

Collaborating with Glyndŵr University provides the girls with experiences of university facilities and time with STEM academics.

'Gender lensing' all products and services permits Techniquest Glyndŵr to identify and address any gender bias in its work.

Contact: dawn@tqg.org.uk

"The ambassadors talking for a short time then the girls completing a related activity was excellent. It was very enjoyable for all students involved."

Mr Baugh, Year 5&6 Teacher

Gender awareness across Techniquest, Cardiff

Using a 'gender lens' to ensure that all Techniquest science activity is developed and delivered in a way that does not exclude or favour any gender

Dr Anita Shaw, Deputy CEO

Techniquest

In its 28-year history, Techniquest in Cardiff has striven to make science accessible to everyone. It works with a range of advisors and partners to ensure that its programmes, exhibits and related materials remain current and relevant. Over 50% of participants are girls and women.

Recently Techniquest has worked with Chwarae Teg, a Welsh charity that supports the economic development of women in Wales, to assess all its science workshops and programmes through a 'gender lens' and to make sure that all presentations and written materials do not exclude or favour any gender. This project was funded by the Welsh Government.

The aims of the project were:

- to alert Techniquest's staff to issues of gender awareness, and how this can be embedded in Techniquest's development work
- to test all Techniquest activity for gender neutrality and, if necessary, modify the activity in line with current best practice
- to evaluate the modified activities with the target audiences
- to embed gender awareness throughout Techniquest's practice, in particular in the delivery of its science programmes

Techniquest's development and delivery staff were trained in gender awareness. The development staff then assessed all Techniquest's schools programmes (inreach and outreach) and its exhibits and associated resource materials for gender bias. Where this was found, the activity was modified.

As part of the project, Techniquest will be delivering its modified (and those that were already deemed gender neutral) programmes to 4,475 primary school pupils and 4,485 secondary school pupils. It will evaluate the project with these pupils and their teachers, and will be reporting its findings to Welsh Government end March 2014.



Key Facts

Women are under-represented in the physical sciences. Techniquest used this gender project to view all their science programmes and activities through a 'gender lens' and modified any that were gender biased. 9,000 students will now test the programme (funded by the Welsh Government).

Sharing Best Practice

Having the opportunity to work with Chwarae Teg and to undergo 'gender lens' training helped us to focus on how our programmes, exhibits and associated resources are developed and delivered. The training has helped us to strengthen our practices and introduced a proactive approach to addressing gender issues in the science work we do. This included removing everyday gendered words when working with schools, such as the word 'guys', when addressing an audience, and the word 'manned' in relation to spacecraft.

Contact: anita@techniquest.org

"It's become second nature for the team to 'gender lens' everything from development through to delivery... because gender awareness matters!"

Andrea Meyrick, Head of Education, Techniquest

Inspiring Guides and Brownies with science

Science and discovery centres: inspiring tens of thousands of all-girl groups with science

Dr Penny Fidler, CEO

UK Association for Science and Discovery Centres

Every year, tens of thousands of girl only groups take part in science centres' sleepovers, discovery days, stargazing evenings, hands-on science challenges and a variety of other science events. They visit as part of Guides, Brownies and Rainbow groups and in many cases these days are co-developed between the Guide Leaders and the staff at the Science Centre and often lead to a science badge.

Girls and young women often do not see physics and engineering as 'something for them' and only 1 in 5 students taking physics A level is a girl. The research tells us we need to inspire girls with science earlier and help them feel it 'is a career for them'. The research also reveals that girls learning in all female groups generally go further in physics, with girls in single-sex schools being 2.5 times more likely to take physics A level than girls in co-educational school.

Science activities for Guides, Brownies and Rainbows are happening at science centres across the UK, from Glasgow to London and Aberdeen to Bristol and Cardiff. It is a great way to inspire girls together with science and engineering. Some activities count towards their stargazer or science badges.

As an example, in October 2013, the Science Museum in London ran Kaboom! a 3-day event for 6,296 girls (Guides, Brownies, Rainbows), which included a science night sleep-over, science activities, challenges and being awarded a Science Museum badge at the end.

At-Bristol, Glasgow Science Centre, Dundee Science Centre, The Observatory Science Centre, Winchester Science Centre, and many more all run vibrant science programmes for these girls-only groups.

Together they represent a great opportunity to inspire girls with physics and engineering in a safe and nurturing space.



Key Facts

- Girlguiding UK is the UK's largest voluntary organisation for girls and young women, with around half a million members
- Science centres strive to make all areas of science, and all science activities, equally appealing to girls and boys. It is part of our normal practice to not exclude half the population

Sharing Best Practice

ASDC created a Space 'Go For It' badge with Girlguiding UK to inspire girls with the physical sciences. It included resources and 'Space Days' which 3,000 Guides and Brownies took part in at Science Centres around the UK.

Most science centres run bespoke science activities for Brownies and Guides that either contributes to one of their science badges, or they get awarded a badge specific to that science centre.

Contact: penny.fidler@sciencecentres.org.uk

"Scouts can take badges in a vast range of science subjects from astronomy to astronautics and aviation to electronics. It would be lovely to see girls being offered the same fun opportunities in the safe and warm environment of Brownies and Guides groups."

Dr Penny Fidler, CEO ASDC

Engaging girls across the UK with hands-on physics

Explore Your Universe: inspiring young people with the physical sciences

Dr Penny Fidler, CEO

UK Association for Science and Discovery Centres

The UK Association for Science and Discovery Centres (ASDC) and Science and Technology Facilities Council (STFC) have an exciting strategic partnership which brings together some of the most fascinating cutting-edge physics and engineering in the country with the talents and infrastructure of the ASDC network of science centres.

ASDC runs a national strategic programme called 'Explore Your Universe: from Atoms to Astrophysics', which has the goal of 'inspiring a new sense of excitement amongst young people around the physical sciences by sharing the amazing stories and technologies of STFC'.

To achieve this, ASDC and expert partners created a set of high-end physics schools workshops, masterclasses and family shows alongside a specially created set of physics equipment. Ten science centres were equipped, trained and supported by ASDC to run this hands-on practical physics-based programme.

In just one year, 'Explore Your Universe' had engaged 156,880 children and adults in these ground-breaking hands-on physics activities, experiments, schools workshops, public shows, meet-the-expert sessions and a variety of other events.

Over 75,000 of the participants were female.

Overall, 45,852 people met an engineer or physicist, (many of whom of course were female), 59,236 people took part in the half-hour family show in a science centre (largely presented by women), and over 12,500 students took part in a curriculum-focussed schools workshop or a 2-hour masterclass.

The full programme was evaluated by academics and it is now the UK's largest robust dataset of the impact of science learning in science centres. 56% of girls and boys (aged 10-13 year) who took part in a 1-hour physics workshop said the experience had made them now more interested in studying science.

The physics and engineering activities from this programme could easily be rolled out nationally to inspire and engage girls aged 10-16 years old.



Key Facts

- Over 75,000 girls and women took part in the physics and engineering activities in one year
- 56% said the one-hour workshop had made them more interested in studying science (aged 10-13)
- Academic evaluation showed that this national physics programme has inspired girls and boys equally
- Over 6,400 schoolgirls took the physics workshops

Sharing Best Practice

- All the resources for Explore Your Universe: Atoms to Astrophysics are freely available online:

www.exploreyouruniverse.org

- Physics activities were designed to appeal to girls and boys equally – we would consider this as standard practice. All marketing materials were also designed for this.

"It was clear and funny and I learnt a lot"

"It was much more practical than note-taking in class"

"It will help me a lot back in class"

Schoolgirls commenting on the workshop

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Image credits

Page	Case Study	Image Credit
1	Front Page	Lee Pullen, At-Bristol Science Centre
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21	Dundee Science Centre	Dundee Science Centre
22	Dark Sky Discovery	Duncan Smith
23	At-Bristol Science Centre	Lee Pullen, At-Bristol Science Centre
24	Centre for Life	Rich Kenworthy
25	Museum of Science and Industry	Museum of Science and Industry
26	Scottish Science Centres	Glasgow Science Centre
27	Science Museum	Science Museum
28	Thinktank	Thinktank
29	Digital and online engagement	At-Bristol Science Centre YouTube
30	Case Studies Part 2	Lee Pullen, At-Bristol Science Centre
31	Centre of the Cell	Centre of the Cell
32	Glasgow Science centre	Glasgow Science Centre
33	Eden Project	ASDC/Wellcome Trust: Hands-on DNA
34	Thinktank	Thinktank
35	Eureka!	Eureka!
36	W5	W5
37	Case Studies Part 3	ASDC/STFC: Explore Your Universe
38	Jodrell Bank Discovery Centre	Jodrell Bank Discovery Centre
39	National Space Academy	Stuart Hollis
40	Science Museum	Tony French
41	Techniquet Glyndŵr	Techniquet Glyndŵr
42	Techniquet	Techniquet
43	Science Museum	Science Museum
44	Explore Your Universe	ASDC/STFC: Explore Your Universe

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With thanks to the CBI for allowing us to reproduce figures 1 and 2 in this report, taken from their report ‘Engineering our Future: Stepping up the urgency on STEM.’