4

Equality and Diversity

Introduction

It is widely understood that gender, ethnicity, social and economic background and disability can have a profound effect on young people's choice of subject and career. This may be a result of the limiting effects of an individual's own culture and background on academic self concept (I'm not good at science) or on career identity (that's not a job anyone I know does). Other factors relevant to STEM careers awareness are the lack of visibility of the breadth and dimension of STEM careers and stereotyped images and perceptions of people working in traditionally conceived STEM jobs.

The desirability of a more diverse STEM workforce is generally well–accepted on the grounds of maximising individual opportunity and meeting economic need.

This part of the pack explores some of the facts about under–representation in STEM courses and careers, offers tried and tested approaches to practice that can produce real and sustained impact and points to some of the sources of information to support change.

There are significant interactions between the various strands of equality that affect young people's progression and achievement in STEM. The STEM Subject Choice and Careers Online Equality and Diversity Toolkit helps practitioners reflect on practice in relation to STEM careers and signposts relevant case studies and resources. www.stem–e–and–d–toolkit.co.uk.

Some of the particular challenges we face on STEM subject choice and careers include:–

- The number of schools offering Triple Science has increased rapidly…'research shows that, compared with other pupils, pupils from more deprived backgrounds achieve relatively larger improvements in their future A level science and maths outcomes when offered Triple Science at GCSE … However, Triple Science is less widely available in areas of higher deprivation, where it could potentially have the greatest impact on take–up and achievement.'[1]
- Only about 20% of those taking A level Physics or studying undergraduate physics courses are female.
- Approximately 1 in 14 of the general population attend higher education but only 1 in 20 of disabled people do so.
- Disabled people represent around 3.8% of the STEM sector as compared to 5.9% in other sectors.[2]
- Low aspirations, poor academic self concept and effort have a disproportionate effect on STEM achievement among working class White British and Black Caribbean boys.
- The UK is ranked worst in Europe for the number of female engineering professionals. Some engineering sub disciplines (aerospace and chemical, processing and engineering) are showing more sustained interest from young women.

The Equality Act 2010 promotes equality across a range of protected characteristics, and public bodies are expected to comply with the requirements. Schools/colleges are encouraged to move towards a single equality policy which should encompass the publication of data on a year by year basis. This could include information relevant to the STEM arena including take up of STEM subjects, breadth of participation in work experience and student destinations.

1. Educating the next generation of scientists – DfE November 2010
2. 2006 Labour Force Survey

Gender

The STEM workforce is not yet truly representative, with a significant gender imbalance in many areas.

Barriers to females choosing STEM subjects and careers

An example of work being carried out to understand the issues related to the gender imbalance in STEM subjects can be seen through initiatives led by the Institute of Physics. The under–representation of girls in post–16 physics was the rationale for the inclusion of a 'Girls in Physics' component in the Institute of Physics 'Stimulating Physics' project. This component was delivered by the UK Resource Centre for Women in Science, Engineering and Technology (UKRC) between February 2007 and July 2009. A substantial number of girls do well at Key Stage 4 but do not choose to study physics post–16. In 2005, only 14% of girls who were awarded an A* or A for GCSE Double Award Science or physics progressed to A level physics (Hollins et al., 2006). Whilst there has been a small year–on–year increase in the number of A level physics candidates between 2006 and 2008 (Institute of Physics, 2008), there has been little change in the proportion of girls that have taken the subject post–16. In 2008, 28,096 students sat physics A level and of these 21,941 (78%) were male (Institute of Physics, 2008).

Outcomes from the 'Stimulating Physics' project indicate that many physics teachers now recognise the barriers that girls face, and are convinced of the need to be proactive.

Examples of recommendations for further development related to learning include:–

- Development of learning methods and materials that support personalised learning and embed gender equality.
- Training and development targeted at girls in the physics classroom to enable them to become more confident and assertive.
- Developing, piloting and evaluating learning activities to demonstrate the 'real world' benefits of studying physics

Recommendations relating to careers include:–

- Researching women in physics–related careers
- Strengthening the links between the physics curriculum and physics–related careers guidance
- Designing strategies for bringing the world of work into the learning of physics
- Designing strategies for bringing positive female role models from universities and industry into the learning of physics
- Designing gender–friendly industrial visits, work placements and employer involvement in the learning of physics. The 'Girls into Physics' action research programme (Institute of Physics, 2008), enabled 100 schools to participate to investigate methods to engage girls with physics. Key recommendations for teachers include:–

Learning & Teaching

- Talk to students to understand the context in your classroom
- Get students onside to work with you to change this – allow students to peer review
- Make sure students understand what physics is
- Discuss the nature, purpose and relevance of physics

Classroom Management

- Ensure interventions are appropriately timed
- Sharing good practice in school and beyond

Careers

- Careers advice should be integrated throughout the school
- Become aware of students' career aspirations
- Improve access to existing physics–related careers materials
- Links to careers should be highlighted throughout normal teaching

Progression

- Use appropriate role models at all stages of progression
- Link the physics covered to wider social relevance and interest

Workforce

- Specialist teachers can work with non–specialists to build their confidence and suggest strategies

School culture and ethos

- Use interventions that the whole school can see or get involved in

Some important messages to emerge from the findings include:–

Making it relevant:

- Integrating physics–related careers in (e.g. through direct references, set assignments, posters and display)
- Creating opportunities in lessons for students to explore the social relevance of physics (including the roles of physicists)
- Real life experiences with work experience and role models were also effective in 'bringing physics to life'

Students' lack of knowledge of careers is a problem and increasing their awareness of physics–related careers would enable them to make informed course choices. This approach relates to all the STEM subjects, and careers. Practitioners have a key role in ensuring young people have access to STEM careers knowledge.

Gender imbalance in STEM careers

Encouraging the greater participation of young women in STEM makes good business sense since by not tapping the skills potential of females, employers are reducing the pool of possible recruits.

Fewer young women choosing STEM subjects leads to gender stereotyping in education with resultant occupational segregation in the workplace. Occupational segregation is one of the three main factors contributing to the gender pay gap alongside pay discrimination and unequal impact of caring.

Without more young women choosing the STEM route, occupational segregation will reinforce the current situation whereby 75% of working women are still found in just 5 occupational groups:

- Associate professional and technical (e.g. nurses)
- Administration and secretarial work
- Personal services (e.g caring for children or the elderly)
- Sales and customer service
- Non–skilled manual work.

Occupational segregation is illustrated by an analysis of successful completions in selected apprenticeship areas. See table below:-

The gender gap in Apprenticeships Completions (2006–07)[1]

Selected Sectors	Women as a % of completions
Retail and Commercial	67.5
Health, public services & care	88.6
Leisure, travel and tourism	48.4
Information & communication technology	23.6
Engineering and manufacturing	3.8
Construction, planning and built environment	0.9

The Gender Pay Gap

Pay rates in male–dominated sectors are higher than in those sectors where the majority of females work:

The national gender pay gap for full–time employees (as measured by the median hourly pay excluding overtime) was 12.6% in 2008. Traditionally, male professions appear to have a smaller gender pay gap than professions with higher proportions of women. (See UKRC Statistics Guide 2010). The message of overall better pay in the STEM area, combined with the exciting opportunities that are available, may encourage more girls to break this cycle of occupational segregation.

Mean annual pay (gross) – 2006	
Selected sectors	**Mean annual pay**
ICT Professionals	£39,228
Engineering Professionals	£34,839
Hairdressing and Beauty Salon Managers and Proprietors	£18,661
Healthcare and Related Personal Services	£12,108
Childcare and Related Personal Services	£9,405

1. LSC 2008. Secondary analysis by the UKRC – Women and men in science, engineering and technology: the UK statistics guide 2010

The Gender Pay Gap for Apprentices

The gender pay gap in the most recent government survey (2007) was 21% with an average weekly earnings for a male apprentice of £186 compared to an average weekly earning for a female apprentice of £147. Occupational segregation was illustrated in that the majority of apprentices in the two highest–paying sectors were male (i.e. engineering manufacturing, and electrotechnical), whereas the majority of apprentices in the three lowest–paying sectors were female (i.e. hairdressing, early years work, health & social care).

To provide greater balance in the gender apprentice earnings ratios, girls may benefit from the campaign to combat the skills shortages in STEM processing and technician roles through the expansion in Apprenticeship opportunities. Success for female apprentices in the STEM area can be exemplified by Katie Lester who is an electrical apprentice based at Tilbury Power Station, Essex. In 2009 she was named as the Institute of Engineering and Technology (IET) Young Woman Apprentice of the Year. This award recognises the very best young female engineers in the UK, highlighting Katie's own abilities as well as her example to others to enter the profession. Katie shows her desire to attract others to the industry by helping set up apprentice recruitment events at Tilbury. She says: *"I'm really chuffed to have won. Engineering is a brilliant career and I want to inspire others to consider it."* Katie is a young woman making a mark in the engineering world and contributing enormously to the fact that it can be a great career for women.

STEM Degrees

Only around a third of undergraduates in STEM disciplines are female, and although this position has improved over time, the gender gap is still considerable. The table below shows the ten year trend relating to the percentage of females taking STEM degree subjects (as a percentage of total number of students):–

% of female students by degree subject (as a % of total)

	2008/09	2003/04	1998/99
Biological sciences	64%	65%	60%
Computer science	19%	24%	22%
Engineering & technology	15%	14%	14%
Mathematical sciences	38%	38%	37%
Physical sciences	41%	40%	36%
Total proportion of female students in all subjects (STEM and non–STEM)	59%	59%	55%

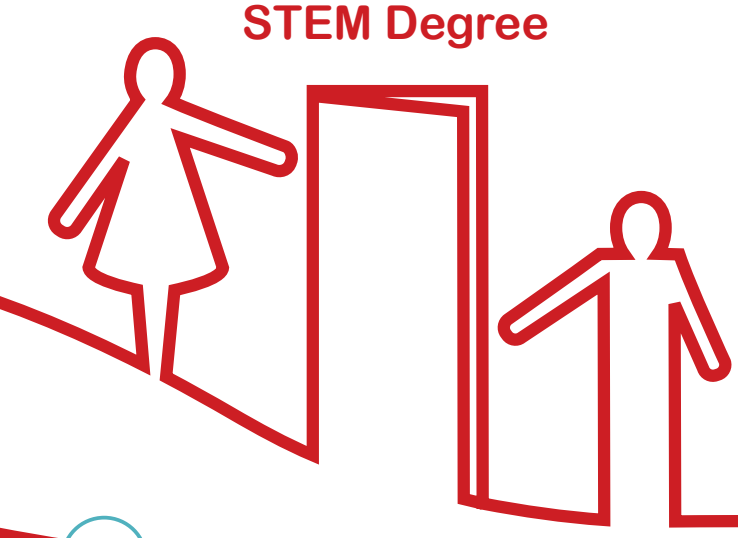
Apart from the biological sciences and subjects allied to medicine, the percentage of females studying STEM degrees is significantly less than the percentage of males, with only a small increase over a ten year period. The main improvement has been in the physical sciences (primarily chemistry). The trend for engineering and technology degrees is the most stark, with females only making up 15% of student numbers – just a one percentage point increase in this low base in over ten years.

Ethnicity

For the purpose of consistency, the term ethnicity will be used rather than race, as ethnicity implies cultural, linguistic and religious aspects of identity as well as (sometimes but not always) visible differences.

Ethnic Minorities in SET Occupations – the statistics in this section refer to SET, which is defined as science, engineering and technology

The representation of ethnic minorities within SET occupations varies considerably. The highest level of employment is among the Chinese population (8.9% of their population) and the Indian population (7.2% of their population). The percentage of the White ethnic population in SET occupations represented just over 5% of their population.



The Black African population (4.0% of their population) and the Pakistani population (4.7% of their population), have rates lower than that of the White population, but the **most under represented groups in SET occupations are the Bangladeshi population (1.6% of their population) and the Black Caribbean population (2.3% of their population)**. **Table 1** illustrates the size of ethnic minority populations working in SET.

Ethnicity	Male	Female	Total
White	1,059,900	189,000	1,248,900
Black – Caribbean	4,700	700	5,400
Black– African	5,400	1,900	7,300
Indian	22,400	7,700	30,100
Pakistani	5,700	1,600	7,300
Bangladeshi	700	200	900
Chinese	5,200	1,600	6,800
Other	18,800	4,400	23,200
Total	**1,122,800**	**207,100**	**1,329,900**

Table 1: Employment in SET in the UK by ethnic group and gender (Labour Force Survey, March 2002 to August 2003 – A Report for the Royal Society, 2005)

Due to the small size of some of the ethnic minority populations, the number working in SET and, therefore, the **number of potential role models for young people is very small (e.g. the Bangladeshi population).**

The analysis reveals that men are much more likely to work in SET occupations than women. A ratio of men to women of approximately 5 to 1 is broadly maintained for all the ethnic groups, including the White population. The highest rates of participation for women are among the Chinese population (4.9% of their population) and the Indian population (3.6% of their population). The lowest rate of employment in SET occupations is among Bangladeshi women, at 0.4% of all those employed.

Disproportionality (disproportionate representation of a given population group) within SET occupations is highlighted by the *Jones and Elias' Royal Society Report, 2005*, which states:

"The two main disadvantaged groups in terms of participation in SET are the Bangladeshi population, where the problem appears to be most apparent among women, and the Black Caribbean population, where the problem of under–representation is greatest among males. ***Members of these ethnic groups are significantly less likely to work in a SET occupation than their White counterparts".***

Ethnic Minority Participation in STEM subjects

Attainment levels at GCSE are relevant to the study of STEM subjects as they have an influence on the likelihood of students staying on to study post–16. A study looking at ethnic minority students performance in public examinations at age 16 (DCSF, 2008) found that, at KS4, the mean score for Black Caribbean students is significantly lower than White British, but the mean score for Pakistani students is only just below the White British mean. The mean scores for Bangladeshi and Black African students do not differ significantly from the mean for White British students, while Indian students are substantially ahead of their White British counterparts at KS4.

The Royal Society (Jones and Elias) Report, 2005, analysed ethnic minority representation in SET at A level. **Table 2 below** illustrates the percentage of students awarded one or more A levels in a SET–related subject (defined as biology, chemistry, physics, mathematics and ICT) and one or more A level of some kind. This shows that Black African, Indian and Chinese students are very well represented in the SET A level cohort, while Black Caribbean and Bangladeshi students are poorly represented:

Ethnicity	% SET A level	% 1 or more A level of some kind
White	19	38
Black – Caribbean	9	28
Black – African	28	48
Indian	37	51
Pakistani	16	31
Bangladeshi	11	19
Chinese	39	52
Other	18	32

Table 2: Young people awarded at least one A level in SET and one or more A level of some kind, by ethnic group

When looking at the numbers of students choosing three or more SET A levels, there is an even more dramatic picture of over representation among Chinese and Indian ethnic minorities. 15% of Chinese students and 11% of Indian students are awarded three or more SET A levels compared to just over 4% of White students. The most pronounced under representation is amongst Black Caribbean students with less than 1% of this group being awarded three or more SET A levels.

In relation to higher education and the numbers from ethnic minority groups entering SET degrees, a similar pattern emerges. Compared to the White population, the Chinese and Indian populations have the highest proportions passing a degree in a SET–related subject. 7.8% of the Chinese population and 5.1% of the Indian population hold SET related degrees, compared to 3% of the White population. Bangladeshi students (1.5%) and the Black Caribbean population (1.4%) hold the lowest percentage of SET related degrees. **See Table 3 below.**

Ethnicity	% holding SET-related degree (within their population)
White	3.0
Black – Caribbean	1.4
Black – African	3.6
Indian	5.1
Pakistani	3.3
Bangladeshi	1.5
Chinese	7.8
Other	5.0

Table 3: Population aged 21+ holding SET–related degrees, by ethnic group (Labour Force Survey, 2002–03 – A Report for the Royal Society, 2005)
** SET–related degree subjects are defined as biological sciences, physical/environmental sciences, mathematical sciences and computing, engineering, technology*

Taking the findings presented to the Royal Society overall regarding participation in SET among ethnic minority groups, the Report concluded that:

"Among Asian groups, Indian and Chinese people are over–represented compared to the White UK population. In contrast, Bangladeshi people are under–represented in SET, both in terms of occupations and educational attainment. ***The problem is more acute among Bangladeshi women.*** *Among the Black ethnic minority population, while Black African people are over–represented in SET compared to the White UK population, this is not the case among* ***Black Caribbean people.*** *In this instance the* ***problem of under–representation is worse among males.***

Ethnic minority students and STEM subject choice and careers

Studies have suggested that there are a number of stereotypes associated with STEM careers. An example is a strong association between science careers and masculinity. A survey of secondary students found that 50% of students saw scientists as middle–aged men in white coats. Mathematicians are usually imagined as middle–aged white men (Mendick et al 2008) while engineering is described by Foskett and Hemsley–Brown as an 'invisible' career, which when imagined at all is often seen as dirty, physical work.

Investigating the attitudes of Bangladeshi girls towards choosing STEM, Smart and Rahman (2008) found that their subject choice at GCSE and A level was influenced by:

- Career ambitions
- Interest in and enjoyment of the subject
- Self–perceived ability
- Perceived difficulty of the subject
- The options on offer in the school/college
- Previous experience of studying the subject
- The assessment method

STEM subjects were seen as of use for a limited number of careers – biology and chemistry perceived as good for medical careers, and maths because of links with accountancy and finance; however, this also had the effect of narrowing their appeal. Girls and teachers indicated that girls might choose not to study STEM subjects because they had no interest in medicine, accountancy or finance. **Therefore it is important to portray STEM subjects as having worth in themselves, as well as for particular careers.** Girls often see the only reason for taking science was to become a scientist, and this perception limited the likelihood of girls studying STEM subjects.

Girls tended to see physics and chemistry especially as male subjects. According to Smart and Rahman, very few girls aspired to careers in engineering, technology or sciences that were not medically related, due both to **a lack of information about the breadth of careers open to those studying STEM subjects and also the perceptions of these careers requiring stereotypical 'masculine' characteristics**. Other studies suggest young people are more positive about science when they can see how it related to everyday life and is relevant (Osborne, Simon and Collins 2003, Jenkins 2006)

Springate et al (2008) found that ethnic minority A level and undergraduate students' choices were influenced by a variety of factors:-

- High–influence factors: enjoyment, future ambitions, perception of careers with a physics or chemistry degree and the relevance of the study of these subjects to life
- Medium–influence factors: the way physics and chemistry are taught, teachers of these subjects, images of scientists and the work they do, and family influences
- Low–influence factors: the difficulty of physics and chemistry, role models, careers advisers and peers

Key factors in encouraging ethnic minority students to continue with STEM were a passion for physics/chemistry and **positive perceptions about the relevance of subjects and careers related to them** (Springate et al, 2008).

The report emphasised the importance of challenging stereotypes. For example, some teachers were unaware of the destinations of previous students, and this may have contributed to some of their stereotyped ideas about the aspirations of Bangladeshi girls, which focused on law, medicine and teaching. While these were the most frequent aspirations among the girls spoken to, the girls discussed a wide range of different careers and teachers did not seem to have appreciated this diversity. **Mentors from STEM occupations could help to break down some of the stereotypes around STEM careers, and challenge some of the perceived barriers.**

With the exception of medicine, aspirations in STEM careers were very limited, and knowledge about careers in this sector was patchy. Girls in this research said that they would be free to pursue a STEM career, and were hopeful that the under–representation of Bangladeshi girls in this area would be challenged: however, because they tended to associate these careers with boys, and with masculine characteristics, they did not see themselves as the kind of person who would have a STEM career.

The report concluded that girls and their parents had limited access to information about careers in non–medical sciences, technology, engineering and mathematics. **Provision of information about these careers, and mentors with experience in STEM could help girls make informed choices.** For some girls, work experience was a factor in shaping their aspirations, but many had undertaken gender–traditional work experience. Monitoring of the gender balance of work experience placements and consideration of ways to challenge gender stereotypical placements would be helpful.

Moving on up? Ethnic minority women and work (R. Bhavnani 2006) commented on the influence of schools/colleges and careers advice:

- Over 4 in 10 Black Caribbean, and around 3 in 10 Pakistani and Bangladeshi girls say their **careers advice has not opened their eyes to a wide range of careers,** suggesting that young people have been given advice about a narrow range of careers
- **5 out of 10 Bangladeshi and Pakistani girls do not know the rates of pay for the jobs they are likely to get.** Given that Pakistani and Bangladeshi women have higher pay gaps than white British women in the labour market (Platt, 2006), it is vitally important that they know this information when making career choices
- Opportunities for flexible working are important when considering future employment. 5 or 6 out of 10 girls and boys across ethnic groups consider flexible employment to be important to them in the future
- An overt commitment to diversity and equality of opportunity from employers is important to this generation, along with opportunities to gain qualifications, training and employment

Role models and support programmes to encourage greater Ethnic Minority representation in STEM

Barriers and challenges exist which need to be overcome if there is to be a better representation of ethnic minority groups in STEM subjects and careers. A resource to help with this is the STEM Subject Choice and Careers Project's 'Equality and Diversity Toolkit' developed by The Centre for Science Education, Sheffield Hallam University. www.stem- e-and-d-toolkit.co.uk highlights truly inclusive STEM careers materials. Inspirational role models, mentors, ambassadors, and curriculum activities will help to encourage a new generation of young people to embrace the exciting opportunities opening up in the STEM area in the forthcoming decades – and at the same time help to close the occupational segregation issues through accessing well paid STEM opportunities. Historical role models (as in the Bessie Coleman example below) can be inspirational. Support programmes using Islamic history and the advancement of science/maths also provide good material – e.g. Museum of the History of Science, Oxford – www.mhs.ox.ac.uk/scienceislam_education/resources.php

1. Example role model – Bessie Coleman (1892-1926)

also faced barriers and challenges – but this did not stop her becoming the first African-American to become an airline pilot – her case study is inspirational (www.bessiecoleman.com):-

- Popularly known as "Queen Bess" she was also the first American of any ethnic background or gender to hold an international pilot licence
- Despite having to study in a poor, one-room school Bess established herself as an outstanding maths student
- Bess took French language classes and travelled to Paris where she was instructed to fly a biplane
- On June 15th, 1921, Bess become the first African-American woman in the world to earn an aviation pilot's licence, which she achieved through the Federation Aeornautique Internationale
- In 1922 she completed an advanced course in aviation
- Her pioneering achievements served as an inspiration for a generation of African-American men and women
- Lieutenant William J. Powell (who served in a segregated unit during World War 1 and promoted the cause of black aviation) said – "Because of Bessie Coleman...we have overcome the barriers within ourselves and dared to dream".

2. London Engineering Project (LEP) – Royal Academy of Engineering (Lead organisation)

In 2005 HEFCE (Higher Education Funding Council) awarded funds for the first phase of the London Engineering Project, including a specific programme for Afro-Caribbean boys and Bangladeshi and Pakistani girls, to widen participation in engineering at higher education level. Key elements of the project include:-

- to engage with 9 – 19 year old students in secondary schools/colleges and primary schools
- to use face to face and other targeted marketing to promote engineering higher education courses to students in the target groups
- to demonstrate real and achievable engineering career destinations

Project strands include:-

- STEM enrichment in schools
- raising awareness of teachers and school/college management teams
- mentoring students
- development of gender inclusive and culturally relevant learning opportunities

With the residential courses, in-school STEM enrichment days, and after-school engineering clubs, thousands of LEP students have been able to experience first-hand the fascinating world of engineering. STEM activities can be used as an integral part of the delivery of the curriculum making links between and within subjects. For more information, contact:- www.thelep.org.uk/contact-us

The HEFC is funding a three year programme which includes building on the success and experience of the London Engineering Project, More Maths Grads, Stimulating Physics and Chemistry for our Future. This HE STEM Programme will be developed by the University of Birmingham and channelled through six regional centres – Midlands, North East, North West, South East, South West and Wales.

3. REACH – example role model project

REACH is a project group led by members of the Black community in London designed to raise the aspirations and achievement among Black boys and young Black men, enabling them to achieve their potential. The group was commissioned to complete an independent report to Government, and key findings included:–

- the need for more Black male role models and more positive images of Black men – a survey conducted by mentoring and life skills training organisation c–a–n–i, found that up to 97% of 12 to 16 year olds (of 400 young Londoners surveyed) **seek positive influences from everyday, hard-working citizens, rather than famous people**
- the powerful influence of the media in reinforcing existing negative stereotypes of Black boys – often the only positive images of successful Black men were those of sportsmen and rap artists, but Black boys needed a greater diversity of images and portrayals, showing that Black men can be successful in a wide range of fields including STEM

In 2008, **20 national role models were named** who are working with hundreds of young Black boys across the country to broaden their horizons by showing them what they can aspire to and improve their self–image, self–confidence and self–esteem.

For information on the REACH programme contact: www.direct.gov.uk/reach

REACH Role Model

Obi Nwofor, Project Manager, London Underground

Obi moved to the UK from Nigeria in 1992, aged 16. His first jobs were sweeping streets for Haringey Council and cleaning at a tube station. He decided he had to get an education – the only way not to remain 'voiceless'.

Obi told the REACH panel that he is struck now by the lack of visible Black role models for him to look up to during this time. His determination and drive led to a Bachelors and a Masters degree and ultimately a position as a senior manager with London Underground. The irony of having swept stations for the same company years earlier is not lost on him!

*He continues to educate himself and is currently undertaking a Railway Engineering Masters degree. Obi says: **"I want to share my modest experiences to guide and enrich the lives of others so that my own child may inherit a better world than that I grew up in."***

4. STEM Ambassadors

The STEM Ambassadors Programme, co–ordinated by STEMNET, is a network of 19,000 people with STEM working knowledge across the UK who work with schools/colleges to run workshops, activities, give talks, and mentor students. STEMNET aims to recruit 8,000 more STEM Ambassadors by 2011.

Young people enjoy meeting 'real life' scientists to see the many different areas of science that people work in – and that scientists are certainly not always men with white coats and crazy hair! STEM Ambassadors are great at delivering 'real life' messages in schools/colleges, and they are a FREE resource for teachers to utilise.

STEM Ambassador Case Study

Ranna Patel, Bioprocess engineer

Ranna Patel did a doctorate in Biochemical Engineering at University College London which broke new ground in the development of processes to make antibiotics, vaccines and monoclonal antibodies. Monoclonal antibodies are similar to the antibodies created by our own body's immune system, and are providing the latest breakthroughs in the treatment of cancer and other diseases.

*Ranna's research contributed to making these life–saving treatments faster, safer and cheaper. Ranna says of her job: "It's challenging and I get to use my knowledge of science and technology to make a direct difference to society. **Meeting an engineer at my school was enough to make me realise it was the career I wanted to pursue** – I want to do that for the next generation."*

Ranna is pictured here inside a giant bubble – her career as a process engineer has included making washing–up liquid and glycerine, both of which are ingredients of bubble solutions.

The local STEM Ambassador Management Contract Holder will organise an Ambassador to visit schools/colleges and support STEM–related activities or events. For more information contact:–

www.stemnet.org.uk/content/ambassadors

Improving Equality and Diversity Practice

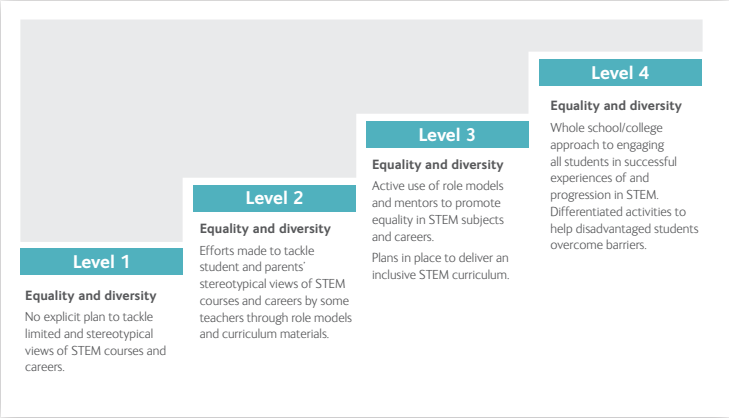
In order to measure the effectiveness of work in relation to promoting equality and diversity in STEM, the following element of the development framework sets out four different levels of performance and provides a ladder of progression.

Level 1 – low level impact

Level 2 – some awareness and use of STEM activities

Level 3 – widespread knowledge and use of STEM activities

Level 4 – whole school/college approach to supporting STEM activities



Top Tips for Supporting Equality and Diversity through STEM Careers Advice

1. Assess your starting points

What evidence is available about participation in STEM courses and careers? What are the perceptions and needs of young people and what feedback do they offer about STEM courses and careers? This can help identify the priorities for your development plan. Particular issues may include numbers progressing to A level Science or Maths, students' attitudes to STEM, participation in work experience or breadth of student destinations.

2. Promotional Material

Be aware you do not know the whole picture and ensure you are up to date on the networks, sources of information and organisations that can help your equality and diversity practice. It is also important to build a team within your own learning community.

3. Help to create a positive image

Use the wide range of available materials to promote awareness of the breadth of STEM careers and the range of people employed. Ensure literature and posters have positive images that reflect your learning community. Make use of available resources such as those from the UK Resource Centre, Royal Society of Chemistry or Institute of Physics (see list in Section 9). It is important to use inclusive language.

4. Open up possibilities

Ensure that you present all of the options. STEM careers are not just open to those studying A levels and a degree. Careers advice should emphasise the potential of a science or engineering career for all including Apprenticeships and vocational pathways. Celebrate success in student achievement.

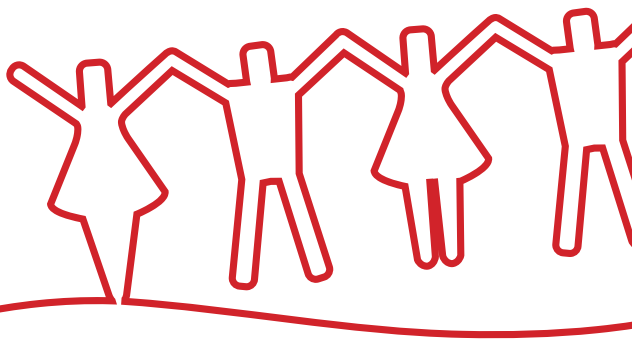
5. Engage your local employers and higher education

Visits

Well organised visits with adequate preparation and debriefing can help widen students' perspectives. It is worth considering sending proportionate numbers of boys and girls to events where practicable. Ensure that the hosts are encouraging and not going to reinforce stereotypes. A panel of speakers can help to balance views rather than relying on a single perspective.

Work experience

Research shows that entry into non–traditional careers is often initiated by a positive work experience. See the A Quick Guide to STEM Work Experience Placement for practical suggestions. A number of professional institutions and training organisations are keen to provide suitable work experience for instance NHS Careers.



6. Plan accessible enhancement activities

STEM enhancement and enrichment activities provide valuable opportunities for problem–based learning and investigating the practical applications of STEM. Examples include after school science and engineering clubs. They can motivate and build the confidence of young people who may be struggling with STEM. They can also enable young people to explore hands on activities in a safe environment (see Section 8). It is important to run activities that appeal to both girls and boys and to ensure the provision is accessible to all (including the time of day that clubs take place and the location).

7. Engage the parents/carers of students

Parents and families have a key influence on young people's choice of careers and courses. There are a variety of ways in which you can engage with parents on STEM careers awareness. These include running a STEM Careers evening (see the example programme in the appendix), running a celebration event involving parents following a STEM enhancement activity and providing information to parents on national events and activities (such as the annual Big Bang Fair) and sources of information (eg. www.futuremorph.org).

8. Measure impact

Review the priorities for development and benchmark your progress.

The Equality and Diversity Tool Kit signposts users to sources of information and advice. Some of the key examples include:-

www.skill.org.uk/page.aspx?c=10&p=106#work

SKILL offers access to leaflets for disabled people, including 'Finding Work' and other education related items

www.shaw–trust.org.uk/home

The Shaw Trust's website has information for individuals with disabilities, employers and others supporting people to live independently

www.iop.org/publications/iop/2008/page_42867.html

The Institute of Physics website provides an 'Access for All' publication offering "support and practical advice to university physics departments in meeting responsibilities towards disabled students"

www.generatinggenius.org.uk/

Generating Genius uses Science, hands–on Engineering, apprentice style competition to mentor boys from underprivileged backgrounds into higher education. It uses residential summer schools based in a number of top British Universities to nurture talented students into Science and Engineering. The boys start at age 11 /12 and attend each summer for the next 5 years, doing top level hands–on science, technology and engineering.

Windsor Fellowship –
www.windsor–fellowship.org

Windsor Fellowship is a charitable organisation that encourages innovative educational programmes, including the REACH project to raise the aspirations and achievement among Black boys and young Black men. Visit the home page and click on REACH National Role Models Programme and Pre–19 Programmes

Stephen Lawrence Charitable Trust –
www.stephenlawrence.org.uk

A trust set up to use Stephen's dream of becoming an architect an inspiration for other young people. Offers bursaries and scholarships to the Architectural Association for BME students interested in architecture. There is also a mentoring scheme available for aspiring architecture students

Museum of the History of Science, Oxford –
www.mhs.ox.ac.uk

MHS offers teaching sessions for schools, on–line resources and a web version of their scientific collections database. Click on the link above to access Science and Islam: Resources – for lesson ideas for science and mathematics and the influence of Islam, at KS3 and above

Construction Skills –
www.cskills.org

Sector Skills Council for the Construction Industry has a team of trained diversity advisers who will provide one–to–one support for Black and Asian candidates and their parents

Architects for Change –
www.architecture.com

The Royal Institute of British Architects (RIBA) have an Equality & Diversity Forum which promotes improved equality of opportunity and diversity in the architectural profession, and can sometimes help with role models, resources or other support

National Centre for Excellence in the Teaching of Mathematics (NCETM) –
www.ncetm.org.uk/resources/9309

NCETM provides and signposts high quality resources to teachers through an extensive on–line resource portal. The link above enables access to the 'Learning Maths Outside the Classroom' initiative which illustrates innovative projects used with ethnic minority students in schools/colleges across the country.