



# IMPACT AND LEGACY

National HE STEM funded projects  
Yorkshire and the North East



Research Toolkit  
Research - Training - Evaluation

Tim Challis  
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# National HE STEM funded projects Yorkshire and the North East: Project staff



## Project Director

"Welcome to this, our report, on the impact and legacy of the National HE STEM Programme in Yorkshire and the North East projects. Each of the nine projects presented here were designed to share good practice amongst outreach practitioners and encourage staff from different institutions to share ideas, effective working practices and the use of STEM as a means for delivering team work, communication and problem solving skills. In our report, we have captured some of the highlights of the outcomes of these projects and collective endeavours. Some of our funded projects were primarily focused upon developing the potential of Looked After Children; others were focused upon widening participation more generally.

I hope you enjoy reading about these projects as much as we enjoyed supporting and working with them."

**Dr Nazira Karodia** was the Yorkshire and North East Regional Director for the National HE STEM Programme. She is a Senior Lecturer in Chemistry and the Associate Dean for Student Recruitment in the School of Life Sciences at the University of Bradford.



## Project Manager

"Each of the projects in the Yorkshire and North East region were designed to share good practice amongst outreach practitioners and encourage staff from different institutions to share ideas, effective working practices and the use of STEM as a means for delivering team work, communication and problem solving skills. Each project was designed to either add STEM to general widening participation and outreach practices or to share STEM outreach activities with institutions that were not delivering those activities at the time. Each individual project developed the skills not only of the young people involved but also the staff members delivering the projects. The group of projects also enabled greater communication and sharing amongst colleagues in different institutions, leaving a lasting legacy of collaboration amongst the partners."

**Dr Kerry Jaine Baker** managed the Widening Participation and Outreach projects for the North East Spoke of the National HE STEM Programme between April 2010 and July 2012.

# Background:

## The National HE STEM Programme

The National HE STEM Programme has been a three-year initiative funded by the Higher Education Funding Councils for England and Wales (HEFCE/HEFCW). It started in August 2009 and ran until July 2012. The Programme sought to increase and widen participation in Science, Technology, Engineering and Mathematics (STEM) and enhance the skills and knowledge base of the workforce in these areas. Although encompassing the STEM subjects more generally, it primarily focused its support on the disciplines of Chemistry, Engineering, Mathematics and Physics with concomitant benefits to the STEM sector as a whole.

The Programme organised activities in three related strands:

- Activities to widen participation within the STEM disciplines at HE level amongst students of traditional age
- HE curriculum developments focusing upon course delivery and design, student support, and knowledge and skills
- Activities to encourage those currently within the workforce and society without a Level 4 qualification to engage in further study to develop enhanced knowledge and skills.

The National HE STEM Programme:

- adopts a holistic approach to increasing and widening participation amongst school age students
- examines the current undergraduate curriculum and explores the teaching of the critical STEM skills to ensure graduates of all ages are adequately prepared for their workplace
- encourages Higher Education Institutions (HEIs) to engage with employers on a regional basis and develop flexible and tailored programmes of study to meet regional skills needs
- delivers this programme in collaboration with six regional spokes, four professional bodies and their and their associated subject centres.

# The Choices Together Project

The Choices Together Project is a joint initiative between the Universities of Sunderland, Northumbria and Newcastle to work with looked after young people (LAYP), a group with very low rates of participation in Higher Education. Over the last five years the Choices Together Project has begun to address this low participation rate by working with looked after young people on higher level skills and concepts, and introducing them to the realities of HE in order that they will see it as an option for themselves in the future.

Looked after young people are under-represented in HE, and their take up of STEM is even lower, and as such the North East spoke of the National HE STEM Programme have supported the Choices Together team to make significant changes to their programme by using STEM subjects and activities. The addition of STEM combines simultaneous promotion of HE and STEM subjects to this group of young people together with a number of other benefits not necessarily initially anticipated in the project.

Choices Together targets young people aged 14-16 over the course of a year and aims to demystify higher education. The programme introduces them to skills and practices used in higher level learning and shows them that they are capable of learning and living in this environment. STEM elements have been added to the programme wherever possible. These include, for example, project and team work activities based around scientific investigation and writing skills exercises based on scientific topics.

# Choices Together:

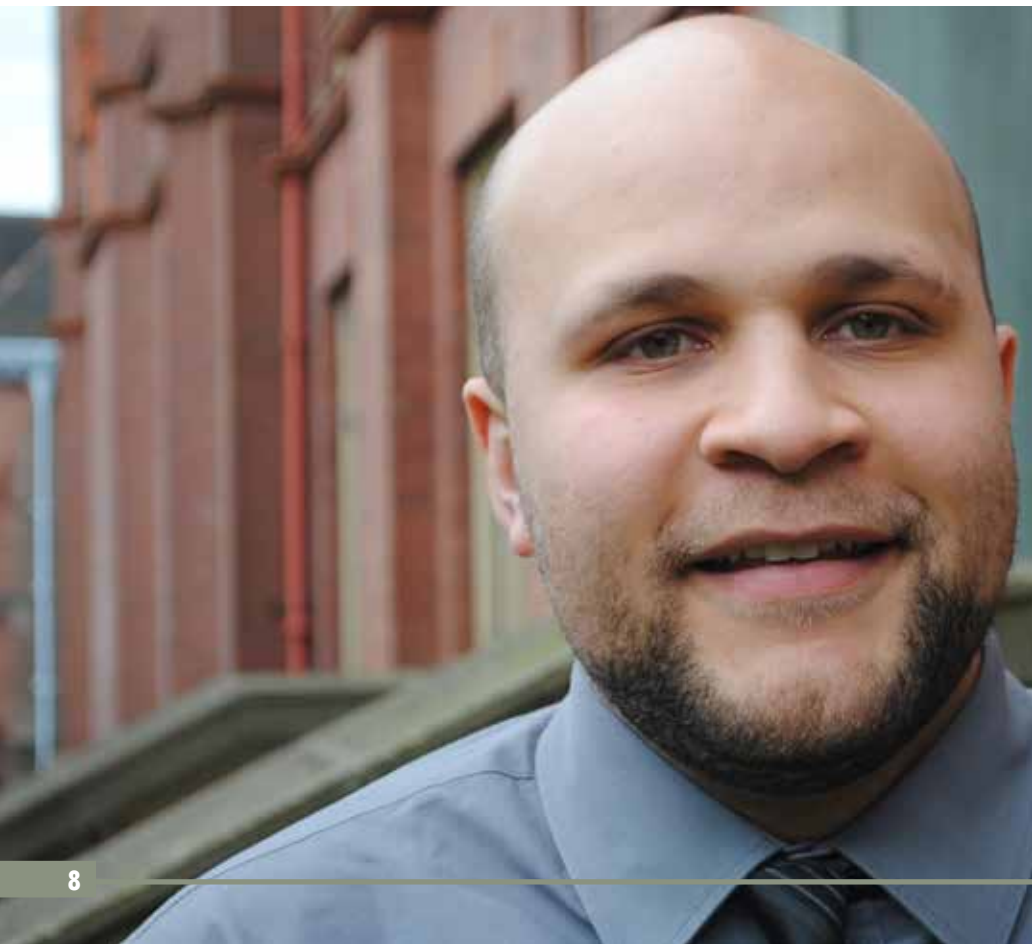
## Raising aspirations amongst looked after young people through collaborative STEM activities

### INTRODUCTION

Choices Together is a collaboration between the Universities of Newcastle, Sunderland and Northumbria aiming to raise aspirations amongst looked after young people in the region. Viewed very much as a 'club' by its organisers, Choices Together members get to visit each campus twice throughout the year, enjoying STEM subject activities and events, meeting undergraduate students, working with University academic staff, enhancing their team building, communication and independence skills and generally finding out what student life might be like.

Within the partnership, it was agreed that the Universities would engage the prospective students through hands on activity rather than bombarding them with information. Megan Lunn, University of Sunderland's dedicated contact for looked after young people, explained. "I have had quite a lot of experience of working with young people, and getting them involved and really committed to something can be quite difficult," she said, "If we sold Choices Together as a science club we would get science-interested young people, but we worked out quite quickly that it might reduce our numbers, so having activities that got them hands-on involved was far more important."

HE STEM funding has been critical to Choices Together's success story, both through enabling activities to take place at all, and in terms of binding the project's various strands together. Ezra Nash, of Northumbria University's Marketing and Student Recruitment Department, doubts that Choices could have continued without HE STEM's support. "On a basic level, we wouldn't have been able to run this year, I don't think, without the HE STEM funding" he said, adding "I think it's given us a focus for other projects this year as well."

A portrait of Ezra Nash, a man with a beard and short hair, wearing a blue shirt and tie, looking directly at the camera. The background is a blurred outdoor setting with a brick wall and a metal railing.

*"On a basic level, we wouldn't have been able to run Choices Together this year, without the HE STEM funding ... I think it's given us a focus for other projects this year as well."*

Ezra Nash, University of Northumbria,  
Marketing and Student Recruitment





*“If we sold Choices Together as a science club we would get science-interested young people, but we worked out quite quickly that this might reduce our numbers, so having activities that got them hands-on involved was far more important.”*

Megan Lunn, Looked after young people and care leaver contact, University of Sunderland

## Added value

Choices Together has had an impact that reaches far beyond its core outcomes, both for its organisers and for the students that take part in its activities.

Some young people have spent time together in children’s homes in the past, and are reunited through Choices Together. Anna Watts, Assistant Student Recruitment Officer at the Newcastle University, gave one example of this. “They’re all from different backgrounds, but some of them have had time together in a children’s home and then they are suddenly reunited on Choices,” she said, “We’ve had twin girls, they’re actually in separate placements, but then they get to meet up whenever it’s Choices Together, and see each other there.”

Choices Together has also impacted on the six student ambassadors (two from each institution) who work with its members. “It’s given them a whole different light on working with young people,” Anna Watts feels. “We had to do quite a bit of training with them initially to give them background information on why we targeted these particular students ... and on what it’s like to be a looked after young person, what the challenges are and what their life experiences might have been.”

Organisers also benefited from the introduction of HE STEM funding. “I know vaguely what courses we run but I didn’t know the specifics of what, say, a forensics student would do on a day-to-day basis,” Ezra Nash said, speaking of a Murder Mystery dinner the project organised for its members, “It was good and interesting to see what tools they use and what activities.”

## Collaboration

The three Universities working in partnership has also brought benefits. Choices Together began life in 2006, offering only a two day course funded by Aimhigher, but the collaboration between the three Universities has seen the initiative grow rapidly. “Working in collaboration with Northumbria and Sunderland is good on a number of levels,” Anna Watts explained, “It’s really good because we each have experience of working with looked after young people, and it’s good to bring all of that together and share best practice.”

The introduction of HE STEM funding not only saved Choices Together but also strengthened that partnership. “We were running out of funds, with Aimhigher coming to an end,” Ezra Nash recalls, “We were looking into other areas, and that’s why we put the bid in for the STEM funding, to continue the project and, obviously, strengthen our relationship.”

## STEM activities

Choices Together's focus has been on hands-on, stimulating activity that engages effectively with young people. Activities have included glass making, computer games design and engineering, and forensics, with each of the three institutions playing to their own particular strengths.

"At Sunderland last year for our club session I took them to the radio station and they talked about producing a radio show," Megan Lunn described, " They looked at the technology involved, they really, really got into it. They could do both sides of it, they could look at the sound and the music side of it, and they could look at the internet, using computers for research."

The challenge was to show how STEM influences a wide range of subjects and careers. "It was about, for me, encompassing STEM into the projects that we do coordinate, and showing that a wide number of subjects and careers are STEM related," Megan said. As well as the visit to Spark FM she also took students to visit the National Glass Centre, where they could watch how glass was made, and invited Sunderland academic John Kilkoynne, who has appeared on Sky TV's Braniac, to give them his 'Chemistry for the terrified' lecture.

## Aspiration

The underlying aim of Choices Together is to raise the aspirations of looked after young people, and show them that university is both a viable and a valuable option for their futures.

"Getting them to think about university as a viable option for them when they get older, so it's with them as they make their way up from school. In our department we try and have an intervention in each year group," Ezra Nash explained, "trying to get kids to want to actually go to a university when they get older, not specifically to come to Northumbria."

"They're going through that stage of doing their GCSEs and they might not be interested, and I just say, 'It's not the end of the world, but I've had to do a lot extra to get where I am, whereas if I'd just buckled down and got on with my GCSEs then it wouldn't have taken me as long.'"

## Sustainability

Although not sure what the future holds for Choices Together, all three organisers are confident that provision both for looked after young people and the STEM subjects will continue into the future. "I do believe that no matter where the funding ends up coming from, that we'll continue to do work with looked after young people at Newcastle University," Anna Watts said, "We've got a dedicated member of staff at the University who is a looked after contact so she'll be endeavouring to keep on doing work, hopefully we will still do it collaboratively with Northumbria and Sunderland."

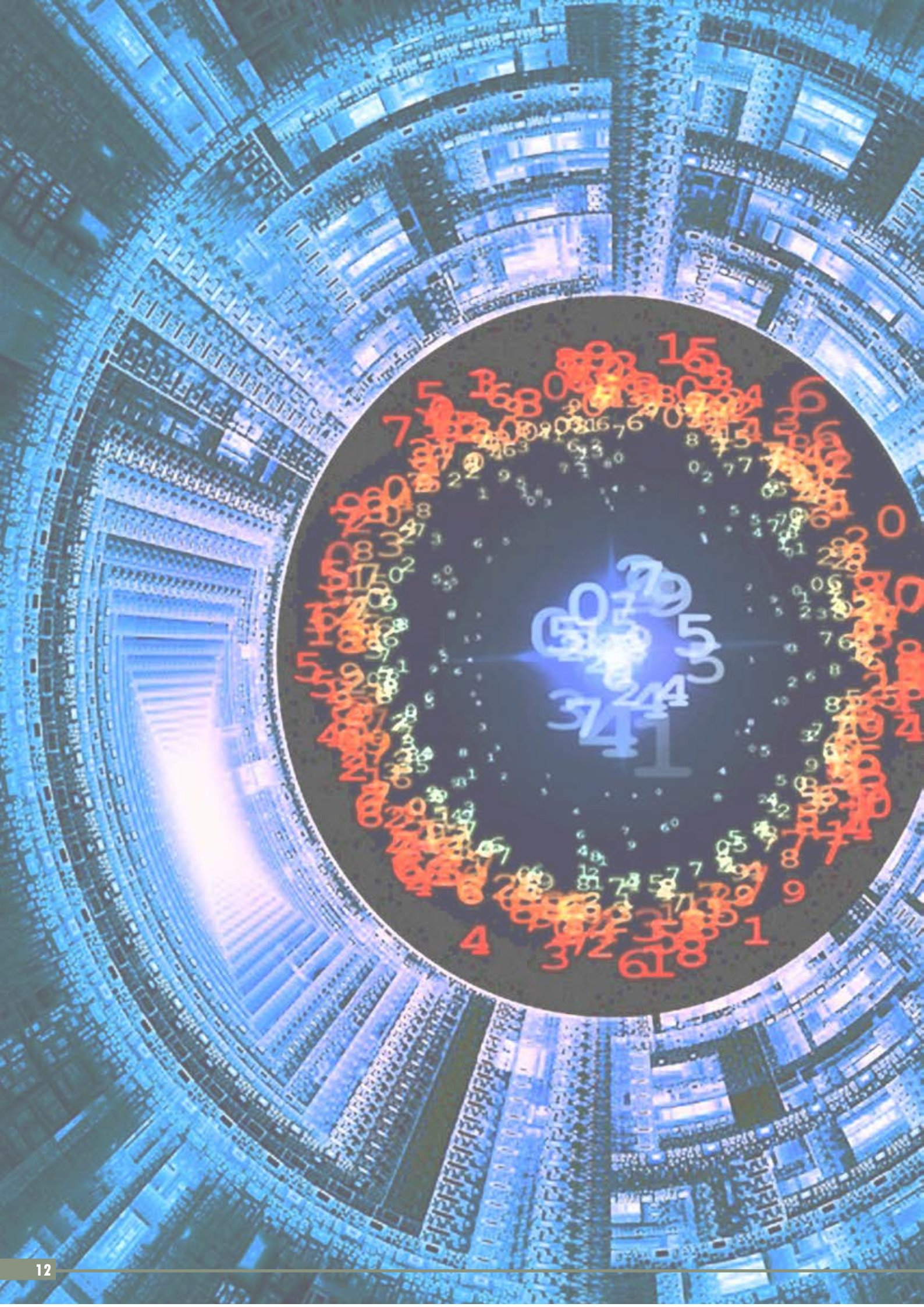
"STEM is a really big agenda for the University at the moment," Northumbria's Ezra Nash said, "We are trying to encourage more applications, and doing more promotion at a younger age to make them more aware of the subjects and careers available."

"We are really lucky, the Vice Chancellor recognises how important that area is, so continuing the work will be really vital," Megan Lunn said, "The STEM influence on Choices has been really interesting this year, and I'd love to maintain those two things together. Whether that is possible I don't know, but I do know that Choices Together or something working with looked after young people will continue."



*"... we'll continue to do work with looked after young people at Newcastle University. We've got a dedicated member of staff, she'll be endeavouring to keep on doing work, hopefully we will still do it collaboratively with Northumbria and Sunderland."*

Anna Watts, Newcastle University  
Student Recruitment Team



# The 'Young Scientists' Project at the University of Huddersfield

In the UK the number of looked after young people, in local authority care going on to undertake a degree is very low and the number undertaking STEM degree subjects is even lower. Under the right conditions more LAYP would go onto university. It is also known that the transition from primary to secondary school can be a barrier to learning and that some children lose interest in STEM subjects at that stage.

This project focused on the transition from year 6 to year 7 for looked after children from Kirklees, Calderdale, Wakefield and Bradford local authorities. The project provided inspirational STEM activities in chemistry, engineering and maths. It also provided study skills and careers support. The project will provide sustainability by continuing to work with the cohort through to Year 9.

# The 'Young Scientist' Project:

Providing inspirational STEM activities in chemistry, engineering and maths for looked after young people

## INTRODUCTION

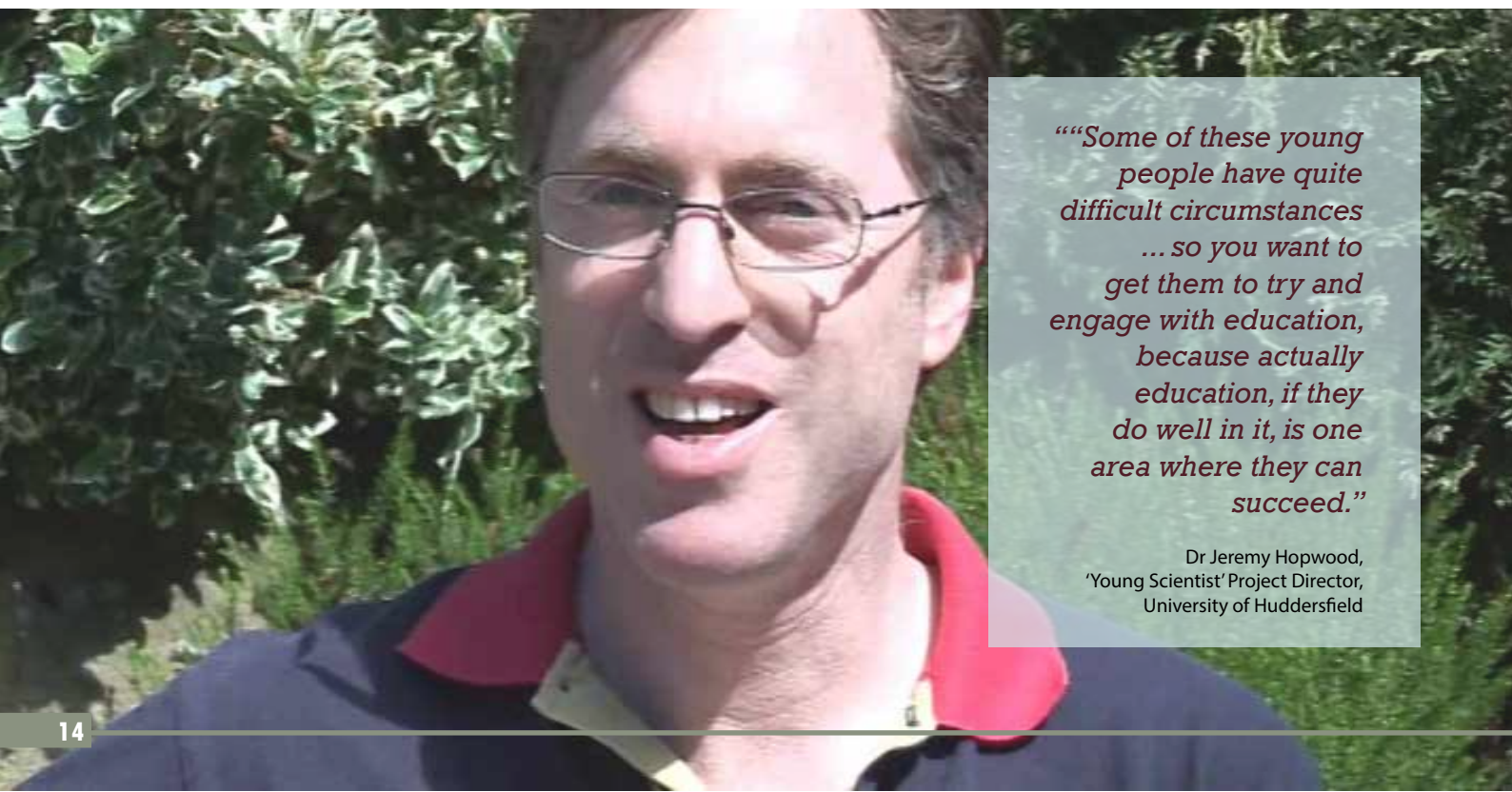
Looked after young people are under-represented group at university. Of the approximately 6000 that leave the care of the state each year only 60 will go to university (representing 1% of the looked after young people population). This project targets this group in an attempt to increase the number of looked after young people who progress to Higher Education.

### Target group

The 'Young scientist' Project at the University of Huddersfield's Department of Chemistry and Biological Sciences was mainly targeted at pupils in their final year at primary school, Year Six, aiming to prepare them for their journey into secondary education.

The project director, Dr Jeremy Hopwood, is a lecturer in Science Communication, and manages the Secondary School and Sixth Form Outreach Programme for Chemistry, Forensics, Pharmacy, Biological Sciences and Nutrition. He believes that looked after young children face particularly daunting challenges, and that education is one area where they can excel.

"Some of these young people have quite difficult circumstances," he said, "so you want to get them to try and engage with education, because actually education, if they do well in it, is one area where they can succeed, and obviously it impacts on other parts of their lives."

A portrait of Dr Jeremy Hopwood, a man with glasses and a red and blue polo shirt, smiling. The background is a blurred green hedge.

*“Some of these young people have quite difficult circumstances ... so you want to get them to try and engage with education, because actually education, if they do well in it, is one area where they can succeed.”*

Dr Jeremy Hopwood,  
'Young Scientist' Project Director,  
University of Huddersfield

## Content of the project

Although it involved other activity days, the project centred on a three-day summer school, which went down extremely well with the young people who attended. "The majority of the feedback forms have come in, the kids loved it," Jeremy said, "they really, really enjoyed the three days."

The young people experienced a range of science activities, including finger-printing, forensics, blood spattering and some biology sessions. "This particular grouping benefit particularly greatly from being engaged in this manner," Jeremy explained, "and they take great value from it, and also, you need things to motivate the young people."

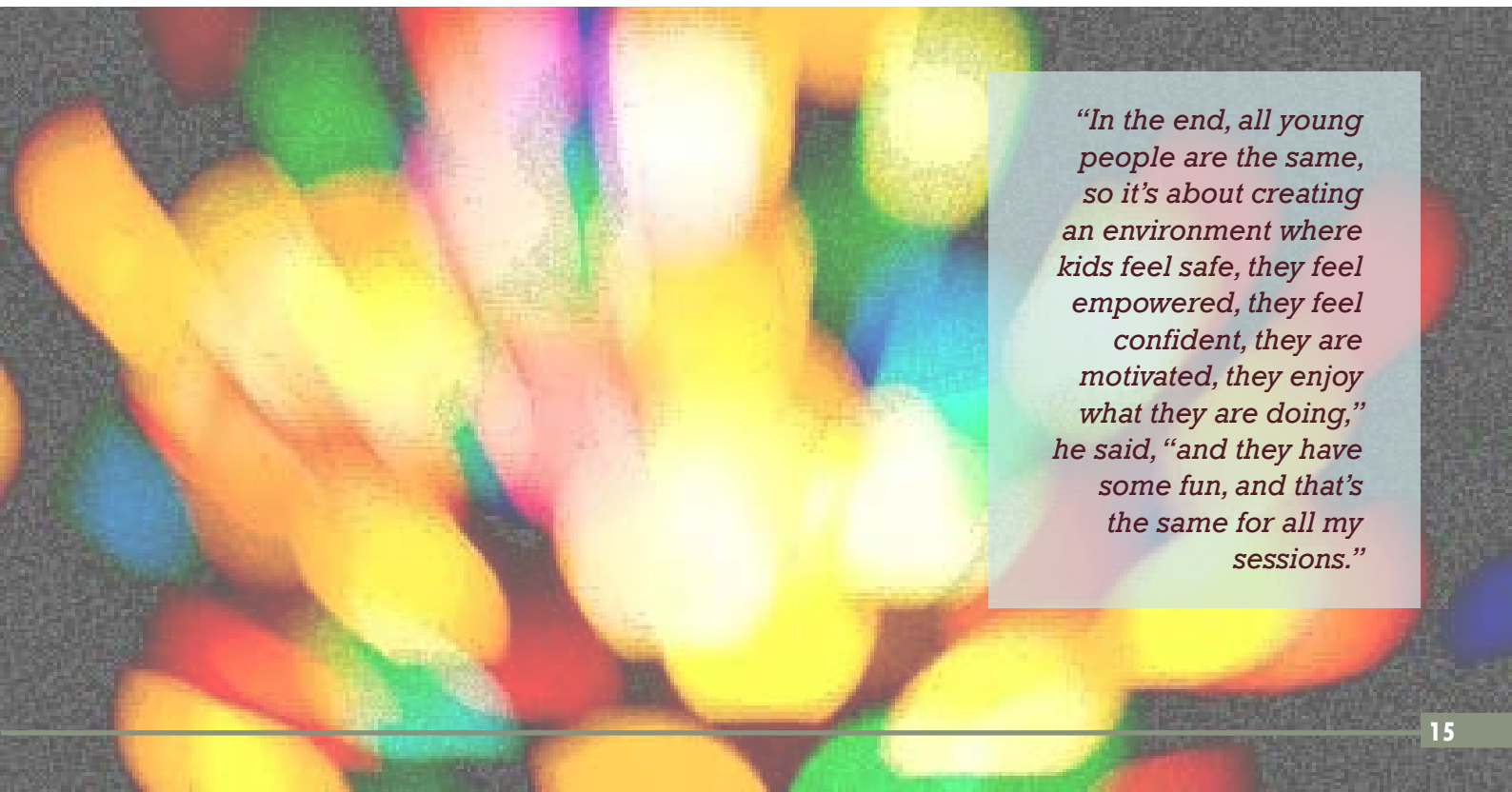
## Practical and hands-on activities

Sessions tended to be 'hands on', which helped engage with many of the young people there, and Jeremy Hopwood feels that, although he might have to work a little harder at facilitation, the programme also benefited him as a teacher. "In the end, all young people are the same, so it's about creating an environment where kids feel safe, they feel empowered, they feel confident, they are motivated, they enjoy what they are doing," he said, "and they have some fun, and that's the same for all my sessions."

## Elements of the 'Young Scientist' project at the University of Huddersfield

- 1 visit per Autumn term.
- 1 visit per spring term (an evening ice breaker session).
- 1 visit per summer term (whole day – fun science day plus study skills and library activity. These visits will be to the University of Huddersfield).
- 3 day summer programme (This will include activities at the University of Huddersfield and the National Coal Mining Museum of England).

The programme also includes HE awareness sessions. The hands-on activities include elements of Chemistry, Physics and Engineering. There is also a follow up session in the autumn and spring term with all of the participants. One of the sessions was provided by Maths PGCE students. The aim is to maintain contact with those students who continue in post 16 education.



*"In the end, all young people are the same, so it's about creating an environment where kids feel safe, they feel empowered, they feel confident, they are motivated, they enjoy what they are doing," he said, "and they have some fun, and that's the same for all my sessions."*

## Challenges and issues

Organising and running the looked after young people project has provided some challenges, and highlighted the need for structure in events aimed at this group of children. "I think we had three days where the first day was well structured, the third day was really well structured, and the second day, we went on a field visit, and it was the second day that perhaps didn't work so well," Jeremy said, "and other issues came to fore, so one of the issues I learned is that it's got to be well structured."

One of the issues that emerged involved racist behaviour by one of the young men taking part in the programme. "We had some difficulties in the group, with one particular lad, and things were good on the first day, but it surfaced on the second day, and it created tension within the group," Dr Hopwood explained, "there was a lad who was teasing, racial teasing, there was another lad who was very sensitive to this, and reacted in a particular way, he got quite agitated and giddy, and this drew off the positive energy from the group, into quite a negative sense."

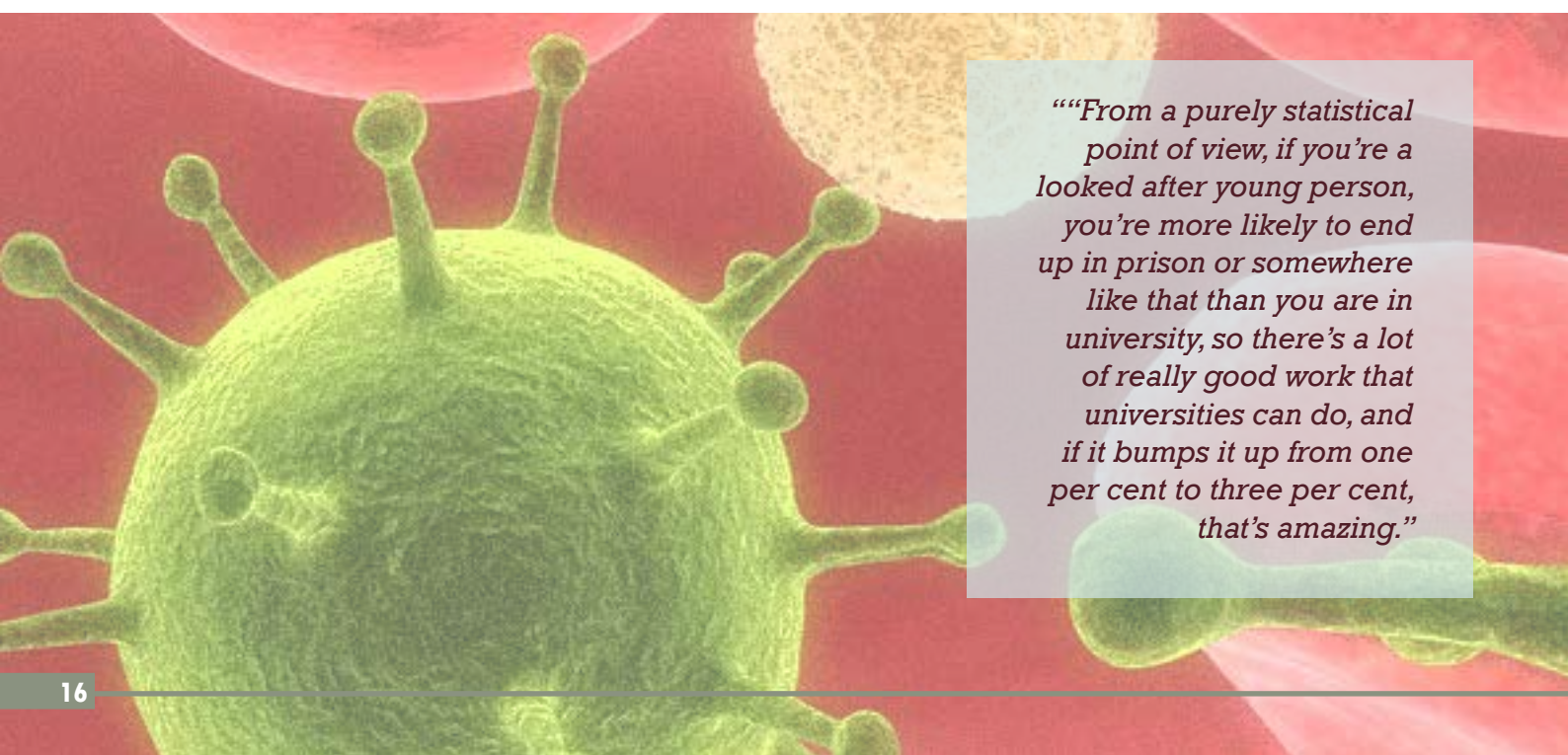
Unfortunately, Jeremy had to stop the protagonists from joining the third day in case it caused further disruption. "At the end of that day, when some of the carers came, there were a couple of lads who, I went and spoke to their carers, and had to say that they couldn't come" he said.

Although there was no realistic option other than to bar the young men from further activity, Dr Hopwood regrets the fact he couldn't have predicted these problems and redirected some of the negative energies involved. "I felt this particular set of circumstances with this lad was probably quite common, and I was sorry that somehow we couldn't have dealt with it in a way that it could have been redirected," he said, "but we weren't to know his problems, and that is one of the things with looked after young people, some of the kids do come with quite a lot of difficulties, which is understandable, given the backgrounds that they've had."

## Future and impact of HE STEM funding

Looking to the future, Jeremy Hopwood would like to be able to track the progress of young people who come through the programme more completely, and share best practice with other institutions engaged in similar work. He has no doubt, however, that the University of Huddersfield will continue working with this group. "We've learned a lot from the project, and we're certainly wanting to carry on working with looked after young people," he said, "because there's quite a skill base to build up when you're working with this sort of group of children, so yes, they will benefit, and we will be carrying on working in this area."

"From a purely statistical point of view, if you're a looked after young person, you're more likely to end up in prison or somewhere like that than you are in university, so there's a lot of really good work that universities can do, and if it bumps it up from one per cent to three per cent, that's amazing."



*““From a purely statistical point of view, if you’re a looked after young person, you’re more likely to end up in prison or somewhere like that than you are in university, so there’s a lot of really good work that universities can do, and if it bumps it up from one per cent to three per cent, that’s amazing.””*



# The looked after young people in Leeds project

Working closely with West Yorkshire STEM (WYSTEM), the Leeds HE STEM project set up a programme with Leeds Stepping Stones programme to provide skilled and knowledgeable STEM Ambassadors to inspire young people to enjoy and think creatively about STEM subjects, and to communicate the importance of STEM in everyday life.

WYSTEM (our collaborative partner in this project work), is the local STEMNET STEM Ambassadors provider in West Yorkshire. WYSTEM's remit includes increasing young people's STEM skills in order to provide employers with the skills needed for a 21st century workforce, thereby ensuring the UK's place as a leader of science-based research and development.

# The looked after young people in Leeds project:

## Raising aspirations amongst looked after young people through collaborative STEM activities

### INTRODUCTION

This project introduced a range of STEM opportunities to support and enhance current practice with Looked After Children – who were supported by volunteer students in an after-school homework club. Activities predominantly focused on the hard sciences (Maths, Chemistry, Engineering and Physics) and were supported by student volunteers and suitably qualified and CRB checked representatives from local industry (STEM Ambassadors).

Activities were spread across each of the three HEIs taking part (University of Leeds, Leeds Metropolitan University, and Leeds Trinity College) allowing students to sample Higher Education over a broad range of STEM subject areas.

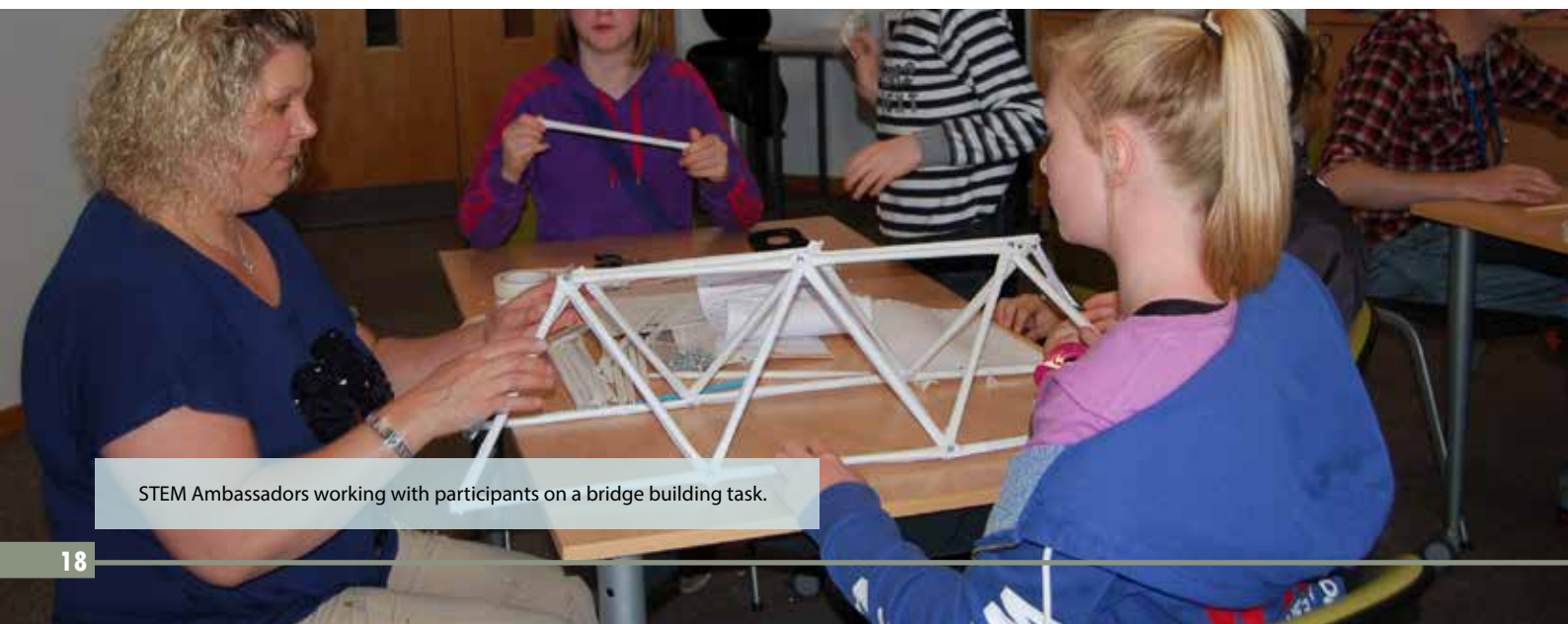
The project previously has linked the three Leeds Universities together in the common aim of providing aspirational opportunities for Looked After Children but with the support of HE STEM was able to add engaging with the hard sciences and raising the profile of these subjects to a group severely underrepresented in STEM at HE. The young people were also crucially supported by local STEM Ambassadors (provided via a collaboratively link with West Yorkshire STEM (WYSTEM – the local STEMNET STEM Ambassadors provider).

### The focus on children and young people looked after (LaC)

Good parents encourage their children to succeed, awaken and support their aspirations and help them to plan for their futures.

A local authority must do likewise for children and young people in its care and fulfil its duty to promote their achievements and support their aspirations.

Current Government policy requires Higher Education Institutions to have Access Agreements aimed at promoting progression to university for young people from disadvantaged backgrounds. Each institution provides a list of statements on how it will work with those young people who may face additional barriers due to their background or circumstances.



STEM Ambassadors working with participants on a bridge building task.

Young people who are in local authority care typically show very low progression rates and, with this in mind, the University of Leeds has worked in partnership with Leeds Metropolitan University, the Local Authority, the City Learning Centres and the Stepping Stones programme to support a programme of activity around STEM. This provision complements the existing homework mentoring programme supported by undergraduate student volunteers. Both the University of Leeds and Leeds Metropolitan University have pledged dedicated support for Looked after Children in their Access Agreements for 2012/13.

However, it is left to local authorities to decide how to comply with these duties and take advantage of the opportunities provided by Higher Education Institutions. Looked after young people in Leeds are benefiting from the ways in which the council, schools, children's services and the universities are continuing to work together through the Stepping Stones programme to develop potential, awaken and raise aspirations and widen participation.

### **The Stepping Stones Programme**

The programme, established in 2004 by Aimhigher in partnership with Education Leeds, Leeds Social Services, Leeds Metropolitan University and Leeds University comprises a wide range of partners and aims to awaken and raise aspirations, promote achievement, widen participation and create opportunities for the future. The support of the University of Leeds and Leeds Metropolitan University has been and is critical to the success of the programme and in recognition of this and their wider work with looked after young people, both universities have been awarded the Quality Mark of Buttle UK (The Frank Buttle Trust).

The Stepping Stones programme actively includes parents and carers and aims to help them to become more effective and confident partners in supporting the education and progression of these young people. Leeds Children's Services has continued to support the Stepping Stones programme and is working with the universities and HEIs to develop further opportunities to promote the achievements and to awaken and raise the aspirations of young people looked after.

### **The Leeds HE STEM Programme**

Working closely with WYSTEM, the Leeds HE STEM project set up a programme with the Leeds Stepping Stones programme to provide skilled and knowledgeable STEM Ambassadors to inspire young people to enjoy and think creatively about STEM subjects, and to communicate the importance of STEM in everyday life. WYSTEM is the local STEMNET STEM Ambassadors provider in West Yorkshire. WYSTEM's remit includes increasing young people's STEM skills in order to provide employers with the skills needed for a 21st century workforce, thereby ensuring the UK's place as a leader of science-based research and development. Many local organisations are involved in working to inspire and engage young people in STEM within West Yorkshire.

### **Leeds HE STEM: Programme of activities**

#### **Euan Bright STEM Session – Electronics (North) KS4 LaC**

This session was a full 2 hour session delivered by Euan Bright of the Leeds College of Building. The session involved looking at a simple light circuit that you would find in a house. Students put their own circuits together using screws, crimping tools and knife switches. Euan then progressed the exercise by showing the students how to add an extra switch in to the circuit.

#### **Dil Rathore STEM session – Medical Science (DFC) KS4 LaC**

Dil talked to the students there about what a Bio Medical Scientist does. He delivered a very interesting and gruesome presentation about diseases and microscopes. The students that attended loved the session and seemed to really engage with the subject.

#### **Andy Swann STEM Session – Bike Maintenance (South, DFC) KS3/4/5 LaC**

Andy delivered 4 hours of Bike Maintenance to the South group over two weeks. Sessions started with a basic introduction and ended with a repair challenge which involved students working in teams to fix an unknown issue with the bike. Across the two sites this session has been completed by 12 students.

#### **CLC Staff – Rocket Challenge (South) KS3/4 LaC**

Students were put into small groups, with mentors and had to design a 'race rocket' for a competition to see which would travel the furthest. Students discussed aerodynamics and speed/friction and created their vehicle. Each effort was attached to a launcher and then tested. The session ran for 1 hour and was attended by 18 students.

#### **CLC Staff – Laser Cutting Technology (South) KS3/4/5 LaC**

Students used CAD/CAM software to create a 2D object on the computers (key-rings, jewellery, door plaque). Students were then taught how to use the laser cutter to cut and create their object out of acrylic. The group had to think carefully about their design, using the different laser cutting settings to create an effective and interesting piece. Session ran for 2x1hr sessions and was attended by 15 students plus university mentors.

#### **Leeds Council Staff – First Aid Awareness (All CLCs) KS3/4/5 LaC**

Students were given a two hour basic first aid workshops which led to an internal certificate. Students took part in a discussion around first aid and basic medical problems following a short video. The rest of the session was based around practice bandages, recovery position and resuscitation dolls. Across the four sites the session was completed by 45 students.

## Leeds HE STEM: After school activities

### **Nick Field STEM Sessions – Computing (North/South) KS3/4/5 LaC**

This was an electronics and computing focus based around the Arduino system. Students developed problem solving and computer programming skills during this two week project. Sessions were held at South and North City Learning Centres.

### **Andy Swann STEM Session – Bike Maintenance (North) KS4 LaC**

Andy delivered 2 hours of Bike Maintenance to the DFC and North group. Session included developing an understanding of basic bike maintenance and troubleshooting.

## Leeds HE STEM: Holiday activities

### **Institute of Civil Engineering - Half Term STEM Day – 6th June 2012 (North) KS2/3/4/5 LaC**

The day was hosted by North CLC and was open to all LaC, siblings and carers with 20 places available for young people. The day started with a civil engineering workshop involving participants building bridges as a team in partnership with the Institute of Civil Engineering. There was also a computing workshop using the Arduino system and an additional STEM session to be arranged. Also provided the opportunity for the carers to meet and join in with the activities.

### **Summer Holiday – 3D Engineering CAD/CAM – (North/South) KS3/4/KS5 LaC**

A four day project using 3D rapid prototype (printer) and advanced 3D design software. Students were guided through the process of 3D design and learned how to create 3D printed objects. Students created a range of objects that could be based around a moving object (e.g mini toy car), jewellery or other objects. The project aims to develop skills in design, CAD and CAM (technology).

### **Summer Holiday – Robotics Club (West) KS2/ KS3 LaC**

This two day club is based around the Lego Mindstorm project where younger students developed skills in controlling and running the robots. There was also an opportunity to build and create robots using the kit as well. This project aims to develop problem solving, maths and computing skills.

### **Summer Holiday – Computing Programming (North) KS3/KS4 LaC**

This four day club used the Arduino kits, with students developing computing programming skills and problem solving. Students used the kit to create a range of programmed solutions whilst learning how to program and to control the robotics.

## End of programme presentation

On 12th July 2012, four young people presented their work with interactive demonstrations and Q&A sessions, providing an insight into the valuable STEM work that has been developed at the Leeds City Learning Centres with help from West Yorkshire's STEM Ambassadors. Topics areas have included electronics, microbiology, bike engineering and more. A number of organisations attending the event also provided presentations to highlight work carried out with Leeds' looked after children's services and future plans for collaboration.

As a result of the networking session the following is now in place:

- WYSTEM are working with the Leeds College of Art on to try to develop their WP work with LaC, exploring cross-curricular links with arts and STEM.
- Marks & Spencer are working with Shirleecia Ward (Leeds Black Health Initiative) on a STEM day.
- A number of schools made Ambassador bookings and/or enquiries for working with the organisations presenting at the event, including Nick Field's Arduino (electronics) project which was particularly popular.

## Reflections on impact

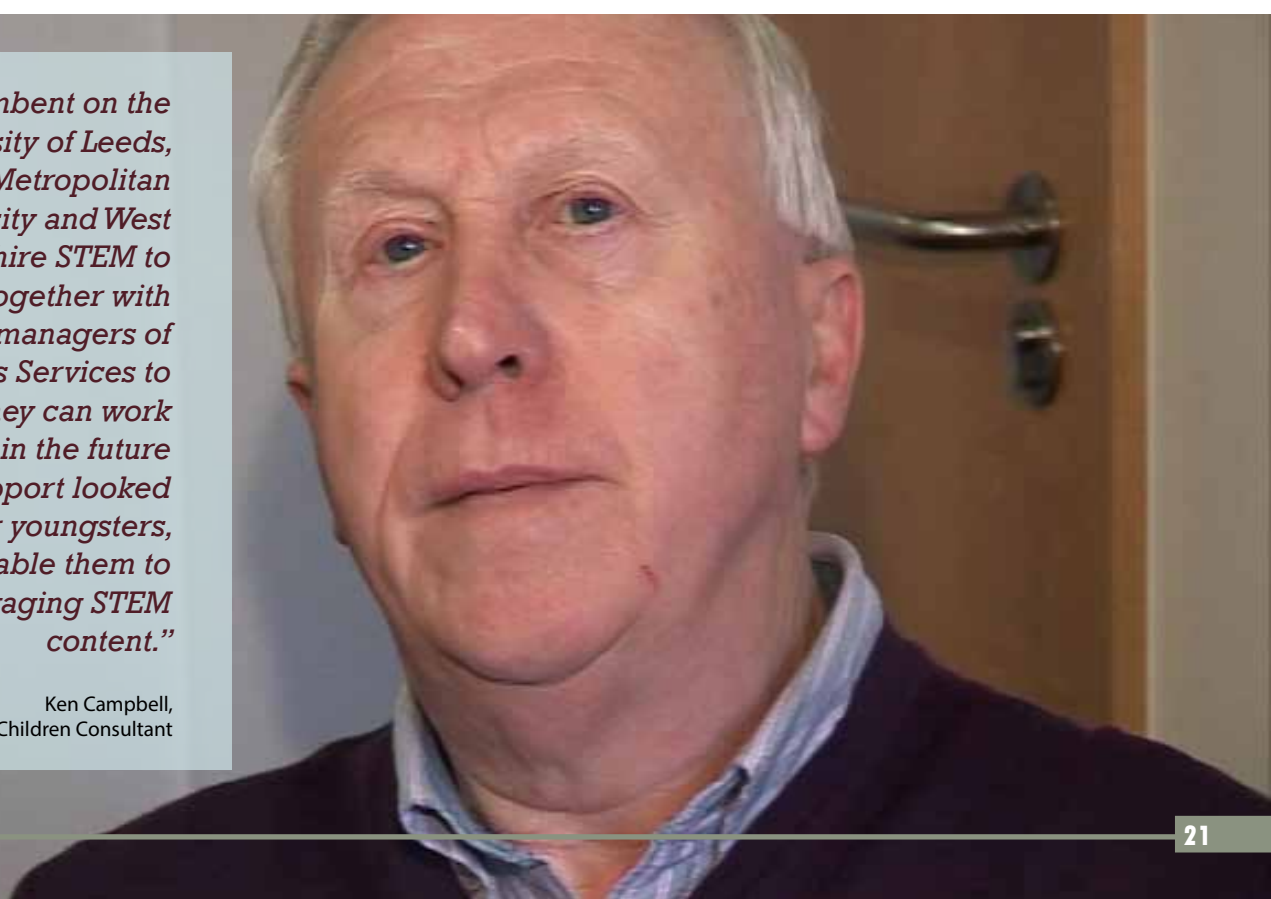
The formal STEM sessions (e.g. medical science, engineering, bike maintenance) were enjoyed by all of those that participated and allowed students to develop additional skills in team work, problem solving and communication which is something we had not foreseen. It is these extra opportunities provided by STEM which make it a particularly valuable project to engage with.

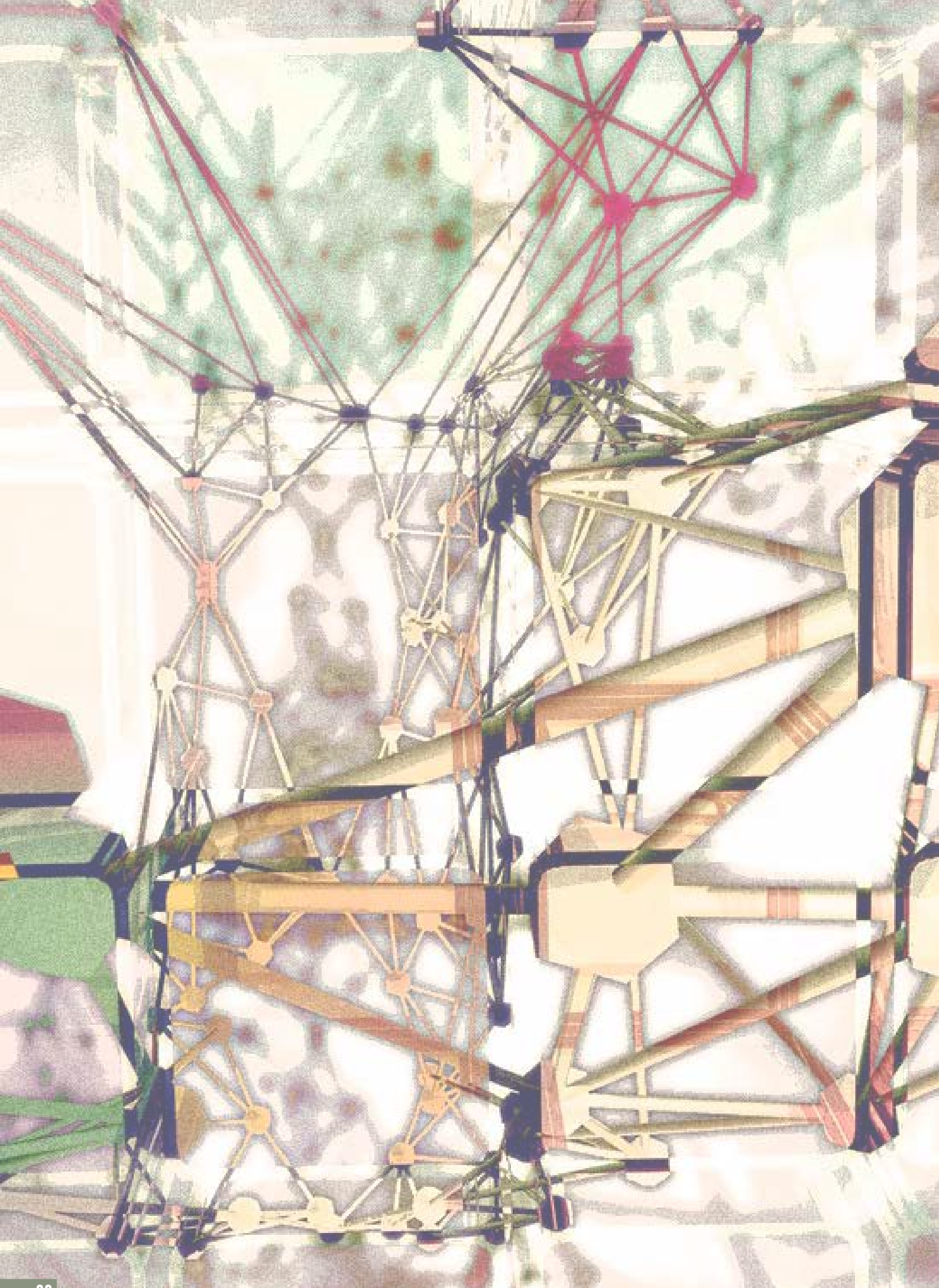
As Stepping Stones will be running across three City Learning Centres, it is important to share good practice in the application of STEM, spread the workshops across the different sites and, as such, strongly recommend that there is a named person to oversee and manage the Stepping Stones project and its links with STEM, HE and FE. Having a central point of contact makes communication and planning much more cohesive. During the school holidays there was a range of STEM based projects and although the content, themes and ideas were popular it was difficult to recruit the number of LaC children needed to make these days viable and so sessions were open to all young people with a guarantee of a place for LaC. It is important to remember for future day/week projects that it is not easy to 'create' LaC only groups to the size often required - one university STEM project was postponed as it was not possible to identify and recruit 30 LaC students in time.

Ken Campbell, Looked After Children Consultant, summarised the need for HEIs and others involved in STEM education to join forces to ensure looked after youngsters enjoyed inspiring STEM-related workshops and events: "It is incumbent on the University of Leeds, Leeds Metropolitan University and West Yorkshire STEM to come together with the senior managers of Childrens Services to see how they can work together in the future to support looked after youngsters, and enable them to access engaging STEM content."

*"It is incumbent on the University of Leeds, Leeds Metropolitan University and West Yorkshire STEM to come together with the senior managers of Childrens Services to see how they can work together in the future to support looked after youngsters, and enable them to access engaging STEM content."*

Ken Campbell,  
Looked After Children Consultant





# The looked after young people in South Yorkshire project

The looked after young people in South Yorkshire project is a partnership between the University of Sheffield and Sheffield Hallam University.

The central aim of this collaborative looked after young people project has been to increase the knowledge and confidence of staff delivering outreach programs within each institution (with a STEM content), to widening participation groups of pupils.

A benefit of the approach undertaken by the project team is that future initiatives involving outreach with other widening participation groups will be more likely to use STEM as the basis for their work, thus promoting both STEM and progression to University.

# The looked after young people in South Yorkshire project:

A collaboration between two major Universities to counter the low admission rates for care leavers across the sector

## INTRODUCTION

The looked after young people in South Yorkshire project at Sheffield Hallam and Sheffield Universities represented an important and successful collaboration between two major higher education institutions to counter the low admission rates for care leavers across the sector.

The project lead, Sheffield Hallam's Jane Taylor, explained how the partnership developed a series of events that were progressive in terms of their content and impact on young people. The effect of this, she felt, was to increase young people's interest in the programme as it developed. "They progressed in their difficulty, in terms of we got them warmed up, and then got them involved, got them excited," she said, "then started to do some harder stuff with them, and we have had two events here at Sheffield Hallam and one event up at the University, with the same group, the same cohort all the way through."

The first session the project ran was modelled on a forensic crime scene investigation (CSI), something tried successfully by other universities not just with looked after young people, but with other low participation groups as well. "We looked at it and we thought, 'It's interactive, it's fun, it connects university courses with careers,'" Jane said, "we devised a session together that we felt was appropriate for this group, and would give them an opportunity to do science in a fun, interactive and engaging way."

A portrait of Jane Taylor, the project lead, smiling. She has dark hair and is wearing a brown top.

*"we devised a session together that we felt was appropriate for this group, and would give them an opportunity to do science in a fun, interactive and engaging way ... It's interactive, it's fun, it connects university courses with careers."*

Jane Taylor, LAC Project Lead,  
Sheffield Hallam University





Participants making shampoo as part of an enterprise workshop.

Working with her opposite number David Broomby, from the University of Sheffield's Widening Participation Team, Jane put on activities such as finger printing for the young people, who had to wear scene of crime protective suits. "We looked ridiculous," Jane laughed, "but we had a really great day interactively exploring science in policing."

The next event was at the University of Sheffield, and brought science and business together, with young people being encouraged to make shampoo before selling it to a 'Dragon's Den.' "It gave everybody an opportunity to see how all that linked together."

### Challenges and learning points for staff involved

The looked after young people in South Yorkshire project brought challenges for its tutors and staff as well as for the young people themselves.

"This was the first time the tutor had worked with this particular group, which we thought could be a bit of a challenge because sometimes we know that students from this background might not engage as well with school," Sheffield University's David Broomby said, "so it was a concern and a challenge to get the academic content right but we decided it was better to challenge them as opposed to dumbing things down, because often we find to engage somebody you really do need to challenge them and that is exactly what we did."

### Support from STEM Ambassadors

The third event in the series explored the science of sport, something particularly topical in the year of the London Olympics. "it is about looking at linking sport to the Olympics and to prestige athletes that we train at the University and that we research at the University," Jane Taylor explained. "We have got a number of ambassadors working with us on this, and out of those, two of them are studying STEM subjects, one is a formerly looked after young person and the other is a STEM ambassador," she said, "one of the impacts that we see from this project is that those young people, those ambassadors are now having experience of working with looked after young people and therefore can take that experience in to the future and work on other events where we have looked after young people."

Adam Goodband, a STEM Ambassador studying for a Masters degree in Science Communication at the University of Sheffield, felt that his age made empathising with the young people easier.

"I think they definitely interact with the ambassadors a little bit more, partly to do with the age so they see us as the step between themselves and the staff and the academics," Adam said, "they certainly are interested in what we've done, I think most of them are still quite in the infancy in terms of thinking about what they might want to do at university at a later stage. They're all certainly interested in it which is good, which I guess is the ultimate goal, and they like to ask questions."



*"it was a concern and a challenge to get the academic content right but we decided it was better to challenge them as opposed to dumbing things down ... and that is exactly what we did."*

David Broomby, University of Sheffield, Widening Participation Team

Carrie Wilson works with Jane Taylor at Sheffield Hallam, and is herself a care leaver. "I understand the challenges that looked after children face, there's a constant low self-esteem and a feeling that you can't really get that far, and that's made worse by stereotypes as well," she said, "so that is what these events are about by saying, 'No, you can achieve this by raising aspirations', and showing them they have all achieved so well and pushed themselves to achieve well in these three events, so they're going to leave after these events a lot more confident."


After Carrie wrote a letter to a newspaper complaining about the negative portrayal of looked after young people in a recent article, she was commissioned by the Guardian to write a feature explaining some of the challenges looked after young people face, and how well they can achieve if encouraged and supported properly. "I have done a draft already, I'll probably need a few more drafts until it gets sent off, but it is really exciting that I have been given this opportunity to have the background knowledge of what perceptions I went through and how I struggled with those stereotyping, especially when I was at school," she said, "and how one simple thing, like my key worker pushed me, and she believed in me, and it just took one person to say, 'No you can do this, you are more than able to do this,' for me to go and go to university, get a degree, even get through college, because I didn't think I could even do that at the time."

David Broomby is clear that the HE Stem funding has made it far easier for the collaborative partnership to function, particularly given that some of its earlier funding streams had dried up. "The funding has been absolutely great for us, we have been able to commit to these three events which has been fantastic, particularly with the loss of Aim Higher," he said, "we were challenged in terms of how we were going to proceed with looked after children, particularly the collaborative work that we do."

### A successful collaboration

Both Universities see the looked after young people in South Yorkshire project as a success, not only for themselves but also for the local authority, which ultimately bears a major responsibility for the welfare of looked after young people.

"For us it has been successful because we've developed relationships within the University that we can use in the future, we've developed activity that can be used in the future and we have learnt ourselves how to run STEM related events for this particular cohort," Sheffield Hallam's Jane Taylor said, "I think it has been successful for the local authority because it has opened their eyes and they can see what we have been able to achieve with these young people using a subject specific event."

A close-up portrait of Carrie Wilson, a young woman with blonde hair tied back, looking slightly to the right with a neutral expression. She is wearing a dark top and a necklace.

*"I understand the challenges that looked after children face, there's a constant low self-esteem and a feeling that you can't really get that far, and that's made worse by stereotypes as well"*

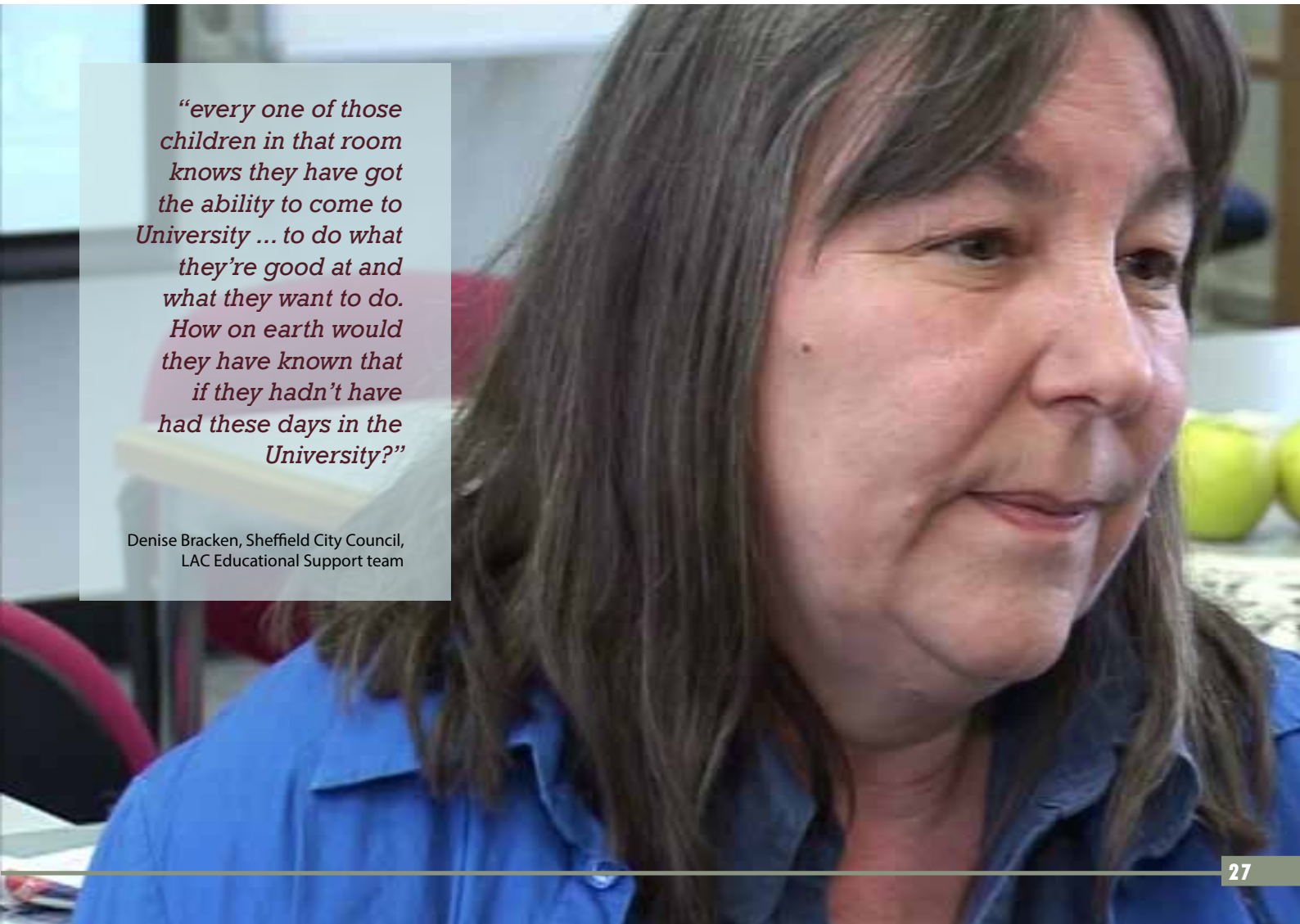
Carrie Wilson,  
Sheffield Hallam University

Carrie Wilson's Guardian article can be read online at:  
<http://www.guardian.co.uk/social-care-network/2012/may/18/looked-after-children-care-system>

## Local Authority support

Denise Bracken, of Sheffield City Council's Looked After Children Educational Support team (LACES) agrees. "I think it was a marvellous idea, for a start, linking the two universities up, because they are very different and I think that's very obvious to the youngsters, I think the way the staff from the two universities work together," she explained, "I think it would be fair to say most looked after children, not just a minority of them, have a very traumatic start in their lives but in their educational school lives, it's not unknown for looked after children to have moved schools five or six times before they start secondary school really, whenever they start a new school they're at a disadvantage.

"It used to be the case that looked after children just didn't go to university, that is changing now, our numbers are getting higher every year and I think it's only just started to kick in, you know, every one of those children in that room knows they have got the ability to come to university and that they can come to university to do what they're good at and what they want to do. How on earth would they have known that if they hadn't have had these days in the university? They've got to be here to see it."



*"every one of those children in that room knows they have got the ability to come to University ... to do what they're good at and what they want to do. How on earth would they have known that if they hadn't have had these days in the University?"*

Denise Bracken, Sheffield City Council,  
LAC Educational Support team



# The Kitchen Science project

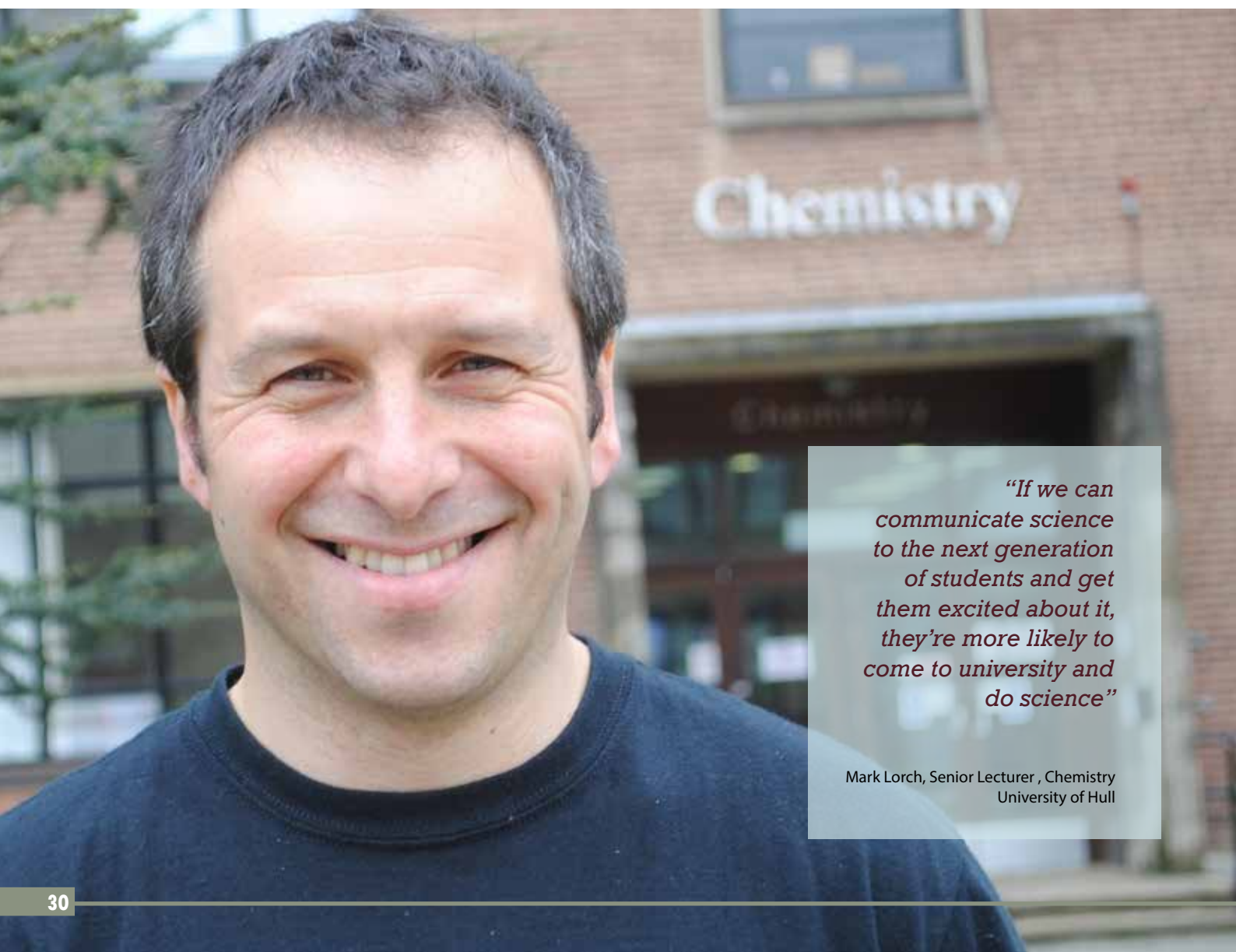
The Kitchen Science project sought to introduce youngsters to fun and exciting science experiments, using everyday materials and resources (which could be found in most kitchens). In addition, the project also produced a play to engage primary school pupils with science. The play was delivered to school children followed by workshops in which the pupils could get hands on experience with the science that they saw in the play. The methods and the science behind the content of the play have been presented in comic book format and are now available on line at [www.sci-toons.co.uk](http://www.sci-toons.co.uk).

# The Kitchen Science project

Attracting more students to STEM subjects through fun science activities made from everyday materials

## INTRODUCTION

Dr Mark Lorch from the University of Hull's Department of Chemistry believes that universities need to engage actively with society if they are going to attract more students to subjects like Science, Technology, Engineering and Maths, and that communication is an essential element of ensuring that engagement works. "If we can communicate science to the next generation of students and get them excited about it, they're more likely to come to university and do science," he said, "and of course, we want to be a knowledge-based economy so we need to train scientists and engineers and mathematicians."



*"If we can communicate science to the next generation of students and get them excited about it, they're more likely to come to university and do science"*

Mark Lorch, Senior Lecturer , Chemistry  
University of Hull

The 'ScienceToons' website where users can find science experiments and explanations of the science behind them.

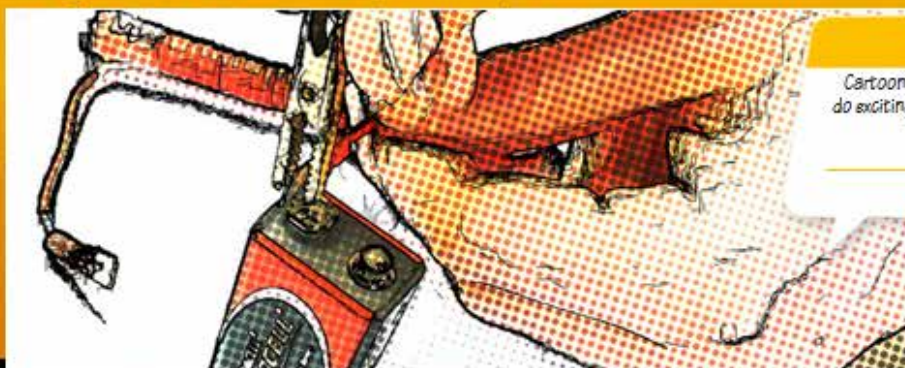
Home

Methods

Explanations

Advanced Explanations

FEATURED



SCIENCE TOONS :: METHODS

Cartoon science methods, showing how to do exciting experiments that can be done at home or within school.

Last updated: 01-05-2011

12

Methods

In this comic we cover:  
01- Safety First

In this comic we cover:  
01- Bandy Water

## Use of media to make science interesting and fun

Mark has used a range of methods and activities to stimulate interest in science, including online comics, a school play and a host of dramatic experiments involving everyday items that can be found in a typical kitchen, such as vinegar, baking powder, candles, red cabbage and orange peel. "The idea really came about because there's actually a huge amount of different simple science experiments that people can do with everyday objects at home," he explained, "but a lot of the information isn't very accessible to children, so what I wanted to do was to create comic style experiments that are really appealing to children, and adults, for that matter."

The first stage in Mark's mission to make science interesting was to create online comics that both give instructions to carry out experiments but also explain the theory behind them. Available either as animated online files or as downloadable PDFs, the comics have proven hugely successful.

"We have had a lot of interest from people, especially people like STEM ambassadors who are always looking for resources that they can take into schools and we have had a huge amount of interest from people who have seen these and got really quite excited about them," Mark said, "A number of people have said to me, 'Oh this is exactly the sort of thing we were looking for, thanks very much,' and downloaded them and used them." Mark's comics are freely available at their dedicated website, <http://www.sci-toons.co.uk/>.

## Kitchen Science events

Mark and his students also hold Kitchen Science events at the British Science Association, Science Weeks in local shopping centres, and family learning workshops. People love seeing science in action like this, he told us, and take the comics home with them so they can repeat the experiments in their own kitchens. "It's proven to be a really excellent way of showing people that science is very accessible, you don't need masses of kit and expensive equipment, or even huge amounts of academic knowledge to be able to access science in an exciting way," he said.

## Communication of science

Kitchen Science is also a valuable way of introducing Mark's existing students to the possibilities of science communication. "I have involved my students in this project, they helped develop the cartoons and one of them produced that website and they have discovered, through that there are other ways that they can do science, they don't have to do research or teaching or development," he said, "they could also go into science communication, and even if it's not full-time, they are realising that this is an aspect of science that they haven't actually previously thought about to any great extent."

Mark and his students are aware of the public's preconceived notions of scientists, or the 'white coat syndrome,' as he labels it, and they consciously encourage a more accessible image. "I have also done what I call 'science busking,' where I just take some of these tricks out and do it as street entertainment," he told us, "in that case, wearing a lab coat can be a bit intimidating, and it is better to strip down to more casual clothing."

## The Kitchen Science play

The next stage in the Kitchen Science project is the development of a play for performance at schools and other venues, and which will involve interesting science in its storyline. When we spoke with him, Mark's original performance company had just pulled out because of funding issues, but he had successfully recruited a replacement, the Double Take theatre group. "We have only had one very short rehearsal of the play, just a five, ten minute section that was done for some of the other people involved in the HE STEM programme," he said, "everybody seems quite impressed with it so far, and yes fingers crossed the children and the schools like it as well."

Recently, the play has been performed in full to a school in Beverley, East Yorkshire, and more performances are expected in the future.

## Kitchen science experiments

Mark gave the Research Toolkit a private demonstration of some of his more popular experiments, starting with a clever trick using red cabbage as a PH indicator. "All you need to do is get a red cabbage, chop it into bits and stick it in a bucket with a load of water, leave it in there for a few minutes, and when you pour it out you'll see that it's a really nice purpley red colour," he explained. If vinegar, which is acidic, is poured in the cabbage water, its colour changes to pink. If, however, an alkali like sodium hydroxide is poured in, it turns green. "This colour range is easily as good as you get from the Universal Indicators that you'll find in laboratories, and that we use every day," he said, "so instead of buying those you can just buy yourself a red cabbage."

In another experiment, Mark showed how to create a flame thrower from orange peel. In this experiment, Mark lit a candle, and squeezed the fluid from the pith-side of a piece of fresh orange peel towards its flame. The orange juice ignited, giving a brief flash of flame. "Orange peel has an oil in it called Limonene, that is extremely inflammable," he told us, "how about that, an orange peel flame thrower?"

Science play performance, Beverley, East Yorkshire.







The 'orange peel flame-thrower' experiment.

Never one to miss a trick, Mark then showed us how to relight a candle without touching the wick with a flame. As a lighted match is held over a recently extinguished candle, the smoke coming off it will reignite. "That's because the paraffin wax in the candle evaporates, and it's in the smoke," he said, "so when you put the lighted match back in the smoke it ignites the paraffin wax vapour and it jumps back down to the wick and relights your candle for you."

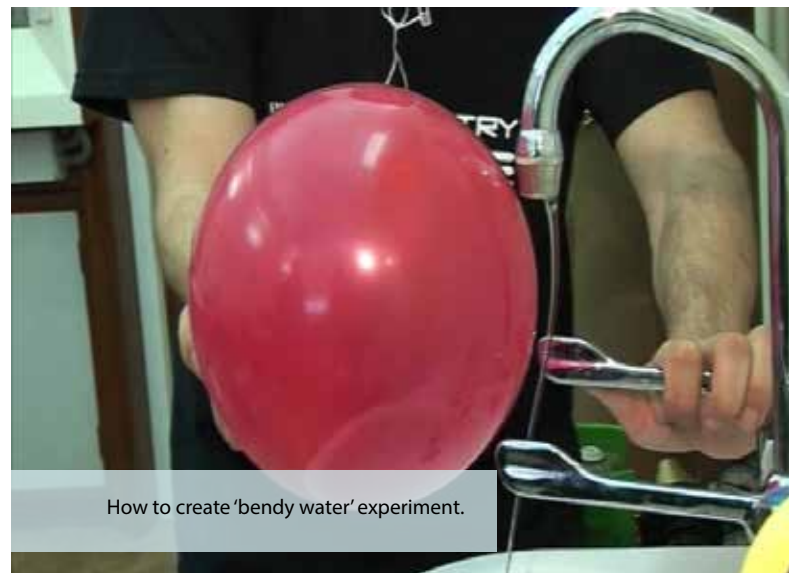
Static electricity was the active element of the next trick, which shows children how they can bend water with a balloon. "All you need is a balloon, a woolly jumper or a nice clean hairy head, and you just rub the balloon on your head or jumper and it produces static electricity," Mark explained, "if you then take that and put it near a stream of water, what happens is the water bends towards the balloon."

"The reason why that works is because we've introduced static electricity to the balloon, so the balloon now has one charge, and water has the opposite charge, and opposite charges attract."

Mark's *pièce de résistance* is using toilet roll, bicarbonate of soda, vinegar and an old-fashioned plastic film canister to make a rocket capable of flying ten feet or more into the air. "It's quite simple, you're just going to pour a little bit of vinegar into the film canister, take a square of paper and stick that on top, that just keeps the vinegar and bicarbonate of soda apart until you're ready to launch, put about a tea spoon of bicarbonate soda on top of that, snap your lid on, turn it and give it a shake two or three times, put in on the ground with the lid end down, then run!" After a few seconds, the gases inside the canister force the lid off, and propel the rocket high into the air.



The 'fizzing rocket' experiment.



How to create 'bendy water' experiment.



# The Spectroscopy in a suitcase project

The Spectroscopy in a Suitcase project is an outreach activity which gives school students the chance to learn about spectroscopy through hands-on experience. The project utilises a spectrometer kit which comes in a pre-packaged box or 'suitcase'. Each suitcase comes with a suite of activities which cover the principles of spectroscopic techniques and use real-life contexts to demonstrate the applications of the techniques.

# The Spectroscopy in a suitcase project

## Making the wonders of spectrometry accessible to school-age children

### INTRODUCTION

The HE STEM-funded Spectrometer in a Suitcase (SIAS) initiative aims to make the wonders of spectrometry accessible to school-age children through a portable spectrometer available for loan either directly to schools, or through a STEM Ambassador. Most regional universities, and some other organisations such as the Royal Society for Chemistry, host Spectrometers in Suitcases, and the one that we saw demonstrated belongs in the Department for Chemistry at the University of Hull.

### Target group

To satisfy the equality, diversity and widening participation aims of the National HE STEM Programme, project work carried out in our region sought to offer SIAS sessions to those participants who satisfied the following criteria:

- Low participation at HE
- Adult learners
- Low socio-economic groups
- Low performing schools
- Ethnic minorities

In organising and delivering SIAS events, providers in our region had the freedom and flexibility to choose the type of activity or event and mode of delivery. The two most commonly employed modes were:

- Trained postgraduates take the Equipment to a school to deliver an event.
- Teachers are trained to use the Equipment and are loaned the Equipment.

### Context

The National HE STEM Spectroscopy in a suitcase project in Yorkshire and the North East was developed following the successful Chemistry for our future (CFOF) programme managed by the Royal Society of Chemistry (for the period September 2006 to August 2008). Some of the methods used were transferred to the Yorkshire and North East Universities. "The project in Yorkshire and the North East satisfied a need expressed by many schools in the region" said Dr Nazira Karodia Yorkshire and North East Regional Director for the National HE STEM Programme.



The SIAS kit box or 'suitcase'.

## Portability of equipment

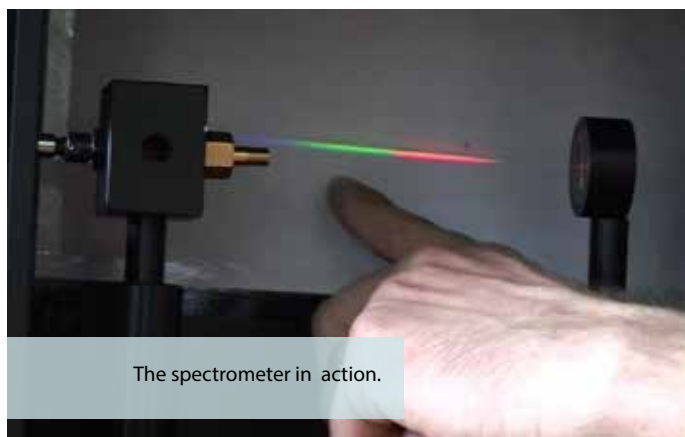
Although the suitcase itself is large, it is nonetheless completely portable. Light enters the spectrometer before hitting a diffraction grating, which splits it into its spectrum. The suitcase contains fluorescent lighting, wave guides and a device that allows the amount of light to be measured, and the results displayed on a PC screen. Spectrometers like this would be too expensive for most schools to afford to purchase, so the Spectrometer in a Suitcase gives schools the opportunity to borrow one instead.

## Use of SIAS

James Machell (Schools and Colleges STEM Curriculum Coordinator), University of Bradford regularly uses the equipment, and trains others to make full use of its capabilities: "The Bradford spectrometer has recently been used in 24 schools across the North East region (during 2013), demonstrating that schools have a desire and need to access and utilise such equipment."

The Hull spectrometer has been used by both primary schools and sixth form colleges, as well as at University career days. HE Stem co-ordinator Dr Mark Lorch also allows work experience students to use it.

Spectrometry can be used in a range of different settings and ways, including forensic science and astronomy. In simple terms, different chemicals emit different spectra of light when they are heated, something the spectrometer can identify and measure. This allows it to identify the chemical composition of a light source, which might be terrestrial, but might also be stellar. "If you want to know what the chemical composition of a star is, you can't fly to that star, bag a bit and bring it back to the lab," Dr Lorch said, "but you can measure the light coming off it, and by measuring the types of light, the particular wavelengths of light coming out of that star, you can figure out what the chemical composition of it is."



The spectrometer in action.

Some universities and other organisations have used their spectrometer in a suitcase more than others, but Dr Lorch feels this reflects difficulties in gaining access to schools rather than the technical challenges of the spectrometer itself. "They are extremely busy, school teachers, and you can show them it, they're really keen on it, and then they just forget about it," Dr Lorch complained, "that's no indictment of them, it's just recognising how busy they are. So in a way you just have to keep plugging and plugging and plugging away. "It's even more difficult if you've got no contact with the school, cold calling doesn't work very well, even if you're offering them something for free. That's the bit that I think is missing in this project, some way of connecting the universities to the schools."

This having been said, where contact can be made, the Spectrometer in a Suitcase is a useful way of allowing the University to work with local schools and colleges. "Once you're in the door, once you've got your foot in the door, and you can show it to them, it's generally quite easy to engage with the schools," Dr Lorch explained, "it's just getting that foot in the door in the first place."

Working with schools in this way can benefit the University too, Dr Lorch believes, and helps to break down the barriers between school and university. The University recruits its students from sixth form colleges, so by going into schools and colleges, pupils can meet the lecturer who might be teaching them if they decide to go to that particular institution.

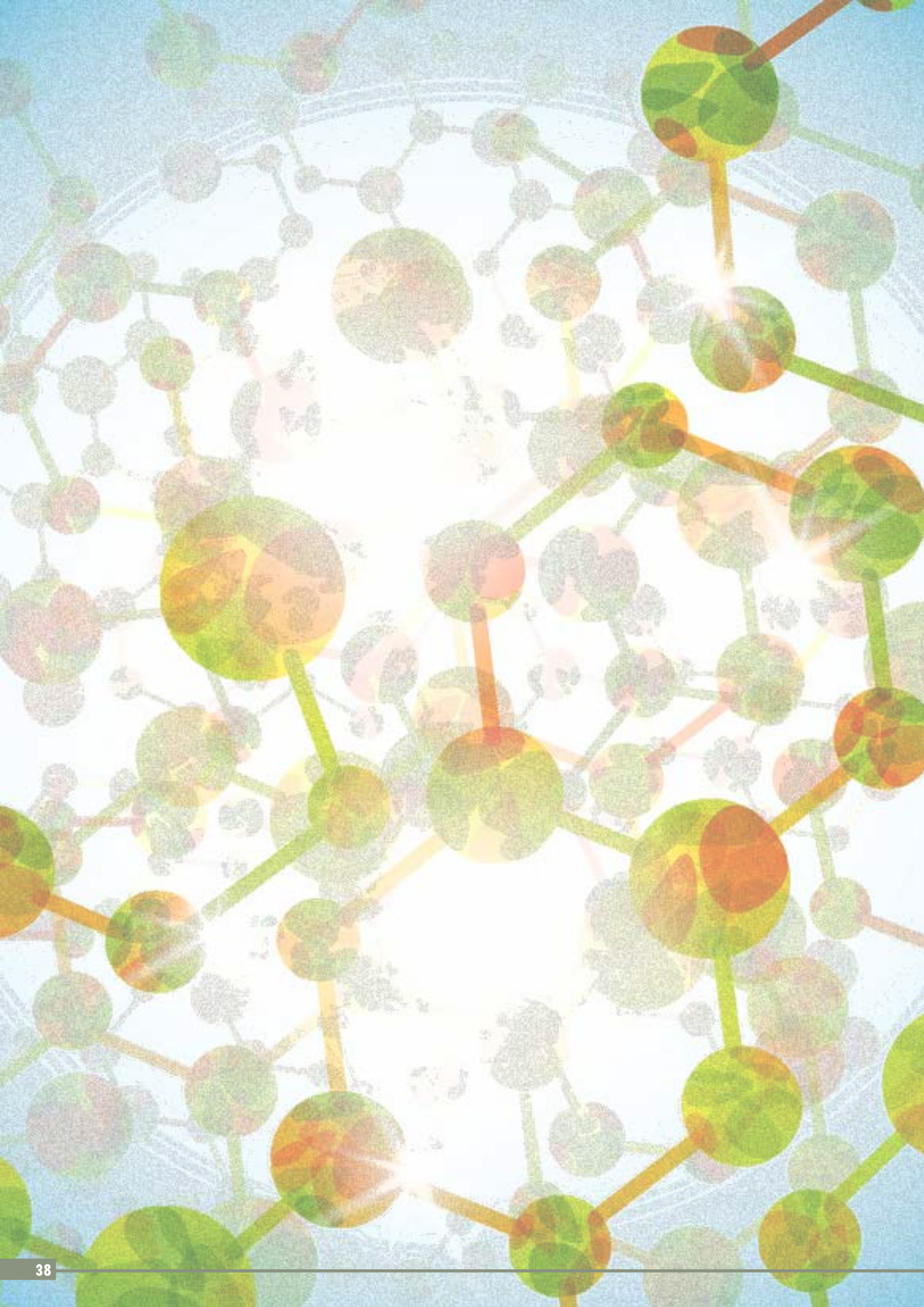
There is a network of people who have a Spectrometer in a Suitcase, and members share their experiences by e-mail. There are also training days organised across the North East of England to show university staff and STEM Ambassadors how to set up and use the spectrometer.

## Spectroscopy in a Suitcase carries on

Through the Royal Society of Chemistry's Spectroscopy in a Suitcase (SIAS) scheme, school students gain hands-on experience of spectroscopic techniques and their applications. From small beginnings, over the last five years SIAS has become increasingly popular and well travelled. In 2011 alone, over 6,000 students participated in SIAS events. The number of universities involved in delivering SIAS has increased from seven in 2010 to 19 for the start of 2012. The RSC is committed to supporting the SIAS programme, and has guaranteed to fund SIAS activities after the end of the current HE STEM Programme support.

Full details of the scheme and the locations of the equipment can be obtained from the RSC web site [www.rsc.org/sias](http://www.rsc.org/sias). For more information or to arrange a visit, please contact [hestem@rsc.org](mailto:hestem@rsc.org).

The spectra school website can be found at: <http://spectraschool.rsc.org/>.



# The Maths Busking Project

The Maths Busking project was set up with funding from the National HE STEM Programme to respond to the perception held too often by members of the general public that mathematics is dull, uninteresting and unpopular. The primary focus of Maths Busking is to develop engaging, innately entertaining mathematics routines that will capture the audience whatever their mathematical background. Maths Busking conveys genuine mathematical content at the core of the routine, not tacked on the end so that when people walk away from seeing Maths Busking, they should: have a better appreciation of mathematics; feel they have been involved; and have ways to develop their mathematical curiosity.

# The Maths Busking Project:

Engaging the general public and school groups through the powerful medium of street entertainment

## INTRODUCTION

An important goal of Maths Busking is to enthuse, train and equip mathematicians (academics, teachers and students) who will then be confident to communicate mathematics in an engaging fashion, both on the street and in the classroom.

The initial project held training days in Birmingham, Bath, London and Manchester (twice). The North East spoke of the National HE STEM Programme agreed to provide further funding to train Maths Buskers from the area who would then be able to perform in regional events. This is the final report from the Yorkshire phase of this project, with the North East spoke hoping to fund a second phase in the North East of England.



The intention of the Yorkshire phase of the Maths Busking project was to build on the success of the national project by broadening the network of trained buskers with experience of hands-on Maths Busking by extending into the Yorkshire region. Academics, students, teachers, trainee teachers and STEM ambassadors would be recruited and trained to be new Maths Buskers and then invited to perform at two large festivals in the region during the year – the Leeds Festival of Science in March/April and the British Science Festival which in September 2011 was to be held in Bradford.





## Initial Preparation

The lead buskers from the national Maths Busking team agreed to come to Leeds to train new buskers in March 2011 and then to lead a Maths Busking performance in the city centre in April 2011. The national Maths Busking team were also selected to be part of the British Science Festival. This would mean that new buskers would be offered at least two chances to perform in the region during the year along with further invitations to participate with the Maths Busking team at other events across the UK.

The idea of Maths Busking generated a great deal of interest across many different parties as the University of Leeds began to publicise the Maths Busking training and performance opportunities in the region. Oral feedback from teachers, academics, post graduates and STEM ambassadors was very positive and translated into a full quota of 27 new buskers registering for the training day. This was a very satisfying result, following on from the national project which had trained 80 new buskers over 5 training events, and benefitting from the good publicity resulting from the initial performances from this team.



## Training Day

On the 7th March 2011 the Maths Busking team came to Leeds to train a pool of local buskers. The day was very well attended by academics, postgraduate students, trainee teachers and undergraduates as well as people from other organizations. The participants were mainly from the Universities of Leeds, Bradford, York and Manchester with others from education, industry and professional bodies. The day was led by Steve Humble, one of the three lead Maths Buskers, with support from Matt Parker and two junior Maths Buskers.

The training began with an example of a starter activity that might be used to draw interest from people nearby which involved flying paper boomerangs. Members of the group also attempted a maze puzzle and the group discussed the benefits of this style of activity.

The Axioms of Maths Busking were presented by Matt Parker. Several participants commented on the importance of this. Busking was a completely alien activity to most trainees and it is important to consider the nature of both the audience and the act. Before developing Maths Busking shows it was necessary to understand that the audience might be transient, coming and going as they pleased, and hadn't asked to be engaged with maths. It was also important to be sensitive about the audience's comfort with maths (or lack thereof), ensuring that they would not be embarrassed through lack of knowledge or skill at any time, whilst at the same time making maths the part of the act that they would find engaging and take away from the experience.

With this in mind, groups of participants developed their own busking acts which were performed, critiqued by all the participants including the experienced buskers, and given the opportunity to be improved upon before they were performed again. The junior buskers spoke about some of their experiences and showed some of the already established acts.



## Evaluation Feedback

The feedback from the Leeds training day was very encouraging with 92% of respondents reporting that they had learnt something new. What was learnt varied amongst participants but most stated either particular tricks, the axioms of busking – what is Maths Busking, or how to improve performance. The day resulted in 95% feeling more confident addressing more challenging topics and concepts with over 20% saying they felt “a lot more confident”.

Many felt that aspects of the training day would also be able to be included in their workplace (if that involved teaching or interacting with the public) or in social events, and almost all thought they might explore different ways of approaching topics in their own work in maths and science communication with 37.5% feeling certain that they would.

Most people enjoyed the day and a third were surprised by something during the training. The “surprise” ranged from a particular trick to just the fact that maths can actually be developed into a busking act and can be really engaging and fun.

Most people felt that the training session would have some impact on some facet of their future work such as when presenting to inexperienced audiences. One person felt that it wouldn't impact on their current job and another felt that there were too many trainees and not enough input during the session to really have provided an impact.

All participants thought that the Maths Busking materials were pitched at an appropriate level for the general public.

79.2% thought the training session was structured appropriately for the participants. Two comments were offered by people who didn't think the structure was appropriate – one thought that the group should have been taught more, and another commented that “If the aim is to prep people to busk then I would say this hasn't been achieved. Much of what we explored were ideas that wouldn't work”. I think that this is something the Maths Busking team should consider for future training sessions and maybe strike a balance between new trainees having time to develop new material and them learning existing Maths Busking routines and developing a delivery for them which might make them more confident to perform in a public setting. Linking to this, when asked for further comments or suggestions 70% of those made related to seeing more demonstrations and gaining more practise of the busking acts including a comment about practising the whole “gather-perform-wrap-up” before performing to the public. The other suggestions were to have more links, smaller groups, and also for the experienced buskers to talk more about previous venues and experiences.

The training event on the whole was a success with participants commenting on how much they had enjoyed the day, meeting new mathematicians, learning new tricks and ideas and talking with like-minded people. Performance in Leeds

Following on from the training day the first Maths Busking performance in Yorkshire and the Humber was held in Leeds on Saturday 2nd April on Briggate (a major pedestrianised shopping street in Leeds). Arrangements for the day were more complicated than expected as we had to hire an event space from the council as well as organize a contingency plan with a local shopping centre. On the day, however, the weather was fine and this all went smoothly.

*What was learnt varied amongst participants but most stated either particular tricks, the axioms of busking – what is Maths Busking, or how to improve performance. The day resulted in 95% feeling more confident addressing more challenging topics and concepts with over 20% saying they felt “a lot more confident”.*

The project benefitted from a very pleasing number of Maths Buskers involved which included the team leader, six people with some previous Maths Busking experience and seven new buskers. The day began with a briefing whereby the team leader and other most experienced busker elected to run the first few shows which would each consist of three Maths Busking acts after which the group would have a debrief.

There were few shoppers around at this time however so after a couple of shows the plan was changed and all buskers spread out over the whole event space, working either individually or in pairs. Each would engage with small groups or individuals as they passed by. This was a good move as there was such a large number of buskers, each wearing a bright yellow "Maths Busking" top, that the team had a great presence. As the day went on the street became crowded with shoppers and the Maths Busking team were able to interact with a great many people including families, couples, individuals, groups of school-age friends, and groups of adults.

The number of Maths Buskers and their attire was a real advantage as one could observe people looking at the way other people were engaging with Maths Buskers and were then more likely to stop with the next Maths Busker they passed to find out what it was all about. Throughout the day Dr Ken, an experienced street performer and science communicator, observed the team and offered advice and guidance to help individuals improve and adapt their acts.

Towards the end of the day another "show" was attempted with the PA system. As at the start of the day, this consisted of an activity to draw in interest and then three acts. The inexperienced buskers involved in this activity found this style of delivery quite different from working with the small groups of passers-by earlier in the day. Some members of the public were more hostile which made it more difficult, and whilst the experienced buskers were more confident there is still quite a lot to learn about this style of performance. Dr Ken gave some very useful feedback and the team should consider more about how to build up the crowd and how to make the most of the crowd once it has been established. These are skills that probably take time to develop.

Overall the day was very successful and there were lots of good comments from the public who had engaged with the various Maths Busking acts.

## Performance in Bradford

On the weekend of the 10th and 11th September the new pool of local buskers were given the opportunity to perform at the British Science Festival which in 2011 was held in Bradford. The first performance was held in Centenary Square in the city centre. This was the venue for the Bang goes the Theory tent where the BBC ONE team were holding live shows and as such there was a very receptive crowd of people queuing for tickets. The Maths Busking team entertained these crowds and further passers-by and had an excellent response. Local media were present and members of the Maths Busking team and people participating in the busking activities were interviewed by local radio and television (Look North).

Following this the Maths Busking team headed to Kirkgate Shopping Centre where the team busked to the general public as they were going about their weekend shopping. Thus the audience was in no way expecting to meet mathematics. However, the vast majority of people who passed-by interacted with the team in a very positive manner. There was a range of different people – couples, families, and groups of friends. Many were of school age and really enjoyed the busking acts, some finding them amazing, and others determined to understand mathematically what was happening. Some people knew very little mathematics, others happened to have studied it themselves and wanted to know more about what we were doing. One person taught in a school (not maths) and intended to visit the maths department in their school the following week to deliver some Maths Busking acts – hopefully through this sort of interaction the ideas and objectives of Maths Busking can reach out further and help spread a positive message about the enjoyment of mathematics which can be had by all.



# The Maths Magic Project

The purpose of the Maths Magic project is to bring greater sustainability to capacity-building activity that increases engagement in maths-related learning and employment. The project team recognized that although project funding is intermittent, there is much greater continuity in the people engaged in activity to broaden participation and develop higher skills. This project has therefore sought to capitalize on that continuity by developing partnership work that sustains ongoing commitment to this area of work.

The project has sought to initiate a new partnership that will ensure the longer-term sustainability of activity and sharing of practice in maths amongst HE and University practitioners. Core to this is to share ideas on ways of separating 'number, as something that can intrigue and be enjoyable' from 'maths, as something to be learnt and assessed', so as to break down anxieties and barriers to eventual learning.

# Maths Magic Project:

## Training and developing staff to engage more creatively in their teaching of maths activities

### INTRODUCTION

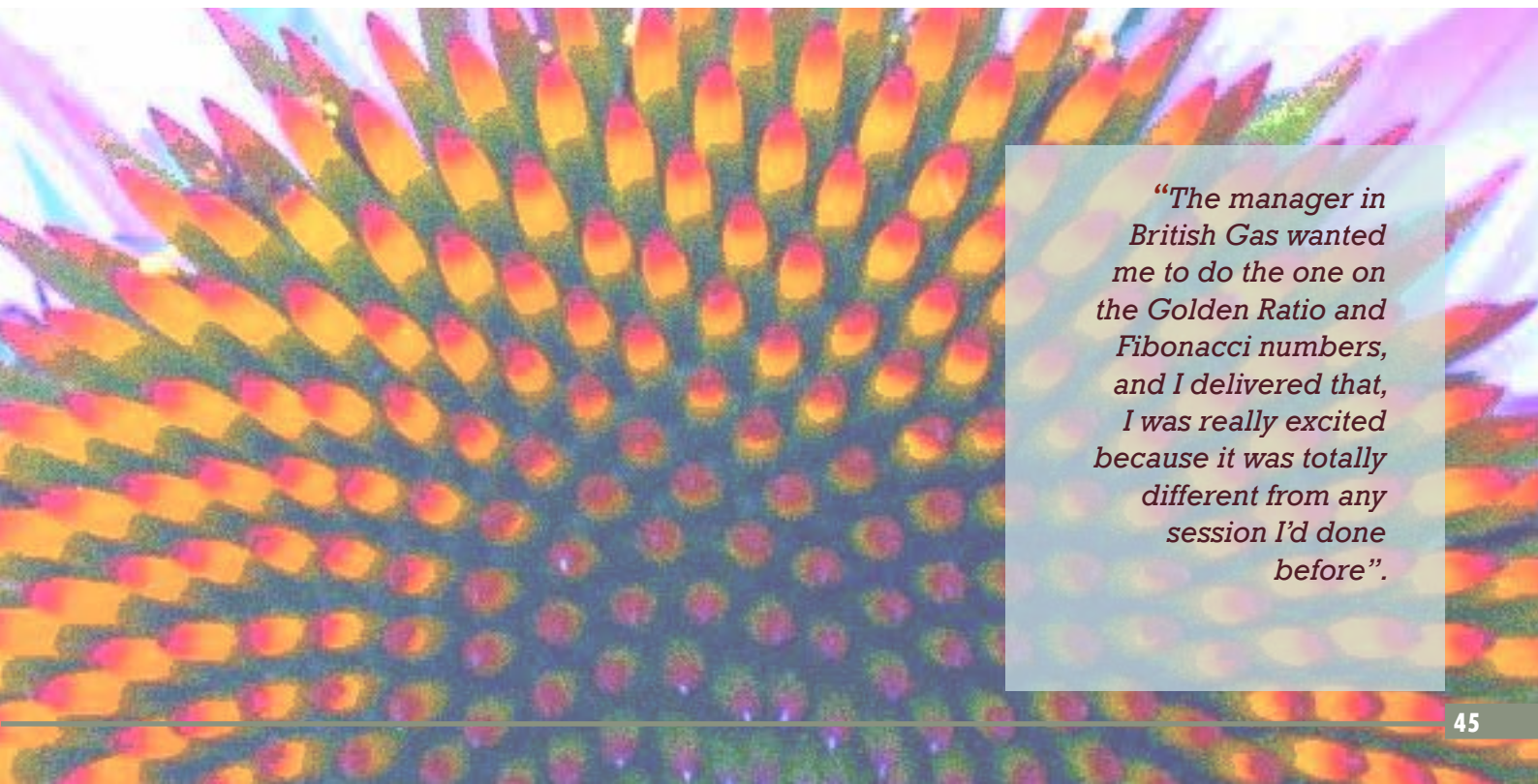
Liz Meenan, who heads up the Maths Magic programme in the Lifelong Learning Centre at the University of Leeds, had worked as both a secondary maths teacher and as an education officer at 4Learning, the educational arm of Channel 4, before working as a part-time Maths PGCE tutor for several years. It was her fascination with specific areas of maths, including the Golden Ratio, Fibonacci numbers and paper folding, that first attracted the attention of the Lifelong Learning Centre. "I do sessions on these for students and for teachers of mathematics both in primary and secondary levels, and at university level," she said, "and Stella Cotterell, who is director of the Lifelong Learning Centre here in Leeds, she got to know some of my sessions, and asked me if I would deliver a session for British Gas employees."

### Success from the start

The first sessions were a great success. "The manager in British Gas wanted me to do the one on the Golden Ratio and Fibonacci numbers, and I delivered that, I was really excited because it was totally different from any session I'd done before," she recalled, "the clientele was different, this was a twilight session for employees of British Gas and it was an opt in, voluntary session and I was amazed at how many people were there, really. And they all expressed an interest in maths but they weren't quite sure what I was going to deliver, and I thoroughly enjoyed it, I had a whale of a time and I hope they did too."

### Positive feedback

After repeating the sessions in the following year, including one on paper folding, the feedback was good. "That is something that is a real interest of mine, using paper folding not only to explain and help learn shape and space but also deliver some number and algebra aspects of mathematics," she explained, "Stella obviously heard about the feedback and she was part of a regional network of Lifelong Learning Centres and FE colleges, and in talks with those colleagues, she understood there was a maths problem, the lecturers felt that the students coming to do the foundation courses found the maths very hard, uninteresting, they weren't motivated."



*"The manager in British Gas wanted me to do the one on the Golden Ratio and Fibonacci numbers, and I delivered that, I was really excited because it was totally different from any session I'd done before".*



*“The Maths Magic Project at Leeds University has helped practitioners think more creatively about teaching maths.”*

Liz Meenan, Education Consultant,  
Maths Magic Project, University of Leeds

It was from this that the HE STEM-funded Maths Magic programme was born, resting heavily on Liz’s experience both as a maths support tutor and a PGCE maths tutor. The project was funded for two years, and included the formation of a steering committee. It was that steering committee that decided to develop some innovative, free courses on areas of maths that are problematic to teach.

### Content of sessions

The courses were targeted at lecturers and teachers who taught maths to students who were doing foundation level STEM subjects, and their content was agreed by the project’s steering committee. The courses covered algebra, mechanics, statistics, use of ICT and specific mathematical software packages such as GeoGebra. This choice of subjects was based on the project staff’s experience of teaching foundation level students, and attendance was maximised by offering the courses free-of-charge, and making sure participants received a good lunch. The sessions were very practical, and would present lots of ideas about how to teach these particular areas of mathematics.


Liz Meenan explained that the sessions are taught in an inspiring way. “Motivating, interesting, really get the lecturers interested in new insights into these topics and areas,” she said, “really get them going, get a buzz going. We felt if we got them buzzing then they would pass that on and inspire their own students, and therefore, the learning of the mathematics would be quite easy.”

Liz and her colleagues feel that maths is central to the STEM subjects. “We know that maths is problematic, and that some adults and teenagers have had a bad experience with maths, and what we want to do is turn that around,” she said, “maths is at the core of all the STEM subjects, and I feel if we inspire the teachers, then they’ll inspire the students, and they’ll be more successful.”

### Practice makes perfect

One example Liz discussed was algebra, which she feels can always be difficult to teach. One mistake that’s often made at secondary level, she believes, is that algebra is taught too quickly, and that the journey from practical, concrete examples to the abstract is often not long enough.

“For a lot of people, they need to have a lot more time to experience the practical and concrete in terms of number and be very, very clear on the number operations and calculations and how number works, before they can translate that into algebra which is the more generalised form,” she said, “and I think sometimes we’re not giving enough time for our students to actually do that.”



*“For a lot of people, they need to have a lot more time to experience the practical and concrete in terms of number ... and I think sometimes we’re not giving enough time for our students to actually do that.”*

## Reaction and impact

For Liz, the reactions of the lecturers and teachers on the Maths Magic courses was a great vindication of her beliefs. “It was the comments of the teachers you know, it was just the, ‘God, this is really interesting,’” she said, “they wanted to do more of it, they didn’t want to stop, they were doing it over lunch time, they were doing it at the break time, they were saying that they wanted to use it straight away, fit it into their teaching.”

Liz feels this is a sign of good teaching abilities. “I think you should, as a good teacher and a good educator, want to keep striving to better your teaching and try and inspire your students more so that they are more successful,” she said, “and I think one of the big ways to do that, if you’re interested in the subject, then that does get passed on to your students, if you enjoy teaching it, your students are more likely to enjoy learning it and progress in it.”

The reaction of her students is a reward in itself. “The students are coming from all different backgrounds, different ages, different cultures, different nationalities, and it is not a homogenous group, and it is hard to teach that type of group but it’s incredibly rewarding,” she said, “because you know that those students are there because they want to be there, and they are going to work their socks off.”

# The STEM at Work Project

The STEM at Work project is based on a highly successful scheme that runs in Belgium with the Flanders Institute for Biotechnology (VIB) where over 2000 students take part each year.

STEM at Work connects 14 and 15-year-old GCSE students and their teachers with university researchers, and leads to a judged competition offering prizes of £1,500, £1,000 and £500. GCSE students who take part also get a voucher as a reward. Projects are offered by all the five North East regional universities (Durham, Newcastle, Sunderland, Northumbria and Teesside), and also by some of the industries that the Science Learning Centre enjoys strong ties with, including Northumbrian Water, Proctor and Gamble, Glaxo SmithKline and Nissan.

Linking schools with those who work in the STEM areas helps to develop sustainable links between schools, universities and STEM industries.

Benefits to students, when engaging with STEM professionals in this way, include increased or enhanced motivation, greater engagement with STEM subject matter and positive influences on their intended career routes.




# The STEM at Work Project:

Linking schools and students with engineers and scientists to work on 'real life' STEM projects

## INTRODUCTION

The idea behind the STEM at Work project at the University of Durham's Science Learning Centre came from a visit its co-ordinator paid to Brussels many years ago, and decided to replicate in the UK. Claire Willis, who co-ordinates the North East Teacher Scientist Network, is herself a Biology graduate, and the model that caught her attention was based in the Flanders Institute of Biotechnology. "What they wanted to do was to get students in doing real life, active research, none of this fabricated stuff" she explained, "it was, 'roll your sleeves up, get involved,' this is current, cutting edge research."



*"What they wanted to do was to get students in doing real life, active research, none of this fabricated stuff ... 'roll your sleeves up, get involved,' this is current, cutting edge research."*

Claire Willis, STEM at Work Project,  
Science Learning Centre, Durham

## Developing a UK-version of the project

The Belgian project had a number of different aims. It wanted to get students in to see their environment, and possibly go into research themselves, but also to attract students from all walks of life, and give them a bit of a 'heads up' if they wanted to further their own education. Claire, who worked for the national network of Sea Life Centres before joining Newcastle's Centre for Life as its education manager, could immediately see the model's potential. "I saw that project, brilliant project, and decided that I would bring it to the UK," she said, "they were over the moon with that, because they'd had some international interest, but nobody actually ran with it."

## Connecting students and researchers

STEM at Work connects 14 and 15-year-old GCSE students and their teachers with university researchers, and leads to a judged competition offering prizes of £1,500, £1,000 and £500. GCSE students who take part also get a voucher as a reward. Projects are offered by all the five North East regional universities (Durham, Newcastle, Sunderland, Northumbria and Teesside), and also by some of the industries that the Science Learning Centre enjoys strong ties with, including Northumbrian Water, Proctor and Gamble, Glaxo SmithKline and Nissan. Projects are allocated to schools on a first come, first served basis, and after spending time with the researchers, GCSE students must write the project up, using a standard, ten sides of A4 format. "It's not onerous, but what we want them to do is to follow a traditional format, as if you were submitting a paper," Claire said, "so an abstract, introduction, research you know, background, the team, all that, they're given guidelines to follow."

## Communicating science

Claire Willis is passionate about science communication, and explained that she wants STEM at Work to encourage this as an outcome too. "What I wanted them to do was not only write the report but I wanted them to stand up and do a two minute presentation in front of a panel of judges about their project," she said, "so that's an integral part of it as well. So it's about the research, it's about conveying that research in a formal written project, but actually then selling it in a sense, it's talking about, it's communicating the science to a fairly knowledgeable group of judges."

## The benefits to researchers

One of the Brussels' judges came to join the panel for the first time the project ran, which attracted five entrants. Now, Claire points out, the number of entrants has risen to eight participating schools.

STEM at Work, she feels, is beneficial for the researchers as well as for the participating schools and students. "It also gives the researchers a fantastic opportunity to be able to convey what they're doing, and sometimes a dose of realism as well, you know," she said, "it's like, 'I'm locked away in this lab for however many hours a day, and now I've got a group of fourteen year olds who are asking me all about this and that,' so it gives them a great opportunity as well."

*"Many researchers can be stuck in their labs for days on end, so to have a noisy group of fifteen year olds from Whitley Bay or wherever it may be, it's just a breath of fresh air for the researchers and can really help to sharpen their thinking."*

## Wider benefits

The STEM at Work project's benefits spread outwards to researcher's institutions more generally, Claire believes. "Many researchers can be stuck in their labs for days on end, so to have a noisy group of fifteen year olds from Whitley Bay or wherever it may be, it's just a breath of fresh air for the researchers and can really help to sharpen their thinking," she said, "and actually, it lifts the department as well, you know, because, again, it's something different, it's something new and there's kids asking questions that these researchers maybe haven't been asked ever, you know, like, 'Oh yeah, why am I doing this?'"

## Widening participation

Claire feels the widening participation aims of STEM at Work are important. "This is open to all schools, and there are some schools on the list that are tough schools, really tough schools," she said, "and the chances of these individuals pursuing an academic career are probably limited.

"But this project is about encouraging those kids, and going, 'Do you know what, you can do this, you *can* walk into a university,' because universities can be quite intimidating."

## The value of HE-STEM funding

HE STEM funding was pivotal for the STEM at Work project, Claire believes. "Basically if we had not had the funding I would not have been able to do the project," she said, "so that's the value that it's given."

Looking to the future, Claire wants to introduce a multimedia element to STEM at Work. "We've had photographs and the posters and the hard copies and the presentations, but we'd never actually really filmed it," she explained, "so what we've said is, we've appointed a film company, a local film company, to show the students basic filming, and then go with them on the day in the lab and maybe two of the group of twenty or fifteen, however many there will be, will start filming, and the others will do their rolling their sleeves up bit or whatever. So in terms of a legacy, that will be a legacy, the film, because reading it is great, but actually seeing it is even better."

Dissemination is one area where Claire feels the project could achieve more. "In terms of a legacy and dissemination, the DVD is what I'd like to create in the end. It would enable us to quickly and effectively show others what we do. So if someone from Huddersfield, for example, says 'I'm really interested in the Durham project,' we could say: there you go, there's a CD, this is the person you need to speak to," she said.

