A Legacy Handbook for STEM

A report prepared by *emda*

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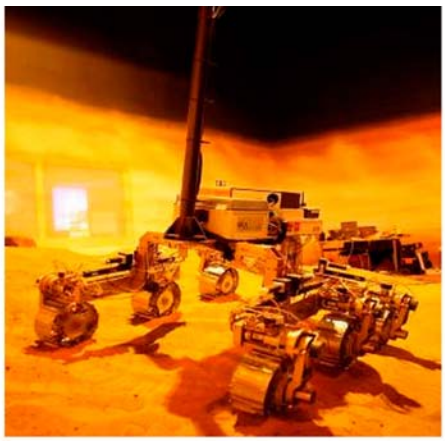
funded by east midlands development agency

A Legacy Handbook for Science, Technology, Engineering and Maths (STEM) (DRAFT)



Foreword

emda's support for employment, learning and skills has encompassed numerous areas of activity. The agency has invested almost £90m in regional projects since 2002 to support this agenda, which has created over 74,000 jobs. We understand and have supported the skills needs of business in priority sectors such as Manufacturing, Construction and Health.

Whilst management and leadership have been championed as key to business success and developing enterprise capability has been a means of unlocking talent and creativity, we judged that the UK's competitive advantage depends increasingly on innovation and high-value products and services, which are underpinned by Science, Technology, Engineering and Maths (STEM).

It was and continues to be important to maintain a strong flow of STEM qualified people entering the workforce. We deliberately took the longer term perspective and invested over £10m in STEM enrichment activities that would shape the workforce of the future. Our role has been to provide exciting activities to awaken young minds to the world of STEM and to inspire teachers, whilst developing strong links with universities and small businesses to provide a logical progression path.

As an Agency we have worked closely with partners to deliver a STEM Programme that added value to what was already there. We have chosen STEM as the topic for this handbook to celebrate the success of the programme. It also offers the opportunity to set out practical advice on delivering STEM enrichment activities distilled from our experiences and provides individual fact sheets for each of the projects we funded. We hope that organisations considering STEM support find the information useful and continue to build on the successes to date.

Haydn Biddle
Deputy Chair,
East Midlands Development Agency

Contents page

Introduction

Science, Technology, Engineering and Mathematics (STEM) are subjects key to the UK's future prosperity and global competitiveness. We need to generate more interest in these areas, harness people's skills and create a strong supply of highly skilled employees.

The East Midlands Development Agency (*emda*) invested £6m between 2008 and 2011 in a STEM support programme, as well as over £4m in the national Learning Grid programme between 2004 and 2009. The long term ambition of *emda's* STEM programme was to initiate a culture change in young people's perception of STEM subjects from 'dull and difficult' to 'exciting and rewarding'. The programme consisted of a range of projects targeting young people, employers and teachers in primary, secondary, Further and Higher Education. The focus was on curriculum enrichment activities and staff development for teachers. The aim was to create opportunities to inspire young people in STEM, to unlock their potential and widen their horizons. We wanted to help teachers and schools illuminate to young people the importance and impact of STEM in their lives and to help enthuse and encourage young people to pursue STEM studies and careers. A strong pipeline of STEM literate young people is fundamental in the drive to grow innovative businesses capable of competing globally.

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Purpose of the Handbook

This handbook has been developed by *emda* as a legacy document on STEM support and provides reflections on *emda's* STEM Programme and other STEM related projects *emda* funded. It outlines how we undertook the projects, highlights their impact and how young people, teachers and employers have benefitted.

The handbook offers practical advice for organisations committed to encouraging more young people to study STEM subjects at school, in college and at university and to delivering an innovative STEM curriculum.

Changes introduced by the Government mean that skills support will be within the remit of Local Enterprise Partnerships and Local Authorities. It will be a local decision as to how far and in what ways STEM is supported.

The handbook is not intended to be prescriptive, nor does it represent the complete picture of STEM support in the East Midlands. It is a collection of experience and learning based on *emda's* engagement with and support for STEM. The Project Fact Sheets and learning may assist in the planning of future activity to maximise returns.

Coalition Government plans for STEM support

The Department for Business, Innovation and Skills and the Department for Education are committed to working together on the STEM skills agenda. This includes increasing the number of young people choosing to study STEM post 16 and ensuring a strong national base of technological and scientific skills. The Government recognises that STEM support is essential for economic growth and ensuring that the needs of employers are met.

Their aim is to increase the scientific literacy of the population at large and to support good enrichment and enhancement activities as part of science education. The Schools White Paper 2010 reinforced the Government's support to increase the number of specialist teachers in physics, chemistry and maths and to improve the skills of existing teachers. The White Paper also confirmed the Government's continued support for the uptake of science and maths subjects, as well as plans to introduce a new measure of achievement, called the English Baccalaureate. To be awarded this, young people will need a minimum of two good GCSE passes in science subjects.

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The Government's 'Plan for Growth', launched within the 2011 Budget, reinforced the importance of STEM skills for industry, in particular the manufacturing sector. To strengthen the STEM skills of young people and improve student awareness of STEM careers, the Government outlined its commitment to:

- supporting the Careers Profession Alliance to improve training for careers professionals in subject-specific specialisms, including STEM, to ensure young people have access to high quality, independent guidance to make informed decisions about STEM subjects and careers,
- improving the teaching of STEM skills, by raising the quality of new entrants to the teaching profession. This will be done by reforming teacher training and protecting bursaries for trainee teachers of science and maths; and
- strengthening STEM promotion activities, including STEMNET, which coordinates a range of activities between business and schools to raise the profile of STEM, including a STEM Ambassadors programme.

Chapter 1
Overview, Achievements and Learning

The principal objective of the Agency's engagement with STEM was to take a strategic overview in order to add value and bring greater coherence to the array of STEM enrichment activity already taking place in the region.

This chapter provides an overview of the individual STEM projects, describes how the Programme was evaluated and demonstrates the difference the Agency has made to the agenda in the last three years through a strong leadership role and investing in innovative projects. The focus of this section is on highlighting achievements and benefits, as well as offering practical advice distilled from the experiences of those who delivered the projects.

Brief overview of the STEM projects

Ignition*

Jointly managed by The Mighty Creatives and Ignite*, the project had six strands:

- **Come Alive with Science**
- **Invent!**
- **Sci-art Fusions**
- **Lab 13**
- **STEM fluency Labs**
- **Creative Sparks**

Through these strands a range of activities were delivered including: invention competitions; film making; public events; teacher residentials; creative STEM workshops, mentoring of young people to become 'Creative Sparks' and the development of six science 'Lab 13s' managed and run by students. Central to the project was the bringing together of creative practitioners, scientists, teachers and young people to encourage creative thinking skills in relation to STEM subjects. The aim was to shift young people's perceptions of STEM subjects.

Lab in a Lorry

A mobile laboratory, managed by STEMNET and staffed largely by volunteers from industry and universities, provided physics enrichment activities for students. The main target audience was young people at key stage 3. It visited schools, public spaces and events across the East Midlands and provided opportunities for young people to observe and have 'hands on' experience of specially designed experiments.

NanoWhat?

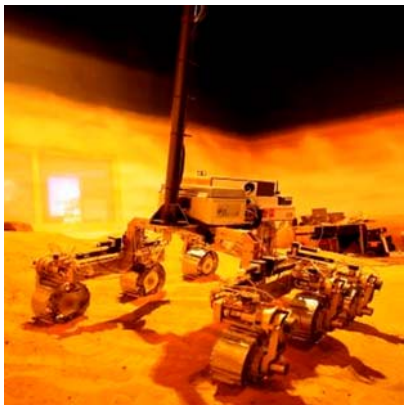
The University of Nottingham coordinated a series of road show events designed to take 'totally tiny technology' to people across the East Midlands during the spring and summer months of 2008. Road shows were held in heavily visited public spaces, with activities and exhibits staffed by students and staff from local universities. Schools were provided with materials (a work book and teachers' resource pack) to support post-visit discussions in the classroom and nanotechnology related work.

The Space Academy

A space education programme which used the context of space exploration to support and embed curriculum studies in science and maths. It provided a menu of activities (e.g. masterclasses, competitions and careers events) that developed young people's interest in and awareness of careers in STEM, using space as the inspirational theme. The programme also offered specialist training to science teachers, again using space as the 'hook'. Activities were delivered by a team at the National Space Centre in partnership with the Universities of Leicester and Nottingham, the Science Learning Centre East Midlands and STEMNET.

STEM Scholarships

Around 200 bursaries of £1,000 per annum were awarded to young people taking a STEM degree in a regional university. The intention was to encourage local students from under-represented groups to study STEM subjects at one of the region's universities. As a condition of the award, students were required to attend an annual conference. The conferences were themed around employability support and to help students understand the range of STEM related careers available.



East Midlands STEM Partnership

The STEM Partnership sought to bring together individuals and organisations in the East Midlands who were interested in STEM education. The partnership included practitioners, educators, representatives from STEM-related industries and policymakers. The purpose of the Partnership was to share ideas, information, knowledge and best practice relating to STEM education. The Partnership was coordinated and promoted by The Marketing Division (TMD), who arranged activities and maintained a web portal for the Partnership. Activities included bi-annual forum events, bi-monthly telephone conferences and Partnership steering group meetings. TMD also ran a STEM Student Journalist project which included media workshops and an annual competition for the best report submitted by a student.

The purpose of the Partnership was to share ideas, information, knowledge and best practice relating to STEM education.

Engineering Development Trust - STEM Pathways

This project comprised 5 strands of activity:

- **Year in Industry** - work placements for gap year students.
- **Headstart** - opportunities for year 12 pupils to spend up to a week at university prior to making their UCAS application
- **Go4set** - pupils in year 9 solving science and engineering problems set by business
- **Engineering Education Scheme (EES)** - linking small groups of year 12 pupils and their teacher with local companies to work on engineering and business problems.
- **Headstart First Editions and Dragonfly** - one day experiences for students in STEM activities to address widening participation issues. First Editions (years 9-10) focused on under-represented groups and Dragonfly (years 9-12) targeted female pupils.

Science in the Peak

This project delivered a series of activities aimed at Derbyshire and Nottinghamshire Key Stage 3 school pupils and other young people including an event that was held at the Buxton campus of the University of Derby. The event comprised a variety of activities over five days, aiming to bring over 4,800 students and 1,500 others from the community to the Buxton campus.

The Learning Grid

Started before *emda's* STEM Programme, the Learning Grid was a national project. It used motorsport to underpin a co-ordinated set of STEM activities covering all ages from primary school pupils to University students. The project funded a series of activities including competitions, events, learning materials and short courses. Examples include Primary Engineer, Formula Schools and the Shell Eco-marathon. An overarching aim was to develop a quality standard for the activities, promote accredited programmes and activities and to facilitate the sharing of best practice. A Learning Grid Directory was developed to provide clear and impartial information on what was available to support STEM. The target audience included young people, teachers and lecturers, those who supported or delivered services to teachers and engineering employers. A number of the projects were incorporated into the National Curriculum for STEM subjects.

PICTURE: Shell Eco-Marathon.

How the STEM Programme was evaluated

emda commissioned the National Federation for Educational Research to evaluate the STEM programme and its constituent projects. The evaluation focused on addressing three key areas:

Programme design and implementation

- meeting the regional objectives of increased interest and involvement in STEM courses and careers
- how far the programme tackled the challenge of making STEM more interested and inspiring
- reach and coverage
- how one-off activities and projects lead to sustainable change.

Learning and good practice

- the learning and good practice demonstrated
- how the good practice was shared and disseminated.

Outcomes and impacts

- changes in perceptions, attitudes and intentions of young people
- changes in the culture and practice of teachers
- the programme's Strategic Added Value.

Data collection for the evaluation was organised into three main strands:

	• **Longitudinal teacher and pupil surveys.** Undertaken annually to gauge impact and benefits at a programme level and to track changes over time.
	• **Interviews** with programme contributors, key partners and beneficiaries. The focus was on project level to see how particular approaches to STEM enrichment activity was being experienced by young people and teachers and record the views of those involved in delivering the projects.
	• **Evaluation and monitoring data** collected by the projects.

The evaluation framework for *emda*'s STEM Programme included measuring the long term impact of the programme in terms of participation and attainment. To support this e*mda* commissioned a benchmark report on STEM skills and qualifications, which assessed the supply and demand for STEM subjects in the East Midlands. Attainment levels at Key Stages 1-4 were analysed, as well as the number of students studying STEM subjects in Further and Higher Education. The demise of *emda* will preclude the longitudinal evaluation from taking place, but the baseline report is a resource for partners to utilise and is located on the *emda* repository website. The very nature of STEM enrichment activities make a longitudinal evaluation crucial for organisations wanting to make a difference to the number of young people opting to study STEM subjects and pursuing a STEM related career in the future.

Penetration

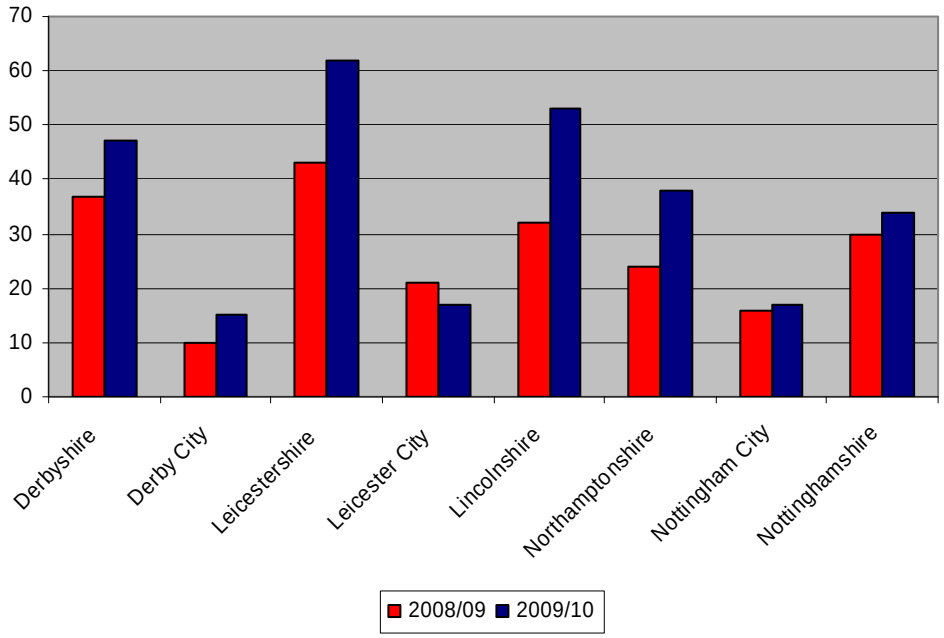
Over two academic years (2008-9 and 2009-10) the *emda* STEM programme worked with 342 schools across the East Midlands, representing 15 per cent of all schools. This included over three quarters of all secondary schools, academies, Further Education Colleges and Sixth Form Colleges in the region. The programme also engaged with 287 STEM employers and organisations with a connection to STEM.

TABLE 1: *emda* outputs data

Totals	Output to March 2011	Estimated Outputs 2011/12	TOTALS	% of Outputs
T2 – Employment Support – Number of people assisted to get a job	**788**	182	**970**	**10%**
T4a / E4a – Business Support – Number of businesses within the region engaged in new collaborations with the UK knowledge base	**83**	1	**84**	**64%**
T6 – Skills – Number of people assisted in their skills development as a result of RDA programmes	**12,891**	456	**13,347**	**70%**
T6b – Skills – number of adults in the workforce who lack a full Level 2 or equivalent qualification that are supported in achieving at least a full Level 2 qualification or equivalent	**69**	-	**69**	**10%**
E6b – Number of people undertaking an additional 12 hours of STEM or Enterprise Capability based learning as a result of RDA programmes	**14,253**	969	**15,222**	**95%**
KPI11 – Business Support – number of businesses assisted with management / leadership skills needs	**215**	33	**248**	
KPI25 – Skills – The number of adults assisted to gain Foundation Degree or other higher level qualifications or skills	**143**	-	**143**	

Note: Learning Grid outputs not included due to it being a national programme.

CHART 1: STEM programme number of schools involved by sub-region



PICTURE: Space Academy, Leicester

Achievements

emda's key achievements fall into the following broad categories:

- Strategic coordination
- Catalyst for change
- Practical advice and the development of best practice.

Strategic co-ordination

emda had the vision to recognise that developing STEM skills in young people was a growing national policy area that would underpin future economic development and pursued this agenda ahead of many other RDAs. The East Midlands STEM Partnership became a national exemplar. The national STEM organisation STEMNET recognised the need for a regional support infrastructure and used the East Midlands as a model.

One of the major successes of the *emda* STEM programme was the formation of the Regional STEM Partnership. It included a steering group for the Programme, forum events and a website and was made up of representatives from key STEM stakeholder organisations. The partnership created a regional model of collaborative working, which helped partners to agree how STEM enrichment activities needed to be developed.

emda actively encouraged partners to make links and to commit to a shared strategic objective. Stakeholders were active in the design and delivery of the STEM projects and committed their own resources. The Agency used its investment to stimulate a coordinated approach to delivery. This maximised funding in the region, as partners were able to identify gaps, exchange good practice, work together to find solutions and create synergies between projects.

The forum events provided partners with the opportunity to meet others from the STEM community, exchange information and network. The website was regarded as a useful means for communication and sharing success stories, and was widely admired by equivalent groups in other regions.

'The forum events are essential. As a novice to the whole arena of STEM outreach, the events and links have been a lifeline.'

STEM Partnership member.

"The partnership has proven ability in uniting the various STEM organisations from across the region in such a way that we positively feel and work as one cohesive team. The support provided to each partner is significant and truly holds the East Midlands as a beacon of effective STEM unity to other regions within the UK".

provider of STEM enhancement and enrichment activities

Throughout the *emda* STEM programme, there was a sense amongst partners that links within the STEM community had been strengthened. Although funding for the Partnership ceased in

March 2011, *emda's* strategic role has generated a commitment amongst members to continue to work together to ensure a coordinated approach is maintained. The partnership, with its forum and networking events, is highly valued by stakeholders.

Catalyst for change

emda took the decision to target its funding on specific activities rather than enhancing statutory provision. *emda* funded a number of highly successful STEM projects that involved creative practitioners (artists, musicians), working alongside teachers and scientists. It was this dynamic mix that unleashed new energy in STEM teachers and inspired young people to look at STEM subjects through fresh eyes. By funding such innovative activity, *emda* has significantly enhanced the use of creativity as a catalyst and stimulus for STEM skills development.

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Introducing the concept of creativity to STEM, young people were afforded an opportunity to pursue their own ideas, rather than respond to teacher generated activities. The projects *emda* supported highlighted the potential for inventiveness and innovation in STEM based activities, courses and careers.

emda demonstrated that non traditional delivery methods, such as taking an articulated lorry into a school as a mobile laboratory, provided the impetus to change how schools delivered STEM subjects.

"We're always seeing it in books… and you never get to see anything for real. And then you get to go on the Lab and actually see it. I think that's what's so good about it you can actually see the theory in practice."

Comment of a year 12 student

Teachers also welcomed the time and space to explore how they could introduce creativity into the classroom. The Agency succeeded in getting teachers to think differently about how they taught STEM in the classroom, which in turn energised young people.

Practical Advice and development of Best Practice

emda's STEM programme provided a considerable enhancement to the portfolio of STEM enrichment activities that could be accessed by students and teachers in the region. It has allowed the development of a spectrum of best practice examples on how to deliver innovative STEM enrichment activities. This portfolio encompasses work with primary schools through to university undergraduates. It provides useful learning on how to successfully deliver STEM enrichment activity and has resulted in a diverse resource for future delivery agencies to draw upon. The best practice examples can be found in Chapter 3 which contains individual Fact Sheets on each of the projects *emda* funded.

Years of working closely with the programme's project managers has enabled *emda* to develop a section in this handbook that distils knowledge and practical advice on successfully managing and delivering STEM enrichment initiatives. This is targeted at organisations wanting to undertake STEM activities in the future.

PICTURE: Lab in a Lorry

Benefits

Benefits to teachers

Supporting teachers was a key aim of the STEM programme. Teachers reported that participating in the projects had made a difference to them in four key areas:

- **their ability to teach STEM subjects** (91 per cent reported an impact, with a third considering the project to have made 'a big difference')
- **the school's attitude to STEM**: (again 91 per cent, with 27 indicating 'a big difference')
- **their interest and willingness to take part in future STEM CPD** (90 percent, with a very large group, 38 per cent, signalling a 'big difference)
- **their ability to build real work applications in STEM lessons** (88 per cent, with 29 per cent indicating a 'big difference').

> **"The Fluency Lab is possibly the single most influential course in my career to date and has armed me with a great many skills for the classroom".**
>
> Ignition programme - teacher participant

Other areas where teachers stated that participation had been beneficial included (percentage of teachers reporting this is in brackets):

- knowledge of STEM career opportunities for pupils (84%)
- links with STEM industry (82%)
- links with other schools (81%)
- pupil progression onto STEM (77%)
- knowledge of employers' skill requirements (76%)
- links with universities (76%)
- pupil attainment in STEM (75%)

Benefits for young people

Over 2000 students were surveyed to find out how the felt they had had benefitted from participating in *emda* sponsored STEM activities. The key messages were:

- **better awareness of STEM careers:** Students' understanding of STEM careers was the area which experienced the greatest effect as a result of participation in the *emda* STEM programme. 85% of students said that the projects had made a difference to them in this respect (21 per cent reported 'a big difference').
- **greater enjoyment of science:** a positive impact was reported by 83 per cent of school aged students (with a third signalling a 'big difference'). Of those currently studying STEM degrees, 79 per cent indicated increased enjoyment of their degrees.
- **improved performance in STEM subjects:** 80 per cent of students (who were currently studying science) confirmed that the projects had positively influenced how well they were doing in science (16 per cent claimed that the projects had made a big difference). A similar proportion of students studying STEM degrees (81 per cent) told us that their performance at university had benefited from the projects.
- **raised interest in pursuing a STEM related career**: 78 per cent of students stated that the projects had heightened their interest in careers linked to STEM subjects (with 21 per cent registering 'a big difference')
- **increased interest in studying science in the future**: 76 per cent of students confirmed that the projects had made a difference to their desire to study science in the future (a quarter of these reported a 'big difference'). 80 per cent of degree level students also responded in this way.

Benefits for employers

Employer involvement in the STEM projects ranged from attendance at one day events to more long-term mentoring commitments. The key benefits cited by employers included:

- **A sense of enjoyment and personal satisfaction that they are contributing to a worthwhile activity.** On a personal level, some employees highlighted the enjoyment they got from helping young people.
- **Professional development.** Volunteers working with Lab in a Lorry reported that the project helped to develop skills such as communication, working in teams, and managing time.
- **Commercial benefits.** Links with education can also generate financial savings for participating companies. The Engineering Education Scheme run by the Engineering Development Trust supported a group of young people to design a solution that was subsequently put into production, saving the company £48,000 a week when it was rolled out to other sites across the country.
- **Positive PR.** Successful involvement in the projects can reflect well on participating companies. Employers recognised that involvement in the projects can lead to positive media coverage. Supporting and mentoring young people and talking about their profession can raise the profile of companies with young people (and possible future employees).
- **Identifying and recruiting future employees**. The STEM Scholarship project hosted an annual conference to bring together local STEM employers and STEM undergraduates. The employers were keen to take part to raise their profile and attract good quality candidates to future posts.
- **Development of links with schools**. Companies commented that they developed a better understanding of the current education system. As one employer commented *''we have also learnt a lot about the STEM curriculum!'*. New links were forged with schools and companies welcomed the opportunity to interact with non-local students and teachers. Initial participation in some cases led to further collaboration. For example a company that supported the Sci-Art fusions project is now going to work with the school on a biodiversity project. Partners involved in Come Alive with Science have now established a STEM after school club.

"Personally it has reawakened my enthusiasm for Science in general".

Invent! STEM ambassador

"It was a great feeling when the students became inspired and excited by STEM subjects".

Lab in the Lorry volunteer

Practical advice

The following is a summary of the **practical advice and tips** from the organisations that ran the individual STEM projects for *emda,* drawing on their wealth of experience. The advice is aimed at organisations committed to encouraging young people to study STEM at school and beyond and to delivering an innovative STEM curriculum in schools.

Effective approaches for increasing young peoples' interest in STEM

- **Maximise opportunities to give young people practical, hands on experiences of STEM.** Young people like to do something themselves, rather than just observing demonstrations and being 'taught' about STEM.

- **Highlight the real world applications of STEM**. Demonstrate how STEM knowledge could be used in the work place to solve every day problems. This increases interest in STEM related careers.

- **Give young people the time and freedom to explore.** Be creative when exploring the world of STEM. Allow young people the opportunity to pursue their own ideas, rather than respond to teacher generated activities. Being inventive and innovative in STEM activities in turn fuels their interest in STEM study.

- **Give teachers the time and freedom to pursue ideas for developing their STEM teaching**. Just like students, teachers enjoy time to 'play' around with ideas and experiment.

- **Recognise the added value of industry involvement**. Young people are given access to professionals connected to the real world of STEM. Face-to-face contact with actual scientists serves to dispel the stereotypes and helps young people appreciate the range of careers available to them.

"Getting them to have a go themselves works very well. They feel part of something when involved".

Volunteer, Lab in a Lorry

"Let the children explore, give them an original stimulus, something to capture them and then let it all come from them - get them to be investigative".

Teacher, Invent

"I really wanted to look at bringing drama in … we got the time to work on something that we really wanted to do and use the ideas of other specialists".

Teacher, STEM Fluency Lab.

Engaging and communicating with schools

- **Make full use of existing networks/partners to contact schools** For example, the Space Academy worked with the Science Learning Centre to identify schools they had not previously worked with.

- **Direct targeting of schools.** Rather than waiting for schools to request provision, visit schools to outline the benefits of involvement and discuss any barriers to participation with senior managers (e.g. timing, cost).

- **Where practical take enrichment activity to schools**. Don't always expect schools to attend events offsite.

- **Be realistic about what can be achieved in the classroom.** Activities need to be easily replicated in the classroom in terms of applicability to the curriculum but also the time, resources and space available.

- **Minimise the paper work.** Teachers appreciate projects where there is support in terms of organising events and the administration is light touch.

"Teachers will tell you that taking kids off site is a nightmare. They have to pay to do it. There is the hassle of filling forms in and getting permission. With Lab in a Lorry we bring it to them and it is all risk assessed."

Project manager, Lab in a Lorry

Encouraging industry involvement:

- **Emphasise the commercial benefits of getting involved**. For employees it is an opportunity to develop their communication skills and to have a sense of personal fulfilment. At a company level it is an opportunity to make contact with future employees, and a chance to raise the company profile in the local community. For one company involved in the engineering education scheme there were substantial cost savings as a result of a student project.
- **Ensure industry volunteers are provided with appropriate training**. Do not assume that industry volunteers have worked with young people or understand the school environment. Lab in a Lorry volunteers were asked to attend an hour before the young people arrived, to get comfortable with the equipment and the classroom setting.
- **Use Universities as an alternative source of support**. Lab in the Lorry successfully recruited volunteers from universities and similarly, the Engineering Development Trust is considering inviting Year in Industry students to act as mentors for its projects.
- **Encourage participating employers to act as advocates.** Call on employers who already take part in STEM initiatives to spread a positive message amongst their own networks and communities about the benefits of participation.

"I was able to work with people who are not just engineers but also scientists and mathematicians. I have seen the sorts of things they can do in the real work. There are lots of different fields!".

Year in Industry student

Disseminating good practice and lessons learnt

- **Where appropriate arrange follow up events.** Build in opportunities to share learning and build on the experiences of participants after the initial participation. The STEM Fluency Lab project hosted a reunion of the participating teachers. Come Alive with Science arranged a sharing event for participating schools. Such events maintain the interest and enthusiasm of participants and help create a network of teachers across different schools.
- **Communicate the lessons learnt to others wishing to implement similar schemes elsewhere.** The STEM Scholarships project is producing a report setting out exactly how to establish its scheme.

Strategies for sustainability

- **Seek a funding contribution from schools that have already experienced the benefits of STEM activities.** Schools may self-fund or make a contribution to the funding of activities once they recognise their value.

- **Promote the commercial benefits of company involvement**. Clarify exactly how employers will benefit from involvement in STEM related projects (e.g. student placements, identification of the best candidates for future posts).

- **Diversify the funding avenues.** Funding for projects should come from more than one source, ensuring a mixed-funding base protects projects should one source dry up.

PICTURE: Learning about bioscience at BioCity, Nottingham.

Chapter 2
emda's approach to STEM support

Economic context

Skilled scientists, technicians, engineers and mathematicians are needed across a number of sectors in which the UK has a competitive advantage (such as advanced manufacturing, low carbon, sustainable construction technologies and digital).

Improving the stock of, and demand for, STEM skills are particular priorities for the East Midlands region. STEM skills have an important direct role in improving productivity and also contribute to other drivers – such as innovation. Economic output (Gross Value Added – GVA) per head in the East Midlands has been consistently below the national average, with the gap widening slightly during the recession. In 2009, regional GVA per head was £17,300 compared to £20,400 in the UK – a 15% difference. In 2005, there was a 13% difference between the East Midlands and the UK.[1]

Important industries in the region, particularly Manufacturing, Construction and Health, all require STEM skills. The East Midlands has the largest proportion of employment in Manufacturing of the nine English regions, at 13.6% of employee jobs in 2009. This compares to 9% in Great Britain overall.[2] Within Manufacturing, advanced engineering – especially the production of transport equipment (automotive, aerospace and rail) – and the production of medical devices and pharmaceuticals represent key regional strengths. These sectors include a number of large multinational companies which have a presence in the region, such as Toyota, Rolls-Royce, Bombardier, Alstom Engineering, 3M Healthcare and Boots Healthcare, which in turn support a network of smaller companies in their supply chains.

[1] ONS Crown Copyright, '*Headline Workplace based GVA at current prices*', table 1.1, GVA per head, December 2010.
[2] ONS Crown Copyright, '*Business Register and Employment Survey*', 2009, from NOMIS, 31st January 2010.

These sectors have particular requirements for skills related to STEM subjects and offer opportunities for individuals with qualifications in relevant subjects to progress to quality, relatively well paid employment. For example, Derby, which has the highest workplace-based earnings in the region, has a concentration of employment in automotive, rail and aerospace manufacturing.

Skilled Trades account for a larger share of employment in the East Midlands than elsewhere. Such jobs require intermediate (i.e. Level 3) skills that are closely related to STEM subjects. Although average earnings for all occupational groups in the region are significantly lower than in the UK, wages in the Skilled Trades are higher in the East Midlands than in the UK overall.

Despite these requirements and opportunities, participation and attainment in STEM subjects in East Midland schools is in line with or below the national average. The Russell Group of Universities argues that school participation and attainment in STEM is failing to keep pace with the growth of these subjects in Higher Education. As STEM subjects at GCSE and A-Level are required in order to study related subjects at university, there is a concern that there may be a shortfall in young-people with the right skills in the future, leading to a reversal in recent growth in STEM at HE.[3]

In recent years the gap in attainment in STEM subjects in the East Midlands narrowed compared to the national average. Between 2003-2004 and 2008-2009, the proportion of GCSE students in the East Midlands attaining an A*-C grade in STEM subjects increased by 22.3 percentage points, compared to a 19.1 percentage point improvement in England overall.[4] It will be important to maintain this recent progress to enable more young people to progress to STEM subjects in HE.

Between 2003-2004 and 2008-2009, the proportion of GCSE students in the East Midlands attaining an A*-C grade in STEM subjects increased by 22.3 percentage points, compared to a 19.1 percentage point improvement in England overall.

[3] The Russell Group of Universities, '*STEM Briefing Paper*', February 2009.
[4] Jonathan Hall, on behalf of emda and Aim Higher East Midlands, '*Supply and Demand for STEM Skills and Qualifications in the East Midlands*'. September 2010.

The region's Higher Education Institutions demonstrate strengths in STEM-related subjects. East Midlands HEIs have recorded some of the highest rates of increase in student take-up of STEM subjects in England – suggesting that, in higher-level skills, the region has competitive advantages that can be built on. The number of STEM students in the East Midlands increased by 2,815 between 2007/2008 and 2008/09. The rate of increase in STEM subjects in HE in the East Midlands exceeded that experienced nationally, at 17.5% compared to 7.6% nationally. The most popular subject areas included subjects allied to Medicine (accounting for 12% of students) and Engineering Technologies (8%).[5]

The East Midlands has demonstrated a high take-up of Apprenticeships related to STEM, in Engineering, Construction, etc. However, recent employer survey data suggests that the recession has made it more difficult for businesses to take on and retain Apprentices. Just under one-fifth of East Midlands businesses in 2009 believed that the recruitment of Apprentices and trainees had decreased due to the recession. There was a notable concentration of employers stating this in Nottingham City and Nottinghamshire.[6] Between 2007/08 and 2008/09, the number of new Apprenticeships in the East Midlands in Engineering and Construction decreased by over one-fifth in each case. This represents a significant challenge for technician-level skills relevant to Priority Sectors.[7]

Rationale for the *emda* STEM programme

The decision to develop a STEM Programme in the East Midlands was based on strong national policy messages which were reinforced by the policy context in the region.

National policy messages:

- The declining popularity of STEM subjects and the need to increase the number of students choosing STEM subjects post 16
- The mismatch between the supply of STEM skills and the demand within the economy and the need to develop and maintain a science base capable of competing in global markets
- The importance of building a STEM education and training environment capable of delivering a strong flow of STEM qualified people into the workforce
- A step change in the quality of science teachers, including through increased professional development opportunities
- Support for enhancement/enrichment activities for students. For example by supporting universities, industry and scientific societies in their outreach activities to schools and colleges
- Partners and stakeholders need to work together to provide a joined up and simplified approach to delivering STEM initiatives, both nationally and regionally.

[5] HESA, '*Students in Higher Education Institutions'*, 2008/09. Students include postgraduates, first degree and other graduates.
[6] Chris Lawton, Denise Haslam and Szilvia Altorjai, *emda, 'The East Midlands Regional Skills Priorities Statement, 2011-2012*', September 2010.
[7] National Apprenticeship Service (NAS), data provided by East Midlands regional office.

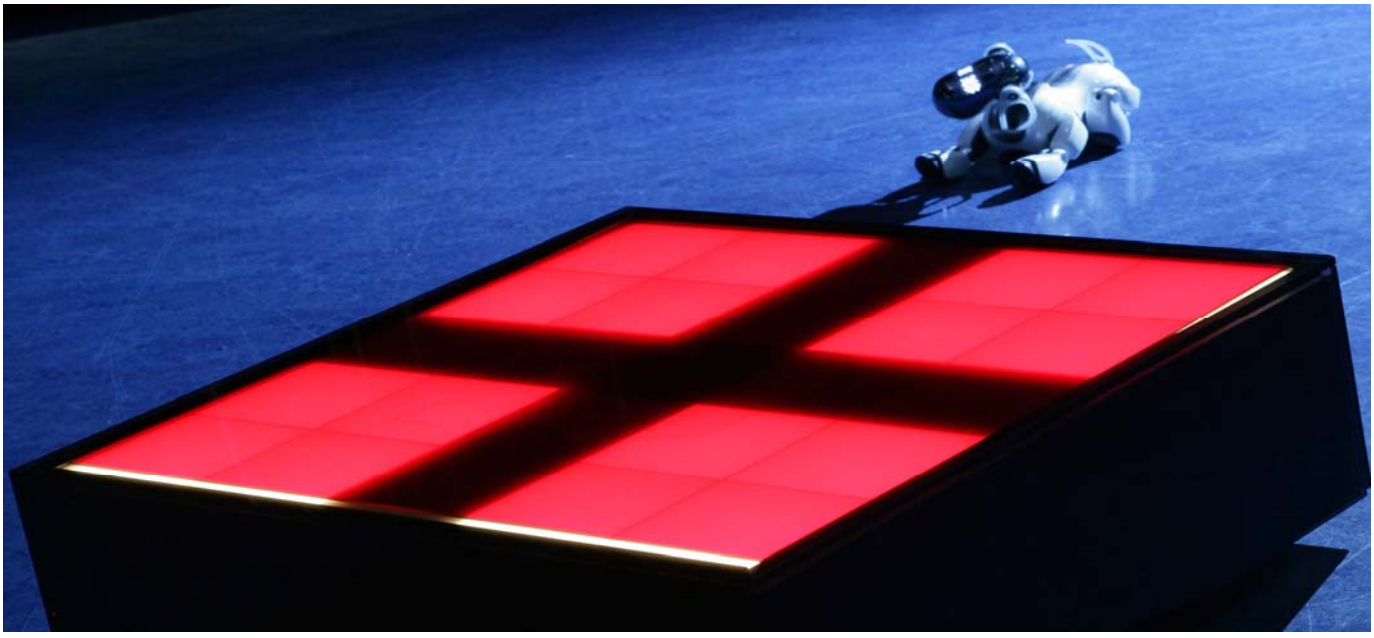
At a regional level the 2006 Regional Economic Strategy (RES) identified four sectors that were likely to make the greatest contribution to the East Midlands' economy - transport equipment, food and drink, construction and healthcare and bioscience. All four sectors were reliant on a STEM workforce but were struggling to fill vacancies in STEM-related disciplines. A Priority Action in the RES was to 'Equip school and college leavers with the skills and knowledge that businesses require by improving the delivery of the provision and coordination of STEM subjects, along with the work-readiness of school leavers.' STEM skills in the workforce for the future will help businesses adapt to change, as well as adopt new technologies and processes. This in turn supported the RES priority action for Innovation 'Developing and applying new technologies'.

The combination of policy momentum at national and regional level and *emda's* lead role in regional economic development provided the opportunity to demonstrate strategic leadership in the STEM agenda.

emda's role

emda defined a clear role in the STEM arena in the East Midlands. It was not appropriate to fund statutory STEM provision in schools, colleges and universities. Therefore the principal objective of the Agency's engagement with STEM was to add value to enrichment and enhancement activity already taking place. The Agency was also well placed to help connect schools with businesses to improve young people's understanding of potential STEM-related careers.

emda recognised the importance of taking a strategic overview, in order to bring greater coherence and impact to the array of STEM initiatives and partners in the region. The approach taken by *emda* was to work with partners to achieve a spectrum of STEM support from primary schools through to universities. The Agency only funded pilot initiatives that added value and expanded partner programmes.



What the STEM Programme set out to achieve

The long term ambition of *emda's* STEM programme was to change how young people perceived STEM subjects – from 'dull and difficult 'exciting and rewarding'.

Through its STEM programme, *emda* aimed to:

- **Engage, inspire and raise the aspirations** of young people by the enrichment of curriculum delivery and targeted support for teachers
- **Connect schools with businesses** to improve young people's understanding of the world of work – especially careers in STEM
- **Provide an over-arching coordination and promotion point** for regional STEM activity, focusing on gaps in order to add value to enrichment and enhancement activity already taking place
- **Encourage and support young people** to progress into STEM subjects in Higher Education and to consider STEM-related careers.

PICTURE: Space Academy, Leicester.

Conclusions

The scale and diversity of projects offered by the *emda* STEM programme has made a significant impact in the region. The programme succeeded in bringing key players in STEM provision together, in order to offer an integrated package of activities to young people of all ages, as well as their teachers.

The projects offered by the *emda* STEM programme made a discernable and significant contribution to STEM education. Feedback from participants showed that the young people were becoming increasingly receptive to STEM study and that they found careers related to these subjects more appealing. At this stage, we cannot be certain whether these attitudinal impacts will eventually translate into greater uptake of STEM related study and employment. However, the programme has undoubtedly raised awareness of STEM for the next generation. With the demise of *emda,* continued investment in STEM enrichment activities is important for partners to consider

Moving forward, the economic importance of keeping STEM high on the agenda relates directly with the structure of employment in the region. A higher than average representation in sectors such as Manufacturing and Construction, will result in a strong employer demand for technician-level skills - which are closely related to STEM subjects. It is therefore crucial that the pipeline of young people engaging in STEM subjects and careers is maintained. The challenge for delivery bodies, such as Local Authorities and LEPs is to work with the grain of the Government's plans for STEM support and to add value and plug gaps appropriate to the needs of their locality. It is important that investment in STEM enrichment activities is viewed as part of a wider portfolio of support for economic development, because STEM skills underpin innovative and competitive businesses.

PICTURE: Nano What? Roadshows

Chapter 3

Project Fact Sheets

PICTURE: Come alive with science

Project Fact Sheet 1

Ignition*

PICTURE: Lab 13 project

Overview

Ignition* is a regional education and awareness raising programme to encourage more young people to take up STEM subjects for study and careers. Ignition* created a diverse programme of activities including projects in which young people and teachers work alongside artists and practitioners to encourage young people to view STEM subjects as creative and engaging.

The project enhanced regional STEM learning experiences through:

	• The delivery of a comprehensive programme involving young people in creative STEM activities.
	• Strengthening links between education and industry; across the arts and the STEM learning disciplines.

Ignition* aimed to increase the pool of leaders in STEM teaching and learning through a range of activities including:

Come Alive With Science

Secondary schools worked with creative practitioners and scientists to devise creative STEM challenges, games and competitions to spark the imaginations of local feeder primary school pupils during National Science and Engineering Week.

Invent!

Pupils were invited to submit their invention prototypes for judging by a panel of scientists. At a day out schools took part in invention workshops, showcasing their own inventions to fellow young inventors and taking part in creative STEM workshops.

Sci-Art Fusions
An enrichment programme commissioning new films on STEM related themes. These were particularly aimed at engaging young people in debates about the ethics and public understanding of STEM discoveries and research. Further commissions, involving a range of art forms such as theatre, dance and the visual arts, were used to engage young people with STEM-related themes and issues.

Creative Sparks
This component identified, developed and supported a cohort of young people (aged 14–21) with exceptional creative abilities and capacities in STEM to act as role models for their peers. Creative Sparks were recruited to help raise peer educational and career expectations and aspirations and they were assigned a mentor. The mentors were provided with training to ensure they worked closely with their Creative Spark.

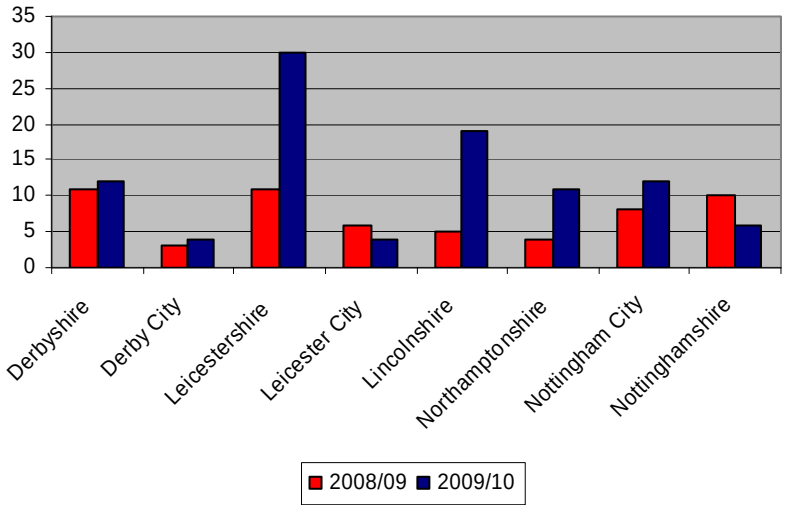
STEM Fluency Lab
A series of Creative Science Labs aimed at meeting the CPD needs of STEM teachers to explore creative teaching and learning through collaboration between artists and scientists. Training was carried out over 5 intensive days with follow-up activities including mentoring support, seminars and sharing events. Teachers supported the CPD needs of colleagues who were less confident in their delivery of STEM subjects.

Lab 13
A lab managed by young people for young people where they can experiment, play, invent, design, solve problems, explore, and work alongside a scientist/designer/engineer in residence. These labs are located in 6 schools, 1 within each Sub Region / County.

IMPACT

• Delivered **3** regional programmes of events for Come Alive with Science activity where **18,265** young people received a minimum of 6 hours learning on STEM.
• Delivered **3** regional Invent competitions which involved **377** young people;
• Produced **7** films, **3** theatre performances and **3** STEM/art collaborations through the Sci-Art Fusions which delivered **827** minimum of 6 hours learning outputs.
• Recruited **9** Creative Sparks and mentors and held **2** residential weekends, which has delivered **53** learning outputs.
• Held **3** STEM Fluency Labs and **2** Reunion events for **55** teachers across the region.
• Established 6 Lab_13s in the region, which has delivered **1452** learning outputs.

CHART 2: number of schools involved by sub-region



KEY LEARNINGS

Participants noted the following factors as instrumental to the success of the Ignition* projects:

- **Using creativity, exploration and enquiry as the approach to teaching STEM** afforded young people an opportunity to pursue their own ideas. Teachers also relished the time and freedom to pursue ideas for developing their STEM teaching.
- **Opportunities to work collaboratively with teachers and other practitioners** from different backgrounds to develop ideas that could be directly applied to improving STEM teaching in the classroom (e.g. creative practitioners, HEI outreach workers, scientists etc.). The use of external partners was said to help take STEM beyond the classroom and the curriculum requirements.
- **Young peoples' contact with real scientists, engineers, inventors and artists** which provided opportunities for exposure to role models from the world of STEM careers.
- **Wide range of activities which enabled young people to be involved as independent learners,** working together, making decisions and determining their own enquiries and solutions to problems.
- **Use of follow up events** which served to maintain interest and enthusiasm of participants, share good practice and help develop a network of teachers across different schools.
- **Strategies for sharing and disseminating good practice** including: peer mentoring; an intranet web platform; the Ignition* website and the Lab 13 'cookbook' of good practice to help support the development of subsequent labs.
- **Ongoing or cross project involvement,** with schools able to experience projects over consecutive years or access multiple Ignition projects.
- **Stakeholder involvement** in development and delivery.

USER FEEDBACK

Student comments:

"In the lesson you're forced to do what's laid out. In there, there's always stuff laid out when you come in, but in class you've just got one thing. If you really want to do something you can ask [scientist is residence] and she'll probably let you. It's really good, it's improved lessons, but it's not a lesson, it's not like you're sitting down listening to a teacher. It's a really good way to learn."

"It's changed the way I look at science and technology because it was a lot more fun than normal lessons are. I do enjoy science more because it's the way I look at it now, it's a lot different. It was the fact that we'd got a lot of room to create whatever we wanted."

"It makes you see that there are different things – science is linked to engineering. Because they [creative/STEM practitioners] talked openly about what jobs they did, it makes you think that all the things are connected, so it's not just being a science teacher, there are loads of jobs that involve science."

PICTURE: Sci-Art Fusion

Teacher comments:

"I think giving the children the independence to learn what they want to learn and giving them the freedom and creativity to be able to do it and the time and not being in a full classroom environment. I can help them on a smaller ratio, so they get more interaction with me - I think that's probably key."

Lab_13
Scientist in residence

"It was very radical, very different - totally different to anything I've been on. Usually you've gone on INSET for a day, 9–4 and you don't always have 'play time' - which is a great way to describe what you do on the STEM Fluency Lab - a lot of 'yeah go and have a go', which is what we try and get our students to do, but you never actually in your day to day time have time to just go and play with kit, with ideas, with experiences, which is what was really good about the STEM fluency."

STEM Fluency Labs

"Everyone has agreed it was fantastic, a worthwhile project that we've really got a lot out of. The head was really impressed with everything as well because it's exactly what he wants the school to be in terms of science, so it was great."

STEM Fluency Labs

CONTACT DETAILS

Ignite! **www.ignitefutures.org.uk**

funded by east midlands development agency

Project Fact Sheet 2

Lab in a Lorry

PICTURE: Lab in a Lorry

Overview

Lab in a Lorry ran from September 2007 to July 2010. It toured all six counties and a range of locations, including universities and public spaces, but primarily visited schools.

The Lab worked exclusively with pupils in the East Midlands, offering the opportunity to explore science through specially created, hands-on experiments. Run by a permanent member of staff (paid for by the Institute of Physics), the facility was also staffed by volunteers, who were practising physicists and engineers.

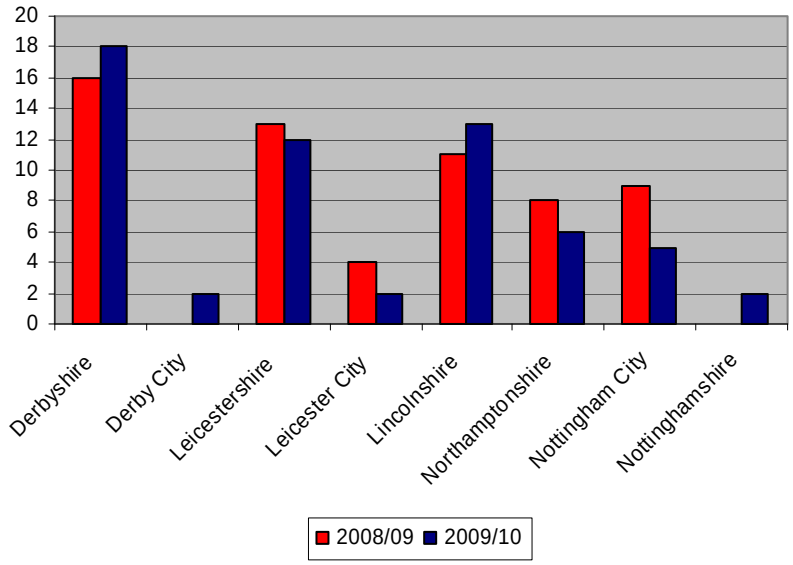
Young people visited Lab in a Lorry to take part in experiments, with a typical visit engaging up to 90 students a day. Development funding for additional experiments, focused on physical science and illustrated scientific excellence and innovation specific to the East Midlands. For example, a spy-themed experiment encouraged pupils to use the latest technology to explore modern computing power and data access/storage. This kept the learning experience offered relevant and varied for return visits.

IMPACT

- Used working scientists and engineers as role models to inspire and enthuse young people about STEM.
- Raised awareness amongst young people of career opportunities in science and engineering.
- Encouraged more young people to study science and/or engineering beyond 16 and to pursue careers in these fields.
- Developed links in the East Midlands between education, industry and universities.
- Used Lab visits as an opportunity to disseminate partner information to schools, teachers and students as appropriate (e.g. information on career and progression routes, suggestions for further STEM engagement opportunities).

	• Supported the work of Local Authorities, Aimhigher and other regional STEM partners in raising achievement, aspirations and awareness in particular schools or groups of students.
	• project worked with **26,253** young people and **138** schools across the East Midlands
	• project delivered 6 hours of training to **391** young people
	• worked with a total of **678** teachers and **1,012** parents

CHART 3: number of schools involved by sub-region



www.labinalorry.org.uk

lab in a lorry

get connected to science

USER FEEDBACK

There was a high level of consensus between project staff, volunteers, students and teachers as to what it is about Lab that made it a success. The main factors were:

- **Direct accessibility**. Schools appreciated enrichment activities brought to their door step, rather than organising trips to events offsite.
- **Widening participation.** The Lab acted as a springboard for advertising other *emda* STEM projects through its STEM Directories and SETPOINT Contract holders.
- **Importance of hands-on learning**. Students spoke about the chance to do something really 'physical' with science, not just 'normal science' where you are sitting down with book, reading about science or being told about science.
- **Face-to-face contact with actual scientists.** Provision that draws on the experience and knowledge of people outside education was said to bring a fresh perspective to STEM study. It helped to dispel stereotypes and demonstrated to young the range of careers available if they choose to study a STEM subject.
- **Flexible delivery**. Experiments and the level of discussion of the science involved could be adjusted to suit a variety of audiences.

USER FEEDBACK

The lab experience was felt to have injected a 'wow' factor into science learning that **'we can't often achieve in school'.** Volunteers worked with children in small groups and the young people themselves recognised the benefits that this brought: **'you get a chance to actually do the practical…. you have more personal contact… everyone can touch stuff as well'.**

Students were of the opinion that activities like Lab can stimulate young people's interest in STEM: **"It makes you feel it's more interesting and more important…. It makes you feel more connected to science, so you know how it works – you feel that you know how to do it."**

Interviews with students helped identify the aspects of the Lab that really appealed to young people. Seeing science put into practice was a clear favourite: **"We're always seeing it in books… and you never get to see anything for real. And then you get to go on the Lab and actually see it. I think that's what's so good about it, you can actually see the theory in practice".** (year 12 student).

Project Fact Sheet 3

Nano what?

PICTURE: The 'Nano What?' Roadshow in Nottingham

Overview

NanoWhat? was a high profile programme of events that took place between April and July 2008. The aim of the programme was to increase awareness of nanotechnology amongst schoolchildren and the general public and was provided by a partnership comprising the region's eight universities as well as representatives of emda, Nottingham Science City, iFestival, the Learning Grid and local authorities.

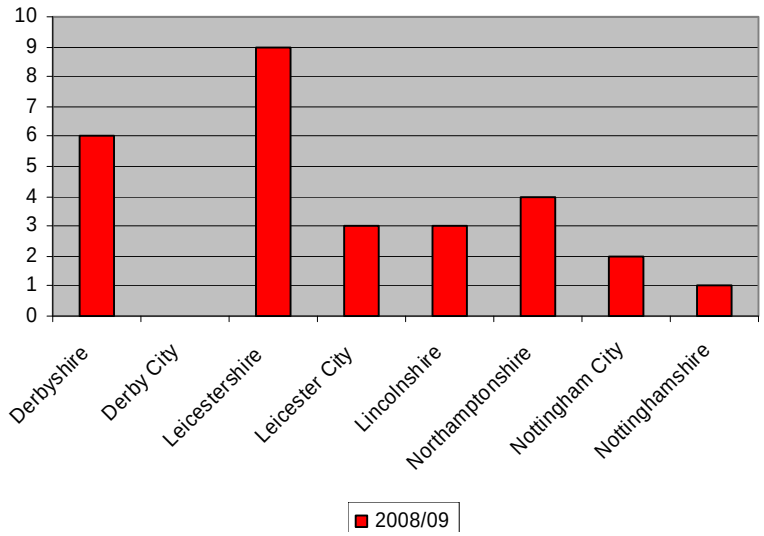
The road show visited four East Midlands city centres as well as Lincolnshire Showground and Rockingham Speedway. The purpose of the road show was to provide hands-on demonstrations of nanotechnology in everyday life as well as illustrate career opportunities in the area of science and technology.

The activities were housed in three, interconnected and highly visual domed marquees and comprised 18 interactive displays, a linked website (www.nanowhat.co.uk) and a schools' pack including a Student Workbook and Teachers' Guide aimed at Years 7-8.

IMPACT

	• Raised the interest amongst students in studying science and changed the public's and young people's perception of science and technology across the region.
	• Encouraged greater connections between schools and HE.
	• Improved students' awareness and understanding of STEM careers
	• The materials helped teachers to develop their ideas with visual examples at the Road show itself, increasing the potential contribution to both teacher and students' (professional) development.
	• The road show ran for 17 days and attracted in excess of **24,000** visitors including **1,296** schoolchildren and **23,000** members of the public

CHART 4: number of schools involved by sub region



KEY LEARNINGS

Feedback from students, teachers, parents and stakeholders suggest that their experiences of the road show were very positive and that it achieved the desired impacts. Key success factors were:

- **Diverse range of activities:** hands on demonstrations which engaged the attention of students; use of prizes, which was appealing to children; use of a nano quiz which ensured that visitors read all the information on nanotechnology and went to all areas within the marquees; interactive computer games within the theatre which encouraged visitors to sit and watch the film
- **Strong event planning:** locations with a 'high footfall', chosen with the help of local authorities; events with a broad appeal across the range of abilities and not constrained by adherence to the National Curriculum; events being heavily staffed with students and academics who were there 'for the fun of it' and very enthusiastic about sharing their knowledge with the public; the use of marketing / communications and events experts
- **Engagement with a wide variety of groups:** with a focus on engagement of parents and careers, the project was particularly important for hard to reach groups where the views of parents and other adults influence the subject and careers choices of young people; the wide-ranging application of the technology, which made it possible to engage people in a variety of different ways.
- **Enthusiasm and knowledge of participants:** strong leadership with the project being championed by individuals with passion and credibility, and fronted by a respected institution;
- **Involvement of universities:** the alignment of the HEIs and a strong collegiate approach to the initiative created strong mechanisms for partnership working, with the model encouraging shared ownership and a commitment to the success of the events, but allowing each institution to preserve and promote its own identity.

USER FEEDBACK

Students' comments indicated that many young participants found their visit to the road show a positive learning experience**: "very interesting and I learnt a lot"; 'I enjoyed learning how tiny the nanometres were."**

Students even signalled a more lasting influence**: "I've learnt loads of science information and [it] has encouraged me to find more of an interest in it".**

Teachers also highlighted the fact that the road show was very popular with students: **"It sparked the pupils' imagination towards science and its use in the future"; "The more things they see, the better their understanding"; "The students enjoyed it and it furthered their knowledge and understanding of a new aspect of the KS4 science curriculum"**

Parents also appreciated the events*:* **"Excellent material and show. My children really enjoyed it and got a lot from it"; "This has been an excellent event that was organised well and was very motivational".**

Project Fact Sheet 4

Space Academy

PICTURE: Space Academy at the National Space Centre, Leicester

Overview

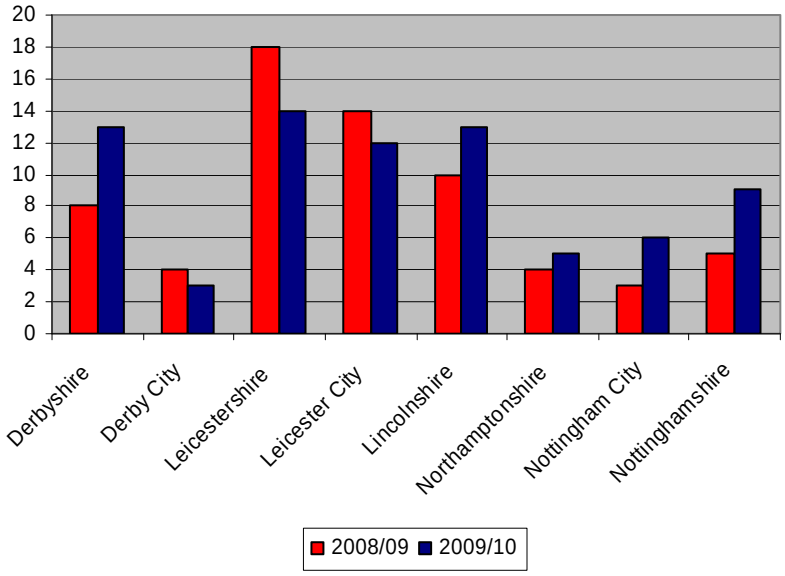
The Space Academy is a curriculum-focussed space education programme delivered by the National Space Centre. It uses the context of space exploration to support and embed curriculum studies in science and maths. It is delivered in partnership with the Universities of Leicester and Nottingham, the Science Learning Centre East Midlands and STEMNET, establishing the East Midlands as a leader in space/science education.

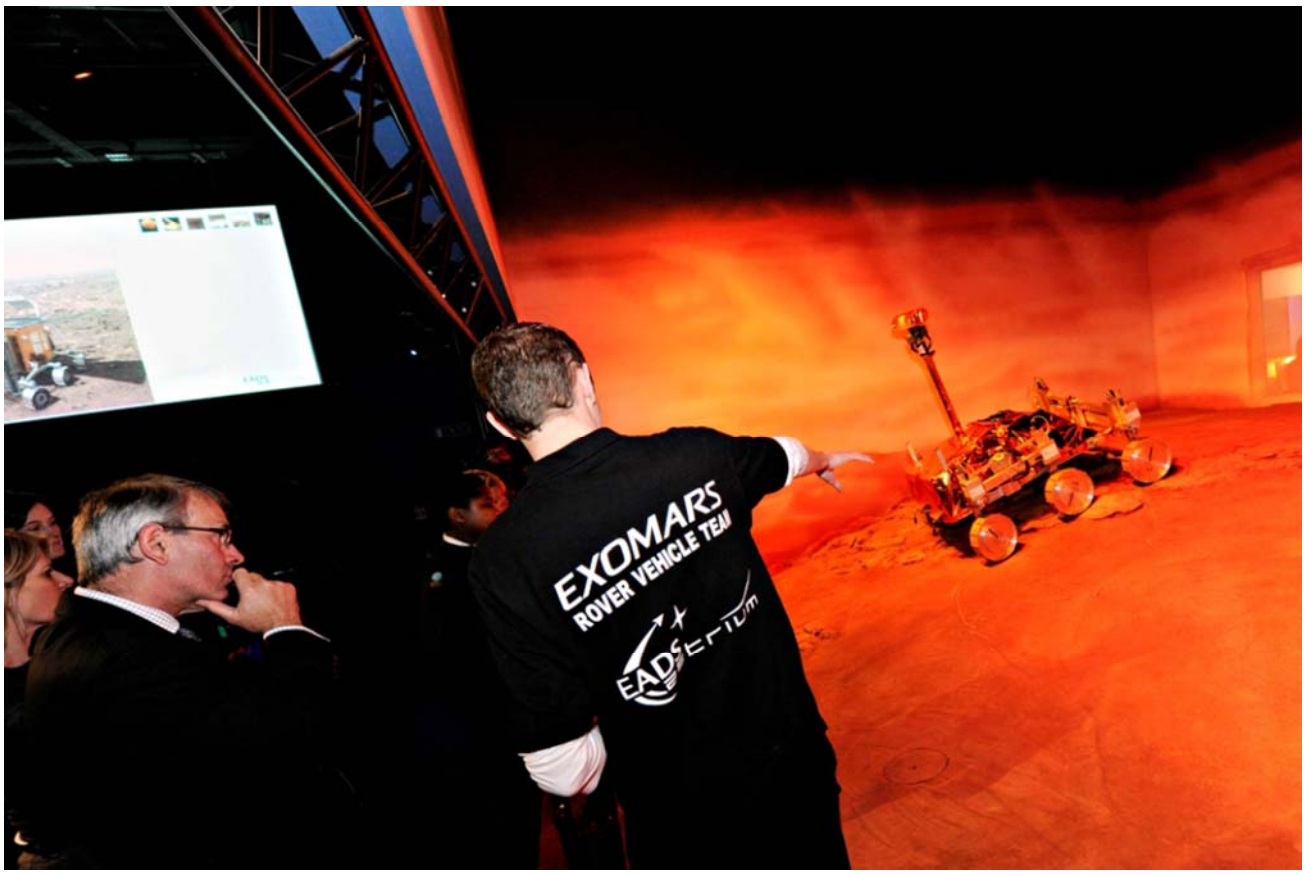
The Space Academy programme was officially launched in October 2008 and will run until 31st August 2011. It aims to contribute science-based skills to the region's workforce, offer specialised training for science teachers and develop young people's interests in careers in STEM using space as the inspirational hook. It also raises awareness of the scope and opportunities for professional careers in regional hi-tech industries.

IMPACT

- Delivered **8** careers events which brought together **788** students, their teachers, representatives of FE and HE institutions, and space industry/STEM employers;
- Developed **6** master classes (intensive day-long courses) by active researchers and expert teachers for KS4 and KS5 students, to date **2547** young people have benefitted from the delivery of the classes;
- Delivered **5** road show/outreach events aimed at the 14-16 age group across the region
- Space competition for Summer School, Space conference and Road Show students. So far, **61** places at the Space School UK have been awarded and a further **14** will be allocated following the 2011 competition.
- Delivered CPD events for **195** science educators. The three-day conferences were designed to help teachers see the relevance of space to different aspects of the STEM curriculum

TABLE 5: number of schools involved by sub-region





PICTURED: EXOmars Robot at National Space Centre

KEY LEARNINGS

Feedback from students, teachers and stakeholders suggest that their experiences were very positive and that it achieved the desired impacts. Key success factors were:

- **'Space sells' - focus on space and space science was pivotal to the projects success:** both facilitating the teaching of a wide array of concepts and providing an inspiring context for the development of knowledge, skills and ambitions in both young people and adults.
- **Involving individuals with both teaching and research expertise:** delivery and content have been very carefully considered and resourced; the lead practitioners are all Advanced Skills Teachers or graded by Ofsted as 'outstanding'; the involvement of the post-doctoral researchers ensures that the science being brought into the classroom is accurate and up-to-date; introducing active scientific research to bring about the realisation by students that they can understand contemporary research
- **Conference planning:** delivered professionally; plenty of variety and opportunities for meeting people; infectious enthusiasm of those delivering the workshops; right balance between theory and practical application
- **Variety of ideas for the classroom:** Overt curriculum value of the events attracted student and teacher involvement; activities could be readily implemented when teachers returned to the classroom; to develop classroom practices further, teachers were given a physical resource that they could take away, in the form of a rocket launcher which could be used at different stages of learning, from key stage 3 right through to physics A level.
- **Value of partners:** partners in industry commended the professional management and organisation of meetings and events and the reassurance that their contribution was valued, and worth sustaining.

funded by east midlands development agency

USER FEEDBACK

"I loved it, it was absolutely fantastic, probably the best sort of course I've ever done! I was buzzing for weeks afterwards. "

"It's the best thing I've experienced in 30 years of teaching, I definitely would say that, because of the way it was done, the way it was constructed. "

"I really enjoyed the KS3 and KS4 workshops – they were a little bit more hands-on, a bit more physical, and actually they were the sorts of things you could take away and use in your classes … interesting things that would make the kids go 'wow' but were relatively easy. You don't have to do a lot of planning for them but it made the kids automatically engage, from the beginning, because they wanted to be involved with it, or they wanted to see it again."

I've got certain classes, that there are certain things that maybe I wouldn't have tried, but then I thought 'You know what? I'm going to give this a go!' And it was like all of a sudden, a class that maybe you would have spent five minutes getting settled, were settled in the first minute because they're like 'Oh, I want to see this, I want to do this!' And it actually made them engaged and enthusiastic about what we were doing that day.

CONTACT DETAILS

National Space Centre. **www.spacecentre.co.uk/Page.aspx/194/SPACE_ACADEMY**

funded by east midlands development agency

Project Fact Sheet 5

STEM Scholarships

PICTURE: STEM is being targeted at University level. (Denise to check)….

Overview

The project was developed by the East Midlands Universities Association, its members, and Aimhigher East Midlands, to provide support to students from within the region who were considering studying a STEM (Science, Technology, Engineering & Mathematics) subject at one of the region's universities.

The project offered two consecutive cohorts of students a scholarship to the value of £1,000 per year for each year of a three year undergraduate degree in one of the strategically important STEM subjects.

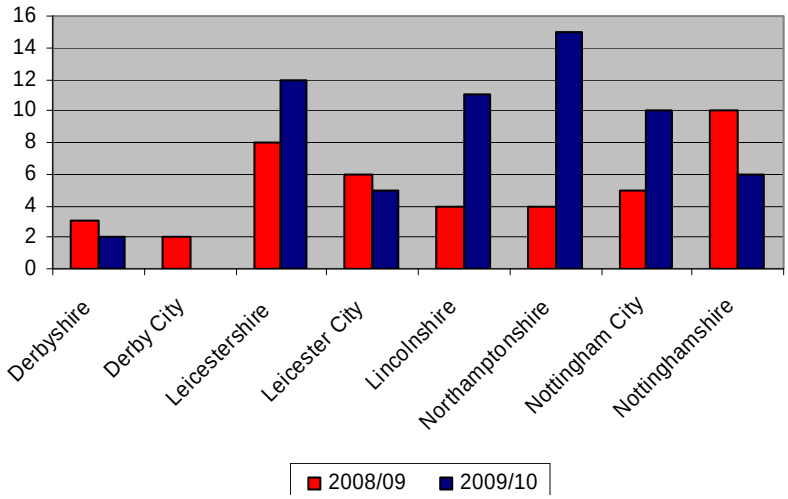
The project targeted potential students from groups which were underrepresented in higher education and STEM subjects specifically. Students were also able to participate in additional activities designed to enhance employability skills and to enable those in receipt of bursaries to meet as a cohort. Annual award holders' conferences were held and covered relevant themes such as entrepreneurship, employability, interview skills and the presentation of project material in the final year of the degree.

Students were also encouraged to take part in the opportunities provided by the universities for personal development and guidance on career choices. Employers were asked to speak at the event, either to talk about their own success in STEM careers or to provide information on their graduate employment programmes. These included Rolls-Royce, 3M, AstraZeneca, Mars, Jaguar Land Rover, Price Waterhouse Cooper and the National Space Centre. Careers workshops were also facilitated by industry experts including the CBI and the National STEM Centre.

IMPACT

- Bursaries helped **143 students** to successfully complete a STEM degree in a regional HEI from **2007 to 2011**
- Delivered **373** six-hour learning outputs for undergraduate students from the yearly conferences.
- Receipt of the award gave recipients more confidence and helped their parents be more positive about them going to university
- Increased retention within the East Midlands, for both first degree uptake and post-graduation (either to work or to complete further studies within the region).

CHART 5: number of schools involved by sub-region



KEY LEARNINGS

- **Annual conference**: provided networking opportunities and practical advice around securing STEM related employment. The conference raised students' awareness of post-graduate employment opportunities, and encouraged them to start thinking about their careers earlier than their university peers.
- **Interaction with employers**: this was deemed as one of the most useful aspects of the conference due to the two-way interaction with employers
- **Financial assistance:** allowed students to focus on their degrees and for some, the financial assistance received through the EMSTA was a factor in their decision to remain at university rather than drop-out.
- **Grant award:** by providing the financial assistance as an award that had to be applied for, it boosted students' confidence and self belief, particularly for the under-represented groups.
- **Partnership working**: the commitment and cooperation of local partners, including Aimhigher, employers and university staff and the strong links made to other activities, such as guaranteed interviews for Hot Prospects and routes into the STEM Ambassadors programme, were seen as integral to this projects success.

USER FEEDBACK

"There were only two at Northampton Uni in my year who got a bursary. Going to uni was a big step as a mature student and on notification of the award I remember thinking, 'Wow, I actually got it – perhaps I can do this, perhaps I am better than I thought, it's achievable'. So it does, it gives you a big lift."

Environmental management student

"The best thing has been the big conferences. Because it's something different, rather than going to your course and things like that. It's a big event and I find it really rewarding. Plus it's very relevant to what you're doing, its completely tailored."

Microbiology student

"It gave me a real confidence boost, someone believing in me and thinking I will become successful."

"I was able to talk about how my scientific skills were needed in the working world and I knew in my interview what to talk about…. It helped me find my placement because I was able to talk about the advantages of my course."

Microbiology student

Project Fact Sheet 6

The East Midlands STEM Partnership

PICTURE: Stem Fluency Lab

Overview

The STEM partnership brought together individuals and organisations in the East Midlands with an interest and involvement in STEM education. The partnership included practitioners, educators, representatives from STEM-related industries and policymakers. The purpose of the Partnership was to share ideas, information, knowledge and best practice relating to STEM education

The STEM partnership sought to:

- **Rationalise and join up** regional STEM activity across all educational sectors
- **Identify gaps in provision** and suggest collaborative ways to fill these
- **Ensure that STEM support** activities were promoted to both educational and business sectors
- **Present a regional model** of best practice to other regions.
- **In connection with the STEM partnership project**, The Marketing Division (TMD) organised and delivered a range of activities, including:

- **Forum events** for STEM stakeholders
- **Development of a STEM Partnership website** to link up and promote all STEM activity across the region and the use of e-marketing to communicate with partners, specifically by circulating a monthly e-newsletter and emailing partners with targeted information about relevant events.
- **Organising and facilitating** quarterly STEM Partnership Steering Group meetings.
- **The running of a STEM Student Journalist project, with an annual competition.** This project involved students between the ages of 11-22 reporting on news or features associated with STEM subjects.
- **Organising and facilitating Partnership teleconferences:** The bi-monthly teleconferences allowed partners to share ideas and discuss STEM issues.
- **Public relations activities:** articles about the work of the STEM Partnership have appeared in ‘Science in Parliament’ and ‘Investment Now’.

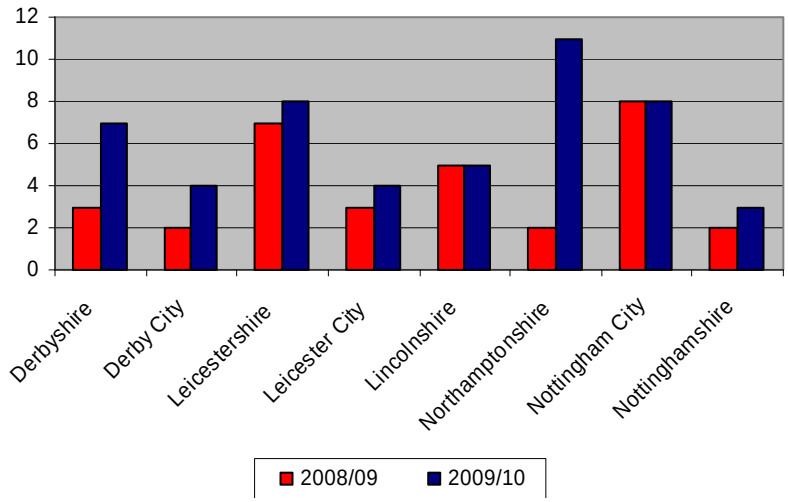
IMPACT

- Seven forum events for STEM stakeholders: These events were attended by a total of **544** individuals, from **147** organisations. Topics covered during the forums included identification of regional strengths and weaknesses for each of the four STEM subjects; the importance of employer engagement in STEM education; the wider application of maths and STEM careers.
- **100** students actively took part in the STEM Student Journalist scheme, with a further **300** attending media workshops.

Strategic level impacts:

- The forums were valued for information exchange and networking opportunities. The opportunity to meet others from the STEM community was consistently cited as the main motivation for attending forum events, suggesting that forums serve as an important vehicle for networking in the region.
- The website was 'widely admired' by equivalent groups in other regions. It was also regarded as a useful means for communication and sharing success stories.
- Others felt that partnership had strengthened links in the STEM community and that the network had created a synergy between projects.

CHART 6: number of schools involved by sub-region



KEY LEARNINGS

- Having a **dedicated team** to drive and develop the partnership
- An **integrated communications and partnership strategy** that utilised partners as the key channel
- A **focussed PR campaign**, investing funds and efforts in a small number of high quality activities (such as the STEM student journalist scheme)
- **Events and forums** that are a valuable means of sharing ideas, networking and gaining information
- **Use of a variety of dissemination methods** and channels that allow interested parties to communicate (e.g. forum meetings, website, e-newsletter etc.)
- **Encouraging projects to make links** and to think about promoting each other, working more closely, and coordinating who they are targeting
- **Use of time-limited impact teams** with small teams of individuals focusing on specific task e.g. forum events, marketing and branding.

USER FEEDBACK

"The rules are, there are no rules. They can turn up if they want and they can stay as long as they want and all I'm asking them to do is go on to the internet or look at newspapers, look for something that could be of interest to them or could be of interest to the rest of school."

"The forums in particular have been excellent opportunities to engage in networking, knowledge transfer, and debate on regional and national levels".

"The website is an extremely useful and easily accessible resource".

Student

"Discovering what other teachers are doing and what activities are out there has really helped me bring STEM subjects alive inside the classroom."

CONTACT DETAILS

The Marketing Division **www.themarketingdivision.co.uk**

funded by east midlands development agency

Project Fact Sheet 7

Engineering Development Trust (EDT) STEM Pathways

PICTURE: School children learning day at Caunton Engineering

Overview

The Engineering Development Trust (EDT) offered a package of work related STEM activities for young people in the East Midlands. The overall intention of the EDT programme was to provide an integrated succession of work-related STEM activities to inspire young people into STEM related careers.

The project built upon the existing programmes of the Engineering Development Trust in order to expand participation in the East Midlands regions. In all, EDT offered five strands of:

Year in Industry (YinI) provided students with work placements at engineering and technology companies. Placements lasted for either 6 months or a year and were available to students in a gap year between A levels and university or as a sandwich placement after the 2nd or 3rd year of a degree.

Headstart is a well-established education programme aimed at encouraging young people interested in mathematics or science to consider technology-based careers. The scheme provides an opportunity for year 12 students to spend up to a week in a HEI, getting a taste of university life, prior to completing their UCAS form. Students spend a week on campus experiencing a STEM degree course alongside participating in activities with local employers.

Go4set links teams of six year 9 students with companies and universities to offer a ten week STEM experience, working on real issues/problems identified by companies. Teachers can also receive accreditation for their involvement.

The Engineering Education Scheme (EES) links teams of four Year 12 students and their teacher with local companies to work on real scientific, engineering and technological problems that help resolve a genuine business need for the company. Students are mentored by an engineer from the company during their time on the scheme (normally 4-6 months). The scheme also involves a residential component at a local university where the students are able to use the university's engineering facilities.

Headstart Dragonfly (years 9-12) and 1st Editions (years 9-10) are one day experiences involving students in STEM activities which seek to widen participation. 1st Editions is focused on under-represented groups, and Dragonfly is targeted at female pupils.

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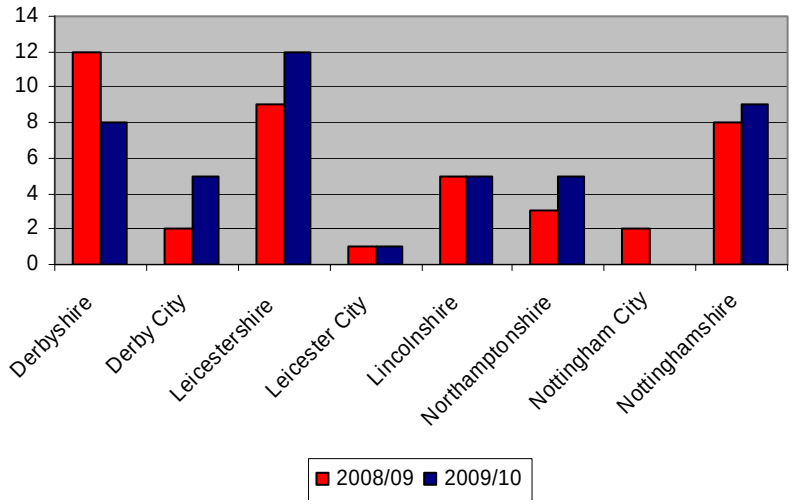
To promote and support the various EDT projects, a number of annual events were organised including:

- **Launch events for EES and Go4SET:** attendees included the team students, teachers, company mentors, university partners, prospective partners in academia or industry, Setpoint representatives and the local media.
- **Celebration events for YinI, EES and Go4SET:** a celebration of the students' projects and to also market the schemes. Students displayed their projects and were also assessed for awards such as Crest or industry sponsored awards in the case of YinI. There were also keynote addresses from senior industry and academic figures.
- **Recruitment events for YinI:** an annual company interview day for YinI placements. Company representatives interviewed a pre-agreed list of students to help fill their placements. The format allowed companies to interview students in a time efficient manner and allowed students to gain formal interviews with more than one company on the day.

IMPACT

	• Provided **713** young people with a minimum of 6 hours of learning across the various strands of activity.
	• Assisted **20** teachers to gain better knowledge of STEM careers opportunities and the skill requirements of STEM employers.
	• Improved teachers' abilities to build real work applications of STEM into teaching and an opportunity to pick up ideas from the companies and universities that they worked with as part of the programmes.
	• Engaged **39** businesses across the region to become more involved with schools and educational issues, allowing them to put something back into their local community.

CHART 7: number of schools involved by sub-region



KEY LEARNINGS

Across the various EDT projects the following factors were associated with effective practice and the success of the schemes:

- **Seeing engineering in practice:** Students involved with EDT projects welcomed the opportunity to see engineering applied to real world problems. Knowing that their solutions would actually make a difference was extremely motivating and helped them understand the practical relevance of engineering.
- **Company site visits** as part of Go4set proved to be very popular. Students and teachers alike enjoyed these and learnt a lot from talking to employees about their jobs, seeing the projects they were involved in, and understanding better the link between STEM subjects and work carried out in the real world.
- **Building on an established reputation:** YinI, Headstart and the Engineering Education Scheme are all well established projects, renowned for offering quality provision, as well as delivering benefits for all involved.
- **Opportunities to progress onto other EDT projects:** The fact that EDT offers a package of provision, targeted at different ages was seen as strength of the programme. Schools and young people can take advantage of a pathway of activities should they be interested in pursuing STEM further.
- **Good relationships with universities:** Positive relationships were seen to have developed due to the benefits available to participating universities.
- **Support for schools:** by allocating resources to mentoring lead to the successful engagement of schools.

USER FEEDBACK

Go4SET

“You were picking up skills, but didn’t realise it. Especially with maths – we had to work out how much energy the school uses and converting from kilojoules to other measures – it was quite complex maths. “

Engineering education scheme

“I had given up on engineering as a degree choice, but this has made me think about doing it again.”

Year in Industry

“YinI has driven me to enjoy [my degree] more because I've got more experience and can actually see where what I am studying is relevant and comes in useful in the real world.”

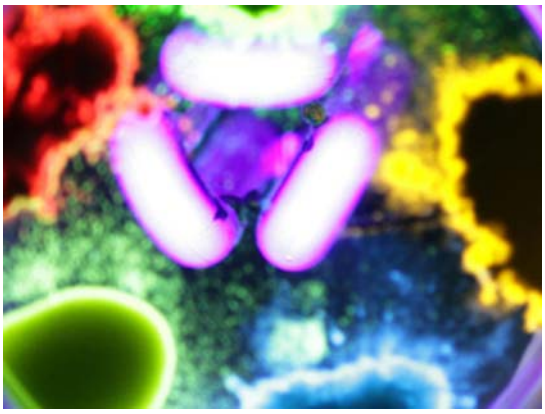
CONTACT DETAILS

Engineering Development Trust. **www.etrust.org.uk**

funded by east midlands development agency

Project Fact Sheet 8

Science in the Peak



Overview

Science in the Peak was a four day event held in Buxton, Derbyshire that aimed to promote STEM subjects to students and raise their awareness of the range of STEM related occupations and progression pathways into STEM based employment.

Held at a variety of venues in Buxton, it also linked up a number of satellite sites within the locality which were of scientific, geological or environmental interest. The setting in the heart of the Peak District and the use of key sites within this rural locality enabled the event to promote STEM technologies and opportunities across a wide range of environments and demonstrate the clear linkage between STEM technologies, the living environment and the daily lives of the beneficiaries who attended the event.

The series of events held at Buxton as part of the Science in the Peak project was extensive.

Examples include:

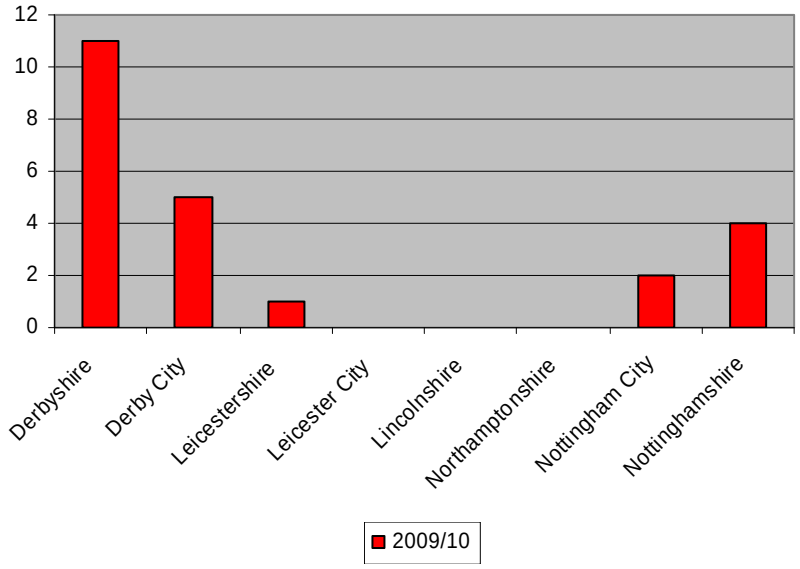
- 12 workshops including ‘Crime Scene Investigation’ and ‘Chocolate Frenzy’;
- A ‘Kinetic Theory’ Lecture;
- A daily STEM master-class for sixth form students
- A hands on exhibition including Medieval machines, and games as part of Darwins’ theory of evolution.

IMPACT

	2,500 students received a minimum of 6 hours of learning
	▪ **4,800 young people** visited over the **4 days**
	39 schools from across Nottinghamshire, Derbyshire and Leicestershire visited the event
	41 businesses engaged with event as either participants or exhibitors
	100 teachers or members of school workforce involved with event

funded by east midlands development agency

CHART 8: number of schools involved by sub-region



USER FEEDBACK

The majority of pupils who attended the Science in the Peak found the day to be interesting, educational and well organised. Most reported learning new things in the workshops and found the lectures and exhibitions were interesting, exciting and informative.

'Showed that science was fun and interesting; engaged students and made them aware of how it affected their lives'

Teacher comment

'The event itself was excellent – very well organised; very high quality publicity materials.'

VIP comment

'This was a great start to what I hope will be a regular feature.'

VIP comment

Project Fact Sheet 9

The Learning Grid

Overview

The Learning Grid was created to meet the needs of students, teachers and industry by bringing together different programmes and running competitions for young people. These activities were all linked to engineering, science, design, technology or mathematics. Several were included as part of the National Curriculum. The Learning Grid offered safe and effective learning opportunities for **school pupils and students**, giving them the chance to develop their practical scientific and technological skills.

It was promoted and funded by Motorsport Development UK (MDUK) whose aims were to sustain and develop Britain's world-leading motorsport industry. Motorsport is an exciting and attractive way to encourage young people to consider engineering as a career. Learning Grid approved activities aimed to offer students a chance to get involved in engineering from its basic principles to the design and manufacture of cars, either in model form or as actual track-worthy vehicles.

The Learning Grid Guide brought together a wide range of STEM related events, competitions, short courses and awards for young people from primary school to university. The Guide was first published in 2006 and enlarged and enhanced in 2009.

The 2009 Guide featured the 22 activities that achieved the **Learning Grid "Approved" Quality Standard** as at June 2009 and included an Activities Map (see below) showing the Key Stages they were designed for and the level of commitment required to participate - from a single day to a whole year's work. A description of the Approval Process can be found at http://webarchive.nationalarchives.gov.uk/20090507080558/http://www.learninggrid.co.uk/quality?s=4besmu51otn9lho.

Activities covered every age group and interest and the information given included links to the curriculum. The Activity Map gave the timing of regional and national finals, together with national celebrations such as Science and Engineering Week and the Rockingham Festival, a 3 day event held annually at Rockingham Motor Speedway, near Corby. The Festival gave young people from 8 to 16 the chance to try a variety of activities including workshops, shows and race events. Each school received an activity programme for their visit to the Festival, tailored to

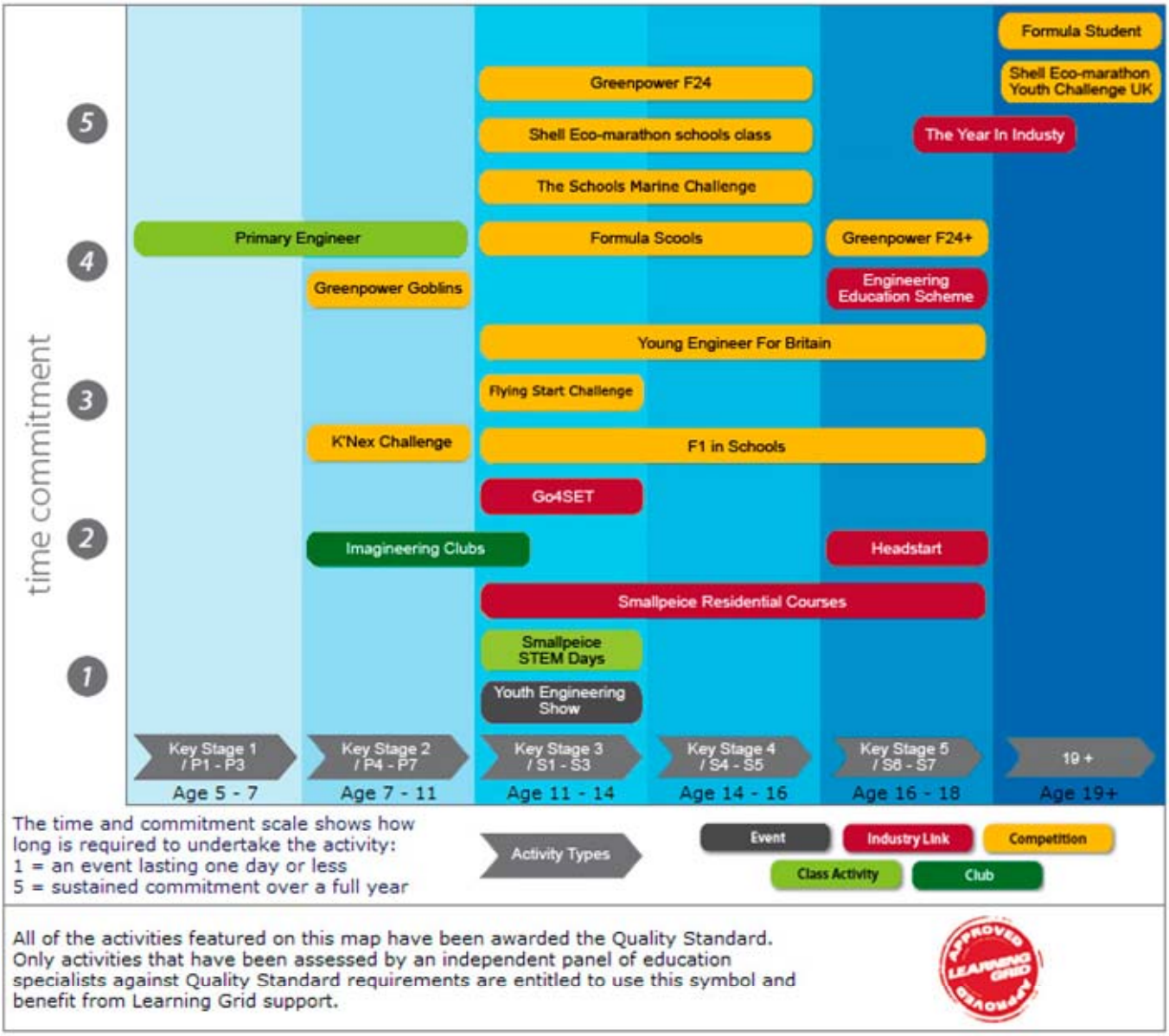
need and age range. In 2008 over 2,400 pupils and 276 teachers from 64 Primary and Secondary schools across the UK came to the Festival. 97% of teachers agreed that the activities offered curriculum enrichment opportunities that were relevant to their pupils.

Activities were designed to balance hands-on workshop activities with entertainment, including free-time to watch Learning Grid competitions taking place on the track. It also provided an opportunity for teachers to assess the suitability of Quality Standard activities on show for use in their own school and meet people already involved.

All of the activities featured on this map were awarded the Quality Standard. Only activities that were assessed by an independent panel of education specialists against Quality Standard requirements were entitled to use this symbol and benefit from Learning Grid support.

PICTURE: Shell Eco-Marathon

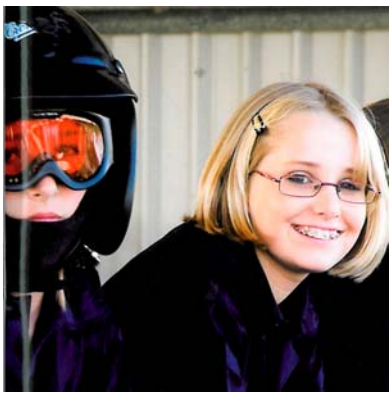
CHART 9: Activities Map – Primary to University



IMPACT

Ekosgen were commissioned to undertake an evaluation of the Learning Grid in 2009. The full impact can not be accurately gauged until 10-15 years into the future, because the Learning Grid worked with children as young as five years (e.g. Primary Engineer). The impact of the Learning Grid can therefore best be measured by the number of young people engaged in quality assured activities and the number of schools engaged. Based on reported management information, the gross impact for all Learning Grid accredited activities is 242,713 pupils engaged (gross) (excluding KS 5+). Based on a total investment of £4m, the Learning Grid has appeared to generate an increase of 98,636 pupils engaged and this is equivalent to £40 invested for each pupil engaged.

Gross to Net Summary - Increase in Pupils Engaged	
• **Gross - all activities**	**242,713**
Deadweight (for part-funded activities) - 32%	9,257
• **Adjusted gross - all activities**	**233,456**
Deadweight (for LG delivery roles) - 35%	81,710
• **Sub-Total**	**151,747**
Displacement - 35%	53,111
Leakage - 0%	0
Substitution - 0%	0
• **Sub-Total**	**98,636**
Multipliers - 0	0
• **Net - all activities**	**98,636**



KEY LESSONS

- **Wide Range of Activities**. Early into the programme, the Learning Grid expanded its remit to cover a broader range of engineering-type activities and provide a greater contribution to the STEM agenda. This approach has been welcomed by the majority of stakeholders.

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- **Independent Quality Assurance.** Over the evaluation period, the Learning Grid has faced recurring questions over what differentiates it from the existing landscape of engineering promotion and its quality assurance role is frequently cited as an example of added value. In contrast to the STEM directories, the Learning Grid insists on independently quality assuring activities before they are included in the Learning Grid guide.

- **Grant funding** was found to be a very important factor for activity providers for increasing the number of schools and pupils they were able to work with. For these activities, providers were more likely to note that the increase in schools and pupils taking part would not have occurred to the same extent without the Learning Grid. Grant funding has largely been allocated based on helping those that can demonstrate highest returns in pupils involved, and those that would not be able to fund the activity without the Learning Grid support.

USER FEEDBACK

"Just to say a big Thank you for the fantastic time that 7 of our Year 6 children had at Rockingham Festival last Wednesday. They were absolutely enthralled and excitedly fed back to the rest of us when they returned. Many thanks to the mentor who accompanied them during their stay. The teacher that accompanied them has thoroughly recommended it. If it's possible we would like to bring our whole Year 6 if you were organising it for 2009"!

Market Harborough C of E School

"There is a shortage of engineers in this country. As an industry, we need to motivate kids through iconic projects. We need to deliver a message that engineering is fun and challenging, but at the same time, that it can do good and help save the environment. The next generation will be more focused on combating climate change. The motorsport industry has the potential to be a leader in this field as a unique testing ground for green technologies."

Lord Drayson, Honorary President of the Motorsport Industry Association and racing driver.