Evaluation of Einstein Year

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By

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Information relevant to this report

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Executive Summary

1. Launched at the UNESCO building in Paris on 13 January 2005, the World Year of Physics was established at concern over the general public's poor awareness of physics and its importance in our daily life. The 100th anniversary of Albert Einstein's *annus mirabilis* offered a unique vehicle for the physics community to promote and celebrate physics. The Institute of Physics defined its role within the World Year of Physics as a coordinator within the physics community of the UK and Ireland and with this established Einstein Year.

2. Einstein Year was launched in January 2005 with a high profile BMX stunt team doing a new manoeuvre termed the Einstein Flip performed by an 18 year-old to emphasis the focus on youth and excitement. The year was characterised by a series of activities:

   - A centrally coordinated programme of high profile, participatory outreach activities.
   - Schools, youth groups, universities and museums developing and running physics-based outreach activities for their local communities.
   - A small awards grant scheme to provide financial support for locally run activities.
   - Resources to provide practical support for locally run activities.
   - A website (www.einsteinyear.org) to act as a focus for the whole initiative.
   - A public relations campaign.

3. The aims of Einstein Year were:

   - Changing attitudes among young people to physics
   - Increasing the quantity and quality of physics outreach activities
   - Building sustainable links between physicists and their communities.

4. This report brings together the findings from fieldwork that used:

   - a questionnaire-based study of attitudes towards science and scientists among 11-14 year olds undertaken across the UK and Ireland over the year
   - observations, interviews and focus groups at Einstein Year events
   - an analysis of the materials used to promote Einstein Year.

5. Einstein Year resulted in positive images of science being presented to a wider community than those who commonly attend science events. Different activities throughout the year were described by attendees as fun, exciting and interesting – often against people's initial judgement. Media profile and interest waned towards the end of the year but was still evident.

6. Over 500 events were enjoyed significantly by those who attended them. Fieldwork revealed a high standard of events run in a professional manner. The ages, needs and interests of the potential audiences were well considered, on the whole, though there was less of a focus on the 11-14 year age group in the events than had been anticipated at the outset.

7. As a result of the Einstein Year focus on physics, people have had positive physics-related experiences. Overall, many people stated that they found they had learned some new piece of information or found out something interesting about physics, science or scientists, and about Einstein too in some cases. Some people were

encouraged to think and look at the world differently, through the eyes of a scientist, and found that they enjoyed the experience.

8. With regards to attitudinal change towards physics, young people who stated that they had participated in Einstein Year events showed a small but consistent increase in interest level over non-participants. No significant changes were found in participants' opinions about the impact of science and technology on society nor about their attitudes to scientists and their work. However, there is a consistent trend of decreasing interest in science from age 11 to age 14 and generally a lower interest level among females of these age groups compared to males.

9. There is a persistent recollection among the public in the early part of 2006 that Einstein was somehow a feature of 2005.

10. The Institute of Physics has developed relationships beyond its normal community and now needs to build on the energy and enthusiasm that has been generated.

11. The findings of the evaluation have been distilled into a number of points that might be considered by future 'year of' celebrations and should be equally useful to ongoing outreach and public engagement activities. We propose the following:

    - Have a plan for the year but leave room for flexibility to respond to emerging ideas, often arising from early events.
    - Develop a mechanism, such as themes, to attract partners and to help them understand where and how they can fit in.
    - Have clear policies about how to target and work with groups and organisations outside your normal stakeholders – ensure a balance between different political, minority and religious groups, for example.
    - Use small funding schemes to target certain groups creatively or pay for administrative assistance for events but also ensure larger grants are available to get events off the ground.
    - Understand what and when the main focus of the year will be and manage the build up to this peak but don't allow activities to only be held at this time or to tail off too quickly after the focus point.
    - Develop effective ways of communicating with your delivery network and 'agents'. Involve them and help them get a sense of what they have helped to achieve. Use more than one communication route.

Table of Contents

List of Tables

List of Figures

Chapter 1 Introduction

The World Year of Physics 2005 was an international celebration of physics. All organisations and groups interested in promoting physics were encouraged to organise events under the WYP2005[1] banner by UNESCO. With worldwide support from the physics community and approval gained from more than 40 physical societies from around the world, the European Union and the International Union of Pure and Applied Physics, in November 2003 the General Conference of UNESCO adopted a resolution supporting the initiative of 2005 as the World Year of Physics.

Launched at the UNESCO building, Paris on 13 January 2005 the World Year of Physics was established at concern over the general public's poor awareness of physics and its importance in our daily life and that awareness was decreasing. Declining numbers of higher education physics students is a global international phenomenon. Action was called for by the international physics community to share its visions and convictions about physics with politicians and the public at large. The aim was to persuade people of the importance that physics plays in the development of science and technology, but also the tremendous impacts it has on our society[1].

Never has the contribution of physics to other sciences been more essential to help solve global problems such as energy production, environmental protection and public health.

The upcoming 100th anniversary of the year when Albert Einstein wrote his legendary famous articles, which provided the basis of three fundamental fields in physics – the theory of relativity, quantum theory and the theory of Brownian motion – offered a unique opportunity and vehicle for the physics community to promote and celebrate physics.

About Einstein Year

The Institute of Physics defined its role within the World Year of Physics as a coordinator within the physics community of the UK and Ireland and stated that it was working to achieve the aims of Einstein Year by:

- Developing a centrally coordinated programme of high profile, participatory outreach activities.
- Encouraging organisations such as schools, youth groups, universities, museums etc. to develop and run physics-based outreach activities for their local communities.
- Running a small awards grant scheme to provide financial support for locally run activities.
- Producing resources to provide practical support for locally run activities.
- Developing a website (www.einsteinyear.org) to act as a focus for the whole initiative.
- Running a coherent and high impact public relations campaign.

Einstein Year was launched in January 2005 and ended in December 2005.

What was hoped to be achieved

The Institute of Physics, according to the Einstein Year programme manager, Caitlin Watson, wanted Einstein Year to "lay the groundwork for future years" and to create a "step change

[1] World Year of Physics website http://www.wyp2005.org/

in the number and type of physics activities and events". As such throughout event organisers were encouraged to consider projects that "target hard-to-reach groups such as ethnic minorities and geographically isolated communities". The strategy for the year included an infrastructure budget, centrally managed and delivered activities, and locally delivered events. These are discussed further in Chapter 2.

As part of its infrastructure budget a small-grant scheme was established to encourage creativity and diversity in the programme. Grant applicants were asked to explore new venues, new media and innovative methods to communicate with groups such as through:

- The use of public spaces such as parks, shopping centres, libraries and theatres
- Taking science to the new audiences such as was achieved at the Glastonbury Festival and by the Rambert Dance Company
- Making greater use of art, theatre and dance to put across physics concepts.

The aims of Einstein Year

The stated aims of Einstein Year were:

- Changing attitudes among young people to physics
- Increasing the quantity and quality of physics outreach activities
- Building sustainable links between physicists and their communities.

This report brings together the data from the different elements of the fieldwork to produce an overview of Einstein Year. We also draw some conclusions about the impact of Einstein Year activities and outcomes, and finally propose some lessons for the future.

About the evaluation of Einstein Year

The evaluation was awarded in December 2004 through competitive tender to the Institute of Education, University of London team led by Professor Michael Reiss. The team proposed a combination of methodologies involving a quantitative survey of attitudes, attendance ethnography at events, interviews and focus groups as well as an analysis of the materials used to advertise Einstein Year events. The purpose of the evaluation was to:

- Capture the essence of the year, the range of activities that took place and their impact;
- Draw together learning from some of the innovative ways of engaging audiences in physics- related activities that were used during Einstein Year;
- Assess any attitudinal changes in 11 to 14 year olds during the year and through so doing to establish a benchmark.

There have been few formal evaluations of 'year of' events undertaken and none are publicly available making it difficult to draw on any lessons of what worked, or what was not successful. The Institute of Physics was keen to use Einstein Year as an action learning exercise that would enable new and innovative methods for science engagement to be developed and tested. The Institute of Physics was also interested in developing relationships with communities they had not engaged with before and seeking ways to reach audiences that do not often have the opportunity to attend science open days, science centres or museums and/or would not consider watching science programmes on TV.

Over the year, the evaluation team worked with many organisations in the UK who were involved in Einstein Year, with a focus on evaluating the success and impact of events on the target age group of 11 to 14 year olds and those who influence them.

Evaluation methodology

Three clear stages to the methodology were defined and full details including the survey questionnaire are included in the Appendices. The two main elements of the evaluation work can be grouped as follows:

- A questionnaire-based study of attitudes towards science and scientists among 11-14 year olds undertaken across the UK and Ireland. This took place in three phases (Phases 1, 2, 3) spread evenly throughout Einstein Year, and crossing two school years, in an attempt to capture any potential change in attitudes among young people as a result of Einstein Year. Phase 1 of the survey took place in January/February 2005, phase 2 in May/June 2005 and phase 3 in November/ December 2005. The questionnaire is included as Appendix 1.
- Observations, interviews and mini groups were employed, by the qualitative evaluation team, at Einstein Year events across the UK to examine the types of events that were taking place and assess the audiences that were attending them and their interests and motivations with regards to physics. The topic guides for interviews and focus groups with adults and young people are included in Appendix 2 and 3 respectively. Exit questionnaires (Appendix 4) were designed around part of the quantitative study and the standard evaluation form (Appendix 5) and were used to collect information about the experience had by visitors at the event in cases where it was not possible to set up discussion groups, to assess whether they had enjoyed attending, learned something useful about physics and improved their perception of physics by attending. The standard evaluation form was widely distributed to event organisers.

In this report, notation is used to define events (E) and participants (A – adult and C – child). In some cases 'F' has been used to denote a family group discussion. These are referred to by number in the text to maintain anonymity. It is not important for readers of the evaluation to know the origin of comments. However, descriptive information is given in the text regarding certain events (with permission from the organisers), quoted adults are linked to their overall 'interest' in physics, and children's ages or school years are noted.

The analysis

The target group for the evaluation of the impact of Einstein Year was 11-14 year- old young people, since the Institute of Physics, in common with other professional societies, is keen to foster enthusiasm for, and therefore, further study in, physics. Understanding the impact of Einstein Year on this age group, and their perceptions and awareness of general science, the relationships of physics to the real world, and scientists, should provide important pointers to other organisations and their science outreach activities.

The fieldwork outcomes were analysed in response to the overall aims of Einstein Year (stated above). Interview notes, feedback questionnaires and event reports were read for common messages and were grouped under headings that responded to the aims of Einstein Year. These were then analysed with respect to:

- The impact on young people in the age group 11 to 14 in terms of their experiences from the Einstein Year events attended.
- What the successes and legacies of Einstein Year might be.
- The motivations to deliver Einstein Year activities that drive those people who are not in a role that is central to the science communication community, to deliver Einstein Year activities.
- Examining how the Institute of Physics might retain the support and motivations of the range of people who got involved in promoting physics in 2005.

The materials collated from event organisers were classified on two scales, A and B, defined in Table 1. The analysis is described further in Appendix 6.

Table 1 Classifications A and B used to analyse the Einstein Year event publicity materials

A Relation of materials to Einstein	B Presentation of science in materials
• Einstein-specific	• Control
• Physics Einstein-related	• Curious
• Physics not Einstein-related	• Exciting
• Science not Einstein-related	• Fun
• Not-science	• Functional
	• Mad

The quantitative survey was analysed using a variety of statistical methods. Likert scale values were allocated scores from 1 (not interested) to 4 (very interested). Means and standard deviations were calculated and a mean value of 2.5 was taken to be neutral. Above 2.5 is taken to be a positive response and below 2.5 a negative one. The responses were then translated into an 'interest value' for a group. Data were also tested for their validity using Cronbach's Alpha calculated measure. Full details regarding the results of the statistical analysis for the quantitative survey are given in the more detailed related report available from the Institute of Physics or the Institute of Education.

The data resource

The range of data collected during this study includes:

- Quantitative survey returns from 26 secondary schools across the UK and Ireland, which were selected for geographical spread and normal variation in school performance characteristic (i.e. KS3 / GCSE results). Schools were targeted in nine regions of England (Inner and Outer London, South East, South West, East of England, East Midlands, West Midlands, North East, North West), as well as in Wales, Scotland, Northern Ireland and Ireland. A total of 10,111 usable questionnaires were returned over the three phases with 7,054 responses from pupils who each took part in at most two phases
- 19 adult formal interviews – which form narrative biographies – as well as numerous other informal conversations and mini interviews. Interviewees were selected to provide a geographic spread, and a balance of event organizers and physicists;
- 5 sets of comments and inputs from adults at events attended;
- 6 focus groups – 2 groups at each of 3 venues. At venues where it proved difficult to set up formal focus groups, face-to-face conversations and mini-group discussions were held with 11-14 year olds supplemented by paper questionnaire responses. These were undertaken at a mix of venues and were often opportunistic, being arranged on the day of the event.
- 15 event ethnographies — events were chosen for geographic spread, potential age profile of participants and a variety of event types.
- 34 event evaluation reports provided by event organizers– plus 'Einstein @ Glastonbury', 'Visualise', the 'Einstein in the Library' family learning week in

Hartlepool, the Ecsite 'Nuclear Debate' and the touring *Move Over Einstein* exhibition — were received. The majority of these 34 events were funded fully or in part by the Institute of Physics grant scheme. The event organisers used a standard evaluation form which we provided for them and submitted a summary of participant numbers, with the gender and age profile of attendees. In addition, organisers were requested to ask respondents three questions about the overall response to the event and their learning experience. The standard evaluation form is in Appendix 5. While some event organisers produced a complete report on their event, others returned a straightforward summary of the data. The size of the grants, if awarded, and in any case funding for events, was comparatively small per event and extensive evaluation was not part of the Institute of Physics' grant conditions, and is not common practice in other cases. Information has been extracted from event reports as appropriate. Event reports contained responses from over 6500 people although many more than this attended the events.

- Fifty eight sets of materials were obtained. A small number, four, were excluded from further analysis because insufficient information was provided to score them on one or both of the two scales. For example, all that is known about the event run by Norton Priory Museum Trust during National Science Week[2] is that it involved making kites that had either $E = mc^2$ or an Einstein cut out on them. This suggests that the classification might be 'Einstein-specific, Fun' – but the data are too sparse to be confident about this. In a number of cases a single set of materials included details of more than the one event. The unit of analysis here was therefore each set of materials produced by organisations (singly or in collaboration) organising events rather than each separate event. The data showing the usage of the Einstein Year website and the websites for associate activities are included in Appendix 7.

Report structure and content

This report provides an overview of Einstein Year. The data from the different elements of the fieldwork are brought together to indicate what Einstein Year was, to assess its impact and draw together some lessons to be learned. The report is illustrated with summaries of many of the events, as well as quotes taken from event evaluation reports and from people interviewed. Some of the views are those given on the evaluation forms and exit questionnaires. The report is structured around the three main aims of Einstein Year.

Chapter 2 presents an overview of the year, its strategic development and the findings of the evaluation team in terms of events that occurred.

Chapter 3 addresses the first aim of Einstein Year, namely the impact of the year in changing attitudes.

Chapter 4 reviews the second aim that is the events in terms of the number taking place across the country and the quality of events and compares these to the experiences of those taking part.

Chapter 5 addresses the third aim of building sustainable links between physicists and their communities.

Chapter 6 brings together the other useful and important findings of the evaluation team.

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[2] National Science Week is held annually in March in the UK (and a number of other countries). In 2005, UK National Science Week lasted from 11 – 20 March, a period that, by design for Einstein Year, included Einstein's birthday (14 March). [there are two fonts in this footnote]

Chapter 7 reviews the findings and draws them together into a summary outlining the impact, spin offs and lessons to be learned from Einstein Year.

Chapter 2 Overview of Einstein Year Activities and Events

Einstein Year evolved within a loose strategic framework that was established to provide some structure to the activities but to allow innovation, creativity and grass roots engagement. Despite there having been other 'year of's', there is little documented information about the planning, delivery or impact of such complex campaigns This chapter presents an overview of the planning framework and to give an idea of the variety of events that took place.

When describing how the year evolved, a number of interviewees used the term 'organic'. The Institute of Physics worked, through its internal committees and regional groups, to spread influence, delegate control and stimulate engagement in activities involving physics across the country. While a number of high profile events were managed centrally from London, others were 'owned' and delivered elsewhere and through links the Institute of Physics has established with other bodies, such as the Rambert Dance Company and the ensuing 'Constant Speed' performances commissioned and 'owned' by Institute of Physics Publishing, Bristol.

Einstein Year delivery strategy

The context in which the Institute of Physics managed Einstein Year is indicated at the start of an article written by Caitlin Watson, the Institute of Physics' programme manager for Einstein Year, on the front page of the January 2005 edition of *Interactions* (the Institute of Physics' newsletter). Under the strapline "*Caitlin Watson* hopes that attitudes towards physics will begin to change in 2005" we read:

> On 5 January the Institute enlisted the help of 18-year-old Ben Wallace to launch Einstein Year, the UK and Ireland's contribution to World Year of Physics 2005. A member of Team Extreme, one of the world's top BMX stunt teams, Wallace performed the first-ever Einstein Flip – a stunt created with the help of physicist Helen Czerski of Cambridge University that shows young people that physics can be cool.

Watson, her steering group and team identified three distinct areas of activity: infrastructure, local delivery and centrally delivered events. The components of these activity areas are illustrated in 2 below.

Table 2 Three strategic elements to the planning of Einstein Year

Strategy	Examples
Infrastructure activities	Grant scheme
	Einstein Year Ambassadors training and kits
	Physics to go packs with physics tricks
	Einstein's birthday party pack
	Einstein Year Website
Local delivery	IEE Faraday Lectures
	Institute of Physics Branch activities

	School, science club, university organised activities, science centre and National Science Week events and science festivals
Centrally delivered	Rambert Dance, Constant Speed Lab in a Lorry Move over Einstein Kung Fu Science Einstein@Glastonbury Inside Story Moon Watch Visualise Debates with a Difference – Nuclear

Infrastructure activities

The infrastructure activities, described in Table 2, included a collection of websites that supported specific projects, a CD ROM containing tools including 'Physics Tricks' and a training session for the Einstein Year Ambassadors which was taken up by 20 of the 33 ambassadors, 25 per cent of whom were female. The Ambassadors received a 'box of tricks' to help them plan and deliver Einstein Year related activities in their area.

Extensive use was made of the Einstein Year website www.einsteinyear.org to offer supporting materials; in total over 126, 000 visits were made to the site during the year. Three other web- based projects associated with Einstein Year were established: www.kungfuscience.org, www.insidestory.iop.org and www.crescentmoonwatch.org; and these also proved popular (see Appendix 7).

The Institute of Physics Einstein Year small grant scheme (Appendix 8) helped to fund 48 projects. Additional funding for events was available from PPARC, and some event organisers managed to secure funding from both organisations for their events. This led to some interesting events with a variety of activities taking place over public holiday weekends.

In Winchester a year- long series of science activities, Bright Sparks, took place that used the Einstein Year logo; and in Newcastle upon Tyne the annual Newcastle Science Festival used Einstein Year as the focus for its activities.

In all, we have estimated that there were well in excess of 500 Einstein Year branded events taking place across the country during the year; this has been calculated mainly from the number of events registered on the Einstein Year database hosted by the BA discussed later in the quantity of events section.

National Science Week was held a week earlier than usual to maximise media interest in Albert Einstein and his three key 1905 publications by ensuring that the anniversary of Einstein's birthday fell in National Science Week. 'Birthday Party' materials helped encourage a wide celebration of Einstein's birthday and extended the feeling of something big happening.

Local delivery events

The Institute of Physics classed 'local delivery' events as those that were not managed centrally but instead occurred through other routes. For example, some events were organised by the Einstein Year Ambassadors (although it should be noted that their day of training and the ‘box-of-tricks’ kits were funded under the ‘Infrastructure’ budget line in the central Einstein Year budget), others through partnerships with other relevant organizations, such as the IEE Faraday Lectures. Finally, there were a lot of local Science Club or Science Festival activities which took Einstein Year as their focus. Some of the local events occurred only because of the dedication and enthusiasm of volunteers including the Einstein Year Ambassadors. The Radstock Science Festival is a good example of the engagement of a rural community through effective local marketing.

> The Radstock Rocket Festival was held in a community school that served two rural Somerset towns (and surrounding villages) with a combined population of 15,000. With funding from the Institute of Physics and PPARC the organisers were able to pay for an event organiser, hold a series of talks in the town museum and host a one day festival with a wide range of activities to suit all age groups. An effective media campaign included leafleting at the school gates, high street shops and an advert in the local papers as well as media interviews on local radio bore fruit as almost 1000 people from the local community attended.

Centrally delivered events

The ‘centrally delivered’ activities were high cost, high profile activities that, in some cases, were developed in partnership with other (appropriate) organisations. In particular, the event content and nature of the event were developed in partnership to meet mutually agreed objectives.

The assignment of substantial funding to these events ensured professional development and delivery, impactful marketing and quality of product. Some of the activities were developed with the primary purpose of reaching a different audience, such as dance audiences through collaboration with the Rambert Dance Company for the ‘Constant Speed’ performances, the Islamic community through Moon Watch, and shoppers with the placement of the *Move Over Einstein* exhibition at for example the Lakeside shopping centre in Essex. Separate evaluations were undertaken of these activities to assess whether or not these events had been delivered successfully and to ensure that lessons learned about and through their delivery were not lost.

> *Move Over Einstein* was a touring collection of large brightly coloured interactive computer games based on contemporary science. Developed through a collaboration between the Institute of Physics, EPSRC and PPARC, the displays toured science centres, museums and shopping centres reaching a wide range of audiences. The exhibition included:
>
> • An electronic 'supernose' that will sniff your breath and give early warning of illness
> • Tiny robots which may soon navigate your bloodstream, targeting drugs to specific sites within your body
> • Production of codes that even the greatest super-sleuth can't crack, making Internet shopping completely safe
> • Using ‘wobbly stars’ which may lead us to discover alien life.
>
> The physical presence of *Move Over Einstein* was substantial, although it was quite well hidden from the normal displays at Herstmonceux and even in part in Edinburgh. But when people came across it they were pleased. This was expressed in many ways from “Wow!” and “Hey, Look Dad!” to skipping over to the exhibits. Edinburgh had promotional posters outside and inside the museum identifying that *Move Over Einstein* had ‘come to town’ and was free to visit.

At the Edinburgh installation of the exhibition some young people had brought their parents along as they had been on a school trip to the exhibition while others came because their teacher had seen it and mentioned it to them. Researchers never came across anyone who had heard of the exhibition through a radio show, poster or advert. Visitors in Lakeside enjoyed *Move Over Einstein* and vowed to return the next week. There weren't any posters around the Mall advertising the exhibition, nor indicating how long it would be there for. Those who we made aware of the length of the stay at Lakeside vowed to return.

These centrally delivered events were an important component of Einstein Year as a whole, as they helped to maintain the momentum and higher profile (in particular in the media) for the wider aims of the World Year of Physics throughout 2005. For example, Einstein went to Glastonbury, supported by the Graphic Science Unit (Figure 1) making 1500 people aware of Einstein Year and enabling over 500 individuals to participate in demonstrations and discussion with performers. A series of often impromptu, music- based, demonstrations were used to educate and entertain the crowds and Einstein's Head made walkabouts around the festival to raise awareness of the stall.

Coupled with the small grant scheme, funding distributed to Institute of Physics regional branches and through the Einstein Year Ambassador scheme meant that there was a wide range of activities taking place across the country, many of which making use of local volunteers and enthusiasts.

Figure 1 Festival goers at the Einstein stall at Glastonbury

Presentation of science

Examination of the images of science presented in promotional materials remains an under-researched area despite the increasing acknowledgement of the importance of both the written word and visual imagery in shaping our perceptions (e.g. Mirzoeff 1998; Weatherall *et al.*, 2001). Reiss (1991) discussed how the images of science portrayed on stamps could give unintended messages that science was difficult, militaristic, only undertaken by men, and so on.

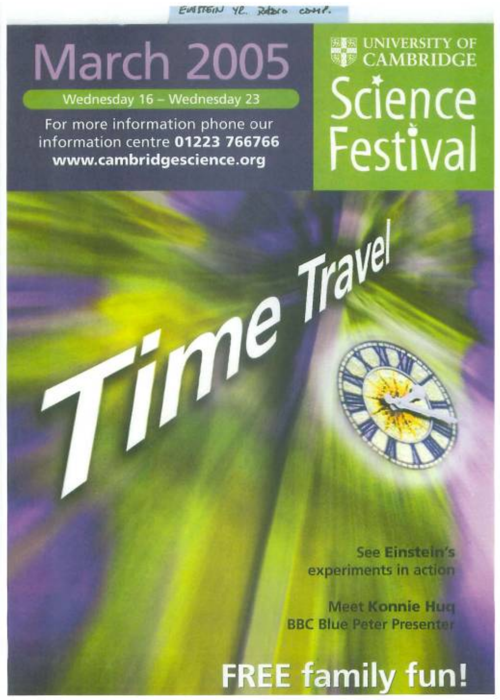
A wide variety of activities took place during Einstein Year including:

- Public hands-on events
- Lectures
- Events for adults with a science background and events for an adult general public
- Exhibitions, displays and performances, concerts and installations focussed on art and music
- Science fairs and fun days, which took place in science- related venues and in other public spaces

- The set up of interactive websites
- National experiments, which sought to engage people in observations
- Discussions and debates
- In school clubs, competitions and visits by scientists.

Analysis of the materials used to market the events that were badged as Einstein Year events offers an overview of the range and types of activities. The analysis set out to group the materials under six headings: fun, exciting, control, curious, mad and functional.

Figure 2 An example of material classified as 'fun' and 'exciting'

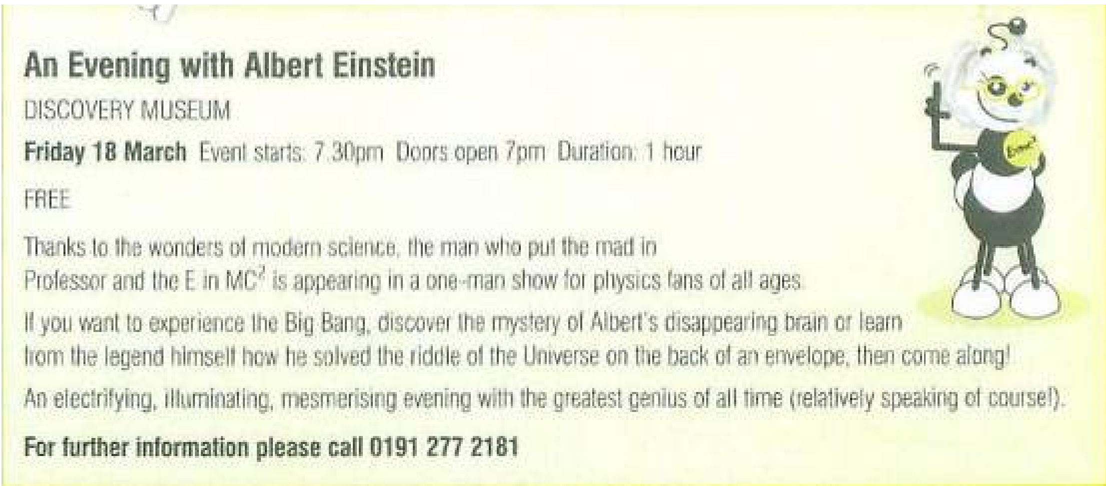


For example, Figure 2 shows the front cover of a 16-page A4 colour booklet produced by the University of Cambridge for its Science Festival held during National Science Week (16-23 March 2005). The booklet was scored as both 'Exciting' and 'Fun'. The word 'fun', with an exclamation mark (though this might relate as much to 'FREE' as to 'fun') appears on the front cover and there is perhaps a hint of fun in the appearance of the clock face which, while reminiscent of Big Ben[3], seems to have a sundial-like face, and the identification of 'Konnie Huq' as a 'BBC Blue Peter Presenter'[4]. At the same time, the design of the front cover suggests excitement both in the use of visual perspective for 'Time Travel', with suggestions of space travel and the explosive design.

Another instance where a set of materials was classified in two categories was provided by the 20-page A5 colour booklet produced for the Newcastle Science Festival (11-21 March 2005). In common with a number of other booklets produced for a science festival, this included a large number (55) of special events. Two of these explicitly referred to Einstein in their titles: 'An Evening with Albert Einstein' (Figure 3) and 'Einstein Made Easy Show'. The booklet was scored as 'Fun' and 'Mad'. The 'An Evening with Albert Einstein' advertisement both shows a zany-looking Einstein cartoon character and explicitly uses the word 'mad'.

[3] Strictly speaking, Big Ben is the hour bell of the Great Clock of the Palace of Westminster. However, most people use the term to refer to the Clock Tower

[4] Blue Peter is a long-running children's TV Programme in the UK. First shown on 16 October 1958 and originally a seven-week experiment, it soon captured a devoted audience and continues to this day


An Evening with Albert Einstein

DISCOVERY MUSEUM

Friday 18 March Event starts: 7.30pm Doors open 7pm Duration: 1 hour

FREE

Thanks to the wonders of modern science, the man who put the mad in Professor and the E in MC^2 is appearing in a one-man show for physics fans of all ages.

If you want to experience the Big Bang, discover the mystery of Albert's disappearing brain or learn from the legend himself how he solved the riddle of the Universe on the back of an envelope, then come along!

An electrifying, illuminating, mesmerising evening with the greatest genius of all time (relatively speaking of course!).

For further information please call 0191 277 2181

Figure 3 Information regarding an event at the Newcastle Science Festival booklet

Table 3 shows the classification of the 54 sets of materials on the scale that measures the presentation of science. The results here are presented from the most frequent of the six categories (Curious) to the least (Control).

Table 3 Frequencies of the presentation of science in the materials (n = 54)

Category	Number of cases (per cent)
Control	1 (2)
Curious	25 (46)
Exciting	5.3 (10)
Fun	12.7 (24)
Functional	7 (13)
Mad	3 (6)

Control

Only one set of materials (two per cent of the total) was categorised as presenting science as 'control' and that was one that explicitly in its heading questioned the notion of control: 'CoNTROL FREAKS?'. This set of materials was perhaps the best designed (if one considers just visual impact) of all of the ones in this study. Produced by the Institution of Electrical Engineers for its 2005 Faraday Lecture, it consists of a striking A3 poster (Figure 4). Less garish in its use of colour than many of the other coloured materials, the notion of control is reinforced by a mechanical (? rusting) arm that holds in its hand, between its second finger and thumb, the first 'o' of 'CoNTROL'. Smaller than the other letters in 'CoNTROL', and white rather than red, this 'o' can either be seen as an egg carefully held so as to avoid breakage or as a ruthlessly squashed 'O', the power underlying the deformation accentuated by the apparent ease with which it was done. Behind the arm lies a network of lines. These can be read in a variety of ways: as the delicate tracery of a spider's web that holds / constricts; as a structure of tight wires that supports / confines; or as a set of mathematical relationships that structure / define the ether / space-time continuum.

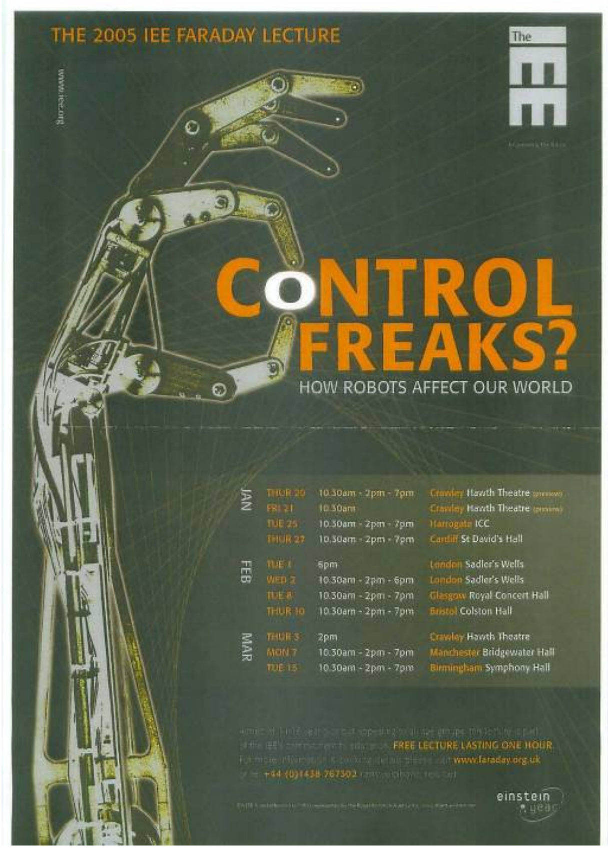


Figure 4 An example of material that was classified as 'Control'

Curious

Forty-six per cent of the promotional materials conveyed the impression that science is about answering questions – dealing with people's curiosity. For example, the colour media release and poster produced by the Border Astronomical Society, which described the three evening events at its observatory during National Science Week, concluded:

> So if you are interested in astronomy or would just like to see what it is all about, why not come along and see us.

A particularly interesting set of materials classified as 'Physics Einstein-related, Curious' was the Science Museum's on-line 'Einstein, Physics and Fascination', part of their www.ingenious.org.uk website. In addition to including a large amount of visual and textual material on Einstein's work this explicitly examined much wider issues of representation. The opening paragraph reads:

Asked to name a famous scientist, most of us would unhesitatingly say 'Albert Einstein'. He is the face of twentieth-century science with his familiar mane of white hair and moustached. But few of us can understand the physics, so why did he become a modern icon? …. We look at how Einstein's fame spread far beyond the scientific community, and our need for a friendly face to represent the obscure.

Fun

The second most frequent category, 24 per cent of materials were identified, was that of 'Fun'. An example of science being presented as 'Fun' is provided by Figure 5 which shows a poster advertising a Science Week lecture for children, organised by the Yorkshire Philosophical Society. 'The Science of Music' is hardly a novel concept – the topic is a familiar one in many science courses – but, more innovatively, this A4 poster shows (in black and white) the distillation of music from notes (piano keys). The apparatus will certainly be familiar to many of the older 'children' ("Suitable for all children from 7 to 77") who would have seen the poster. The retort stand, glassware, thermometer, water-cooling system and beaker were all familiar school chemistry items, if some of them are less frequently seen in school science nowadays.

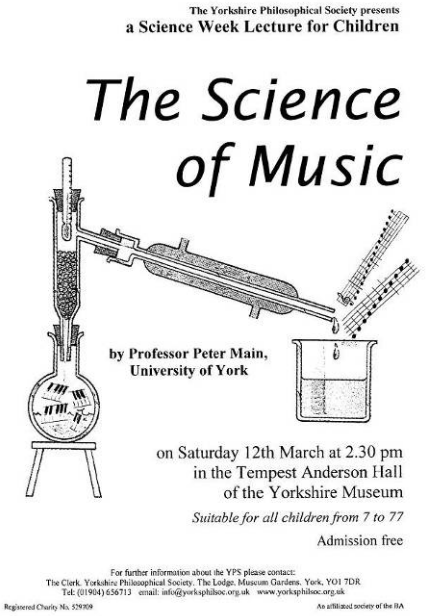


Figure 5 An example of a 'Fun' Poster

Another example of a set of materials classified as 'Fun' was the press release for "punkscience: the Albert Einstein Experience" with a subheading "Stand-up comedians return to Dana Centre":

> In an unprecedented bid to make physics funny, our very own comedy science team, punkscience, has decided to tackle one of the most complex (and possibly least amusing) scientific achievements of all time: Einstein's major theories on Brownian motion, the Photoelectric Effect and, most famously, the Special and General Theories of Relativity.
>
> Through a series of comedy nights at the Science Museum's Dana Centre – the UK's only venue for adults to tackle contemporary and controversial science – the punkscience team will explain ALL of it in just under an hour. Not only that, but they'll also look at Einstein as an icon, what happened to his brain and why, like Oasis, he never quite lived up to the promise of his early work.

The researcher who attended this show confirmed that it was indeed funny, parts of it exceptionally so; but it also included a great deal of excellent science.

The word 'fun' was quite frequently employed in materials and 'fun' was sometimes indicated through such images as the famous photograph of Einstein sticking his tongue right out and activities such as 'A Fizzics experiment' (using fizzy drinks to get balloons to inflate through release of carbon dioxide) as part of an 'Einstein's Birthday Party!' activity.

Functional

Thirteen percent of the materials were classified as presenting science as 'Functional'. An example of a set of materials that did so is the A3 coloured poster produced by the University of Wales Centre for Widening Participation and Social Inclusion. Its English version is shown in Figure 6 (a Welsh version features on its obverse).

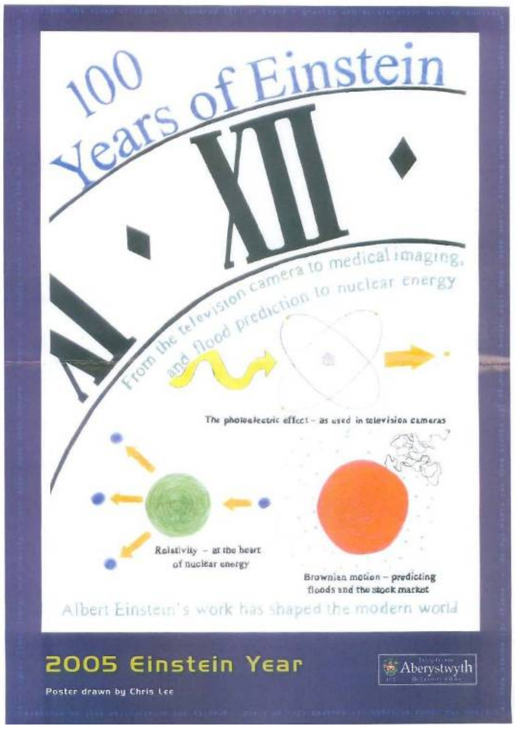


Figure 6 An example of a 'Functional' poster

At the edges is a border that (with difficulty) can be seen as consisting of a repeated refrain:

> energy (E) equals mass (m) times the speed of light (c) squared (2), or E=mc2 – gravity and acceleration must be equivalent – Light, Time, Energy and Gravity – Look deep, deep into nature

Within this border part of a large clock face (time travel again) are drawings illustrating three of Einstein's 1905 contributions to the world of physics. At the bottom of the poster sits the conclusion: "Albert Einstein's work has shaped the modern world".

Another example of a set of materials classified as 'Functional', that also illustrates the way in which some Einstein Year events had nothing to do with physics, let alone Einstein, was provided by the Earthwatch Institute's lecture and debate series on "Grey Wales & Orca – Habits and Health", "South American Forest Birds – Ecotourism, Enterprise & Extinction", "Back to nature – Eradicating Invasive Species from the UK" and "Conservation & the Community – Conflict Resolution".

Exciting

Only 10 per cent of the materials presented science as exciting – and some of these also outlined their activities as 'fun'. For example, Hartlepool Central Library advertised its 'Einstein in the Library' (E14) day as follows:

> **'Calling all science fans!'**

FAMILIES can take a journey of discovery through the wonder of physics in a day of special events at Hartlepool's Central Library.

Called 'Einstein in the Library,' it's on **Saturday 15 October** and has been organised to coincide with family Learning Week.

The activities are being run by Hartlepool Council's Libraries Service in partnership with Hartlepool College of Further Education. Together they won funding for the activities from the Institute of Physics as part of the Einstein Year celebrations to mark the centenary of the publication of Einstein's Theory of Relativity. The free events include:

Starlab- Take a trip around the universe without leaving the earth! Enter the Starlab inflatable dome and take a whistle-stop tour of our solar system as images of the stars and planets are projected onto the inside of the dome. Sessions at 1pm, 2.15pm and 3.30pm. Advance booking required.

'Whatever Next' family story time - Explore the magic of science in a story-reading session with crafts and experiments. From 10am to 12 noon. Advance booking required.

Crafts in Space - A fun craft session on a space theme, 12 noon to 2pm.

There will also be a treasure hunt throughout the day – follow the clues around the library to learn more about Einstein's life. Plus there'll be physics experiments, lots of free giveaways and everyone who enters the treasure hunt will receive a free goody bag and all entries will go into a prize draw.

Gillian Slimmings, Hartlepool's Children and Young Person's Librarian, said: "We've lined up some great events to feed the minds of little Einsteins and their families. So come along to Central Library and make some fun discoveries of your own!"

Mad

'Mad' here is used in the sense of zany not psychotic and was found in only 6 per cent of the materials. Perhaps the most extreme example of science being associated with madness was provided by Heworth Grange Comprehensive School (Figure 7). In large capital letters each of two, two and a half hour events advertised on an A4 colour poster are titled "SCIENCE MADNESS" and star "Blue Peter and Brainiac extreme scientist Dr. Bunhead".[5] The poster, which features the official Einstein Year logo, presented an image of a particularly mad scientist complete with unusual attire (including a bucket over his head) and a massive explosion (apparently triggered by a sparkler). The two advertised 'Make and take' workshops are modestly titled 'Build a planet' and 'Circuit frenzy'.

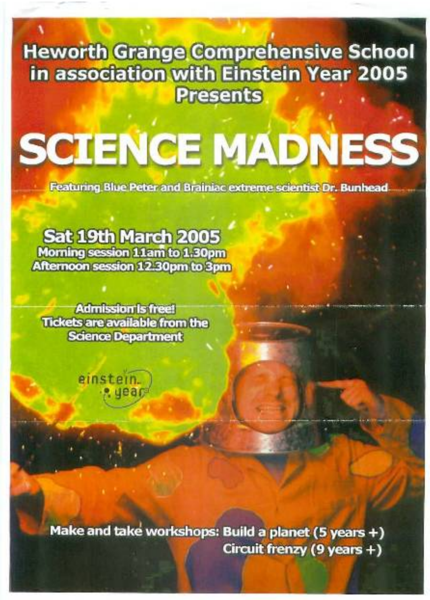


Figure 7 An example of material classified as 'Mad'

The Einstein Year website (www.einsteinyear.org) was (and at the time of writing still is) extremely extensive and changed during the year. It was used as a central hub for information and follow up material to support event attendees and delivery agents.

[5] Dr Bunhead (aka Tom Pringle) is a very successful freelance science communicator

Audiences – who were they and what did we find?

The primary target audience for Einstein Year activities was the 11 to 14 year old age group and those that influence them. Einstein Year activities occurred in a diversity of places including outdoor spaces such as rocket festivals (Figure 8) and the Centre of the Universe (Figures 9, 10 and 11) installation.

Figure 8 Rocket launching at the Radstock Rocket Festival, safely making use of the large sports field

Figure 9 The centre of the universe – in Oxford - as defined by artist Jem Finer

Figure 10 Jem Finer's telescope installation in Oxford made from recycled materials

Figure 11 Recycled equipment to record the sounds of the universe. Artist Jem Finer found the patterns and images on the paperloop "fascinating and stimulating"

11 – 14 year olds

The qualitative evaluation exercise focused on the 11-14 year old audience and on the need principally to reach them through non-school routes. This defined the evaluation methodologies which were based around various venues and also activities that took place out of school.

One of the challenges the science communication community faces in reaching 11-14 year olds is that they appear generally less inclined to go on a family outing. There is also often a considerable difference between the behaviour and activities that an 11 year- old participates in and a 14 year- old. Pre teens (11 to 12 year olds) tend to be at a developmental stage where they are exerting their independence and are likely to be started to be trusted to undertake activities with friends, but would still go out in a family group. By the early teen years (13 and 14 year olds), social confidence and parental trust has generally increased to enable the young people to either stay at home or go out with friends. At some venues (E9, E8, E11, E13) researchers came across 13 and 14 year olds in family groups, but most often when they had younger siblings or were on holiday in the area, however in shopping centres they were encountered looking at exhibits in peer groups. Discussions with the 13 and 14 year olds therefore tended to be at events attended by school groups, although out of the school environment.

Many of the Einstein Year public events aimed to attract audiences of young people on day trips with their families. A large concentration of activities took place during Science Week 2005 (11-17 March). Often school trips are organised for 14 year olds (year 10's) who are at the stage of making decisions about careers and futures; in fact, many Institute of Physics branch activities are organised annually, and were so in Einstein Year, around this age group for this purpose.

Science Festivals, such as those held in Cheltenham, Newcastle upon Tyne and Cambridge, had a strong Einstein Year theme and held a range of activities for young people, including school trips and family- oriented events.

Teachers

Teachers were not defined as a primary target group for Einstein Year. However, their role in influencing young people meant that many were encountered at events as both teachers and parents. At an event attended by over 60 science teachers, held at Science Learning Centre, London were interviewed about their experiences of Einstein Year. Twenty eight evaluation forms were returned and eight short interviews held.

The evaluation form returns were predominantly from female attendees (24/28). Only 3 of the teachers questioned had organised an Einstein Year activity; one had used the Institute of Physics Einstein Year website material in their teaching; some others had used the Einstein Year materials and downloads presumably for their own interests. Only 9/28 of the respondents had not heard about Einstein Year, although a further 6/28 indicated they had heard about it only ‘somewhat’.

Over half felt initiatives such as Einstein Year had little if any impact on their pupil’s enthusiasm for physics. While 12/28 thought Einstein was the correct choice as the figurehead of the year compared to (4/28) who didn’t.

However, just over half (15/28) felt that the contact of physicists and other scientists with young people was important in fostering an interest in physics and only 3 disagreed.

Parents and other carers

Parents, grandparents and other carers play an important role influencing the attitude of young people to science subjects. But as well as helping to engage young people in their studies, carers are also significant in identifying places to visit or activities to undertake with young people when on holiday or an outing. The Home Learning Network, which is growing in popularity, uses public science activities extensively to enrich their curriculum.

Reasons given by those interviewed during Einstein Year for interacting with a public science activity were:

- Responding to the interests of a child
- Entertainment during vacations or weekends
- Belief that there is educational value in the activity
- Chance encounter.

Whatever the reasons, the benefits are many fold and include a shared experience that can lead to:

- Shared interest in a subject
- Cross generational interaction
- Shared learning
- Shared fun.

One event organiser and physicist stated:

> [parents] are important for everything a child does and influence them in their choices in school. We are getting to them at this event but more could be done to get them here on their own, not just trying to occupy the kids.

Further, a parent, interviewed at the ‘Einstein in the Library’ event in Hartlepool said:

physics needs events like this to make it more accessible, making it more relevant to people's experiences of now. Physics is relevant but the links are often not stated, so people don't realise. Not reinforcing positive messages only serves for negative ones to be fostered

Beyond traditional audiences

As well as traditional science fun days and hands- on activity sessions, events also employed the Institute of Physics resource packs to great effect. Lectures on Einstein explaining Brownian motion and relativity to audiences with an age range from 7 to 70, as well as a large number of music- and art- related events, took place. These varied from the low tech 'Centre of the Universe' event in a park in Oxford during May and June and 'Heavenly Music' activity, held at the National Maritime Museum where people composed their own music and had it sent into space, to 'Super Strings', a lecture and recital intertwining Einstein's theories with music that toured the world. Reaching different audiences in different ways these events explored the physical and metaphysical relationship between the universe and music. Heavenly Music demonstrated how the event was able to touch people in different ways from factual to psychological learning:

- I learnt what a helioseismologist was
- I wasn't aware of the variety of sounds in space
- The sun expands and contracts
- Light and colour are part of the same frequency range
- I learnt that hearing things is just as important as seeing things
- I learnt that you should listen to your surroundings.

At Oakwell Hall Country Park, near Bradford, a family fun day invited participants to "investigate time and space" at an 'It's all relative' family fun day.   This was held on a Sunday in March, and one of the aims of the event organiser was in linking history to physics:

"[we] sell science into the public realm in terms of the past, present and future and relating scientific discoveries in the past to our present lives and how we might behave in the future. That's one of the aims of the group of museums we're a part of".

A8 event organiser/ museum manager

The exploration by event organizers of more creative ways of exploring science extended beyond the obvious to include activities such as 'Visualise', a science show given without speech, produced by Science Made Simple[6].   The Institute of Physics also collaborated with the Rambert Dance Company in the production of 'Constant Speed', which, inspired by Einstein's major theories on Brownian motion, the photoelectric effect and special relativity, demonstrated how physics and dance can fire the creative imagination. Constant Speed premiered in London on 24 May 2005 and met with positive response in the media:

Constant Speed is hugely enjoyable

The Times

Constant Speed is an absolute hoot

The Independent on Sunday

[6] http://www.sciencemadesimple.co.uk/

and then toured the UK with the animateurs holding dance workshops with schools.

> The workshop provides a unique opportunity to approach what is perceived to be a very academic subject, through physical involvement. Hopefully the process of exploring these theories physically will bring to life what students read on the page.
>
> *Rambert Animateur*

Another creative way of reaching new groups was taking science and physics into the arts festival arena such as to the Glastonbury Festival and the Urdd (youth) Eisteddfod in Wales. The Urdd Eisteddfod is the largest youth festival in Europe and helps develop young talent and encourage cultural activities in Wales. The Science Pavilion was used as a platform for competitions and award ceremonies (Figure 12) with KNEX workshops, MathsCymru, the final heat of the Young Engineers of Britain and the Welsh Science Society Mathematical Challenge Ceremony. The Pavilion attracted over 3000 schools children and parents and over 80 teachers. The Eisteddfod infrastructure of competitions offers science communicators a route to connect to a large cross section of the Welsh community. Similarly a collaboration launched in October in partnership with the Islamic community in the UK aimed at a more accurate prediction of the appearance of the new crescent moon. This was aimed at helping to more accurately predict the start of Ramadhan, and has helped to bridge a cultural gap, as well as the website proving very popular (Appendix 7).

Figure 12 A school science club at the Urdd Eisteddfod

Some event organisers also looked for different venues for their activities. In part, the aim of this was to try to build sustainable links between physicists and their communities:

> Libraries offer a natural venue; they are socially inclusive, accessible to general audiences and offer a non-traditional venue for events. The Framework for the Future (F4F) requires libraries to develop close working relationships with schools and provide a 'complimentary learning service' (DCMS paper 2003). In Hartlepool the 'Einstein in the Library' project, a family learning day, was an example of complimentary learning for pupils and community alike. Community events such as this promote the fun aspect of physics to a wide audience; the treasure hunt set up for the day took some regular users of the library into areas (such as the reference section) that they hadn't used before, Overall the events were hugely successful, encouraging nearly 500 more people than usual into the library

A14 event organiser

The result of using venues outside schools and museums, also resulted, in some cases, in broader engagement of the local community, both families and older people getting involved and interacting in activities. The result of one library- based event resulted in the presenter being featured in the local paper and being involved in other events (A2).

> Linking the Institute of Physics event to the Family Learning day resulted in good publicity before, during and after the event. Local papers highlighted the event, and used photographs of children enjoying themselves to illustrate various articles (included in the event evaluation document).
>
> Various physics activities, developed by SETPOINT, were run during the two days; these included firing rockets, tasting space food and some physics experiments (for example gravity and feathers).
>
> Friday was an education day, and Saturday a communication / family day. One overheard comment from a member of staff in the library, stated was "[this is] the most successful event ever".
>
> The Institute of Physics funding contributed to the event, allowing more scope at the planning stage to include more activities. Reaching the level required was gained through discussions with Ruth Wiltsher [an Institute of Physics Member] and the local SETPOINT. Teachers at the Friday education day said that the activities "delivered at the right level". Saturday worked well to get whole families into the library and individuals of all ages taking part and learning more about what the library can offer. Some elderly regular customers came in, took part, and commented that there were bits of the library they hadn't known existed!
>
> *Event E14 Einstein in the Library*

Exploring new locations and styles of delivery during National Science Week 2005 saw the BA hold a national poetry competition to engage the poetic nature of the population. There were over 2,000 entries and winners were selected in five categories encouraging poets to tackle difficult subjects and in so doing to help others to enjoy and have greater understanding of the beauty of science.

> 'I've written a number of poems on scientific themes in the past, but never one on Einstein's work,' says Gordon, a retired engineer from Horsham, Sussex. 'The competition asked us to write poems on time, space and energy; I thought I would try all three. I'd tried to get to grips with relativity some time ago and thought this would be a good challenge.'
>
> *Gordon Judge, winner of the Adult category BA poetry competition*

The BA produced supporting material on their website with tips on writing poetry and links to scientific poetry resources for teachers to help bring science into the literacy sphere of the curriculum. The winning entry in the 12 to 15 year old category was Simon Arch with 'Time'

> Time
>
> When you fly away to space,
> Time is at a snail's pace,
> I age a week, you age one day,
> It seems like years you've been away,
> You glance to see a minute's past,
> An hour has gone, life goes so fast.
>
> I'm getting weak, I have grey hair,
> You're miles away, you're unaware,
> I'm sorry that it was like this,
> All the time you had to miss,

You have no wrinkles on your face,
The twisted paradox of space.

Winner, 12-15 year category BA poetry competition

Discussion

Einstein Year spawned many more physics- related activities across the UK and Ireland than had previously been organized. Later in the year Einstein was still being mentioned in the press, demonstrating continued media interest in Einstein — in November, the Metro and Guardian Education Supplement included Einstein related cartoons (Figure 13).

Events ranged from professional lectures, touring exhibits and shows through to directed and university- led events assisted with Institute of Physics sponsored Tricks Boxes, to libraries and local museums holding open days and monthly talks. It is without doubt that a wide spectrum of the public crossed paths with physics during 2005 in ways that they may still have not realized.

Overall the combination of funding schemes and engagement with schools, as well as the common branding of various touring lectures (such as the IEE Faraday Lectures, and the Institute of Physics schools lecture series) led to a significant increase in the visibility and number of physics-related activities during 2005.

Figure 13 Einstein-related cartoons, *The Guardian* 29 November 2005 and NEMI from *The Metro*)

Chapter 3 Aim 1 Changing Attitudes to Physics Among Young People

Young people's attitudes towards science have been studied using a variety of methodologies for many years. The most comprehensive recent review is provided by Osborne et al. (2003). The largest study since that review is the on-going Relevance of Science Education Project (ROSE[7]). There are also a number of 'public engagement in science' surveys running including (ROSE) and Eurobarometer. These take a snapshot of public engagement and interest in science in a number of countries and at fixed instants in time.

Science versus school science

Attitudes towards science have been examined using a number of methods and at a variety of times in the past 30 years. One of the key issues relevant to studies on attitudes to science is that science itself contains a series of linked subdivisions that contribute towards young people's attitudes to it. These factors include:

- Anxiety towards science
- Value of science
- Self-esteem and science
- Motivation
- Enjoyment
- Peer attitudes
- Parental attitudes
- Achievement.

It is also difficult to take science out of context. For example a young person may feel positive about science, but not feel it is suitable for them, because of peer pressure.

Young people frequently have very different attitudes to science as compared to school science. A common technique has been to look at preferences for science. Whitfield (1979) found that as students moved through the school from age 14 to 16 their interest in all subjects fell, but that this fall was much more severe, on average, in physics and chemistry. The overall falling trend was thought to be a result of a general lack of interest in school as children got older.

Some studies have examined subjects that students like best. This has often shown a fall in a preference for science as students got older and in fact, Hadden and Johnson (1983) found that school science seemed to have a negative impact on children's enjoyment of science.

One conclusion is that young people in the UK are generally positive towards science, providing it is not done in the classroom. In 1988 the Assessment and Performance Unit (APU 1988) published the data in Table 4, collected from English 15 year olds (reproduced from Osborne et al. (2003)).

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[7] http://www.ils.uio.no/english/rose/

Table 4 Data from Osborne et al. (2003) on attitudes to science of English 15 year olds

	Interesting		Useful		Easy	
Subject	B (%)	G (%)	B (%)	G (%)	B (%)	G (%)
Biology	48	46	63	52	4	2
Chemistry	53	49	51	53	5	1
Physics	73	72	32	36	8	4

One thing that is interesting is the lack of difference between the genders. In the UK girls' performance outstrips boys at age 14 and 16, however their perception is that they do not do as well in science as they do in other subjects such as English. In subjects other than science performance increases later in their school career, so they feel their performance in science is stagnant relative to other disciplines. Also of interest is that, despite science's usefulness, children find it very difficult. Even though they feel science is important it is this difficulty that seems to stifle engagement.

Recently the ROSE project has looked at English students' attitudes to science and found that they were generally very positive towards science (Jenkins, 2006). For example, they are very optimistic that science will lead to cures for diseases like cancer and HIV/AIDS. However they are less positive that science and technology can help the developing world, with only a minority saying science will be able to improve lives in the world.

In summary there are a number of interleaving factors that affect children's attitudes towards science. These include the difference between school science and science; how science can be interesting to children but something that they would not choose to do themselves. This can be because they perceive it as too hard.

Quantitative survey

A shortened and adapted version of the large, well-constructed questionnaire in the current international ROSE study was used for the purposes of assessing attitudinal change during Einstein Year. This consisted of 39 closed and 3 open-ended questions, grouped in four main sections (see Appendix 1 and the separate detailed analysis).

In Section A, pupils were presented with 15 statements describing physics topics and were asked to rate their interest in finding out more about each of them on a four-point Likert scale – from 'Not Interested' to 'Very Interested'. An example of such a statement is

> A12 – The effect of electric shocks and lightning on the human body.

Pupils were instructed to leave blank any question they did not understand in this section as well as in other sections of the questionnaire. Section A concluded with a question asking pupils to choose the one statement (out of the 15 presented to them) that they would like to investigate if they were a scientist, and to explain this choice.

Section B examined pupils' perceptions regarding the impact of science and technology on society. It contained eight assertions about science, technology and society, expressed in four roughly (i.e. not rigidly) opposite pairs of statements. An example of such a pair is:

> B01 – Science and technology benefit mainly rich developed countries
>
> B03 – Science and technology will help get rid of poverty and famine in the world.

Pupils were asked to rate their agreement with each statement on a four-point Likert scale from 'Disagree' to 'Agree'.

In section C questions related directly to the events in Einstein Year and were the only ones that changed between the different phases of the survey. In phase 1 they asked about pupils' expectations of Einstein Year. In phases 2 and 3 an additional first question asked whether they had participated in any event related to Einstein Year either in school or out of school. If they replied yes, pupils were asked as before, to rate their agreement with statements suggesting that because of Einstein Year they found out something interesting about physics or physicists and that Einstein Year events had helped to give them a positive feeling about science and scientists.

Section D examined pupils' attitudes to scientists and their work. It contained 14 stereotypical views of scientists and their work, expressed in seven roughly (but not rigidly) opposite pairs of statements. An example of such a pair is:

D01 – Scientists as middle aged men in white coats

D09 – Scientists as normal and attractive young men or women

Pupils were asked to think of scientists and their work and rate their agreement with each statement on a four-point Likert scale from 'Disagree' to 'Agree'. This section concluded with two questions that asked pupils respectively to choose the one statement (out of the 14 presented to them) which might make them decide to become a scientist and the one which might make them decide not to become a scientist, and to explain these choices.

Sample of respondents

A total of 26 secondary schools participated in the study across the UK and Ireland, which were selected for geographical spread and normal variation in school performance characteristic (i.e. KS3 / GCSE results). Schools were targeted in nine regions of England (Inner and Outer London, South East, South West, East of England, East Midlands, West Midlands, North East, North West), as well as in Wales, Scotland, Northern Ireland and Ireland. The number of pupils who responded in one or more phases of the survey from each region is referred to in the rest of the report as 'unique pupils' to reinforce the point that pupils who responded in more than one phase are not double-counted.

All schools were asked to participate in all three phases of the survey. Phase 1 aimed to have half of the target class groups in years 7 to 10 (or their equivalent) complete the questionnaire. In phase 2, the survey was completed by the other half of the year group and in phase 3, i.e. towards the end of Einstein Year, it was intended that all pupils would complete it again. In this way a large enough number of pupils would get the chance to repeat the questionnaire, but also no individual pupil would be asked to complete the questionnaire more than twice.

A total of 10,111 usable questionnaires were returned over the three phases with 7,054 'unique pupil' responses from phase 1, phase 2 and year 7 from phase 3. These are unique because schools were instructed to give phase 1 and phase 2 questionnaires to different classes and phase 3 to repeat over these classes. Phase 1 - Jan, Phase 2 - May, Phase 3 Dec meant that phase 3 was in a new academic year and therefore year 7 pupils in phase 3 cannot have been present in the schools in phases 1 and 2.

Analysis of survey data

A brief analysis of the quantitative questionnaires is presented in this report. A full analysis is available in a separate report.

Interest in Science

The results showed that pupils express interest in topics that are about the effects of science on themselves but do not appear interested in the knowledge required to understand these effects.

A slight drop in interest level was shown across all individual statements as age increases. Although the effect is small the drop in interest level is shown consistently.

Interest differences between males and females are not consistently in the same direction reflecting varying interests of boys and girls in different topics, (Figure 14). Most statements show significant differences between males and females with effect sizes ranging from 0.10 to 0.62 of a standard deviation. There is only one statement,

A04 – How the sunset colours the sky

where females show more interest than males at above a weak effect size (Cohen's d above 0.2). In contrast, males show more interest than females at above a weak effect size for statements:

A02 – How cassette tapes, CDs and DVDs store and play sound and music

A05 – The use of lasers for technical purposes (e.g. barcode readers)

A07 – How a nuclear power plant functions

A14 – Rockets, satellites and space travel

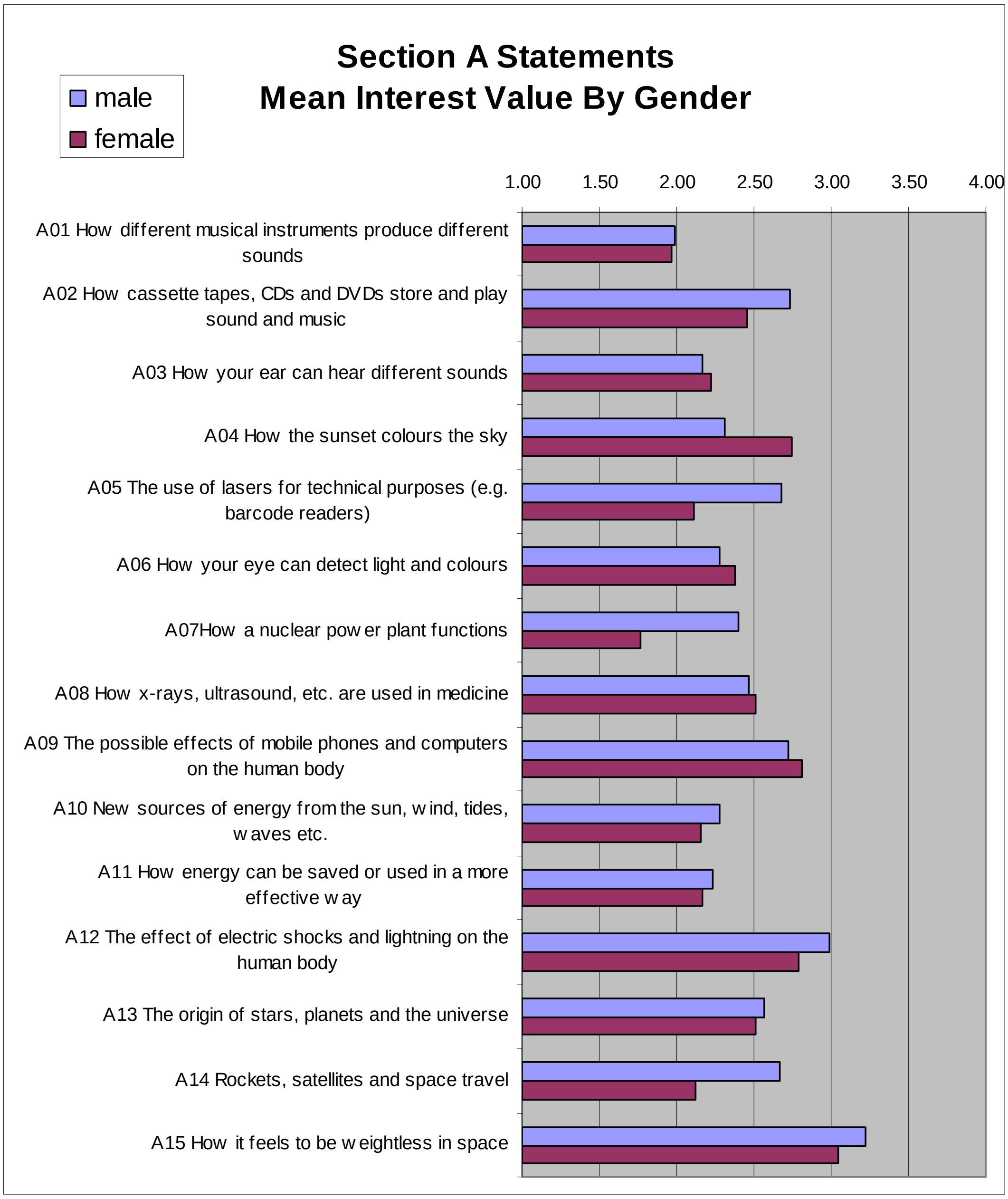

Figure 14 Section A statements. Mean interest value by gender.

When pupils were asked to select one of the 15 statements from Section A that they would like to investigate further if they were a scientist. By far the largest selection for both males and females was:

A15 – How it feels to be weightless in space.

This one selection from the fifteen statements accounts for 27% of the selections. The next three most popular were:

A09 – The possible effects of mobile phones and computers on the human body (12%),

A13 – The origin of stars, planets and the universe (12%)

A12 – The effect of electric shocks and lightning on the human body (10%).

Of these selections A09 was much more popular with females and A12 with males.

Science, Technology and Society

The results in order of mean agreement value (Figure 15) show that the strongest agreement is with:

B02 – Science and technology make our lives easier and more comfortable

Generally there was agreement with the positive statements and disagreement with the negative statements which implied an overall positive perception of the impact of science and technology on society. This is refreshing given the generally negative interest in science depicted in the Section A results.

The exceptions were with:

B01 – Science and technology benefit mainly rich developed countries

which was just on the agreement side of neutral (mean agreement value = 2.52) and:

B03 – Science and technology will help get rid of poverty and famine in the world

though positive in connotation, was slightly disagreed with overall (2.29). These are simple statements about large and complicated issues and it is not possible to say here what factors influenced pupil answers in these cases. They may well have considered issues other than science in coming to some of their responses.

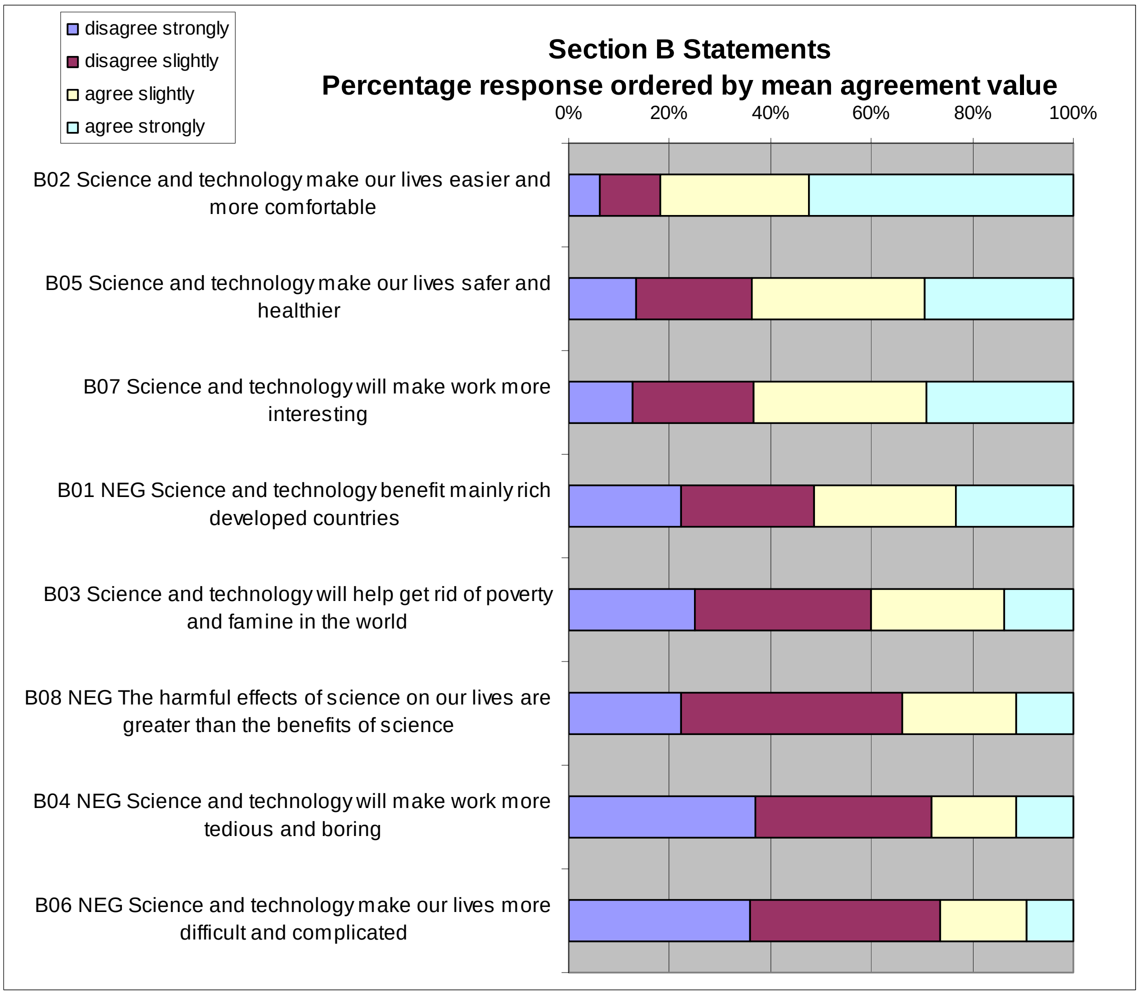

Figure 15 Section B statements. Percentage response ordered by mean agreement value.

Six out of eight Section B statements show statistically significant changes in mean agreement value from age 11 to age 14 but in every case the changes are at a weak effect size. Overall, the picture presented by section B appears to support Section A results, which showed lower interest in science in females; attitude to 'science, technology and society', though positive overall, is again less positive for females than males, even if only just so.

Attitudes to scientists and their work

Section D explored attitudes to scientists and their work and the results (see Figure 16) showed the strongest agreement with:

D13 – scientists as doing very important work

(mean agreement value 3.24). As with Section B, generally there is agreement with the positive statements and disagreement with the negative statements. The exceptions where the strongest attitudes are held in this case are agreement with the negative:

D04 – scientists as having to work hard and long hours

(mean agreement value 2.92) and disagreement with the positive:

D09 – scientists as normal and attractive young men or women

(mean agreement value 2.10).

The general agreement with the positive statements and disagreement with negative statements shows that, overall, pupils have a good attitude to scientists and their work. However, the disagreement with scientists being 'normal and attractive', agreement with 'having to work hard', and agreement with 'being brainy' all might be factors that could be off putting to a typical pupil choosing to be a scientist.

Eight of the Section D statements show statistically significant changes in mean agreement value with the statements from age 11 to age 14. Although these changes are at small effect sizes, they are consistently in the direction of a worsening image for scientists and their work.

When broken down by gender, the statement with highest difference for mean agreement is:

D07 – scientists as being really brainy people,

showing females in higher agreement than males.

Questions D15 and D16 at the end of Section D each ask pupils to select one of the 14 statements from Section D which might make them decide to become a scientist, and which might make them decide not to become a scientist, respectively. The top four selections *for* becoming a scientist were statements:

D05 – scientists as working at places where new and exciting things happen (chosen by 26% of pupils);

D02 – scientists as working creatively and imaginatively (18%);

D13 – scientists as doing very important work (14%)

D03 – scientific work done as part of a team with other people working together (10%).

The top four selections *against* becoming a scientist were statements:

D04 – scientists as having to work hard and long hours (chosen by 32% of pupils)

D06 – scientific work as being mostly tedious and repetitive (12%)

D01 – scientists as middle-aged men in white coats (12%)

D10 – scientists as having just to follow strict rules and guidelines in their work (9%).

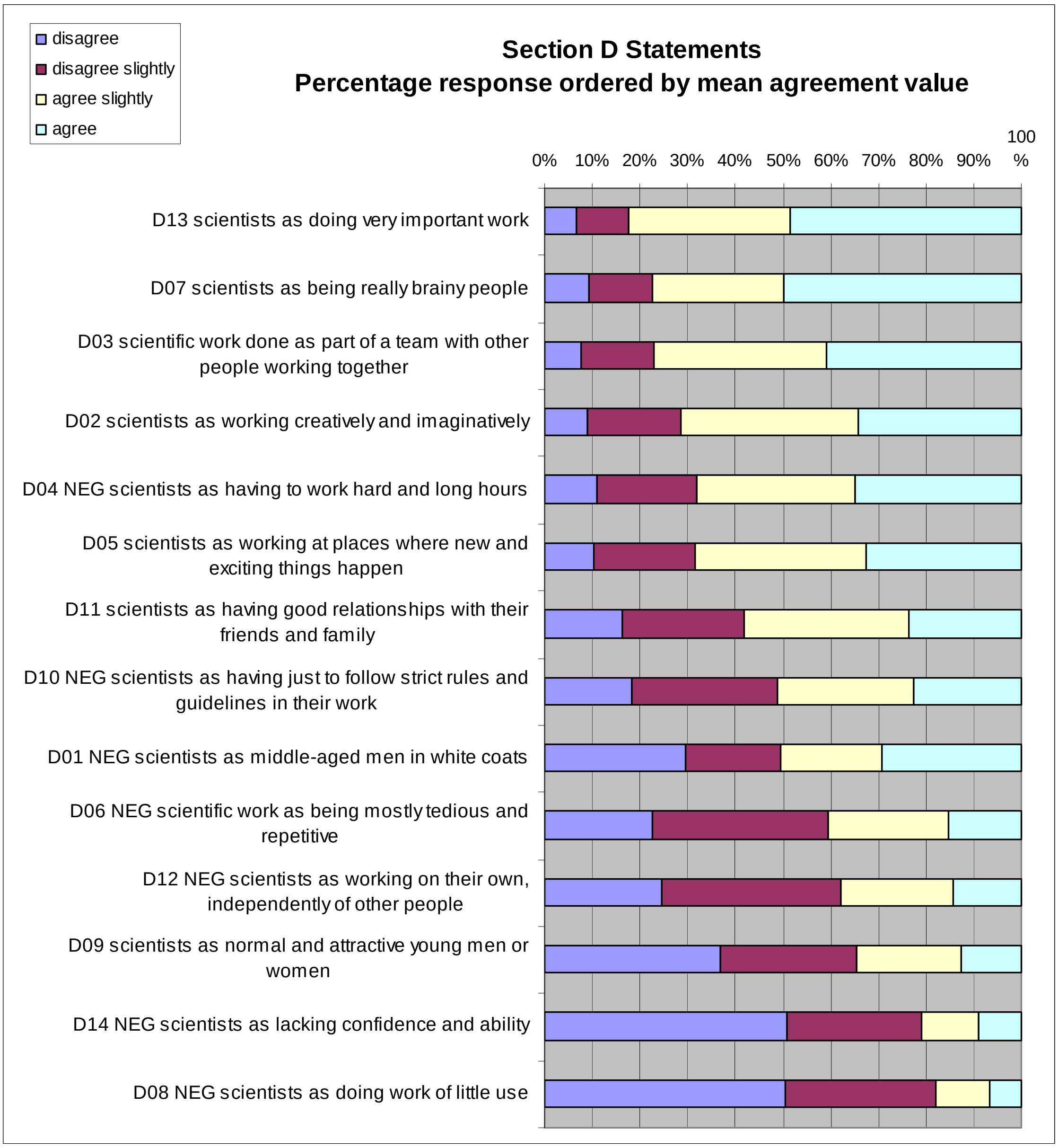

Figure 16 Section D statements. Percentage response ordered by mean agreement value

Interestingly, the 5th selection in both the *for* and the *against* lists was:

D07 – scientists as being really brainy people

This suggests that the brainy statement was seen as a factor both for and against scientists in pupils' attitudes. D07 has a strong mean agreement value of 3.18 which is second from top of all the Section D statements.

It is interesting to note that:

D13 – doing important work

D07 – being brainy

D03 – working in a team

have the top agreement values. The top two choices for becoming a scientist:

D05 – places with new and exciting things

D02 – working creatively and imaginatively still have good agreement, but lower in value. This suggests that promoting the image of scientists as involved in work that is new, exciting, creative and imaginative may be more important in encouraging pupils to become scientists, than emphasising the importance, team work and brainy people aspects of science.

The statements:

D04 – working hard and long hours

D07 – being brainy,

both figure both in the 'top five' list of reasons *against* becoming a scientist, and in the 'top five' list of statements with high agreement value. 'Working hard and long hours' (D04), in particular, was both thought of as a fairly accurate image of scientists and their work by the big majority of pupils (68%) and an important reason for *not* becoming a scientist by many of them (32%).

Einstein Year event participation

The qualitative evaluation aimed to repeat some of the questions asked by the survey in person, and also through observation of 11-14 year olds at a variety of events, as well as through event evaluation data. The evaluation data was collected through the use of paper-based questionnaires, interviews, focus groups and observation.

Impact of the events

This section considers the impact of events on people's attitudes towards physics and is based on analysis of the event evaluation reports, survey scripts and interview notes collated over the year. The formal event evaluation form (Appendix 5) was used by recipients of the Institute of Physics Einstein Year grants and other organisations that the research team contacted in order to obtain marketing literature. Event organisers were asked to record the gender and age of attendees and to calculate the median response to the questions the aggregate results of which are shown in Table 5.

The thirty four event reports represent over 6000 individual responses. The evaluation reports were analysed and those events that attracted participants with a median age from 10 to 18 (n= 2103) were studied more closely, since this included the target age group for the evaluation exercise and allowed for the presence of a number of adults.

The results showed that, on the whole, participants were glad they had attended, felt they had learned something about physics and also, importantly, felt more positive about physics when they left than before they attended. Adults (n= 4554) were more likely to have strongly agreed that they were glad they had attended the event and that they had learned something about physics. But they were equally as likely to strongly agree that they felt more positive about physics than before attending the event.

Table 5 Summary of exit questionnaires from the submitted Einstein Year events that contained predominantly young people (n=2103) and adults (n=4554)

Question	Median Age <18	Median Age >18
I am glad I came to this event	3.5	3.7
I learnt something about physics here that was worth learning	3.2	3.4
I feel more positive about physics now than I did before I came here	3.1	3.1

NOTE: Using the Likert scale answers were scored 4 for strongly agree and 1 for strongly disagree.

The impact of individual events was difficult to ascertain as people were often only met once, and there were few ways in which the qualitative review could follow up on what people, or in particular the young people, remembered later and had taken away from the event, whether this was actual learning, or just an overall positive impression of the subject. However, the immediate impact of events was easy to see, and overwhelmingly positive and this should be an aim for organisers of such events, since enjoyment may lead to a more positive outlook in future.

Observations of attitudinal change

Some attitudinal change was evident in people's response to the exciting events that they were attending. Whole scale attitudinal change from participation in one event should not be expected and this evaluation work did not set out to monitor just attitudinal change but to gauge enjoyment of events, the quality and quantity of events and to benchmark the attitudes of young people towards physics and physicists.

During the *Move Over Einstein* installation at the Royal Museum, Edinburgh the evaluation team set up a 'graffiti wall' that worked as a tool in that setting as there was only one exit / entrance for the exhibition. Visitors were encouraged (and were happy) to write their feeling about 'what physics is' on a sticky note on entry and to repeat the exercise on exit (see Table 6). Often events are held in larger areas, with multiple entry and exit points; and even when the *Move Over Einstein* exhibition was held elsewhere there were more entry and exit points.

Before and after comments on the 'graffiti wall' at the Royal Museum in Edinburgh, illustrated an increased sense of excitement following participation in the activities. Non showed the converse. Questionnaires handed out at the event and interviews carried out on the day also showed that even reluctant attendees enjoyed their experience of the events and had become more disposed to making positive comments in relation to science during their participation. Students questioned at events did reveal the anticipated "bored", "dull" and "boring", answers to their attitude to physics but comments such as "dudesumful" "cool" and "excellent" were received, in particular with respect to the experiments presented in the exhibition.

Table 6 Selection of responses to the "what do you think of physics?" graffiti exercise

'Before' Wall Comments: I think physics is…	**'After' Wall Comments: I think physics is…**
I didn't understand (G1 age 13)	It made it much more fun and easier to understand (G1 age 13)
Super un-cool (G age16)	Super cool (G age 16)
confusing (G)	More exciting (G3)
Boring(G2)	Fun! ☺ (G2)
Boring!! (G age15)	A science about how things move! (G age 15)
Confusing ??? (M1)	On the right track now!! (M1)

This particular exhibition certainly gave more enjoyment than the visitors had anticipated when they realised the topics to be covered, and also resulted in the ability to recall physics facts immediately afterwards.

How much actual learning or understanding of physics was achieved at events sponsored by Einstein Year among audiences is uncertain, and, in any case, was not one of the primary aims of the year. However, in terms of engagement, and ultimately perception, it is likely that a great many of the events and activities that took place during Einstein Year contributed towards moving science, particularly physics-connected aspects of science, from the dull, dusty and fusty category into one better defined by fun, relevant and collaborative.

Perception of who's a scientist

One of the more interesting findings of the field work was the response to the question 'who or what is a scientist ?'. Many young people couldn't name a scientist they knew and didn't even classify their teacher as a scientist while others immediately stated their teacher(s). A few cited parent(s), relations or family friends. When asked who they think of as scientists the general perception was that anyone could be a scientist. Responses varied depending on what students were doing, or had recently covered, in school. One focus group was taking part in a project where they each were given a scientist to research and those young people were able to make a long list of well known scientists. However, when asked to describe what a scientist might look like they were a little confused and often chose clothing as the defining characteristics:

> Specs, goggle, long white coat - girls and boys year 7 / 8

Although this was followed up with further comments from others in the group:

> Scientists can look whatever, as long as they are good at their job girl year 7, boy year 8
>
> Not all chemists wear white coats - boy year 7
>
> I think a scientist can be anyone, that's what you see on TV on the news they're often women and men, but they're older, kind of middle aged - boy aged 11-14

One event organizer had an anecdote about one of his PhD students, from a child who asked, "Are you a scientist?", and when the answer came back yes, said, "Really?! But you're so young", with amazement. During another focus group a year 10 child, unprompted, said:

> Lots of people can be anything, it doesn't matter what they look like, there are lots of scientists who don't live in labs and therefore don't wear white coats

Asked about one presenter and whether he looked like what they would expect a scientist to look like responses were completely mixed and varied from "yes, he was exactly like I pictured" through, "kind of" to "not really" from year 4 girls. But one boy from the same school group thought "he looked like a good scientist". The presenter in question was male, balding and bespectacled with an affable air. However, in a focus group with older children (year 10), with regard to their perceptions of scientists the young people were quite indignant: they didn't like the accusation that they (young people) believed all scientists looked "mad, like Einstein" and were old men (Event 15).

Very few of the young people interviewed had considered studying science – they often couldn't make the link to the wide variety of careers available, beyond knowing they needed physics as a prerequisite for certain careers such as medicine or veterinary medicine, and being an electrician. On the whole, only young people who had an idea of what they wanted to do as a career and could define a particular job role could see themselves continuing to study science. Otherwise they found science jobs disconnected from their lives. Science is done by 'other people'. However, in the questionnaire results and in interviews science was valued and seen as important.

Enjoyment of the science

Discussions with young people in the 11-14 year age group when asked about how much they liked science produced similar responses. On the whole this age group told us they enjoy science, so long as it is activity- based, hands on and not "copying from the blackboard" or listening to the teachers, "just blabbering on". There was evident enjoyment of 'whizz-bang' science shows and acceptance of things that sometimes went wrong, so long as on the whole the presentation was fast paced and interesting. Participants in the Nuclear Debate (E12), run by EcSite, at sites in Newcastle, Sellafield and Glasgow, thought it was "something different, getting us more involved in making decisions", but expressed boredom and disillusionment that the planned video conferencing had not worked and "took ages to sort out" (in fact only telephone conferencing was possible at the event due to unfortunate technical difficulties).

A good many of the science shows, events and activities included a 'Wow!' factor: dry ice, liquid nitrogen, explosions, flashes and so forth (E2, E4, E9, E11, E15) and these drew the attention of the young people such as shown in Figure 17 at the Radstock Rocket Festival.

Figure 17 Indoor activities in the sports hall at the Radstock Rocket Festival helped to engage a broad age range and interest group

Shows that included the audience in participating on stage were also popular. But younger audiences were quick to condemn dull speakers in their post event evaluation. At the 'It's all Relative' event at Oakwell Hall near Bradford (E8) an exhibition of lunar rocks and meteorites and a planetarium show caught the interest of an older audience as well as children. However, there were in excess of 800 visitors to the event, and on evaluation forms after the event, some of the respondents expressed disappointment that there was not enough space in the planetarium for everyone (in fact 2 extra shows over those originally planned were squeezed into the day at short notice) and with the size of the lunar rocks after they had had to queue for so long (they expected big rocks, not "bits of gravel").

At a number of events, albeit with a higher audience age profile such as U3A[8] events, participants asked for more events, longer talks, more detail and more facts and for events to be held more frequently, illustrating a thirst for more knowledge. This was the overall response to the Einstein's Brain lecture, and one carer who attended with an 11 year old said she wished it "had been put on twice, once at a better time for children, as they would have enjoyed it". At the Hartlepool Einstein in the Library event one respondent wondered whether experiments could have been done in a larger space so that more people at once

[8] U3A is the University of the Third Age

could see. Similar issues were expressed at other public events where large numbers of people could overwhelm small display areas.

However, despite some of the exciting delivery styles and topics some young people still found the science indigestible. For example despite thinking the experiment of "ice cream making with dry-ice" was cool enough to go home and talk about, a group of year 10 girls and boys agreed: "although the guy explained it really well and carefully and by showing us as he went along, I don't think I could do it again, and for the optics I didn't understand at all as the lecture was too boring" (E15).

Evidence of learning or increase in awareness

What people say about their learning from attending a science event, contrasted to reality. For example, *Move Over Einstein* questionnaires collected in Edinburgh suggested that people thought they had understood the science. In reality though, when probed, few had really understood what the exhibit was about. However, they could recount a few relevant facts, but whether this constitutes learning and a long- term increase in knowledge we can't say for sure, although they had gained a sense of how wide the science was: "from outer space to medicines".

The target age group for the evaluation seemed to have a sense that science was useful in everyday life, that it is "all around us", "it's important for loads of things like electricity and things we rely on for transport" and it could "help you do jobs", "for every job really" and that even waste disposal required science both for safe disposal and to make the dustbins. Some had a sense of the benefits in the discovery of new medicines, and techniques for medicine, as demonstrated by the nanobots part of the *Move Over Einstein* exhibit for exploring inside bodies. As such there was agreement in focus groups, one-to-one interviews and on evaluation questionnaires that that science and scientists are of value.

Brainiac was cited as the best science show and TV programme repeatedly by young people from year 4 to year 8. However, the sometimes overt sexual references, in one programme about women and large fruit doesn't place this show in the category of being respectful of women; rather, it reinforces gender stereotypes, and makes it somewhat unsuitable for the younger audience who find it fun and instructional nonetheless. However, the show's efforts to take science out of the laboratory and into the real world can be applauded and is appreciated more generally:

> It's physical and fun and they are showing you results at the same time – girl year 7
>
> Like blowing up the caravan. They do tests to see if things will break when it blows up. Some things didn't break like the plastic cups. - girl year 7, boy year 8
>
> Brainiac. I learnt that wee-wee can cure itchy feet – girl year 4
>
> I love Brainiac. Science abuse and how they explode stuff – girl year 4

Children observed and interviewed at or directly after events tended to appear to remember most about things which moved, went bang, or were interactive. When asked what they thought physics was important for, many children showed some insight, such as:

> Physics is the science where we learn all these ideas and even hard concepts about the world (male age 11)
>
> [Physics] let's us find out how the world works (girl age 10)

Children who'd seen the moon rocks and meteors at the Oakwell Hall event in Bradford (E8) remembered that "meteors are very heavy and full of iron", and that "the moon is moving further away from the earth each year" – these could be described just as facts which amaze, but this should not affect their validity as a learning outcome, Lab in a Lorry was brought to Durham by one of the Einstein Year Ambassadors, and parked outside the library and local cinema. It was badged as an Einstein Year event in the marketing materials, and there was also a hired Einstein impersonator on site. Here, the children were asked their opinions on the lorry concept and the science as they left. One 12 year- old boy said:

> I learnt more about physics than I already did, and I hope I remember some for school

two other boys (one 11, one 12) came back a second time as they:

> hadn't had time to see it all and understand the polarised light stuff the first time

However, the thing that made the biggest impact was that it was "in a lorry!" One child (age 10) did comment that "now I know why aircraft windows are round and not square"; and two others (ages 9 and 13) were amazed that sound alone can break a glass.

A teacher at a schools event linked to the Hartlepool Einstein in the Library public event summed up her feelings:

> I thoroughly enjoyed it, and it was great to see *all* the children totally engaged in the learning"; another mentioned that "the hands-on activities …… .gave lots of new knowledge and key scientific vocabulary that my children remembered back in class.

Perceived impact of events and attitudinal change assessed by the quantitative survey

The quantitative survey had extra questions added in the phase 2 and phase 3 questionnaires to assess the number of students who had taken part in an Einstein Year related event and then to assess the perceived impact on taking part in the event. The key questions were:

> C01 – I have found out something interesting about physics or physicists because of Einstein Year and
>
> C02 – Events in Einstein Year have helped to give me a positive feeling about science and scientists

The overall agreement value with these statements for unique participants was 2.61 for C01 and 2.57 for C02, both above the neutral 2.5 value, showing slight agreement with the statements. These scores therefore reflected a 'perceived' outcome for pupils who stated they have participated in Einstein Year and related events.

As with the corresponding phase 1, the agreement at age 14 is lower than at age 11, showing a more negative perception as age increases. However, in this case the agreement for females is slightly higher than for males, which reverses the trend observed in most other areas. This appears to show that the females who participated in events thought that they gained more from them, than they originally hoped for, and in comparison to males.

While the results about attitudinal change resulting from participation in Einstein Year events need to be treated with care because of the small numbers, the difference between pupils who have stated participation in Einstein Year or related events (about 7%) in phases 2 and 3, compared to the start of the year (phase 1 results), is that they show a small but consistent increased interest in science (Section A). However, there is no corresponding improvement in attitudes to science, technology and society or in attitudes to scientists and their work (Sections B and D). The general interest in science level was neutral to start with so has room for improvement. However the attitudes in Sections B and D were generally positive allowing less room for improvement. Furthermore, interest levels may be varied by positive and negative experiences, but many attitudes, particularly stereotypical ones, are much more entrenched.

The anonymous nature of the questionnaire meant that the results show general patterns and cannot compare individuals on their responses before and after participation. Further care needs to be taken with interpretation of the participation results as while it is possible that the improvements in interest levels were due to participation in events, it is also possible that pupils who were more interested at the outset, were the ones that became aware of, or participated in more of the events. The participation question may, therefore, simply have selected existing pupils of higher interest level.

These results were compared with survey questionnaires collated at events and in interviews with young people at events. From this source of data in the qualitative work it was not possible to detect any significant difference between males and females in their level of enjoyment or the impact of attending the event. However there is evidence to suggest that attendance did have an overall positive effect on attendees, in that there was no evidence of people not enjoying themselves.

Chapter 4 Aim 2 Increasing the Quality and Quantity of Physics Outreach

The Institute of Physics set up a database in conjunction with the BA, which was open for editing by the community so that events could be added by grant holders, event organisers, and Institute of Physics branches and members as these were organised. Figure 18 shows the profile of events as they were recorded on the database over the year. The evaluation team found that more events occurred than were recorded.

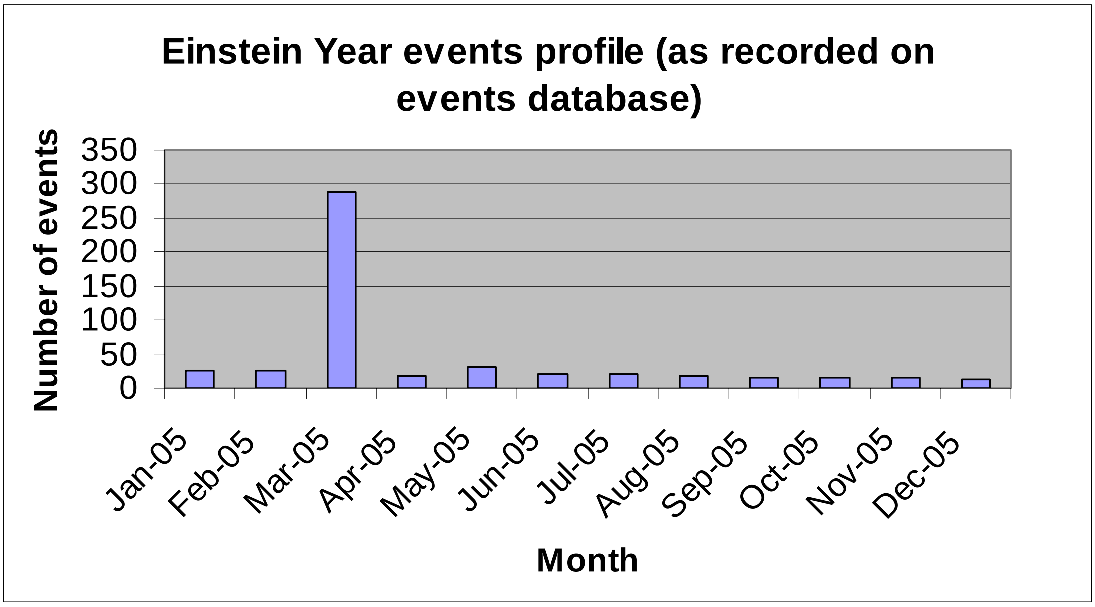

Figure 18 Events profile for Einstein Year taken from entries in the BA database

With over 500 events registered on the database, fifteen events were selected by the researchers to undertake ethnographic analysis and focus groups. Many more events were tracked to be taken in *en passant* or observed when the evaluators undertook interviews with speakers or event organisers.

There was certainly a lot of activity. Events targeted a wide range of age groups and there were many events targeted at primary age children events for all age groups and many targeted at adults. A number of the events (Faraday lectures, schools lecture series, small grants and Science Week) would have happened regardless of Einstein Year. However, event organisers and those who do outreach work agreed that although they would have done "something anyway" many did more or encouraged others to do more such as the Ambassadors who responded to an end of year survey:

> I didn't use the kits, but my students did

Some organised much bigger and better structured events than they would have normally while others would have organised, most probably, non- science- related activities and were pleased to work within a national celebration.

Quantity of events

The Institute of Physics used the Einstein Year brand to raise awareness and interest, as much as specifically create new events. There is no benchmark of the number of science outreach activities taking part across the UK in a 'normal' year. The Einstein Year small grant-funded events were entered on the Einstein Year database by Institute of Physics staff and other Einstein Year event organisers were encouraged to use the database, but it was not a condition of involvement.

An analysis of the Einstein Year database shows a heavy concentration of events during National Science Week. However, there also appeared to be other concentrated activity at Easter and during the summer half term break that didn't register on the database. So the estimate of 500 events taking place is likely to be a considerable under-estimate. Many events in National Science Week and individual Einstein Year related activities at regional science festivals were not recorded in the database. Also, some events ran more than once, and some event organisers confessed to not really using the database:

> No, I've not really been encouraged to [use the database], and I don't see it as a useful way to get people to come to events. For example, schools would never consult it as far as I can see
>
> *A1 (Einstein Year Ambassador)*

> Yes, I've used the database and the events I'm involved with are there, but I don't have time to look for what else might be on
>
> *A10 (Event Organiser in Science Centre)*

> Yes, although I didn't find it that useful, as not everyone was [using it], and there were more events in my area than those listed. I also found that some listed events did not happen
>
> *A7 (Physicist and event organiser)*

The evaluation team was unable to attend some events because of the clustering of events at specific times of the year such as in Science Week and during school half terms. In addition, cancelled events (for whatever reason) were not always updated soon enough on the database for plans to be changed.

A series of programmes on BBC and a feature on the national news of new footage of Einstein in his garden ensured that people, by June, when prompted in interviews had some recollection of having heard about Einstein "sometime recently". For example about half the parents asked at the Urdd Eistedfodd in Wales in June had some memory of Einstein having been in the news or recalled having heard his name mentioned "somewhere". Some of these parents agreed though that they were prompted to remember this by having seen posters around the 'Science Tent' at the Festival. Other adults who attended the Einstein in the Library event in Hartlepool during October remembered the "Einstein's Brain" TV programme on Channel 4 and that there was "stuff on the radio earlier in the year".

Overall, the combination of funding schemes and engagement with schools, as well as the common branding of various touring lectures (such as the IEE Faraday Lectures, and the Institute of Physics schools lecture series), led to a significant increase in the visibility and number of physics-related activities during 2005.

Quality of events

Of the events attended only one showed any signs of poor preparation, with too much material, and yet even here the audience enjoyed the 'performance' and information imparted – a testament to the personality and enthusiasm of the presenter.

Event reports that were submitted coupled with events attended saw a variety of events held in libraries, universities, public spaces, schools and community halls as well as public venues such as theatres and arts centres. As many of the events were free it is most likely that those who were unimpressed with any activity would simply leave and not be bothered to offer any feedback. On the other hand, those participants who had a positive time at the event, would be more likely to return and, take the time to congratulate and thank organisers. Most respondents, when asked to comment on suggestions to improve events, produced such comments as:

> Nothing, it was excellent
>
> Perfect
>
> Couldn't be improved it was already great
>
> If we had more time to work
>
> It was just the best
>
> *At Heavenly Music*

As already discussed in the section describing the 'enjoyment of science' at events senior audiences were pleased with the quality of the events. From audiences with a young age profile the comments were similar, for example at the Hartlepool Einstein in the Library event and at an event for year 5 and 6 pupils at the Discovery Museum in Newcastle) when asked how the event could be improved responded:

> it couldn't be (girl age 11)
>
> it was great fun (boy age 12)
>
> better than when we do it at school (girl age 9)
>
> finally from a parent: I don't think it could have been. It was really well organised (parent, female, age 38).

The Institute of Physics schools lectures and the IEE Faraday lecture:

> Prior to the lecture starting the atmosphere in the theatre was "buzzy". The main part of the auditorium was full, some groups were sitting out to the sides.
>
> The two lecturers come onto the stage together. The entire performance is choreographed, with each lecturer taking turns to speak, and the lecture materials integrated in each section. The event seems unlike the perceived view of a formal lecture. The lecturers (one of each sex) wore the same unisex casual clothes, black t-shirt and beige trousers.
>
> The stage show started with "Matrix (the film) – like" numbers streaming down the screen, a visual key relevant to the age group, and the numbers 2050 up on screen. The audience whistled and clapped.
>
> "In 2050 robots will be as fundamental to every day life as mobiles are now".
>
> Some history on the study of robots and robotics was given to set the scene, as well as a link to literature through the Isaac Asimov book and the recent movie "I Robot" with Will Smith, as well as Steven Spielberg's "AI", outlining that "most of what we know about robotics is based on science fiction not science fact".
>
> The first volunteer was on stage within 6 minutes of the lecture starting, and volunteers were then brought onto the stage at least once in every 11 minutes throughout the hour- long lecture. Volunteers always raised the energy levels in the auditorium, and also broke up the learning and reinforced the theoretical lessons with a practical exercise.
>
> The entire lecture was story- boarded – designed around the development of a diagram of a control system, and its elements, linking these to robotics research and robot manufacture and use.
>
> Use of multi media, such as video, was frequent; one clip was shown approximately every 10 minutes.

Some technology didn't work properly. The lecturers handled this well, "technology is like that", and carried the audience swiftly to the next topic, rather than trying to fix the problem and thereby lose the momentum of the show.

Use of a human dressed as a robot on stage was fun, and raised cheers from the audience whenever the actor was called on to interact with the lecturers, or perform on stage.

At the end of the lecture there was applause, and as the music started the children were animatedly talking, some even discussing topics in the lecture as they left the theatre.

All teachers were handed enough evaluation forms for each child, to be submitted subsequent to the event. All schools left immediately for transport.

Faraday Lecture - the "show": Glasgow February 2005

are examples of where the quality of the whole show was carefully managed from start to finish, following years of experience in putting on the lecture series. The investment in the planning, choreography and training of the presenters is critical to the show's success. One of the presenters was recruited through her connections with the Robot Football Team. She very much enjoyed taking part in it, describing the build up to the actual events as a "mad six weeks, some of the hardest work I've done, including 2 weeks voice training and learning the script, starting from nothing".

However the other Faraday presenter recalled seeing a similar lecture when he was at school and although impressed could not even recall the topic and didn't recall that it had much impact on him or his learning. But then he was, he says, "born to (be an) engineer", as many of his close family are also engineers. In contrast, the female Faraday presenter who took A' levels in physics, maths and biology, was inspired by a history teacher and the industrial revolution to go into engineering.

Some events intertwined historical factors with science such as at Awesome Electricity in Hampshire:

The presenter was paid for the show and the auditorium was full. He was relaxed and candid. "Hello, I'm …". His enthusiasm was evident and he took the audience back to when he was a 14 year old, and that he started doing technical things "because I like getting things to work".

Zipping between past and present he made lively links between the past and present and explained what was happening even when things went wrong. Pencils were burned, wires melted and bulbs smashed "to see what's inside" and to then show why light bulbs are made from glass:

"OK this is what is inside your bulb. You've probably seen inside it before through the glass. I'll connect this now and you will see how the vacuum is important. See, it doesn't last long at all. That's why we need the glass." The show kept the audience entertained.

One presenter (A4) aimed to "go beyond just demonstrations and theoretical explanations and to share my energy and enthusiasm for electricity and what it can do, with young people". To that extent he succeeded.

One very popular event was the Einstein's Brain lecture, based on a Channel 4 documentary and given by two excellent science communicators (Jim Al-Khalili and Mark Lythgoe). The tour of lectures was funded by a small Einstein Year grant. The lecture successfully toured the UK giving sell-out performances. At two performances exit surveys were handed out producing a high yield of responses from an engaged and interested audience:

The target audience for this event was the general public, including families. The event was held on a Monday evening at York University Campus, outside the town centre. The event was widely advertised around York, in local papers, and on the Internet. The lecture was based on the Channel 4 programme of the same name, so the publicity from this assisted in getting an audience. The event was hosted by York University, organised by a lecturer from the Department of Physics. The event was found on the Einstein Year database of events. Entry was free.

The event was a one off occurrence although the organiser was an Einstein Year Ambassador, and was involved in organising other events with schools and a Space Family Day at the end of August, funded by the Institute of Physics.

The purpose of the event was to celebrate Einstein Year and to engage not only university staff and students, but also local people interested in science.

The event was held in a traditional lecture theatre seating just more than 200 people. About 120-130 people attended the lecture – a large range of students and staff from the university, and some visitors. People came straight to the lecture theatre; there was little or no interaction between participants who did not already know each other.

All attendees apart from one eleven year old were adults. About 50 per cent of the audience were not physicists (hands up poll during lecture).

The Institute of Physics branch members present commented that local publicity to families was not as effective as for some other events. Publicity within the University resulted in c.70 per cent of the audience; about 5 Institute of Physics members attended. The event was widely marketed within the local area using a combination of leafleting, adverts (paid for) and articles in local newspapers. There was no pre-booking. Questions were taken for approximately 15 minutes after the hour- long lecture.

Everyone spoken to by the evaluator afterwards said they enjoyed the event, thought it was interesting and would have engaged children, had they attended. People would have mentioned it to others if they had heard about it further in advance. There was a buzz of discussion as the audience left the lecture theatre.

E5 Einstein's Brain ethnography

Improving events

As already discussed in the section on quality of events, evaluation forms were overwhelmingly appreciative of the events and their quality. However there were comments and observations that lead the evaluation team to draw some conclusions about how things might be improved further still.

A year 10 focus group interviewed immediately after participating in the Nuclear Science Debate run by Ecsite, mentioned that the mixture of ages (years 10-14 represented) expected to work together was not necessarily ideal. Although the younger ones felt they had enjoyed the event overall, and learnt things from the older ones, there were times in the exercise when they were told to "write what you know about …" and they knew little as they had yet to start to cover the topics in class. Care should be taken by organizers of such events as children are particularly sensitive to being made to "look stupid" (boy, age 14) in front of their peers.

Science engagement activities that target a specific age group should also consider the wider audience which could result in events having a greater impact. For example, parents interviewed for this evaluation indicated that activities that are targeted at family groups need to consider the whole group and provide actives or elements that will entertain or inform younger as well as older children. This includes providing visual and textual clues for carers to be able effectively to guide different members of their group around an activity. At some venues and activities there was criticism as displays lacked visual aids for parents, were inaccessible for younger or smaller visitors, and although in some cases (such as with the *Move Over Einstein* exhibition) backpacks of activities were developed, often they weren't very visible or promoted to family groups.

It was indicated, by parents and carers in particular, that the simple provision of steps, variable height 'peep-holes' and sets of smaller controls could help interactive activities to be more widely accessible to a range of age groups. Family events targeted at the 10 – 12 age group need to be able to entertain children as young as three, in order to retain the older children long enough for an impact (especially enjoyment and/or learning):

> I wish there was something for the little ones to do, as she's (12 year old) really enjoying this
>
> *Mother, Move Over Einstein Exhibition, Edinburgh*

This type of modification was seen in operation at one science centre Halloween lecture during the October half term (E22), which used age- appropriate props to engage the whole audience. The organiser ended up with a Barbie doll sitting on top of the van de Graf generator to the interest of the much younger and great amusement of the slightly older parts of the audience.

Efforts still need to be made to improve activities and help make the links to science, school and careers:

> I wish I could take this away with me. Even though I usually teach younger ones (9-10) I could have brought my whole class here; it explains some theories very well, and with some tuition and help younger kids could do the same exercises and learn something. I'm not sure any of the children here today will have learnt anything as I can't see anyone really prompting them to, but they seem to be enjoying playing. I think this is the kind of thing that should get kids interested in science – you guys have done a brilliant job putting this together, but you should think about how it could be used more, and to more affect if that's what you want to achieve.
>
> *Event E14, New Zealand teacher*

> Perhaps if there is a crisis in getting people to study science then there needs to be more explanation of what you can do with a science degree. I don't think [physicists] can hope to have a positive or negative impact on the 11-14 year olds as I don't think they are exposed enough to them. Documentaries, especially about people like Einstein tend to be good, but I'm not sure 11-14 year olds would choose to watch them, or enough to be encouraged to by their parents… … and there's not much other media coverage for science that kids would see.
>
> *Museum Education Officer*

Practical demonstrations are not without risk of equipment failure or a desired effect simply not working as well as it should. Presenters were not phased by the failure of technology, professionalism won through and audiences were forgiving:

> Some chaotic moments …. IT problems, an exploding power supply, a girl whose hair wouldn't stand on end … but the lecture was fast paced and full of information and historical facts. The audience were involved despite one row becoming bored and at the end the overall response was positive with exclamations from some girls "mega" and "cool".
>
> *Event E4*

Chapter 5 Aim 3 Building Sustainable Links between Physicists and their Communities

Science engagement, explaining and the running and coordination of events for the public is undertaken by a variety of people. For some it is their job to set up and run public events, such as in libraries, museums or activity centres. For others, freelance science communicators, it is their livelihood or a requirement of a grant. But without knowledgeable enthusiastic people many of the public events simply could not happen. As part of the evaluation we looked at the motivations behind the organisers and the physicists in creating and making the public science events that helped make Einstein Year happen.

Engagement and motivation of organisers

The event organisers whom the researchers interacted with were a combination of physics outreach officers in universities, libraries or museums, volunteers and /or science communication specialists. They were specifically asked about their motivations and what more needed to be done to increase awareness of young people in physics and whether more physicists should be engaged in outreach work. Some made passing comments about the value of the Einstein Year grants. Some (for example A12 and A13) valued having some real money from one or more sources to manage and run events and to be able to actually pay an administrator to coordinate things. While one (A2) thought the grants were too small to do much more than pay for a few consumables and travel costs, "but certainly not time [to do much research and preparation]". Other comments were more appreciative:

> I paid R. I bought specific time. I won't organize another event now without paying someone. That was the secret to the whole project. I only paid for eight days but it enabled him to give it his full attention and because I was paying him he couldn't take on another job.
>
> *A13 (event organiser and physicist)*

> The only reason I could run it this year was because of the grants. I paid for a person to be here that [grant] paid for part of that.
>
> I also had a grant from PPARC that helped. Otherwise we couldn't have run the event. That paid for the room and starlab and general running of the whole thing. We had 3 workshops going on continuously. On Tuesday we had prize givings and so on. I needed someone to help and coordinate.
>
> *A12 (event organiser and teacher)*

> [I took] £500 – didn't ask for full grant as didn't need it; but I would like more freebies for giving away at events, i.e. to '"promote physics'". I'm spending two days in primary schools and getting to c. 700 children which has expanded my target audience
>
> *A5 (Einstein Year ambassador/ event org/ physicist)*

Another organiser (event organiser A7) felt that the grants were useful but commented that "small grants can be as difficult to manage as a large one. Marketing costs can be as much as £500 in all for a two day event – it is essential to write this in".

Organisers in places like libraries who were always on the lookout for new activities for school holiday activities valued the availability of speakers with expenses paid or with activity packs or kits. They were delighted to be able to have a national event to link their activities into and provide some extra excitement. Few of these people have any science background, but over the years have come to see science as important and interesting (A11, A20, A14 and A10).

Some of the event organisers were people who have worked (or still are working) in science and technology and are simply committed to engaging young people in their own personal passion. For some it is possible that their involvement is driven by some sense of lack of power or control at work, an absence of positive feedback in whatever sense that might be or a realisation that their talents lie beyond their work desk. Others mentioned they had an opportunistic amount of time available (in one case this was maternity leave) and 'need' to fill it. It is without doubt that the science communication community depends quite heavily on this group of people –- scientists with a passion for public engagement. It is almost their hobby, and for some it has become a major role even when they have other responsibilities, such as within a University. Thus, developing a system of identifying, communicating with and rewarding these individuals will be important for the Institute of Physics if it is to nurture and maintain their support and engagement.

Clearly much of the success of Einstein Year would not have been possible without volunteers, scientists and event organisers working beyond their everyday jobs. Following up their engagement and sharing any sense of success and the 'where next' could be a good way of sustaining the relationship and valuing their contribution.

Engagement and motivation of physicists

The extent to which physicists became engaged in Einstein Year depended on a number of things. Personal motivation seemed to be a primary driver. In the case of one interviewee, this superseded all else and he worked with ex-colleagues to set up an event and run it rather than to engage his existing employer in something (A13). The physicists interviewed were involved in Einstein Year because they:

- Believed they must do it as they are publicly funded
- Wanted to share their enthusiasm
- Had to as it was a part of their job
- Were members of Institute of Physics and want to promote its work.

Despite this, engagement was patchy across the country.

During the evaluation, the research team contacted the Einstein Year Ambassadors, who had been left after an initial training session to develop their own local programme of activities. About one third responded to requests about their activities. There was no centrally held information about the events that Ambassadors attended or organised. A follow up email with some evaluative questions was sent to the Ambassadors after the end of Einstein Year, and their responses have been included as appropriate.

Few of the Ambassadors seemed to be particularly active in setting up and running events; as some put it in the feedback survey: "pressure of work". Time was an issue as these were employed, practising scientists. But this was countered by others who did more events and activities than they would have done normally or helped students and colleagues to.

Many of the Institute of Physics regional groups didn't participate in any significant way despite access to a special grant scheme. Contact by email and phone only produced a small number of leads. The extent to which an event was driven or precipitated by a regional Institute of Physics branch was unclear and there is no central database that assesses events by this criterion. The research evaluation team had expected the branches to be a main conduit to events, but this was not the case.

Physicists' motivations for being involved in Einstein Year were wide ranging including one interviewee who is motivated to be involved with physics because: "I want to understand how the universe works; physics tries to answer these questions". This event organiser was, and is, inspired by the night sky, and expressed his personal need to study physics to gain more of an understanding of it.

Issues that need to be addressed for future development of the Institute of Physics's engagement with physicists are:

- Help the presenters with marketing their presentations / talks / lectures / events, perhaps through a database.
- Isolation – some of the physicists operating locally didn't "feel part of a bigger thing", whereas others were content to get on delivering their small piece of Einstein Year.

But those physicists, such as A18, who operate more on the science engagement scene nationally, felt part of the whole, most likely because they were doing (sell-out) lecture tours and had a different perspective of Einstein Year. Follow up interviews have indicated that the Einstein Year activities have led onto new contacts and funding opportunities for some.

How the Institute of Physics might engage more physicists in outreach work

One event organiser who specialises in science and history thinks it essential that the science is put into a context of a real world setting that children can relate to and that these messages are conveyed to physicists doing outreach work. (A8). Others, though, think it is more a simple case of hiding the 'geeks':

> Need to develop role models who aren't too geeky. We need more physicists on TV, but not geeky ones like Adam Hart Davis or Patrick Moore who is too eccentric; [they] aren't cool enough to really inspire children to continue their studies.

or simply paying people to do it:

> Mmm. Ideas to engage more people in outreach work? pay for scientists to staff the lab in a lorry, set up a gifted and talented fund to reward success and to run physics fairs over whole weekends. (A7)
>
> Incentives? Or get them young, usually PhD students welcome the opportunity, particularly to work with a museum, and see another way in which science 'education', if you can call it that, can be delivered (E3)

One presenter (A15), supported by at least one other (A2), questioned whether more physicists were needed to do outreach work:

> I'm not a physicist, but from my own interest in the topic area … I can explain and inspire kids to want to understand and learn more". He explained …. kids get turned off by hard stuff that's not explained well and by adults treating them, I don't know, like children … they like some seriousness and they like to learn, on the whole and so then its just down to capturing their imagination.

Another (A21) queried whether young people could relate to research scientists:

> I don't know. If you are too far along the career path then the kids can't see how to get there…. .not sure it will turn them on much. I can't see increasing the size of the 'army' would have much impact (A21).

A physicist (A15) and science presenter (A9) both felt that young people needed to be shown what's going on in business – the "wow factor needs to be put across". They both stated that scientists are sometimes better at what they do than putting it the science across to the public. Motivations for these two (A9 and A15) were an unbending belief that it is important to encourage young people into physics as they need it for engineering jobs and even in later life. Because "it is integral to technological developments".

A number of the event organisers and outreach physicists would like to see greater use made of specialist science schools to run physics fairs at weekends and library- based event organisers think that libraries offer excellent opportunities to reach different groups outside of the school environment.

Holding events in 'non- traditional' arenas was seen to be a successful way of reaching a broader group of people and reaching beyond the academically able. In addition to tapping into organisations with a need for an event and a well- oiled publicity machine. As one interviewee said "it's not just for the brightest", referring to both science and the activities that are held to capture their interest.

Teachers that were encountered during Einstein Year were asked what they needed from the Institute of Physics. Some of the suggestions were:

> Offering training and regional events for school physicists.
>
> Don't really know about the Institute of Physics – more publications to schools.
>
> Show teachers hands- on aspects.
>
> Volunteer more in schools – -talk about their careers and what they do, and why they chose it.
>
> School visits with actual practising physicists, doing jobs children could relate to.
>
> Look at students leisure activities e.g. skate boarding, BMX biking and apply to physics.
>
> Consider more primary outreach work.
>
> More information for schools on how they can contact scientists working with local industry. More schools outreach will hopefully encourage more scientists to respond.
>
> [Institute of Physics'] Members to work with KS3 & KS4 students.
>
> Call up the retired.
>
> Visit schools with 'Wow' factor- type demos including advice and participation.
>
> Funding so they can promote themselves in schools.
>
> *Suggestions from physics teachers*

Building sustainable links is a balance of building on what is there and reinforcing quality. There are now clear grassroots- based networks linked with a diversity of organisations. The Institute of Physics needs to develop these relationships further with a programme of community- based activities and if further evaluation shows they are useful, with kits.

What are the critical steps in changing perceptions?

When asked "What do you think is critical in helping to change the perception of physics as a subject or a career?", responses varied from having more fun and practical activities, changing the image, being less 'boffiny' or serious and reaching children earlier to holding more outreach activities for teachers in the regions. The following comment sums up a common response from interviews:

> Making it seem like fun at a young age so that kids aren't put off by the theory; contact with scientists and science through museums (well I would have to say that!) but also in the media too; the media that's aimed at children that is, not just in newspapers and adult journals
>
> *ScienceMuseum Education Officer*

This reinforces comments from parents and carers mentioned earlier about the need for science activities that there needs to be more career information that is interesting and accessible, and to illustrate that careers involving physics, and other sciences, are varied. Science engagement professionals agreed that the image needed updating, a point reinforced by one interviewee who wanted to see style dressing for Ambassadors (both Einstein and SEAs) believing that the image they portrayed was that physicists had poor dress sense but above all were poor financially and socially.

Key issues that need to be addressed are:

- Physics graduates are good prospects for a diversity of employers
- Physics is "losing out" to the perceived more exciting biochemistry
- The excitement from the private sector needs to reach young people
- Personality needs injecting into physics
- Physics helps us understand how the universe works.

And for some this last point justification is enough.

Role models are also important in convincing young people that science is a viable choice of study and career. This was shown in a recent study published by the Royal Society[9] and also reiterated in interviews during this study:

> … role models are important. Take the example we have here today, there's me [young and female], presenting the day, and then I've enlisted the help of two female PhD students…. … they're both young, women, and in jeans, and [we] completely thwart the children's impressions of old men doing science, especially as today we're mainly dealing with 8-10 year olds who might not have met a scientist before. (E3)

Finally, from a non-physicist, when asked about the engagement of physicists in changing young people's perceptions of physics one presenter asked:

> Is that necessary? What you need are more people generally to be more interested in physics, like me, I'm not a physicist, but I find from my own interest in the topic area that I can explain and inspire kids and adults to want to understand and learn more
>
> *Planetarium presenter*

[9] http://www.royalsoc.ac.uk/page.asp?id=2785[9] 'Taking a leading role', The Royal Society, London (2005)

Chapter 6 The ‘Einstein’ in Einstein Year

A topic of discussion that was raised all through the year was whether Einstein was a good choice as figurehead for the year.

The event marketing materials were analysed to assess the extent to which Einstein himself was a focus for the year’s events. At one extreme some of the sets of materials, classified as ‘Einstein-specific’, made explicit reference to Einstein himself and one or more of his key ideas and were concerned only with these. For a set of materials to be classified as ‘Physics Einstein-related’, some component of the event that it was promoting / advertising had to have a connection with the life or work of Einstein or to a concept (e.g. ‘time travel’) clearly associated with his work. For example, the Hartlepool Central Library ‘Einstein in the Library’ day (described in more detail below) was classified as ‘Physics Einstein-related’ on the grounds that the day included “a treasure hunt … to learn more about Einstein’s life”. Had this treasure hunt not have been specified, the materials would have been classified as ‘Physics not Einstein-related’.

Throughout this classification physics is taken to include astronomy and cosmology. The next category, ‘Science not Einstein-related’, includes all of science except physics. ‘Science’ here is construed widely; for example, it includes technology and robotics as well as biology, chemistry and earth science. Finally, a set of materials could have no connection at all with science and so be classified as ‘Not-science’. In nine instances, a set of materials was scored as falling into two or more categories; in such a case each category scored 1/n where n is the number of categories (in all but two cases, n = 2; in these two cases, n = 3).

Table 7 Frequencies of the relationship between the materials and science / Einstein (n = 54)

Category	Number of cases (per cent)
Einstein-specific	17.7 (33)
Physics Einstein-related	10 (19)
Physics not Einstein-related	15.2 (28)
Science not Einstein-related	10.7 (20)
Not-science	0.5 (1)

Table 7 shows the overall classification of the 54 sets of materials that could be classified, on this scale. The majority (99 per cent) of the materials were science-related (i.e. fell into one or more of the first four categories). Indeed, 80 per cent were physics-related (i.e. fell into one or more of the first three categories), 52 per cent (those that fell into the first and second category) had a direct connection with Einstein and 33 per cent (one-third) were Einstein-specific (the first category).

An example of one of the sets of materials that was scored as ‘Science not Einstein-related’ is provided in Figure 19, a poster produced by Roots and Shoots (a charity devoted to vocational training, environmental education and urban conservation).

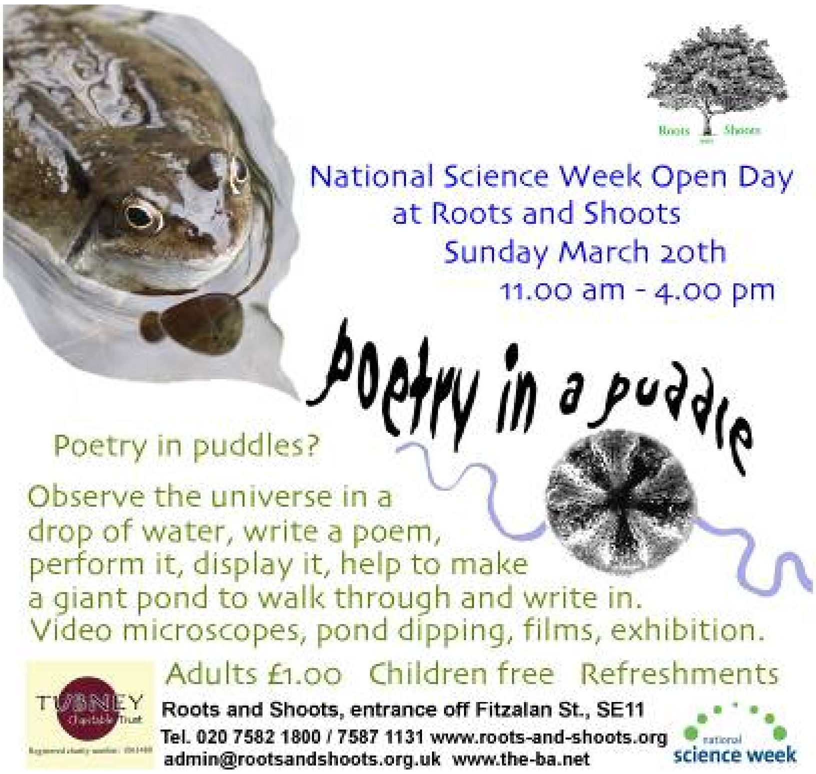

Figure 19 Example of an event that managed to link to Einstein - the Roots and Shoots poetry event

A useful e-mail from the organiser of this event, though, indicates two notable things. First, that many organisers of events that ended up being badged as Einstein Year merely used the label as a hook on which they hung something they would have done in any event (in which case they were fitting into part of the Institute of Physics marketing strategy). Secondly, and somewhat orthogonally, even events that might have been supposed to have no particular connection with Einstein could in fact have some such link.

> I manage a Wildlife Garden for education and conservation at Roots and Shoots in north Lambeth and have done National Science Week events for the last six years. This year it is "Poetry in a Puddle" - it was time I mixed poetry with science having done film, drama and sculpture. Although I have not referred to Einstein Year in the publicity I am using my video-microscope equipment to explore microscopic life in pond water - I have used the theme in various ways in the past (Universe in a Grain of Sand....) - and will refer throughout the day and in displays etc to an understanding of life, the universe and everything through appreciating the micro- to macro-cosmos scales of things. Kind of Einstein-ish I quess. Poetry will be encouraged on any subject seen during the day under the microscope, in the pond, etc. For more information about the Wildlife Garden see www.roots-and-shoots.org - not updated too often but good background.

Another example where Einstein Year was used as a brand includes the Institution of Electrical Engineers annual Faraday lecture. In 2005 this lecture series took robots as its topic, and was linked to Einstein Year. It was a deliberate strategy by the Institute of Physics to foster such relationships, to spread the word about Einstein Year more widely, and raise awareness of the focus in broader communities than normally targeted by Institute of Physics events. Given the number of activities 'Science not Einstein-related', this part of the strategy appears to have worked.

It was fairly uncommon for reference to be made to aspects of Einstein's life and work other than his physics. There were no references to his private life (despite considerable publicity given in 2005 to such books as Overbye (2000/2003)) and there were only a couple of references to his commitment to pacifism. One of these came in the materials to promote an 'Understanding Einstein' day in the Museum of the History of Science at the University of Oxford:

> **The Pugwash Society (basement)**
>
> Find out about the International Pugwash Movement, an international group of scientists campaigning for peace founded by Albert Einstein and Bertrand Russell.

One of the few other sets of materials to reference Einstein's life, including an extensive discussion of his humanism and pacifism, was the display 'Einstein's Century' put together by Steve Morley of the University of Birmingham.

Having said that, as noted above, the Science Museum's on-line 'Einstein, Physics and Fascination', part of their www.ingenious.org.uk website, was unusual for its critical analysis of how Einstein was both represented and represented himself in the media.

The Einstein Year website probably came within the categories 'Einstein-specific and Physics not Einstein-related' and 'Curious and Fun'. This fits fairly closely with the classifications in Appendix 6 of the 54 sets of materials analysed here: 61 per cent of the materials fell within the 'Einstein-specific' and 'Physics not Einstein-related' categories and 70 per cent of them fell within the 'Curious' and 'Fun' categories. Indeed, the 'Einstein-specific' and 'Physics not Einstein-related' categories are detailed in Table 7, and the 'Curious' and 'Fun' categories are the two most frequent in Table 3 so that there is considerable congruence between the messages given by the Einstein Year website and those given by the materials used to promote Einstein Year events.

That Einstein's life can be reduced to just a few key ideas – $E = mc^2$, special relativity, time travel, Brownian motion, the photoelectric effect – is hardly surprising. It is always the lot of famous historical figures, whether in science or elsewhere, to have their lives distilled in most of school education and public communication to the point of caricature. Indeed, this is particularly understandable for Einstein Year – intended to mark the centenary of 1905 and celebrate physics.

Finally, Einstein has, understandably and surely deservedly, inspired huge admiration. The set of materials that most displayed this was one of the most unusual ones. Nick Anderson, course manager for physics at Richard Huish College, has:

> been using rhymes and songs to help my students remember facts and formulae in lessons, and had the idea of a song to celebrate Einstein Year. The band grew out of this idea with the musical students also taking A-level physics enthusiastically taking up the challenge. We have produced a set around physics themes with styles incorporating blues, hard rock, and ballad, In February the band played to a packed and enthusiastic audience of hundreds at the college's Rockfest event. Band members Scott Jenkins and Thomas Rosenthal wrote the music behind Nick's lyrics for "Genius" and Simon Varley suggested the blues music for "suvat[10] – Pretty equations."

[10] The suvat equations are the various Newtonian equations of motion: $v = u + at$, $s = ut + ½at^2$, etc..

Using Einstein as a figurehead – a good idea?

A frequent topic of discussion during the year was whether Einstein was a good choice as the figurehead for the UK and Ireland's response to the World Year of Physics. People's responses during interviews and discussion groups were predictably varied and in many cases polarised between yes and no. Critical adult responses often related to "I thought we were supposed to be working to dispel the stereotype" while others were stronger: "absolutely not". The reasoning summarised by another who said that Einstein was not such a good choice because he's

> weird, strange with crazy hair and [was] an old man

In contrast to the strongly opposed views were the emphatic 'absolutely, who else?' A third category of responses were more supportive than not of using Einstein gave responses, typically along the line of "more good than bad".

The reasons most commonly given for supporting the choice of Einstein as a figurehead were that people have heard of Einstein, he's from a more recent era than other famous physicists (e.g. Newton), "he is an icon", "his equation is the most famous in the world", and

> in terms of tagging science, people know about it even if they don't understand it

One year 10 child in a focus group felt that it was

> good to feed a stereotype for advertising [to attract people to events].

As Caitlin Watson, Einstein Year project manager said "The point is that while Einstein is physically a stereotype, intellectually he is not."

Another year 10 child in the same group felt that from what they'd been taught in school

> he was more of a mathematician

One event organiser, also a university physics lecturer, felt that:

> In the sense that he's the only physicist, apart from Stephen Hawking, that most people have heard of he's a good choice. It's a good publicity stunt, or hook into getting people's interest. In most people's minds there are positive connotations, so it's a good name for the public. On the other hand, the mad scientist type is not necessarily helpful, so I've tended to be cautious in using 'Einstein' with school's publicity, instead concentrating on celebrating the World Year of Physics. Some schools / teachers have indicated slightly strange expectations when using Einstein as a figurehead and it can be confusing if the topic of the event is then not about Einstein specifically.

Without doubt, using Einstein enabled the use of impersonators and large images of Einstein, the latter used to good effect at the Glastonbury Festival, Science Museum, local science shows and in the *Move Over Einstein* Exhibition.

The use of Einstein as a figurehead also very clearly made links between activities and the media coverage surrounding Einstein in the first half of 2005.

In one focus group the discussion ranged over whether it was fair to give one person credit and profile over the whole year, but in the end the group agreed that Einstein was a good choice.

When balanced against the feedback from young people about their perception of who is a scientist or what a scientist looks like, it seems that today's pre and early teens are more 'savvy' and know that scientists aren't mad and / or necessarily male. And that they generally don't look like Einstein.

Nonetheless, event organisers and outreach workers found that at times it was hard work getting teachers or others to accept their general physics activities if there wasn't a clear or direct link to Einstein or his work. Many people couldn't get beyond Einstein Year being about more than just Einstein and his science. In the early part of the year this didn't seem to be a problem as there was a high level of media interest. However the latter part of the year fell a little flat and needed a bigger 'pick-me-up' than further monthly launches, which did not have enough of a profile in the regions.

Chapter 7 Summary

As there are no public evaluations of 'national year of' campaigns, there is nothing with which this evaluation team can make a comparison. No examples of clever devices to renew public or media interest such as renaming an event mid- year or having a second anniversary or even building up to the anniversary as a climax exist in the public domain.

The event organisers and some volunteer physicists expressed some disappointment at the lack of effort to make them feel part of a bigger thing, but did comment that if they wanted something (publicity for an event, or marketing materials) from the Institute of Physics they received it. Another concern was the unevenness of events over the year.

There were comments from the Einstein Year Ambassadors and other regional event organisers regarding the focus on London for all the big launches and media- led events. Follow up interviews showed these (albeit few) people had been unaware of the end of year event in Cardiff.

In terms of the findings of young people's interactions with Einstein Year and science generally:

- They enjoy finding out about how the world works.
- They don't enjoy physics unless it involved hands on stuff (they love activities).
- They don't really watch science on TV or read about it in the news unless their parents do.
- Science shows, science centres, public events and clubs, if they are well planned, improve enjoyment of science not only for the kids but also the adults.
- On the whole, they had found out something interesting because of Einstein Year.
- Lab in a *L*orry was very popular (with young people), in part because it was in a lorry! But event organisers had to work extremely hard to staff it.
- Young people who are already interested in science already are more likely to say they got something out of an event, and remember what they did and how it relates to science.
- They liked Brainiac.
- They thought anyone could be a scientist –- they didn't always have the stereotypical Einstein image in their heads.
- They came down in favour of calling it Einstein Year.
- They were enthused by the events.
- Thought science was important though while a few wanted to be vets or doctors, we don't recall any saying they wanted be a physicist.

Although some young people had attended a lot of science centre type events in the past, there were an equal number who had not, and who wanted to repeat the experience after attending an Einstein Year event.

There was a comment (A7) that "there were lots of events on in Science Week, but there had been too many events on [in Yorkshire] at once and these were at the wrong time of the teaching / learning year". This tension was mentioned with respect to the topics covered by events regionally also. One teacher at the Nuclear Debate commented, "It would have been more useful if we could have tied this into the curriculum, though that said, they (years

10-12) seem to have enjoyed it, and I think they understood some of the science from the responses they gave in the telephone conference".

It was found that around a third of the materials were 'Einstein-specific', a half directly connected to Einstein, four-fifths were physics-related and virtually all were science-related. The most common representation of science was as 'Curious' - i.e. that science strives to answer questions, and to satisfy people's curiosity. The second most frequent category was 'Fun', presumably hoping to spark people's interest. The third most frequent category, 'Functional', sits in opposition to assertions of irrelevance, and the fourth most frequent category, 'Exciting' to those of dullness.

Headline findings

Einstein Year resulted in positive images of science being presented to a wider community than those who commonly attend science events. Different activities throughout the year were described by attendees as fun, exciting and interesting – often against people's initial judgement.

Over 500 events were enjoyed significantly by the participants. Field work showed a high standard of events run in a professional manner. The ages, needs and interests of the potential audiences were well considered, on the whole, though there was less of a focus on the 11-14 year age group in the events than had been anticipated at the outset.

Through the Einstein Year focus on physics, people have had positive physics -related experiences. Overall, many people expressed that they found they had learned some new piece of information, or found out something interesting about physics, science or scientists, and in fact about Einstein too in some cases. Finally, some people had been encouraged to think and look at the world differently, albeit through the eyes of a scientist, and found that they enjoyed the experience.

What did Einstein Year achieve?

New communities

Arts and music, although not new ways to engage people in science, have proved popular in the context of Einstein Year. Previous dialogues and partnerships with art, music, theatre and also museum organisers have been strengthened, which has helped create a new platform from which to move forward. These relationships should be fostered, and if possible regular new ventures presented to wider audiences.

Physicists have been encouraged to find new ways and new avenues to present and help the public explore physics

Kits, provided by the Institute of Physics, to support speakers were useful, but not always in the way that the kit developers had intended, nor were they always used just by the people who were given them (i.e. the Ambassadors); further evaluation of the use of kits needs to consider the opportunities to use them and by how many people. Training sessions that were offered to the 'kit owners' might end up being wasted and do little to improve event quality if this training is not passed on to the person actually handling the event.

New enablers

In a number of cases the search for new venues resulted in new partnerships with 'enablers', i.e. people within venues who can carry event planning forward, such as librarians. Many non-physicists have demonstrated interest and willingness to engage with physics during Einstein Year. Further, these people have also indicated that they would be willing (in particular with further funding) to continue to work with physicists in their area to run more events in future. Other people, such as the Rambert Dance Company, and art galleries have found that the relationships built with the Institute of Physics have been valuable and brought them new audiences also.

Running events

Event originators found it of enormous importance to have money that enabled them to pay for an event organizer or 'enabler'. They found it time consuming staffing the Lab in a Lorry when they had booked it, although it was a good attraction, albeit for a small number of visitors. Grants were also important in producing high quality publicity materials that attracted good audiences.

The three aims:

The Institute of Physics identified three aims for Einstein Year.

- Changing attitudes among young people to physics
- Increasing the quantity and quality of physics outreach activities
- Building sustainable links between physicists and their communities.

Attitudes to physics

With regards to attitudinal change towards physics, young people who stated that they had participated in Einstein Year events showed a consistent but small increase in interest level over non-participants. No significant changes were found in participants' opinions about the impact of science and technology on society and their attitudes about scientists and their work. However, females and 11 year-olds, who stated participation, assess a much stronger impact of Einstein Year events on their knowledge about physics and physicists and their attitudes towards science and scientists, than they hoped for at the start of the year (as judged by their statements then). However, there is a consistent trend of decreasing interest in science from age 11 to age 14 and generally a lower interest level among females of these age groups compared to males. The findings can be summarized as follows:

- Pupils appear to be interested in the effects of science applications on themselves, but not so much in the science knowledge that might be needed to understand these.
- Pupils' views about the impact of science and technology on society, as well as their attitudes towards scientists and their work, are overall positive and show only small variation with age and gender. This shows pupils' general appreciation of the role and importance of science and technology in society and of the work of scientists.
- Even with positive attitudes towards science and the work of scientists, pupils might not choose to become scientists themselves. More specifically, scientists working creatively and imaginatively, doing important work and at places where new and exciting things happen, seem to be important factors according to pupils if they are to decide to become scientists.
- The images of scientists as having to work hard and for long hours in a tedious and repetitive work, or following strict rules and guidelines, seem to be putting pupils off from this career and are also strongly held opinions.

Quantity and Quality of events

A significant number of events were enabled during the year that would not have been able to go ahead without the extra funding and effort afforded by the Institute of Physics. Overall, the combination of funding schemes and engagement with schools, as well as the branding of various touring lectures and events (including Lab in a Lorry, which was linked to Einstein Year events in certain venues), led to a significant increase in the visibility and number of physics-related activities during 2005. Further, Einstein's 'Birthday Party' materials helped encourage a wide celebration of Einstein's birthday in March and extended the feeling of something big happening across the country and through the media.

Of the events attended and evaluated the standard was high. Evaluation forms returned illustrated a high level of satisfaction. But as most events were free and open to all it is likely that anyone who was unimpressed with any activity would simply leave and not be bothered to offer any feedback.

Building sustainable links between physicists and their communities

The Institute of Physics would be advised to continue:

- Making use of existing and new contacts and resources
- Maintaining a dialogue with the Einstein Year grant holders, Ambassadors and speakers
- Making all the people who were involved in Einstein Year feel part of something bigger which is continuing into the future
- Sharing the successes of Einstein Year and indicating what future there is for some of the findings from the year.

Following up, communicating, and, celebrating with those people who have been involved for their hard work and efforts (in particular the volunteers) and feeding back to them how their part contributed to the whole of Einstein Year would be a valuable exercise, as would sharing this report with the wider science communication community who may be considering a series of events such as Einstein Year.

Although the organisers of Einstein Year did not have any targets for what proportion of events should be Einstein-specific, what proportion to do with other aspects of physics, and so on, overall the individual events were often an unqualified great success, and so contributed to the overall success of Einstein Year in raising the profile of physics to a general and broader audience.

Lessons and next steps

The results of the quantitative survey, interviews, and observations collected by the research team over the year from event organisers, speakers and participants of all ages have been distilled into a number of points that might be considered by future 'year of' celebrations or should be equally useful to ongoing outreach and public engagement activities.

Science engagement activities for young people need to progress from role model activities and knowledge sharing to a sphere in which the young people are engaged and can see how they can connect and contribute to science. Providing a stronger sense of different STEM-related job roles and the benefits and opportunities from persevering with studying science, and in particular physics, can bring to the individual (in terms of personal achievement and financial reward) and to society (in terms of the environment and economic development) is needed.

We propose the following key learning points which are lessons that could be learned to the benefit of the whole science communication community:

- Have a plan for the year but leave room for flexibility to respond to emerging ideas, often arising from early events.

- Develop a mechanism, such as themes, to attract partners and to help them understand where and how they can fit in.
- Have clear policies about how to target and work with groups and organisations outside your normal stakeholders – ensure a balance between different political, minority and religious groups, for example.
- Use small funding schemes to target certain groups creatively or pay for administrative assistance for events but also ensure larger grants are available to get events off the ground.
- Understand what and when the main focus of the year will be and manage the build up to this peak but don't allow activities to only be held at this time or to tail off too quickly after the focus point.
- Develop effective ways of communicating with your delivery network and 'agents'. Involve them and ensure they get a sense of what they have helped to achieve. Use more than one communication route.

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Appendix 1 Quantitative Survey Questionnaire

Phase I questionnaire

Institute *of* **Physics**

einstein year

2005 World Year of Physics: Einstein Year

Attitudes to Science Questionnaire

Name of School:		Your age in years:		Male ☐	Female ☐
Year and Form:					

A. **How interested are you in finding out more about the following?**
(Give your answer with a tick in the appropriate box next to each statement. If you do not understand, leave the boxes blank.)

		Not interested			*Very interested*
1.	How different musical instruments produce different sounds	☐	☐	☐	☐
2.	How cassette tapes, CDs and DVDs store and play sound and music	☐	☐	☐	☐
3.	How your ear can hear different sounds	☐	☐	☐	☐
4.	How the sunset colours the sky	☐	☐	☐	☐
5.	The use of lasers for technical purposes (e.g. barcode readers)	☐	☐	☐	☐
6.	How your eye can detect light and colours	☐	☐	☐	☐
7.	How a nuclear power plant functions	☐	☐	☐	☐
8.	How x-rays, ultrasound, etc. are used in medicine	☐	☐	☐	☐
9.	The possible effects of mobile phones and computers on the human body	☐	☐	☐	☐
10.	New sources of energy from the sun, wind, tides, waves etc.	☐	☐	☐	☐
11.	How energy can be saved or used in a more effective way	☐	☐	☐	☐
12.	The effect of electric shocks and lightning on the human body	☐	☐	☐	☐
13.	The origin of stars, planets and the universe	☐	☐	☐	☐
14.	Rockets, satellites and space travel	☐	☐	☐	☐
15.	How it feels to be weightless in space	☐	☐	☐	☐

Imagine you are a scientist.

Choose one statement from numbers 1 to 15 above, which describes an area of science that you would like to investigate. Your choice is _______. Explain why you are interested in investigating this:

____

____

B. **To what extent do you agree with the following statements?**
(Give your answer with a tick in the appropriate box next to each statement. If you do not understand, leave the boxes blank.)

		Disagree			*Agree*
1.	Science and technology benefit mainly rich developed countries	☐	☐	☐	☐
2.	Science and technology make our lives easier and more comfortable	☐	☐	☐	☐
3.	Science and technology will help get rid of poverty and famine in the world	☐	☐	☐	☐
4.	Science and technology will make work more tedious and boring	☐	☐	☐	☐
5.	Science and technology make our lives safer and healthier	☐	☐	☐	☐
6.	Science and technology make our lives more difficult and complicated	☐	☐	☐	☐

Page 1 of 2 *PLEASE TURN OVER*

7.	Science and technology will make work more interesting	☐	☐	☐	☐
8.	The harmful effects of science on our lives are greater than the benefits of science	☐	☐	☐	☐

C. The year 2005 is World Year of Physics. In the UK and Ireland Einstein and his work are being celebrated throughout 2005. This is why 2005 is also called Einstein Year.

To what extent do you agree with the following statements about Einstein Year?

		Disagree			*Agree*
1.	I hope I will find out something interesting about physics or physicists because of Einstein Year	☐	☐	☐	☐
2.	Events in Einstein Year should help to give me a positive feeling about science and scientists	☐	☐	☐	☐

D. To what extent do you agree with the following statements?

"If I think of scientists and their work then I imagine...:

		Disagree			*Agree*
1.	scientists as middle-aged men in white coats	☐	☐	☐	☐
2.	scientists as working creatively and imaginatively	☐	☐	☐	☐
3.	scientific work done as part of a team with other people working together	☐	☐	☐	☐
4.	scientists as having to work hard and long hours	☐	☐	☐	☐
5.	scientists as working at places where new and exciting things happen	☐	☐	☐	☐
6.	scientific work as being mostly tedious and repetitive	☐	☐	☐	☐
7.	scientists as being really brainy people	☐	☐	☐	☐
8.	scientists as doing work of little use	☐	☐	☐	☐
9.	scientists as normal and attractive young men or women	☐	☐	☐	☐
10.	scientists as having just to follow strict rules and guidelines in their work	☐	☐	☐	☐
11.	scientists as having good relationships with their friends and family	☐	☐	☐	☐
12.	scientists as working on their own, independently of other people	☐	☐	☐	☐
13.	scientists as doing very important work	☐	☐	☐	☐
14.	scientists as lacking confidence and ability	☐	☐	☐	☐

Choose one statement from numbers 1 to 14 above, which might make you decide to become a scientist. Your choice is _______

Explain why: ____

____

Choose one statement from numbers 1 to 14 above, which might make you decide NOT to become a scientist. Your choice is _______

Explain why: ____

____

Phase 2 & 3 questionnaire

Institute of Physics   einstein year   *2005 World Year of Physics: Einstein Year*

Attitudes to Science Questionnaire

Name of School:		Your age in years:		Male ☐	Female ☐
Year and Form:					

A. **How interested are you in finding out more about the following?** *(Give your answer with a tick in the appropriate box next to each statement. If you do not understand, leave the boxes blank.)*

		Not interested			*Very interested*
1.	How different musical instruments produce different sounds	☐	☐	☐	☐
2.	How cassette tapes, CDs and DVDs store and play sound and music	☐	☐	☐	☐
3.	How your ear can hear different sounds	☐	☐	☐	☐
4.	How the sunset colours the sky	☐	☐	☐	☐
5.	The use of lasers for technical purposes (e.g. barcode readers)	☐	☐	☐	☐
6.	How your eye can detect light and colours	☐	☐	☐	☐
7.	How a nuclear power plant functions	☐	☐	☐	☐
8.	How x-rays, ultrasound, etc. are used in medicine	☐	☐	☐	☐
9.	The possible effects of mobile phones and computers on the human body	☐	☐	☐	☐
10.	New sources of energy from the sun, wind, tides, waves etc.	☐	☐	☐	☐
11.	How energy can be saved or used in a more effective way	☐	☐	☐	☐
12.	The effect of electric shocks and lightning on the human body	☐	☐	☐	☐
13.	The origin of stars, planets and the universe	☐	☐	☐	☐
14.	Rockets, satellites and space travel	☐	☐	☐	☐
15.	How it feels to be weightless in space	☐	☐	☐	☐

Imagine you are a scientist.

Choose one statement from numbers 1 to 15 above, which describes an area of science that you would like to investigate. Your choice is ______. Explain why you are interested in investigating this:

____

____

B. **To what extent do you agree with the following statements?** *(Give your answer with a tick in the appropriate box next to each statement. If you do not understand, leave the boxes blank.)*

		Disagree			*Agree*
1.	Science and technology benefit mainly rich developed countries	☐	☐	☐	☐
2.	Science and technology make our lives easier and more comfortable	☐	☐	☐	☐
3.	Science and technology will help get rid of poverty and famine in the world	☐	☐	☐	☐
4.	Science and technology will make work more tedious and boring	☐	☐	☐	☐
5.	Science and technology make our lives safer and healthier	☐	☐	☐	☐
6.	Science and technology make our lives more difficult and complicated	☐	☐	☐	☐
7.	Science and technology will make work more interesting	☐	☐	☐	☐
8.	The harmful effects of science on our lives are greater than the benefits of science	☐	☐	☐	☐

Page 1 of 2   *PLEASE TURN OVER*

C. **The year 2005 is World Year of Physics. In the UK and Ireland, Einstein and his work are being celebrated throughout 2005. This is why 2005 is also called Einstein Year.**

Have you participated in any way in any event related to Einstein Year either in school or out of school? Yes ☐ No ☐

If you answered YES in the previous question, to what extent do you agree with the following statements about Einstein Year?

		Disagree			*Agree*
1.	I have found out something interesting about physics or physicists because of Einstein Year	☐	☐	☐	☐
2.	Events in Einstein Year have helped to give me a positive feeling about science and scientists	☐	☐	☐	☐

D. **To what extent do you agree with the following statements?**

"If I think of scientists and their work then I imagine...:

		Disagree			*Agree*
1.	scientists as middle-aged men in white coats	☐	☐	☐	☐
2.	scientists as working creatively and imaginatively	☐	☐	☐	☐
3.	scientific work done as part of a team with other people working together	☐	☐	☐	☐
4.	scientists as having to work hard and long hours	☐	☐	☐	☐
5.	scientists as working at places where new and exciting things happen	☐	☐	☐	☐
6.	scientific work as being mostly tedious and repetitive	☐	☐	☐	☐
7.	scientists as being really brainy people	☐	☐	☐	☐
8.	scientists as doing work of little use	☐	☐	☐	☐
9.	scientists as normal and attractive young men or women	☐	☐	☐	☐
10.	scientists as having just to follow strict rules and guidelines in their work	☐	☐	☐	☐
11.	scientists as having good relationships with their friends and family	☐	☐	☐	☐
12.	scientists as working on their own, independently of other people	☐	☐	☐	☐
13.	scientists as doing very important work	☐	☐	☐	☐
14.	scientists as lacking confidence and ability	☐	☐	☐	☐

Choose one statement from numbers 1 to 14 above, which might make you decide to become a scientist. Your choice is ______

Explain why: ____

____

Choose one statement from numbers 1 to 14 above, which might make you decide NOT to become a scientist. Your choice is ______

Explain why: ____

____

Appendix 2 Fieldwork Topic Guide for Interviews with Adults

Questions and Direction for the Interviews with Adults

About the Interviewee

Circle the appropriate grouping

Sex M F

Age group 24 or under 25 – 34 35-44 45 – 59 60 or over

Ethnicity

White	British	Irish	Other white background	
Mixed	White and Asian	White and Black African	White and Black Caribbean	Other mixed
Asian or Asian British	Indian	Pakistani	Bangladeshi	Other Asian background
Black or Black British	Caribbean	African	Other Black background	
Chinese	Chinese			
Other				

Level of education in physics

- ❑ None
- ❑ Basic science
- ❑ O' Level / GCSE
- ❑ A' Level
- ❑ BSc
- ❑ MSc
- ❑ PhD
- ❑ Other…………………….

Employment area

- ❑ Private sector
- ❑ Public Sector
- ❑ Higher Education
- ❑ Physics related
- ❑ Science related
- ❑ Teaching
- ❑ Not employed
- ❑ Other …………………………………… …………………………….

Ever been involved in outreach work, visiting schools, careers fairs, local science centre, taking part in science related projects?

❑ Yes	❑ No

2005 is the World Year of Physics, in the UK and Ireland, as part of this celebration, we are celebrating Einstein. Were you aware of this, what is significant about 2005?

❑ Yes	❑ No

How many people do you know who are involved in these kind of activities?

❑ 0	❑ 1-5	❑ 6-10	❑ more

Have you ever considered doing outreach work with young people?

❑ Yes	❑ No

Do you think that the contact of physicists and other scientists / engineers with young people is important?

❑ Yes	❑ No

Why?

……………………………………………………………………………………………………
……………………………………………………………………………………………………

What / who influenced you in your career choice?

- ❑ Teacher
- ❑ Parent
- ❑ Family friend
- ❑ Newspaper article
- ❑ Just liked it
- ❑ Other

IOP AND ENGAGING YOUNG PEOPLE IN PHYSICS

How do you think the IoP could engage more physicists in outreach work?

Do you think that physicists have a positive or negative impact on children in the age range………………………………………………………………………………………………
………

Because.
…………………………………………………………………………………………………..

……………………………………………………………………………………………………
…………

……………………………………………………………………………………………………
…………

Give me 3 words that describe physics

1. ………………….
2. …………………
3. …………………

What is your job? ....………………………………………………….............

For people working in science or physics related areas, give me three words that summarise how you feel about your job

4. ………………….
5. …………………
6. …………………

How do you describe your job to another adult?

................………………………………………………............. ....………………………………………………............. ....……………………………………………….............

How do you describe your job to an 11-14 year old?

................………………………………………………............. ....………………………………………………............. ....……………………………………………….............

Is your job hard, easy, challenging, ……….?

................………………………………………………............. ....……………………………………………….............

What do you think is critical in helping to change the perception pf physics as a subject or career?

................……………………………………………….……………………............. ....……………………………………………………………….…............. ....………………………………………………….......................................

- ❑ Basis for getting a job
- ❑ Career
- ❑ What jobs do you think a physics based education could lead to ……
- ❑ Which words would you use to describe these eg are these dull, financially secure, exciting, worthwhile, worthy,…interactions with people working in physics
- ❑ Mentoring
- ❑ Regular contact with people
- ❑ Hands on projects and activities

- ## Interview topic guide

Understand level of engagement in public science events

……………………………………………………………………………………………………

……………………………………………………………………………………………………

…………………………………………………………………………………………

Explore reasons for engagement or lack of:

……………………………………………………………………………………………………

……………………………………………………………………………………………………

…………………………………………………………………………………………

Perception of importance and value of role models in helping bring science to life,

……………………………………………………………………………………………………

……………………………………………………………………………………………………

…………………………………………………………………………………………

Interest in young people

……………………………………………………………………………………………………

……………………………………………………………………………………………………

…………………………………………………………………………………………

Belief in level of impact in influencing science policy agenda

Would you be interested in learning more about outreach opportunities, how to get involved and being contacted by your SETpoint or the Institute of Physics?

- ❑ Yes
- ❑ No

Name ……………………………………………….

Address

………………………………………………………….

………………………………………………………….

………………………………………………………….

………………………………………………………….

Telephone: ………………………………………..

Email: ……………………………………………….

Additional Questions for Event Organisers

ABOUT CONTACT AND INTERACTION WITH PHYSICISTS

Start of Year

How many physicists do you have contact with in your local area?

End of Year

How many physicists do you have good contact with at your events?

Have you seen any growth in numbers attending your events over the year?

Have you seen any change in the feedback on your exit questionnaires?

How do you communicate with them?

What plans do you have for this year in getting them more actively involved in Einstein Year?

Are you having any success?

Do they respond to requests for involvement in your activities?

About events programme

How many Einstein Year events are you planning for this year?

- ❑ Is this about the same
- ❑ More
- ❑ Less
- ❑ Than you would usually have in your programme related to physics
- ❑ Have you bid for extra funds?

If so where from?

Marketing of Einstein Year events

Is this different to other activities?

Level of response to date?

Examples of marketing materials

Would you like more help from IOP / About right?

Can you get information when you need it?

Have you ever asked?

Are you using their database?

Do you have good links with the IoP regional branch?

Appendix 3 Interview Topic Guide for Young People

First let's say our name, favourite subject at school, and why

What does school science mean for your everyday life?

Prompts

- Is science an important part of your life?
- Pin the subject on the heart: where would you put these subjects; put the ones you like best closest to the read heart.
- What do you feel about science, when you are about to go into class, when you have homework to do
- What does it make you think about?

Statement: science is one of the most important subjects I study

What do you think about physics?

Prompts

- Would you say that you enjoy physics?
- What use is science? For health? Poverty?
- What do you think are the main benefits of studying physics?
- Would you like to carry on studying physics?
- If not, why not?
- What jobs can you do if you study science?
- Do you know where you can go to find out more
- Do you know anyone who is a scientist, physicist? What are they like? Do you like them?

Statement: physics is completely different to the other subjects I study at school

How might you describe how important physics is to society?

Prompts

- Do your friends enjoy science and physics?
- Have you ever read about science in newspapers? What, can you remember?
- Is science ever on TV? Which programmes, which are your favourite? Did you learn anything?
- Is science an important part of your friends lives? *Explore*
- Is science an important part of your families lives? *Explore*

What do you like most about physics at school?

Prompts

- How would you describe your physics lessons?
- What is good about them?
- What is not good about them?

What did you enjoy about the event today?

Prompts

- Tell me about what happened today.
- How do you feel about it? Was it fun? Dull?
- What do you think about the activities?
- What was the best thing about the activities?
- Is there anything you didn't like about the activities?
- What do you think you might have learned?
- Was it better than how you would normally do science?

- What did you think of the speaker? Good, bad? Is that what you would expect a scientist to be like?

Statement: The physics we learned about today would be of no interest to most people. Do you agree?

What do you think are good ways to explain physics?

Prompts

- What do you like about demonstrations?
- Should lessons use videos and TV programmes?
- Do you like doing experiments?

Appendix 4 Young Person Event Evaluation Form

Please complete your forms now and hand back before you leave if possible.

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1) How old are you? **Are you : Male** ☐ **Female** ☐

2) Do you watch science / physics programmes on TV?

Yes ☐ No ☐

3) What do you think about science on TV and in the media?

☺☺ ☐ ☺ ☐ 😐 ☐ ☹ ☐ ☹☹ ☐

4) How would you describe your physics lessons in school?

☺☺ ☐ ☺ ☐ 😐 ☐ ☹ ☐ ☹☹ ☐

5) Do you know anyone who is a scientist or physicist?

Yes ☐ No ☐ If so, who? ....

6) Why did you come to the event today?

☐

7) Your views about physics

(i) *What did you think about physics before you came here?* ☹ ☐ or ☺ ☐

(ii) *And after today's activities, what do you think now?* ☹ ☐ or ☺ ☐

If it is different, can you explain why?

8) The year 2005 is World Year of Physics. In the UK and Ireland Einstein and his work are being celebrated throughout 2005. This is why 2005 is also called Einstein Year. This is an Einstein Year Event.

What do you think about Einstein Year?

(i) *"I have found out something interesting about physics or physicists because of Einstein Year"*

☺☺ ☐ ☺ ☐ 😐 ☐ ☹ ☐ ☹☹ ☐

(ii) *"Events in Einstein Year have helped to give me a positive feeling about science and scientists"*

☺☺ ☐ ☺ ☐ 😐 ☐ ☹ ☐ ☹☹ ☐

About the Event

9) What did you think about the event today?

(i) How well do you think the activities explained the science to you?

☺☺ ☐ ☺ ☐ 😐 ☐ ☹ ☐ ☹☹ ☐

(ii) Have the activities increased your interest in studying subjects such as maths, physics or technology?

☺☺ ☐ ☺ ☐ 😐 ☐ ☹ ☐ ☹☹ ☐

(iii) What was the best bit of the activities?

10) Demonstrations and visual materials:

(i) Were they interesting?

☺☺ ☐ ☺ ☐ 😐 ☐ ☹ ☐ ☹☹ ☐

(ii) Did you enjoy taking part?

☺☺ ☐ ☺ ☐ 😐 ☐ ☹ ☐ ☹☹ ☐

(iii) Did you understand the science?

☺☺ ☐ ☺ ☐ 😐 ☐ ☹ ☐ ☹☹ ☐

(iv) What was exciting enough that you would go home and talk about it?

11) Presenters

(i) How well do you think the presenters explained the science to you?

☺☺ ☐ ☺ ☐ 😐 ☐ ☹ ☐ ☹☹ ☐

If ☹☹, *then who do you think the event was aimed at?* **Choose**: younger/ older/ adults

12) Any other comments?

Thank you for your assistance. We value your opinion.

Appendix 5 Standard Event Evaluation Form

Questionnaire for Evaluating Einstein Year events/activities

Your age in years:		**Male** ☐	**Female** ☐

		Strongly agree	***Agree***	***Disagree***	***Strongly disagree***
1.	I am glad I came to this event	☐	☐	☐	☐
2.	I learnt something about physics here that was worth learning	☐	☐	☐	☐
3.	I feel more positive about physics now than before I came here	☐	☐	☐	☐

4. Write up to three things you have learnt from this event

- ______________________________
- ______________________________
- ______________________________

5. What were the three best things about this event?

- ______________________________
- ______________________________
- ______________________________

6. How could this event have been improved?

____

____

____

Thank you for coming and for filling in this sheet!

Appendix 6 The Methodology for Analysis of Marketing Materials

All those organising events that were listed on the Einstein Year database were e-mailed / written to, on two occasions if they hadn't replied the first time. Checks were made throughout 2005 to ensure that new entrants on the database were contacted.

Each set of materials was examined and eventually classified on two scales. The first scale (A) indicates the relationship between the materials and science / Einstein and can be ordered from most closely connected to Einstein to least closely connected to Einstein. The second scale (B) attempts not to measure the intention of those producing the materials (which could better be ascertained by asking them directly) but the effect of the materials on their audience. Of course, there is no single audience. Furthermore no claim is made here that the resulting classification is strictly objective; indeed, it clearly is more subjective than the classification of the relationship between the materials and science / Einstein (i.e. on the first scale), so that the boundaries between the various categories are fuzzy. Rather, the hope was that the materials could be read (à la reader response theory) in ways that audiences might, usually unconsciously, read them. The intention is to highlight how materials might be perceived (and the above order of the scale's six possibilities is intentionally alphabetical rather than otherwise ordered).

A Relation of materials to Einstein	**B Presentation of science in materials**
• Einstein-specific	• Control
• Physics Einstein-related	• Curious
• Physics not Einstein-related	• Exciting
• Science not Einstein-related	• Fun
• Not-science.	• Functional
	• Mad

In the majority of cases (47 out of 54, and materials whose only visual component was a logo were classified as text-only), the materials that were analysed combined visual and textual material – in other words they were multimodal (e.g. Jewitt & Kress, 2003). The techniques used here to interpret the visual elements are predominantly those that derive from the field of visual literacies (e.g. Kress & van Leeuwen 1996; van Leeuwen & Jewitt, 2001; the journals *Journal of Visual Culture* and *Visual Communication*); the textual elements are interpreted using conventional, straightforward discourse analysis (e.g. Phillips & Hardy, 2002).

Appendix 7 Data for the Einstein Year Associated Websites

Site	Visits during Einstein Year from launch to end	Total visits to end of Feb 2006
Kung Fu www.kungfuscience.org	97,000	163,261
Einstein Year www.einsteinyear.org:	126,026	155,186
Inside Story www.insidestory.iop.org:	6,635	14,162
Moon Watch www.crescentmoonwatch.org:	20,742 14,714 unique visitors	26,179 18,464 unique visitors

Appendix 8 Small Grant Scheme Information

Institute of Physics

einstein year

Explore, Discover, Invent · Physics

Einstein Year Grant Scheme – Round 2.

Further Information and Guidelines for Making a Grant Application

Einstein Year

Einstein Year is the UK & Ireland's contribution to World Year of Physics in 2005. It is part of the international celebrations of the centenary of Einstein's ground-breaking work on Brownian motion, the photoelectric effect and special relativity.

The aim of Einstein Year is to inspire young people, and those who influence them, about the range and applications of physics and to build a sustainable increase in the public awareness of physics and its role in society. It is a unique opportunity to highlight the contribution of contemporary physics to society.

More information about Einstein Year can be found at **www.einsteinyear.org**.

Primary aims of the Institute's Einstein Year grant scheme

The Institute's Einstein Year grant scheme aims to encourage and support the development of activities that meet the aims of Einstein Year as well as:

- Supporting individuals running activities that promote physics to general audiences.
- Supporting good activities that would not go ahead without the Institute's funding.
- Encouraging the Institute's members and individuals from affiliated institutions to communicate the exciting aspects and applications of physics to general audiences beyond the classroom and workplace.
- Encouraging people external to the Institute to communicate physics.
- Encouraging the ongoing commitment of individuals to physics communication.
- Building contacts between science communicators and the Institute.

Rounds and Application deadlines

This is the second and final round of the Einstein Year Grant Scheme. Please note that funding decisions will not be announced until April 2005.

Round 2 closing date: 5pm, 25 February 2005, priority will be given to those activities taking place in the period July – December 2005

(Decisions will be made in April 2005 and grants issued by June 2005.)

Due to the larger number received, applications will not be acknowledged unless requested and an SAE is enclosed with postal applications.

Applicants may apply for support in more than one round although success in one round does not guarantee success in another. If you were unsuccessful in Round 1 of the scheme, you may find it helpful to talk to Caitlin Watson, Einstein Year Programme Manager, before submitting an application to Round 2. Email **caitlin.watson@iop.org** or phone 020 7470 4814.

Criteria for the grant scheme

The panel will look for the following in the grant applications:

An original/innovative event or topic which involves parents, families or the wider community.

- An event or activity that is physics-based.
- Clear objectives for the activity.
- Potential of the event to make an impact on the target audience.
- Evidence that the applicant is committed to raising the profile of physics through his/her activity.
- Activity is dependent on Institute funding or adds significant element.
- Amount of grant requested is no more than £1500.
- Evidence that the applicant has a plan to meet any shortfall in funding not covered by the Institute's sponsorship or by other institutions they might have applied to.
- Evidence of adequate and appropriate means of publicity to reach the target audience(s).
- A positive recommendation for support from a suitable referee.

Applications must be for activities that will take place in the UK & Ireland. Grants must be used by the end of the 2005.

Additional Information

12. Completion of forms

Complete the attached grant form fully. Indicate the amount of grant required, and state the purpose for which the money will be used e.g. hire of equipment. Incomplete forms will NOT be considered. DO NOT ATTACH ANY SUPPLEMENTARY MATERIAL with this application, except sheets for continuation purposes.

13. Priority for grants

- Any type of physics-based outreach event is eligible for a grant.
- Priority for grants will be given to individuals organising events that are aimed at the general public or mixed audiences.
- Applications from schools: a significantly higher priority will be given to individuals organising activities that involve parents, families or the wider community, rather than activities that are aimed at school children and aid the delivery of the school curriculum.
- Applications from individuals wishing to work in partnership with their local science centre or similar organisation are encouraged. However,

applications from organisations such as science centres will be considered to be a low priority unless they involve significant outreach work with the local community.

- Applications for funding to purchase general purpose hardware, such as digital cameras and video recording equipment, will be considered a very low priority and applicants are asked to consider alternatives, including hiring, such equipment.

14. Grants will not be awarded to:

- Activities that will take place outside of the UK & Ireland.
- Cover the cost of refreshments provided for the event.
- Meet staff salaries. However, applications to cover the cost of time spent developing new activities by third parties (eg freelance communicators or similar) may be considered where it is clear that the activity will be widely accessible and have a lasting impact. In such cases it is unlikely that the cost of delivering the activity (eg venue hire) will also be met.

15. Previous applicants

Previous recipients of Institute of Physics grants are welcome to apply for funding, but the Institute will look for development of the idea or activity in the new application. The completed feedback forms from previous events may be used by the panel during the assessment process.

16. Evaluation and feedback

Feedback forms will be sent to all those who receive grants. Event evaluation and feedback can be of enormous benefit both to the organisers and to those who provide support.

17. Recognition of the Institute of Physics funding and Einstein Year

Recipients of grants are required to acknowledge the Institute of Physics sponsorship and Einstein Year on all of their promotional materials. The Einstein Year logo is available from www.einsteinyear.org/get_involved/logo.

Please include copies of promotional material and any press cuttings of your event with your feedback form.

18. Assessment of the grant applications

Grant applications will be assessed and grants allocated by a panel made up of professional science communicators and physicists.

19. National Science Week, 11-20 March 2005

National Science Week is an annual event organised by the British Association (the BA). Next year, the dates are 11-20 March 2005. The current round of the Einstein Year grant scheme is not suitable for applicants seeking funding for activities during National Science Week as funding decisions will not be announced until April 2005.

For more information about National Science Week, contact National Science Week Officer, The BA, Wellcome Wolfson Building, 165 Queen's Gate, London SW7 5HE. Tel: 0870 770 7101 Fax: 0870 770 7102 Email: nsw@the-ba.net Website: www.the-ba.net